



Department of Veterans Affairs

VA Pittsburgh Healthcare System HZ Renovate B51 (Unit 3B)

VA Project No: 646-09-130

Project Manual – Bid Documents

Volume 2 of 2

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**DEPARTMENT OF VETERANS AFFAIRS
 VHA MASTER SPECIFICATIONS**

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**SECTION 21 05 11
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 21.
- B. Definitions:
 - 1. Exposed: Piping and equipment exposed to view in finished rooms.
 - 2. Option or optional: Contractor's choice of an alternate material or method.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Concrete and Grout: Section 03 30 53, MISCELLANEOUS CAST-IN-PLACE CONCRETE.
- D. Section 07 84 00, FIRESTOPPING.
- E. Section 07 92 00, JOINT SEALANTS.

1.3 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.
 - 2. Equipment Service: Products shall be supported by a service organization which maintains a complete inventory of repair parts and is located reasonably close to the site.
 - 3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
 - 4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 - 5. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

6. Asbestos products or equipment or materials containing asbestos shall not be used.

B. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COTR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

C. Supports for sprinkler piping shall be in conformance with NFPA 13.

D. Supports for standpipe shall be in conformance with NFPA 14.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.

1. Equipment and materials identification.

2. Fire-stopping materials.

3. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.

4. Wall, floor, and ceiling plates.

C. Coordination Drawings: Provide details of the following.

1. Mechanical equipment rooms.

2. Interstitial space.

3. Hangers, inserts, supports, and bracing.

4. Pipe sleeves.

5. Equipment penetrations of floors, walls, ceilings, or roofs.

D. Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.

2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A36/A36M-2001Carbon Structural Steel
 - A575-96Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)
 - E84-2003Standard Test Method for Burning Characteristics of Building Materials
 - E119-2000Standard Test Method for Fire Tests of Building Construction and Materials
- C. National Fire Protection Association (NFPA):
- 90A-96Installation of Air Conditioning and Ventilating Systems
 - 101-97Life Safety Code

PART 2 - PRODUCTS**2.1 LIFTING ATTACHMENTS**

- A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.2 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 5 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters and fans.
- C. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- D. Valve Tags and Lists:

1. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm (1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
2. Valve lists: Typed or printed plastic coated card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
3. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

2.3 FIRESTOPPING

- A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping.

2.4 GALVANIZED REPAIR COMPOUND

- A. Mil. Spec. DOD-P-21035B, paint form.

2.5 PIPE PENETRATIONS

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
 1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
 2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
 3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from this requirement must receive prior approval of the COTR.
- D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

- F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating
Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.
- G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.
- I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.6 TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the COTR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COTR.
- D. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.7 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate location of piping, sleeves, inserts, hangers, and equipment. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Protection and Cleaning:
 - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COTR. Damaged or defective items in the opinion of the COTR, shall be replaced.
 - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly exposed materials and equipment.
- C. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 53, Miscellaneous Cast-in-Place Concrete D. Install gages, valves, and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- E. Work in Existing Building:
 - 1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section

- 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
 3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the COTR. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the COTR for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After the COTR's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.
- F. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.
- G. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 LUBRICATION

- A. Field check and lubricate equipment requiring lubrication prior to initial operation.

3.3 STARTUP AND TEMPORARY OPERATION

- A. Startup equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.4 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COTR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.5 INSTRUCTIONS TO VA PERSONNEL

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

- - - E N D - - -

**SECTION 21 10 00
WATER-BASED FIRE-SUPPRESSION SYSTEMS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The design and installation of a hydraulically calculated automatic fire sprinkler system complete and ready for operation, for the penthouse, mechanical equipment rooms, linen and trash chutes, and accessible shafts.
- B. The design and installation of a standpipe system combined with the sprinkler system.
- C. Installation of new sectional valves in the sprinkler/standpipe system feed mains as indicated on the drawings.
- D. Modification of the existing sprinkler and standpipe systems as indicated on the drawings. Size system by pipe schedule in accordance with NFPA 13 and NFPA 14 the latest editions.
- E. Existing piping to be reused, replaced or removed as indicated on the drawings. Removal of piping to include all valves, flow switches, supervisory devices, hangers, supports, and associated fire alarm system conduit and wire.
- F. Existing occupant-use hose racks, valves, and accessible piping to be disconnected from their supply, drained, removed, and all remaining inaccessible piping capped.
- G. Replacement of all existing sprinklers. Work to include all necessary piping modifications, new sprinklers and new sprinkler escutcheons.
- H. Provide access doors or panels where control or drain valves are located behind plaster or gypsum walls or ceilings as necessary to install piping above suspended plaster or gypsum ceilings.
- I. Painting of exposed piping and supports to follow Section 09 91 00, PAINTING.

1.2 RELATED WORK

- A. Treatment of penetrations through rated enclosures: Section 07 84 00, FIRESTOPPING.
- B. Access panels for plaster ceilings: Section 08 31 13, ACCESS DOORS AND FRAMES.

- C. Painting of exposed pipe: Section 09 91 00, PAINTING.
- D. Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION.
- E. Alarm Supervision: Section 28 31 00, FIRE DETECTION AND ALARM.
- F. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 DESIGN CRITERIA

- A. The design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system / and standpipe system shall be in accordance with the required advisory provisions of NFPA 13, 14, 20, 25, 75, 82, . Exception to NFPA Fire Codes are as follows:
 - 1. Standpipe system shall be sized to meet volume requirements of NFPA 14 but not pressure requirements.
 - 2. Sprinklers are not required in interstitial areas.
- B. Base system design hydraulic calculations using the area/density method on the following criteria and in accordance with NFPA 13 latest edition.
 - 1. Sprinkler Protection:
 - a. All patient care, sleeping, treatment, office, waiting areas, educational areas, dining areas, corridors and attics: Light hazard, (0.10 gpm/sq. ft.) over the hydraulically most remote 140 m² (1500 sq. ft.).
 - b. Patient Sleeping Rooms/Areas: Sprinklers with a residential listing shall be installed in accordance with their listed flows and pressures.
 - c. Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, Elevator Shafts (if required), Elevator Machine Rooms, Refrigeration Service Rooms, and storage between 9 and 23 m² (100 and 250 sq. ft.): Ordinary Hazard, Group 1, 6.1 L/minute/m² (0.15 gpm/sq. ft.) over the hydraulically most remote 140 m² (1500 sq. ft.).
 - d. Clean and soiled linen rooms, trash rooms, clean and soiled utility rooms, laundry, laboratories, retail sales and storage rooms, storage room over 23 m² (250 sq. ft.), Pharmacy and SPD areas: Ordinary Group 2, 8.1 L/minute/m² (0.20 gpm/sq. ft.) over the hydraulically most remote 140 m² (1500 sq. ft.).

- e. Provide sprinklers in accessible shafts per NFPA 13 latest edition.
- 2. Add water allowance of 15 L/s (250 gpm) for inside and outside hose streams to the sprinkler requirements at the connection to the distribution main.
- 3. Hydraulic Calculations: The calculated demand including hose stream requirements shall fall no less than 10 percent below the available supply curve.
- 4. Water Supply:
 - a. Elevation of static and elevation of residual test gage: 600 mm (2 ft.) above site grade
- C. For each sprinkler zone provide a control valve, flow switch, self-contained test, drain assembly and pressure gage.
- D. Provide a guard for each sprinkler in the janitors' closets, the elevator machine room and sprinklers within 2100 mm (7 ft.) of the floor and other areas as required by NFPA 13.
- E. Locate sprinklers in patient bedrooms assuming all privacy curtains have 13 mm (1/2 in.) openings in mesh extending 450 mm (18 in.) from ceiling.

1.4 QUALIFICATIONS:

- A. Designer's Qualifications: Design work and shop drawings shall be prepared by a licensed engineer practicing in the field of Fire Protection Engineering or a NICET (National Institute for Certification in Engineering Technologies) Level III sprinkler technician.
- B. Installer's Qualifications: The installer shall possess a valid State fire protection contractor's license. The installer shall provide documentation of having successfully completed three projects of similar size and scope.
- C. On-site emergency service within four hours notification.

1.5 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

- B. Sprinkler design shall be done by a certified professional. All plans shall be stamped by qualified P.E.
- C. Emergency service point of contact name and 24 hour emergency telephone number.
- D. Manufacturer's Literature and Data:
 - 1. Pipe and fittings.
 - 2. Valves
 - 3. Drips
 - 4. Fire Department Siamese Connection
 - 5. Sprinklers-each type, temperature and model
 - 7. Inspectors Test Alarm Modules
 - 8. Sprinkler Cabinets
 - 9. Sprinkler Plugs
 - 10. Pressure Gages
 - 11. Pressure Switches
 - 12. Pipe Hangers and Supports
 - 13. Water Flow Switches
 - 14. Valve Tamper Switches
 - 21. Valve Cabinet
- E. Detailed drawings in accordance with NFPA 13 NFPA the latest editions. Drawings shall be prepared using CADD software stamped by fire protection professional engineer and include all new and existing sprinklers and piping. Use format in use at the VA medical center. Drawings are subject to change during the bidding and construction periods. Any wall and ceiling changes occurring prior to the submittal of contractors shop drawings shall be incorporated into the contractors detailed design at no additional contract cost.
- F. Hydraulic calculations for each sprinkler system in accordance with NFPA 13 latest edition.
- G. Operation and Maintenance Data:
 - 1. Indicating Valves
 - 2. Water Flow and valve tamper switches
 - 3. Alarm Valves
- H. Recommended preventive maintenance schedule.

1.6 AS-BUILT DOCUMENTATION

- A. As-built drawing and two blue-line copies shall be provided for each drawing. One copy of final CADD drawing files shall also be provided on 89 mm (3 1/2 in.), Writable CD, for each drawing.
- B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of hydraulic calculations for each sprinkler system updated to include submittal review comments and any changes to the installation which affect the calculations including one electronic set in PDF format.
- D. Four copies of the hydrostatic report and NFPA 13 material and test certificate for each sprinkler system.
- E. Four sets of operation and maintenance data updated to include submittal review comments and any equipment substitutions including one copy of NFPA 25.
- F. Manufacturers literature, hydraulic calculations, reports and operation and maintenance data shall be in a labeled 3-ring binder.

1.7 WARRANTY

- A. All work performed and materials and equipment furnished under this contract shall be free from defects for a period of one year from date of acceptance by the government.
- B. All new piping and equipment incorporated into the new system shall be hydrostatically tested and warranted as new.

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA)
 - 13-2010Installation of Sprinkler Systems
 - 14-2010Installation of Standpipe and Hose Systems
 - 17A-2009Standard for wet chemical extinguishing systems
 - 20-2003Installation of Centrifugal Fire Pump
 - 24-2010Installation of Private Fire Service Mains and Their Appurtenances

- 25-2011Inspection, Testing and Maintenance of water
Based Fire Protection Systems
- 70-2011National Electrical Code
- 72-2010National Fire Alarm Code
- 82-2009Incinerators, Waste and Linen Handling Systems
and Equipment
- 170-2009Standards for Fire Safety Symbols
- 291-2010Fire Flow Testing and Marking of Hydrants
- C. Underwriters Laboratories Inc. (UL)
- 2011Fire Protection Equipment Directory
- D. Factory Mutual Engineering Corporation (FM)
- 2010Approval Guide
- E. American Society of Sanitary Engineering (ASSE)
- 1015-2009Double Check Backflow Prevention Assembly
- F. Complete maintenance and inspection service for the fire pump and
sprinkler systems shall be provided by a factory trained authorized
representative of the manufacturer of the major equipment for a period
of three years after acceptance of the entire installation by the
government.
- G. Contractor shall provide all necessary test equipment, parts and labor
to perform required maintenance.
- H. All inspections, testing and maintenance work required by NFPA 25, NFPA
20, NFPA 13 and recommended by the equipment manufacturer shall be
provided. Work shall include operation of sprinkler system alarm and
supervisory devices.
- I. Service and emergency personnel shall report to the Engineering Office
or their authorized representative upon arrival at the hospital and
again upon the completion of the required work. A copy of the work
ticket containing a complete description of work performed and parts
replaced shall be provided.
- J. Emergency Service:
1. Normal and overtime emergency call-back service shall consist of an
on-site response to calls within four hours of notification.

2. Overtime emergency call-back service shall be limited to minor adjustments and repairs to affect the integrity of the system.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All devices and equipment shall be Underwriters Laboratories Inc. listed for their intended purpose. All sprinklers shall be Factory Mutual approved.

2.2 PIPING AND FITTINGS

- A. Pipe and fittings from inside face of building 300 mm (12 in.) above finished floor to a distance of approximately 1500 mm (5 ft.) outside building: Ductile Iron, flanged fittings and 316 stainless steel bolting.
- B. Sprinkler piping downstream of the isolation valve on wet-pipe systems shall be per NFPA 13 black steel, schedule 10 minimum.
- C. Threaded or flanged fittings shall be ANSI B1 6.3 cast iron, class 125 minimum. Threaded fittings are not permitted on pipe with wall thickness less than schedule 40.
- D. Slip type or clamp-on type rubber gasketed fittings shall be listed for each piping application.
- E. Piping Materials Standards:
 1. Ferrous piping - follow ASTM A 795 Standard
 2. Welded and seamless steel pipe - follow ANSI/ASTM A 53
 3. Wrought steel pipe - follow ANSI/ASME B36.10M
 4. Electric resistance welded steel pipe - follow ASTM A 135
 5. Seamless copper tube - follow ASTM B 75
 6. Seamless copper water tube - follow ASTM B 88
 7. Wrought seamless copper and copper alloy tube - follow ASTM B 251
 8. Fluxes for soldering applications of copper and copper alloy tube - follow ASTM B 813
 9. Brazing filler metal - follow AWS A5.8
 10. Solder metal, 95-5 - follow ASTM B 32
 11. Alloy material - follow ASTM B 446
- F. Fitting Materials Standards:

1. Cast iron threaded fitting, Class 125 and 250 - follow ASME B16.4
2. Cast iron pipe flanges and flanged fittings - follow ASME B16.1
3. Malleable iron threaded fittings, Class 150 and 300 steel - follow ASME B16.3
4. Factory made wrought steel buttweld fittings - follow ASME B16.9
5. Buttwelding ends for pipe, valves, flanges, and fitting - follow ASME B16.25
6. Wrought copper and copper alloy solder joint pressure fittings - follow ASME B16.22
7. Cast copper alloy solder joint pressure fitting - follow ASME B16.18
- G. Pipe Identification - All pipe, including specially listed pipe allowed by NFPA 13, shall be marked continuously along its length by the manufacturer in such a way as to properly identify the type of pipe. Pipe identification shall include the manufacturer's name, model designation, or schedule.

2.3 VALVES

A. Listed Indicating Valves:

1. Gate: OS&Y, 2400 kPa (350 psi)Water Working Pressure (WWP) .
2. Butterfly: Gear operated, indicating type, 2400 kPa (350 psi) water working pressure (WWP). Butterfly valves are to be installed in a manner that does not interfere with the operation of any system component.
3. Ball (inspectors test and drain only): iron body, stainless steel trim, for 2050 kPa (300 psi) service, indicating type.
4. Ball and butterfly valves shall not be used on incoming water service, and on the suction side of either the fire pump or jockey pump.

B. Check Valves: Swing type, rubber faced or wafer type spring loaded butterfly check valve, 2400 kPa (350 lb.) water working pressure (WWP).

C. Alarm Check: Iron body, bronze mounted, variable pressure type with retarding chamber. Provide basic trimmings for alarm test by pass, gages, drain connections, mounting supports for retarding chamber, and drip funnel. Provide pressure sensitive alarm switch to actuate the fire alarm system.

D. Drain Valves: Threaded bronze angle, globe, ball or butterfly, 4100 kPa (600 psi), Water or gas (WOG) equipped with reducer and hose connection with cap or connected to a drain line.

E. Self-contained Test and Drain Valve:

1. Ductile iron body with bronze "Drain" and "Test" bonnets. Acrylic sight glass for viewing test flow. Various sized orifice inserts to simulate flow through 14 mm (17/32 in.), 13 mm (1/2 in.), 12 mm (7/16 in.), and 10 mm (3/8 in.) diameter sprinklers, 32 mm (1 1/4 in.) female threaded outlets or 32 mm (1 1/4 in.) one-quarter turn locking lug outlets for plain end pipe (end preparation to be in accordance with manufacturer's recommendation).
2. Bronze body, with chrome plated bronze ball, brass stem, steel handle, Teflon seat and sight glasses. Provide valve with three position indicator plate (off, test, and drain), 6 mm (1/4 in.) tapping for pressure gage and various other orifice inserts to simulate flow through 10 mm (3/8 in.), 12 mm (7/16 in.), 13 mm (1/2 in.), and 14 mm (17/32 in.) diameter sprinklers.

F. Standpipe Hose Valve: 65 mm (2 1/2 in.) screwed, brass hose angle valve, 2400 kPa (350 psi) water working pressure, WWP, male hose threads same as local fire department service, 65 mm x 40 mm (2 1/2 in. x 1 1/2 in.) reducer, and with permanently attached polished brass cap and chain: Provide for valves installed in a cabinet a 65 mm (2 1/2 in.) attached cap and chain and a 65 mm x 40 mm (2 1/2 in. x 1 1/2 in.) reducer placed in cabinet.

G. Standpipe hose valve cabinets: Cabinets shall be white glossy polyester coated 20 gage steel with continuous steel hinge with brass pin, recessed type 600 x 600 x 250 mm (24 x 24 x 10 in.).

2.4 AUTOMATIC BALL DRIPS

A. Cast brass 20 mm (3/4 in.) in line automatic ball drip with both ends threaded with iron pipe threads.

2.5 SPRINKLERS

A. Quick response sprinklers shall be standard type except as noted below. The maximum distance from the deflector to finished ceiling shall be 50 mm (2 in.) for pendent sprinklers. Pendent sprinklers in finished

areas shall be provided with semi-recessed adjustable screwed escutcheons and installed within the center one-third of their adjustment. The sprinkler shall be installed in the flush position with the element exposed below the ceiling line. Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval, and the following:

LOCATION	TYPE
Mechanical Equipment Rooms, Electrical & Electrical Switch Gear Rooms	Quick Response, Upright or Telephone Closets, Transformer Vaults Pendent Brass [93 °C (200 °F)]
Gravity Type Linen & Trash Chutes	Standard Upright or Pendent Brass [66-74 °C (150-165 °F)]
Kitchen Hoods, Exhaust Ducts & Duct Collars	Standard Pendent or Upright (Extra High Temperature [163-191 °C (325- 375 °F.)])
Patient Sleeping, Patient Bathrooms, and Corridors within a Patient Ward	Residential, Quick Response, Recessed Pendent, Chrome Plated, [66-74 °C (150-165 °F)]
All Patient Treatment, Elevator Lobbies and Corridors	Quick Response, Recessed Pendent, Chrome Plated [66-74 °C [150- 165 °F)]
All Areas Not Listed Above	Quick Response, Recessed Pendent, Sidewall, Chrome Plated [66-74 °C (150-165 °F)]

B. Do not use quick response sprinklers in the same sprinkler zone with other sprinklers types. In sprinklered light hazard patient zones that are expanded into fully sprinklered zones, revise the existing system to contain quick response sprinklers.

C. Sprinklers to be installed as per NFPA 13.

2.6 TOOLS AND REPLACEMENT PARTS

A. Sprinkler Cabinet:

1. Provide a minimum 5 percent spare sprinklers with escutcheons with a minimum of two of each type/or as required by NFPA-13, whichever is more demanding.
2. Provide a minimum of two of each type sprinkler wrenches used.
3. Install cabinets in each building where directed by the COTR.

- 4. Spare sprinklers shall be kept in a cabinet where ambient temperatures do not exceed 100 Deg F.
- B. Sprinkler system water flow switch: one of each size provided.
- C. Sprinkler system valve tamper switch: one of each type provided.
- D. Sprinkler system pressure switch: one of each type provided.
- E. Provide two sprinkler plugs attached to multi-section extension poles 2400 mm (8 ft.) minimum.

2.7 IDENTIFICATION SIGNS

- A. Provide for all new and existing sectional valves, riser control valves, system control valves, drain valves, test and drain connections and alarm devices with securely attached identification signs (enamel on metal) in accordance with NFPA 13.

2.8 STANDPIPE HOSE VALVE CABINETS

- A. White glossy polyester coated 20 gage steel box, 20 gage tubular steel door and 18 gage frame with continuous steel hinge with brass pin, welded and ground smooth steel corner seams, recess type, 600 x 600 x 250 mm (24 x 24 x 10 in.). Finish door and frame with white prime polyester coating.

2.9 WATERFLOW SWITCHES

- A. Integral, mechanical, non-coded, non-accumulative retard type, with two sets of SPDT auxiliary contacts and adjustable from 0 to 90 seconds. Set flow switches at an initial setting between 20 and 30 seconds.
- B. All conduit and wiring connected thereto shall be provided in Section 28 31 00, FIRE DETECTION AND ALARM.

2.10 VALVE SUPERVISORY SWITCHES

- A. Provide each indicating sprinkler, standpipe and fire pump control valve with adequate means for mounting a valve supervisory switch.
- B. Mount switch so as not to interfere with normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem is moved no more than one fifth of the distance from its normal position.
- C. The mechanism shall be contained in a weatherproof die cast aluminum housing, which shall provide a 20 mm (3/4 in.) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.

- D. Switch housing to be finished in red baked enamel.
- E. Supervisory switches for ball and butterfly valves may be integral with the valve.
- F. All conduit and wiring connected thereto shall be provided in Section 28 31 00, FIRE DETECTION AND ALARM.

2.11 PRESSURE SWITCHES

- A. Provide with 15 mm (1/2 in.) NPT male pressure connection.
- B. Alarm switch shall be activated by any flow of water equal to or in excess of the discharge from one sprinkler.
- C. Supervisory switch shall be activated by either high or low air pressure condition.
- D. Furnish switch in a red baked enamel, weatherproof, oil resistant housing with tamper resistant screws.

2.12 WALL, FLOOR AND CEILING PLATES

- A. Exposed piping passing through walls, floors or ceilings shall be provided with chrome colored escutcheon plates.
- B. Comply with NFPA 101 Fire Barrier Penetration codes.

2.13 WET CHEMICAL EXTINGUISHING SYSTEMS

- A. Pre-engineered system installed in accordance with NFPA 17A.

2.14 KITCHEN VENTILATOR HOOD FIRE PROTECTION

- A. Provide piping from the building sprinkler system to the stub-out point on the ventilator control cabinet.
- B. Water pressure at the control cabinet shall be a minimum of 276 kPa (40 psi), maximum 552 kPa (80 psi). Provide a pressure reducing valve if the water pressure exceeds 552 kPa (80 psi).
- C. Activation of the flow switch shall shut off the electrical equipment and initiate a local alarm and the fire alarm for the affected zone.

2.15 PRESSURE GAUGE

- A. Provide a 690 kPa (100 psi) 1280 kPa (200 psi) pressure gauge at each flow alarm switch location, at the top of each sprinkler or standpipe riser, at each main drain connection, and on the suction and discharge of the fire pump.

2.23 HANGERS

- A. Hangers shall be designed to support five times the weight of the water filled pipe plus 250 Lb (114Kg) at each point of piping support.
- B. These points of support shall be adequate to support the system.
- C. The spacing between hangers shall not exceed the value given for the type of pipe as indicated in NFPA 13 tables.
- D. Hanger components shall be ferrous.
- E. Detailed calculations shall be submitted, when required by the reviewing Authority, showing stress developed in hangers, piping, fittings and safety factors allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Supervisory Switches: For each indicating sprinkler zone, Standpipe hose valves and test and drain valves shall not be provided with supervisory switches.
- B. Waterflow Switches: For each sprinkler zone and each standpipe riser and where indicated on drawings, provide a waterflow switch. Install waterflow switch and adjacent valves in easily accessible locations.
- C. Sprinkler Zone: Each sprinkler zone shall coincide with each smoke zone and fire alarm zone.
- D. Piping connections:
 - 1. Combined Standpipe and Sprinkler System: Provide standpipe system complete including fire pump, where required. Start the sprinkler system work for each zone at valve connection to standpipe location at each zone.
- E. Drains, Test Pipes and Accessories:
 - 1. Provide a drain at base of risers, drain connection on valved sections, and drains at other locations for complete drainage of the system. Provide valve in drain lines and connect to the central drain riser. Discharge riser outside over splash block, indirectly over standpipe drain connected to storm sewer, or as indicated. The main drain shall be capable of full discharge test without allowing water to flow onto the floor.

2. Provide test pipes in accordance with NFPA 13. Test pipes shall be valved and piped to discharge through proper orifice as specified above for drains.
- F. Provide a 690 kPa (100 psig) pressure gage at each flow alarm switch location, at the top of each sprinkler or standpipe riser, at each main drain connection, and on the suction and discharge of the fire pump.
- G. Conceal all piping, except in pipe basements, stairwells and rooms without ceilings.
- H. Install new piping and sprinklers aligned with natural building and other sprinklers lines.
- I. Locate piping in stairways as near ceiling as possible to prevent tampering by unauthorized personnel. Provide a minimum headroom of 2250 mm (7 ft.-6 in.) for all piping.
- J. Piping arrangement shall avoid contact with other piping and equipment and allow clear access to other equipment or devices requiring access or maintenance.
- K. Cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections, shall be affixed near to the pipe where they originated. They shall be displayed until final inspection and then removed.
- L. For each new or existing fire department connection, locate the symbolic sign given in NFPA 170 a distance of 2400 to 3000 mm (8 to 10 ft.) above each connection location. The sign shall be 450 x 450 mm (18 x 18 in.) with symbol at least 350 x 350 mm (14 x 14 in.).
- M. Firestopping shall comply with Section 07 84 00, FIRESTOPPING. All holes through stairways, smoke barrier walls, and fire walls shall be sealed on a daily basis.
- N. Provide hydraulic design information signage as required by NFPA 13 and 14.
- O. Install access doors in ceilings of rooms where above ceiling access is required.

3.2 TEST

- A. Automatic Sprinkler System: NFPA 13 and 25.
- B. Standpipe and Hose System: NFPA 25.

3.3 INSTRUCTIONS

A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the fire pump and sprinkler system, on the dates requested by the COTR.

- - - END - - -

**SECTION 21 12 00
FIRE-SUPPRESSION STANDPIPES**

PART 1 - GENERAL

1.1 DESCRIPTION

Fire-suppression wet standpipes.

1.2 SCOPE OF WORK

- A. Design, installation and testing shall be in accordance with NFPA 14 except for specified exceptions.
- B. Design, materials, equipment and installation, inspection and testing of a complete and ready for operation fire-suppression wet standpipe system as required by NFPA 14.
- C. Modification of the existing standpipe system as indicated on the drawings and as further required by these specifications.
- D. Expansion or revision of the building system fire alarm system to incorporate new system alarms and supervisory devices.
- E. Providing of access panels where control or drain valves are located behind plaster or gypsum walls or ceilings.
- F. Painting of exposed piping and supports to match surrounding background in stairways and red in unfinished areas.

1.3 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 07 84 00, FIRESTOPPING, Treatment of penetrations through rated enclosures.
- C. Section 08 31 13, ACCESS DOORS AND FRAMES: for access panels for plaster or gypsum finishes.
- D. Section 09 91 00, PAINTING.
- E. Section 21 10 00, WATER-BASED FIRE-SUPPRESSION SYSTEMS, for dry sprinklers, fire pumps, etc.
- F. Section 28 31 00, FIRE DETECTION AND ALARM, Connection to fire alarm of flow switches, pressure switches and valve supervisory switches.
- G. Section 21 05 11 COMMON WORK RESULTS FOR FIRE SUPPRESSION for general mechanical requirements and items, which are common to more than one section.

1.4 QUALITY ASSURANCE

- A. Designer's Qualifications: Design work and shop drawings shall be prepared by a licensed engineer practicing in the field of Fire Protection Engineering.
- B. Installer Reliability: The installer shall possess a valid State of Pennsylvania contractor's license. The installer shall provide documentation of having successfully completed three projects of similar size and scope.
- C. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL and approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA.
- D. Testing: Materials and Testing Certificate as per NFPA 14. Provide certificates for all parts of the system.

1.5 DESIGN CRITERIA

- A. The design, materials, equipment, installation, and testing of the system shall be in accordance with NFPA 14 the latest edition.
- B. For hydraulic calculations, calculated demand shall not fall less than 10 percent below the water supply curve.
- C. Water Supply: Base water supply on a fire pumper truck being able to provide 3785 l/m (1000 gpm) at 1035 kPa (150 psig) and 2650 l/m (700 gpm) at 1380 kPa (200 psig) at the fire department connection.

1.6 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering. As Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. / Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide index referencing the appropriate specification section. Submittals shall include, but not be limited to, the following:
 - 1. Certificates:
 - a. Designer's and Installer's qualifications and documentation of previous work.

- b. Materials and Testing certificates as specified.
- 2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to NFPA 14.
- 3. Manufacturers Literature and Data Sheets: All pertinent literature and data for the materials and equipment proposed for the project. Include listing information and installation instructions in data sheets. Clearly identify the item to be used.
 - a. Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.
- 4. Calculation Sheets: Submit hydraulic calculations in accordance with NFPA 14.
- 5. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Submittals shall include, but not be limited to, the following:
 - a. One complete set of reproducible as-built drawings showing the installed system with the specific interconnections between the waterflow switch or pressure switch and the fire alarm equipment. One copy of final CADD drawing files shall be provided on diskettes that are compatible with the VAMC CADD system.
 - b. Four sets of complete, simple, understandable, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing all equipment, and a complete trouble shooting manual. Provide maintenance instructions on replacing any components of the system including internal parts, periodic cleaning and adjustment of the equipment and components with information as to the address and telephone number of both the manufacturer and the local supplier of each item.
 - c. Certificates shall document all parts of the installation.
 - 1. Designer's and Installer's qualifications and documentation of previous work.
 - 2. Materials and Testing certificates as specified.

- d. Instruction Manual: Provide one copy of the instruction manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser.

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
B16.3-99Malleable Iron Threaded Fittings
- C. Factory Mutual Engineering Corporation (FM):
Approval Guide - 2001
- D. National Fire Protection Association (NFPA):
14-2003Installation of Standpipe, Private Hydrant and
Hose Systems
101-2003Safety to Life from Fire in Buildings and
Structures (Life Safety Code)
170-1999Fire Safety Symbols
- E. Underwriters Laboratories, Inc. (UL):
Fire Protection Equipment Directory - 2002
- F. Uniform Building Code - 1997

PART 2 PRODUCTS

2.1 GENERAL

- A. All devices and equipment shall be Underwriters Laboratories listed for their intended purpose.

2.2 PIPING & FITTINGS

- A. Shall be in accordance with NFPA 14. black steel, schedule 10 minimum.
- B. Threaded or flanged fittings shall be ANSI B 16.3 cast iron, class 125 minimum. Threaded fitting are not permitted on pipe with wall thickness less than Schedule 40.
- C. Clamp-on fittings with rubber gaskets shall be listed for the piping application.
- D. Plain end pipe, fittings with locking lugs or shear bolts are not permitted. Use nonferrous piping in MRI Scanning Rooms.

2.3 VALVES

- A. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.
- B. The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI. (No Substitutions Allowed).
- C. Alarm valve shall be UL Listed and Factory Mutual Approved. The alarm valve shall be equipped with a removable cover assembly. The alarm valve shall be listed for installation in the vertical or horizontal position. The alarm valve shall be equipped with gauge connections on the system side and supply side of the valve clapper. The alarm valve shall be equipped with an external bypass to eliminate false water flow alarms. The alarm valve trim piping shall be externally galvanized. Maximum water working pressure to 250 PSI.
- D. Listed Indicating Valves:
 - 1. Gate: OS&Y, 1200kPa (175 psig) WOG.
 - 2. Butterfly: Gear operated, indicating type, 1200 kPa (175 psig) WOG.
- E. Check Valves: Swing type, rubber faced or wafer type spring loaded butterfly check valve, 1200 kPa (175 psig) WOG.
- F. Drain Valves: Threaded bronze angle, globe, ball or butterfly, 1000 kPa (150 psig.) WOG equipped with reducer and hose connection with cap or connected to a drain line.
- G. Standpipe Hose Valves: 65 mm (2-1/2 inch) screwed, brass hose angle valve, male hose threads same as local fire protection service, 65 mm (2-1/2 inch) by 40 mm (1-1/2 inch) reducer, and with permanently attached polished brass cap and chain.
- H. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.

2.4 IDENTIFICATION SIGNS/HYDRAULIC PLACARDS

- A Provide for all new and existing sectional valves, riser control valves, drain valves and alarm devices. The signs shall be in accordance with NFPA 14 and attached securely to each item.
- B Plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Enter pertinent data for each system on the hydraulic placard.

2.5 VALVE SUPERVISORY SWITCHES:

- A. Provide each indicating standpipe and control valve with adequate means for mounting a valve supervisory switch.
- B. Mount switch so as not to interfere with normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem is moved no more than one fifth of the distance from its normal position.
- C. The mechanism shall be contained in a weatherproof die cast aluminum housing, which shall provide a 20 mm (3/4 in.) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
- D. Switch housing to be finished in red baked enamel.
- E. Water flow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.
- F. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.
- G. All conduit and wiring connected thereto shall be provided in Section 28 31 00, FIRE DETECTION AND ALARM.

2.6 GAUGES

- A. Provide gauges as required by NFPA 14.

2.7 PIPE HANGERS AND SUPPORTS

- A. Supports, hangers, etc., of an approved pattern placement to conform to NFPA 14. System piping shall be substantially supported to the building structure. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application. Hangers or supports not specifically listed for service shall be designed and bear the seal of a professional engineer.

2.8 WALL, FLOOR AND CEILING PLATES

- A. Provide chrome plated steel escutcheon plates for exposed piping passing through walls, floors or ceilings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of

the type of system being installed, to supervise the installation and testing of the system.

- B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Install concealed piping in spaces that have finished ceilings. Sidewall heads may need to be utilized. Locate piping in stairways as near to the ceiling as possible to prevent tampering by unauthorized personnel, and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.
- C. Face fire department connections in valve cabinets outward in a manner which prevents crimping of the hose.
- D. Welding: Conform to the requirements and recommendations of NFPA 14.
- E. Drains: Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 14.
- F. Valve Supervisory Switches: Provide supervisory switches for standpipe control valves. Do not provide standpipe hose valves and test and drain valves with supervisory switches. Do not provide valve supervisory switches on standpipe hose valves, test or drain valves. See Section 28 31 00, FIRE DETECTION AND ALARM for connections.
- G. Waterflow Alarm Switches: Install waterflow switch and adjacent valves in easily accessible locations.
- H. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.
- I. Provide pressure gauge at each water flow alarm switch location, at the top of each standpipe, and at each main drain connection.
- J. Penetrations: Sleeve or core drill concrete and masonry. Provide clearance between pipe and openings as required by NFPA 14. Seal penetrations and clearances in fire rated wall and floor assemblies with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.

- K. For each fire department supply connection, provide the symbolic sign given in NFPA 170 located 2400 to 3000 mm (8 to 10 feet) above each connection. The sign shall be 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).
- L. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.
- M. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the Contracting Officer. Contractor shall develop an interim fire protection program where interruptions involve in occupied spaces. Request in writing at least one (1) week prior to the planned interruption. Any interruption shall be limited to 4 hours for final connections or repairs.
- N. Welding: All welding shall conform to the requirements and recommendations of NFPA 14 latest editions.

3.2 INSPECTION AND TEST

- A. Flushing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed.
- B. Hydrostatic Testing: Hydrostatically test the system including the fire department connections, as specified in NFPA 14, NFPA-25 and NFPA 13 latest edition, in the presence of the Authority Having Jurisdiction or his designated representative.
- C. Final Inspection and Testing: Test the system in accordance with NFPA 14, NFPA 25 and NFPA 13 latest editions after all necessary corrections have been accomplished. Advise the Authority Having Jurisdiction who will then schedule the final inspection and test. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct any deficiencies found and retest the system. Include the operation of all features of the systems under normal conditions in the test.

3.3 INSTRUCTIONS

- A. Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COTR.

3.4 WARRANTY

- A. All work performed and materials and equipment furnished under this contract shall be free from defects for a period of one year from date of acceptance by the government.
- B. All new piping and equipment incorporated into the new system shall be hydrostatically tested and warranted as new.

- - - E N D - - -

**SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS**

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Design, installation and testing shall be in accordance with NFPA 13 except for specified exceptions.
- B. Modification of the existing sprinkler system as indicated on the drawings and as further required by these specifications.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 07 84 00, FIRESTOPPING, Treatment of penetrations through rated enclosures.
- C. Section 09 91 00, PAINTING.
- D. Section 21 10 00, WATER-BASED FIRE-SUPPRESSION SYSTEMS
- E. Section 21 12 00, FIRE-SUPPRESSION STANDPIPES.
- F. Section 28 31 00, FIRE DETECTION AND ALARM, Connection to fire alarm of flow switches, pressure switches and valve supervisory switches.
- G. Section 21 05 11 COMMON WORK RESULTS FOR FIRE SUPPRESSION

1.3 QUALITY ASSURANCE

- A. Installer Reliability: The installer shall possess a valid State of Pennsylvania fire sprinkler contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.
- B. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL and approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA.
- C. Submittals: Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering. As Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be

accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide index referencing the appropriate specification section. Submittals shall include, but not be limited to, the following:

1. Qualifications:

- a. Provide a copy of the installing contractors fire sprinkler and state contractor's license.
- b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering.

2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to NFPA 13.

3. Manufacturers Data Sheets:

- a. For backflow preventers, provide flow test curves from UL, FM, or the Foundation for Hydraulic Research and Cross-Connection Control to verify pressure loss calculations.
- b. Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.

4. Calculation Sheets: Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of NFPA 13.

5. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

Submittals shall include, but not be limited to, the following:

- a. One complete set of reproducible as-built drawings showing the installed system with the specific interconnections between the waterflow switch or pressure switch and the fire alarm equipment.
- b. Complete, simple, understandable, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing all equipment, and a complete trouble shooting manual. Provide maintenance instructions on replacing any components of the system including internal parts,

- periodic cleaning and adjustment of the equipment and components with information as to the address and telephone number of both the manufacturer and the local supplier of each item.
- c. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13.
 - d. Certificates shall document all parts of the installation.
 - e. Instruction Manual: Provide one copy of the instruction manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser.
- D. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13. Recommendations in appendices shall be treated as requirements.
- 1. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.
 - 2. Sprinkler Protection: To determining spacing and sizing, apply the following coverage classifications:
 - a. Light Hazard Occupancies: Patient care, treatment, and customary access areas.
 - b. Request clarification from the Government for any hazard classification not identified.
 - 3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.
 - 4. Zoning:
 - a. For each sprinkler zone provide a control valve, flow switch and a test and drain assembly with pressure gauge.
 - b. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):
 - 13-20010Installation of Sprinkler Systems
 - 101-2009Safety to Life from Fire in Buildings and Structures (Life Safety Code)
 - 170-2009Fire Safety Symbols
- C. Underwriters Laboratories, Inc. (UL):
 - Fire Protection Equipment Directory - 2001
- D. Factory Mutual Engineering Corporation (FM):
 - Approval Guide - 2009
- E. Uniform Building Code - 2009
- F. Foundation for Cross-Connection Control and Hydraulic Research-2005

PART 2 PRODUCTS**2.1 PIPING & FITTINGS**

- A. Sprinkler systems in accordance with NFPA 13. Use nonferrous piping in MRI Scanning Rooms.

2.2 VALVES

- A. Valves in accordance with NFPA 13.
- B. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.
- C. The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI. (No Substitutions Allowed).
- D. Alarm valve shall be UL Listed and Factory Mutual Approved. The alarm valve shall be equipped with a removable cover assembly. The alarm valve shall be listed for installation in the vertical or horizontal position. The alarm valve shall be equipped with gauge connections on the system side and supply side of the valve clapper. The alarm valve shall be equipped with an external bypass to eliminate false water flow alarms. The alarm valve trim piping shall be externally galvanized. Maximum water working pressure to 250 PSI.

- E. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.

2.3 SPRINKLERS

- A. All sprinklers except "institutional" type sprinklers shall be FM approved. Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval.
1. Cold storage rooms: Standard response dry pendant sprinklers.
- B. Temperature Ratings: In accordance with NFPA 13, except as follows:
1. Sprinklers in Generator Rooms: High temperature rated.

2.4 SPRINKLER CABINET

- A. Provide sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each system. Locate adjacent to the riser. Sprinkler heads shall be installed in center of tile or center to center.

2.5 IDENTIFICATION SIGNS/HYDRAULIC PLACARDS

- A. Plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Enter pertinent data for each system on the hydraulic placard.

2.6 SWITCHES:

- A. Contain in a weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.
- B. Water flow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.
- C. Pressure Switches: Activation by any flow of water equal to or in excess of the discharge from one sprinkler. Water Flow Indicating Pressure Switch will activate an alarm by way of an alarm pressure switch. The alarm pressure switch shall be compatible with system devices. The alarm pressure enclosure shall be UL Listed and Factory Mutual Approved for the application in which it is used. The alarm pressure switch shall have the ability to be wired for Class A or Class B service.
- D. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

2.7 GAUGES

- A. Provide gauges as required by NFPA 13.

2.8 PIPE HANGERS AND SUPPORTS

- A. Supports, hangers, etc., of an approved pattern placement to conform to NFPA 13. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in NFPA 13, Standard for Installation of Sprinkler Systems. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application. Hangers or supports not specifically listed for service shall be designed and bear the seal of a professional engineer.

2.9 WALL, FLOOR AND CEILING PLATES

- A. Provide chrome plated steel escutcheon plates for exposed piping passing through walls, floors or ceilings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.
- B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Install concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, such as in operating and radiology rooms, install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. Locate piping in stairways as near to the ceiling as possible to prevent tampering by unauthorized personnel, and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.
- C. Welding: Conform to the requirements and recommendations of NFPA 13.
- D. Drains: Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry

the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13.

- E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.
- F. Waterflow Alarm Switches: Install waterflow switch and adjacent valves in easily accessible locations.
- G. Inspector's Test Connection: Install and supply in conformance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.
- H. Kitchen Ventilator Hood Fire Protection: Provide piping from the building sprinkler system to the stub-out point on the ventilator control cabinet. Size piping in accordance with manufacturer specifications.
- I. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.
- J. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.
- K. Provide pressure gauge at each water flow alarm switch location and at each main drain connection.
- L. For each fire department connection, provide the symbolic sign given in NFPA 170 and locate 2400 to 3000 mm (8 to 10 feet) above each connection location. Size the sign to 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).
- M. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.
- N. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.

O. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.

P. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the Contracting Officer. Contractor shall develop an interim fire protection program where interruptions involve in occupied spaces. Request in writing at least one week prior to the planned interruption.

3.2 INSPECTION AND TEST

A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in the presence of the Contracting Officers Technical Representative (COTR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.

B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COTR to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

3.3 INSTRUCTIONS

A. Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COTR.

- - - E N D - - -

**SECTION 22 05 11
COMMON WORK RESULTS FOR PLUMBING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section shall apply to all sections of Division 22.
- B. Definitions:
 - 1. Exposed: Piping and equipment exposed to view in finished rooms.
 - 2. Option or optional: Contractor's choice of an alternate material or method.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.
- D. Section 07 84 00, FIRESTOPPING.
- E. Section 07 92 00, JOINT SEALANTS.
- F. Section 09 91 00, PAINTING.
- G. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- H. Section 23 09 23, DIRECT DIGITAL CONTROLS FOR HVAC.
- I. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

1.3 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
 - 2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification

- by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Contracting Officers Technical Representative (COTR).
 5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
 6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
 8. Asbestos products or equipment or materials containing asbestos shall not be used.
- B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
 3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
 4. All welds shall be stamped according to the provisions of the American Welding Society.
- C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COTR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- D. Execution (Installation, Construction) Quality:
1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract drawings and specifications shall be referred to the RE/COTR for resolution. Written hard copies or computer files of manufacturer's installation instructions shall be provided to the RE/COTR at least two weeks prior to commencing installation of any item.
 2. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved.
- E. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- F. Plumbing Systems: IPC, International Plumbing Code.

1.4 SUBMITTALS

- A. Submittals shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.
- C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Upon request by Government, lists of previous installations for selected items of equipment shall be provided. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
 2. Equipment and materials identification.
 3. Fire stopping materials.
 4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
 5. Wall, floor, and ceiling plates.
- H. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify

and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping until layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.

1. Mechanical equipment rooms.
2. Interstitial space.
3. Hangers, inserts, supports, and bracing.
4. Pipe sleeves.
5. Equipment penetrations of floors, walls, ceilings, or roofs.

I. Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided.
3. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.

2. Damaged equipment shall be replaced with an identical unit as determined and directed by the RE/COTR. Such replacement shall be at no additional cost to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC), latest edition. All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
Boiler and Pressure Vessel Code (BPVC):
SEC IX-2007Boiler and Pressure Vessel Code; Section IX,
Welding and Brazing Qualifications.
- C. American Society for Testing and Materials (ASTM):
A36/A36M-2008Standard Specification for Carbon Structural
Steel

- A575-96 (R 2007)Standard Specification for Steel Bars, Carbon,
Merchant Quality, M-Grades R (2002)
- E84-2005Standard Test Method for Surface Burning
Characteristics of Building Materials
- E119-2008aStandard Test Methods for Fire Tests of
Building Construction and Materials
- D. Manufacturers Standardization Society (MSS) of the Valve and Fittings
Industry, Inc:
- SP-58-02Pipe Hangers and Supports-Materials, Design and
Manufacture
- SP 69-2003 (R 2004)Pipe Hangers and Supports-Selection and
Application
- E. National Electrical Manufacturers Association (NEMA):
- MG1-2003, Rev. 1-2007 ..Motors and Generators
- F. International Code Council, (ICC):
- IBC-06, (R 2007)International Building Code
- IPC-06, (R 2007)International Plumbing Code

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. STANDARDIZATION OF COMPONENTS SHALL BE MAXIMIZED TO REDUCE SPARE PART requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
1. All components of an assembled unit need not be products of same manufacturer.
 2. Constituent parts that are alike shall be products of a single manufacturer.
 3. Components shall be compatible with each other and with the total assembly for intended service.
 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate

securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

- D. Major items of equipment, which serve the same function, shall be the same make and model

2.2 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.3 SAFETY GUARDS

- A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 6 mm (1/4-inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.
- B. All Equipment shall have moving parts protected from personal injury.

2.4 LIFTING ATTACHMENTS

- A. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.5 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (2"-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, fans, etc. shall be identified.

- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 5 mm (3/16-inch) high riveted or bolted to the equipment.
- D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
 - 1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
 - 2. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm(1/4-inch) for service designation on 19 gage, 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
 - 3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. A copy of the valve list shall be mounted in picture frames for mounting to a wall.
 - 4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling.

2.6 FIRE STOPPING

- A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION, for pipe insulation.

2.7 GALVANIZED REPAIR COMPOUND

- A. Mil. Spec. DOD-P-21035B, paint.

2.8 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC), latest edition, and SECTION 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Submittals based on the International Building Code (IBC), latest edition, SECTION 13 05 41 requirements, or the following paragraphs of this Section shall be stamped and signed by a professional engineer registered in a state where the project is located. The Support system of suspended equipment over 227 kg (500 pounds) shall be submitted for approval of the COTR in all cases. See these specifications for lateral force design requirements.
- B. Type Numbers Specified: MSS SP-58. For selection and application refer to MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.
- C. For Attachment to Concrete Construction:
1. Concrete insert: Type 18, MSS SP-58.
 2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (4 inches) thick when approved by the COTR for each job condition.
 3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (4 inches) thick when approved by the COTR for each job condition.
- D. For Attachment to Steel Construction: MSS SP-58.
1. Welded attachment: Type 22.
 2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8-inch) outside diameter.
- E. For Attachment to Wood Construction: Wood screws or lag bolts.
- F. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

- G. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Trapeze hangers are not permitted for steam supply and condensate piping.
1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13 mm (1/2-inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- H. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
1. General Types (MSS SP-58):
 - a. Standard clevis hanger: Type 1; provide locknut.
 - b. Riser clamps: Type 8.
 - c. Wall brackets: Types 31, 32 or 33.
 - d. Roller supports: Type 41, 43, 44 and 46.
 - e. Saddle support: Type 36, 37 or 38.
 - f. Turnbuckle: Types 13 or 15.
 - g. U-bolt clamp: Type 24.
 - h. Copper Tube:
 - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with isolation tape to prevent electrolysis.
 - 2) For vertical runs use epoxy painted or plastic coated riser clamps.

- 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
- 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
- i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp. Spring Supports (Expansion and contraction of vertical piping):
 - 1) Movement up to 20 mm (3/4-inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - 2) Movement more than 20 mm (3/4-inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
- j. Spring hangers are required on all plumbing system pumps one horsepower and greater.
- 2. Plumbing Piping (Other Than General Types):
 - a. Horizontal piping: Type 1, 5, 7, 9, and 10.
 - b. Chrome plated piping: Chrome plated supports.
 - c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
 - d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.
- I. Pre-insulated Calcium Silicate Shields:
 - 1. Provide 360 degree water resistant high density 965 kPa (140 psi) compressive strength calcium silicate shields encased in galvanized metal.
 - 2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
 - 3. Shield thickness shall match the pipe insulation.
 - 4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.

- a. Shields for supporting cold water shall have insulation that extends a minimum of one inch past the sheet metal.
 - b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psi) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.
5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

2.9 PIPE PENETRATIONS

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all fire stopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
 1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
 2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
 3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of the COTR.
- D. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the

sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.

- F. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel Sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- G. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
- H. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
- I. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.10 TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the COTR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the COTR.
- D. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.11 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening

to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3 inch) pipe, 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

2.12 ASBESTOS

- A. Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.

Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.

- B. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.
- C. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.

- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
1. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by RE/COTR where working area space is limited.
 2. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by RE/COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to RE/COTR for approval.
 3. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COTR. Damaged or defective items in the opinion of the COTR, shall be replaced.
 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

- I. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 53, MISCELLANEOUS CAST-IN-PLACE CONCRETE. shall be used for all pad or floor mounted equipment. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- J. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- K. Many plumbing systems interface with the HVAC control system. See the HVAC control points list and section 23 09 23 DIRECT DIGITAL CONTROLS FOR HVAC
- L. Work in Existing Building:
1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
 2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.
- M. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.
- N Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.
- O. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance,

equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.

2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

- A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Para. 3.1 shall apply.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3.3 RIGGING

- A. Openings in building structures shall be planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered and will be considered by Government under specified restrictions of phasing and service requirements as well as structural integrity of the building.
- C. All openings in the building shall be closed when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.

- E. Contractor shall check all clearances, weight limitations and shall provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to RE/COTR for evaluation prior to actual work.

3.4 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the COTR.
- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.
- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work shall be provided.
- D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC), latest edition, and these specifications.
- E. Overhead Supports:
 - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
 - 2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
 - 3. Tubing and capillary systems shall be supported in channel troughs.
- F. Floor Supports:
 - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled

- to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
 3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.
 4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 LUBRICATION

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
- B. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered to RE/COTR in unopened containers that are properly identified as to application.
- C. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
- E. All lubrication points shall be extended to one side of the equipment.

3.6 PLUMBING SYSTEMS DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the RE/COTR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and

debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.

- B. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards. Inspections will be made by personnel of the VA Medical Center, and the Contractor shall follow all directives of the RE or COTR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to RE/COTR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications.

Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

3.7 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
 - 1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
 - 2. The following Material And Equipment shall NOT be painted::
 - a. Motors, controllers, control switches, and safety switches.
 - b. Control and interlock devices.
 - c. Regulators.
 - d. Pressure reducing valves.
 - e. Control valves and thermostatic elements.
 - f. Lubrication devices and grease fittings.
 - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
 - h. Valve stems and rotating shafts.
 - i. Pressure gages and thermometers.
 - j. Glass.
 - k. Name plates.
 - 3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint obtained from manufacturer or computer matched.
 - 4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
 - 5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.

6. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this.

3.8 IDENTIFICATION SIGNS

- A. Laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance shall be placed on factory built equipment.
- C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.9 STARTUP AND TEMPORARY OPERATION

- A. Start up of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.10 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COTR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests such systems respectively during first actual seasonal use of respective systems following completion of work.

3.11 OPERATION AND MAINTENANCE MANUALS

- A. Provide four bound copies. The Operations and maintenance manuals shall be delivered to RE/COTR not less than 30 days prior to completion of a phase or final inspection.
- B. All new and temporary equipment and all elements of each assembly shall be included.
- C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- D. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.
- E. Lubrication instructions, type and quantity of lubricant shall be included.
- F. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
- G. Set points of all interlock devices shall be listed.
- H. Trouble-shooting guide for the control system troubleshooting guide shall be inserted into the Operations and Maintenance Manual.
- I. The combustion control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
- J. Emergency procedures.

3.12 INSTRUCTIONS TO VA PERSONNEL

- A. Instructions shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

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SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.

1.2 RELATED WORK

- A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
1. Valves.
 2. Backflow Preventers.
 3. Pressure Reducing Valves.
 4. Backwater Valves5. All items listed in Part 2 - Products.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):A536-84(R 2004)
Standard Specification for Ductile Iron Castings
- C. American Society of Sanitary Engineering (ASSE)
ASSE 1003-01 (R 2003) ..Performance Requirements for Water Pressure Reducing Valves
ASSE 1012-02Backflow Preventer with Intermediate Atmospheric Vent
ASSE 1013-05Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
- D. International Code Council (ICC)
IPC-09 (R 2007)International Plumbing Code
- E. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-25-98Standard Marking System for Valves, Fittings,
Flanges and UnionsSP-67-02a (R 2004) Butterfly
Valve of the Single flange Type (Lug Wafer)
SP-70-06Cast Iron Gate Valves, Flanged and Threaded
Ends.
SP-72-99Ball Valves With Flanged or Butt Welding For
General Purpose
SP-80-03Bronze Gate, Globe, Angle and Check Valves.
SP-110-96Ball Valve Threaded, Socket Welding, Solder
Joint, Grooved and Flared Ends

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Valves shall be prepared for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Valves shall be prepared for storage as follows:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature.
- C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES

- A. Asbestos packing and gaskets are prohibited.
- B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.
- C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or

disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.

- D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 meters (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
- E. Ball valves, pressure regulating valves, gate valves, globe valves, and plug valves used to supply potable water shall meet the requirements of NSF 61.
- F. Shut-off:
 - 1. Cold, Hot and Recirculating Hot Water:

- a. Seventy-five millimeter (3inches) and smaller:

- 1) Ball valve, bronze two-piece body with stainless steel ball and stem, full port, lever handle, solder ends, 400 psi WOG. 3-inch valves shall be three-piece type. Valves shall be as manufactured by "Apollo Combraco" or approved equal, Size 1/2" = Model 70-243-01, 3/4" thru 2-1/2" = 77-240 series, 3" - Model 82-240.

- b. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A 536, ductile iron.

- c. 100 mm (DN100) (4 inches) and larger:

- 1) Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS-SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A 126, grey iron with bolted bonnet, flanged ends, bronze trim, and solid wedge disc. The gate valve shall be gear operated for sizes under 200 mms or DN200 (8 inches) and crank operated for sizes 200 mms or DN200 (8 inches) and above
 - 2) Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for

bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.

- 3) Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The grooved butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall be polyamide coated ductile iron conforming to ASTM A536 with two piece stainless steel stem, EPDM encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated

G. Balancing:

1. Hot Water Re-circulating, 80 mm or DN80 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT ($\frac{1}{4}$ " NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.
2. Larger than 80 mm or DN80 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 862 kPa (125 psi) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless steel stem. The design pressure shall be 1207 kPa (175) at 121 deg C (250 deg F).

H. Check:

1. Check valves less than 80 mm or DN80 (3 inches) and smaller) shall be class 125, bronze swing check valves with non metallic Buna-N disc. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The

check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B 62, solder joints, and PTFE or TFE disc.

2. Larger than 100 mm or DN100 (4 inches and larger):
 - a. Check valves shall be class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A 126, bolted bonnet, flanged ends, bronze trim.
 - b. All check valves on the discharge side of submersible sump pumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

I. Globe:

1. 80 mm or DN80 (3 inches) or smaller: Class 150, bronze globe valve with non metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 2070 kPa (300 psig). The valve material shall be bronze with integral seal and union ring bonnet conforming to ASTM B 62 with solder ends, copper-silicon bronze stem, TPFTE or TFE disc, malleable iron hand wheel.
2. Larger than 80 mm or DN80 (3 inches): Similar to above, except with cast iron body and bronze trim, class 125, iron globe valve. The globe valve shall meet MSS SP-85, Type 1 standard. The globe valve shall have a CWP rating of 1380 kPa (200 psig). The valve material shall be gray iron with bolted bonnet conforming to ASTM A 126 with flanged ends, bronze trim, malleable iron handwheel.

2.2 WATER PRESSURE REDUCING VALVE AND CONNECTIONS

- A. 80 mm or DN80 (3 inches) or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no

flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.

- B. 100 mm or DN100 (4 inches) and larger: The pressure reducing valve shall consist of a flanged cast iron body and rated to 1378-kPa (200-psig). The valve shall have a large Hycar diaphragm for sensitive response.
- C. The regulator shall have a tap for pressure gauge.
- D. The regulator shall have a temperature rating of 100° C (210° F) for hot water or hot water return service. Pressure regulators shall have accurate pressure regulation to 6.9-kPa (+/- 1 psig).
- C. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.
- D. Connections Valves and Strainers: shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the low pressure side of the line.

2.3 BACKFLOW PREVENTERS

- A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. The backflow prevention assembly shall be ASSE 1013 listed and certified.
- B. Reduced pressure backflow preventers shall be installed in the following applications.
 - 1. Deionizers.
 - 2. Sterilizers.
 - 3. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
 - 4. Atmospheric Vacuum Breaker: ASSE 1001
 - a. Hose bibs and sinks w/threaded outlets.
 - b. Disposers.
 - c. Showers (telephone type).
 - d. Hydrotherapy units.
 - f. All kitchen equipment, if not protected by air gap.

- g. Ventilating hoods with wash down system.
- C. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated duct iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be Noryl (NSF listed). The stem shall be stainless steel conforming to ASTM A276. The seat disc elastomer shall be EPDM. The checks and the relief valve shall be accessible for maintenance without removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the inlet.
- D. The atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be either cast bronze. All internal polymers shall be NSF listed. The seat disc elastomer shall be silicone. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable.
- E. The double check detector backflow prevention assembly shall be ASSE listed 1048 and supply with full port OS&Y gate valves. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade. The seat ring and check valve shall be Noryl (NSF listed). The stem shall be stainless steel conforming to ASTM A 276. The seat disc elastomers shall be EPDM. The first and second check valve shall be accessible for maintenance without removing the device from the line.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.

D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.

C. Valves shall be installed in horizontal piping with stem at or above center of pipe

D. Valves shall be installed in a position to allow full stem movement.

E. Install chain wheels on operators for ball valves NPS 100 mm or DN100 (4 inches) and larger and more than [2400 mm (12 feet) above floor. Chains shall be extended to 1500 mm 3600 mm (60 inches) above finished floor.

F. Check valves shall be installed for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

- - E N D - - -

**SECTION 22 07 11
PLUMBING INSULATION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for
 - 1. Plumbing piping and equipment.
- B. Definitions
 - 1. ASJ: All service jacket, white finish facing or jacket.
 - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
 - 3. Cold: Equipment or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
 - 4. Concealed: Piping above ceilings and in chases, interstitial space, and pipe spaces.
 - 5. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, interstitial spaces, , crawl spaces and pipe basements are not considered finished areas.
 - 6. FSK: Foil-scrim-kraft facing.
 - 7. Hot: Plumbing equipment or piping handling media above 41 degrees C (105 degrees F).
 - 8. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
 - 9. Thermal conductance: Heat flow rate through materials.
 - a. Flat surface: Watts per square meter (BTU per hour per square foot).
 - b. Pipe or Cylinder: Watts per square meter (BTU per hour per linear foot).
 - 10. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
 - 11. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor

retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.

- 12. R: Pump recirculation.
- 13. CW: Cold water.
- 14. SW: Soft water.
- 15. HW: Hot water.
- 16. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- B. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
- C. GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.

1.3 QUALITY ASSURANCE

- A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

- B. Criteria:

- 1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

4.3.3.1 Pipe insulation and coverings, vapor retarder facings, adhesives, fasteners, tapes, unless otherwise provided for in 4.3.3.1.12 or 4.3.3.1.2, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2.)

4.3.3.3 Pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-

Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.10.2.6.3 Nonferrous fire sprinkler piping shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

4.3.10.2.6.7 Smoke detectors shall not be required to meet the provisions of this section.

2. Test methods: ASTM E84, UL 723, or NFPA 255.

3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.

a. Insulation materials: Specify each type used and state surface burning characteristics.

- b. Insulation facings and jackets: Each type used.
 - c. Insulation accessory materials: Each type used.
 - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
 - e. Make reference to applicable specification paragraph numbers for coordination.
- C. Samples:
- 1. Each type of insulation: Minimum size 100 mm (4 inches) square for board/block/ blanket; 150 mm (6 inches) long, full diameter for round types.
 - 2. Each type of facing and jacket: Minimum size 100 mm (4 inches square).
 - 3. Each accessory material: Minimum 120 ML (4 ounce) liquid container or 120 gram (4 ounce) dry weight for adhesives cement mastic.

1.5 STORAGE AND HANDLING OF MATERIAL

A. Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):
- L-P-535E (2)-91Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. Military Specifications (Mil. Spec.):
- MIL-A-3316C (2)-90Adhesives, Fire-Resistant, Thermal Insulation
- MIL-A-24179A (1)-87Adhesive, Flexible Unicellular-Plastic Thermal Insulation
- MIL-C-19565C (1)-88Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier

MIL-C-20079H-87Cloth, Glass; Tape, Textile Glass; and Thread,
Glass and Wire-Reinforced Glass

D. American Society for Testing and Materials (ASTM):

A167-04Standard Specification for Stainless and
Heat-Resisting Chromium-Nickel Steel Plate,
Sheet, and Strip

B209-07Standard Specification for Aluminum and
Aluminum-Alloy Sheet and Plate

C411-05Standard test method for Hot-Surface
Performance of High-Temperature Thermal
Insulation

C449-07Standard Specification for Mineral Fiber
Hydraulic-Setting Thermal Insulating and
Finishing Cement

C533-09Standard Specification for Calcium Silicate
Block and Pipe Thermal Insulation

C534-08Standard Specification for Preformed Flexible
Elastomeric Cellular Thermal Insulation in
Sheet and Tubular Form

C547-07Standard Specification for Mineral Fiber pipe
Insulation

C552-07Standard Specification for Cellular Glass
Thermal Insulation

C553-08Standard Specification for Mineral Fiber
Blanket Thermal Insulation for Commercial and
Industrial Applications

C585-09Standard Practice for Inner and Outer Diameters
of Rigid Thermal Insulation for Nominal Sizes
of Pipe and Tubing (NPS System) R (1998)

C612-10Standard Specification for Mineral Fiber Block
and Board Thermal Insulation

C1126-10Standard Specification for Faced or Unfaced
Rigid Cellular Phenolic Thermal Insulation

- C1136-10Standard Specification for Flexible, Low
Permeance Vapor Retarders for Thermal
Insulation
- D1668-97a (2006)Standard Specification for Glass Fabrics (Woven
and Treated) for Roofing and Waterproofing
- E84-10Standard Test Method for Surface Burning
Characteristics of Building
Materials
- E119-09CStandard Test Method for Fire Tests of Building
Construction and Materials
- E136-09 bStandard Test Methods for Behavior of Materials
in a Vertical Tube Furnace at 750 degrees C
(1380 F)
- E. National Fire Protection Association (NFPA):
- 101-09Life Safety Code
- 251-06Standard methods of Tests of Fire Endurance of
Building Construction Materials
- 255-06Standard Method of tests of Surface Burning
Characteristics of Building Materials
- F. Underwriters Laboratories, Inc (UL):
- 723UL Standard for Safety Test for Surface Burning
Characteristics of Building Materials with
Revision of 08/03
- G. Manufacturer's Standardization Society of the Valve and Fitting
Industry (MSS):
- SP58-2002Pipe Hangers and Supports Materials, Design,
and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m³ (3 pcf), k = 0.037 (.26) at 24 degrees C (75 degrees F), external insulation for temperatures up to 204 degrees C (400 degrees F).
- B. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at

temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.2 MINERAL WOOL OR REFRACTORY FIBER

- A. Comply with Standard ASTM C612, Class 3, 450 degrees C (850 degrees F).

2.3 RIGID CELLULAR PHENOLIC FOAM

- A. Preformed (molded) pipe insulation, ASTM C1126, type III, grade 1, $k = 0.021(0.15)$ at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with vapor retarder and all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.
- B. Equipment Insulation, ASTM C 1126, type II, grade 1, $k = 0.021 (0.15)$ at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with rigid cellular phenolic insulation and covering, and all service vapor retarder jacket.

2.4 CELLULAR GLASS CLOSED-CELL

- A. Comply with Standard ASTM C177, C518, density 120 kg/m³ (7.5 pcf) nominal, $k = 0.033 (0.29)$ at 24~~0~~ degrees C (75 degrees F).
- B. Pipe insulation for use at temperatures up to 200 degrees C (400 degrees F) with all service vapor retarder jacket.

2.5 POLYISOCYANURATE CLOSED-CELL RIGID

- A. Preformed (fabricated) pipe insulation, ASTM C591, type IV, $K=0.027(0.19)$ at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for use at temperatures up to 149 degree C (300 degree F) with factory applied PVDC or all service vapor retarder jacket with polyvinyl chloride premolded fitting covers.
- B. Equipment and duct insulation, ASTM C 591, type IV, $K=0.027(0.19)$ at 24 degrees C (75 degrees F), for use at temperatures up to 149 degrees C (300 degrees F) with PVDC or all service jacket vapor retarder jacket.

2.6 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

ASTM C177, C518, $k = 0.039 (0.27)$ at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

2.7 CALCIUM SILICATE

- A. Preformed pipe Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- B. Premolded Pipe Fitting Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- C. Equipment Insulation: ASTM C533, Type I and Type II
- D. Characteristics:

Insulation Characteristics		
ITEMS	TYPE I	TYPE II
Temperature, maximum degrees C (degrees F)	649 (1200)	927 (1700)
Density (dry), Kg/m ³ (lb/ ft ³)	232 (14.5)	288 (18)
Thermal conductivity: Min W/ m K (Btu in/h ft ² degrees F)@ mean temperature of 93 degrees C (200 degrees F)	0.059 (0.41)	0.078 (0.540)
Surface burning characteristics: Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

2.8 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance ≤ 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt

strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.
- E. Aluminum Jacket-Piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.
- F. Aluminum jacket-Rectangular breeching: ASTM B209, 3003 alloy, H-14 temper, 0.5 mm (0.020 inches) thick with 32 mm (1-1/4 inch) corrugations or 0.8 mm (0.032 inches) thick with no corrugations. System shall be weatherproof if used for outside service.

2.9 PIPE COVERING PROTECTION SADDLES

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as

adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

2.10 ADHESIVE, MASTIC, CEMENT

- A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.
- E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.
- F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
- G. Other: Insulation manufacturers' published recommendations.

2.11 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.

- B. Staples: Outward clinching galvanized steel
- C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- D. Bands: 13 mm (1/2 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.12 REINFORCEMENT AND FINISHES

- A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.
- E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.
- F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.13 FIRESTOPPING MATERIAL

- A. Other than pipe insulation, refer to Section 07 84 00 FIRESTOPPING.

2.14 FLAME AND SMOKE

- A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM 84, NFPA and UL standards and specifications.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of piping joints and connections shall be completed and the work approved by the COTR for application of

insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

- B. Except for specific exceptions, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- E. Construct insulation on parts of equipment such as cold water pumps and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- G. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
- H. Plumbing work not to be insulated:
 - 1. Piping and valves of fire protection system.

2. Chromium plated brass piping.
3. Water piping in contact with earth.
4. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).
5. Distilled water piping.
- I. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- J. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights.
Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- K. Firestop Pipe insulation:
 1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
 2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
 - a. Pipe risers through floors
 - b. Pipe chase walls and floors
 - c. Smoke partitions
 - d. Fire partitions
- L. Freeze protection of above grade outdoor piping (over heat tracing tape): 20 mm (0.75) thick insulation, for all pipe sizes 75 mm(3 inches) and smaller and 25 mm(1inch) thick insulation for larger pipes. Provide metal jackets for all pipes. M. Provide vapor barrier jackets over insulation as follows:
- M. Provide metal jackets over insulation as follows:
 - a. All plumbing piping exposed to outdoor weather.
 - b. Piping exposed in building, within 1800 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment.

Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.

- c. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

A. Mineral Fiber Board:

1. Faced board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
2. Plain board:
 - a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9 inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
 - b. For hot equipment: Stretch 25 mm (1 inch) mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 6 mm (1/4 inch) thick, trowel led to a smooth finish.
 - c. For cold equipment: Apply meshed glass fabric in a tack coat 1.5 to 1.7 square meter per liter (60 to 70 square feet per gallon) of vapor mastic and finish with mastic at 0.3 to 0.4 square meter per liter (12 to 15 square feet per gallon) over the entire fabric surface.
3. Cold equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
 - a. Water filter, chemical feeder pot or tank.
 - b. Pneumatic, cold storage water and surge tanks.
4. Hot equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
 - a. Domestic water heaters and hot water storage tanks (not factory insulated).

- b. Booster water heaters for dietetics dish and pot washers and for washdown grease-extracting hoods.
- B. Molded Mineral Fiber Pipe and Tubing Covering:
- 1. Fit insulation to pipe, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
 - 2. Contractor's options for fitting, flange and valve insulation:
 - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
 - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
 - c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
 - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
 - 3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

C. Rigid Cellular Phenolic Foam:

1. Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).
2. Note the NFPA 90A Burning Characteristics Requirements: of 25/50 in paragraph 1.3.B this section.
3. Provide secure attachment facilities such as welding pins.
4. Apply insulation with joints tightly drawn together
5. Apply adhesives, coverings, neatly finished at fittings, and valves.
6. Final installation shall be smooth, tight, neatly finished at all edges.
7. Minimum thickness in millimeters (inches) specified in the schedule at the end of this section.
8. Condensation control insulation: Minimum 25 mm (1.0 inch) thick for all pipe sizes.
 - a. Plumbing piping as follows:
 - 1) Body of roof and overflow drains horizontal runs and offsets (including elbows) of interior downspout piping in all areas above pipe basement.
 - 2) Waste piping from electric water coolers and icemakers to drainage system.
 - 3) Waste piping located above basement floor from ice making and film developing equipment and air handling units, from equipment(including trap) to main vertical waste pipe.
 - 5) Bedpan sanitizer atmospheric vent
 - 6) Reagent grade water piping.
 - 7) Cold water piping.

D. Cellular Glass Insulation:

1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
2. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ.

3.3 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS for all

inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.4 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature Range/Service	Insulation Material	Less than 25 (1)	25 - 32 (1 - 1¼)	38 - 75 (1½ - 3)	100 (4) and Above
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Rigid Cellular Phenolic Foam (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Polyiso-cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	----	----
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	----	----

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SECTION 22 11 00
FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures
B. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION, PIPE INSULATION.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Manufacturer's Literature and Data:
1. All items listed in Part 2 - Products.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
B. American National Standards Institute (ANSI):
American Society of Mechanical Engineers (ASME): (Copyrighted Society)
A13.1-2007Scheme for Identification of Piping Systems
B16.3-2006Malleable Iron Threaded Fittings Classes 150 and 300
B16.9-2007..... Gray Iron Threaded Fittings Classes 125 and 250
B16.9-2007Factory-Made Wrought Butt Welding Fittings
ANSI/ASME
B16.11-2009Forged Fittings, Socket-Welding and Threaded
ANSI/ASME
B16.12-2009Cast Iron Threaded Drainage Fittings ANSI/ASME
B16.15-2006Cast Bronze Threaded Fittings Classes 125 and 250 ANSI/ASME

B16.18-01 (R2005)Cast Copper Alloy Solder-Joint Pressure
Fittings ANSI/ASME
B16.22-01 (R2005)Wrought Copper and Copper Alloy Solder Joint
Pressure Fittings ANSI/ASME Element ANSI/ASME
NSF/ANSI 61Drinking Water System Components - Health
Effects

C. American Society for Testing and Materials (ASTM):

A47/A47M-99(2009)Ferritic Malleable Iron Castings Revision 1989
A53/A53M-07Pipe, Steel, Black And Hot-Dipped, Zinc-coated
Welded and Seamless
A183-03(2009)Carbon Steel Track Bolts and Nuts
A269-10Standard Specification for Seamless and Welded
Austenitic Stainless Steel Tubing for General
Service
A312/A312M-09Seamless, Welded, and Heavily Cold Worked
Austenitic Stainless Steel Pipes
A403/A403M-10aStandard Specification for Wrought Austenitic
Stainless Steel Piping Fittings
A536-84(2009)Ductile Iron Castings
A733-03(2009)Welded and Seamless Carbon Steel and Austenitic
Stainless Steel Pipe Nipples
B32-08Solder Metal
B61-08Steam or Bronze Castings
B62-09Composition Bronze or Ounce Metal Castings
B75-02Seamless Copper Tube
B88-09Seamless Copper Water Tube
B300-10AWWA Standard for Hypochlorites
B301-10AWWA Standard for Liquid Chlorine
B584-09aCopper Alloy Sand Castings for General
Applications Revision A
B687-99(2005) e1Brass, Copper, and Chromium-Plated Pipe Nipples
D1785-06Standard Specification for Poly (Vinyl
Chloride) (PVC) Plastic Pipe, Schedules 40, 80,
and 120
D2000-08Rubber Products in Automotive Applications

- D4101-09Propylene Plastic Injection and Extrusion
Materials
- D2447-03Polyethylene (PE) Plastic Pipe, Schedule 40 and
80, Based on Outside Diameter
- D2564-04(2009) e1Solvent Cements for Poly (Vinyl Chloride) (PVC)
Plastic Pipe and Fittings
- D4101-09Propylene Plastic Injection and Extrusion
Materials
- E1120-08Standard Specification For Liquid Chlorine
- E1229-08Standard Specification For Calcium Hypochlorite
- D. American Water Works Association (AWWA):
- C110-08Ductile Iron and Gray Iron Fittings - 75 mm
thru 1200 mm (3 inch thru 48 inches) for Water
and other liquids AWWA/ANSI
- C151/A21.51-09Ductile-Iron Pipe, Centrifugally Cast in Metal
Molds or Sand-Lined Molds, for Water or Other
Liquids AWWA/ ANSI
- C153/A21.53-06AWWA Standard for Ductile-Iron Compact Fittings
for Water Service AWWA/ANSI
- C203-08Coal-Tar Protective Coatings and Linings for
Steel Water Pipelines - Enamel and Tape - Hot
Applied AWWA/ANSI
- C213-07Fusion Bonded Epoxy Coating For The Interior &
Exterior Of Steel Water Pipelines
- C651-05Disinfecting Water Mains
- E. American Welding Society (AWS):
- A5.8/A5.8M:2004Filler Metals for Brazing
- F. International Plumbing Code
International Plumbing Code - 2009
- G. American Society of Sanitary Engineers (ASSE):
- ANSI/ASSE (Plumbing)
- 1001-2008Pipe Applied Atmospheric Type Vacuum Breakers
- ANSI/ASSE 1010-2004Water Hammer Arresters
- ANSI/ASSE 1018-2001Performance for trap seal primer valves -
potable water supplied.
- ANSI/ASSE (Plumbing)

1020-2004Pressure Vacuum Breaker Assembly

H. Plumbing and Drainage Institute (PDI):

PDI WH-201 2007Water Hammer Arrestor

1.5 QUALITY ASSURANCE

- A. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and more than one year old.
- B. For mechanical pressed sealed fittings, only tools of fitting manufacture shall be used.
- C. Mechanical pressed fittings shall be installed by factory trained workers.
- D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.
- E. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.6 SPARE PARTS

- A. For mechanical pressed sealed fittings provide tools required for each pipe size used at the facility.

PART 2 - PRODUCTS

2.1 UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS

- A. From inside face of exterior wall to a distance of approximately 1500 mm (5 feet) outside of building and underground inside building, material selected shall be the same for the size specified.
- B. Seventy five millimeters (3 inch) Diameter and Over: Ductile iron, AWWA C151, 850 kPa (125 psi) water steam pressure (WSP), exterior bituminous coating, and cement lined. Provide flanged and anchored connection to interior piping.
- C. Under 75 mm (3 inch) Diameter: Copper tubing, ASTM B88, Type K, seamless, annealed. Fittings as specified under Article 2.2, INTERIOR DOMESTIC WATER PIPING. Use brazing alloys, AWS A5.8, Classification BCuP.

2.2 INTERIOR DOMESTIC WATER PIPING

- A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless, steel ASTM A312, schedule 10 may be used.
- B. Fittings for Copper Tube:
1. Wrought copper or bronze castings conforming to ANSI B16.18 and B16.22. Unions shall be bronze, MSS SP72 & SP 110, Solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
 2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75 C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, CDA 844. Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or malleable iron, ASTM A47 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
 3. Mechanical press sealed fittings, 65 mm (2-1/2") in size and smaller. Fittings shall be double pressed type NSF/ANSI 61 approved and utilize EPDM (Ethylene Propylene Diene Monomer) non toxic synthetic rubber sealing elements.
 4. Mechanically formed tee connection: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting. Braze joints.
- C. Fittings for Stainless Steel:
1. Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ANSI B16.9.
 2. Grooved fittings, stainless steel, Type 316, Schedule 10, conforming to ASTM A403. Segmentally fabricated fittings are not allowed. Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or Malleable iron, ASTM A47 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
- D. Adapters: Provide adapters for joining screwed pipe to copper tubing.

E. Solder: ASTM B32 Composition Sb5 HA or HB. Provide non-corrosive flux.

F. Brazing alloy: AWS A5.8, Classification BCuP.

G. Reagent Grade Water Piping and Dialysis Water Piping:

1. Polypropylene, ASTM D4101, Schedule 80 pressure pipe with dimensions in conformance with ASTM D2447, but without additions of modifiers, plasticizers, colorants, stabilizers or lubricants. This virgin unplasticized pipe and fittings shall transport 10 megohm water with no loss of purity. Provide socket fusion joints.
2. Polyethylene, food and medical grade, capable of transporting 10 megohm water with no loss of purity. Processed by continuous compression molding without the addition of fillers, polymer modifiers or processing aids. Uniform color with no cracks, flaws, blisters or other imperfections in appearance. Provide heat fusion butt welded joints. In accordance with manufacturer's recommendations, provide continuous channel support under all horizontal piping.
3. Reverse Osmosis (RO) Water Piping:
 - a. Low Pressure Feed, Reject and Recycle Piping (75 psi and under): ASTM D 1785, Schedule 80 PVC, socket welded and flanged.
 - b. RO Product Tubing From Each Membrane Housing: ASTM D1785, Schedule 80 PVC, socket welded and flanged.
 - c. Low Pressure Control and Pressure Gage Tubing: Polyethylene.
 - d. High Pressure Reject and Recycle Piping (above 75 psi): ASTM A269, Type 304 schedule 10 stainless steel with butt welded joints.
 - e. High Pressure Control and Pressure Gage Tubing: 1000 psi burst nylon.

2.3 EXPOSED WATER PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. Pipe: Fed. Spec. WW-P-351, standard weight.
2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
3. Nipples: ASTM B 687, Chromium-plated.

4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish.
Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

- B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

2.4 TRAP PRIMER WATER PIPING:

- A. Pipe: Copper tube, ASTM B88, type K, hard drawn.
B. Fittings: Bronze castings conforming to ANSI B16.18 Solder joints.
C. Solder: ASTM B32 composition Sb5. Provide non-corrosive flux.

2.5 STRAINERS

- A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.
B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.
C. Body: Smaller than 80 mm (3 inches), brass or bronze; 80 mm (3 inches) and larger, cast iron or semi-steel.

2.6 DIELECTRIC FITTINGS

- A. Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.7 STERILIZATION CHEMICALS

- A. Hypochlorites ANSI/AWWA B300-10
B. Liquid Chlorine ANSI/AWWA B301-10

2.8 WATER HAMMER ARRESTER:

- A. Closed copper tube chamber with permanently sealed 410 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N O-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010 for sealed wall installations without an access panel. Size and install in accordance with Plumbing and Drainage Institute requirements (PDI WH 201). Provide water hammer arrestors at:
1. All solenoid valves.
 2. All groups of two or more flush valves.
 3. All quick opening or closing valves.

4. All medical washing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Plumbing Code and the following:

1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
3. All pipe runs shall be laid out to avoid interference with other work.
4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports and Accessories:
 - a. All piping shall be supported per the International Plumbing Code, Chapter No. 3.
 - b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with red lead or zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
 - c. Floor, Wall and Ceiling Plates, Supports, Hangers:
 - 1) Solid or split unplated cast iron.
 - 2) All plates shall be provided with set screws.
 - 3) Pipe Hangers: Height adjustable clevis type.
 - 4) Adjustable Floor Rests and Base Flanges: Steel.
 - 5) Concrete Inserts: "Universal" or continuous slotted type.
 - 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 - 7) Riser Clamps: Malleable iron or steel.
 - .
 - 8) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.

- 9) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.
 - 10) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
 - 11) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints.
6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:
- a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the fire stopping materials.
 - b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- B. Piping shall conform to the following:
1. Domestic Water:
 - a. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
 - b. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect

branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

- A. General: Test system either in its entirety or in sections.
- B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 690 kPa (100 psi) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested.
- C. Reagent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 690 kPa (100 psi) gage during inspection and prove tight.
- D. All Other Piping Tests: Test new installed piping under 1 1/2 times actual operating conditions and prove tight.

3.3 STERILIZATION

- A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.
- B. Use liquid chlorine or hypochlorites for sterilization.

3.4 COMMISSIONING

- A. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

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SECTION 22 13 00
FACILITY SANITARY AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- B. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Pipe Insulation.
- E. Section 07 92 00 Joint Sealants: Sealant products.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Piping.
 - 2. Floor Drains.
 - 4. Cleanouts.
 - 5. All items listed in Part 2 - Products.
- C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME): (Copyrighted Society)
 - A112.6.3-01 (R 2007) ...Standard for Floor and Trench Drains
 - A13.1-07Scheme for Identification of Piping Systems
 - B16.3-06Malleable Iron Threaded Fittings, Classes 150 and 300.

- B16.4-06Standard for Grey Iron Threaded Fittings
Classes 125 and 250
- B16.12-98 (R 2006)Cast Iron Threaded Drainage Fittings
- B16.15-06Cast Bronze Threaded Fittings, Classes 125 and
250
- C. American Society for Testing and Materials (ASTM):
- A47/A47M-99 (R 2004) ...Standard Specification for Steel Sheet,
Aluminum Coated, by the Hot Dip Process
- A53/A53M-07Standard Specification for Pipe, Steel, Black
And Hot-Dipped, Zinc-coated, Welded and
Seamless
- A74-06Standard Specification for Cast Iron Soil Pipe
and Fittings
- A183-03Standard Specification for Carbon Steel Track
Bolts and Nuts
- A536-84(R 2004)Standard Specification for Ductile Iron
Castings
- B32-08Standard Specification for Solder Metal
- B75-02Standard Specification for Seamless Copper Tube
- B306-02Standard Specification for Copper Drainage Tube
(DWV)
- B584-06aStandard Specification for Copper Alloy Sand
Castings for General Applications
- C564-03aStandard Specification for Rubber Gaskets for
Cast Iron Soil Pipe and Fittings
- D2000-08Standard Classification System for Rubber
Products in Automotive Applications
- D2564-04E1Standard Specification for Solvent Cements for
Poly (Vinyl Chloride) (PVC) Plastic Pipe and
Fittings
- D2665-08Standard Specification for Poly (Vinyl
Chloride) (PVC) Plastic Drain, Waste, and Vent
Pipe and Fittings
- D. International Code Council:
- IPC-06International Plumbing Code
- E. Cast Iron Soil Pipe Institute (CISPI):

301-05Hubless Cast Iron Soil Pipe and Fittings for
Sanitary and Storm Drain, Waste, and Vent
Piping Applications

310-04Coupling for Use in Connection with Hubless
Cast Iron Soil Pipe and Fittings for Sanitary
and Storm Drain, Waste, and Vent Piping
Applications

F. American Society of Sanitary Engineers (ASSE):

1018-01Trap Seal Primer Valves - Potable, Water
Supplied

G. Plumbing and Drainage Institute (PDI):

PDI WH-201Water Hammer Arrestor

PART 2 - PRODUCTS

2.1 SANITARY WASTE, DRAIN, AND VENT PIPING

A. Cast iron waste, drain, and vent pipe and fittings

1. Cast iron waste, drain, and vent pipe and fittings shall be used for
the following applications:

- a. pipe buried in or in contact with earth
- b. sanitary pipe extensions to a distance of approximately 1500 mm
(5 feet) outside of the building.
- c. interior waste and vent piping above grade.

2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-
hub or hubless).

3. The material for all pipe and fittings shall be cast iron soil pipe
and fittings and shall conform to the requirements of CISPI Standard
301, ASTM A-888, or ASTM A-74.

4. Joints for hubless pipe and fittings shall conform to the
manufacturer's installation instructions. Couplings for hubless
joints shall conform to CISPI 310. Joints for hub and spigot pipe
shall be installed with compression gaskets conforming to the
requirements of ASTM Standard C-564 or be installed with lead and
oakum.

B. Copper Tube, (DWV):

1. Copper DWV tube sanitary waste, drain and vent pipe may be used for
piping above ground, except for urinal drains.

2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME 16.29.
4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.
5. Fittings:
 - a. PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

2.2 EXPOSED WASTE PIPING

- A. Full iron pipe size chrome plated brass piping shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
 1. The Pipe shall meet Fed. Spec. WW-P-351, standard weight.
 2. The Fittings shall conform to ANSI B16.15, cast bronze threaded fittings with chrome finish, (125 and 250).
 3. Nipples shall conform to ASTM B 687, Chromium-plated.
 4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
- B. In unfinished Rooms such as mechanical Rooms and Kitchens, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph "Sanitary Waste, Drain, and Vent Piping" can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 91 00, PAINTING.

2.3 SPECIALTY PIPE FITTINGS

- A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:

1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
 2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F 477 or ASTM D5926.
 3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.
- B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 860 kPa (125 psig) at a minimum temperature of 82°C (180°F). The end connection shall be solder joint copper alloy and threaded ferrous.
- C. Dielectric flange insulating kits shall be of non conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.
- D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F 1545 with a pressure ratings of 2070 kPa (300 psig) at 107°C (225°F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.4 CLEANOUTS

- A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.
- B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw

plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.

- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.
- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

2.5 FLOOR DRAINS

- A. Type A (SD-1) floor drain shall comply with ANSI A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening will not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a 2.2 kg (16-ounce) soft copper membrane, 600 mm

(24 inches) square or another approved waterproof membrane shall be provided.

- M. Type M (FD-1) floor drain shall comply with ANSI A112.6.3 The type M floor drain shall have a cast iron body, nickel bronze adjustable funnel strainer and clamping device. Funnel strainer shall consist of a perforated floor-level square or round grate and funnel extension.

Minimum dimensions as follows:

1. Area of strainer and collar - 23 000 square mm (36 square inches).
2. Height of funnel - 95 mm (3-3/4 inches).
3. Diameter of lower portion of funnel - 50 mm (2 inches).
4. Diameter of top portion of funnel - 100 mm (4 inches).
5. Provide paper collars for construction purposes.

2.6 TRAPS

A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as pipe connected to. Slip joints are not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

2.7 TRAP SEAL PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS

- B. Trap Primer (TP-1): The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 5.98 kPa (125 psig) and conforming to standard ASSE 1018.
1. The inlet and outlet connections shall be 15 mm or DN15 (NPS ½ inch)
 2. The trap seal primer valve shall be fully automatic with an all brass or bronze body.
 3. The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.
 4. The trap seal primer valve shall include a manifold when serving two, three, or four traps.
 5. The manifold shall be omitted when serving only one trap.

2.8 WATERPROOFING

- A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing

device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

B. Walls: See detail shown on drawings.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.
- B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings where possible.
- F. The piping shall be installed to permit valve servicing or operation.
- G. The piping shall be installed free of sags and bends.
- H. Seismic restraint shall be installed where required by code.
- I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- J. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"
- K. Aboveground copper tubing shall be installed according to CDA's "Copper Tube Handbook".
- L. Aboveground PVC piping shall be installed according to ASTM D2665.
Underground PVC piping shall be installed according to ASTM D2321.

3.2 JOINT CONSTRUCTION

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service
 - 2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.
- F. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

3.3 SPECIALTY PIPE FITTINGS

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.3 PIPE HANGERS, SUPPORTS AND ACCESSORIES:

- A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.
- B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
 2. 80 mm or DN 80 (NPS 3 inch): 1500 mm (60 inches) with 13 mm (1/2 inch) rod.
 3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 to NPS 5): 1500 mm (60 inches) with 16 mm (5/8 inch) rod.
 4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 19 mm (3/4 inch) rod.
 5. 250 mm or DN250 to 300 mm or DN 300 (NPS 10 inch to NPS 12 inch): 1500 mm (60 inch) with 22 mm (7/8 inch) rod.
- E. The maximum spacing for plastic pipe shall be 1.22 m (4 feet).
- F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.57 m (15 feet).
- G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:
1. Solid or split unplated cast iron.
 2. All plates shall be provided with set screws.
 3. Height adjustable clevis type pipe hangers.

4. Adjustable floor rests and base flanges shall be steel.
 5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 7. Riser clamps shall be malleable iron or steel.
 8. Rollers shall be cast iron.
 9. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.
- H. Miscellaneous materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.
- I. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- J. Penetrations:
1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
 2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- K. Piping shall conform to the following:
1. Waste and Vent Drain to main stacks:

Pipe Size	Minimum Pitch
80 mm or DN 80 (3 inches) and smaller	2%
100 mm or DN 100 (4 inches) and larger	1%

2. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

3.4 TESTS

- A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.
- B. Waste System tests shall be conducted before fixtures are connected. A water test or air test shall be conducted, as directed.
 1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
 2. For an air test, an air pressure of 35 kPa (5 psig) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the air test.
 3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
3. Final Tests: Either one of the following tests may be used.
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
 - b. Peppermint Test: Introduce (2 ounces) of peppermint into each line or stack.

- - - E N D - - -

**SECTION 22 40 00
PLUMBING FIXTURES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.

1.2 RELATED WORK

- A. Sealing between fixtures and other finish surfaces: Section 07 92 00, JOINT SEALANTS.
- B. Flush panel access doors: Section 08 31 13, ACCESS DOORS AND FRAMES.
- C. Through bolts: Section 10 21 13, TOILET COMPARTMENTS.
- D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit plumbing fixture information in an assembled brochure, showing cuts and full detailed description of each fixture.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):
The American Society of Mechanical Engineers (ASME):
A112.6.1M-02(R2008)Floor Affixed Supports for Off-the-Floor
Plumbing Fixtures for Public Use
A112.19.1M-08Enameled Cast Iron Plumbing Fixtures
A112.19.2M-03Vitreous China Plumbing Fixtures
A112.19.3-2001(R2008) ..Stainless Steel Plumbing Fixtures (Designed for
Residential Use)
- C. American Society for Testing and Materials (ASTM):
A276-2010Stainless and Heat-Resisting Steel Bars and
Shapes
WW-P-541-E/GENPlumbing Fixtures with Amendment 1

- D. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM
AMP 500-505
Metal Finishes Manual (1988)
- E. American Society of Sanitary Engineers (ASSE):
1016-05Performance Requirements for Individual
Thermostatic, Pressure Balancing and Combination
Pressure Balancing and Thermostatic Control
Valves for Individual Fixture Fittings
- F. National Sanitation Foundation (NSF)/American National Standards
Institute (ANSI):
61-2009Drinking Water System Components-Health Effects
- G. American with Disabilities Act (A.D.A) Section 4-19.4 Exposed Pipes and
Surfaces
- H. Environmental Protection Agency EPA PL 93-523 1974; A 1999) Safe
Drinking Water Act.
- I. International Building Code, ICC IPBC 2009.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL

- A. Corrosion-resistant Steel (CRS):
 - 1. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
 - 2. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.
- B. Die-cast zinc alloy products are prohibited.

2.2 STOPS

- A. Provide lock-shield loose key or screw driver pattern angle stops, straight stops or stops integral with faucet, with each compression type faucet whether specifically called for or not, including sinks in wood and metal casework, laboratory furniture and pharmacy furniture. Locate stops centrally above or below fixture in accessible location.
- B. Furnish keys for lock shield stops to COTR.
- C. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
- D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.

- E. Psychiatric Area: Provide stainless steel drain guard for all lavatories not installed in casework.

2.3 ESCUTCHEONS

- A. Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

2.4 LAMINAR FLOW CONTROL DEVICE

- A. Smooth, bright stainless steel or satin finish, chrome plated metal laminar flow device shall provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device shall also have a flow control restrictor and have vandal resistant housing.
- B. Flow Control Restrictor:
1. Capable of restricting flow from 95 ml/s to 110 ml/s (1.5 gpm to 1.7 gpm) for lavatories; 125 ml/s to 140 ml/s (2.0 gpm to 2.2 gpm) for sinks P-505 through P-520, P-524 and P-528; and 170 ml/s to 190 ml/s (2.75 gpm to 3.0 gpm) for dietary food preparation and rinse sinks or as specified.
 2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 170 kPa and 550 kPa (25 psi and 80 psi).
 3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-cleaning action, and is capable of easy manual cleaning.

2.5 CARRIERS

- A. ASME/ANSI A112.6.1M, with adjustable gasket faceplate chair carriers for wall hung closets with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down.
- B. ASME/ANSI A112.6.1M, lavatory, chair carrier for thin wall construction. All lavatory chair carriers shall be capable of supporting the lavatory with a 250-pound vertical load applied at the front of the fixture.
- C. Where water closets, lavatories or sinks are installed back-to-back and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers. The drainage fitting of the back to back carrier shall be so constructed that it prevents the discharge from one fixture from flowing into the opposite fixture.

2.6 FIXTURE LIST (THE MANUFACTURER AND MODEL NUMBERS LISTED ARE FOR REFERENCE TO INDICATE THE TYPE AND QUALITY OF FIXTURES TO BE USED. ALL FIXTURES AND TRIM SHALL BE AS FOLLOWS OR APPROVED EQUAL.

2.7 WATER CLOSETS

WC-1 WATER CLOSET - ADA ACCESSIBLE

"KOHLER" - K-4330 - KINGSTON - Vitreous china, siphon jet, 1.6 GPF, wall-hung closet with elongated bowl and 1 ½" top spud mounted on "Fixture Support", fitted with:

"SLOAN" - BPW-1100SG - Exposed, ADA compliant closet flushometer with bed pan washer. Provide "SaniGuard Antimicrobial handle, handle socket and spray arm.

"BENEKE" - #527 - Solid white plastic seat, open front with stainless steel check hinges.

"Fixture Support" Water-closet support Heavy-duty, 500 lb. combination carrier. Wall mounted. Adjustable cast iron frame, Josam model 12704-SD, single-stabilizer assembly, finishing frame.

WC-2, WATER CLOSET

"KOHLER" - K-4330 - KINGSTON - Vitreous china, siphon jet, 1.6 GPF, wall-hung closet with elongated bowl and 1 ½" top spud mounted on "Fixture Support", fitted with:

"SLOAN" - Royal 111 - Exposed, ADA compliant closet flushometer. Provide "SaniGuard Antimicrobial handle.

"BENEKE" - #527 - Solid white plastic seat, open front with stainless steel check hinges.

"Fixture Support" Water-closet support Heavy-duty, 500 lb. combination carrier. Wall mounted. Adjustable cast iron frame, Josam model 12704-SD, single-stabilizer assembly, finishing frame.

WC-2, HC WATER CLOSET - ADA ACCESSIBLE

"KOHLER" - K-4330 - KINGSTON - Vitreous china, siphon jet, 1.6 GPF, wall-hung closet with elongated bowl and 1 ½" top spud mounted on "Fixture Support", fitted with:

"SLOAN" - Royal 111 - Exposed, ADA compliant closet flushometer. Provide "SaniGuard Antimicrobial handle.

"BENEKE" - #527 - Solid white plastic seat, open front with stainless steel check hinges.

"Fixture Support" Water-closet support Heavy-duty, 500 lb. combination carrier. Wall mounted. Adjustable cast iron frame, Josam model 12704-SD, single-stabilizer assembly, finishing frame.

WC-3,HC WATER CLOSET - BARIATRIC - ADA ACCESSIBLE

Provide and install Whitehall Bariatric Model 2125-A-T-2-RM-SFB-HSBJ. 1.6 GPF. Flush valve to be EVSFV (Master-Trol Flush Valve) Fixture shall be fabricated from 14 gage, type 304 stainless steel. Construction shall be seamless welded and exposed surfaces shall have a satin finish. Toilet shall have an elongated bowl and a self-draining flushing rim and punched for seat by others. Toilet shall meet ANSI 112.19.2M requirements. Fully enclosed toilet trap shall have a minimum 3-1/2" seal that shall pass a 2-1/8" diameter ball. Provide satin finish bowl.

WC-4 WATER CLOSET

"KOHLER" - K-4329 - KINGSTON - Vitreous china, siphon jet, 1.6 GPF, wall-hung closet with elongated bowl and 1 1/2" top spud mounted on "Fixture Support", fitted with:

"SLOAN" - 140-1.28 ES-S TMO SWB - Sensor activated flushometer.

"BENEKE" - #527 - Solid white plastic seat, open front with stainless steel check hinges.

"Fixture Support" Water-closet support Heavy-duty, 500 lb. combination carrier. Wall mounted. Adjustable cast iron frame, Josam model 12704-SD, single-stabilizer assembly, finishing frame.

WC-4 WATER CLOSET - ADA ACCESSIBLE

"KOHLER" - K-4330 - KINGSTON - Vitreous china, siphon jet, 1.6 GPF, wall-hung closet with elongated bowl and 1 1/2" top spud mounted on "Fixture Support", fitted with:

"SLOAN" - 140-1.28 ES-S TMO SWB - Sensor activated flushometer. ADA compliant closet flushometer with bed pan washer. Provide "SaniGuard Antimicrobial handle, handle socket and spray arm.

"BENEKE" - #527 - Solid white plastic seat, open front with stainless steel check hinges.

"Fixture Support" Water-closet support Heavy-duty, 500 lb. combination carrier. Wall mounted. Adjustable cast iron frame, Josam model 12704-SD, single-stabilizer assembly, finishing frame.

CSS-1 CLINIC SERVICE SINK

"KOHLER" - K12867 - CAMERTON - Vitreous china, wall hung, siphon jet flushing rim service sink with K-8935 stainless steel rim guard, 1 ½" top spud, bolt caps, fitted with:

"SLOAN" - BPW-110 Royal service sink flush valve with Dual-Flush, "Uppercut" - ADA compliant, green, antimicrobial coated handle on front. (Down 1.6 GPF, Up 1.1 GPF)

"CHICAGO FAUCET" - 814XK - Chrome plated flushing rim sink fitting with 814S rigid spout assembly, 319 - 6" elbow blade handles, "R" adjustable supply arms with integral stops, ceramic disk cartridges, pail hook, and flush valve pipe support.

"CHICAGO FAUCET" - 910G-777-19K - Chrome plated wall mounted pedal valve bedpan flusher with long pedals, loose key stops, 892-G elevated vacuum breaker, 777-019K hand spray outlet with bent nozzle tube and 4 feet of white rubber hose. Mount wall spout at same elevation as vacuum breaker discharge line to minimize dripping.
Exposed brass chrome plated.

2.8 URINALS

UR-1 URINAL

"KOHLER" - K-4960-ET - BARDON SUPERIOR - VITREOUS CHINA, WALL-HUNG, WASHOUT URINAL WITH FLUSHING RIM, INTEGRAL TRAP, ¾" TOP SPUD, 2" OUTLET SPUD, WALL HANGERS, AND MOUNTED ON "ZURN" 1222 CHAIR CARRIER, FITTED WITH:

"SLOAN" - ROYAL MODEL FLUSHOMETER - 186 - EXPOSED, ADA COMPLIANT URINAL FLUSHOMETER

"Fixture Support" Urinal support Heavy-duty, Adjustable cast iron frame, Josam model 17550-SD, single-stabilizer assembly, finishing frame.

UR-1,HC URINAL - HANDICAP (MOUNT 1'-5" FROM FLOOR TO RIM)

"KOHLER" - K-4960-ET - BARDON SUPERIOR - VITREOUS CHINA, WALL-HUNG, WASHOUT URINAL WITH FLUSHING RIM, INTEGRAL TRAP, ¾" TOP SPUD, 2" OUTLET SPUD, WALL HANGERS, AND MOUNTED ON "ZURN" 1222 CHAIR CARRIER, FITTED WITH:

"SLOAN" - ROYAL MODEL FLUSHOMETER - 186 - EXPOSED, ADA COMPLIANT URINAL FLUSHOMETER

"Fixture Support" Urinal support Heavy-duty, Adjustable cast iron frame, Josam model 17550-SD, single-stabilizer assembly, finishing frame.

UR-2,HC URINAL - HANDICAP (MOUNT 1'-5" FROM FLOOR TO RIM)

"KOHLER" - K-5016 - DEXTER - VITREOUS CHINA, WALL-HUNG, WASHOUT URINAL WITH FLUSHING RIM, INTEGRAL TRAP, ¾" TOP SPUD, 2" REAR OUTLET SPUD, WALL HANGERS, AND MOUNTED ON "ZURN" 1222 CHAIR CARRIER, FITTED WITH:

"SLOAN" - ROYAL MODEL FLUSHOMETER - 190 ES-S - ENCLOSED ADA COMPLIANT URINAL FLUSHOMETER

"Fixture Support" Urinal support Heavy-duty, Adjustable cast iron frame, Josam model 17550-SD, single-stabilizer assembly, finishing frame.

2.9 LAVATORIES

- A. Dimensions for lavatories are specified, Length by width (distance from wall) and depth.
- B. Brass components in contact with water shall contain no more than 3 percent lead content by dry weight.

L-1,HC LAVATORY - HANDICAP (Mount 29" from floor to bottom of apron)

"KOHLER" - K-2210-N - CAXTON - 17" x 14" Vitreous china lavatory with front overflow, integral back, fitted with:

"CHICAGO FAUCET" - 895-317ABCP - Chrome plated deck mounted faucet with rigid/swing plain end gooseneck spout, #317 indexed wristblade handles, ceramic disk cartridges and 1.6 GPM integral flow control.

"LAWLER" - TMM-1070 - ASSE 1070 Point of use, chrome plated thermostatic mixing valve, with single outlet, 3/8" compression fittings, integrated check valves, adjustment control knob and under sink mounting bracket.

L-2,HC LAVATORY - HANDICAP (Mount 29" from floor to bottom of apron)

"KOHLER" - K-2006 - KINGSTON - 21" x 18" Vitreous china lavatory with front overflow, integral back and single hole drilling, mounted on "Joasam" 17380-HD floor mounted heavy duty concealed arm carrier, fitted with:
"CHICAGO FAUCET" - 786-GN2FCXK - Chrome plated deck mounted faucet with rigid/swing plain end gooseneck spout, #317 indexed wristblade handles, ceramic disk cartridges and 1.6 GPM integral flow control.
"LAWLER" - TMM-1070 - ASSE 1070 Point of use, chrome plated thermostatic mixing valve, with single outlet, 3/8" compression fittings, integrated check valves, adjustment control knob and under sink mounting bracket.

L-3,HC LAVATORY - HANDICAP (Mount 29" from floor to bottom of apron)

"KOHLER" - K-2209 - CAXTON - 15" x 12" Vitreous china lavatory with front overflow, integral back, fitted with:
"CHICAGO FAUCET" - 895-317ABCP - Chrome plated deck mounted faucet with rigid/swing plain end gooseneck spout, #317 indexed wristblade handles, ceramic disk cartridges and 1.6 GPM integral flow control.
"LAWLER" - TMM-1070 - ASSE 1070 Point of use, chrome plated thermostatic mixing valve, with single outlet, 3/8" compression fittings, integrated check valves, adjustment control knob and under sink mounting bracket.

L-4 LAVATORY

"KOHLER" - K-2314 - PURIST - 24" x 24" fireclay lavatory, mounted directly on counter, fitted with:
"MOEN" T6906 - ADA_- Watersense - Two-Handle wall mounted faucet.
"LAWLER" - TMM-1070 - ASSE 1070 Point of use, chrome plated thermostatic mixing valve, with single outlet, 3/8" compression fittings, integrated check valves, adjustment control knob and under sink mounting bracket.

L-4,HC LAVATORY - HANDICAP

"KOHLER" - K-2314 - PURIST - 24" x 24" fireclay lavatory, mounted directly on counter, fitted with:
"MOEN" T6906 - ADA_- Watersense - Two-Handle wall mounted faucet.

"LAWLER" - TMM-1070 - ASSE 1070 Point of use, chrome plated thermostatic mixing valve, with single outlet, 3/8" compression fittings, integrated check valves, adjustment control knob and under sink mounting bracket.

Drain and Supply Pipe Covering: Manufactured plastic drain and pipe covering complying with ADA requirements. TrueBro Model 2018 lavatory protective enclosure or ProWrap™, seamless insulators, anti-microbial, PVC resin as manufactured by McGuire.

2.10 SINKS AND LAVATORIES

A. Dimensions for sinks and laundry tubs are specified, length by width (distance from wall) and depth.

S-1, STAINLESS STEEL SINK (Mount in top furnished by G.C.)

"ELKAY" -DLR-222210 - 18 gauge, type 304 stainless steel, self-rimming, satin finish, sound deadened, 10" deep bowl, fitted with:

"- Chrome plated deck mounted faucet with rigid/swing plain end gooseneck spout, #317-PR indexed wristblade handles, ceramic disk cartridges and 1.6 GPM integral flow control.

"ELKAY" - LK-18B - Perforated grid strainer waste with 1-1/2" tailpiece.

"CHICAGO FAUCET" - #1016 supplies with angle stop fitting and loose key handle, 3/8" NPT female inlet, 12" long 3/8" O.D. flexible riser and wall flange. Provide 3/8" IPS chrome plated nipple from valve to wall.

"McGUIRE" - C8912 - 1-1/2" x 1-1/2" cast brass "P" trap with cleanout plug and 17 gauge tubing drain to wall, swivel joint, slip inlet, cast brass escutcheon, and set screw.

S-2, STAINLESS STEEL SINK (Mount in top furnished by G.C.)

"KOHLER" -K-3996-1131881 ADA - top mounted type - 18 gauge, type 304 stainless steel, self-rimming, satin finish, sound deadened, 10" deep bowl, fitted with:

"CHICAGO FAUCET" - 786-GN2FCXK - Chrome plated deck mounted faucet with rigid/swing plain end gooseneck spout, #317 indexed wristblade handles,

ceramic disk cartridges and 1.6 GPM integral flow control. Provide hand held spray.

"KOHLER" - K-8801 - Perforated grid strainer waste with 1-1/2" tailpiece.

"CHICAGO FAUCET" - #1016 supplies with angle stop fitting and loose key handle, 3/8" NPT female inlet, 12" long 3/8" O.D. flexible riser and wall flange. Provide 3/8" IPS chrome plated nipple from valve to wall.

"McGUIRE" - C8912 - 1-1/2" x 1-1/2" cast brass "P" trap with cleanout plug and 17 gauge tubing drain to wall, swivel joint, slip inlet, cast brass escutcheon, and set screw.

S-3, STAINLESS STEEL SINK (Mount in top furnished by G.C.)

"KOHLER" -K-3894-1131881 ADA -Undermount type - 18 gauge, type 304 stainless steel, self-rimming, satin finish, sound deadened, 6" deep bowl, fitted with:

"CHICAGO FAUCET" - 786-GN2FCXK - Chrome plated deck mounted faucet with rigid/swing plain end gooseneck spout, #317 indexed wristblade handles, ceramic disk cartridges and 1.6 GPM integral flow control. Provide hand held spray.

"KOHLER" - K-8801 - Perforated grid strainer waste with 1-1/2" tailpiece.

"CHICAGO FAUCET" - #1016 supplies with angle stop fitting and loose key handle, 3/8" NPT female inlet, 12" long 3/8" O.D. flexible riser and wall flange. Provide 3/8" IPS chrome plated nipple from valve to wall.

"McGUIRE" - C8912 - 1-1/2" x 1-1/2" cast brass "P" trap with cleanout plug and 17 gauge tubing drain to wall, swivel joint, slip inlet, cast brass escutcheon, and set screw.

2.11 DISPENSER, DRINKING WATER

- A. Standard rating conditions: 10 degrees C (50 degrees F) water with 27 degrees C (80 degrees F) inlet water temperature and 32 degrees C (90 degrees F) ambient air temperature.

EWC-1, HC ELECTRIC WATER COOLER - HANDICAP (Mount 36" from floor to spout outlet)"OASIS" - Barrier Free "VERSACOOLER II" - P8AC - ADA Compliant - 1/4 HP, 120 volts, with capacity to provide 8.0 GPM of 50° water at 90° room temperature. Unit to include flexible guard bubbler, a one-piece stainless steel basin polished to a uniform satin finish and a vandal-proof drain. Cooling tank shall be a combination tube tank type, non-pressurized, fully insulated with polyurethane foam. Water cooler shall have a wide self-closing pressbar control on front of unit plus additional pressbar water controls on left and right sides of cabinet. Unit shall have stainless steel lower shroud. Plumbing trade shall coordinate electrical service connections with the Electrical trade to properly conceal electrical service connections within the water cooler cabinet.

Provide "CHICAGO FAUCET" No. 441-LK stop on water supply.

"McGUIRE" - C8902 - 1 ¼" x 1 ½" cast brass "P" trap with 17 gauge tubing drain to wall, swivel joint, cleanout plug, slip inlet and escutcheon.

Exposed brass chrome plated.

EWC-2 BOTTLE FILLER -"OASIS" - Barrier Free - Model MW8SBF 1/4 HP, 120 volts, with capacity to provide 8.0 GPM of 50° water at 90° room temperature. Plumbing trade shall coordinate electrical service connections with the Electrical trade to properly conceal electrical service connections within the water cooler cabinet.

Provide "CHICAGO FAUCET" No. 441-LK stop on water supply.

"McGUIRE" - C8902 - 1 ¼" x 1 ½" cast brass "P" trap with 17 gauge tubing drain to wall, swivel joint, cleanout plug, slip inlet and escutcheon.

Exposed brass chrome plated.

2.12 SHOWER FIXTURESSH-1 SHOWER - JOB BUILT - HANDICAP

Provide "MOEN" 8346 Single-Handle Pressure Balancing Shower Valve with Hand-Held Shower

System along with Moen Model 3838 4-function shower head.

"MOEN" T2513/ Single Handle Pressure Balancing Control, Tub/Shower With Stops

Shower drain shall be Model No. 2005Y-A6 manufactured by J.R. Smith Manufacturing Company.

Contractor to provide:

Provide "MOEN" 8346 Single-Handle Pressure Balancing Shower Valve With Hand-Held Shower System along with Moen Model 3838 4-function shower head.

SH-2,HC SHOWER - (Floor/basin, drain pan membrane by G.C.)

The shower enclosure shall be Comfort Designs Model XST6239BFADA.75 center, right or left. Finished surface shall be of a sanitary- grade Century Stone Cotton Seed exhibiting a minimal thickness of 55 dry mils, and a finished cured Barcol hardness of 80 -90 as tested with ASTM D-2583. Unit construction shall be of molded reinforced fiberglass with a 15% minimum fiberglass content. The unit shall have outside dimensions of 62" x 39 ½ "x 78 ¾ ". The base shall be attached to the sump unit in such a manner to form and integral part with an inner and outer coating of reinforced polyester resin. The unit shall meet the ANSI 1171.1, ANSI 124.2, ASA, HUD, BOCA, NAHB, UFAS.

Note: All showers shall be set in a bed of cement grout to provide a firm setting bed.

2.13 MISCELLANEOUS DEVICES

F. WB-1 Washing Machine Supply and Drain Units: Fabricate of 16-gage steel with highly corrosion resistant epoxy finish. Unit to have 51 mm (2 inches) drain connection, 13 mm (1/2 inch) combination MPT brass sweat connection, ball type shut-off valve, 51 mm (2 inches) cast brass P-trap, duplex electric grounding receptacle and dryer outlet. Size 229 mm by 375 mm (9 inches by 14 3/4 inches) rough wall opening 203 mm by 330 mm by 92 mm (8 inches by 13 inches by 3 5/8 inches). Centerline of box shall be 1118 mm (44 inches) above finished floor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed as specified under Section 07 92 00, JOINT SEALANTS.
- B. Supports and Fastening: Secure all fixtures, equipment and trim to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.

- C. Through Bolts: For free standing marble and metal stud partitions refer to Section 10 21 13, TOILET COMPARTMENTS.
- D. Toggle Bolts: For hollow masonry units, finished or unfinished.
- E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4 inch) diameter bolts, and to extend at least 76 mm (3 inches) into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.
- F. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4 inch) threaded studs, and shall extend at least 32 mm (1 1/4 inches) into wall.
- G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
- H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.
- I. Do not use aerators on lavatories and sinks.

3.2 CLEANING

- A. At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

3.3 COMMISSIONING

- A. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

- - - E N D - - -

SECTION 22 62 00
VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Central Laboratory and Healthcare Vacuum Systems: This section describes the labor, equipment, and services necessary for and incidental to the installation of piped medical vacuum systems and medical vacuum and waste anesthesia gas disposal systems (WAGD). Medical vacuum and WAGD systems shall be installed started, tested, and ready for use. The scope of work shall include all necessary piping, fittings, valves, cabinets, station outlets and inlets, rough ins, ceiling services, gages, alarms including low voltage wiring, vacuum pumps, electric motors and starters, receivers, and all necessary parts, accessories, connections and equipment. Match existing station inlet terminal connections.
- B. The contractor shall provide all elements and accessories required for a complete system according to the most recent edition of NFPA 99C, Gas and Vacuum Systems.
- C. All necessary connections to owner furnished equipment shall be made as indicated on the documents. A separate construction isolation valve shall be made at the point of connection to an existing vacuum system.
- D. Electrical power and control wiring for vacuum pump(s), WAGD Producer(s), ceiling columns, alarms wiring from equipment to alarm panels, and modular accessories associated with the system(s) shall be included.
- E. Pressure testing, cross connection testing and final testing per NFPA 99 most recent edition and using procedures shall be performed.
- F. The contractor shall retain a qualified third party medical vacuum verifier acceptable to the engineer and VA to perform and attest to

final verification of the systems. The contractor shall make all corrections as determined by this third party verifier, including additional testing if necessary to attain full and unqualified certification.

- G. Coordinate with owner retained verifier for final verification of the systems. Make corrections as required, including additional testing if necessary to attain full and unqualified certification.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Sealing around pipe penetrations to maintain the integrity of time rated construction.
- B. Section 07 92 00, JOINT SEALANTS: Sealing around pipe penetrations through the floor to prevent moisture migration.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General requirements and items common to more than one section of Division 22.
- D. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Alarm interface with ECC.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.
- F. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Control wiring.
- G. Section 26 27 26, WIRING DEVICES: Electrical wiring and accessories.
- I. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS: Motor starters.
- J. Section 10 25 13, PATIENT BED SERVICE WALLS: Prefabricated bedside patient units.
- K. Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES: Laboratory and Healthcare Gases and Vacuum Alarms.

1.3 QUALITY ASSURANCE

- A. Installation and Start-up: The manufacturer will provide factory authorized representatives to review installation and perform initial start up of system.
- B. Contractor shall include with submittals an affidavit attesting to compliance with all relevant paragraphs of NFPA 99 most recent edition. Personnel assembling medical vacuum and WAGD system shall meet NFPA 99 5.1.10.10.11 "Qualification of Installers" and hold medical gas endorsements as under ASSE 6010. The Contractor shall furnish documentation attesting that all installed piping materials were purchased cleaned and complied with the requirements of NFPA 99 5.1.10.1 and 5.1.10.2. Electrical Control systems and Medical vacuum Alarms are to be UL listed as assemblies with label affixed. Medical vacuum controls are to be wired in accordance with NEC.
- C. Equipment Installer: The equipment installer shall show documentation proving that the personnel installing the equipment meet the standards set by the American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas System Installers. Show technical qualifications and previous experience in installing medical gas equipment on three similar projects. Submit names and addresses of referenced projects. The equipment install shall perform the following coordination functions:
 - 1. Coordinate with other trades to ensure timely installations and avoid conflicts and interferences.
 - 2. Work with the metal stud partition installer and/or mason to ensure anchors, sleeves and similar items are provided in sufficient time to avoid delays; chases and openings are properly sized and prepared.

3. Coordinate with VA to ensure medical vacuum inlets, whether owner supplied or contractor supplied, in walls, ceiling and all equipment is provided by the same Medical Vacuum Equipment Manufacturer satisfactory to the owner.
4. The contractor shall coordinate with the Medical Vacuum System Verifier to deliver a complete, tested medical gas installation ready for owner's use.
- D. Equipment Supplier: The Equipment supplier shall demonstrate evidence of installing equivalent product at three installations similar to this project that has been in satisfactory and efficient operation for three years. Names and addresses where the product is installed shall be submitted for verification.
- E. Medical Gas System Testing Organization: The Medical vacuum verifier shall show documentation proving that the medical gas verifier meet the standards set by the American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas Ssystem Verifiers. The testing shall be conducted by a party technically competent and experienced in the field of medical gas pipeline testing. Such testing shall be performed by a party other than the installing contractor.
- F. Names of three projects where testing of vacuum systems has been performed by the testing agency shall be provided. The name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification shall be included in the documentation.
- G. The testing agency's detailed procedure which will be followed in the testing of this project shall be submitted. In the testing agency's procedure documentation, include details of the testing sequence,

procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, data on test methods, types of equipment to be used, calibration sources and method references shall be submitted.

- H. Installation and Start-up: The manufacturer shall provide factory authorized representatives to review the installation and perform the initial startup of the system. The factory authorized representatives shall submit a report to the construction administrator and to the Contractor. The Contractor shall make all corrections identified by the factory authorized representative.
- I. Certification: The Final inspection documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.
- J. The installing contractor shall maintain as-built drawings of each completed phases for verification; and, shall provide the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings shall be provided, and a copy of them on Auto-Cad version (R-14 or later) provided on compact disk.

1.4 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Complete specifications for the product intended to be installed, dimensional drawings, and wiring schematics.

2. Package drawing indicating package style, dimensions when complete, method of disassembly and sizes of subsections for rigging and installation.
 3. Piping.
 4. Valves.
 5. Inlet and outlet cocks
 6. Valve cabinets.
 7. Gages.
 8. Station inlets, and rough in assemblies.
 9. Alarm controls and panels.
 10. Vacuum switches.
 11. Vacuum bottle brackets.
- C. Station Inlets: A letter from manufacturer shall be submitted stating that inlets are designed and manufactured to comply with NFPA 99. Inlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer, certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.
- D. Certification: The completed systems have been installed, tested, purged and analyzed in accordance with the requirements of this specification.

E. A notarized affidavit from the verifier stating that the verifier undertakes to verify this project and thus agrees to disqualify themselves from supplying any equipment which will be included in the scope of their verification. No verifier who supplies equipment shall be permitted to verify that equipment. Statement declaring that the vacuum system manufacturer has no fiduciary interest in the verifier and that the verifier is not an agent or representative of the vacuum system manufacturer. Statement declaring that the contractor has no fiduciary interest in the third party verifier and that the third party verifier has no fiduciary interest in the contractor.

1.5 TRAINING

- A. The services of a competent instructor shall be provided for not less than two four-hour periods for instructing personnel in the operation and maintenance of the vacuum systems, on the dates requested by COTR.
- B. The other training requirements specified in Section 01 00 00, GENERAL REQUIREMENTS shall be coordinated with the above paragraph

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the test by the basic designation only.
- B. American National Standards Institute (ANSI):
- A13.1-2007Scheme for Identification of Piping Systems
- B16.22-01 (R2005)Wrought Copper and Bronze Solder-Joint Pressure Fittings
- B40.1-(2006) Pressure Gauges and Gauge Attachments
- C. American Society for Testing and Materials (ASTM):

B819-00Standard Specification for Seamless Copper Tube
for Medical Gas Systems

D. American Society of Mechanical Engineers (ASME):

Section IX-04Welding and Brazing Qualifications

E. American Welding Society (AWS):

AWS A5.8/A5.8M-2004Brazing Filler Metal

AWS B2.2-91Standard for Brazing Procedure and Performance
Qualification (Modified per NFPA 99)

F. Compressed Gas Association (CGA):

P-9-92Inert Gases Argon, Nitrogen and Helium

G. National Electrical Manufacturers Association (NEMA):

ICS-6-(1993, R 2006) ...Industrial Controls and Systems Enclosures

H. National Fire Protection Association (NFPA):

70(2007)National Electric Code

99-2005Health Care Facilities with 2005 errata

I. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)

J. Manufacturing Standardization Society (MSS):

MSS-SP-72-99Ball Valves With Flanged or Butt Welding For
General Purpose

MSS-SP-110-96Ball Valve Threaded, Socket Welding, Solder
Joint, Grooved and Flared Ends

MSS-SP-73-03Braze Joints for Copper and Copper Alloy
Solder Pressure Fittings

1.7 WARRANTY

- A. Warranty will be expressly complete, include all components of the system and be the responsibility of the vacuum system manufacturer of record only. Warranties limiting the responsibility of the vacuum system for any system component or which pass through to another manufacturer are not acceptable.
- B. Warranties shall include on site repairs including travel, labor and parts. Warranties requiring return of equipment for adjustment are not acceptable.

1.8. MAINTENANCE SUPPORT

- A. The medical vacuum equipment manufacturer shall demonstrate a national factory direct service capability able to perform major overhauls. The medical vacuum equipment manufacturer shall offer factory direct preventative maintenance contract for the owner's consideration. The medical vacuum equipment manufacturer shall offer formal maintenance training courses.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. One Medical Vacuum Equipment Manufacturer shall supply the medical vacuum system(s) and equipment to include outlets, valves and gauges, valve boxes, alarm panels, manifolds, medical air, instrument air, vacuum and WAGD sources.

2.2 PIPING

- A. Copper Tubing: Copper tubing shall be type "K" or "L", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ANSI B16.22 or brazing fittings complying with MSS SP-73. The copper tubing size designated reflects nominal inside diameter. All

tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".

- B. Brazing Alloy: The brazing alloy shall comply with AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux shall be strictly prohibited for copper to copper connections.
- C. Screw Joints: Screw joints shall use polytetrafluoroethylene (teflon) tape.
- D. Galvanized Steel: Galvanized steel shall only be used for the discharge from the vacuum producer. The galvanized steel vacuum discharge pipe and fittings shall comply with the following:
 - 1. Pipe: The galvanized steel pipe shall comply with ASTM A53, standard weight.
 - 2. Fittings: The fittings shall comply with the following
 - a. Flexible groove, malleable iron, ASTM A47, or ductile iron, ASTM A536.
 - b. Malleable iron screwed, ANSI B16.3.
- E. Memory metal couplings shall have temperature and pressure ratings not less than that of a brazed joint.
- F. Piping identification labels shall be applied at time of installation in accordance with current NFPA. Supplementary color identification shall be in accordance with CGA Pamphlet C-9.
- G. Special Fittings: The following special fittings shall be permitted to be used in lieu of brazed joints:
 - 1. Memory-metal couplings having temperature and pressure ratings joints not less than that of a brazed joint.

2. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint.
3. Dielectric fittings where required by the manufacturer of special medical equipment to electrically isolate the equipment from the piping distribution system.
4. Axially swaged, elastic strain preload fittings providing metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable.

2.3 EXPOSED LABORATORY AND HEALTHCARE VACUUM PIPING

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed laboratory and healthcare vacuum piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. Pipe: Fed. Spec. WW-P-351, standard weight.
2. Fittings: Fittings shall comply with ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
3. Nipples: Nipples shall comply with ASTM B 687, Chromium-plated.
4. Unions: Unions shall comply with Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
5. Valves: Valves shall comply with Mss SP-72, SP-110, Brass or bronze with chrome finish.

2.4 VALVES

- A. Ball: Ball valves shall be in line, other than zone valves in cabinets.

1. Sixty five millimeter or DN65 (2 1/2 inches) and smaller: Ball valves shall be bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full ported, three piece or double union end connections, teflon seat seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle.
2. Eighty millimeter or DN80 to 100 millimeter or DN100 (3" to 4" inches): Ball valves shall be bronze/ brass body, Fed. Spec. MSS SP72 & SP 110, Type II, Class 150, Style 1 with tubing extensions brazed to flanges, full ported, three piece, double seal, teflon seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle.

B. Check:

1. Check valves eighty millimeters (DN80) (3 inches) and smaller: brass and Bronze body, straight through design for minimum pressure drop, spring loaded, self aligning with teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, 2750 kPa (400 psi) WOG minimum working pressure.
2. One hundred millimeter or DN100 (4 inches) and larger check valves shall be iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 1025 kPa (150 psi) WSP.

- C. Zone valve in cabinet shall be ball valve with bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non shock gas working pressure or vacuum service to 29 inch Hg, blowout proof stem, one quarter turn of handle to completely open or close. Tubing extensions, factory brazed, pressure tested, cleaned for oxygen service shall be provided. A 3 mm (1/8 inch) NPT gauge port shall be provided for a 50mm (2 inch) diameter monitoring gauge downstream of

the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick on labels. Valves shall be in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
MEDICAL VACUUM	Black letters on white background	WHITE
Evacuation (Waste Gas)	White letters on purple background	PURPLE

2.5 VALVE CABINETS

- A. Valve cabinets shall be flush mounted, commercially available item for use with medical gas services, constructed from steel not lighter than 1.3 mm (18 gage) steel or extruded aluminum not lighter than 1.9 mm (14 gage). The valve cabinets shall be rigidly assembled, of adequate size to accommodate all valve(s) and fittings indicated. Holes shall be predrilled to receive pipe connections. These pipe connections shall be made outside of the valve box. Anchors shall be provided to secure cabinet to wall construction. Openings in cabinet shall be sealed to be dust tight. Bottom of cabinet shall be located 1375 mm (4 foot 6 inches) above finished floor.
- B. Engraved rigid plastic identification plate shall be mounted on the wall above or adjacent to the cabinet. Color code identification plate to match gas identification colors as indicated above. Identification

plate shall be clearly visible at all times. Inscriptions shall be provided on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS." The final wording must be approved by the VA project manager.

- C. Cover plate: The cover plate shall be fabricated from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. A cover window shall be provided of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. The following shall be permanently painted or stenciled on window: "FOR EMERGENCY SHUT-OFF VALVES ONLY, SHUT OFF VALVES FOR PIPED GASES", or equivalent wording. The valve cabinet shall be configured such that it is not possible to install window with any valve in the closed position. Each valve shall have a pressure gauge upstream of valve and this pressure gauge shall be inside valve box.
- D. Cabinets and isolation valves shall be located and piped as shown, and at a minimum, so as to allow the isolation of each smoke compartment separately. Each cabinet shall serve no more than one smoke compartment.

2.6 GAGES

A. Vacuum Gages:

1. For vacuum line adjacent to source equipment the vacuum gages shall comply with ANSI B40.1, vacuum gage type, size 115 mm (4-1/2 inches), gage listed for vacuum, accurate to within 2-1/2 percent, with metal case. The vacuum gage range shall be 0 to-100 kPa (0-30 inches Hg). Dial graduations and figures shall be black on a white background, or white on a black background. Label shall be for vacuum service. A gage cock shall be installed. Compound gages shall be installed for Vacuum system.

2. For vacuum service upstream of main shutoff valve: A 40 mm (1-1/2 inch) diameter gage shall be provided with steel case, bourdon tube and brass movement, dial range 0 to -100 kPa (0-30 inches Hg). Compound gages shall be provided for Vacuum system.

2.7 STATION INLETS

A. Vacuum Station inlets:

1. Station inlets shall be for designated service, consisting of a quick coupler, quick disconnect type with inlet supply tube.
2. The outlet station shall be made, cleaned, and packaged to NFPA 99 standards and shall be UL listed and CSA certified.
3. A coupler shall be provided that is non-interchangeable with other services, and leak proof under three times normal working pressure.
4. Each station inlet shall be equipped with an automatic valve to conform with NFPA 99. Valves shall be placed in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing.
5. Each inlet shall be securely fastened to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm outside diameter) (3/8-inch outside diameter) tubing for connection to supply tubing. Stub tubing shall be labeled for appropriate service. Rough in shall be indexed and gas specified latch valve with non-interchangeable safety keying with color coded gas service identification.
6. Rough-in kits and test plugs for PATIENT BED SERVICE WALLS (PBPUs) shall be furnished under this specification but installed by manufacturer of PBPUs before initial test specified herein.
7. Completion kits (valve body and face plate) shall be installed for the remainder of required tests.

2.8 STATION INLETS

A. Vacuum Station inlets:

1. Station inlets shall be brass, stainless steel or chromed metal non-interchangeable DISS connections for appropriate service to conform with CGA V-5.
2. The outlet station shall be made, cleaned, and packaged to NFPA 99 standards and shall be UL listed and CSA certified.
3. A coupler shall be provided that is non-interchangeable with other services, and leak proof under three times normal working pressure. Threaded DISS connector shall be per CGA standards
4. Each station inlet shall be equipped with an automatic valve to conform with NFPA 99. Valves shall be placed in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing.
5. Each inlet shall be securely fastened to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) 10 mm outside diameter (3/8-inch outside diameter) tubing for connection to supply tubing. Stub tubing shall be labeled for appropriate service. Rough in shall be indexed and gas specified latch vale with non-interchangeable safety keying with color coded gas service identification.
6. Rough-in kits and test plugs for PATIENT BED SERVICE WALLS(PBPU) shall be furnished under this specification but installed by manufacturer of PBPU's before initial test specified herein.
7. Completion kits (valve body and face plate) shall be installed for the remainder of required tests.

2.9 STATION INLET ROUGH-IN

- A. Station inlet rough in shall be Flush mounted, and protected against corrosion. Rough in shall be anchored securely to unit or wall construction.
- B. The modular cover plate shall be constructed from die cast plate, two piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, secured to rough in with stainless steel or chromium plated countersunk screws. The latch mechanism shall be designed for one handed, single thrust mounting and one handed fingertip release of secondary equipment.
- C. Cover Plate for Prefabricated Bedside Patient Units (PBPU) shall be One piece with construction and material as indicated for modular cover plate.
- D. Permanent, metal or plastic, identification plates shall be provided securely fastened at each inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
MEDICAL VACUUM	Black letters on white background
EVACUATION (Waste Gas)	White letters on purple background

2.11 VACUUM SWITCHES

- A. Vacuum switches shall be general purpose, contact or mercury type, allowing both high and low set points, with contact type provided with a protective dust cover. The vacuum switch shall have an adjustable range set by inside or outside adjustment. Vacuum switches shall activate when indicated by alarm requirements. One orifice nipple (or DISS demand check valve) shall be used for each sensor switch.

2.12 VACUUM BOTTLE BRACKET

- A. Vacuum bottle bracket shall be single plate of one piece, .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal or aluminum, finish matching cover of adjoining vacuum inlet. All components shall be of same material as plate and assembly anchored securely. The bracket shall be provided and plastic vacuum bottle holder for each vacuum wall inlet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All installation shall be performed in strict accordance with NFPA 99 5.1.10. Brazing procedures shall be as detailed in NFPA 99 5.1.10.5. Brazing shall be performed only by brazers qualified under NFPA 99 5.1.10.10.11.
- B. Contractor shall furnish 4 inch high concrete housekeeping pads. The contractor shall furnish inertia bases in lieu of housekeeping pads where the equipment installed is not factory isolated by the manufacturer. Anchor bolts shall be cast into bases
- C. Cast escutcheon shall be installed with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- D. Open ends of tube shall be capped or plugged at all times or otherwise sealed until final assembly.
- E. Piping shall be cut square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. The tubing shall be reamed to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. The tubing shall be worked into place without springing or forcing. The tubing shall be bottomed in socket so there are no gaps between tube and fitting. Care

shall be exercised in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease from being introduced into the tubing. Where contamination has occurred, material shall be no longer suitable for vacuum service and new, sealed tube sections used.

- F. Piping shall be supported with pipe trays or hangers at intervals as shown on the drawings or as defined in NFPA 99 Table 5.1.10.10.4.5. Piping shall not be supported by other piping. Isolation of copper piping from dissimilar metals shall be of a firm, positive nature. Duct tape is not acceptable as an isolation material.
- G. Valves and other equipment shall be rigidly supported to prevent strain on tube or joints.
- H. Piping exposed to physical damage shall be protected.
- I. During any brazing operation, the interior of the pipe shall be purged continuously with oil free, dry nitrogen, following the procedure in NFPA 99 5.1.10.5.5. At the completion of any section, all open pipe ends shall be capped using an EXTERNAL cap. The flow of purged gas shall be maintained until joint is cool to touch. The use of flux is prohibited when making of joints between copper to copper pipes and fittings.
- J. Threaded joints in piping systems shall be avoided whenever possible. Where unavoidable, make up the male threads with polytetrafluorofethylene (such as Teflon) tape. Liquid sealants shall not be used.
- K. Tubing shall not be bent. Fittings shall be used in all change of direction or angle.
- L. After installation of the piping, but before installation of the outlet valves, blow lines clear using nitrogen.

- M. Two 25 mm (1 inch) minimum conduits shall be provided from ceiling column assembly to the adjacent corridor, one for mass spectrometer tubing and wiring and one for monitor wiring, and for connection to signal cabling network.
- N. Pressure and vacuum switches, transmitter and gauges shall be installed to be easily accessed, and provide access panel where installed above plaster ceiling. Pressure switch and sensors shall be installed with orifice nipple between the pipe line and switches/sensors.
- O. Pipe labeling shall be applied during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.
- P. After initial leakage testing is completed, the piping shall be allowed to remain pressurized with testing gas until testing agency performs final tests.
- Q. Penetrations:
1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked partitions, or floors, fire stopping shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, Clearances between raceways and openings with the fire stopping material shall be completely filled and sealed..
 2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- R. A vacuum gage 40mm (1 1/2 inch) diameter line shall be installed downstream of each zone valve in cabinets.

- S. Zone valves shall be provided in cabinets where indicated and outside each Operating Room and a minimum one zone valve assembly for each 18 outlets.
- T. Piping shall be labeled with name of service, identification color and direction of flow. Where non-standard pressures are piped, pressure shall be labeled. Labels shall be placed at least once every 20 feet of linear run or once in each story (whichever is more frequent). A label shall additionally be placed immediately on each side of all wall or floor penetrations. Pipe labels shall be self adhesive vinyl type or other water resistant material with permanent adhesive colored in accordance with NFPA 99 Table 5.1.11 and shall be visible on all sides of the pipe. Each master alarm signal shall be labeled for function after ring out. Each zone valve shall be labeled and each area alarm labeled for the area of control or surveillance after test. Labels shall be permanent and of a type approved by the VAMC
- U. Alarms and valves shall be labeled for service and areas monitored or controlled. Coordinate with the VAMC for final room or area designations. Valves shall be labeled with name and identification color of the gas and direction of flow

3.2 INSTALLER TESTING

- A. Prior to declaring the lines ready for final verification, the installing contractor shall strictly follow the procedures for verification as described in NFPA 99 5.1.12.2 and attest in writing over the notarized signature of an officer of the installing company the following;
1. That all brazing was conducted by brazers qualified to ASSE 6010 and holding current medical gas endorsements.
 2. That all brazing was conducted with nitrogen purging. (Procedure per NFPA 99 5.1.10.5.5).

3. That the lines have been blown clear of any construction debris using oil free dry nitrogen or air are clean and ready for use. (Procedure per NFPA 99 5.1.12.2.2).
4. That the assembled piping, prior to the installation of any devices, maintained a test pressure 1 1/2 times the standard pressures listed in NFPA 99 Table 5.1.11 without leaks. (Procedure per NFPA 99 5.1.12.2.3).
5. That after installation of all devices, the pipeline was proven leak free for 24hours at a pressure 20% above the standard pressures listed in NFPA 99 Table 5.1.11. (Procedure per NFPA 99 5.1.12.2.2.6)
6. That the systems have been checked for cross connections and none were found. (Procedure per NFPA 99 5.1.12.2.4)
7. That the manufacturer has started up all medical air compressors, medical vacuum pumps WAGD producers, liquid oxygen system(s) and manifolds, and that they are in operating order.

- B. Four originals of the affidavit, shall be distributed; (1) to the engineer, (1) to the owners representative, (1) to the general contractor and (1) to the verifier.

3.3 VERIFIER TESTING

- A. Prior to handing over the systems to VAMC, the contractor shall retain a Verifier acceptable to the engineer and owner who shall follow strictly the procedures for verification as described in NFPA 99 5.1.12.3 and provide a written report and certificate bearing the notarized signature of an officer of the verification company which contains at least the following:
1. A current ACORD insurance certificate indicating professional liability coverage in the minimum amount of \$1 Million per

occurrence, and general aggregate liability in the minimum amount of \$1 Million, valid and in force when the project is to be verified. General liability insurance is not alone acceptable.

2. An affidavit bearing the notarized signature of an officer of the verification company stating that the verification company is not the supplier of any equipment used on this project or tested in this report and that the verification contractor has no relationship to, or pecuniary interest in, the manufacturer, seller, or installer of any equipment used on this project or tested in this report
3. A listing of all tests performed, listing each source, outlet, valve and alarm included in the testing.
4. An assertion that all tests were performed by a Medical Vacuum System Certified Medical Gas or vacuum Verifier or by individuals qualified to perform the work and holding valid qualifications to ASSE 6030 and under the immediate supervision a Verifier. Include the names, credential numbers and expiration dates for all individuals working on the project.
5. A statement that equipment used was calibrated at least within the last six months by a method traceable to a National Bureau of Standard Reference and enclosing certificates or other evidence of such calibration(s). Where outside laboratories are used in lieu of on site equipment, those laboratories shall be named and their original reports enclosed.
6. A statement that where and when needed, equipment was re calibrated during the verification process and describing the method(s) used.
7. A statement that the systems were tested and found to be free of debris to a procedure per NFPA 99 5.1.12.3.7.

8. The flow from each outlet when tested to a procedure per NFPA 99-5.1.12.3.10.
9. A statement that the systems were tested and found to have no cross-connections to a procedure per NFPA 99 5.1.12.3.3.
10. A statement that the systems were tested and found to be free of contaminants to a procedure per NFPA 99 5.1.12.3.8 except that the purity standard shall be 2 ppm difference for halogenated hydrocarbons and 1 ppm total hydrocarbons (as methane).
11. Statement that all local signals function as required under NFPA 99 5.1.3.4.7 and as per the relevant NFPA 99 sections relating to the sources.
12. A listing of local alarms, their function and activation per NFPA 99 5.1.12.3.14.
13. A listing of master alarms, their function and activation, including pressures for high and low alarms per NFPA 99 5.1.12.3.5.2.
14. A listing of area alarms, their function and activation pressures per NFPA 99 5.1.12.3.5.3.
15. A statement that the sources include all alarms required by NFPA 99 Table A.5.1.9.5.
16. The concentration of each component of NFPA 99 Table 5.1.12.3.12 in the medical air after 24hours of operation of the medical air source.
17. The concentration of each gas at each outlet as specified in NFPA 99 5.1.12.3.11.
18. A statement that all valves and alarms are accurately labeled as to zone of control.

19. Provide four originals of this affidavit, and report, distributed;
(1) to the engineer, (1) to the owner's representative, (1) to the general contractor and (1) to the installing contractor.
- B. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.
- C. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.
- D. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.
- E. Inlet flow test:
 1. Test all inlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
 2. Needle valve vacuum inlets must draw no less than 1.0 scfm with adjacent inlet flowing, at a dynamic inlet pressure of 12-inches Hg, and a static vacuum of 15-inches Hg.
 3. Vacuum inlets must draw no less than 85 Lpm (3.0 scfm) with adjacent inlet flowing, at a dynamic inlet pressure of 40 kPa (12-inches Hg), and a static vacuum of 50 kPa (15-inches Hg).

4. Anesthesia evacuation inlets must draw no less than 1 L/mm (1.0 scfm) at a dynamic inlet pressure of 40 kPa (12-inches Hg), and a static vacuum of 50 kPa (15-inches Hg).

3.4 CONNECTION TO EXISTING LABORATORY VACUUM SYSTEM:

- A. Contactor shall test the existing system for hydrocarbons, dew point, etc. If problems are present, the COTR (RE) would notify the facility of the results. The facility would then make the necessary repairs and/or maintenance.
- B. Double Shut-off valves shall be installed at the connection of new line to existing line.
- C. Time for shut-down of the existing vacuum system shall be coordinated with the VA medical center.
- D. Prior to any work being done, new pipeline shall be checked for particulate or other forms of contamination.
- E. Insure that the correct type of pipe tubing and fittings are being used.
- F. A spot check of the existing pipelines shall be made in the facility to determine the level of cleanness present.
- G. The tie-in shall be made as quickly as possible. A nitrogen purge is not required since this would require another opening in the pipe.
- H. After the tie-in is made and allowed to cool, slowly bleed the source Vacuum back into the pipeline. Test the work area for leaks with soapy water and repair any leaks.
- I. After all leaks, if any, are repaired and the line is fully recharged, perform blow down and testing. Open the zone that is closest to the main to the system, access the closest outlet to the work, and blow the main through the inlet. After the inlet blows clear into a white

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cloth, make an additional check at a zone most distant from the work.
Perform all required current NFPA tests after connection.

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**SECTION 22 63 00
GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Central Laboratory and Healthcare Gas Systems: Consisting of oxygen, nitrous oxide, nitrogen, and compressed air services; complete, ready for operation, including all necessary piping, fittings, valves, cabinets, station outlets, rough-ins, ceiling services, gages, alarms including low voltage wiring, nitrogen control panels, cylinder manifolds, air compressors, electric motors and starters, air dryers, filters, pressure regulators, dew point, carbon monoxide monitors and all necessary parts, accessories, connections and equipment. Match existing station outlet and inlet terminal connections.
- B. Laboratory and healthcare gas system alarm wiring from equipment to alarm panels.

1.2 RELATED WORK

- A. Sealing around pipe penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. Sealing around pipe penetrations through the floor to prevent moisture migration: Section 07 92 00, JOINT SEALANTS.
- C. General requirements and items common to more than one section of Division 22. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Alarm interface with ECC. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- E. Conduit: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- F. Control wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- G. Electrical wiring and accessories: Section 26 27 26, WIRING DEVICES.

H. Prefabricated bedside patient units: Section 10 25 13, PATIENT BED SERVICE WALLS.

I. Vacuum Piping and Equipment: SECTION 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

1.3 QUALITY ASSURANCE

A. Materials and Installation: In accordance with NFPA 99, (2005) and as specified.

B. Equipment Installer: Show technical qualifications and previous experience in installing laboratory and healthcare equipment on three similar projects. Submit names and addresses of referenced projects. Installers shall meet the qualifications of ANSI/ASSE Standard 6010.

C. Equipment Supplier: Show evidence of equivalent product installed at three installations similar to this project that has been in satisfactory and efficient operation for three years. Submit names and addresses where the product is installed.

D. Laboratory and healthcare System Testing Organization: The testing shall be conducted by a party technically competent and experienced in the field of laboratory and healthcare pipeline testing. Testing and systems verification shall be performed by personnel meeting the qualifications of ANSI/ASSE Standard 6030. Such testing shall be performed by a party other than the installing contractor.

E. Provide names of three projects where testing of medical or laboratory gases systems has been performed by the testing agency. Include the name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification.

F. Submit the testing agency's detailed procedure which will be followed in the testing of this project. Include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm

tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.

- G. Certification: Provide documentation prior to submitting request for final inspection to include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.
- H. Installing contractor shall maintain as-built drawings of each completed phases for verification; and, shall provide the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings shall be provided on prints and in digital format. The digital format shall be in the native CAD system required for the project design. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- I. "Hot taps" are not permitted for operating medical oxygen systems. Methods for connection and extension of active and pressurized medical gas systems without subsequent medical gas testing and verification are not allowed.

1.4 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Piping.
 - 2. Valves.
 - 3. Inlet and outlet cocks
 - 4. Valve cabinets.

5. Gages.
 6. Station outlets and rough-in assemblies.
 7. Ceiling services.
 8. Alarm controls and panels.
 9. Manifolds.
- C. Station Outlets: Submit letter from manufacturer stating that outlets are designed and manufactured to comply with NFPA 99. Outlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer, certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.
- D. Certification: The completed systems have been installed, tested, purged, analyzed and verified in accordance with the requirements of this specification.
- E. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 TRAINING

- A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the laboratory and healthcare gas systems, on the dates requested by COTR.
- B. Coordinate with other requirements specified in Section 01 00 00, GENERAL REQUIREMENTS.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the test by the basic designation only.

B. American Society for Testing and Materials (ASTM):

B819-(R2006)Seamless Copper Tube for Medical Gas Systems

C. American Society of Mechanical Engineers (ASME):

A13.1-07Scheme for Identification of Piping Systems

B16.22-01(R2005)Wrought Copper and Bronze Solder-Joint Pressure Fittings

B40.100 (2005)Pressure Gauges and Gauge Attachments Boiler and Pressure Vessel Code -

Section VIII-07Pressure Vessels, Division I

Section IX-07Welding and Brazing Qualifications

D. American Welding Society (AWS):

AWS A5.8-04Brazing Filler Metal

AWS B2.2-91Standard for Brazing Procedure and Performance Qualification (Modified per NFPA 99)

E. Compressed Gas Association (CGA):

C-9-04Standard Color Marking of Compressed Gas Cylinders

G-4.1 (2009)Cleaning Equipment for Oxygen Service

G-10.1(2008)Nitrogen, Commodity

P-9-01Inert Gases Argon, Nitrogen and Helium

V-1-05Standard for Compressed Gas Cylinder Valve
Outlet and Inlet Connections

F. National Electrical Manufacturers Association (NEMA):

ICS-6-93(R2006)Industrial Controls and Systems Enclosures

G. National Fire Protection Association (NFPA):

99-05Health Care Facilities

H. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)

I. Manufacturing Standardization Society (MSS):

MSS-SP-72-99Ball Valves With Flanged or Butt Welding For
General Purpose

MSS-SP-110-96Ball Valve Threaded, Socket Welding, Solder
Joint, Grooved and Flared Ends

MSS-SP-73-03Brazing Joints for Copper and Copper Alloy
Solder Pressure Fittings

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Copper Tubing: Type "L", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ASME B16.22 or brazing fittings complying with MSS SP-73. Size designated reflecting nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".

B. Brazing Alloy: AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux is strictly prohibited for copper-to-copper connections.

C. Screw Joints: Polytetrafluoroethylene (teflon) tape.

- D. Memory metal couplings: Temperature and pressure rating shall not be less than that of a brazed joint.
- E. Apply piping identification labels at the time of installation in accordance with current NFPA. Apply supplementary color identification in accordance with CGA Pamphlet C-9.
- F. Special Fittings: The following special fittings shall be permitted to be used in lieu of brazed joints:
1. Memory-metal couplings having temperature and pressure ratings joints not less than that of a brazed joint.
 2. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint.
 3. Dielectric fittings where required by the manufacturer of special medical equipment to electrically isolate the equipment from the piping distribution system.
 4. Axially swaged, elastic strain preload fittings providing metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable.

2.2 VALVES

- A. Ball: In-line, other than zone valves in cabinets:
1. Seventy five millimeter (2 1/2 inches) and smaller: Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full port, three-piece or double union end connections, teflon seat seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle, cleaned for oxygen use and labeled for intended service
 2. Eighty to one hundred millimeter (3-4 inches): Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110, Type II, Class 150, Style 1 with tubing extensions brazed to flanges, full port~~ed~~, three piece, double

seal, teflon seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle, cleaned for oxygen use and labeled for intended service.

B. Check:

1. Eighty millimeter (3 inches) and smaller: Bronze/brass body, straight through design for minimum pressure drop, spring loaded, self aligning with teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, cleaned for oxygen use and labeled for intended service, 2750 kPa (400 psi) WOG minimum working pressure.
2. One hundred millimeter (4 inches) and larger: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, with flow direction arrow permanently cast into, cleaned for oxygen use and labeled for intended service, 1025 kPa (150 psi) WSP.

C. Zone Valve in Cabinet: Ball valve, bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non-shock gas working pressure service to 100 kPa (29 inch Hg), cleaned for oxygen use and labeled for intended service, blowout proof stem, one quarter turn of handle to completely open or close. Provide tubing extensions factory brazed, and pressure tested. Provide 3 mm (1/8 inch) NPT gauge port for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick-on labels. Install valves in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
OXYGEN	White letters on green background	GREEN
MEDICAL AIR	Black or white letters on yellow background	YELLOW

2.3 VALVE CABINETS

- A. Flush mounted commercially available item for use with laboratory and healthcare services, not lighter than 1.3 mm (18 gage) steel or 1.9 mm (14 gage) extruded aluminum, rigidly assembled, of adequate size to accommodate valve(s) and fittings. Punch or drill sides to receive tubing. Provide anchors to secure cabinet to wall construction. Seal openings in cabinet to be dust tight. Locate bottom of cabinet 1375 mm (4 foot 6 inches) above floor.
- B. Mount engraved rigid plastic identification plate on wall above or adjacent to cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate must be clearly visible at all times. Provide inscriptions on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS."
- C. Cover plate: Fabricate from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. Provide cover window of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. Permanently paint or stencil on window: CAUTION-CLOSE ONLY IN EMERGENCY, SHUT-OFF VALVES FOR PIPED GASES", or equivalent wording. Configure such that it is not possible to install window with any valve in the closed position. Each valve shall have gauge upstream of valve inside valve box.

- D. Cabinets and isolation valves shall be located and piped as shown, and at a minimum, so as to allow the isolation of each smoke compartment separately. No cabinet shall serve more than one smoke compartment.

2.5 GAGES

- A. Pressure Gages: Includes gages temporarily supplied for testing purposes.
1. For line pressure use adjacent to source equipment: ASME B40.1, pressure gage, single, size 115 mm (4-1/2 inches), for compressed air, nitrogen and oxygen, accurate to within two percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gage shall be cleaned for oxygen use, labeled for appropriate service, and marked "USE NO OIL". Install with gage cock.
 2. For all services downstream of main shutoff valve: Manufactured for oxygen use, labeled for the appropriate service and marked "USE NO OIL", 40 mm (1-1/2 inch) diameter gage with dial range 1-690 kPa (1-100 psi) for air service , and 1-690 kPa (1-100 psi) / 1-2050 kPa (1-300 psi) .

2.6 STATION OUTLETS

- A. For all services except ceiling hose drops and nitrogen system: For designated service, consisting of a quick coupler and inlet supply tube. Provide coupler that is non-interchangeable with other services, and leak proof under three times the normal working pressure. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet and inlet securely to rough-in to prevent floating and provide each with a capped stub length of 6 mm (10 mm outside diameter) (3/8-inch outside diameter) tubing for connection to supply. Identification of each gas service shall be permanently cast into the back plate and shall be

visible through a transparent plastic guard. Label stub tubing for appropriate service. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPU) are furnished under this specification but installed by manufacturer of PATIENT BED SERVICE WALLS before initial test specified herein. Install completion kits (valve body and face plate) for the remainder of required tests.

2.7 STATION OUTLETS

For all services: Brass, stainless steel or chromed metal non-interchangeable DISS connections for appropriate service to conform with CGA V-5. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation, for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet securely to outlet rough-in to prevent floating, and provide each outlet with a capped stub length of 6 mm (1/4-inch) (10 mm (3/8-inch) outside diameter) tubing for connection to supply. Label stub tubing for appropriate service. Adjustable to compensate for variations in plaster or cover thickness. Rough-in kits and test plugs for PATIENT BED SERVICE WALLS (PBPU) are furnished under this specification but installed by manufacturer of PBPU before initial tests specified herein. Install outlet completion kits (valve body and face plate) for the remainder of required tests.

2.8 STATION OUTLET ROUGH-IN

- A. Flush mounted, protected against corrosion. Anchor rough-in securely to unit or wall construction.
- B. Modular Cover Plate: Die cast back plate, two-piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, with mounting flanges on all four sides, secured to rough-in with stainless steel or chromium plated countersunk screws.

- C. Cover Plate for Prefabricated Bedside Patient Units (PBPUs): One-piece with construction and material as indicated for modular cover plate.
- D. Provide permanent, metal or plastic, identification plates securely fastened at each outlet and inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked-on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
OXYGEN	White letters on green background
MEDICAL AIR	Black or white letters on yellow

2.9 ALARMS

- A. Provide all low voltage control wiring, except for wiring from alarm relay interface control cabinet to ECC, required for complete, proper functioning system, in conformance with Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Run wiring in conduit, in conformance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

1. Compressed Air Alarms:

- a. Medical air dew point high alarm: Functions when the line pressure dew point rises above 2 °C (35 °F) at 380 kPa (55 psi).

- b. Carbon Monoxide Alarm: Functions when the carbon monoxide levels rise above 10 parts per million; receives signal from the carbon monoxide monitor.
- c. Main Bank Filter Set Alarm: Functions when the pressure drop across filter set increases more than 14 kPa (2 psi) over that when filters are clean and new; operates by differential pressure switch or transmitters.
- d. Desiccant Prefilter Alarm: Functions when pressure across the filter increases more than 21 kPa (3 psi) over that when filters are clean and new; operates by pressure differential switch.
- e. Desiccant Post Filter Alarm: Functions when pressure drop across filter increases more than 21 kPa (3 psi) over that when filters are clean and new; operates by pressure differential switch.
- f. Desiccant Dryer Malfunction Alarm: Functions on any combination of failure of tower cycling and/or pressure dew point rise above 60 • C at 690 kPa (140 • F at 100 psi).
- g. Aftercooler High temperature Alarm: Functions when aftercooler discharge air temperature exceeds 38 • C (100 • F).
- h. Pressure Abnormal Alarm: Functions when system pressure downstream of main shutoff valve drops below 550 kPa (80 psi) (plus/minus gage or increases above 830 kPa (120 psi) (plus/minus 14 kPa (2 psi) set points; operated by pressure switch.
- i. Compressor Malfunction Alarm: Functions when compressor system control panel signals compressor thermal malfunction alarm, lead compressor fails to start alarm or high water level in receiver or separator (if so required) receives signal from system control panel.

j. Low Lubricant Shutdown: For rotary screw compressors. Functions when lubricant level drops to a low point. Receives signal from compressor control panel.

k. Instrument air dew point high alarm: Functions when the line pressure dew point rises above -30°C (-22°F) at 380 kPa (55 psi).

B. Alarm Functions:

1. Oxygen, compressed air alarms: Pressure alarms: Functions when pressure in branch drops below 275 kPa (40 psi), plus/minus 14 kPa (2 psi) or increases above 414 kPa (60 psi), plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.

3. Vacuum alarms: Low vacuum alarm: Functions when vacuum in branch drops below 40 kPa (12-inches Hg); operated by vacuum switch.

5. Vacuum alarms:

a. Low vacuum alarm: Function when system vacuum upstream of main shutoff valve drops below 40 kPa (12 inches Hg); operated by vacuum switch.

b. Filter differential pressure/back pressure alarm: Functions when discharge oil filter differential rises to set level, or when back pressure is sensed; receives signal from pump control panel.

c. Laboratory vacuum pump malfunction.

6. Waste Anesthetic Gas Disposal (WASG) low alarm: Functions when WAGD vacuum level or flow is below effective operating limits.

B. Alarm Panels:

1. General: Modular design, easily serviced and maintained; alarms operate on alternative current low voltage control circuit; provide required number of transformers for efficient functioning of complete

system. Alarm panels shall be integral units, reporting PSIG.], compressed air and vacuum services, as required.

2. Box: Flush mounted, sectional or one piece, corrosion protected. Size to accommodate required number of service functions for each location, and for one audible signal in each box. Anchor box securely. Provide spare capacity to accommodate 50% of the number of provided alarm points.
3. Cover plate: Designed to accommodate required number of signals, visual and audible, for each location, and containing adequate operating instructions within the operator's view. Bezel shall be extruded aluminum, chromium plated metal, or plastic. Secure to the box with chromium plated or stainless steel countersunk screws.
4. Service indicator lights: Red translucent plastic or LED with proper service identification inscribed thereon. Number of lights and service instruction shall be as required for each location. Provide each panel with a green test button of the same material, inscribed with "PUSH TO TEST" or similar message.
5. Audible signal: Provide one in each alarm panel and connect electrically with all service indicator light functions.
6. Controls:
 - a. Visual signal: When the condition occurs which any individual service indicator light is to report, button for particular service shall give a lighted visual signal which cannot be canceled until such condition is corrected.
 - b. Audible signal: Alarm shall give an audible signal upon circuit energization of any visual signal. Audible signal shall be continuous until silenced by pushing a button. This shall cancel and reset audible only, and not affect the visual signal. After silencing, subsequent alarms shall reactivate the audible alarm.

- c. Signal tester: Test button or separate normal light shall be continuously lighted to indicate electrical circuit serving each individual alarm is energized. Pushing test button shall temporarily activate all visual signals and sound audible signal, thereby providing desired indications of status of system.
- F. Alarm Relay Interface Control Cabinet: Design cabinet to transfer the closed circuit alarm signals through relays to a set of terminals for monitoring signals at the ECC without interrupting the closed circuit system. Construct of 1.9 mm (14 gage) steel, conforming with NEMA ICS-6, Type 1, enclosures. Provide both normally open and normally closed contacts for output signals, with number of circuits required for full alarm capability at the ECC. Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for compatibility.
- G. Alarm Network Communication: Network communications board shall be installed in local alarm and connected to the facility's Ethernet. Local alarm modules shall send information to the master alarm and the data can be downloaded thru the computer connected to the facility's Ethernet. Master alarm displays the message, sound its alarm and saves the information in an event log. This event log shall be downloaded to a computer file for tracking data and troubleshooting.

2.11 PRESSURE SWITCHES

General purpose, contact type, allowing both high and low pressure set points, with contact type provided with a protective dust cover; adjustable range set by inside or outside adjustment; switches activate when indicated by alarm requirements. Use one orifice nipple (or DISS demand check valve) for each sensor or pressure switch.

2.16 EMERGENCY LOW PRESSURE OXYGEN INLET

- A. The Low Pressure Emergency Oxygen Inlet provides an inlet for connecting a temporary auxiliary source of oxygen to the oxygen pipeline system for emergency or maintenance situations per NFPA 99.
- B. The inlet consist of a 1" (25 mm) ball valve, pressure gauge and a 1/2"/1" NPTF connection housed in a weather tight enclosure. The enclosure is labeled "Emergency Low Pressure Gaseous Oxygen Inlet", and includes a padlock staple to prevent tampering or unauthorized access. The enclosure is suitable for recess mounting on the exterior of the building being served. The enclosure is 14 gauge, cold rolled steel with a primer coat of paint. The Emergency Oxygen Inlet is connected at a point downstream of the main supply line shutoff valve.
- C. Check valves are provided for installation in the emergency supply line and in the main supply line between the main line shutoff valve and the emergency supply line connection per by NFPA 99. Check valves have a cast bronze body and straight through design for minimum pressure drop.
- D. The check valves for sizes under 3" (76 mm) are soft seated, bubble tight, self aligning, and spring loaded, and ball type check valves. Three inch (76 mm) check valves are hard seated, spring loaded, self aligning ball type checks with cone seats. Check valves are fast acting.

- E. A relief valve is provided for installation in the emergency supply line per NFPA 99. The relief valve has a brass body, single seat design, and is cleaned for oxygen use. It automatically reseats to provide a "bubble tight" seal after discharging excess gas. Pre-set at 75 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- B. Keep open ends of tube capped or plugged at all times or otherwise sealed until final assembly.
- C. Cut piping square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. Ream tube to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. Work into place without springing or forcing. Bottom tube in socket so there are no gaps between tube and fitting. Exercise care in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease being introduced into tubing. Where contamination has occurred, material is no longer suitable for oxygen service.
- D. Spacing of hangers: Current NFPA.
- E. Rigidly support valves and other equipment to prevent strain on tube or joints.
- F. While being brazed, joints shall be continuously purged with *oil* free nitrogen. The flow of purged gas shall be maintained until joint is cool to touch.
- G. Do not bend tubing. Use fittings.
- H. Support ceiling column assembly from heavy sub-mounting castings furnished with the unit as part of roughing-in. Anchor with 15 mm

(1/2-inch) diameter bolts attached to angle iron frame supported from structural ceiling, unless otherwise indicated.

- I. Provide two 25 mm (1 inch) minimum conduits from ceiling column assembly to adjacent corridor, one for mass spectrometer tubing and wiring and one for monitor wiring, for connection to signal cabling network.
- J. Install pressure switches, transmitter and gauges to be easily accessed, and provide access panel where installed above plaster ceiling. Install pressure switch and sensors with orifice nipple between the pipe line and switches/sensors.
- K. Apply pipe labeling during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.
- L. Pipe compressor intake to a source of clean ambient air as indicated in current NFPA.
- M. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.
- N. Penetrations:
 - 1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with intumescent materials only. Completely fill and seal clearances between raceways and openings with the fire stopping material.
 - 2. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- O. Provide 40mm (1 1/2 inch) diameter line pressure gage downstream of zone valve in cabinets.

3.2 TESTS

A. Initial Tests: Blow down, and high and low pressure leakage tests as required by current NFPA with documentation.

B. Laboratory and healthcare testing agency shall perform the following:

1. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.
2. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.
3. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.
4. Piping purity test: For each positive pressure system, verify purity of piping system. Test each zone at the most remote outlet for dew point, carbon monoxide, total hydrocarbons (as methane), and halogenated hydrocarbons, and compare with source gas. The two tests must in no case exceed variation as specified in Paragraph. Perform test with the use of an inert gas as described in CGA P-9.
5. Outlet and inlet flow test:
 - a. Test all outlets for flow. Perform test with the use of an inert gas as described in CGA P-9.

- b. Oxygen, nitrous oxide and air outlets must deliver 100 Lpm (3.5 scfm) with a pressure drop of no more than 35 kPa (5 psi), and static pressure of 350 kPa (50 psi).
 - c. Nitrogen outlets must deliver 565 Lpm (20 scfm) with a pressure drop of no more than 35 kPa (5 psi), and static pressure of 1445 kPa (210 psi).
 - d. Needle valve air outlets must deliver 1.5 scfm with a pressure drop of no more than five psi, and static pressure of 350 kPa (50 psi).
6. Source Contamination Test: Analyze each pressure gas source for concentration of contaminants, by volume. Take samples for air system test at the intake and at a point immediately downstream of the final filter outlet. The compared tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Allowable concentrations are below the following:

Dew point, air	4 degrees C (39 degrees F) pressure dew point at 690 kPa (100 psi)
Carbon monoxide, air	10 mg/L (ppm)
Carbon dioxide, air	500 mg/L (ppm)
Gaseous hydrocarbons as methane, air	25 mg/L (ppm)
Halogenated hydrocarbons, air	2 mg/L (ppm)

7. Analysis Test:

- a. Analyze each pressure gas source and outlet for concentration of gas, by volume.

b. Make analysis with instruments designed to measure the specific gas dispensed.

c. Allowable concentrations are within the following:

1) Laboratory air 19.5 percent to 23.5 percent oxygen.

Oxygen	>=97 plus percent oxygen
Medical air	19.5 percent to 23.5 percent oxygen

8. Maximum Allowable Variation: Between comparative test results required are as follows:

Dew point	2 degrees C (36 degrees F)
Carbon monoxide	2 mg/L (ppm)
Total hydrocarbons as methane	1 mg/L (ppm)
Halogenated hydrocarbons	2 mg/L (ppm)

C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COTR and Commissioning Agent. Provide a minimum of 7 days prior to notice.

3.3 CONNECTION TO EXISTING LABORATORY GAS SYSTEM:

A. Contactor shall test the existing system for hydrocarbons and dew point. If problems are present, the COTR (RE) would notify the facility of the results. The facility would then make the necessary repairs and/or maintenance.

- B. Install shut-off valve at the connection of new line to existing line.
- C. Coordinate time for shut-down of the existing laboratory and healthcare system with the VA medical center.
- D. Shut off all oxygen zone valves and gas riser valves if the section to be connected to cannot be totally isolated from the remainder of the system.
- E. Prior to any work being done, check the new pipeline for particulate or other forms of contamination.
- F. Ensure that the correct type of pipe tubing and fittings are being used.
- G. Make a spot check of the existing pipelines in the facility to determine the level of cleanness present.
- H. Reduce the pressure to zero and make the tie-in as quickly as possible. A nitrogen purge is not required since this would require another opening in the pipe.
- I. After the tie-in is made and allowed to cool, slowly bleed the source gas back into the pipeline. Test the work area for leaks with soapy water and repair any leaks.
- J. After all leaks, if any, are repaired and the line is fully recharged, perform blow down and testing. Open the zone that is closest to the main to the system, access the closest outlet to the work, and blow the main through the outlet. After the outlet blows clear into a white cloth, make an additional check at a zone most distant from the work. Perform all required current NFPA tests after connection.

3.4 COMMISSIONING

- A. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

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HZ Renovate B51 (Unit 3B)

Bid Documents

3.5 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct VA Personnel in operation and maintenance of units.

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SECTION 23 05 10
DUCTWORK CLEANING

PART 1 - GENERAL

1.1 SPECIAL PROVISIONS

A. Qualification of the HVAC System Cleaning Contractor

1. Membership: The HVAC system cleaning contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA), or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.
2. Certification: The HVAC system cleaning contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
3. Supervisor Qualifications: A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.
4. Experience: The HVAC system cleaning contractor shall submit records of experience in the field of HVAC system cleaning as requested by the owner. Bids shall only be considered from firms which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.
5. Equipment, Materials and Labor: The HVAC system cleaning contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services.
 - a. The contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for

the work by the U.S. Occupational Safety and Health Administration, and as described by this specification.

- b. The contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs and this specification
- c. Contractor shall submit to the owner all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning.

- 6. Licensing: The HVAC system cleaning contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. Contractor shall comply with all Federal, state and local rules, regulations, and licensing requirements.

1.2 Standards

- A. NADCA Standards: The HVAC system cleaning contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).
 - 1. All terms in this specification shall have their meaning defined as stated in the NADCA Standards.
 - 2. NADCA Standards must be followed with no modifications or deviations being allowed.

1.3 Documents

- A. Mechanical Drawings: The owner shall provide the HVAC system cleaning contractor with one copy of the following documents:
 - 1. Project drawings and specifications.
 - 2. Approved construction revisions pertaining to the HVAC system.
 - 3. Any existing indoor air quality (IAQ) assessments or environmental reports prepared for the facility.

Part 2 - HVAC System Cleaning Specifications and Requirements

2.1 Scope of Work

- A. Scope: This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.
- B. The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.
- C. The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system that is left in place after demolition has occurred as described on the contract documents.

2.2 HVAC System Component Inspections and Site Preparations

- A. HVAC System Component Inspections: Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. The cleanliness inspection should include air handling units and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple air handling units, a representative sample of the units should be inspected. The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering control measures should be implemented.
 - 1. Damaged system components found during the inspection shall be documented and brought to the attention of the owner.
- B. Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details

how each area of the building will be protected during the various phases of the project.

- C. Inspector Qualifications: Qualified personnel assigned by the VA will perform the HVAC cleanliness inspection to determine the need for cleaning.

2.03 General HVAC System Cleaning Requirements

- A. Containment: Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.
- B. Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.
- C. Controlling Odors: Measures shall be employed to control odors and/or mist vapors during the cleaning process.
- D. Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards (see NADCA Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.
- E. Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position

marked prior to cleaning and, upon completion, must be restored to their marked position.

- F. Service Openings: The contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.
1. Contractor shall utilize the existing service openings already installed in the HVAC system where possible.
 2. Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.
 3. Closures must not significantly hinder, restrict, or alter the airflow within the system.
 4. Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.
 5. Openings must not compromise the structural integrity of the system.
 6. Construction techniques used in the creation of openings should This General Specification describes the minimum requirements necessary for commercial HVAC system cleaning.
 7. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.
 8. Rigid fiber glass duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques that comply with UL Standard 181 or UL Standard 181a are suitable for fiber glass duct system closures.
 9. All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the owner in project report documents.
- J. Duct Systems. Contractor shall:
1. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.

2. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Tests (see NADCA Standards).

2.04 Health and Safety

- A. Safety Standards: Cleaning contractors shall comply with applicable federal, state, and local requirements for protecting the safety of the contractor's employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.
- B. Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.
- C. Disposal of Debris: All Debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state and local requirements.

2.05 Mechanical Cleaning Methodology

- A. Source Removal Cleaning Methods: The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the contractor's responsibility to select Source Removal methods that will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 1. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum

collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.

2. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.
3. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor.
4. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

B. Methods of Cleaning Fibrous Glass Insulated Components

1. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.
2. Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).

C. Damaged Fibrous Glass Material

1. Evidence of damage: If there is any evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be

restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.

2. Replacement: When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.
3. Replacement material: In the event fiber glass materials must be replaced, all materials shall conform to applicable industry codes and standards, including those of UL and SMACNA.

D. Cleaning of coils

1. Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not This General Specification describes the minimum requirements necessary for commercial HVAC system cleaning. Coils shall be thoroughly rinsed with clean water to remove any latent residues.

E. Antimicrobial Agents and Coatings

1. Antimicrobial agents shall only be applied if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.
2. Application of any antimicrobial agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.
3. When used, antimicrobial treatments and coatings shall be applied in strict accordance with the manufacturer's written recommendations and EPA registration listing.
4. Antimicrobial coatings shall be applied according to the manufacturer's written instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces.

2.06 Cleanliness Verification

- A. General: Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- B. Visual Inspection: The HVAC system shall be inspected visually to ensure that no visible contaminants are present.
 - 1. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the owner reserves the right to further verify system cleanliness through Surface Comparison Testing or the NADCA vacuum test specified in the NADCA standards.
 - 2. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
 - 3. NADCA vacuum test analysis should be performed by a qualified third party experienced in testing of this nature. This General Specification describes the minimum requirements necessary for commercial HVAC system cleaning.
- C. Verification of Coil Cleaning
 - 1. Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

2.07 Pre-existing System Damage

- A. Contractor is not responsible for problems resulting from prior inappropriate or careless cleaning techniques of others.

2.08 Post-project Report

- A. At the conclusion of the project, the Contractor shall provide a report to the owner indicating the following:

1. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.
2. Areas of the system found to be damaged and/or in need of repair.

2.09 Applicable Standards and Publications:

- A. National Air Duct Cleaners Association (NADCA): "Assessment, Cleaning & Restoration of HVAC Systems (ACR 2005)," 2004.
- B. National Air Duct Cleaners Association (NADCA): "Understanding Microbial Contamination in HVAC Systems," 1996.
- C. National Air Duct Cleaners Association (NADCA): "Introduction to HVAC System Cleaning Services," 2004.
- D. National Air Duct Cleaners Association (NADCA): Standard 05 "Requirements for the Installation of Service Openings in HVAC Systems," 2004.
- E. Underwriters' Laboratories (UL): UL Standard 181.
- F. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE): Standard 62-89, "Ventilation for Acceptable Indoor Air Quality".
- G. Environmental Protection Agency (EPA): "Building Air Quality," December 1991.
- H. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): "HVAC Duct Construction Standards - Metal and Flexible," 1985.

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**SECTION 23 05 11
COMMON WORK RESULTS FOR HVAC**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23.
- B. Definitions:
 - 1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
 - 2. Option or optional: Contractor's choice of an alternate material or method.
 - 3. COTR: Contracting Officer's Technical Representative.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Building Components for Attachment of Hangers: Section 05 31 00, STEEL DECKING,
- D. Section 07 84 00, FIRESTOPPING.
- E. Section 07 92 00, JOINT SEALANTS.
- F. Section 09 91 00, PAINTING.
- G. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

1.3 QUALITY ASSURANCE

- A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in institutional HVAC construction.
- B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- C. Equipment Vibration Tolerance:
 - 1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.

2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.

D. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the Contracting Officers Technical Representative (RE/COTR).
4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

E. Equipment Service Organizations:

1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located reasonably close to the site.
- F. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
 1. Qualify welding processes and operators for piping according to ASME Section IX, "Welding and Brazing Qualifications".
 2. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- H. Execution (Installation, Construction) Quality:
 1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the RE/COTR for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the RE/COTR at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
 2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the RE/COTR for resolution.
 3. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and with requirements in the individual specification sections.

- B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- E. Upon request by RE/COTR, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.
- F. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- G. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
 - 1. Submit belt drive with the driven equipment.
 - 2. Submit electric motor data and variable speed drive data with the driven equipment.
 - 3. Equipment and materials identification.
 - 4. Fire-stopping materials.
 - 5. Hangers, inserts, supports and bracing.
 - 6. Wall, floor, and ceiling plates.
- H. HVAC Maintenance Data and Operating Instructions:
 - 1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
- I. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (ARI):
430-99 (R2002)Central Station Air-Handling Units
- C. Rubber Manufacturers Association (ANSI/RMA):
IP-20-2007Drives Using Classical V-Belts and Sheaves
- D. Air Movement and Control Association (AMCA):
410-96Recommended Safety Practices for Air Moving
Devices
- E. American Society of Mechanical Engineers (ASME):
Boiler and Pressure Vessel Code (BPVC):
Section IX-2007Welding and Brazing Qualifications
- F. American Society for Testing and Materials (ASTM):
A36/A36M-08Carbon Structural Steel
A575-96(2007)Steel Bars, Carbon, Merchant Quality, M-Grades
E84-09Standard Test Method for Burning Characteristics
of Building Materials
E119-08aStandard Test Method for Fire Tests of Building
Construction and Materials
- G. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
SP-58-2002Pipe Hangers and Supports-Materials, Design and
Manufacture
SP 69-2003Pipe Hangers and Supports-Selection and
Application
SP 127-2001Bracing for Piping Systems, Seismic - Wind -
Dynamic, Design, Selection, Application
- H. National Electrical Manufacturers Association (NEMA):
MG 1-2006Motors and Generators
- I. National Fire Protection Association (NFPA):
70-08National Electrical Code
90A-09Installation of Air Conditioning and Ventilating
Systems
101-09Life Safety Code

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the RE/COTR. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 1. All components of an assembled unit need not be products of same manufacturer.
 2. Constituent parts that are alike shall be products of a single manufacturer.
 3. Components shall be compatible with each other and with the total assembly for intended service.

4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 BELT DRIVES

- A. Drive Types, Based on ARI 435:
 1. Provide adjustable-pitch or fixed-pitch drive as follows:
 - a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
 - b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
 2. Provide fixed-pitch drives for drives larger than those listed above.
 3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

2.4 DRIVE GUARDS

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory fabricated air handling unit casings.
- B. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 6 mm (1/4-inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

2.5 LIFTING ATTACHMENTS

- A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 ELECTRIC MOTORS

- A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC; and, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application use electric motors with the following requirements.
- B. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).
- C. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.
- D. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation not to exceed nameplate rating without service factor.
- E. Special Requirements:
 - 1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Government.
 - 2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
 - 3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:

- a. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
- 4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
- 5. Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.
- F. Motor Efficiency and Power Factor: All motors, when specified as "high efficiency" by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as "NEMA premium efficient" and the requirements generally exceed those of the Energy Policy Act of 1992 (EPACT). Motors not specified as "high efficiency" shall comply with EPACT.
- G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.7 VARIABLE SPEED MOTOR CONTROLLERS

- A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS for specifications.
- B. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be product of a single manufacturer.
- C. Motors shall be energy efficient type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.
- D. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, etc., nor shall be affected from other devices on the AC power system.

2.8 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 3/16 inch high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 3/16 inch high riveted or bolted to the equipment.
- D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
 - 1. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm (1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
 - 2. Valve lists: Typed or printed plastic coated card(s), sized 216 mm(8-1/2 inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.

2.9 FIRESTOPPING

- A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 07 11, HVAC, PLUMBING INSULATION, for firestop pipe and duct insulation.

2.10 GALVANIZED REPAIR COMPOUND

- A. Green Seal Standard GC-03, paint form.

2.11 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- B. Supports for Roof Mounted Items:

1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory installed 50 mm by 100 mm (2 by 4) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, minimum height 280 mm (11 inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.
- C. Pipe Supports: Comply with MSS SP-58-2002. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69-2003.
- D. Attachment to Concrete Building Construction:
 1. Concrete insert: MSS SP-58-2002, Type 18.
 2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the COTR for each job condition.
 3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (four inches) thick when approved by the COTR for each job condition.
- E. Attachment to Steel Building Construction:
 1. Welded attachment: MSS SP-58-2002, Type 22.
 2. Beam clamps: MSS SP-58-2002, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23mm (7/8-inch) outside diameter.
- F. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING H. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58-2002. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- G. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts.
 1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).

2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2-inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

H. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.

2.12 PIPE PENETRATIONS

- A. Install sleeves during construction.
- B. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of RE/COTR.
- C. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- D. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- E. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for.
- F. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- G. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.
- H. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight

with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

- I. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.13 SPECIAL TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the RE/COTR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

2.14 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Submit the drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the

floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
 - 1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by RE/COTR where working area space is limited.
 - 2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by RE/COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to RE/COTR for approval.
 - 3. Do not penetrate membrane waterproofing.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Electrical Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- I. Protection and Cleaning:
 - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COTR. Damaged or defective items in the opinion of the COTR, shall be replaced.
 - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs

- during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum.
- K. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- L. Work in Existing Building:
1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
 2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
 3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the COTR. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the COTR for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After COTR's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.
- M. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.
- N. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.

2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

- A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Para. 3.1 apply.

3.3 RIGGING

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to RE/COTR for evaluation prior to actual work.
- G. Restore building to original condition upon completion of rigging work.

3.4 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the RE/COTR.
- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.
- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69-2003. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.
- E. Overhead Supports:
 - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
 - 2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
- F. Floor Supports:
 - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
 - 2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
 - 3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.

3.5 MECHANICAL DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor after approval for structural integrity by the RE/COTR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Do not permit debris to accumulate in the area to the detriment of plant operation. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VA Cemetery, and Contractor shall follow all directives of the RE/COTR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to RE/COTR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such

material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

3.6 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
 - 1. Cleaning shall be thorough. Use cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
 - 2. Material And Equipment Not To Be Painted Includes:
 - a. Motors, controllers, control switches, and safety switches.
 - b. Control and interlock devices.
 - c. Regulators.
 - d. Pressure reducing valves.
 - e. Control valves and thermostatic elements.
 - f. Lubrication devices and grease fittings.
 - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
 - h. Valve stems and rotating shafts.
 - i. Pressure gauges and thermometers.
 - j. Glass.
 - k. Name plates.
 - 3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
 - 4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
 - 5. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.7 IDENTIFICATION SIGNS

- A. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size and performance.
- B. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.8 MOTOR AND DRIVE ALIGNMENT

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.9 LUBRICATION

- A. Lubricate all devices requiring lubrication prior to initial operation, and field-check all devices for proper lubrication.
- B. Equip all devices with required lubrication fittings or devices.
- C. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.10 STARTUP AND TEMPORARY OPERATION

- A. Startup equipment per manufacturer's instructions. Verify that vibration is within specified tolerance prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.11 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the RE/COTR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

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**SECTION 23 05 12
GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of motors for HVAC equipment.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one Section of Division 26.
- B. Other sections specifying motor driven equipment in Division 23.

1.3 SUBMITTALS

- A. In accordance with Section, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, materials, horsepower, RPM, enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.
- C. Manuals:
 - 1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and application data.
- D. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certification to the COTR:
 - 1. Certification that the motors have been properly applied, installed, adjusted, lubricated, and tested.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. National Electrical Manufacturers Association (NEMA):
 - MG 1-2006 Rev 1 2007 ...Motors and Generators

C. National Fire Protection Association (NFPA)

D. National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 MOTORS

A. For alternating current, fractional and integral horsepower motors, NEMA Publications MG 1 and MG 2 shall apply.

B. Voltage ratings shall be as follows:

1. Single phase:

a. Motors connected to 120-volt systems: 115 volts.

b. Motors connected to 208-volt systems: 200 volts.

c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.

2. Three phase:

a. Motors connected to 208-volt systems: 200 volts.

b. Motors, less than 74.6 kW (100 HP), connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.

C. Number of phases shall be as follows:

1. Motors, less than 373 W (1/2 HP): Single phase.

2. Motors, 373 W (1/2 HP) and larger: 3 phase.

3. Exceptions:

a. Hermetically sealed motors.

b. Motors for equipment assemblies, less than 746 W (one HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

D. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation.

E. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.

F. Motor Enclosures:

1. Shall be the NEMA types shown on the drawings for the motors.

2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being installed.

3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.

- G. Additional requirements for specific motors, as indicated in other sections, shall also apply.
- H. Energy-Efficient Motors (Motor Efficiencies): All permanently wired polyphase motors of 746 Watts or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 746 Watts or more with open, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Efficiencies Open Drip-Proof				Minimum Efficiencies Totally Enclosed Fan-Cooled			
Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM	Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%

- I. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM.
- J. Premium efficiency motors shall be used where energy cost/kW x (hours use/year) > 50.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.

3.2 FIELD TESTS

- A. Megger all motors after installation, before start-up. All shall test free from grounds.

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**SECTION 23 05 41
NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Noise criteria, vibration tolerance and vibration isolation for HVAC and plumbing work.

1.2 RELATED WORK

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- B. Section 23 31 00, HVAC DUCTS AND CASINGS: requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining.
- C. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: requirements for sound and vibration tests.

1.3 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Noise Criteria:
1. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed following NC levels:

Type Of Room	NC LEVEL
Bathrooms and Toilet Rooms	40
Chapels	35
Conference Rooms	35
Corridors(Public)	40
Lobbies, Waiting Areas	40
Locker Rooms	50
Offices, large open (3 or more occupants)	40
Offices, small private (2 or fewer occupants)	35
Maintenance	50

2. For equipment which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the foregoing noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in

- accordance with ASHRAE Fundamentals Handbook, Chapter 8, Sound and Vibration.
3. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.
 4. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.
- C. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.

1.4 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 1. Vibration isolators:
 - a. Floor mountings
 - b. Hangers
 - c. Snubbers
 - d. Thrust restraints
 2. Bases.
 3. Acoustical enclosures.
- C. Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
2009.....Fundamentals Handbook, Chapter 8, Sound and Vibration
- C. American Society for Testing and Materials (ASTM):
A123/A123M-08.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A307-07.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
D2240-05.....Standard Test Method for Rubber Property - Durometer Hardness
- D. Manufacturers Standardization (MSS):
SP-58-02.....Pipe Hangers and Supports-Materials, Design and Manufacture
- E. Occupational Safety and Health Administration (OSHA):
29 CFR 1910.95.....Occupational Noise Exposure

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements indicated herein and in the schedule on the drawings.
- B. Elastometric Isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness of 60 durometer and have a straight-line deflection curve.
- D. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.
- E. Color code isolators by type and size for easy identification of capacity.

2.3 VIBRATION ISOLATORS

- A. Floor Mountings:

1. Double Deflection Neoprene (Type N): Shall include neoprene covered steel support plated (top and bottom), friction pads, and necessary bolt holes.
2. Spring Isolators (Type S): 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.
3. Spring Isolators with Vertical Limit Stops (Type SP): Similar to spring isolators noted above, except include a vertical limit stop to limit upward travel if weight is removed and also to reduce movement and spring extension due to wind loads. Provide clearance around restraining bolts to prevent mechanical short circuiting. 5.

Pads (Type D), Washers (Type W), and Bushings (Type L): Pads shall be felt, cork, neoprene waffle, neoprene and cork sandwich, neoprene and fiberglass, neoprene and steel waffle, or reinforced duck and neoprene. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 345 kPa (50 pounds per square inch).

- B. Hangers: Shall be combination neoprene and springs unless otherwise noted and shall allow for expansion of pipe.
1. Combination Neoprene and Spring (Type H): 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.
 2. Spring Position Hanger (Type HP): Similar to combination neoprene and spring hanger except hanger shall hold piping at a fixed elevation during installation and include a secondary adjustment feature to transfer load to spring while maintaining same position.
 3. Neoprene (Type HN): Vibration hanger shall contain a double deflection type neoprene isolation element. Hanger rod shall be separated from contact with hanger bracket by a neoprene grommet.

4. Spring (Type HS): Vibration hanger shall contain a coiled steel spring in series with a neoprene grommet. 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.
 5. Hanger supports for piping 50 mm (2 inches) and larger shall have a pointer and scale deflection indicator.
- C. Snubbers: Each spring mounted base shall have a minimum of four all-directional or eight two directional (two per side) seismic snubbers that are double acting. Elastomeric materials shall be shock absorbent neoprene bridge quality bearing pads, maximum 60 durometer, replaceable and have a minimum thickness of 6 mm (1/4 inch). Air gap between hard and resilient material shall be not less than 3 mm (1/8 inch) nor more than 6 mm (1/4 inch). Restraints shall be capable of withstanding design load without permanent deformation.

2.4 BASES

- A. Rails (Type R): Design rails with isolator brackets to reduce mounting height of equipment and cradle machines having legs or bases that do not require a complete supplementary base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension but not less than 100 mm (4 inches). Where rails are used with neoprene mounts for small fans or close coupled pumps, extend rails to compensate overhang of housing.
- B. Integral Structural Steel Base (Type B): Design base with isolator brackets to reduce mounting height of equipment which require a complete supplementary rigid base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension, but not less than 100 mm (four inches).
- C. Inertia Base (Type I): Base shall be a reinforced concrete inertia base. Pour concrete into a welded steel channel frame, incorporating prelocated equipment anchor bolts and pipe sleeves. Level the concrete to provide a smooth uniform bearing surface for equipment mounting. Provide grout under uneven supports. Channel depth shall be a minimum of 1/12 of longest dimension of base but not less than 150 mm (six inches). Form shall include 13-mm (1/2-inch) reinforcing bars welded in

place on minimum of 203 mm (eight inch) centers running both ways in a layer 40 mm (1-1/2 inches) above bottom. Use height saving brackets in all mounting locations. Weight of inertia base shall be equal to or greater than weight of equipment supported to provide a maximum peak-to-peak displacement of 2 mm (1/16 inch).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vibration Isolation:

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 temperatures over 38 degrees C (100 degrees F).
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. Non-rotating equipment such as heat exchangers and convertors shall be mounted on isolation units having the same static deflection as the isolation hangers or support of the pipe connected to the equipment.

- ##### **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.

3.2 ADJUSTING

- A. Adjust vibration isolators after piping systems are filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 6-mm (1/4inch) movement during start and stop.
- D. Adjust active height of spring isolators.
- E. Adjust snubbers according to manufacturer's recommendations.

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SELECTION GUIDE FOR VIBRATION ISOLATORS

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
1) ROOF VENTILATORS															
ABOVE OCCUPIED AREAS:															
5 HP & OVER	---	---	---	CB	S	1.0	CB	S	1.0	CB	S	1.0	CB	S	1.0
2) CENTRIFUGAL BLOWERS															
UP TO 50 HP:															
UP TO 200 RPM	B	N	0.3	B	S	2.5	B	S	2.5	B	S	3.5	B	S	3.5
201 - 300 RPM	B	N	0.3	B	S	1.7	B	S	2.5	B	S	2.5	B	S	3.5
301 - 500 RPM	B	N	0.3	B	S	1.7	B	S	1.7	B	S	2.5	B	S	3.5
501 RPM & OVER	B	N	0.3	B	S	1.0	B	S	1.0	B	S	1.7	B	S	2.5
60 HP & OVER:															
UP TO 300 RPM	B	S	1.7	I	S	2.5	I	S	3.5	I	S	3.5	I	S	3.5
301 - 500 RPM	B	S	1.7	I	S	1.7	I	S	2.5	I	S	3.5	I	S	3.5

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 AE Works Project No. 11020

Pittsburgh VAMC
 HZ Renovate B51 (Unit 3B)
 Bid Documents

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
501 RPM & OVER	B	S	1.0	I	S	1.7	I	S	1.7	I	S	2.5	I	S	2.5
AIR HANDLING UNIT PACKAGES															
SUSPENDED:															
UP THRU 5 HP	---	---	---	---	H	1.0	---	H	1.0	---	H	1.0	---	H	1.0
7-1/2 HP & OVER:															
UP TO 500 RPM	---	---	---	---	H, THR	1.7	---	H, THR	1.7	---	H, THR	1.7	---	H, THR	1.7
501 RPM & OVER	---	---	---	---	H, THR	1.0	---	H, THR	1.0	---	H,TH R	1.7	---	H,TH R	1.7
FLOOR MOUNTED:															
UP THRU 5 HP	---	D	---	---	S	1.0	---	S	1.0	---	S	1.0	---	S	1.0
7-1/2 HP & OVER:															
UP TO 500 RPM	---	D	---	R	S, THR	1.7	R	S, THR	1.7	R	S, THR	1.7	R	S, THR	1.7

VA Project No. 646-09-130
 AE Works Project No. 11020

Pittsburgh VAMC
 HZ Renovate B51 (Unit 3B)
 Bid Documents

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
501 RPM & OVER	---	D	---	---	S, THR	1.0	---	S, THR	1.0	R	S, THR	1.7	R	S, THR	1.7
IN-LINE CENTRIFUGAL AND VANE AXIAL FANS, FLOOR MOUNTED: (APR 9)															
UP THRU 50 HP:															
UP TO 300 RPM	---	D	---	R	S	2.5	R	S	2.5	R	S	2.5	R	S	3.5
301 - 500 RPM	---	D	---	R	S	1.7	R	S	1.7	R	S	2.5	R	S	2.5
501 - & OVER	---	D	---	---	S	1.0	---	S	1.0	R	S	1.7	R	S	2.5
60 HP AND OVER:															
301 - 500 RPM	R	S	1.0	R	S	1.7	R	S	1.7	R	S	2.5	R	S	3.5
501 RPM & OVER	R	S	1.0	R	S	1.7	R	S	1.7	R	S	1.7	R	S	2.5

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:

1. Planning systematic TAB procedures.
2. Design Review Report.
3. Systems Inspection report.
4. Duct Air Leakage test report.
5. Systems Readiness Report.
6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
7. Vibration and sound measurements.
8. Recording and reporting results.

Definitions:

1. Basic TAB used in this Section: Chapter 37, "Testing, Adjusting and Balancing" of ASHRAE Handbook, "HVAC Applications".
2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
3. AABC: Associated Air Balance Council.
4. NEBB: National Environmental Balancing Bureau.
5. Hydronic Systems: Includes chilled water,
6. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
7. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.2 RELATED WORK

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General Mechanical Requirements.
- B. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise and Vibration Requirements.

- C. Section 23 07 11, HVAC AND PLUMBING INSULATION: Piping and Equipment Insulation.
- D. Section 23 36 00, AIR TERMINAL UNITS: Terminal Units Performance.
- E. Section 23 31 00, HVAC DUCTS AND CASINGS: Duct Leakage.
- F. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Controls and Instrumentation Settings

1.3 QUALITY ASSURANCE

- A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Qualifications:
 - 1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
 - 2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the RE/COTR and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
 - 3. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the RE/COTR and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary

- action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.
4. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the RE/COTR. The responsibilities would specifically include:
- a. Shall directly supervise all TAB work.
 - b. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB.
 - c. Would follow all TAB work through its satisfactory completion.
 - d. Shall provide final markings of settings of all HVAC adjustment devices.
 - e. Permanently mark location of duct test ports.
5. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing.
- C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.
- D. Tab Criteria:
1. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.

2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.
 - a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 0 percent to plus 10 percent.
 - b. Air terminal units (maximum values): Minus 2 percent to plus 10 percent.
 - c. Minimum outside air: 0 percent to plus 10 percent.
 - d. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 2 percent to plus 10 percent except if the air to a space is 100 CFM or less the tolerance would be 0 to plus 5 percent.
 - f. Chilled water coils: 0 percent to plus 5 percent.
3. Systems shall be adjusted for energy efficient operation as described in this section.
4. Typical TAB procedures and results shall be demonstrated to the RE/COTR for one air distribution system (including all fans, three terminal units and three rooms) and one hydronic system (pumps and three coils) as follows:
 - a. When field TAB work begins.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.
- C. For use by the RE/COTR staff, submit one complete set of applicable AABC or NEBB publications that will be the basis of TAB work.
- D. Submit Following for Review and Approval:
 1. Design Review Report within 90 days for conventional design projects after the system layout on air and water side is completed by the Contractor.

2. Systems inspection report on equipment and installation for conformance with design.
3. Duct Air Leakage Test Report.
4. Systems Readiness Report.
5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.

E. Prior to request for Final Inspection, submit completed Test and Balance report for the area.

1.5 APPLICABLE PUBLICATIONS

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
2007HVAC Applications ASHRAE Handbook, Chapter 37,
Testing, Adjusting, and Balancing and Chapter
47, Sound and Vibration Control
- C. Associated Air Balance Council (AABC):
2002AABC National Standards for Total System
Balance
- D. National Environmental Balancing Bureau (NEBB):
7th Edition 2005Procedural Standards for Testing, Adjusting,
Balancing of Environmental Systems
2nd Edition 2006Procedural Standards for the Measurement and
Assessment of Sound and Vibration
2nd Edition 1999Procedural Standards for Building Systems
Commissioning
- E. Sheet Metal and Air Conditioning Contractors National Association
(SMACNA):
3rd Edition 2002HVAC SYSTEMS-Testing, Adjusting and Balancing

PART 2 - PRODUCTS

2.1 PLUGS

- A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

- A. See Section 23 07 11, HVAC AND PLUMBING INSULATION. Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to TAB Criteria in Article, Quality Assurance.
- B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.2 DESIGN REVIEW REPORT

- A. The TAB Specialist shall review the Contract Plans and specifications and advise the RE/COTR of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.3 SYSTEMS INSPECTION REPORT

- A. Inspect equipment and installation for conformance with design.
- B. The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.
- C. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.4 DUCT AIR LEAKAGE TEST REPORT

- A. See paragraphs "Duct leakage Tests and Repairs" in Section 23 31 00, HVAC DUCTS AND CASINGS for TAB agency's role and responsibilities in witnessing, recording and reporting of deficiencies.

3.5 SYSTEM READINESS REPORT

- A. Inspect each System to ensure that it is complete including installation and operation of controls.
- B. Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the RE/COTR.

3.6 TAB REPORTS

- A. Submit an intermediate report for minimum of 50 percent of systems and equipment tested and balanced to establish satisfactory test results.
- B. The TAB contractor shall provide raw data immediately in writing to the RE/COTR if there is a problem in achieving intended results before submitting a formal report.
- C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated and re-submitted for approval.
- D. Do not proceed with the remaining systems until intermediate report is approved by the RE/COTR.

3.7 TAB PROCEDURES

- A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.
- B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.
- C. Coordinate TAB procedures with any phased construction completion requirements for the project. Provide TAB reports for each phase of the project prior to partial final inspections of each phase of the project.

- D. Allow sufficient time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.
- E. Air Balance and Equipment Test: Include air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets.
 - 1. Artificially load air filters by partial blanking to produce air pressure drop of at least 90 percent of the design final pressure drop.
 - 2. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
 - 3. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.
 - 4. Variable air volume (VAV) systems:
 - a. Coordinate TAB, including system volumetric controls, with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
 - b. Section 23 36 00, AIR TERMINAL UNITS, specifies that maximum and minimum flow rates for air terminal units (ATU) be factory set. Check and readjust ATU flow rates if necessary. Balance air distribution from ATU on full cooling maximum scheduled cubic meters per minute (cubic feet per minute). Reset room thermostats and check ATU operation from maximum to minimum cooling, to the heating mode, and back to cooling. Record and report the heating coil leaving air temperature when the ATU is in the maximum heating mode.
 - 5. Record final measurements for air handling equipment performance data sheets.
- F. Water Balance and Equipment Test: Include circulating pumps and coils:
 - 2. Adjust flow rates for equipment. Set coils to values on equipment submittals, if different from values on contract drawings.
 - 3. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for coils. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

3.8 VIBRATION TESTING

- A. Furnish instruments and perform vibration measurements as specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT. Field vibration balancing is specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide measurements for all rotating HVAC equipment of 373 watts (1/2 horsepower) and larger, including rotary and screw compressors, pumps, fans and motors.
- B. Record initial measurements for each unit of equipment on test forms and submit a report to the RE/COTR. Where vibration readings exceed the allowable tolerance Contractor shall be directed to correct the problem. The TAB agency shall verify that the corrections are done and submit a final report to the RE/COTR.

3.9 SOUND TESTING

- A. Perform and record required sound measurements in accordance with Paragraph, QUALITY ASSURANCE in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC or NEBB.
- C. Sound reference levels, formulas and coefficients shall be according to ASHRAE Handbook, "HVAC Applications", Chapter 46, SOUND AND VIBRATION CONTROL.
- D. Determine compliance with specifications as follows:
 1. When sound pressure levels are specified, including the NC Criteria in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT:
 - a. Reduce the background noise as much as possible by shutting off unrelated audible equipment.
 - b. Measure octave band sound pressure levels with specified equipment "off."
 - c. Measure octave band sound pressure levels with specified equipment "on."
 - d. Use the DIFFERENCE in corresponding readings to determine the sound pressure due to equipment.

DIFFERENCE:	0	1	2	3	4	5 to 9	10 or More
FACTOR:	10	7	4	3	2	1	0

Sound pressure level due to equipment equals sound pressure level with equipment "on" minus FACTOR.

- e. Plot octave bands of sound pressure level due to equipment for typical rooms on a graph which also shows noise criteria (NC) curves.
- 2. When sound power levels are specified:
 - a. Perform steps 1.a. thru 1.d., as above.
 - b. For indoor equipment: Determine room attenuating effect, i.e., difference between sound power level and sound pressure level. Determined sound power level will be the sum of sound pressure level due to equipment plus the room attenuating effect.
- E. Where measured sound levels exceed specified level, the installing contractor or equipment manufacturer shall take remedial action approved by the RE/COTR and the necessary sound tests shall be repeated.

3.10 MARKING OF SETTINGS

- A. Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the RE/COTR.

3.11 IDENTIFICATION OF TEST PORTS

- A. The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

- - - E N D - - -

SECTION 23 07 11
HVAC INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for
 - 1. HVAC piping, ductwork and equipment.
 - 2. Plumbing piping and equipment.
- B. Definitions
 - 1. ASJ: All service jacket, white finish facing or jacket.
 - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
 - 3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
 - 4. Concealed: Ductwork and piping above ceilings and in chases and pipe spaces.
 - 5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical, and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases unfinished attics, crawl spaces and pipe basements are not considered finished areas.
 - 6. FSK: Foil-scrim-kraft facing.
 - 7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F); HVAC and plumbing equipment or piping handling media above 41 degrees C (105 degrees F)
 - 8. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
 - 9. Runouts: Branch pipe connections up to 25-mm (one-inch) nominal size to fan coil units or reheat coils for terminal units.
 - 10. Thermal conductance: Heat flow rate through materials.
 - a. Flat surface: Watt per square meter (BTU per hour per square foot).
 - b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).

- 11. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
- 13. CW: Cold water.
- 15. HW: Hot water.
- 16. CH: Chilled water supply.
- 17. CHR: Chilled water return.
- 19. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.
- D. Section 23 21 13, HYDRONIC PIPING
- E. Section 23 31 00, HVAC DUCTS AND CASINGS: Ductwork, plenum and fittings.

1.3 QUALITY ASSURANCE

- A. Criteria:
 - 1. Comply with NFPA 90A:
 - a. 4.3.3.1 - Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.2 or 4.3.3.1.3, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - b. 4.3.3.1.1 - Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25

and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2.)

- c. 4.3.3.1.2 - The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.
- 2. Test methods: ASTM E84, UL 723, or NFPA 255.
- 3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.
- 4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- B. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data:
 - 1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
 - a. Insulation materials: Specify each type used and state surface burning characteristics.
 - b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.

- c. Insulation accessory materials: Each type used.
- d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
- e. Make reference to applicable specification paragraph numbers for coordination.

1.5 STORAGE AND HANDLING OF MATERIAL

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):
 - L-P-535E (3)-99Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. Military Specifications (Mil. Spec.):
 - MIL-A-3316C (2)-90Adhesives, Fire-Resistant, Thermal Insulation
 - MIL-A-24179A (2)-91Adhesive, Flexible Unicellular-Plastic Thermal Insulation
 - MIL-C-19565C (1)-88Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier
 - MIL-C-20079H-87Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
- D. American Society for Testing and Materials (ASTM):
 - A167-04Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - B209-07Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C411-05	.....Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation
C449-07	.....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
C534-08	.....Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
C547-07	.....Standard Specification for Mineral Fiber pipe Insulation
C552-07	.....Standard Specification for Cellular Glass Thermal Insulation
C553-08	.....Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
C585-90	.....Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System) R (2004)
C612-04	.....Standard Specification for Mineral Fiber Block and Board Thermal Insulation
C1126-04	.....Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
C1136-08	.....Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
D1668-97a (2006)	.....Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
E84-09	.....Standard Test Method for Surface Burning Characteristics of Building Materials
E119-08	.....Standard Test Method for Fire Tests of Building Construction and Materials
E136-09	.....Standard Test Methods for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C (1380 F)

E. National Fire Protection Association (NFPA):

- 90A-08Installation of Air Conditioning and
Ventilating Systems
- 101-08Life Safety Code
- 251-06Standard methods of Tests of Fire Endurance of
Building Construction Materials
- 255-06Standard Method of tests of Surface Burning
Characteristics of Building Materials

F. Underwriters Laboratories, Inc (UL):

- 723UL Standard for Safety Test for Surface Burning
Characteristics of Building Materials with
Revision of 09/08

G. Manufacturer's Standardization Society of the Valve and Fitting
Industry (MSS):

- SP58-2002Pipe Hangers and Supports Materials, Design,
and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER

- A. ASTM C612 (Board, Block), Class 1 or 2, $k = 0.037$ Watt per meter, per degree C (0.26), external insulation for temperatures up to 204 degrees C (400 degrees F).
- B. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 16 kg/m^3 (1 pcf), $k = 0.045$ (0.31), for use at temperatures up to 204 degrees C (400 degrees F)
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, $k = 0.037$ (0.26) for use at temperatures 230 degrees C (450 degrees F).

2.2 MINERAL WOOL OR REFRACTORY FIBER

- A. Comply with Standard ASTM C612, Class 3, 450 degrees C (850 degrees F).

2.3 RIGID CELLULAR PHENOLIC FOAM

- A. Preformed (molded) pipe insulation, ASTM C1126, type III, grade 1, $k = 0.021$ (0.15), for temperatures up to 121 degrees C (250 degrees F) with vapor retarder and all service jacket with polyvinyl chloride premolded fitting covering.

- B. Equipment and Duct Insulation, ASTM C 1126, type II, grade 1, $k = 0.021$ (0.15), for temperatures up to 121 degrees C (250 degrees F) with rigid cellular phenolic insulation and covering, vapor retarder and all service jacket.

2.4 CELLULAR GLASS CLOSED-CELL

- A. Comply with Standard ASTM C177, C518, density 120 kg/m³ (7.5 pcf) nominal, $k = 0.033$ (0.29) at 0 degrees C (75 degrees F).
- B. Pipe insulation for temperatures up to 200 degrees C (400 degrees F).

2.5 POLYISOCYANURATE CLOSED-CELL RIGID

- A. Preformed (fabricated) pipe insulation, ASTM C591, type IV, $K=0.027$ (0.19), for use at temperatures up to 149 degree C (300 degree F) with factory applied PVDC or all service jacket vapor retarder with polyvinyl chloride premolded fitting covers.
- B. Equipment and duct insulation, ASTM C 591, type IV, $K=0.027$ (0.19), for use at temperatures up to 149 degrees C (300 degrees F) with PVDC or all service jacket vapor retarder jacket.

2.7 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 5 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 100 mm (4 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.

- D. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.
- E. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.
- F. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.
- G. Aluminum Jacket-Piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 20 mm (0.75 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.
- H. Aluminum jacket-Rectangular breeching: ASTM B209, 3003 alloy, H-14 temper, 0.5 mm (0.020 inches) thick with 32 mm (1-1/4 inch) corrugations or 0.8 mm (0.032 inches) thick with no corrugations. System shall be weatherproof if used for outside service.

2.8 PIPE COVERING PROTECTION SADDLES

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]) cellular glass. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

2.9 ADHESIVE, MASTIC, CEMENT

- A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.
- E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.
- F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
- G. Other: Insulation manufacturers' published recommendations.

2.10 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with tin-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching monel or stainless steel.
- C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- D. Bands: 20 mm (3/4 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.11 REINFORCEMENT AND FINISHES

- A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.

- D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.
- E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.
- F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.12 FIRESTOPPING MATERIAL

- A. Other than pipe and duct insulation, refer to Section 07 84 00 FIRESTOPPING.

2.13 FLAME AND SMOKE

- A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM E84 standards.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the COTR prior to application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and

exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

- D. Install vapor stops at all insulation terminations on both sides of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- E. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- F. HVAC work not to be insulated:
 - 1. Internally insulated ductwork and air handling units.
 - 2. Relief air ducts (Economizer cycle exhaust air).
 - 3. Exhaust air ducts and plenums, and ventilation exhaust air shafts.
 - 4. Equipment: Expansion tanks and hot water pumps.
 - 5. In hot piping: Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.
- G. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- H. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- I. Firestop Pipe and Duct insulation:
 - 1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
 - 2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
 - a. Pipe risers through floors
 - b. Pipe or duct chase walls and floors
 - c. Smoke partitions

- d. Fire partitions
- J. Provide metal jackets over insulation as follows:
 - 1. Piping exposed in building, within 1800 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.
 - 2. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

A. Mineral Fiber Board:

- 1. Faced board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
- 2. Plain board:
 - a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9 inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
- 3. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics, and duct work exposed to outdoor weather:
 - a. 40 mm (1-1/2 inch) thick insulation faced with ASJ (white all service jacket): Supply air duct and after filter housing.
 - b. 25 mm (1 inch) thick insulation faced with ASJ: Return air duct, mixed air plenums and prefilter housing.
 - c. Outside air intake ducts: 25 mm (one inch) thick insulation faced with ASJ.
 - b. Reheat coil casing and separation chambers on steam humidifiers located above ceilings.

B. Flexible Mineral Fiber Blanket:

1. Adhere insulation to metal with 100 mm (4 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.
2. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To prevent condensation insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.
3. Concealed supply air ductwork.
 - a. Above ceilings at a roof level: 50 mm (2 inch) thick insulation faced with FSK.
 - b. Above ceilings for other than roof level: 40 mm (1 ½ inch) thick insulation faced with FSK.
4. Concealed return air duct above ceilings at a roof level, unconditioned areas, and in chases with external wall; 40 mm (1-1/2 inch) thick, insulation faced with FSK. Concealed return air ductwork in other locations need not be insulated.
5. Return air duct in interstitial spaces: 40 mm (1-1/2 inch thick insulation faced with FSK.
6. Concealed outside air duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.

C. Molded Mineral Fiber Pipe and Tubing Covering:

1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of

- vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
2. Contractor's options for fitting, flange and valve insulation:
- a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
 - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
 - c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
 - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
3. Nominal thickness in millimeters and inches specified in table below, for piping above ground:

Nominal Thickness of Molded Mineral Fiber Insulation		
Nominal Pipe Size, millimeters (inches):	25 (1) & below	32- 75 (1-1/4-3)
a. Domestic hot water supply and return	15 (0.5)	20(0.75)

D. Rigid Cellular Phenolic Foam:

1. Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).
2. Surface burning characteristics shall meet the requirements of 25/50 in accordance with ASTM E84.
3. Provide secure attachment facilities such as welding pins.
4. Apply insulation with joints tightly drawn together
5. Apply adhesives, coverings, neatly finished at fittings, and valves.
6. Final installation shall be smooth, tight, neatly finished at all edges.
7. Minimum thickness in millimeters (inches) specified in table below, for piping above ground:

Nominal Thickness of Rigid Closed-Cell Phenolic Foam Insulation			
Nominal Pipe Size millimeters (inches):	25 (1) & below	32-75 (1 1/4-3)	100-150 (4-6)
1. 4-16 degrees C (40-60 degrees F), CH, CHR, GC, and GCR.	20 (0.75)	20 (0.75)	25 (1)
1. 10 degrees C (50 degrees F) and less, RS for DX refrigerants.	15 (0.5)	20 (0.75)	--
2. Domestic hot water supply and return.	15 (0.5)	15 (0.5)	20 (0.75)

8. Condensation control insulation: Minimum 20 mm (0.75 inch) thick for all pipe sizes.
 - a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.

E. Cellular Glass Insulation:

1. Pipe and tubing, covering nominal thickness in millimeters and inches as tabulated below for chilled water piping.

Nominal Thickness of Cellular Glass Insulation		
Millimeters (inches)	Thru 38 (1 1/2)	50- 150 (2-6)
1. 4-16 degrees C (40-60 degrees F) (CH and CHR pipe chase and underground)	50 (2.0)	80 (3.0)
2. 4-16 degrees C (40-60 degrees F) (CH and CHR)	40 (1.5)	50 (2.0)

F. Polyisocyanurate Closed-Cell Rigid Insulation:

1. Polyisocyanurate closed-cell rigid insulation (PIR) may be provided for piping, equipment and ductwork for temperature up to 149 degree C (300 degree F) provided insulation thickness requirement does not exceed 38 mm (1.5 inches).
2. Install insulation, vapor retarder and jacketing per manufacturer's recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder integrity.
3. Install insulation with all joints tightly butted (except expansion joints in hot applications).
4. If insulation thickness exceeds 63 mm (2.5 inches), install as a double layer system with longitudinal (lap) and butt joint staggering as recommended by manufacturer.
5. For cold applications, vapor retarder shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall be used to attach the vapor retarder or jacketing. No wire ties capable of penetrating the vapor retarder shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.
6. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill PVC elbow jacket is prohibited on cold applications.

7. For cold applications, the vapor retarder on elbows/fittings shall be either mastic-fabric-mastic or 2 mil thick PVDC vapor retarder adhesive tape.
8. All PVC and metal jacketing shall be installed so as to naturally shed water. Joints shall point down and shall be sealed with either adhesive or caulking (except for periodic slip joints).
9. Surface burning characteristics shall meet the requirements of 25/50 in accordance with ASTM E84.
10. Minimum thickness in millimeter (inches) specified in table below, for piping:

Nominal Thickness of Polyisocyanurate Rigid Insulation		
Nominal Pipe Size	25(1)	32-75
millimeters(inches):	& below	(1 1/4-3)
1. 4-16 degrees C (40-60 degrees F), CH, CHR, GC and GCR for relative humidity up to 80 percent or underground location	25 (1.00)	25 (1.0)

11. Condensation control insulation: Minimum 20 mm (0.75 inch) thick for all pipe sizes.
 - a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.

- - - E N D - - -

SECTION 23 08 00

COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the HVAC systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.
- C. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance

personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following HVAC systems will be commissioned:

1. Air Handling Systems (including terminal units and energy recovery units)
2. Air Handling Systems (Fans, motors, Variable Speed Drives, cooling coils and control valves, heating coils and control valves, filters, dampers, safeties such as smoke detectors and freezestats, damper end switches, controls, gages, and vibration isolation).
3. Exhaust Fans (Fan, motor, Variable Speed Drives, controls and safeties).
4. Steam System (Controls, gages and instrumentation, safety relief valves).
5. Direct Digital Control System (BACnet or similar Local Area Network (LAN), Operator Work Station hardware and software, building controller hardware and software, terminal unit controller hardware and software, all sequences of operation, system accuracy and response time).
6. Room Pressurization Equipment (Pressure sensors, terminal units/dampers, and controls and alarms).
7. Commercial Kitchen Hoods & Associated Fire Suppression Systems (Fans, motors, Variable Speed Drives, automatic shut down on fire suppression discharge, and gas valve operation).

1.6 SUBMITTALS

- A. The commissioning process requires review of all Submittals. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems

Functional Performance Test procedures for review and approval by the COTR. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

----- END -----

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The control system(s) shall be as indicated on the project documents, point list, drawings and described in these specifications. This scope of work shall include a complete and working system including all controls and installation materials, installation labor, commissioning and start-up.
- B. Connect the new work to the existing DDC system manufactured by Automated Logic New system including interface to existing systems and equipment shall operate and function as one complete system including one database of control point objects and global control logic capabilities. Provide color graphic screens for all new systems. Provide trends for all physical points. Trend sampling rates shall be initially set to one sample every 15 minutes. The local controller shall store a minimum of 3 days worth of trends. All trends shall also be stored in the existing Automated Logic server.
- C. The Controls Subcontractor shall supply as required, all necessary hardware equipment and software packages to interface between any existing and new system Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices, hardware and software points provided.
- D. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. Controls Subcontractor shall provide controllers for each mechanical system.
- E. The Top End of the NAC shall communicate using American Society of Heating and Refrigerating Engineers/American National Standards Institute (ASHRAE/ANSI) Standard 135 protocol and shall be UL tested, certified and labeled. The NAC shall reside on the Ethernet local area network, and provide information via standard object types and application services. The Bottom End of the NAC, the unit level controllers and all other field devices shall reside on the network, and provide data using standard network variable types and configuration properties.

F. The intent of this specification is to provide a peer-to peer networked, stand-alone, distributed control system.

1. Power wiring shall not be run in conduit with communications trunk wiring or signal or control wiring operating at 100 volts or less.

1.2 RELATED WORK

- A. Section 28 31 00, FIRE DETECTION AND ALARM.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC
- C. Section 23 81 00, UNITARY HVAC EQUIPMENT
- F. Section 23 21 13, HYDRONIC PIPING
- G. Section 23 36 00, AIR TERMINAL UNITS.
- I. Section 23 31 00, HVAC DUCTS AND CASINGS.
- J. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- K. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- L. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- M. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- N. Section 26 27 26, WIRING DEVICES.

1.3 DEFINITION

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem; A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.
- B. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc.
- C. BAC: Building Automation Control.
- D. Baud: It is a signal change in a communication link. One signal change can represent one or more bits of information depending on type of transmission scheme. Simple peripheral communication is normally one bit per Baud. (e.g., Baud rate = 78,000 Baud/sec is 78,000 bits/sec, if one signal change = 1 bit).
- E. Binary: A two-state system where a high signal level represents an "ON" condition and an "OFF" condition is represented by a low signal level.
- F. BMP or bmp: Suffix, computerized image file, used after the period in a DOS-based computer file to show that the file is an image stored as a series of pixels.
- G. Bus Topology: A network topology that physically interconnects workstations and network devices in parallel on a network segment.

- H. Control Unit (CU): Generic term for any controlling unit, stand-alone, microprocessor based, digital controller residing on secondary LAN or Primary LAN, used for local controls or global controls.
- I. Deadband: A temperature range over which no heating or cooling is supplied, i.e., 22-25 degrees C (72-78 degrees F), as opposed to a single point change over or overlap).
- J. Diagnostic Program: A software test program, which is used to detect and report system or peripheral malfunctions and failures. Generally, this system is performed at the initial startup of the system.
- K. Direct Digital Control (DDC): Microprocessor based control including Analog/Digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices in order to achieve a set of predefined conditions.
- L. Download: The electronic transfer of programs and data files from a central computer or operation workstation with secondary memory devices to remote computers in a network (distributed) system.
- M. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.
- N. Electrical Control: A control circuit that operates on line or low voltage and uses a mechanical means, such as a temperature sensitive bimetal or bellows, to perform control functions, such as actuating a switch or positioning a potentiometer.
- O. Electronic Control: A control circuit that operates on low voltage and uses a solid-state components to amplify input signals and perform control functions, such as operating a relay or providing an output signal to position an actuator.
- P. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.
- Q. Firmware: Firmware is software programmed into read only memory (ROM) chips. Software may not be changed without physically altering the chip.
- R. FTT-10: Echelon Transmitter-Free Topology Transceiver.
- S. GIF: Abbreviation of Graphic interchange format.

- T. Graphic Program (GP): Program used to produce images of air handler systems, fans, chillers, pumps, and building spaces. These images can be animated and/or color-coded to indicate operation of the equipment.
- U. Graphic Sequence of Operation: It is a graphical representation of the sequence of operation, showing all inputs and output logical blocks.
- V. I/O Unit: The section of a digital control system through which information is received and transmitted. I/O refers to analog input (AI, digital input (DI), analog output (AO) and digital output (DO). Analog signals are continuous and represent temperature, pressure, flow rate etc, whereas digital signals convert electronic signals to digital pulses (values), represent motor status, filter status, on-off equipment etc.
- W. IP: Internet Protocol global network, connecting workstations and other host computers, servers etc. to share the information.
- X. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.
- Y. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.
- Z. Network: A set of computers or other digital devices communicating with each other over a medium such as wire, coax, fiber optics cable etc.
- AA. Network Area Controller: Digital controller, supports a family of unitary control units, and communicates with peer-to-peer network for transmission of global data.
- BB. MS/TP: Master-slave/token-passing.
- CC. Operating system (OS): Software, which controls the execution of computer application programs.
- DD. PCX: File type for an image file. When photographs are scanned onto a personal computer they can be saved as PCX files and viewed or changed by a special application program as Photo Shop.
- EE. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.
- FF. Peer-to-Peer: A networking architecture that treats all network stations as equal partners.
- GG. PICS: Protocol Implementation Conformance Statement.

HH. UCU: Unitary Control Unit, digital controller, dedicated to a specific piece of equipment, such as: air handling unit, heat pump, chiller, heat exchanger etc.

1.4 QUALITY ASSURANCE

A. Criteria:

1. The Controls Subcontractor shall be a primary equipment manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Facility Management Systems of similar size, scope and complexity to the extent specified in this Contract. Distributors, manufacturer's representatives and wholesalers will not be acceptable.
2. Single Source Responsibility of subcontractor: The Controls Subcontractor shall obtain hardware and software supplied under this Section and delegates the responsibility to a single source controls installation subcontractor. The Controls Subcontractor shall be responsible for the complete design, installation, and commissioning of the system. The controls subcontractor shall be in the business of design, installation and service of such building automation control systems similar in size and complexity.
3. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

B. Codes and Standards:

1. All work shall conform to the applicable Codes and Standards.
2. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.
3. Peer-to-peer controllers, unitary controllers shall conform to the requirements of UL 916, Category PAZX.
4. UL508A for auxiliary fabricated control panels.
5. All controllers provided must be UL tested and labeled.
6. System provided to comply to ASHRAE-135 and shall be UL tested, certified and labeled.

1.5 PERFORMANCE

A. The system shall conform to the following:

1. Graphic Display: The system shall display up to 4 graphics on a single screen with a minimum of (20) dynamic points per graphic. All current data shall be displayed within (10) seconds of the request.
2. Graphic Refresh: The system shall update all dynamic points with current data within (10) seconds. Data refresh shall be automatic, without operator intervention.
3. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be (10) seconds. Analog objects shall start to adjust within (3) seconds.
4. Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or work-station will be current, within the prior (10) seconds.
5. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed (10) seconds.
6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every (5) seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every five (5) seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Reporting Accuracy: Listed below are minimum acceptable reporting accuracies for all values reported by the specified system:

Measured Variable	Reported Accuracy
Space temperature	±0.5 degrees C (±1 degrees F)
Ducted air temperature	±1.0 degrees C [±2 degrees F]
Outdoor air temperature	±1.0 degrees C [±2 degrees F]
Water temperature	±0.5 degrees C [±1 degrees F]

Relative humidity	±2 percent RH
Water flow	±5 percent of full scale
Air flow (terminal)	±10 percent of reading
Air flow (measuring stations)	±5 percent of reading
Air pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air pressure (space)	±3 Pa [±0.001 "W.G.]
Water pressure	±2 percent of full scale *Note 1
Electrical Power	5 percent of reading
CO Carbon Monoxide	±10 percent of reading 0-300 ppm
CO2 Carbon Dioxide	±50 ppm or 3% of reading

Note 1: for both absolute and differential pressure

1.7 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's literature and data for all components including the following:
 1. A wiring diagram for each type of input device and output device including DDC controllers, modems, repeaters, etc. Diagram shall show how the device is wired and powered, showing typical connections at the digital controllers and each power supply, as well as the device itself. Show for all field connected devices, including but not limited to, control relays, motor starters, electric or electronic actuators, and temperature pressure, flow and humidity sensors and transmitters.
 2. A diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.
 3. Control dampers and control valves schedule, including the size and pressure drop.
 4. Installation instructions for smoke dampers and combination smoke/fire dampers, if furnished.
 5. Catalog cut sheets of all equipment used. This includes, but is not limited to DDC controllers, panels, peripherals, airflow measuring

stations and associated components, and auxiliary control devices such as sensors, actuators, and control dampers. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted. Each submitted piece of literature and drawings should clearly reference the specification and/or drawings that it supposed to represent and shall be provided in both hardcopy and electronic formats.

6. Provide sequence of operations for each HVAC system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
7. Color prints of proposed graphics with a list of points for display.
8. Furnish PICS (protocol implementation conformance statement) for each device.

C. Product Certificates: Compliance with Article, QUALITY ASSURANCE.

D. As Built Control Drawings:

1. Furnish three (3) copies of as-built drawings for each control system. The documents shall be submitted for approval prior to final completion.
2. Furnish one (1) CD-ROM in PDF format for the drawings noted in subparagraphs above.

1.8 INSTRUCTIONS

- A. Instructions to VA operations personnel: Perform in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS, and as noted below.
- B. Provide sixteen (16) hours of onsite instruction. Instruction shall include operation and trouble shooting of the systems installed under this project.

1.9 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)

- A. The CUs and associated equipment used in controlled environment shall be mounted in NEMA 1 enclosures for operation at 0 to 50 degrees C (32 to 122 degrees F) at a relative humidity of 10 to 90 percent non-condensing.
- C. All electronic equipment shall operate properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.

- D. Sensors and controlling devices shall be designed to operate in the environment, which they are sensing or controlling.

1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
Standard 135-04Building Automation and Control Networks
- C. Federal Communication Commission (FCC):
Rules and Regulations Title 47 Chapter 1-2001 Part 15, Radio Frequency Devices.
- D. Institute of Electrical and Electronic Engineers (IEEE):
802.3-05Information Technology-Telecommunications and Information Exchange between Systems-Local and Metropolitan Area Networks- Specific Requirements-Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access method and Physical Layer Specifications
- E. National Fire Protection Association (NFPA):
70-08National Electric Code
90A-09Standard for Installation of Air-Conditioning and Ventilation Systems
- F. Underwriter Laboratories Inc (UL):
94Tests for Flammability of Plastic Materials for Parts and Devices and Appliances
294Access Control System Units
486A/486BWire Connectors
555SStandard for Smoke Dampers
916Energy Management Equipment
1076Proprietary Burglar Alarm Units and Systems
508AIndustrial Control Panels

PART 2 - PRODUCTS

2.1 CONTROLS SYSTEM ARCHITECTURE

- A. General

1. The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.
 2. Provide licenses for all software residing on and used by the Controls Systems and transfer these licenses to the Owner prior to completion.
- B. The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards and to meet all requirements of the Contract Documents.
- C. Network Architecture
1. The Controls Systems Application network shall utilize an open architecture capable of each and all of the following:
 - a. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec.
 - b. Connecting via Ethernet with ANSI/ASHRAE Standard 135.
 2. The networks shall utilize only copper and optical fiber communication media as appropriate and shall comply with applicable codes, ordinances and regulations. They may also utilize digital wireless technologies if required by the VA.
 3. All necessary telephone lines, and internet Service Provider services and connections will be provided by the owner.
- D. Third Party Interfaces:
1. The Controls Systems shall include necessary hardware, equipment and software to allow data communications between the Controls Systems and building systems supplied by other trades.
 2. The other manufacturers and contractors supplying other associated systems and equipment will provide their necessary hardware, software and start-up at their cost and will cooperate fully with the Controls Contractor in a timely manner and at their cost to ensure complete functional integration.

2.2 DIRECT DIGITAL CONTROLLERS

- A. (NAC) Network Area Controllers shall be stand-alone, multi-tasking, multi-user, real-time digital processor complete with all hardware, software, and communications interfaces, power supplies. The Controls System shall be designed and implemented entirely for use and operation

on the Internet. NACs shall have access to data within the industry standard IT network to the Data Server and other NACs as needed to accomplish required global control strategies.

1. NACs shall provide both standalone and networked direct digital control of mechanical and electrical building system controllers as required by the Specifications. The primary NAC shall support a minimum of 5,000 field points together with all associated features, sequences, schedules, applications required for a fully functional distributed processing operation.
2. NACs shall monitor and report communication status to the Controls Systems Application. The Controls Systems shall provide a system advisory upon communication failure and restoration.
3. The controllers shall reside on the Ethernet (ISO 8802-3) local area network and provide Read (Initiate) and Write (Execute) services as defined in Clauses 15.5 and 15.8, respectively of ASHRAE Standard 135. Objects supported shall include: Analog input, analog output, analog value, binary input, binary output, binary value, and device.
5. NAC shall be provided with the necessary un-interruptible power facilities to ensure its continued normal operation during periods of line power outages of, at minimum, 1-minute duration. Normal functionality shall include all normal software processing, communication with powered field devices and network communications with other powered Controls Systems NAC, Data Servers and OWS. Each NAC shall report its communication status to the Application. The Application shall provide a system advisory upon communication failure and restoration. Each NAC shall retain program, control algorithms, and setpoint information in non-volatile memory in the event of a power failure, and shall return to normal operation upon restoration of power.
6. NAC shall support firmware upgrades without the need to replace hardware and shall have a minimum of 15 percent spare capacity of secondary system controllers, point capacity and programming functions.
7. NAC shall continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any

- detected component failures, low battery condition; and upon failure shall assume the predetermined failure mode.
8. NAC shall monitor the status of all overrides and inform the operator that automatic control has inhibited, and allow the operator to manually override automatic or centrally executed command.
 9. Provide the capability to generate and modify the Controls Systems Application software-based sequences, database elements, associated operational definition information and user-required revisions to same at any designated Workstation together with the means to download same to the associated System Controllers.
- B. Unitary Control Units (UCUs) shall be microprocessor-based. They shall be capable of stand-alone operation, continuing to provide stable control functions if communication is lost with the rest of the system.
1. Unitary Control Units shall either reside on the network or provide data using Ethernet standard network variable types and configuration properties.
 2. Each UCU shall have sufficient memory to support its own operating system, including data sharing.
 3. In the event of loss of normal power, there shall be orderly shut down of the controllers to prevent the loss of database or software programming. When power is restored flash memory, battery backup or super capacitor will be automatically loaded into non-volatile flash memory and shall be incorporated for all programming data.
 4. Unitary Controllers shall be mounted in a dust proof box with Plexiglas removable cover.
- C. Provide I/O module that connects sensors and actuators onto the field bus network for use by the direct digital controllers. I/O devices shall support the communication technology specified for each controller.
1. Analog input shall allow the monitoring of low voltage (0-10 VDC), current (4-20 ma), or resistance signals (thermistor, RTD). Analog input shall be compatible with, and field configurable to commonly available sensing devices. Analog output shall provide a modulating signal for these control devices.

2. Binary inputs shall allow the monitoring of on/off signals from remote devices. Binary inputs shall provide a wetting current of at least 12 milliamps to be compatible with commonly available control devices. Binary outputs shall provide on/off operation, or a pulsed low voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.
3. Binary outputs on remote and auxiliary controllers shall have 3-position (on/off/auto) override switches and status lights. Analog outputs on remote and auxiliary controllers shall have status lights and a 2-position (auto/manual) switch and manually adjustable potentiometer for manual override.
4. Each output point shall be provided with a light emitting diode (LED) to indicate status of outputs.

D. Communication Ports:

1. NACs controllers in the DDC systems shall be connected in a system local area network using protocol defined by ASHRAE Standard 135.
2. The control supplier shall provide connectors, repeaters, hubs, and routers necessary for inter-network communication.

E. Diagnostic Devices (DD):

1. Touch screen computer shall be a device connected via Ethernet to the network and shall contain necessary software capable of accessing all system data. This device may be connected to any point on the system network for programming, set-up, and troubleshooting.
2. Touch screen computer shall contain as a minimum:
 - a. 32-bit Processor
 - b. 245MB, 100 MHz RAM
 - c. Real time clock
 - d. Super capacitor for 72-hour backup
 - e. Touch screen LCD with minimum 7 inch diagonal display
 - f. High resolution 800x 480, 16 bit color
 - g. Two speakers

2.3 DIRECT DIGITAL CONTROLLER SOFTWARE

- A. The software programs specified in this section shall be commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS or Microsoft Windows.

- B. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the operator workstation.
- C. All control functions shall execute within the stand-alone control units via DDC algorithms.
- D. All CU's shall be capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Default values shall be invoked upon sensor failure or, if the primary value is normally provided by the central or another CU, or by loss of bus communication. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors.
- E. All DDC control loops shall be able to utilize any of the following control modes:
 - 1. Two position (on-off, slow-fast) control.
 - 2. Proportional control.
 - 3. Proportional plus integral (PI) control.
 - 4. Proportional plus integral plus derivative (PID) control. All PID programs shall automatically invoke integral wind up prevention routines whenever the controlled unit is off, under manual control of an automation system or time initiated program.
 - 5. Automatic tuning of control loops.
- F. System Security: Operator access shall be secured using individual password and operator's name. Passwords shall restrict the operator to the level of object, applications, and system functions assigned to him. A minimum of six (6) levels of security for operator access shall be provided.
- G. Application Software: The CUs shall provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. All application software shall reside and run in the system digital controllers.
 - 1. Power Demand Limiting (PDL): Power demand limiting program shall monitor the building power consumption and limit the consumption of electricity to prevent peak demand charges. PDL shall continuously track the electricity consumption from a pulse input generated at the kilowatt-hour/demand electric meter. PDL shall sample the meter data to continuously forecast the electric demand likely to be used

- during successive time intervals. If the forecast demand indicates that electricity usage will likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads. Once the demand load has met, loads that have been shed shall be restored and returned to normal mode. Control system shall be capable of demand limiting by resetting the HVAC system set points to reduce load while maintaining indoor air quality.
2. Economizer: An economizer program shall be provided for VAV systems. This program shall control the position of air handler relief, return, and outdoors dampers. If the outdoor air dry bulb temperature and humidity fall below changeover set point the energy control center will modulate the dampers to provide 100 percent outdoor air. The operator shall be able to override the economizer cycle and return to minimum outdoor air operation at any time.
 3. Night Setback/Morning Warm up Control: The system shall provide the ability to automatically adjust set points for this mode of operation.
 4. Optimum Start/Stop (OSS): Optimum start/stop program shall automatically be coordinated with event scheduling. The OSS program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by the time of occupancy, and it shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period and still maintain desired comfort conditions. The OSS program shall consider both outside weather conditions and inside zone conditions. The program shall automatically assign longer lead times for weekend and holiday shutdowns. The program shall poll all zones served by the associated air handling unit and shall select the warmest and coolest zones. These shall be used in the start time calculation. It shall be possible to assign occupancy start times on a per air handler unit basis. The program shall meet the local code requirements for minimum outdoor air while the building is occupied.
 5. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or a group of points according to a stored time. This program shall provide the capability to individually command a point or group of points. When

- points are assigned to one common load group it shall be possible to assign variable time advances/delays between each successive start or stop within that group. Scheduling shall be calendar based and advance schedules may be defined up to one year in advance. Advance schedule shall override the day-to-day schedule. The operator shall be able to define the following information:
- a. Time, day.
 - b. Commands such as on, off, auto.
 - c. Time delays between successive commands.
 - d. Manual overriding of each schedule.
 - e. Allow operator intervention.
6. Alarm Reporting: The system shall be able to start programs, log the event, and display the messages.
7. Remote Communications: The system shall have the ability to dial out and broadcast on the internet via email in the event of an alarm. The operator shall be able to remotely access and operate the system using dial up communications or a web browser using the internet. Remote access shall allow the operator to function the same as local access.
8. Maintenance Management (PM): The system shall monitor equipment status and generate maintenance messages based upon the operators defined equipment run time, starts, and/or calendar date limits. A preventative maintenance alarm shall be displayed indicating maintenance requirements based on pre-defined run time. Each preventive message shall include point description, limit criteria and preventative maintenance instruction assigned to that limit. A minimum of 480-character PM shall be provided for each component of units such as air handling units.

2.4 SENSORS (AIR AND WATER)

A. Temperature and Humidity Sensors:

1. Electronic Sensors: Provide all remote sensors as required for the systems. All sensors shall be vibration and corrosion resistant for wall, immersion, and/or duct mounting.
 - a. Temperature Sensors: Thermistor type for terminal units and Resistance Temperature Device (RTD) with an integral transmitter type for all other sensors.

- 1) Duct sensors shall be rigid or averaging type as shown on drawings. Averaging sensor shall be a minimum of 1 linear ft of sensing element for each sq ft of cooling coil face area.
 - 2) Immersion sensors shall be provided with a separable well made of stainless steel, bronze or monel material. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
 - 3) Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings. Match room thermostats, locking cover.
 - 4) Outdoor air temperature sensors shall have watertight inlet fittings and be shielded from direct sunlight.
 - 5) Room security sensors shall have stainless steel cover plate with insulated back and security screws.
 - 6) Wire: Twisted, shielded-pair cable.
 - 7) Output Signal: 4-20 ma.
- b. Humidity Sensors: Bulk polymer sensing element type.
- 1) Duct and room sensors shall have a sensing range of 20 to 80 percent with accuracy of ± 2 to ± 5 percent RH, including hysteresis, linearity, and repeatability.
 - 2) Outdoor humidity sensors shall be furnished with element guard and mounting plate and have a sensing range of 0 to 100 percent RH.
 - 3) 4-20 ma continuous output signal.
- c. Static Pressure Sensors: Non-directional, temperature compensated.
- 1) 4-20 ma output signal.
 - 2) 0 to 5 inches wg for duct static pressure range.
 - 3) 0 to 0.25 inch wg for Building static pressure range.
- B. Water flow sensors:
1. Type: Insertion vortex type with retractable probe assembly and 2 IN full port ball valve.
 - a. Pipe size: 3 to 24 IN.
 - b. Retractor: ASME threaded, non-rising stem type with hand wheel.
 - c. Mounting connection: 2 IN 150 PSI flange.
 - d. Sensor assembly: Design for expected water flow and pipe size.

- e. Seal: Teflon (PTFE).
- 2. Controller:
 - a. Integral to unit.
 - b. Locally display flow rate and total.
 - c. Output flow signal to BMCS: Digital pulse type.
- 3. Performance:
 - a. Accuracy: 1.0% of reading
 - b. Repeatability: 0.15% of reading
 - c. Turndown: 20:1
 - d. Response time: Adjustable from 1 to 100 seconds.
 - e. Power: 24 volt DC
- 4. Manufacturer: Emco V-Bar 910
- 5. Install flow meters according to manufacturer's recommendations.
Where recommended by manufacturer because of mounting conditions,
provide flow rectifier.
- C. Domestic Water Flow Sensors:
 - 1. Sensor shall be insertion turbine type with turbine element,
retractor and preamplifier/transmitter mounted on a two-inch full
port isolation valve; assembly easily removed or installed as a
single unit under line pressure through the isolation valve without
interference with process flow; calibrated scale shall allow precise
positioning of the flow element to the required insertion depth
within plus or minute 1 mm (0.05 inch); wetted parts shall be
constructed of stainless steel. Operating power shall be nominal 24
VDC. Local instantaneous flow indicator shall be LED type in NEMA 4
enclosure with 3-1/2 digit display, for wall or panel mounting.
 - 2. Performance characteristics:
 - a. Ambient conditions: -40 to 60 degrees C (-40 to 140 degrees F), 5
to 100 percent humidity.
 - b. Operating conditions: 850 kPa (125 psig), 0 to 120 degrees C (30
to 250 degrees F), 0.15 to 12 m per second (0.5 to 40 feet per
second) velocity.
 - c. Nominal range (turn down ratio): 10 to 1.
 - d. Overall accuracy plus or minus one percent of reading.
 - e. Repeatability: plus or minus 0.25 percent of reading.

- f. Preamplifier mounted on meter shall provide 4-20 ma divided pulse output or switch closure signal for units of volume or mass per a time base. Signal transmission distance shall be a minimum of 1,800 meters (6,000 feet).
 - g. Pressure Loss: Maximum 1 percent of the line pressure in line sizes above 100 mm (4 inches).
 - h. Ambient temperature effects, less than 0.005 percent calibrated span per degree C (degree F) temperature change.
 - i. RFI effect - flow meter shall not be affected by RFI.
 - j. Power supply effect less than 0.02 percent of span for a variation of plus or minus 10 percent power supply.
- D. Flow switches:
- 1. Shall be either paddle or differential pressure type.
 - a. Paddle-type switches (liquid service only) shall be UL Listed, SPDT snap-acting, adjustable sensitivity with NEMA 4 enclosure.
 - b. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap acting, NEMA 4 enclosure, with scale range and differential suitable for specified application.
- E. Current Switches: Current operated switches shall be self powered, solid state with adjustable trip current as well as status, power, and relay command status LED indication. The switches shall be selected to match the current of the application and output requirements of the DDC systems.

2.6 CONTROL CABLES

- A. As specified in Section 26 05 11, Low-Voltage Electrical Power Conductors and Cables.

2.7 THERMOSTATS

- A. Room thermostats controlling heating and cooling devices shall have three modes of operation (heating - null or dead band - cooling). Wall mounted thermostats shall have polished or brushed aluminum finish, setpoint range and temperature display and external adjustment:
 - 1. Electronic Thermostats: Solid-state, microprocessor based, programmable to daily, weekend, and holiday schedules.
 - a. Public Space Thermostat: Public space thermostat shall be a platinum sensor and shall not have a visible means of set point

adjustment. Adjustment shall be via the digital controller to which it is connected.

- B. Strap-on thermostats shall be enclosed in a dirt-and-moisture proof housing with fixed temperature switching point and single pole, double throw switch.
- C. Freezestats shall have a minimum of 300 mm (one linear foot) of sensing element for each 0.093 square meter (one square foot) of coil area. A freezing condition at any increment of 300 mm (one foot) anywhere along the sensing element shall be sufficient to operate the thermostatic element.
- D. Room Humidistats: Provide fully proportioning humidistat with adjustable throttling range for accuracy of settings and conservation. The humidistat shall have set point scales shown in percent of relative humidity located on the instrument. Systems showing moist/dry or high/low are not acceptable.

2.9 FINAL CONTROL ELEMENTS AND OPERATORS

- A. Fail Safe Operation: Control valves and dampers shall provide "fail safe" operation in either the normally open or normally closed position as required for freeze, moisture, and smoke or fire protection.
- B. Spring Ranges: Range as required for system sequencing and to provide tight shut-off.
- C. Power Operated Control Dampers (other than VAV Boxes): Factory fabricated, balanced type dampers. All modulating dampers shall be opposed blade type and gasketed. Blades for two-position, duct-mounted dampers shall be parallel, airfoil (streamlined) type for minimum noise generation and pressure drop.
 - 1. Leakage: maximum leakage in closed position shall not exceed 7 L/S (15 CFMs) differential pressure for outside air and exhaust dampers and 200 L/S/ square meter (40 CFM/sq. ft.) at 50 mm (2 inches) differential pressure for other dampers.
 - 2. Frame shall be galvanized steel channel with seals as required to meet leakage criteria.
 - 3. Blades shall be galvanized steel or aluminum, 200 mm (8 inch) maximum width, with edges sealed as required.
 - 4. Bearing shall be nylon, bronze sleeve or ball type.

5. Hardware shall be zinc-plated steel. Connected rods and linkage shall be non-slip. Working parts of joints shall be brass, bronze, nylon or stainless steel.
- D. Actuators shall be electronic type operating as required for proper operation.
 1. See drawings for required control operation.
 2. Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel.
 3. Maximum air velocity and pressure drop through free area the dampers:
 - b. Duct mounted damper; 600 meter per minute (2000 fpm).
 - c. Maximum static pressure loss, 50 Pascal (0.20 inches water gage).
- E. Smoke Dampers and Combination Fire/Smoke Dampers: Dampers and actuators are specified in Section 23 31 00, HVAC DUCTS AND CASINGS. Control of these dampers is specified under this Section.
- F. Control Valves:
 1. Valves shall be rated for a minimum of 150 percent of system operating pressure at the valve location but not less than 900 kPa (125 psig).
 2. Valves 50 mm (2 inches) and smaller shall be bronze body with threaded or flare connections.
 3. Valves 60 mm (2 1/2 inches) and larger shall be bronze or iron body with flanged connections.
 4. Brass or bronze seats except for valves controlling media above 100 degrees C (210 degrees F), which shall have stainless steel seats.
 5. Flow characteristics:
 - a. Three way valves shall have a linear relation or equal percentage relation of flow versus valve position.
 - b. Two-way valves position versus flow relation shall be equal percentage for water flow control.
 6. Maximum pressure drop:
 - a. Modulating water flow control, greater of 3 meters (10 feet) of water or the pressure drop through the apparatus.
 - b. Two position water valves shall be line size.

G. Damper and Valve Operators and Relays:

1. Electric damper actuator shall provide full modulating control of dampers. A linkage and pushrod shall be furnished for mounting the actuator on the damper frame internally in the duct or externally in the duct or externally on the duct wall, or shall be furnished with a direct-coupled design.
2. Electronic damper actuators: VAV Box actuator shall be mounted on the damper axle or shall be of the air valve design, and shall provide complete modulating control of the damper. The actuator shall have a closure torque of 35-inch pounds minimum with full torque applied at close off to attain minimum leakage.

2.11 AIR FLOW CONTROL

A. Airflow and static pressure shall be controlled via digital controller (CUs) with inputs from airflow control measuring stations and static pressure inputs as specified. Controller outputs shall be true analog output signals to variable frequency drives. Pulse width modulation outputs are not acceptable. The CUs shall include the capability to control via simple proportional (P) control, proportional plus integral (PI), proportional plus integral plus derivative (PID), and on-off. The airflow control programs shall be factory-tested programs that are documented in the literature of the control manufacturer.

C. Static Pressure Measuring Station:

1. Static Pressure Control:

- a. Systems shall consist of one or more static pressure sensors and transmitters along with relays or auxiliary devices as required for a complete functional system. The span of the transmitter shall not exceed two times the design static pressure at the point of measurement. The output of the transmitter shall be true representation of the input pressure with plus or minus 25 Pascal (0.1 inch) W.G. of the true input pressure.

- 1) Static pressure sensors shall have the same requirements as Airflow Measuring Devices except that total pressure sensors are optional.

D. Constant Volume Control:

1. Systems shall consist of an air flow measuring station along with such relays and auxiliary devices as required to produce a complete

functional system. The transmitter shall receive its air flow signal and static pressure signal from the flow measuring station and shall have a span not exceeding three times the design flow rate. The CU shall receive the transmitter signal and shall provide an output to the fan volume control device to maintain a constant flow rate. The CU shall provide proportional plus integral (PI) (automatic reset) control mode and where required also inverse derivative mode. Overall system accuracy shall be plus or minus the equivalent of 2 Pascal (0.008 inch) velocity pressure as measured by the flow station.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Examine project plans for control devices and equipment locations; and report any discrepancies, conflicts, or omissions to RE/COTR for resolution before proceeding for installation.
2. Work Coordination: Section 00 72 00, GENERAL CONDITIONS.
3. Install equipment, piping, wiring /conduit parallel to or at right angles to building lines.
4. Install all equipment and piping in readily accessible locations. Do not run tubing and conduit concealed under insulation or inside ducts.
5. Mount control devices, tubing and conduit located on ducts and apparatus with external insulation on standoff support to avoid interference with insulation.
6. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
7. Run tubing and wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing.
8. Install equipment level and plum.

C. Electrical Wiring Installation:

1. Install conduits and wiring in accordance with Specification Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

2. Install signal and communication cables in accordance with Specification Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
3. Install conduit and wiring between operator workstation(s), digital controllers, electrical panels, indicating devices, instrumentation, miscellaneous alarm points, thermostats, and relays as shown on the drawings or as required under this section. All wiring shall be installed in conduits.
4. Install all electrical work required for a fully functional system and not shown on electrical plans or required by electrical specifications. Where low voltage power is required, provide suitable transformers.
5. Install all system components in accordance with local Building Code and National Electric Code.
 - a. Splices: Splices in shielded and coaxial cables shall consist of terminations and the use of shielded cable couplers. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties.
 - b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 300 mm (12 inches) long. Equipment for fiber optics system shall be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables shall be supported for minimum sag.
 - c. Cable Runs: Keep cable runs as short as possible. Allow extra length for connecting to the terminal board. Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
 - d. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.
6. Conceal cables, except in mechanical rooms and areas where other conduits and piping are exposed.
7. Permanently label or code each point of all field terminal strips to show the instrument or item served along with the name and address of the point. Color-coded cable with cable diagrams may be used to accomplish cable identification.

8. Grounding: ground electrical systems per manufacturer's written requirements for proper and safe operation.
9. Fabricated control panels built to support auxiliary devices such as power supplies, relays, controllers, and control devices shall be certified to UL508.

D. Install Sensors and Controls:

1. Temperature Sensors:

- a. Install all sensors and instrumentation according to manufacturer's written instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.
- b. Calibrate sensors to accuracy specified, if not factory calibrated.
- c. Use of sensors shall be limited to its duty, e.g., duct sensor shall not be used in lieu of room sensor.
- d. Install room sensors permanently supported on wall frame. They shall be mounted at 1.5 meter (5.0 feet) above the finished floor.
- e. Mount sensors rigidly and adequately for the environment within which the sensor operates.
- f. Sensors used in mixing plenum, and hot and cold decks shall be of the averaging of type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- g. All pipe mounted temperature sensors shall be installed in wells.
- h. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor reading.
- i. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.

2. Pressure Sensors:

- a. Install duct static pressure sensor tips facing directly downstream of airflow.

- b. Install high-pressure side of the differential switch between the pump discharge and the check valve.
- 3. Actuators:
 - a. Mount and link damper and valve actuators according to manufacturer's written instructions.
 - b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed position.
 - c. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.
- 4. Flow Switches:
 - a. Install flow switch according to manufacturer's written instructions.
 - b. Mount flow switch a minimum of 5 pipe diameters up stream and 5 pipe diameters downstream or 600 mm (2 feet) whichever is greater, from fittings and other obstructions.
 - c. Assure correct flow direction and alignment.
 - d. Mount in horizontal piping-flow switch on top of the pipe.
- E. Installation of Network:
 - 1. Ethernet:
 - a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed Ethernet Networks.

3.2 SYSTEM DEMONSTRATION

A. DEMONSTRATION

- 1. System operation and calibration to be demonstrated by the Installer in the presence of the Owner's representative
- 2. Demonstrate to authorities that systems are fully functional and complete.
- 3. Make accessible, personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
- 4. The following witnessed demonstrations of field control equipment shall be included:

- a. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.
 - b. Demonstrate hardware interlocks and safeties functions, and that the control systems perform the correct sequence of operation after power loss and resumption of power loss.
5. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust and operate DDC Controls. Include 16 hours of on site training.

----- END -----

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Water piping to connect HVAC equipment, including the following:
 - 1. Chilled water
 - 2. Hot water
 - 3. Drain piping.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- D. Section 23 07 11, HVAC AND PLUMBING INSULATION: Piping insulation.
- E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Temperature and pressure sensors and valve operators.

1.3 QUALITY ASSURANCE

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.
- B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Pipe and equipment supports.
 - 2. Pipe and tubing, with specification, class or type, and schedule.
 - 3. Pipe fittings, including miscellaneous adapters and special fittings.
 - 4. Flanges, gaskets and bolting.
 - 5. Valves of all types.
 - 6. Strainers.
 - 7. Flexible connectors for water service.

8. Pipe alignment guides.
 9. Expansion joints.
 10. Expansion compensators.
 11. All specified hydronic system components.
 12. Water flow measuring devices.
 13. Gages.
 14. Thermometers and test wells.
- D. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.
- E. As-Built Piping Diagrams: Provide drawing as follows for chilled water, hot water, and other piping systems and equipment.
1. One wall-mounted stick file with complete set of prints.
 2. One complete set of reproducible drawings.
 3. One complete set of drawings in electronic pdf format.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
- B1.20.1-83 (R2006)Pipe Threads, General Purpose (Inch)
 - B16.1-2005Cast Iron Pipe Flanges and Flanged Fittings
 - B16.3-2006Malleable Iron Threaded Fittings
 - B16.4-2006Gray Iron Threaded Fittings Classes 125 and 250
 - B16.5-03Pipe Flanges and Flanged Fittings
 - B16.9-2007Factory-Made Wrought Buttwelding Fittings
 - B16.11-05Forged Fittings, Socket-Welding and Threaded
 - B16.14-91Ferrous Pipe Plugs, Bushings, and Locknuts with
Pipe Threads
 - B16.22-01Wrought Copper and Copper Alloy Solder-Joint
Pressure Fittings
 - B16.23-02Cast Copper Alloy Solder Joint Drainage
Fittings

- B16.24-2006Cast Copper Alloy Pipe Flanges and Flanged
Fittings, Class 150, 300, 400, 600, 900, 1500
and 2500
- B16.39-98Malleable Iron Threaded Pipe Unions, Classes
150, 250, and 300
- B16.42-98Ductile Iron Pipe Flanges and Flanged Fittings:
Classes 150 and 300
- B31.9-2008Building Services Piping
- B40.100-05Pressure Gauges and Gauge Attachments
- C. American National Standards Institute, Inc. (ANSI):
- B16.18-2001Cast Copper Alloy Solder joint Pressure
fittings
- D. American Society for Testing and Materials (ASTM):
- A47/A47M-99 (2004)Ferritic Malleable Iron Castings
- A53/A53M-07Standard Specification for Pipe, Steel, Black
and Hot-Dipped, Zinc-Coated, Welded and
Seamless
- A106/A106M-08Standard Specification for Seamless Carbon
Steel Pipe for High-Temperature Service
- A126-04Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe Fittings
- A181/A181M-06Standard Specification for Carbon Steel
Forgings, for General-Purpose Piping
- A183-03Standard Specification for Carbon Steel Track
Bolts and Nuts
- A216/A216M-08Standard Specification for Steel Castings,
Carbon, Suitable for Fusion Welding, for High
Temperature Service
- A234/A234M-07Piping Fittings of Wrought Carbon Steel and
Alloy Steel for Moderate and High Temperature
Service
- A307-07bStandard Specification for Carbon Steel Bolts
and Studs, 60,000 PSI Tensile Strength
- A536-84 (2004)e1Standard Specification for Ductile Iron
Castings

B32-08Standard Specification for Solder Metal
B61-08Standard Specification for Steam or Valve
Bronze Castings
B62-09Standard Specification for Composition Bronze
or Ounce Metal Castings
B88-05Standard Specification for Seamless Copper
Water Tube
C177-04Standard Test Method for Steady State Heat Flux
Measurements and Thermal Transmission
Properties by Means of the Guarded Hot Plate
Apparatus
C552-07Cellular Glass Thermal Insulation
D 3350-08Polyethylene Plastics Pipe and Fittings
Materials
C591-08aUnfaced Preformed Rigid Cellular
Polyisocyanurate Thermal Insulation
D1784-08Rigid Poly (Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly (Vinyl Chloride) (CPVC)
Compounds
D1785-06Poly (Vinyl Chloride) (PVC) Plastic Pipe,
Schedules 40, 80 and 120
D2241-05Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe
(SDR Series)
D2464-06Threaded Poly (Vinyl Chloride) (PVC) Plastic
Pipe Fittings, Schedule 80.
D3139-98(2005)Joints for Plastic Pressure Pipes Using
Flexible Elastomeric Seals
F439-06Standard Specification for Chlorinated Poly
(Vinyl Chloride) (CPVC) Plastic Pipe Fittings,
Schedule 80
F441/F441M-02(2008)Standard Specification for Chlorinated Poly
(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules
40 and 80
F477-08Elastomeric Seals Gaskets) for Joining Plastic
Pipe

E. American Welding Society (AWS):

A5.8/A5.8M-04Specification for Filler Metals for Brazing and
Braze Welding

B2.1/B2.1M-09Standard Welding Procedure Specification

F. Copper Development Association, Inc. (CDA):

4013-3939; 1993Copper Tube Handbook

G. Expansion Joint Manufacturer's Association, Inc. (EJMA):

EMJA-9th EditionExpansion Joint Manufacturer's Association
Standards, Eighth Edition

H. Manufacturers Standardization Society (MSS) of the Valve and Fitting
Industry, Inc.:

SP-67-2002aButterfly Valves

SP-70-2006Gray Iron Gate Valves, Flanged and Threaded
Ends

SP-71-2005Gray Iron Swing Check Valves, Flanged and
Threaded Ends

SP-72-1999Ball Valves with Flanged or Butt-Welding Ends
for General Service

SP-78-2005aGray Iron Plug Valves Flanged and Threaded Ends

SP-80-2008Bronze Gate, Globe, Angle and Check Valves

SP-85-2002Cast Iron Globe and Angle Valves, Flanged and
Threaded Ends

I. National Fire Protection Association (NFPA):

70-08National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR
HVAC.

2.2 PIPE AND TUBING

A. Chilled Water (above ground), hot water, and Vent Piping:

1. Steel: ASTM A53 Grade B, seamless or ERW, Schedule 40.

2. Copper water tube option: ASTM B88, Type K or L, hard drawn.

C. Cooling Coil Condensate Drain Piping:

From Unitary Equipment: Copper water tube, ASTM B88, Type L.

- D. Pipe supports, including insulation shields, for above ground piping:
Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.3 FITTINGS FOR STEEL PIPE

- A. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Mechanical couplings and fittings are optional for water piping only.
1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
 2. Welding flanges and bolting: ASME B16.5:
 - a. Water service: Weld neck or slip-on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).
 - 1) Contractor's option: Convoluted, cold formed 150 pound steel flanges, with teflon gaskets, may be used for water service.
 - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- B. 50 mm (2 inches) and Smaller: Screwed or welded. Mechanical couplings are optional for water piping only.
1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
 2. Forged steel, socket welding or threaded: ASME B16.11.
 3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
 4. Unions: ASME B16.39.
 5. Water hose connection adapter: Brass, pipe thread to 20 mm (3/4 inch) garden hose thread, with hose cap nut.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.
- D. Mechanical Pipe Couplings and Fittings: May be used, with cut or roll grooved pipe, in water service up to 110 degrees C (230 degrees F) in lieu of welded, screwed or flanged connections.

1. Grooved mechanical couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two or more parts, securely held together by two or more track-head, square, or oval-neck bolts, ASTM A183.
2. Gaskets: Rubber product recommended by the coupling manufacturer for the intended service.
3. Grooved end fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

2.4 FITTINGS FOR COPPER TUBING

A. Solder Joint:

1. Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

2.5 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 99 degrees C (210 degrees F).

2.6 SCREWED JOINTS

- A. Pipe Thread: ANSI B1.20.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.7 VALVES

- A. Asbestos packing is not acceptable.

- B. All valves of the same type shall be products of a single manufacturer. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.
- C. Provide chain operators for valves 100 mm (4 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.
- D. Gate Valves:
1. 50 mm (2 inches) and smaller: MSS-SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
 2. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke.
 - a. MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.
- E. Globe, Angle and Swing Check Valves:
1. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.)
Globe and angle valves shall be union bonnet with metal plug type disc.
 2. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for globe valves and MSS-SP-71 for check valves.
- F. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
1. Body: Cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
 2. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62.
Seats may be elastomer material.
- G. Butterfly Valves: May be used in lieu of gate valves in water service except for direct buried pipe. Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation.
1. MSS-SP 67, flange lug type (for end of line service) or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F).

- a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
- b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
- c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
 - 1) Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
- H. Ball Valves: Brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig) working pressure rating. Screwed or solder connections. Provide stem extension to allow operation without interfering with pipe insulation.
- I. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size and be one of the following types.
 - 1. Butterfly valve as specified herein with memory stop.
 - 2. Eccentric plug valve: Iron body, bronze or nickel-plated iron plug, bronze bearings, adjustable memory stop, operating lever, rated 861 kPa (125 psig) and 121 degrees C (250 degrees F).
- J. Circuit Setter Valve: A dual purpose flow balancing valve and adjustable flow meter, with bronze or cast iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.
- K. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control.

Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:

1. Gray iron (ASTM A126) or brass body rated 1205 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless steel piston and spring.
2. Brass or ferrous body designed for 2067 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.

2.8 WATER FLOW MEASURING DEVICES

- A. Minimum overall accuracy plus or minus three percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.
- B. Flow Measurement/Balance Valves: A system comprised of two valves of bronze and stainless steel metallurgy designed for 1205 kPa (175 psig) pressure at 121 degrees C (250 degrees F), with thermal insulation sleeve.
 1. Measurement and shut-off valve: An on/off ball valve with integral high regain venturi and dual quick connect valves with integral check valves and color coded safety caps for pressure/temperature readout.
- C. Flow Measuring Device Identification:
 1. Metal tag attached by chain to the device.
 2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate in l/m (gpm).

2.9 STRAINERS

- A. Y Type.
 1. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations.
 2. 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.

2.11 EXPANSION JOINTS

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.
- C. Bellows - Internally Pressurized Type:
 - 1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
 - 2. Internal stainless steel sleeve entire length of bellows.
 - 3. External cast iron equalizing rings for services exceeding 340 kPa (50 psig).
 - 4. Welded ends.
 - 5. Design shall conform to standards of EJMA and ASME B31.1.
 - 6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
 - 7. Integral external cover.
- D. Bellows - Externally Pressurized Type:
 - 1. Multiple corrugations of Type 304 stainless steel.
 - 2. Internal and external guide integral with joint.
 - 3. Design for external pressurization of bellows to eliminate squirm.
 - 4. Welded ends.
 - 5. Conform to the standards of EJMA and ASME B31.1.
 - 6. Threaded connection at bottom, 25 mm (one inch) minimum, for drain or drip point.
 - 7. Integral external cover and internal sleeve.
- E. Expansion Compensators:
 - 1. Corrugated bellows, externally pressurized, stainless steel or bronze.
 - 2. Internal guides and anti-torque devices.
 - 3. Threaded ends.
 - 4. External shroud.
 - 5. Conform to standards of EJMA.

- F. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.
- G. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

2.14 GAGES, PRESSURE AND COMPOUND

- A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.
- C. Range of Gages: Provide range equal to at least 130 percent of normal operating range.

2.15 PRESSURE/TEMPERATURE TEST PROVISIONS

Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

2.16 THERMOMETERS

- A. Organic liquid filled type, red or blue column, clear plastic window, with 150 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.
- B. Case: Chrome plated brass or aluminum with enamel finish.
- C. Scale: Not less than 225 mm (9 inches), range as described below, two degree graduations.

- D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
- E. Scale ranges may be slightly greater than shown to meet manufacturer's standard. Required ranges in degrees C (F): Chilled Water, 0 to 38 degrees C (32-100 degrees F)

2.17 FIRESTOPPING MATERIAL

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

3.1 GENERAL

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to unitary equipment, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- D. Install piping parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves

with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- H. Provide manual air vent at all piping system high points and drain valves at all low points.
- I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
 - 1. Water treatment pot feeders.
 - 2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- J. Thermometer Wells: In pipes 65 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.
- K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC AND PLUMBING INSULATION.
- L. Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. Mechanical Joint: Pipe grooving shall be in accordance with joint manufacturer's specifications. Lubricate gasket exterior including

lips, pipe ends and housing interiors to prevent pinching the gasket during installation. Lubricant shall be as recommended by coupling manufacturer.

D. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.

E. Solvent Welded Joints: As recommended by the manufacturer.

3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.

B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.

C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.

D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding packing.

3.5 LEAK TESTING ABOVEGROUND PIPING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the RE/COTR. Tests may be either of those below, or a combination, as approved by the RE/COTR.

B. An operating test at design pressure, and for hot systems, design maximum temperature.

C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.6 FLUSHING AND CLEANING PIPING SYSTEMS

A. Water Piping:

1. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the RE/COTR.

3.9 OPERATING AND PERFORMANCE TEST AND INSTRUCTION

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Adjust red set hand on pressure gages to normal working pressure.

- - - E N D - - -

SECTION 23 22 13
STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Steam, condensate and vent piping inside buildings.

1.2 RELATED WORK

- A. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Piping insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- C. Heating and cooling radiant panels: Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.
- D. Temperature and pressure sensors and valve operators: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

1.3 QUALITY ASSURANCE

Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, which includes welding qualifications.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Pipe and equipment supports.
 - 2. Pipe and tubing, with specification, class or type, and schedule.
 - 3. Pipe fittings, including miscellaneous adapters and special fittings.
 - 4. Flanges, gaskets and bolting.
 - 5. Valves of all types.
 - 6. Strainers.
 - 7. Flexible connectors.
 - 8. Pipe alignment guides.
 - 9. Expansion joints.
 - 10. Expansion compensators.
 - 11. Flexible ball joints: Catalog sheets, performance charts, schematic drawings, specifications and installation instructions.
 - 12. All specified steam system components.
 - 14. Gages.
 - 15. Thermometers and test wells.

- C. Coordination Drawings: Refer to Article, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- D. As-Built Piping Diagrams: Provide drawing as follows for steam and steam condensate piping and other central plant equipment.
1. One wall-mounted stick file for prints. Mount stick file in the chiller plant or adjacent control room along with control diagram stick file.
 2. One set of reproducible drawings.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Institute Standard (ANSI):
- B1.20.1-01Pipe Threads, General Purpose (Inch)
- C. American Society of Mechanical Engineers (ASME):
- B16.1-98Cast Iron Pipe Flanges and Flanged Fittings
- B16.3-98Malleable Iron Threaded Fittings
- B16.4-98Gray Iron Threaded Fittings
- B16.9-01Factory-Made Wrought Buttwelding Fittings
- B16.11-02Forged Fittings, Socket-Welding and Threaded
- B16.14-91Ferrous Pipe Plugs, Bushings, and Locknuts with
Pipe Threads
- B16.22-98Wrought Copper and Copper Alloy Solder-Joint
Pressure Fittings
- B16.23-92Cast Copper Alloy Solder Joint Drainage Fittings
- B16.24-01Cast Copper Alloy Pipe Flanges and Flanged
Fittings, Class 150, 300, 400, 600, 900, 1500
and 2500
- B16.39-98Malleable Iron Threaded Pipe Unions, Classes
150, 250, and 300
- B31.1-01Power Piping
- B31.9-96Building Services Piping
- B40.100-98Pressure Gauges and Gauge Attachments
- Boiler and Pressure Vessel Code: SEC VIII D1-2001, Pressure Vessels,
Division 1
- D. American Society for Testing and Materials (ASTM):
- A47-99Ferritic Malleable Iron Castings

- A53-01Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless
- A106-99Seamless Carbon Steel Pipe for High-Temperature
Service
- A126-01Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe Fittings
- A181-01Carbon Steel Forgings, for General-Purpose
Piping
- A183-98 Carbon Steel Track Bolts and Nuts
- A216-98 Standard Specification for Steel Castings,
Carbon, Suitable for Fusion Welding, for High
Temperature Service
- A285-01 Pressure Vessel Plates, Carbon Steel, Low-and-
Intermediate-Tensile Strength
- A307-00 Carbon Steel Bolts and Studs, 60,000 PSI Tensile
Strength
- A516-01 Pressure Vessel Plates, Carbon Steel, for
Moderate-and- Lower Temperature Service
- A536-99 Standard Specification for Ductile Iron Castings
- B32-00 Solder Metal
- B61-93 Steam or Valve Bronze Castings
- B62-93 Composition Bronze or Ounce Metal Castings
- B88-99 Seamless Copper Water Tube
- F439-01 Socket-Type Chlorinated Poly (Vinyl Chloride)
(CPVC) Plastic Pipe Fittings, Schedule 80
- F441-99 Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic
Pipe, Schedules 40 and 80
- E. American Welding Society (AWS):
- A5.8-92Filler Metals for Brazing and Braze Welding
- B2.1-00Welding Procedure and Performance Qualifications
- F. Manufacturers Standardization Society (MSS) of the Valve and Fitting
Industry, Inc.:
- SP-67-95Butterfly Valves
- SP-70-98Cast Iron Gate Valves, Flanged and Threaded Ends
- SP-71-97Gray Iron Swing Check Valves, Flanged and
Threaded Ends
- SP-72-99Ball Valves with Flanged or Butt-Welding Ends
for General Service

SP-78-98Cast Iron Plug Valves, Flanged and Threaded Ends

SP-80-97Bronze Gate, Globe, Angle and Check Valves

SP-85-94Cast Iron Globe and Angle Valves, Flanged and
Threaded Ends

G. Military Specifications (Mil. Spec.):

MIL-S-901D-1989Shock Tests, H.I. (High Impact) Shipboard
Machinery, Equipment, and Systems

H. National Board of Boiler and Pressure Vessel Inspectors (NB): Relieving
Capacities of Safety Valves and Relief Valves

I. Tubular Exchanger Manufacturers Association: TEMA 18th Edition, 2000

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR
HVAC AND STEAM GENERATION.

2.2 PIPE AND TUBING

A. Steam Piping: Steel, ASTM A53, Grade B, seamless or ERW; A106 Grade B,
Seamless; Schedule 40.

B. Steam Condensate Piping:

1. Concealed above ceiling, in wall or chase: Copper water tube ASTM
B88, Type K, hard drawn.

2. All other locations: Copper water tube ASTM B88, Type K, hard drawn;
or steel, ASTM A53, Grade B, Seamless or ERW, or A106 Grade B
Seamless, Schedule 80.

2.3 FITTINGS FOR STEEL PIPE

A. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Mechanical
couplings and fittings are optional for water piping only.

1. Butt welding fittings: ASME B16.9 with same wall thickness as
connecting piping. Elbows shall be long radius type, unless otherwise
noted.

2. Welding flanges and bolting: ASME B16.5:

a. Steam service: Weld neck or slip-on, raised face, with
non-asbestos gasket. Non-asbestos gasket shall either be stainless
steel spiral wound strip with flexible graphite filler or
compressed inorganic fiber with nitrile binder rated for saturated
and superheated steam service 750 degrees F and 1500 psi.

c. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM
A307, Grade B.

B. 50 mm (2 inches) and Smaller: Screwed or welded.

1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
 2. Forged steel, socket welding or threaded: ASME B16.11.
 3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron, except for steam and steam condensate piping. Provide 300 pound malleable iron, ASME B16.3 for steam and steam condensate piping. Cast iron fittings are piping is not acceptable for steam and steam condensate piping. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
 4. Unions: ASME B16.39.
 5. Steam line drip station and strainer quick-couple blowdown hose connection: Straight through, plug and socket, screw or cam locking type for 15 mm (1/2 inch) ID hose. No integral shut-off is required.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and thredolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.

2.4 FITTINGS FOR COPPER TUBING

- A. Solder Joint:
1. Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
- B. Bronze Flanges and Flanged Fittings: ASME B16.24.

2.5 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 121 degrees C (250 degrees F) for steam condensate and as required for steam service.

2.6 SCREWED JOINTS

- A. Pipe Thread: ANSI B1.20.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.7 VALVES

- A. Asbestos packing is not acceptable.

- B. All valves of the same type shall be products of a single manufacturer. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.
- C. Provide chain operators for valves 100 mm (4 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.
- D. Gate Valves:
1. 50 mm (2 inches) and smaller: MSS-SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
 2. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke.
 - a. High pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, 1034 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel solid disc and seats. Provide factory installed bypass with globe valve on valves 100 mm (4 inches) and larger.
 - b. All other services: MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.
- E. Globe, Angle and Swing Check Valves:
1. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Globe and angle valves shall be union bonnet with metal plug type disc.
 2. 65 mm (2 1/2 inches) and larger:
 - a. Globe valves for high pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, flanged, OS&Y, 1034 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
 - b. All other services: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for globe valves and MSS-SP-71 for check valves.
- F. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
1. Body: Cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
 2. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.

G. Butterfly Valves: May be used in lieu of gate valves in water service except for direct buried pipe. Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation.

1. MSS-SP 67, flange lug type (for end of line service) rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F).

a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.

b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.

c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.

1) Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.

2) Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.

H. Manual Radiator/Convactor Valves: Brass, packless, with position indicator.

2.8 STRAINERS

A. Basket or Y Type. Tee type is acceptable for water service.

B. High Pressure Steam: Rated 1034 kPa (150 psig) saturated steam.

1. 65 mm (2-1/2 inches) and larger: Flanged cast steel or 1723 kPa (250 psig) cast iron.

2. 50 mm (2 inches) and smaller: Iron, ASTM A116 Grade B, or bronze, ASTM B-62 body with screwed connections (250 psig).

3. Mechanical coupled pipe: Ductile iron.

C. All Other Services: Rated 861 kPa (125 psig) saturated steam.

1. 65 mm (2-1/2 inches) and larger: Flanged, iron body.

2. 50 mm (2 inches) and smaller: Cast iron or bronze.

D. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows:

1. 75 mm (3 inches) and smaller: 20 mesh for steam and 1.1 mm (0.045 inch) diameter perforations for liquids.
2. 100 mm (4 inches) and larger: 1.1 mm (0.045) inch diameter perforations for steam and 3.2 mm (0.125 inch) diameter perforations for liquids.

2.9 EXPANSION JOINTS

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Minimum Service Requirements:
 1. Pressure Containment:
 - a. Steam Service 35-200 kPa (5-30 psig): Rated 345 kPa (50 psig) at 148 degrees C (298 degrees F).
 - b. Steam Service 214-850 kPa (31-125 psig): Rated 1025 kPa (150 psig) at 186 degrees C (366 degrees F).
 - c. Steam Service 869-1025 kPa (126-150 psig): Rated 1375 kPa (200 psig) at 194 degrees C (382 degrees F).
 - d. Condensate Service: Rated 690 kPa (100 psig) at 154 degrees C (310 degrees F).
 2. Number of Full Reverse Cycles without failure: Minimum 1000.
 3. Movement: As shown on drawings plus recommended safety factor of manufacturer.
- C. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.
- D. Bellows - Internally Pressurized Type:
 1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
 2. Internal stainless steel sleeve entire length of bellows.
 3. External cast iron equalizing rings for services exceeding 340 kPa (50 psig).
 4. Welded ends.
 5. Design shall conform to standards of EJMA and ASME B31.1.
 6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
 7. Integral external cover.
- E. Bellows - Externally Pressurized Type:

1. Multiple corrugations of Type 304 stainless steel.
 2. Internal and external guide integral with joint.
 3. Design for external pressurization of bellows to eliminate squirm.
 4. Welded ends.
 5. Conform to the standards of EJMA and ASME B31.1.
 6. Threaded connection at bottom, 25 mm (one inch) minimum, for drain or drip point.
 7. Integral external cover and internal sleeve.
- F. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.
- G. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

2.10 FLEXIBLE BALL JOINTS

- A. Design and Fabrication: One piece component construction, fabricated from steel with welded ends, designed for a working steam pressure of 1720 kPa (250 psig) and a temperature of 232 degrees C (450 degrees F). Each joint shall provide for 360 degrees rotation in addition to a minimum angular flexible movement of 30 degrees for sizes 6 mm (1/4 inch) to 150 mm (6 inch) inclusive, and 15 degrees for sizes 65 mm (2-1/2 inches) to 750 mm (30 inches). Joints through 350 mm (14 inches) shall have forged pressure retaining members; while size 400 mm (16 inches) through 760 mm (30 inches) shall be of one piece construction.
- B. Material:
1. Cast or forged steel pressure containing parts and bolting in accordance with Section II of the ASME Boiler Code or ASME B31.1. Retainer may be ductile iron ASTM A536, Grade 65-45-12, or ASME Section II SA 515, Grade 70.
 2. Gaskets: Steam pressure molded composition design for a temperature range of from minus 10 degrees C (50 degrees F) to plus 274 degrees C (525 degrees F).

C. Certificates: Submit qualifications of ball joints in accordance with the following test data:

1. Low pressure leakage test: 41 kPa (6psig) saturated steam for 60 days.
2. Flex cycling: 800 Flex cycles at 3445 kPa (500 psig) saturated steam.
3. Thermal cycling: 100 saturated steam pressure cycles from atmospheric pressure to operating pressure and back to atmospheric pressure.
4. Environmental shock tests: Forward certificate from a recognized test laboratory, that ball joints of the type submitted has passed shock testing in accordance with Mil. Spec MIL-S-901.
5. Vibration: 170 hours on each of three mutually perpendicular axis at 25 to 125 Hz; 1.3 mm to 2.5 mm (0.05 inch to 0.1 inch) double amplitude on a single ball joint and 3 ball joint off set.

2.11 STEAM SYSTEM COMPONENTS

A. Steam Pressure Reducing Valves in PRV Stations:

1. Type: Single-seated, diaphragm operated, spring-loaded, external or internal steam pilot-controlled, normally closed, adjustable set pressure. Pilot shall sense controlled pressure downstream of main valve.
2. Service: Provide controlled reduced pressure to steam piping systems.
3. Pressure control shall be smooth and continuous with maximum drop of 10 percent. Maximum flow capability of each valve shall not exceed capacity of downstream safety valve(s).
4. Main valve and pilot valve shall have replaceable valve plug and seat of stainless steel, monel, or similar durable material.
 - a. Pressure rating for high pressure steam: Not less than 1034 kPa (150 psig) saturated steam.
 - b. Connections: Flanged for valves 65 mm (2-1/2 inches) and larger; flanged or threaded ends for smaller valves.
5. Select pressure reducing valves to develop less than 85 dbA at 1500 mm (5 feet) elevation above adjacent floor, and 1500 mm (5 feet) distance in any direction. Inlet and outlet piping for steam pressure reducing valves shall be Schedule 80 minimum for required distance to achieve required levels or sound attenuators shall be applied.
6. Pneumatically controlled valve: May be furnished in lieu of steam-operation. All specification requirements for steam operated valves apply. Valves shall close on failure of air supply.

- B. Safety Valves and Accessories: Comply with ASME Boiler and Pressure Vessel Code, Section VIII. Capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors, maximum accumulation 10 percent. Provide lifting lever. Provide drip pan elbow where shown.
- C. Steam PRV for Individual Equipment: Cast iron or bronze body, screwed ends, rated 861 kPa (125 psig) working pressure. Single-seated, diaphragm operated, spring loaded, adjustable range, all parts renewable.
- E. Steam Trap: Each type of trap shall be the product of a single manufacturer. Provide trap sets at all low points and at 61 m (200 feet) intervals on the horizontal main lines.
1. Floats and linkages shall provide sufficient force to open trap valve over full operating pressure range available to the system. Unless otherwise indicated on the drawings, traps shall be sized for capacities indicated at minimum pressure drop as follows:
 - a. For equipment with modulating control valve: 1.7 kPa (1/4 psig), based on a condensate leg of 300 mm (12 inches) at the trap inlet and gravity flow to the receiver.
 - b. For main line drip trap sets and other trap sets at steam pressure: Up to 70 percent of design differential pressure. Condensate may be lifted to the return line.
 2. Trap bodies: Bronze, cast iron, or semi-steel, constructed to permit ease of removal and servicing working parts without disturbing connecting piping. For systems without relief valve traps shall be rated for the pressure upstream of the PRV supplying the system.
 3. Balanced pressure thermostatic elements: Phosphor bronze, stainless steel or monel metal.
 4. Valves and seats: Suitable hardened corrosion resistant alloy.
 5. Mechanism: Brass, stainless steel or corrosion resistant alloy.
 6. Floats: Stainless steel.
 7. Inverted bucket traps: Provide bi-metallic thermostatic element for rapid release of non-condensables.
- G. Thermostatic Air Vent (Steam): Brass or iron body, balanced pressure bellows, stainless steel (renewable) valve and seat, rated 861 kPa (125 psig) working pressure, 20 mm (3/4 inch) screwed connections. Air vents shall be balanced pressure type that responds to steam pressure-temperature curve and vents air at any pressure.

H. Steam Humidifiers: Steam separator type that discharges steam into the air stream through a steam jacketed distribution manifold or dispersion tube. Humidifiers shall be complete with Y-type steam supply strainer; modulating, normally closed steam control valve; normally closed condensate temperature switch; and manufacturer's standard steam trap.

1. Steam separator: Stainless steel or cast iron.
2. Distribution manifold: Stainless steel, composed of dispersion pipe and surrounding steam jacket, manifold shall span the width of duct or air handler, and shall be multiple manifold type under any of the following conditions:
 - a. Duct section height exceeds 900 mm (36 inches).
 - b. Duct air velocity exceeds 5.1 m/s (1000 feet per minute).
 - c. If within 900 mm (3 feet) upstream of fan, damper or prefilter.
 - d. If within 3000 mm (10 feet) upstream of afterfilter.

2.12 GAGES, PRESSURE AND COMPOUND

- A. ASME B40.1, Accuracy Grade 1A, (pressure, vacuum, or compound), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass, lever handle union cock. Provide brass/bronze pressure snubber for gages in water service. Provide brass pigtail syphon for steam gages.
- C. Range of Gages: For services not listed provide range equal to at least 130 percent of normal operating range:

Low pressure steam to 103 kPa(15 psig)	0 to 207 kPa (30 psig).
Medium pressure steam nominal 413 kPa (60 psig)	0 to 689 kPa (100 psig).
High pressure steam nominal 620 kPa to 861 kPa (90 to 125 psig)	0 to 1378 kPa (200 psig).

2.13 PRESSURE/TEMPERATURE TEST PROVISIONS

- A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores,

permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

B. Provide one each of the following test items to the COTR:

1. 6 mm (1/4 inch) FPT by 3 mm (1/8 inch) diameter stainless steel pressure gage adapter probe for extra long test plug. PETE'S 500 XL is an example.
2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gage, , 762 mm (30 inches) Hg to 689 kPa (100 psig) range.
3. 0 - 104 degrees C (220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (one inch) dial, 125 mm (5 inch) long stainless steel stem, plastic case.

2.14 FIRESTOPPING MATERIAL

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

PART 3 - EXECUTION

3.1 GENERAL

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Install convertors and other heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
- D. Install piping parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope steam, condensate and drain

piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

- E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- H. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
 - 1. Water treatment pot feeders and condenser water treatment systems.
 - 2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- I. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- J. Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.

3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

- A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.
- B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
- C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.
- D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding packing.

3.4 STEAM TRAP PIPING

Install to permit gravity flow to the trap. Provide gravity flow (avoid lifting condensate) from the trap where modulating control valves are used. Support traps weighing over 11 kg (25 pounds) independently of connecting piping.

3.6 LEAK TESTING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COTR. Tests may be either of those below, or a combination, as approved by the COTR.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Avoid excessive pressure on mechanical seals and safety devices.

3.7 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Steam, Condensate and Vent Piping: No flushing or chemical cleaning required. Accomplish cleaning by pulling all strainer screens and cleaning all scale/dirt legs during start-up operation.

3.8 OPERATING AND PERFORMANCE TEST AND INSTRUCTION

- A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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Bid Documents

B. Adjust red set hand on pressure gages to normal working pressure.

- - - E N D - - -

**SECTION 23 31 00
HVAC DUCTS AND CASINGS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Ductwork and accessories for HVAC including the following:
 - 1. Supply air, return air, outside air, exhaust, roof hoods, goosenecks and relief systems.
- B. Definitions:
 - 1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
 - 2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
 - 3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
 - 4. Exposed Duct: Exposed to view in a finished room

1.2 RELATED WORK

- A. Fire Stopping Material: Section 07 84 00, FIRESTOPPING.
- B. Outdoor and Exhaust Louvers: Section 08 90 00, LOUVERS AND VENTS.
- D. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- F. Duct Insulation: Section 23 07 11, HVAC INSULATION
- G. Air Flow Control Valves and Terminal Units: Section 23 36 00, AIR TERMINAL UNITS.
- H. Duct Mounted Coils: Section 23 82 16, AIR COILS.
- I. Return Air and Exhaust Air Fans: Section 23 34 00, HVAC FANS.
- J. Duct Mounted Instrumentation: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- K. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- L. Smoke Detectors: Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

- B. Comply with NFPA 90A.
- C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
- D. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA Standards for duct pressure classes.
- E. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Rectangular ducts:
 - a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
 - b. Sealants and gaskets.
 - c. Access doors.
 - 2. Round and flat oval duct construction details:
 - a. Manufacturer's details for duct fittings.
 - b. Duct liner.
 - c. Sealants and gaskets.
 - d. Access sections.
 - e. Installation instructions.
 - 3. Volume dampers, back draft dampers.
 - 4. Upper hanger attachments.
 - 5. Fire dampers, fire doors, and smoke dampers with installation instructions.
 - 6. Flexible ducts and clamps, with manufacturer's installation instructions.
 - 7. Flexible connections.
 - 8. Instrument test fittings.
 - 9. Details and design analysis of alternate or optional duct systems.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 230511, COMMON WORK RESULTS FOR HVAC.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Civil Engineers (ASCE):
ASCE/SEI 7-05Minimum Design Loads for Buildings and Other Structures
- C. American Society for Testing and Materials (ASTM):
A653/A653M-08Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process
B209-07Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
C1071-05e1Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
E84-09Standard Test Method for Surface Burning Characteristics of Building Materials
- D. National Fire Protection Association (NFPA):
90A-09Standard for the Installation of Air Conditioning and Ventilating Systems
- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
3rd Edition - 2005HVAC Duct Construction Standards, Metal and Flexible
1st Edition, 1985HVAC Air Duct Leakage Test Manual
- F. Underwriters Laboratories, Inc. (UL):
UL 33Heat Responsive Links for Fire-Protection Service
UL 181Factory-Made Air Ducts and Connectors
UL 555Fire Dampers
UL 555SSmoke Dampers

PART 2 - PRODUCTS**2.1 DUCT MATERIALS AND SEALANTS**

- A. General: Except for systems specified otherwise, construct ducts and accessories of galvanized sheet steel, ASTM A527, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.
- B. Joint Sealing:

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable.
2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
3. Gaskets in Flanged Joints: Soft neoprene.

C. Approved factory made joints such as DUCTMATE SYSTEM may be used.

2.2 DUCT CONSTRUCTION AND INSTALLATION

- A. Follow SMACNA HVAC Duct Construction Standards.
- B. Duct Pressure Class: (2 inch) W.G.
- C. Seal Class: As shown on the drawings and in accordance with SMACNA Standards.
- D. Round Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.
 1. Elbows: Diameters 150mm through 200 mm (6 through 8 inches) shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
 2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.
- E. Volume Dampers: Single blade, opposed blade, or multi-louver type as detailed in SMACNA Standards.
- F. Duct Hangers and Supports: Refer to SMACNA Standards. Avoid use of trapeze hangers for round duct.

2.4 DUCT ACCESS DOORS, PANELS AND SECTIONS

- A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
 - 1. Each duct mounted coil.
 - 2. Each fire damper (for link service), smoke damper and automatic control damper.
 - 3. Each duct mounted smoke detector.
- B. Openings shall be as large as feasible in small ducts, 300mm by 300mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double-wall, insulated.
 - 1. Refer to SMACNA HVAC Duct Construction Standards.

2.5 FIRE DAMPERS

- A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 70 degrees C (160 degrees F) fusible link, 100 percent free opening with no part of the blade stack or damper frame in the air stream.
 - 1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 1.9mm (14 gage), required to provide installation equivalent to the damper manufacturer's UL test installation.
 - 2. Submit manufacturer's installation instructions conforming to UL 555 rating test.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

- A. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S.
- B. Closing rating in ducts up to 1 kPa (4-inch wg) static pressure class and minimum 20 m/s (4000-fpm) velocity.
- C. Fire Rating: 1-1/2 hours.
- D. Frame: Multiple-blade type; fabricated with roll-formed, 0.85mm (0.034 inch) thick galvanized steel; with mitered and interlocking corners.
- E. Heat-Responsive Device: Replaceable, 74 deg C (165 deg F) rated, fusible links.
- F. Smoke Detector: Integral, factory wired for single-point connection.
- G. Blades: Roll-formed, horizontal, interlocking, 0.85mm (0.034 inch) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.85mm (0.034 inch thick, galvanized-steel blade connectors.
- H. Leakage: Class I.

- I. Rated pressure and velocity to exceed design airflow conditions.
- J. Mounting Sleeve: Factory-installed, 1.3mm (0.052 inch) thick, galvanized sheet steel; length to suit wall or floor application.
- K. Damper Motors: Two-position action.
- L. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 12 GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
 - 1. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 17 Nm (150 in. x lbf) and breakaway torque rating of 17 Nm (150 in. x lbf).
 - 2. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).

2.8 FLEXIBLE AIR DUCT

- A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors or buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated flexible air duct connectors in supply air duct systems and elsewhere as shown.
- B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 200 mm (8 inches) in diameter shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.
- C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (1 foot) of straight duct, at 500 Hz, based on 150 mm (6 inch) duct, of 750 m/min (2500 fpm).
- D. Application Criteria:
 - 1. Temperature range: -18 to 93 degrees C (0 to 200 degrees F) internal.
 - 2. Maximum working velocity: 1200 m/min (4000 feet per minute).

3. Minimum working pressure, inches of water gage: 2500 Pa (10 inches) positive, 500 Pa (2 inches) negative.

- E. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

2.9 FLEXIBLE CONNECTIONS

- A. Where duct connections are made to fans and air handling units, install a non-combustible flexible connection of 822g (29 ounce) neoprene coated fiberglass fabric approximately 150 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50mm (2 inches) on center. Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack to insure that no vibration is transmitted.

2.12 FIRESTOPPING MATERIAL

Refer to Section 07 84 00, FIRESTOPPING.

2.14 THERMOMETER (AIR)

Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

2.15 INSTRUMENT TEST FITTINGS

- A. Manufactured type with a minimum 50 mm (two inch) length for insulated duct, and a minimum 25 mm (one inch) length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.
- B. Provide instrument test holes at each duct mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, cooling coil, and heat recovery unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.
- B. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:

1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
 2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA HVAC Duct Construction Standards. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
 3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA HVAC Duct Construction Standards.
- C. Install duct hangers and supports in accordance with SMACNA HVAC Duct Construction Standards.
- D. Install fire dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test.
- E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- F. Flexible duct installation: Refer to SMACNA HVAC Duct Construction Standards. Ducts shall be continuous, single pieces not over 1.5m (5 feet) long, as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA Standards. Clamp per SMACNA Standards with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support flexible ducts per SMACNA HVAC Duct Construction Standards.
- G. Control Damper Installation:
1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.

2. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- H. Air Flow Measuring Devices (AFMD): Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.
- J. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by RE/COTR. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

3.2 DUCT LEAKAGE TESTS AND REPAIR

- A. Leak testing company shall be independent of the sheet metal company employed by General Contractor.
- B. Ductwork leak test shall be performed for the entire air distribution supply, return, exhaust system Section by Section including fans, coils and filter Section designated as static pressure class 750 Pa (3 inch W.G.) and above. All supply ductwork less than 500 Pa (3 inch W.G.) shall also be tested where there is no air terminal unit employed in the system.
- C. Test procedure, apparatus and report shall conform to SMACNA HVAC Air Duct Leakage Test Manual. The maximum leakage rate allowed is 4 percent of the design air flow rate, at 2 inch pressure.
- D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- E. All tests shall be performed in the presence of the RE/COTR and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the RE/COTR and identify leakage source with excessive leakage.
- F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the RE/COTR.
- G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.

H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

3.4 TESTING, ADJUSTING AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.5 OPERATING AND PERFORMANCE TESTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

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SECTION 23 34 00
HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Fans for heating, ventilating and air conditioning.
- B. Product Definitions: AMCA Publication 99 Standards Handbook, 99-0066-01 Definitions.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- D. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- E. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC.
- F. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

1.3 QUALITY ASSURANCE

- A. Refer to paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fans and power ventilators shall bear the AMCA performance seal.
- C. Fans and power ventilators shall comply with the following standards:
 - 1. Testing and Rating: AMCA 210-08.
 - 2. Reverberant Room Method for Sound Testing of Fans: AMCA 300-08.
- D. Vibration Tolerance for Fans and Power Ventilators: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- E. Performance Criteria:
 - 1. Provide fans and motors capable of stable operation at design conditions and at 110 percent pressure.
 - 2. Lower than design pressure drop of approved individual components may allow use of a smaller fan motor and still provide the safety factor. When submitted as a deviation a smaller motor may be approved in the interest of energy conservation. The contractor shall be responsible for making necessary changes to the electrical system.
 - 3. Select fan operating point as follows:
 - a. Forward curved and axial fans: Right hand side of peak pressure point.
 - b. Airfoil, backward inclined or tubular: Near the peak of static efficiency.

F. Safety Criteria: Provide manufacturer's standard screen on fan inlet and discharge where exposed to operating and maintenance personnel.

G. Corrosion Protection:

1. All steel shall be mill-galvanized, or phosphatized and coated with minimum two coats, corrosion resistant enamel paint. Manufacturers paint and paint system shall meet the minimum specifications of: ASTM D1735 water fog and ASTM B117 salt spray.
2. If flammable gas, vapor or combustible dust is present the fan construction shall be as recommended by AMCA's Classification for Spark Resistant Construction.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers Literature and Data:
 1. Fan sections, motors and drives.
 2. Centrifugal fans, motors, drives, accessories and coatings.
 - a. In-line centrifugal fans.
- C. Certified Sound power levels for each fan.
- D. Motor ratings types, electrical characteristics and accessories.
- F. Belt guards.
- G. Maintenance and Operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
- H. Certified fan performance curves for each fan showing cubic meters per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation and at 110 percent of design static pressure.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Movement and Control Association International, Inc. (AMCA):
 - 99Standards Handbook
 - 210-07Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating
 - 300-08Reverberant Room Method for Sound Testing of Fans
- C. American Society for Testing and Materials (ASTM):

B117-07aStandard Practice for Operating Salt Spray (Fog)
Apparatus

D1735-08Standard Practice for Testing Water Resistance
of Coatings Using Water Fog Apparatus

E. Underwriters Laboratories, Inc. (UL):

UL 181Factory-Made Air Ducts and Air Connectors

PART 2 - PRODUCTS

2.2 CENTRIFUGAL FANS

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE. Record factory vibration test results on the fan or furnish to the Contractor.
- B. Fan arrangement, unless noted or approved otherwise:
 - 1. DWDI fans: Arrangement 3.
 - 2. SWSI fans: Arrangement 1, 3, 9 or 10.
- C. Construction: Wheel diameters and outlet areas shall be in accordance with AMCA standards.
 - 1. Housing: Low carbon steel, arc welded throughout, braced and supported by structural channel or angle iron to prevent vibration or pulsation, flanged outlet, inlet fully streamlined. Provide lifting clips, and casing drain. Provide manufacturer's standard access door. Provide 12.5mm (1/2") wire mesh screens for fan inlets without duct connections.
 - 2. Wheel: Steel plate with die formed blades welded or riveted in place, factory balanced statically and dynamically.
 - 3. Shaft: Designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fans class.
 - 4. Bearings: Heavy duty ball or roller type sized to produce a B10 life of not less than 40,000 hours, and an average fatigue life of 200,000 hours.
 - 6. Belt Drives: Factory installed with final alignment belt adjustment made after installation.
 - 7. Motors and Fan Wheel Pulleys: Select pulleys, so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
 - 8. Motor, adjustable motor base, drive and guard: Furnish from factory with fan. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for specifications. Provide protective sheet metal enclosure for fans located outdoors.

9. Furnish variable speed fan motor controllers where shown on the drawings. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for controller/motor combination requirements
- D. In-line Centrifugal Fans: In addition to the requirements of paragraphs A and C, provide inlet and outlet flanges, bolted access door and arrangement 1, 4 or 9 supports as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fan, motor and drive in accordance with manufacturer's instructions.
- B. Align fan and motor sheaves to allow belts to run true and straight.
- C. Bolt equipment to curbs with galvanized lag bolts.
- D. Install vibration control devices as shown on drawings and specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

3.2 PRE-OPERATION MAINTENANCE

- A. Lubricate bearings, pulleys, belts and other moving parts with manufacturer recommended lubricants.
- B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.
- C. Clean fan interiors to remove foreign material and construction dirt and dust.

3.3 START-UP AND INSTRUCTIONS

- A. Verify proper operation of motor, drive system and fan wheel.
- B. Check vibration and correct as necessary for air balance work.
- C. After air balancing is complete and permanent sheaves are in place perform necessary field mechanical balancing to meet vibration tolerance in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

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SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air terminal units.

1.2 RELATED WORK

- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise requirements.
- D. Section 23 31 00, HVAC DUCTS: Ducts and flexible connectors.
- E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Damper actuators.
- F. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Flow rates adjusting and balancing.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Air Terminal Units: Submit performance data.
- C. Certificates:
 - 1. Compliance with paragraph, QUALITY ASSURANCE.
 - 2. Compliance with specified standards.
- D. Operation and Maintenance Manuals: Submit in accordance with paragraph, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):

90A-09Standard for the Installation of Air
Conditioning and Ventilating Systems

70-08National Electrical Code

C. Underwriters Laboratories, Inc. (UL):

UL 181Standard for Factory-Made Air Ducts and Air
Connectors

UL 1995Heating and Cooling Equipment

PART 2 - PRODUCTS

2.1 AIR TERMINAL UNITS (BOXES)

A. General: Factory built, pressure independent units, factory set, field adjustable air flow rate, suitable for single duct applications, as indicated. Clearly show on each unit the factory set air volumes. Coordinate flow controller sequence and damper operation details with the drawings and Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

B. Rating and Performance Certification: Terminal units shall be certified by AHRI Standard 880-98 Air Terminals, and bear the AHRI seal.

1. Maximum pressure drop: As shown on the drawings.

2. Maximum room sound levels: Not to exceed criteria stated in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT unless shown otherwise on drawings. Provide terminal sound attenuators where necessary to comply with the noise criteria. Sound tests and correction of deficiencies is specified in Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

C. Casing: Unit casing shall be constructed of galvanized steel not lighter than 0.85mm (22 gauge) or aluminum sheet not lighter than 1 mm (18 gauge). Provide hanger brackets for attachment of supports.

1. Lining material: Suitable to provide required acoustic performance, thermal insulation and prevent sweating. Meet the requirements of NFPA 90A and comply with UL 181 for erosion. Insulation shall consist of 13mm (1/2 inch) thick non-porous foil faced rigid fiberglass insulation of 4-lb/cu.ft, secured by full length galvanized steel z-strips which enclose and seal all edges. Tape and adhesives shall not be used. Comply with UL Standard 181 for

- erosion. Surfaces, including all edges, shall be faced with perforated metal or coated so that the air stream will not detach material.
2. Total leakage from casing: Not to exceed 2 percent of the nominal capacity of the unit when subjected to a static pressure of 747 pa (3 IN WG), with all outlets sealed shut and inlets fully open.
- D. Construct dampers and other internal devices of corrosion resisting materials which do not require lubrication or other periodic maintenance.
1. Damper Leakage: Not greater than 2 percent of maximum rated capacity, when closed against inlet static pressure of 1 kPa (4 inch WG).
- E. Provide multi-point velocity pressure sensors with external pressure taps.
1. Provide direct reading air flow rate table pasted to box.
- F. Provide static pressure tubes.
- G. Factory shall calibrate air terminal units to air flow rates indicated. All settings including maximum and minimum air flow shall be field adjustable.
- H. Externally powered DDC variable air volume controllers and damper actuators shall be furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for factory mounting on air terminal units.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.
- B. Handle and install units in accordance with manufacturer's written instructions.
- C. Support units rigidly so they remain stationary at all times. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.
- D. Locate air terminal units to provide a straight section of inlet duct for proper functioning of volume controls.

3.2 OPERATIONAL TEST

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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AE Works Project No. 11020

Pittsburgh VAMC
HZ Renovate B51 (Unit 3B)
Bid Documents

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SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air outlets and inlets, including the following: Grilles, registers and diffusers.

1.2 RELATED WORK

- A. Outdoor and Exhaust Louvers: Section 08 90 00, LOUVERS AND VENTS.
- C. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- D. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- E. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

1.3 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fire Safety Code: Comply with NFPA 90A.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Air intake/exhaust hoods.
 - 2. Grilles, registers, diffusers and accessories.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Civil Engineers (ASCE):
ASCE/SEI 7-05Minimum Design Loads for Buildings and Other Structures
- C. American Society for Testing and Materials (ASTM):
A653/A653M-08Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process

- B209-07Standard Specification for Aluminum and
Aluminum-Alloy Sheet and Plate
- E84-09Standard Test Method for Surface Burning
Characteristics of Building Materials
- D. National Fire Protection Association (NFPA):
- 90A-09Standard for the Installation of Air
Conditioning and Ventilating Systems
- E. Underwriters Laboratories, Inc. (UL):
- UL 33Heat Responsive Links for Fire-Protection
Service

PART 2 - PRODUCTS

2.4 AIR OUTLETS AND INLETS

- A. Materials:
1. Steel or aluminum, as indicated on the schedule: Provide manufacturer's standard gasket.
 2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel.
 3. Contractor shall review all ceiling drawings and details and provide all ceiling mounted devices with appropriate dimensions and trim for the specific locations.
- B. Performance Test Data: In accordance with ANSI/ASHRAE Standard 70-2006. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT for NC criteria.
- C. Air Supply Outlets:
1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar ceilings, white finish, square or round neck connection as shown on the drawings.
 - a. Louver face, 360 degree pattern: Round neck, surface mounting unless shown otherwise on the drawings.
 - b. Modular core type: Square, removable core for 1, 2, 3, or 4 way directional pattern.
 - c. Perforated face type: Manual adjustment for one-, two-, three-, or four-way horizontal air distribution pattern without change of air volume or pressure. Perforated face diffusers shall have the pattern controller on the inner face, rather than in the neck and designed to discharge air horizontally at the ceiling maintaining a Coanda effect.

2. Supply Grilles and Registers: Extruded aluminum, white finish, and individually adjustable blades. Front bars parallel to the short dimension.
 - a. Border: Flat, 30 mm (1-1/4 inch) wide.
 - b. Bar spacing: 20 mm (3/4 inch) maximum.
 - c. Provide opposed blade damper where shown.
3. Double Deflection Supply Grilles and Registers: Extruded aluminum, white finish, and individually adjustable blades. Front bars parallel to the short dimension.
 - a. Border: Flat, 30 mm (1-1/4 inches) wide.
 - b. Bar spacing: 20 mm (3/4 inch) maximum.
 - c. Provide opposed blade damper where shown.
4. Grilles: Same as registers but without the opposed blade damper.
- D. Return and Exhaust Registers and Grilles: Provide opposed blade damper for registers.
 1. Finish: white baked enamel.
 2. Standard Type: Fixed horizontal face bars set at 35 degrees, 30 mm (1-1/4 inch) margin.
 3. Perforated Face Type: To match supply units.

2.5 WIRE MESH GRILLE

- A. Fabricate grille with 2 x 2 mesh 13 mm (1/2 inch) galvanized steel or aluminum hardware cloth in a spot welded galvanized steel frame with approximately 40 mm (1-1/2 inch) margin.
- B. Use grilles where shown in unfinished areas such as mechanical rooms.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.
- B. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by RE/COTR. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

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3.3 TESTING, ADJUSTING AND BALANCING (TAB)

A. Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.4 OPERATING AND PERFORMANCE TESTS

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

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**SECTION 23 40 00
HVAC AIR CLEANING DEVICES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air filters for heating, ventilating and air conditioning.
- B. Definitions: Refer to ASHRAE Standard 52.1 for definitions of face velocity, net effective filtering area, media velocity, resistance (pressure drop), atmospheric dust spot efficiency and dust-holding capacity. ASHRAE Standard 52.1 measures arrestance, dust spot efficiency and dust holding capacity of filters.
- C. Refer to ASHRAE Standard 52.2 for definitions of MERV (Minimum Efficiency Reporting Value) PSE (Particle Size Efficiency) and particle size ranges for each MERV number. ASHRAE Standard 52.2 measures particle size efficiency (PSE).

1.2 RELATED WORK

- A. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.3 QUALITY ASSURANCE

- A. Comply with UL Standard 586 for flame test.
- B. Each filter shall bear a label indicating manufacturer's name, filter size and rated efficiency.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Holding frames. Identify locations.
 - 2. Side access housings. Identify locations, verify insulated doors.
 - 3. Magnehelic gages.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

- B. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE):
- 52.1-92Gravimetric and Dust-Spot procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
 - 52.2-2007.....Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- C. Underwriters Laboratories, Inc. (UL):
- UL 900Air Filter Units

PART 2 - PRODUCTS

2.1 REPLACEMENT FILTER ELEMENTS TO BE FURNISHED

- A. To allow temporary use of HVAC systems for testing and in accordance with Paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL SYSTEMS in Section 01 00 00, GENERAL REQUIREMENTS, provide one complete set of additional (replacement) filter elements.
- B. The RE/COTR will direct whether these additional filters will either be installed as replacements for dirty units or turned over to VA for future use as replacements.

2.2 DISPOSABLE PANEL FILTER

- A. Description: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with holding frames.
- 1. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
 - 2. Frame: Cardboard frame with perforated metal retainer.
 - 3. MERV-8.

2.3 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS

- A. Description: Factory-fabricated, extended-surface filters with holding frames.
- 1. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
 - 2. Media-Grid Frame: Nonflammable cardboard.
 - 3. MERV-8.

2.4 FILTER GAGES

- A. Description: Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
- B. Diameter: 4-1/2 inches (115 mm).

C. Range: 0- to 0.5-inch wg (0 to 125 Pa).

D. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supports, filters and gages in accordance with manufacturer's instructions.

B. Position each filter unit with clearance for normal service and maintenance.

C. Install filters in position to prevent passage of unfiltered air.

D. Install filter gage for each filter bank.

E. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position.

F. Coordinate filter installations with duct and air-handling unit installations.

3.2 START-UP AND TEMPORARY USE

A. Clean and vacuum air handling units to the satisfaction of the RE/COTR prior to starting air handling systems.

B. Install or deliver replacement filter units as directed by the RE/COTR.

C. If permanently installed air handlers are used during construction, filtration media with MERV 8 shall be used at each return air inlet. Replace all filtration media immediately prior to occupancy.

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SECTION 23 72 00
AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

This Section specifies run-around heat exchangers.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: Requirements for pre-test of equipment.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.
- E. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Requirements for piping insulation.
- G. Section 23 82 16, AIR COILS: Requirements for run-around system coils.
- H. Section 23 31 00, HVAC DUCTS AND CASINGS: Requirements for sheet metal ducts and fittings.
- I. Section 23 40 00, HVAC AIR CLEANING DEVICES: Requirements for filters used before heat recovery coils.
- J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.
- K. Section 23 05 93, TESTING, ADJUSTING AND BALANCING FOR HVAC: Requirements for testing, adjusting and balancing of HVAC system.

1.3 QUALITY ASSURANCE

- A. Refer to specification Section 01 00 00, GENERAL REQUIREMENTS for performance tests and instructions to VA personnel.
- B. Refer to paragraph QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- C. Performance Criteria: Heat recovery equipment shall be provided by a manufacturer who has been manufacturing such equipment and the equipment has a good track record for at least 5 years.
- D. Performance Test: In accordance with this section.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 2. Rotary Heat Exchanger
- C. Certificate: Submit, simultaneously with shop drawings, an evidence of satisfactory service of the equipment on three similar installations.

- D. Submit type, size, arrangement and performance details. Present application ratings in the form of tables, charts or curves.
- E. Provide installation, operating and maintenance instructions, in accordance with Article, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (ARI)
ARI 1060-2005Performance Rating of Air-to-Air Heat Exchangers
for Energy Recovery Ventilation Heat Equipment
- C. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
15-07Safety Standard for Refrigeration Systems (ANSI)
52.1-92Gravimetric and Dust-Spot Procedures for Testing
Air-Cleaning Devices Used in General Ventilation
for Removing Particulate Matter
52.2-07Method of Testing General Ventilation Air-
Cleaning Devices for Removal Efficiency by
Particle Size
84-91Method of Testing Air-to-Air Heat Exchangers
- D. American Society for Testing and materials (ASTM)
D635-06Standard Test Method for Rate of Burning and/ or
Extent and Time of Burning of Plastics in a
Horizontal Position
E84-07Standard Test Method for Surface Burning
Characteristics of Building Materials
- E. Underwriters Laboratories, Inc (UL)
1812-95 (Rev. 2006)Standard for Ducted Heat Recovery Ventilators
1815-01 (Rev. 2006)Standard for Nonducted Heat Recovery Ventilators

PART 2 - PRODUCTS

2.2 ROTARY AIR-TO-AIR HEAT EXCHANGER:

- A. Exchanger Rotor or Wheel: Aluminum transfer media with a flame spread rating of not more than 25 and smoke developed rating of not more than 50 and independently tested in accordance with ASTM standard E-84. Rotor media shall be independently tested in accordance with ASHRAE Standard . It shall allow laminar flow (but not radial) at usual velocities and prevent leakage, bypassing and cross contamination by cross flow within

wheel. Size the transfer media to allow passage of 300 micrometers particles without fouling or clogging. When latent heat transfer is required, treat media with non-degrading desiccant that is bacteriostatic, non-corroding and non-toxic. No asbestos material will be allowed. Wheel shall not condense water directly or require a condensate drain for summer or winter operation. Performance rating shall be in accordance with ARI Standard 1060.

- B. Rotor: Glass-fibersegmented wheel strengthened with radial spokes impregnated with non-migrating, water-selected, molecular-sieve desiccant coating.
 - 1. Maximum Solid Size for media to pass: 500 micrometers.
- C. Casings shall be sealed on periphery of rotor as well as on duct divider and purge section. Seals shall be adjustable, of extended life materials and effective in limiting air leakage.
- D. Wheel shall be supported by ball or roller bearings and belt driven by a fractional horsepower, totally enclosed, NEMA Standard motor through a close coupled positively lubricated speed reducer, or gear/chain speed reduction.
 - 1. Motors for constant speed wheel shall be an AC motor.
 - 2. Variable-speed exchanger wheels shall have exchanger wheel speed and leaving-air temperature controlled by means of a variable-speed motor controller. Operation shall be from 115/1/60 and by a proportioning temperature controller which shall vary output voltage of a silicon controlled rectifier (SCR) to a rectified power motor which will change speed in proportion to changes of voltage to its armature. Automatic changeover for summer-winter operations shall be controlled by an adjustable thermost switch. Set point of adjustable proportioning temperature controller and thermost switch shall be indicated on visible scale. System shall be capable of speed reduction down to 5 percent of capacity while maintaining adequate torque at any point of operation to rotate wheel.
- E. An automatic, factory-fabricated, field-adjustable purge unit shall limit exhaust air carry-over to less than 1.0 percent of rated volume. Purge shall be effective when static pressure difference between supply and exhaust is 125 Pa (one-half, inch wg) or greater, and it shall have provision for restriction or adjustment to limit purge air volume to not over five percent of rated air flow when a static pressure difference up to 2.5 kPa (10 inch wg) exists.

- F. Unit shall be constructed of heavy gage steel to insure rigidity and stability. Casing side panels shall be removable to insure easy access to internal parts and have integral flanges for flanged duct connection and lifting holes or lugs.
- G. Controls starting relay shall be factory mounted and wired, and include a manual motor starter for field wiring. Variable frequency controller shall be factory mounted and wired, permitting input of field connected 4-20 mA or 1-10-V control signal. Variable frequency controller shall be factory mounted and wired, with exhaust-air sensor to vary rotor speed and maintain exhaust temperature above freezing
- H. Filters Disposable Panel Filters: Comply with NFPA 90A.
 - 1. Minimum Arrestance: According to ASHRAE 52.1
 - 2. Minimum Efficiency Reporting Value (MERV): According to ASHRAE 52.2.
 - 3. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
 - 4. Flat-Panel Type: Factory-fabricated, viscous-coated, 25 mm (1 inch).
 - 8. Arrestance (According to ASHRAE 52.1): 80.
 - 9. MERV (According to ASHRAE 52.2): 8.
 - 10. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
 - 11. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

2.5 AIR FILTERS

Air Filters: MERV rating of 8 or 13, or as indicated on the drawings. Comply with requirements in specification Section 23 40 00, HVAC AIR CLEANING DEVICES.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Follow the equipment manufacturer's instructions for handling and installation, and setting up of ductwork for makeup and exhaust air steamers for maximum efficiency.
- B. Rotary Air-to-Air Exchanger: Adjust seals and purge as recommended by the manufacturer. Verify correct installation of controls.
- C. Seal ductwork tightly to avoid air leakage.
- D. Install units with adequate spacing and access for cleaning and maintenance of heat recovery coils as well as filters.

3.2 FIELD QUALITY CONTROL

- A. Operational Test: Perform tests as per manufacturer's written instructions for proper and safe operation of the heat recovery system.
 - 1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Adjust seals and purge.
 - 3. Test and adjust controls and safeties.
- B. Replace damaged and malfunctioning controls and equipment.
- C. Set initial temperature and humidity set points. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Prepare test and inspection reports to the Senior COTR in accordance with specification Section 01 00 00, GENERAL REQUIREMENTS.

3.3 INSTRUCTIONS

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of heat recovery equipment.

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**SECTION 23 73 00
INDOOR CENTRAL-STATION AIR-HANDLING UNITS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air handling units including integral components specified herein.
- B. Definitions: Air Handling Unit (AHU): A factory fabricated assembly consisting of fan, coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, humidifying, dehumidifying, and mixing of air. Design capacities of units shall be as scheduled on the drawings.

1.2 RELATED WORK

- B. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- C. Sound and vibration requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- D. Piping and duct insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- E. Piping and valves: Section 23 21 13 / 23 22 13, HYDRONIC PIPING / STEAM AND CONDENSATE HEATING PIPING.
- F. Heating and cooling coils and pressure requirements: Section 23 82 16, AIR COILS.
- G. Return and exhaust fans: Section 23 34 00, HVAC FANS.
- H. Requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining, and air leakage: Section 23 31 00, HVAC DUCTS AND CASINGS .
- I. Air filters and filters' efficiency: Section 23 40 00, HVAC AIR CLEANING DEVICES.
- J. HVAC controls: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- K. Testing, adjusting and balancing of air and water flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- L. Types of motors: Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.

1.3 QUALITY ASSURANCE

- A. Refer to Article, Quality Assurance, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

- B. Air Handling Units Certification: Certify air-handling units in accordance with ARI 430.
- C. Heating, Cooling, and Air Handling Capacity and Performance Standards: ARI 430, ARI 410, ASHRAE 51, and AMCA 210.
- D. Performance Criteria:
 - 1. The fan schedule indicates design cubic meter per minute (cubic feet per minute) and design static pressure. Scheduled fan motors, 375 watts (1/2 horsepower) and larger, are sized for the maximum of design cubic meter per minute (cubic feet per minute) at 110 percent design static pressure, but not to exceed 187 Pa (3/4 inch water gage) additional pressure.
 - 2. Fans and motors shall be capable of stable operation at design conditions cubic meters per minute (cubic feet per minute) and 110 percent pressure as stated above.
 - 3. Lower than design pressure drop of approved individual components may allow use of a smaller fan motor and still provide the safety factor. When submitted as a deviation, a smaller motor may be approved in the interest of energy conservation. Such a deviation shall not qualify for any value engineering incentive claim or reward.
 - 4. Select fan operating point to right hand side of peak static pressure point and near the peak of static efficiency.
 - 5. Operating Limits: AMCA 99.
- E. Units shall be constructed by a manufacturer who has been manufacturing air handling units for at least five (5) years.
- F. Units shall be shipped in one (1) piece where possible and in shrink wrapping to protect the unit from dirt, moisture and /or road salt. Shipping splits can be provided as required for installation. Lifting lugs will be supplied on each side of the split to facilitate rigging and joining of segments.

1.4. SUBMITTALS:

- A. The contractor shall, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish a complete submission for all air handling units covered in the project. The submission shall include all information listed below. Partial and incomplete submissions shall be rejected without reviews.
- B. Manufacturer's Literature and Data:

1. Submittals for AHUs shall include fans, drives, motors, coils, humidifiers, mixing box with outside/return air dampers, filter housings, and all other related accessories. The contractor shall provide custom drawings showing total air handling unit assembly including dimensions, operating weight, access sections, flexible connections, door swings, controls penetrations, electrical disconnect, lights, duplex receptacles, switches, wiring, utility connection points, unit support system, vibration isolators, drain pan, pressure drops through each component (filter, coil etc) and rigging points. Submittal drawings of section or component only, will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details; and the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements. This data shall be submitted in hard copies and in electronic version compatible to AutoCAD version used by the VA at the time of submission.
2. Submit sound power levels in each octave band for fan and at entrance and discharge of AHUs at scheduled conditions. Include sound attenuator capacities and itemized internal component attenuation. Internal lining of supply air ductwork with sound absorbing material is not permitted. In absence of sound power ratings refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
3. Provide fan curves showing cubic meters per minute (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design cubic meters per minute (cubic feet per minute) and 110 percent of design static pressure.
4. Submit total fan static pressure, external static pressure, for AHU including total, inlet and discharge pressures, and itemized specified internal losses and unspecified internal losses. Refer to air handling unit schedule on drawings.
- C. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS. Include instructions for lubrication, filter replacement, motor and drive replacement, spare part lists, and wiring diagrams.
- D. Submit written test procedures two weeks prior to factory testing. Submit written results of factory tests for approval prior to shipping.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air-Conditioning and Refrigeration Institute (ARI):
- 260-01Sound Rating of Ducted Air Moving and Conditioning Equipment
 - 410-01Standard for Forced-Circulation Air-Heating and Air-Cooling Coils
 - 430-89Standard for Central Station Air Handling Units
 - ARI-DCAACPDirectory of Certified Applied Air Conditioning Products
- C. Air Moving and Conditioning Association (AMCA):
- 210-00Laboratory Methods of Testing Fans for Rating
- D. Anti-Friction Bearing Manufacturer's Association, Inc. (AFBMA):
- 9-90Load Ratings and Fatigue life for Ball Bearings
- E. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
- 51-01Standard, Laboratory Methods of Testing Fans for Rating
- F. American Society for Testing and Materials (ASTM):
- A653/653M-02Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - B117-97Salt Spray (Fog) Testing
 - C1071-00Thermal and Acoustical Insulation (Mineral Fiber, Duct Lining Material)
 - D1654-00Standard Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
 - D1735-97Water Resistance of Coatings Using Water Fog Apparatus
 - D3359-95Standard Test Methods for Measuring Adhesion by Tape Test
 - E84-01Surface Burning Characteristics of Building Materials
- G. Anti-Friction Bearing Manufacturer's Association, Inc. (AFBMA):
- 9-90Load Ratings and Fatigue life for Ball Bearings

H. Military Specifications (Mil. Spec.):

DOD-P-21035A-77Paint, High Zinc Dust Content, Galvanizing
Repair

I. National Fire Protection Association (NFPA):

90A-99Installation of Air Conditioning and Ventilating
Systems

PART 2 - PRODUCTS

2.1 AIR HANDLING UNITS

A. General:

1. AHUs shall be entirely of double wall galvanized steel construction. Foil face lining is not an acceptable substitute for double wall construction. Galvanizing shall be hot dipped conforming to ASTM A525 and shall provide a minimum of 0.275 kg of zinc per square meter (0.90 oz. of zinc per square foot) (G90). Aluminum constructed units may be provided subject to VA approval and documentation that structural rigidity is equal or greater than the galvanized steel specified.
2. The contractor and the AHU manufacturer shall be responsible for insuring that the unit will not exceed the allocated space shown on the drawings, including required clearances for service and future overhaul or removal of unit components. All structural, piping, wiring, and ductwork alterations of units, which are dimensionally different than those specified, shall be the responsibility of the contractor at no additional cost to the government.
3. AHUs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown on the drawings. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the job site. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.
4. The AHU manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a local representative at the job site to

supervise the assembly and to assure the units are assembled to meet manufacturer's recommendations and requirements noted on the drawings. Provide documentation that this representative has provided this service on similar jobs to the Contracting Officer. If a local representative cannot be provided, the manufacturer shall provide a factory representative.

5. Gaskets: All door and casing and panel gaskets and gaskets between air handling unit components, if joined in the field, shall be high quality which seal air tight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.
6. Structural Rigidity: Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed $1/200$ of the span based on a differential static pressure of 1991 Pa (8 inches water gage) or higher.

B. Base:

1. Provide a heavy duty steel base for supporting all AHU major components. Bases shall be constructed of wide-flange steel I-beams, channels, or minimum 125 mm (5 inch) high 3.5 mm (10 gauge) steel base rails. Welded or bolted cross members shall be provided as required for lateral stability. Contractor shall provide supplemental steel supports as required to obtain proper operation heights for cooling coil condensate drain trap and as shown on drawings.
2. AHUs shall be completely self supporting for installation on concrete housekeeping pad, steel support pedestals, or suspended as shown on drawings.
3. The AHU bases not constructed of galvanized material shall be cleaned, primed with a rust inhibiting primer, and finished with rust inhibiting exterior enamel.

C. Casing (including wall, floor and roof):

1. General: AHU casing shall be entirely double wall insulated panels, integral of or attached to a structural frame. Construction shall be such that removal of any panel shall not affect the structural integrity of the unit. Casing finished shall meet ASTM B117 125-hour or better salt-spray test (5 percent solution). All casing and panel sections shall be tightly butted and gasketed. No gaps of double wall

- construction will be allowed where panels bolt to air handling unit structural member. Structural members, not covered by the double wall panels, shall have equivalent insulated double wall construction.
2. Double wall galvanized steel panels shall be minimum 51 mm (2 inches) thick, constructed of minimum 1.3 mm (18 gauge) outer skin and 1.0 mm (20 gauge) solid or perforated inner skin. Perforated panels (inner skin) are not allowed in cooling coil sections, floors, door panels and where solid sheet is required to avoid air bypass.
 3. Blank-Off: Provide where required to ensure no air bypass between sections, through perforated panels or around coils or filters. Blank-Off shall be installed at each component of the air handling unit and also at the internal panels to prevent recirculation of the air through perforated panels. Seal any holes where bypass occurs.
 4. Insulation: High density, insulation shall be encased in double-wall casing between exterior and interior panels such that no insulation can erode to the air stream. Insulation shall be 50 mm (2 inch) thick, 24 kg/m³ and (1.5 lb/ft³) with a thermal conductivity R of approximately 13.8 W/m.K (8.0 BTU/hr-ft² °F). Air handling units with less than 50 mm (2 inch) of insulation in any part of the walls, floor, roof or drain pan shall not be acceptable. The insulation shall comply with NFPA 90-A for the flame and smoke generation requirements.
 5. Condensation through metal connections between inner and outer panels shall be kept to an absolute minimum.
 6. Casing panels shall be secured to the support structure with stainless steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to allow removal of fan, coils, and other internal components for future maintenance, repair, or modifications. Welded exterior panels are not acceptable.
 7. Access Doors: Provide in each access section and where shown on drawings. Doors shall be a minimum of 50 mm (2 inches) thick with same double wall construction as the unit casing. Doors shall be a minimum of 600 mm (24 inches) wide, unless shown of different size on drawings, and shall be the full casing height up to a maximum of 1850 mm (6 feet). Doors shall be gasketed, hinged, and latched to provide an airtight seal. The access doors for fan section, mixing box, humidifier coil section shall include a minimum 150 mm x 150 mm (6

inch x 6 inch) double thickness, with air space between the glass panes tightly sealed, reinforced glass or Plexiglas window in a gasketed frame.

- a. Hinges: Manufacturers standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 45 kg (100 pound) weight hung on latch side of door.
 - b. Latches: Non-corrosive alloy construction, with operating levers for positive cam action, operable from either inside or outside. Doors that do not open against unit operating pressure shall allow the door to ajar and then require approximately 0.785 radian (45 degrees) further movement of the handle for complete opening. Latch shall be capable of restraining explosive opening of door with a force not less than 1991 Pa (8 inches water gage).
 - c. Gaskets: Neoprene, continuous around door, positioned for direct compression with no sliding action between the door and gasket. Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.
8. Provide sealed sleeves, metal or plastic escutcheons or grommets for penetrations through casing for power and temperature control wiring and pneumatic tubing. Coordinate with electrical and temperature control subcontractors for number and location of penetrations. Coordinate lights, switches, and duplex receptacles and disconnect switch location and mounting. All penetrations and equipment mounting may be provided in the factory or in the field. All field penetrations shall be performed neatly by drilling or saw cutting. No cutting by torches will be allowed. Neatly seal all openings airtight.

E. Floor:

1. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (100 pounds per square foot) distributed load without permanent deformation or crushing of internal insulation. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insulation. Unit floors in casing sections, which may contain water or condensate, shall be watertight with drain pan.

- F. Condensate Drain Pan: Drain pan shall be designed to extend entire length of cooling coils including headers and return bends. Depth of

drain pan shall be at least 43 mm (1.7 inches) and shall handle all condensate without overflowing. Drain pan shall be of double wall construction of 304 stainless steel and have a minimum of 50 mm (2 inch) insulation, and shall be sloped to drain. Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan shall be placed on top of casing floor or integrated into casing floor assembly. Drain pan shall be pitched in all directions to drain line.

1. An intermediate condensate drip pan shall be provided on stacked cooling coils and shall be constructed of 304 stainless steel with copper downspouts factory piped to main condensate pan. Use of intermediate condensate drain channel on upper casing of lower coil is permissible provided it is readily cleanable. Design of intermediate condensate drain shall prevent upper coil condensate from flowing across face of lower coil.
2. Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.
3. Installation, including frame, shall be designed and sealed to prevent blow-by.

G. Fans Sections:

1. Fans shall be minimum Class II construction, double width, double inlet centrifugal, air foil or backward inclined type, factory balanced and rated in accordance with AMCA 210 or ASHRAE 51. Provide self-aligning, pillow block, regreasable ball-type bearings selected for a B (10) life of not less than 40,000 hours and an L(50) average fatigue life of 200,000 hours per AFBMA Standard 9. Extend bearing grease lines to motor and drive side of fan section. Fan shall be located in airstream to assure proper air flow.
2. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

H. Fan Motor, Drive and Mounting Assembly:

1. Provide internally vibration isolated fan, motor and drive, mounted on a common integral bolted or welded structural steel base with adjustable motor slide rail with locking device. Provide vibration isolators and flexible duct connections at fan discharge to completely isolate fan assembly. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, for additional requirements.
 2. Fan Motor and Drive: Motors shall be energy efficient type with efficiencies as shown on drawings and suitable for use in variable frequency drive applications on AHUs where this type of drive is indicated. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, for additional motor and drive specifications. Where variable speed drives are required they shall be compatible with fan and motor. Refer to Specification Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
 3. Fan drive and belts shall be factory mounted with final alignment and belt adjustment to be made by the Contractor after installation. Drive and belts shall be as specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Provide additional drive(s) if required during balancing, to achieve desired airflow.
- I. Mixing Boxes: Mixing box shall consist of casing and outdoor air and return air dampers in opposed blade arrangement with damper linkage for automatic operation. Coordinate damper operator with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Dampers shall be of ultra-low leak design with metal compressible bronze jamb seals and extruded vinyl edge seals on all blades. Blades shall rotate on stainless steel sleeve bearings or bronze bushings. Leakage rate shall not exceed 1.6 cubic meters/min/square meter (5 cfm per square foot) at 250 Pa (1 inch water gage) and 2.8 cubic meters/min/square meter (9 cfm per square foot) at 995 Pa (4 inches water gage) Electronic damper operators shall be furnished and mounted in an accessible and easily serviceable location by the air handling unit manufacturer at the factory. Damper operators shall be of same manufacturer as controls furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- J. Filter Section: Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES, for filter requirements.
1. Filters including one complete set for temporary use at site shall be provided independent of the AHU. The AHU manufacturer shall install

- filter housings and racks in filter section compatible with filters furnished. The AHU manufacturer shall be responsible for furnishing temporary filters (pre-filters and after-filters, as shown on drawings) required for AHU testing.
2. Factory-fabricated filter section shall be of the same construction and finish as the AHU casing including filter racks and hinged double wall access doors. Filter housings shall be constructed in accordance with side service or holding frame housing requirements in Section 234000, HVAC AIR CLEANING DEVICES.
- K. Coils: Coils shall be mounted on hot dipped galvanized steel supports to assure proper anchoring of coil and future maintenance. Coils shall be face or side removable for future replacement thru the access doors or removable panels. Each coil shall be removable without disturbing adjacent coil. Cooling coils shall be designed and installed to ensure no condensate carry over. Provide factory installed extended supply, return, drain and vent piping connections. Refer to Drawings and Section 23 82 16, AIR COILS for additional coil requirements.
- L. Humidifier: When indicated on the drawings, AHUs shall include factory installed humidifiers. Refer to Drawings and Section 23 21 13, HYDRONIC PIPING, for additional requirements.
- M. Discharge Section: Provide aerodynamically designed framed discharge openings or spun bellmouth fittings to minimize pressure loss.
- N. Electrical and Lighting: Wiring and equipment specifications shall conform to Division 26, ELECTRICAL.
1. Vapor-proof lights using cast aluminum base style with glass globe and cast aluminum guard shall be installed in access sections for fan, mixing box, humidifier and any section over 300mm (12 inch) wide. A switch shall control the lights in each compartment with pilot light mounted outside the respective compartment access door. Wiring between switches and lights shall be factory installed. All wiring shall run in neatly installed electrical conduits and terminate in a junction box for field connection to the building system. Provide single point 115 volt - one phase connection at junction box.
2. Install compatible 100 watt bulb in each light fixture.
3. Provide a GFCI convenience duplex receptacle next to the light switch.

4. Disconnect switch and power wiring: Provide factory or field mounted disconnect switch. Coordinate with Division 26, ELECTRICAL.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air handling unit in conformance with ARI 435.
- B. Assemble air handling unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas with paint in accordance with Military Spec. DOD-P-21035. Repair painted units by touch up of all scratches with finish paint material. Vacuum the interior of air handling units clean prior to operation.
- D. Leakage and test requirements for air handling units shall be the same as specified for ductwork in Specification Section 23 31 00, HVAC DUCTS AND CASINGS except leakage shall not exceed Leakage Class (C_L) 12 listed in SMACNA HVAC Air Duct Leakage Test Manual when tested at 1.5 times the design static pressure. Repair casing air leaks that can be heard or felt during normal operation and to meet test requirements.
- E. Perform field mechanical (vibration) balancing in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- F. Seal and/or fill all openings between the casing and AHU components and utility connections to prevent air leakage or bypass.

3.2 STARTUP SERVICES

- A. A factory-trained service representative of the manufacturer shall supervise the unit startup and application specific calibration of control components.
- B. The air handling unit shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated and fan has been test run under observation.
- C. After the air handling unit is installed and tested, provide startup and operating instructions to VA personnel.

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SECTION 23 82 00
CONVECTION HEATING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Radiant ceiling panels
 - 1. Electric (bathrooms)
 - 2. Hot water (perimeter)

1.2 RELATED WORK

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.
- B. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise requirements.
- C. Section 23 21 13, HYDRONIC PIPING: Heating hot water and chilled water piping.
- D. Section 23 31 00, HVAC DUCTS AND CASINGS: Ducts and flexible connectors.
- E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Valve operators.
- F. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Flow rates adjusting and balancing.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Radiant ceiling panels.
- D. Certificates:
 - 1. Compliance with paragraph, QUALITY ASSURANCE.
 - 2. Compliance with specified standards.
- E. Operation and Maintenance Manuals: Submit in accordance with paragraph, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (ARI):
440-05Room Fan Coils
- C. National Fire Protection Association (NFPA):
90A-02Standard for the Installation of Air
Conditioning and Ventilating Systems
70-05National Electrical Code
- D. Underwriters Laboratories, Inc. (UL):
181-05Standard for Factory-Made Air Ducts and Air
Connectors
1995-05Heating and Cooling Equipment

1.6 GUARANTY

In accordance with FAR clause 52.246-21.

PART 2 - PRODUCTS**2.8 RADIANT CEILING PANELS:**

- A. Electric Heating Panels: UL listed, 0.55 mm (26 gage) steel backplate, 0.70 mm (24 gage) steel faceplate, with one inch thick insulation between plates and over radiant panel. Finish with two coats flat white baked-on polyester paint for lay-in installation in an exposed "T" suspended ceiling.
1. Controls: Provide low voltage wall thermostats and required control transformers, relays and contactors for installation by the Electrical Contractor.
- B. Hydronic Radiant Panels: Lay-in type, 1.00 mm (0.040) inch aluminum faceplate with 13 mm (1/2-inch) I.D copper serpentine water coil mechanically bonded to faceplate, finished with two coats baked white polyester finish with a light reflection value of 70 to 80 percent. Panels shall weigh no more than 0.68 kg (1.5 pounds) per square foot when filled with water. Provide (3 IN) unfaced fiberglass blanket insulation pre-cut for installation above panels.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.
- B. Handle and install units in accordance with manufacturer's written instructions.
- C. Support units rigidly so they remain stationary at all times.
Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.
- D. Install fiberglass blanket insulation above hydronic radiant panels.

3.2 OPERATIONAL TEST

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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SECTION 23 82 16
AIR COILS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies heating and cooling coils for air handling units and duct applications.

1.2 RELATED WORK

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.3 QUALITY ASSURANCE

- A. Refer to paragraph, QUALITY ASSURANCE, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Unless specifically exempted by these specifications, heating and cooling coils shall be tested, rated, and certified in accordance with AHRI Standard 410 and shall bear the AHRI certification label.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data for Heating and Cooling Coils: Submit type, size, arrangements and performance details. Present application ratings in the form of tables, charts or curves.
- C. Provide installation, operating and maintenance instructions.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating and Refrigeration Institute (AHRI):
AHRI 410-02Forced-Circulation Air-Cooling Air-Heating
Coils.
- C. American Society for Testing and Materials (ASTM):
B75/75M-02Seamless Copper Tube (Metric)
- D. National Fire Protection Association (NFPA):
70-08National Electric Code
- E. National Electric Manufacturers Association (NEMA):
250-08Enclosures for Electrical Equipment (1,000 Volts
Maximum)
- F. Underwriters Laboratories, Inc. (UL):
1996-2004Electric Duct Heaters
- G. National Electrical Manufacturer's Association (NEMA):
70-2008National Electrical Code

PART 2 - PRODUCTS

2.1 HEATING AND COOLING COILS

- A. Conform to ASTM B75 and AHRI 410.
- B. Tubes: Minimum 16 mm (0.625 inch) tube diameter; Seamless copper tubing.
- C. Fins: 0.1397 mm (0.0055 inch) aluminum or 0.1143 mm (0.0045 inch) copper mechanically bonded or soldered or helically wound around tubing. Fin spacing of 2.6 through 4.7 fins per cm (80 through 144 fins per foot).
- D. Headers: Copper, welded steel or cast iron. Provide seamless copper tubing or resistance welded steel tube for volatile refrigerant coils.
- E. "U" Bends, Where Used: Machine die-formed, silver brazed to tube ends.
- F. Coil Casing: 1.6 mm (16 gage) galvanized steel with tube supports at 1200 mm (48 inch) maximum spacing. Construct casing to eliminate air bypass and moisture carry-over. Provide duct connection flanges.
- G. Pressures kPa (PSIG):

Pressure	Water Coil
Test	2070 (300)
Working	1380 (200)

- H. Protection: Unless protected by the coil casing, provide cardboard, plywood, or plastic material at the factory to protect tube and finned surfaces during shipping and construction activities.
- I. Vents and Drain: Coils that are not vented or drainable by the piping system shall have capped vent/drain connections extended through coil casing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Follow coil manufacturer's instructions for handling, cleaning, installation and piping connections.
- B. Comb fins, if damaged. Eliminate air bypass or leakage at coil sections.

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SECTION 23 84 00
HUMIDITY CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies desiccant dehumidifier units for preconditioning of existing or new air conditioning systems

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: Requirements for pre-test of equipment.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 21 13, HYDRONIC PIPING: Requirements for field hot water piping.
- D. Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING: Requirements for field steam and condensate piping.
- E. Section 23 82 16, AIR COILS: Requirements for run-around system coils.
- F. Section 23 31 00, HVAC DUCTS AND CASINGS: Requirements for sheet metal ducts and fittings.
- G. Section 23 40 00, HVAC AIR CLEANING DEVICES: Requirements for filters including efficiency.
- H. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.
- I. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Requirements for testing, adjusting and balancing of HVAC system.
- J. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT: Requirements for HVAC motors.

1.3 QUALITY ASSURANCE

- A. Refer to paragraph, GUARANTEE, in specification Section 00 72 00, GENERAL CONDITIONS.
- B. Refer to specification Section 01 00 00, GENERAL REQUIREMENTS for performance tests and instructions to VA personnel.
- C. Refer to paragraph, QUALITY ASSURANCE, in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- D. Unit(s) shall be provided by a manufacturer who has been manufacturing desiccant dehumidifiers and have been in satisfactory service for at least five (5) years.

1.4 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Technical data on design operating inlet and outlet conditions, air flows with diagram showing air volumes and conditions throughout the system, dehumidification capacity, filtration and fan motor and electrical power data.
 - 2. A general arrangement diagram with overall dimensions showing all major components with overall dimensions, utility and duct work connections, bolting arrangement, operating weight and required service and equipment removal clearances.
 - 3. Control diagrams for preconditioning new air conditioning system, electric circuits interface all control set points.
- C. Certificate: Evidence of satisfactory performance on three similar installations.
- D. Provide installation, operating and maintenance instructions, in accordance with Article, INSTRUCTIONS, in specification Section 01 00 00, GENERAL REQUIREMENTS.
- E. Performance test report.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air-conditioning and Refrigeration Institute (ARI)
 - 410-01Forced-Circulation Air-Cooling and Air-Heating Coils
- C. Air Movement and Control Association (AMCA):
 - 210-99Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI)
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 - 52.2-07METHOD OF TESTING General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size (ANSI)
 - 62.1-07Ventilation for Acceptable Indoor Air Quality (ANSI)
- E. American Bearing Manufacturers Association (ABMA)

9-1990 (R2000)Load Ratings and Fatigue Life for Ball
Bearings (ANSI)

F. National Fire Protection Association (NFPA)

90A-02Standard for the Installation of Air-
Conditioning and Ventilating Systems

70-05National Electrical Code

PART 2 - PRODUCTS

2.1 HUMIDIFIER UNITS

A. General: Devices shall be complete, factory assembled, and tested; and of sizes, arrangements, capacities, and performance as scheduled and as specified herein suitable; and for installation within the air handling unit for humidifying the supply air.

B. Humidifier:

1. The humidifier shall provide absorption characteristics that do not allow water accumulation on any in-duct surface within 6" (152 mm) of the humidifier tube panel while maintaining conditions of 75% maximum relative humidity at a minimum of 55°F (13°C) in the duct airstream.
2. Air pressure loss across the humidifier panel shall not exceed 0.16" water column at a duct air velocity of 1600 fpm.
3. Each packaged humidifier panel assembly of tubes and headers shall be contained within a galvanized metal casing to allow convenient air handling unit mounting.
4. All tubes and headers shall be 304 stainless steel and be Heli-arc welded. Tubes shall be joined to headers with slip-fit couplings.

C. Controls and Wiring:

1. All internal wiring shall be in accordance with the National Electrical Code.
2. Controls shall be capable of shutting down the humidifier when humidity loads are increased and the process shall be reversed when there is a reduction in humidity loads.

D. Drain Pan and Connection: Stainless steel and complying with ASHRAE 62.1-2007.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow equipment manufacturer's written instructions for handling and installation of equipment.

- B. Verify correct settings and installation of controls.

3.2 CONNECTIONS

- A. Install piping adjacent to machine to allow service and maintenance.
- C. Connect condensate drain pans using minimum NPS 1 copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan, and install clean out at changes in direction.
- D. Steam and Condensate Piping: Comply with applicable requirements in Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING. Connect with shutoff valve and union or flange.

3.3 STARTUP SERVICE

- A. Perform the following final checks before startup:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connection to piping, ducts, and electrical systems are complete.
 - 3. Perform cleaning and adjusting specified in this Section.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Startup Report: Report findings during startup. Identify startup steps, corrective measures taken, and final results.

3.4 ADJUSTING

- A. Adjust initial temperature and humidity set points.

3.5 CLEANING

- A. Clean humidification units internally, on completion of installation, according to manufacturer's written instructions.

3.6 INSTRUCTIONS

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of humidification coils.

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SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, motor control centers, and other items and arrangements for the specified items are shown on drawings.
- C. Electrical service entrance equipment (arrangements for temporary and permanent connections to the utility's system) shall conform to the utility's requirements. Coordinate fuses, circuit breakers and relays with the utility's system, and obtain utility approval for sizes and settings of these devices.
- D. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. References to the International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as

NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed; Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled; Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified; equipment or product which:
 - a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
 - c. Bears a label, tag, or other record of certification.
4. Nationally recognized testing laboratory; laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.

2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

Applicable publications listed in all Sections of Division are the latest issue, unless otherwise noted.

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class or type of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.

2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.

4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COTR a minimum of 15 working days prior to the manufacturers making the factory tests.

2. Four copies of certified test reports containing all test data shall be furnished to the COTR prior to final inspection and not more than 90 days after completion of the tests.

3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.7 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 EQUIPMENT PROTECTION

- A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
 - 1. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to switchgear, switchboards, panelboards, transformers, motor control centers, motor controllers, uninterruptible power systems, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
 - 2. During installation, equipment shall be protected against entry of foreign matter; and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
 - 3. Damaged equipment shall be, as determined by the COTR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 - 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 - 5. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished

in this manner for the required work, the following requirements are mandatory:

1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
 2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
 3. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and documented by the COTR and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
 4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COTR.
- D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the NEC for all voltages specified.
- C. Inaccessible Equipment:
 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 2. "Conveniently accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over

obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. Nameplates for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Nameplates for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch [12mm] high. Nameplates shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

1.12 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements.
Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
3. Parts list which shall include those replacement parts recommended by the equipment manufacturer.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.

- h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of manuals together with shop drawings.
- H. After approval and prior to installation, furnish the COTR with one sample of each of the following:
- 1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
 - 2. Each type of conduit coupling, bushing and termination fitting.
 - 3. Conduit hangers, clamps and supports.
 - 4. Duct sealing compound.
 - 5. Each type of receptacle, toggle switch, occupancy sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 ACCEPTANCE CHECKS AND TESTS

The contractor shall furnish the instruments, materials and labor for field tests.

1.15 TRAINING

- A. Training shall be provided in accordance with Article 1.25, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the COTR at least 30 days prior to the planned training.

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SECTION 26 05 21
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

1.2 RELATED WORK

- A. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. General electrical requirements that are common to more than one section in Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 - 1. Manufacturer's Literature and Data: Showing each cable type and rating.
 - 2. Certificates: Two weeks prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
 - D2301-04Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical Insulating
Tape
- C. Federal Specifications (Fed. Spec.):
 - A-A-59544-00Cable and Wire, Electrical (Power, Fixed
Installation)

D. National Fire Protection Association (NFPA):

70-05National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-02Thermoset-Insulated Wires and Cables

83-03Thermoplastic-Insulated Wires and Cables

467-01Electrical Grounding and Bonding Equipment

486A-01Wire Connectors and Soldering Lugs for Use with
Copper Conductors

486C-02Splicing Wire Connectors

486D-02Insulated Wire Connector Systems for Underground
Use or in Damp or Wet Locations

486E-00Equipment Wiring Terminals for Use with Aluminum
and/or Copper Conductors

493-01Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cable

514B-02Fittings for Cable and Conduit

1479-03Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CABLE AND WIRE (POWER AND LIGHTING)

A. Cable and Wire shall be in accordance with Fed. Spec. A-A-59544, except as hereinafter specified.

B. Single Conductor:

1. Shall be annealed copper.

2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.

3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.

C. Insulation:

1. THW, XHHW, or dual rated THHN-THWN shall be in accordance with UL 44, and 83.

2. Direct burial: UF or USE shall be in accordance with UL 493.

3. Isolated power system wiring: Type XHHW with a dielectric constant of 3.5 or less.

D. Color Code:

1. Secondary service, feeder and branch circuit conductors shall be color coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

- a. The lighting circuit "switch legs" and 3-way switch "traveling wires" shall have color coding unique and distinct (i.e. pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Field coordinate for a final color coding with the COTR.
2. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors and neutral sizes.
3. Phase conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
 - a. Solid color compound or solid color coating.
 - b. Stripes, bands, or hash marks of color specified above.
 - c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (three inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES AND JOINTS

- A. In accordance with UL 486A, C, D, E and NEC.
- B. Branch circuits (No. 10 AWG and smaller):
 1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped wires.

3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.

C. Feeder Circuits:

1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.
4. Plastic electrical insulating tape: ASTM D2304 shall apply, flame retardant, cold and weather resistant.

2.3 CONTROL WIRING

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 WIRE LUBRICATING COMPOUND

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

2.5 FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with the NEC, and as specified.

- B. Install all wiring in raceway systems, except where direct burial or HCF Type AC cables are used.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- G. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- H. Wire Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use ropes made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COTR.
 - 4. Pull in multiple cables together in a single conduit.
- I. No more than (3) single-phase branch circuits shall be installed in any one conduit.
- J. The wires shall be derated in accordance with NEC Article 310. Neutral wires, under conditions defined by the NEC, shall be considered current-carrying conductors.

3.2 SPLICE INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

3.3 CONTROL AND SIGNAL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.4 CONTROL AND SIGNAL SYSTEM IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.5 FEEDER IDENTIFICATION

- A. In each interior pulbox and junction box, install metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.
- B. In each manhole and handhole, provide tags of the embossed brass type, showing the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

3.6 EXISTING WIRING

Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

3.7 FIELD TESTING

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Tests shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductor phase-to-phase and phase-to-ground.
- D. The Contractor shall furnish the instruments, materials, and labor for these tests.

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Product Data:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:
 - 1. Certification that the materials and installation is in accordance with the drawings and specifications.
 - 2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.4 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

- A. American Society for Testing and Materials (ASTM):
 - B1-2001Standard Specification for Hard-Drawn Copper Wire
 - B8-2004Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-1983IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- C. National Fire Protection Association (NFPA):
 - 70-2005National Electrical Code (NEC)
 - 99-2005Health Care Facilities
- D. Underwriters Laboratories, Inc. (UL):
 - 44-2005Thermoset-Insulated Wires and Cables
 - 83-2003Thermoplastic-Insulated Wires and Cables
 - 467-2004Grounding and Bonding Equipment
 - 486A-486B-2003Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.

- D. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.2 GROUND RODS

- A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 SPLICES AND TERMINATION COMPONENTS

Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.4 GROUND CONNECTIONS

- A. Above Grade:
1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
 3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x 3/4 inch).

2.6 GROUND TERMINAL BLOCKS

At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.7 SPLICE CASE GROUND ACCESSORIES

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
 3. Isolation transformers and isolated power systems shall not be system grounded.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.
- D. Special Grounding: For patient care area electrical power system grounding, conform to NFPA 99, and NEC.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
 2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- C. Conduit Systems:
1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.

3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- D. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- E. Boxes, Cabinets, Enclosures, and Panelboards:
 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- F. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- G. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
- H. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- I. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- J. Panelboard Bonding: The equipment grounding terminal buses of the normal and essential branch circuit panelboards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than 16 mm² (10 AWG). These conductors shall be installed in rigid metal conduit.

3.4 CORROSION INHIBITORS

When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.5 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the gases and suction piping, at the outlets, directly to the room or patient ground bus.

3.6 WIREWAY GROUNDING

- A. Ground and Bond Metallic Wireway Systems as follows:
 - 1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
 - 2. Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
 - 3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
 - 4. Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

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SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Mounting board for telephone closets: Section 06 10 00, ROUGH CARPENTRY.
- B. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- C. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- D. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- E. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- F. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

- A. Shop Drawings:
 - 1. Size and location of main feeders;
 - 2. Size and location of panels and pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):
70-08National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL):
1-03Flexible Metal Conduit
5-01Surface Metal Raceway and Fittings
6-03Rigid Metal Conduit
50-03Enclosures for Electrical Equipment
360-03Liquid-Tight Flexible Steel Conduit
467-01Grounding and Bonding Equipment
514A-01Metallic Outlet Boxes
514B-02Fittings for Cable and Conduit
514C-05Nonmetallic Outlet Boxes, Flush-Device Boxes and
Covers
651-02Schedule 40 and 80 Rigid PVC Conduit
651A-03Type EB and A Rigid PVC Conduit and HDPE Conduit
797-03Electrical Metallic Tubing
1242-00Intermediate Metal Conduit
- D. National Electrical Manufacturers Association (NEMA):
TC-3-04PVC Fittings for Use with Rigid PVC Conduit and
Tubing
FB1-03Fittings, Cast Metal Boxes and Conduit Bodies
for Conduit, Electrical Metallic Tubing and
Cable

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (3/4 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Conduit:
1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
 2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.

3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
 4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
 5. Flexible galvanized steel conduit: Shall Conform to UL 1.
 6. Surface metal raceway: Shall Conform to UL 5.
- C. Conduit Fittings:
1. Rigid steel and IMC conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - a. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 2. Rigid aluminum conduit fittings:
 - a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
 - b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
 - c. Set screw fittings: Not permitted for use with aluminum conduit.
 3. Electrical metallic tubing fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.

- d. Indent type connectors or couplings are prohibited.
- e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- 4. Flexible steel conduit fittings:
 - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp type, with insulated throat.
- 5. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- 6. Expansion and deflection couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
 - 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
 - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 - 3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
 - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
 - 1. UL-50 and UL-514A.
 - 2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
 - 3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
 - 4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall.

Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

- F. Wireways: Equip with hinged covers, except where removable covers are shown.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:

1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COTR prior to drilling through structural sections.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COTR as required by limited working space.

- B. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, as shown, and as hereinafter specified.
- B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where specifically "accepted" by NEC Article 517.
- C. Install conduit as follows:
1. In complete runs before pulling in cables or wires.
 2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
 3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
 5. Mechanically and electrically continuous.
 6. Independently support conduit at 8'0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).

7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
 8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
 9. Conduit installations under fume and vent hoods are prohibited.
 10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
 11. Do not use aluminum conduits in wet locations.
 12. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.
- D. Conduit Bends:
1. Make bends with standard conduit bending machines.
 2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
 3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown.
 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR.

3.3 CONCEALED WORK INSTALLATION

- A. In Concrete:
1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
 2. Align and run conduit in direct lines.
 3. Install conduit through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
 4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
 - a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.

- b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
- c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
- 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.
- B. Furred or Suspended Ceilings and in Walls:
 - 1. Conduit for conductors 600 volts and below:
 - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
 - 2. Align and run conduit parallel or perpendicular to the building lines.
 - 3. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture.
 - 4. Tightening set screws with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 volts and below:
 - 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
 - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 - 2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.
- B. Install UL approved sealing fittings, that prevent passage of explosive vapors, in hazardous areas equipped with explosive proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.6 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.
- C. Unless otherwise shown, use rigid steel or IMC conduit within 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

3.7 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.8 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

C. Install expansion and deflection couplings where shown.

3.9 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
 - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 BOX INSTALLATION

- A. Boxes for Concealed Conduits:

1. Flush mounted.
 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

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SECTION 26 09 23
LIGHTING CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of the lighting controls.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 26 24 16, PANELBOARDS: Panelboard enclosure and interior bussing used for lighting control panels.
- E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Product Data: For each type of lighting control, submit the following information.
 - 1. Manufacturer's catalog data.
 - 2. Wiring schematic and connection diagram.
 - 3. Installation details.
- C. Manuals:
 - 1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
 - 2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the Contracting Officer's Technical Representative (COTR).
- D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the COTR:

- a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Green Seal (GS):
GC-12Occupancy Sensors
- C. Illuminating Engineering Society of North America (IESNA):
IESNA LM-48 Guide for Calibration of Photoelectric Control Devices
- D. National Electrical Manufacturer's Association (NEMA)
C136.10American National Standard for Roadway Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
ICS-1Standard for Industrial Control and Systems General Requirements
ICS-2..... Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
ICS-6Standard for Industrial Controls and Systems Enclosures
- E. Underwriters Laboratories, Inc. (UL):
20Standard for General-Use Snap Switches
773Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting
773ANonindustrial Photoelectric Switches for Lighting Control
98Enclosed and Dead-Front Switches
917.....Clock Operated Switches

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

- A. Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: SPST.
 - 2. Contact Rating: 40-A inductive or resistive, 240-V ac and 20-A ballast load, 120/240-V ac.
 - 3. Astronomical Clock: Capable of switching a load on at sunset and off at sunrise, and automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Additionally, it shall be programmable to a fixed on/off weekly schedule.
 - 4. Battery Backup: For schedules and time clock.

2.2 TIMER SWITCHES

- A. Digital switches with backlit LCD display, 120/277 volt rated, fitting as a replacement for standard wall switches.
 - 1. Compatibility: Compatible with all ballasts.
 - 2. Warning: Audible warning to sound during the last minute of "on" operation.
 - 3. Time-out: Adjustable from 5 minutes to 12 hours.
 - 4. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

2.3 INDOOR OCCUPANCY SENSORS

- A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.
 - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
 - 2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
 - 3. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
 - 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Manual/automatic selector switch.
 9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
- B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch [150mm] minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. [232 sq. cm], and detect a person of average size and weight moving not less than 12 inches [305 mm] in either a horizontal or a vertical manner at an approximate speed of 12 inches/s [305 mm/s].
 3. Detection Coverage: as scheduled on drawings.

2.4 LIGHTING CONTROL PANEL - RELAY TYPE

- A. Controller: Comply with UL 508; programmable, solid-state, astronomic 365-day control unit with non-volatile memory, mounted in preassembled relay panel with low-voltage-controlled, latching-type, single-pole lighting circuit relays. Controller shall be capable of receiving inputs from sensors and other sources, and capable of timed overrides and/or blink-warning on a per-circuit basis. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays.
- B. Cabinet: Steel with hinged, locking door. Barriers separate low-voltage and line-voltage components.
- C. Directory: Identifies each relay as to load controlled.
- D. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
- E. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125-V ac for tungsten filaments and 20 A, 277-V ac for ballasts, 50,000 cycles at rated capacity.
- F. Double-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 40A, 240-V AC for resistive loads.

2.5 LIGHTING CONTROL PANEL - MICRO-PANELS

- A. Micro relay panels shall have from 2 to 8 relays and shall control all lighting in the designated area indicated on the plans and be part of the lighting control network. Each micro relay panel shall provide minimum 300ma at 12/24vdc for powering occupancy sensors. Micro relay panels that require a separate occupancy sensor power pack are not acceptable.
- B. Micro relay panels shall be capable of outputting a minimum of 4 and up to 8 independent 0v to 10v dimming signals, one independent dimming signal per relay for each of 8 relays. In order to maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim, fade up rate, fade down rate, time delay and enable/disable masking. All photocell settings must be remotely accessible. Systems providing On, Off with Time Delay only, and system that do not provide remote access are not acceptable.

2.5 LOW VOLTAGE SWITCHES

- A. All switches shall be digital and communicate via RS 485. Contact closure style switches, except as specified for connection to the micro relay panel programmable contact closure inputs, shall not be acceptable. The programming for a digital switch shall reside in the switch itself, via double EPROM memory. Any digital switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.
- B. Digital low voltage switch shall be a device that sits on the lighting control system bus. Digital switch shall connect to the system bus using the same cable and connection method required for relay panels. Each button shall be capable of being programmed for On only, Off only, Mix (Some on some off), On/Off (toggle), Raise (Dim up) and Lower (Dim down). Further each button shall be able to be enabled or disabled over the bus. An audible alarm shall be available on all switches that can be programmed to beep on button push or with warning light blinks.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
- B. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer's recommendations.

- C. Set occupancy sensor "on" duration to 15 minutes.
- D. Label time switches and contactors with a unique designation.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations.
- B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.
- C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.
- D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.
- E. Program lighting control panels per schedule on drawings.
- F. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory-authorized technician who will verify all adjustments and sensor placements.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function.

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SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of panelboards.

1.2 RELATED WORK

- A. Section 09 91 00, PAINTING: Identification and painting of panelboards.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.
- D. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, materials, wiring diagrams accessories and weights of equipment. Complete nameplate data including manufacturer's name and catalog number.
- C. Certification: Two weeks prior to final inspection, submit four copies of the following to the COTR:
 - 1. Certification that the material is in accordance with the drawings and specifications has been properly installed, and that the loads are balanced.

1.4 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent

referenced. Publications are referenced in the text by the basic designation only.

- A. National Electrical Manufacturers Association (NEMA):
 - PB-1-2006Panelboards
 - AB-1-2002Molded Case Circuit Breakers, Molded Case
Switches and Circuit Breaker Enclosures
- B. National Fire Protection Association (NFPA):
 - 70-2005National Electrical Code (NEC)
 - 70E-2004Standard for Electrical Life Safety in the
Workplace
- C. Underwriters Laboratories, Inc. (UL):
 - 50-2003Enclosures for Electrical Equipment
 - 67-2003Panel boards
 - 489-2006Molded Case Circuit Breakers and Circuit
Breaker Enclosures

PART 2 - PRODUCTS

2.1 PANELBOARDS

- A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.
- B. Panelboards shall be standard manufactured products. All components of the panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards to be of the same manufacturer.
- C. All panelboards shall be hinged "door in door" type with:
 - 1. Interior hinged door with hand operated latch or latches as required to provide access to circuit breaker operating handles only, not to energized ports.
 - 2. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips or other fasteners requiring a tool for entry, hand operated latches are not acceptable.
 - 3. Push inner and outer doors shall open left to right.
- D. All panelboards shall be completely factory assembled with molded case circuit breakers. Include one-piece removable, inner dead front cover independent of the panelboard cover.

- E. Panelboards shall have main breaker or main lugs, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as scheduled on the drawings.
- F. Panelboards shall conform to NEMA PB-1, NEMA AB-1 and UL 67 and have the following features:
1. Nonreduced size copper or aluminum bus bars, complete with current ratings as shown on the panel schedules connection straps bolted together and rigidly supported on molded insulators.
 2. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard busing shall be such that when any two adjacent single-pole breakers are connected to opposite phases, two-pole breakers can be installed in any location. Three-phase, four-wire busing shall be such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two-or three-pole breakers can be installed at any location. Current-carrying parts of the bus assembly shall be plated. Mains ratings shall be as shown.
 3. Mechanical lugs furnished with panelboards shall be cast, stamped or machined metal alloys of sizes suitable for the conductors indicated to be connected thereto.
 4. Neutral bus shall be 100% rated, mounted on insulated supports.
 5. Grounding bus bar equipped with screws or lugs for the connection of grounding wires.
 6. Buses braced for the available short circuit current, but not less than 22,000 amperes symmetrical for 120/208 volt and 120/240 volt panelboards, and 14,000 amperes symmetrical for 277/480-volt panelboards.
 7. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.
 8. Protective devices shall be designed so that they can be easily replaced.
 9. Where designated on panel schedule "spaces", include all necessary bussing, device support and connections. Provide blank cover for each space.

10. In two section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panels, and with cable connections to the second section. Panelboard sections with tapped bus or crossover bus are not acceptable.

11. Series rated panelboards are not permitted.

2.2 CABINETS AND TRIMS

A. Cabinets:

1. Provide galvanized steel cabinets to house panelboards. Cabinets for outdoor panels shall be factory primed and suitably treated with a corrosion-resisting paint finish meeting UL 50 and UL 67.
2. Cabinet enclosure shall not have ventilating openings.
3. Cabinets for panelboards may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.

2.3 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS

A. Breakers shall be UL 489 listed and labeled, in accordance with the NEC, as shown on the drawings, and as specified.

B. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar.

1. Molded case circuit breakers for lighting and appliance branch circuit panelboards shall have minimum interrupting rating as indicated but not less than:
 - a. 120/208 Volt Panelboard: 22,000 amperes symmetrical.
 - b. 120/240 Volt Panelboard: 22,000 amperes symmetrical.
 - c. 277/480 Volt Panelboard: 14,000 amperes symmetrical.
2. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100-ampere frame or less.

C. Breaker features shall be as follows:

1. A rugged, integral housing of molded insulating material.
2. Silver alloy contacts.
3. Arc quenchers and phase barriers for each pole.
4. Quick-make, quick-break, operating mechanisms.

5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates ON, TRIPPED, and OFF positions.
 - a. Line connections shall be bolted.
 - b. Interrupting rating shall not be less than the maximum short circuit current available at the line terminals as indicated on the drawings.
8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
9. Shunt trips shall be provided where indicated
10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory.

2.4 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.
- B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the breakers are being installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the Manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected. Coordinate the sizes of cabinets with designated closet space.
- C. In accordance with Section 09 91 00, PAINTING, paint the panelboard system voltage, and feeder sizes as shown on the riser diagram in 1 inch block lettering on the inside cover of the cabinet door. Paint the words "LIFE SAFETY BRANCH", "CRITICAL BRANCH", or "EQUIPMENT SYSTEM" as applicable and the panel designation in one inch block letters on the outside of the cabinet doors.

- D. Install a typewritten schedule of circuits in each panelboard after being submitted to and approved by the COTR. Schedules, after approval, shall be typed on the panel directory cards and installed in the appropriate panelboards, incorporating all applicable contract changes pertaining to that schedule. Include the room numbers and items served on the cards.
- E. Mount the panelboard fully aligned and such that the maximum height of the top circuit breaker above finished floor shall not exceed 1980 mm (78 inches). For panelboards that are too high, mount panelboard so that the bottom of the cabinets will not be less than 150 mm (6 inches) above the finished floor.
- F. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.
- G. Directory-card information shall be typewritten to indicate outlets, lights, devices, and equipment controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.
- H. Where new panels are to be installed in existing backboxes, backboxes shall have rust and scale removed from inside. Paint inside of backboxes with rust preventive paint before the new panel interior is installed. Provide new trim and doors for these panels. Covers shall fit tight to the box with no gaps between the cover and the box.
- I. Provide ARC flash identification per NFPA 70E.

- - - E N D - - -

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of wiring devices.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlets boxes.
- C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, construction materials, grade and termination information.
- C. Manuals: Two weeks prior to final inspection, deliver four copies of the following to the COTR: Technical data sheets and information for ordering replacement units.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent

referenced. Publications are referenced in the text by basic designation only.

- B. National Fire Protection Association (NFPA):
 - 70National Electrical Code (NEC)
- C. National Electrical Manufacturers Association (NEMA):
 - WD 1General Color Requirements for Wiring Devices
 - WD 6Wiring Devices - Dimensional Requirements
- D. Underwriter's Laboratories, Inc. (UL):
 - 5Surface Metal Raceways and Fittings
 - 20General-Use Snap Switches
 - 231Power Outlets
 - 467Grounding and Bonding Equipment
 - 498Attachment Plugs and Receptacles
 - 943Ground-Fault Circuit-Interrupters

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall be listed by Underwriters Laboratories, Inc., and conform to NEMA WD 6.
 - 1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
 - 2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four min.) and side wiring from four captively held binding screws.
- B. Duplex Receptacles: Hospital-grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6. The duplex type shall have break-off feature for two-circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal.
 - 1. Bodies shall be ivory in color.
 - 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The remaining receptacle shall be unswitched.
 - 3. Duplex Receptacles on Emergency Circuit:
 - a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
 - b. Bodies shall be red in color.
 - 4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box.

- a. Ground fault interrupter shall be consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliamp) on the load side of the device. Device shall have a minimum nominal tripping time of 1/30th of a second.
 - b. Ground Fault Interrupter Duplex Receptacles (not hospital-grade) shall be the same as ground fault interrupter hospital-grade receptacles except for the "hospital-grade" listing.
5. Safety Type Duplex Receptacles:
- a. Bodies shall be gray in color.
 - 1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
 - 2) Screws exposed while the wall plates are in place shall be the tamperproof type.
 - C. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.

2.2 TOGGLE SWITCHES

- A. Toggle Switches: Shall be totally enclosed tumbler type with bodies of phenolic compound. Toggle handles shall be ivory in color unless otherwise specified. The rocker type switch is not acceptable and will not be approved.
1. Switches installed in hazardous areas shall be explosion proof type in accordance with the NEC and as shown on the drawings.
 2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
 3. Ratings:
 - a. 120 volt circuits: 20 amperes at 120-277 volts AC.
 - b. 277 volt circuits: 20 amperes at 120-277 volts AC.

2.3 WALL PLATES

- A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.

- B. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD 6.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- D. In psychiatric areas, wall plates shall be 302 stainless steel, have tamperproof screws and beveled edges.
- E. Wall plates for data, telephone or other communication outlets shall be as specified in the associated specification.
- F. Duplex Receptacles on Emergency Circuit:
 - 1. Bodies shall be red in color. Wall plates shall be red with the word "EMERGENCY" engraved in 6 mm, (1/4 inch) white letters.

2.4 SURFACE MULTIPLE-OUTLET ASSEMBLIES

- A. Assemblies shall conform to the requirements of NFPA 70 and UL 5.
- B. Shall have the following features:
 - 1. Enclosures:
 - a. Thickness of steel shall be not less than 0.040 inch [1mm] steel for base and cover. Nominal dimension shall be 1-1/2 by 2-3/4 inches [40 by 70mm] with inside cross sectional area not less than 3.5 square inches [2250 square mm]. The enclosures shall be thoroughly cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard baked enamel or lacquer finish.
 - 2. Receptacles shall be duplex, hospital grade. See paragraph 'RECEPTACLES' in this section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
 - 3. Unless otherwise shown on drawings, spacing of the receptacles along the strip shall be 24 inches [600mm] on centers.
 - 4. Wires within the assemblies shall be not less than No. 12 AWG copper, with 600 volt ratings.
 - 5. Installation fittings shall be designed for the strips being installed including bends, offsets, device brackets, inside couplings, wire clips, and elbows.
 - 6. Bond the strips to the conduit systems for their branch supply circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the green equipment grounding conductor.
- C. Outlet boxes for light and dimmer switches shall be mounted on the strike side of doors.
- D. Provide barriers in multigang outlet boxes to separate systems of different voltages, Normal Power and Emergency Power systems, and in compliance with the NEC.
- E. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- F. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades. In addition, check for exact direction of door swings so that local switches are properly located on the strike side.
- G. Install wall switches 48 inches [1200mm] above floor, OFF position down.
- H. Install convenience receptacles 18 inches [450mm] above floor, and 6 inches [152mm] above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- I. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.
- J. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
- k. Test GFCI devices for tripping values specified in UL 1436 and UL 943.

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SECTION 26 43 13
TRANSIENT-VOLTAGE SURGE SUPPRESSION

PART 1 - GENERAL

1.1 DESCRIPTION

Section includes transient voltage surge suppression equipment for low-voltage power distribution and control equipment.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 24 16, PANELBOARDS: For factory-installed TVSS.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.
- C. Warranties: Sample of special warranties.
- D. Certifications:
 - 1. Two weeks prior to final inspection, submit four copies of the following to the COTR:
 - a. Certification by the Contractor that the assemblies have been properly installed, adjusted and tested.
 - b. Certified copies of all of the factory design and production tests, field test data sheets and reports for the assemblies.

1.5 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplement and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

- A. Institute of Engineering and Electronic Engineers (IEEE):
 - IEEE C62.41.2Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

IEEE C62.45Recommended Practice on Surge Testing for
Equipment Connected to Low-Voltage (1000
V and Less) AC Power Circuits

B. National Electrical Manufacturers Association (NEMA):

NEMA LS 1Low Voltage Surge Protective Devices

C. Underwriters Laboratories, Inc. (UL):

UL 1283Electromagnetic Interference Filters

UL 1449.....Surge Protective Devices

D. National Fire Protection Association (NFPA):

NFPA 70National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 PANELBOARD SUPPRESSORS

A. Surge Protection Devices:

1. Non-modular.
2. LED indicator lights for power and protection status.
3. Audible alarm, with silencing switch, to indicate when protection has failed.

B. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

C. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

D. Protection modes and UL 1449 SVR for grounded wye circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
2. Line to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
3. Neutral to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.

2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices panelboard on load side, with ground lead bonded to ground.

- B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide a circuit breaker, sized by manufacturer, as a dedicated disconnecting means for TVSS unless otherwise shown on drawings.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:
 - 1. Visual and Mechanical Inspection
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify that disconnecting means and feeder size and maximum to TVSS unit correspond to approved shop drawings.
 - d. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - e. Clean TVSS unit.
 - f. Complete startup checks according to manufacturer's written instructions.
 - g. Verify the correct operation of all sensing devices, alarms, and indicating devices.

3.3 STARTUP

- A. Do not energize or connect switchgear, switchboards, or panelboards to their sources until TVSS devices are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 SPARE PARTS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Replaceable Protection Modules: One of each size and type installed.

3.5 INSTRUCTION

Provide factory certified technician to train Government maintenance personnel to maintain TVSS devices. Training shall be provided for a total period of 4 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance test. Training shall cover all essential items contained in the operation and maintenance manual.

- - -END OF SECTION - - -

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies the furnishing, installation and connection of the interior lighting systems.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Product Data: For each type of lighting fixture (luminaire) designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of fixture designation, submit the following information.
 - 1. Material and construction details include information on housing, optics system and lens/diffuser.
 - 2. Physical dimensions and description.
 - 3. Wiring schematic and connection diagram.
 - 4. Installation details.
 - 5. Energy efficiency data.
 - 6. Photometric data based on laboratory tests complying with IESNA Lighting Measurements, testing and calculation guides.
 - 7. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours) and color temperature (degrees Kelvin).

8. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts and total harmonic distortion (THD).

C. Manuals:

1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the COTR.

D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the COTR:
 - a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

E. Warranty:

1. Provide

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
C62.41-91Guide on the Surge Environment in Low Voltage
(1000V and less) AC Power Circuits
- C. National Fire Protection Association (NFPA):
70National Electrical Code (NEC)
101Life Safety Code
- D. National Electrical Manufacturer's Association (NEMA):
C82.1-97Ballasts for Fluorescent Lamps - Specifications
C82.2-02Method of Measurement of Fluorescent Lamp
Ballasts
C82.4-02Ballasts for High-Intensity-Discharge and Low-
Pressure Sodium Lamps
C82.11-02High Frequency Fluorescent Lamp Ballasts
- E. Underwriters Laboratories, Inc. (UL):
496-96Edison-Base Lampholders
542-99Lampholders, Starters, and Starter Holders for
Fluorescent Lamps

844-95Electric Lighting Fixtures for Use in Hazardous
(Classified) Locations
924-95Emergency Lighting and Power Equipment
935-01Fluorescent-Lamp Ballasts
1029-94High-Intensity-Discharge Lamp Ballasts
1029A-06.....Ignitors and Related Auxiliaries for HID Lamp
Ballasts
1598-00Luminaires
1574-04.....Standard for Track Lighting Systems
2108-04.....Standard for Low-Voltage Lighting Systems
8750-08.....Light Emitting Diode (LED) Light Sources for Use
in Lighting Products

F. Federal Communications Commission (FCC):
Code of Federal Regulations (CFR), Title 47, Part 18

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES (LUMINAIRES)

- A. Shall be in accordance with NFPA 70 and UL 1598, as shown on drawings, and as specified.
- B. Sheet Metal:
 - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
 - 2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
 - 3. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
 - 4. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, latches shall function easily by finger action without the use of tools.
- C. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- D. Lamp Sockets:
 - 1. Fluorescent: Lampholder contacts shall be the biting edge type or phosphorous-bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542. Lamp holders for

- bi-pin lamps shall be of the telescoping compression type, or of the single slot entry type requiring a one-quarter turn of the lamp after insertion.
2. High Intensity Discharge (H.I.D.): Shall have porcelain enclosures.
- E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- G. Metal Finishes:
1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
 2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
 3. Exterior finishes shall be as shown on the drawings.
- H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
- I. Light Transmitting Components for Fluorescent Fixtures:
1. Shall be 100 percent virgin acrylic.
 2. Flat lens panels shall have not less than 1/8 inch [3.2mm] of average thickness. The average thickness shall be determined by adding the maximum thickness to the minimum unpenetrated thickness and dividing the sum by 2.
 3. Unless otherwise specified, lenses, diffusers and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction of the lens without distortion or cracking.
- J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Group areas as defined in NFPA 70, and shall comply with UL 844.
- K. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballast integral to the fixture.

Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures (not the lamp). Fixtures shall be designed for lamps as specified.

2.2 BALLASTS

- A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V) electronic programmed-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated; including the following features:
1. Lamp end-of-life detection and shutdown circuit (T5 lamps only).
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion Rating: 10 percent or less.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. Ballast Factor: 0.87 or higher unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. Interference: Comply with 47 CFT 18, Ch.1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 13. Dimming ballasts shall be as per above, except dimmable from 100% to 5% of rated lamp lumens.
- B. Compact Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V), electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated; including the following features:
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion Rating: 10 percent or less.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. Ballast Factor: 0.95 or higher unless otherwise indicated.
 9. Power Factor: 0.98 or higher.

10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
11. Dimming ballasts shall be as per above, except dimmable from 100% to 5% of rated lamp lumens.
- C. Ballasts for high intensity discharge fixtures: Multi-tap voltage (120-480v) electromagnetic ballast for high intensity discharge lamps. Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:
 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
 3. Rated Ambient Operating Temperature: 104 deg F (40 deg C).
 4. Open-circuit operation that will not reduce average life.
 5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- D. Electronic ballast for high intensity discharge metal-halide lamps shall include the following features unless otherwise indicated:
 1. Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C) for single-lamp ballasts.
 2. Rated Ambient Operating Temperature: 130 deg F (54 deg C).
 3. Lamp end-of-life detection and shutdown circuit.
 4. Sound Rating: Class A.
 5. Total Harmonic Distortion Rating: 20 percent or less.
 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 7. Lamp Current Crest Factor: 1.5 or less.
 8. Power Factor: 0.90 or higher.
 9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 10. Protection: Class P thermal cut.

2.3 LAMPS

- A. Linear and U-shaped T5 and T8 Fluorescent Lamps:
 1. Rapid start fluorescent lamps shall comply with ANSI C78.1; and instant-start lamps shall comply with ANSI C78.3.
 2. Chromacity of fluorescent lamps shall comply with ANSI C78.376.

3. Except as indicated below, lamps shall be low-mercury energy saving type, have a color temperature between 3500° and 4100°K, a Color Rendering Index (CRI) of greater than 70, average rated life of 20,000 hours, and be suitable for use with dimming ballasts, unless otherwise indicated. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.

- a. Over the beds in Intensive Care, Coronary Care, Recovery, Life Support, and Observation and Treatment areas; Electromyographic, Autopsy (Necropsy), Surgery, and certain dental rooms (Examination, Oral Hygiene, Oral Surgery, Recovery, Labs, Treatment, and X-Ray) use color corrected lamps having a CRI of 85 or above and a correlated color temperature between 5000 and 6000°K.
- b. Other areas as indicated on the drawings.

B. Compact Fluorescent Lamps:

- 1. T4, CRI 80 (minimum), color temperature 3500 K, and suitable for use with dimming ballasts, unless otherwise indicated.

2.4 EXIT LIGHT FIXTURES

A. Exit light fixtures shall meet applicable requirements of NFPA 101 and UL 924.

B. Housing and Canopy:

- 1. Shall be made of die-cast aluminum.
- 2. Optional steel housing shall be a minimum 20 gauge thick or equivalent strength aluminum.
- 3. Steel housing shall have baked enamel over corrosion resistant, matte black or ivory white primer.

C. Door frame shall be cast or extruded aluminum, and hinged with latch.

D. Finish shall be satin or fine-grain brushed aluminum.

E. There shall be no radioactive material used in the fixtures.

F. Fixtures:

- 1. Maximum fixture wattage shall be 1 watt or less.
- 2. Inscription panels shall be cast or stamped aluminum a minimum of 0.090 inch [2.25mm] thick, stenciled with 6 inch [150mm] high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of

letters on red color stable plastic or fiberglass. The LED shall be rated minimum 25 years life.

3. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
4. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltages: Refer to Lighting Fixture Schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
- B. Align, mount and level the lighting fixtures uniformly.
- C. Fluorescent bed light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable.
- D. Lighting Fixture Supports:
 1. Shall provide support for all of the fixtures. Fixtures shall be supported independently of the ceiling grid.
 2. Shall maintain the fixture positions after cleaning and relamping.
 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
 4. Single or double pendant-mounted lighting fixtures:
 - a. Each stem shall be supported by an approved outlet box, mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.
 5. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.
- E. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.
- F. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and

installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.

- G. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- H. Exercise electronic dimming ballasts over full range of dimming capability by operating the control devices(s) in the presence of the COTR. Observe for visually detectable flicker over full dimming range.
- I. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless a lesser period is specifically recommended by lamp manufacturer. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage. Replace any lamps and ballasts which fail during burn-in.
- J. At completion of project, relamp/reballast fixtures which have failed lamps/ballasts. Clean fixtures, lenses, diffusers and louvers that have accumulated dust/dirt/fingerprints during construction. Replace damaged lenses, diffusers and louvers with new.
- K. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

- - - E N D - - -

SECTION 27 05 00
COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Division 26 Specification Sections shall apply to this and all related Division 27 specification sections.
- B. Related Specification Sections:
1. 07 08 00 - Fire Stopping
 2. 08 31 13 - Access Doors
 3. 26 05 00 - Requirements for Electrical Installations.
 4. 26 05 21 - Low Voltage Electrical Power Conductors and Cables.
 5. 26 05 26 - Grounding and Bonding for Electrical Systems
 6. 26 05 33 - Raceways and Boxes for Electrical Systems
 7. 27 11 00 - Network Communications
 8. 27 41 31 - Master Antenna Television Equipment and Systems
 9. 27 52 23 - Nurse Call and Code Blue Systems
- C. Reference Symbols:
1. All device symbols are defined by the appropriate symbol schedule on the symbols and abbreviations sheet in the communications system drawing package. Not all device symbols as indicated may be required for the project.
 2. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location. Contractor shall coordinate exact locations with architectural drawings and all affected trades prior to submittal of shop drawings.
- D. Abbreviations:
1. AP: Wireless Access Point.
 2. A/V: Audio Visual Systems - For purposes of this specification section A/V systems shall include all Media Management, Video Broadcasting, Intercommunications (Paging/Public Address, Clock, Auxiliary Sound), Nurse Call\Code Blue, Video Intercom, Master Antenna (MATV) and Distance Learning Systems
 3. AVI Audio Visual Systems Integrator: Shall be a qualified contractor experienced in the installation and certification of A/V systems. The AVI contractor shall be responsible for the design, testing and certification of all audio/visual systems including but not limited to Intercommunications, Nurse Call\Code Blue, TV Distribution, Audio/Visual, Master Antenna and Bi-Directional Antenna systems as well as all structured cabling systems supporting these technologies.

- 4. BACnet: TCP/IP broadcast management methods as outlined in ISO 16484-5.
- 5. BAS: Building Automation System
- 6. BICSI: Building Industry Consultant Services International - International organization whose primary objective is to enhance the reputation and skills of companies and individuals employed in the telecommunications and security industries by ensuring that current and developing standards are maintained.
- 7. CATV: Community Antenna Television System - Cable TV Network
- 8. CCD: Charge-coupled device.
- 9. CCTV: Closed Circuit Television Surveillance System.
- 10. CMOS: Complementary metal-oxide-semiconductor
- 11. CP: Consolidation Point - Local Interconnection Point between horizontal cables from the building IDF/MDF rooms and horizontal cables for the furniture drops.
- 12. CPU: Central Processing Unit
- 13. DP: Demarcation Point - The point of interface between the Communications Networks, MATV, any Auxiliary Systems, and the associated Service Providers or Public Utilities. Also known as Entrance Facility. Shall also serve as the primary termination point for all incoming OSP cabling as well as the primary main grounding bus-bar for all communications systems. Refer to project documents for exact location and termination requirements.
- 14. DVR: Digital Video Recorder.
- 15. DGP: Data Gathering Panel- component of the Physical Access Control System (PACS) which provides the portal at the door location to communicate, store and process information received from readers, reader modules, input modules, output modules with the Security Management System CPU and software.
- 16. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
- 17. EMI: Electromagnetic interference.
- 18. EMT: Electric Metallic Tubing.
- 19. ESS: Electronic Security Systems - Including but not limited to; intrusion detection, physical access control, CCTV video surveillance, electronic perimeter detection, duress alarm, programmable logic controllers (PLC), supervisory control and data acquisition (SCADA), integrated security management platforms and electronic screening systems.
- 20. ESSI: Electronic Security Systems Integrator - Shall be a qualified contractor experienced in the design, programming, installation, testing and certification of all Intrusion Alarm, Access Control, CCTV Surveillance and Security Management Systems. The ESSI shall have a registered RCDD professional review and seal the designs, installations and certifications of all structured cabling networks related to the installation of any IP based electronic security system.
- 21. EVAC: UL Listed Emergency Voice Evacuation System. Not to be confused with the building; Public Address/Intercom, Intercommunications and/or Mass Notification systems.
- 22. FASS: Fire Alarm and Signaling System

- 23. FASI: Fire Alarm System Integrator - Shall be engaged in the full time business of providing the installation of life safety systems and shall employ on staff a minimum of one NICET Level III certified contractor experienced in the installation, programming, testing and certification of Rescue Assistance, Protected Premises and Central Station Signaling Fire Alarm Systems as defined by NFPA 72.
- 24. GAP: Graphic Annunciator Panel - A custom fabricated fixed display panel providing operational control and visual display of all alarm and system functions related to the operation of the FAS and/or ESSM as described in related specification sections.
- 25. GFI: Ground fault interrupter.
- 26. GUI: Graphic User Interface - A specialized program employing graphical display maps of a facility and/or site which, also provides a manual user interface for all system functions and operations by utilizing control and annunciation ICON's from dedicated human machine interface terminals.
- 27. HMI: Human Machine Interface - A Computer-operated, video control terminal complying with FCC Part 15 CFR Title 47, Subparts A and B, and shall utilize multiple dynamic GUI based displays for annunciation and control LCD flat panel computer monitor or display screen as defined by related specification sections.
- 28. ICS: Intercommunications system - Shall include but not limited to all intercoms, public address, clock, program, and auxiliary sound or emergency communications systems as defined by related specification sections.
- 29. IDF: Intermediate Distribution Frame - The room/space that shall serve as the local termination point for all horizontal and backbone cabling. Also shall be known as Equipment Room (ER), Horizontal Cross-Connect (HC) or Floor Distribution (FD).
- 30. IDS: Intrusion Detection System.
- 31. I/O: Input/Out - Commonly associated with dry/contact relay based digital integration.
- 32. ITS: Information Transport Systems - For purposes of this specification section ITS shall include all data and telecommunications communications systems including but not limited to all Data, Telephone, Intercommunications (Paging/Public Address), TV Distribution Systems (MATV) and Audio Visual Systems (A/V) and IP based CCTV Surveillance Systems.
- 33. ITSI: Information Technology System Integrator - Shall be a qualified contractor experienced in the installation and certification of all data, telecommunications and A/V systems. The ITSI shall be responsible for the design, testing and certification of Data, Telephone communications systems and all structured cabling systems supporting these technologies.
- 34. LAN: Local Area Network
- 35. LCD: Liquid-crystal display.
- 36. LED: Light Emitting Diode.

- 37. LV: Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- 38. MATV: Master Antenna System - Shall include all TV and media management distribution cabling, termination jacks, head-end components, control, equipment racks, amplifiers, projection equipment and video monitoring devices as defined by the project drawings and related specification sections.
- 39. MDF: The Main Distribution Frame - The room/space that shall serve as the primary termination point for all backbone cabling to each IDF locations and horizontal connection point for local communication drops. May also serve as a local IDF location as well as the cross-connection and interconnection of all entrance cables from the DP for all PSTN and WAN connections. Also shall be known as Main Cross Connect (MC), Telecommunications Room (TR) and/or Campus Distributor (CD)
- 40. M-JPEG: Motion - Joint Photographic Experts Group.
- 41. MPEG: Moving picture experts group.
- 42. MNS: Mass Notification System
- 43. NEC: National Electric Code
- 44. NEMA: National Electrical Manufacturers Association
- 45. NFPA: National Fire Protection Association
- 46. NTSC: National Television System Committee.
- 47. NRTL: Nationally Recognized Testing Laboratory.
- 48. NVR: Network Video Recorder
- 49. NVS: Network Video Server
- 50. OTDR: Optical Time Domain Reflectometer
- 51. OSP: Outside Plant - All cabling associated with building services supporting the incoming service connections to Service Providers, Public Utilities and Wide Area Networks.
- 52. PA: Public Address or Building Intercommunications System.
- 53. PACS: Physical Access Control System.
- 54. POTS: Plain Old Telephone Service - Analog Telephone Circuit used for the connection of FAX machines, BAS and FAS communications devices and shall be wired upstream of the facility's telephone switch.
- 55. PSTN: Public Switched Telephone Network - Connection to local telephone utility providing local telephony communications service.
- 56. RCDD: BICSI accredited Reregistered Communications Distribution Designer
- 57. RFI: Radio-frequency interference.
- 58. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
- 59. RS-232: A TIA/EIA standard for asynchronous serial data communications protocol between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- 60. RS-485: A TIA/EIA standard for multipoint communications protocol.
- 61. SCADA: Supervisory Control and Data Acquisition - A system used in to monitor and control plant status of facilities scattered over wide geographic areas.

- 62. SMS: Security Management System - A system incorporating security alarms, door controls, emergency intercoms/paging, duress alarms and surveillance systems all integrated through a single operating platform, providing centralized command and control capability for the various systems via dedicated human machine interface terminals.
- 63. TCP/IP: The standard communications protocol that implement protocol stack on which the Internet and data communications networks operate
- 64. TGB: Telecommunications Grounding Busbar - Located in each IDF
- 65. TMGB: Main Grounding Busbar - Located at the building DP/MDF
- 66. TP: Transition Point - A location in the horizontal cabling where flat under-carpet cable transitions to a horizontal cabling consolidation point (CP).
- 67. TVSS: Transient voltage surge suppressor
- 68. VLAN: Virtual LAN - A technique made possible by switching technologies that permits the logical grouping of any number of network devices into one or more sub- networks.
- 69. UPS: Uninterruptible Power Supply
- 70. UTP: Unshielded Twisted Pair
- 71. VMS: Video Management Software
- 72. VoIP: Voice Over IP telephone Network
- 73. WAN: Wide Area Network
- 74. WLAN: Wireless Local Area Network

E. Definitions:

- 1. Contract Documents: The documents consisting of the Form of Agreement between Owner and Contractor, Conditions of the Contract, (General, Supplementary, and other Conditions), Drawings, Specifications and all Addenda issued prior to the execution of the Contract.
- 2. Contract Drawings: The drawings that form a part of the Contract Documents that provides the graphical representation of the project requirements intended design and/or performance criteria to be delivered by the Contractor.
- 3. Reference Drawings: A drawing and/or set of drawings produced by a proprietary supplier, manufacturer, subcontractor, or fabricator included in the Contract Documents for informational purposes, providing specific information related to the installation of related appurtenances, components, devices, hardware, products and/or systems. Reference Drawings shall also include any Contract Drawings from prior bid packages that may have pertinent information or require coordination of trades related to this contract.
- 4. Shop Drawings: A drawing and/or set of drawings produced by the contractor, supplier, manufacturer, subcontractor, or fabricator as a detailed representation of the proper installation of the related, appurtenance, component, device, hardware, product and/or system to be delivered in conformance to the requirements of the Contract Documents.

1.2 SUMMARY

- A. This Section contains the overall requirements associated with all Division 27 Specification Sections, and includes the project design intent for all communication systems as well as requirements for

submittals, quality assurance, product handling, record documents, project conditions, installation, system performance, demonstrations, testing, training and certifications for all scopes of work related to these systems. Refer to related specification sections and contract drawings for additional information.

1. The Contractor shall have overall responsibility for all work related to all Division 27 scopes of work and shall ensure full coordination of all work with relationship to the VA's Contracting Officer, Design Professional and all trades as required to provide fully operational communications systems as herein specified and in accordance with all requirements of related specification sections and contract drawings.
 - a. All Division 27 system integrators shall be responsible for providing all equipment, devices, system components, final cable terminations, programming, commissioning and testing in accordance with the appropriate and related specification sections.
 - b. All integrators shall meet the minimum technical capabilities, certifications and licensing requirements as defined by the "Quality Assurance" chapters in all related specification sections.
- B. It shall be the responsibility of the Contractor to furnish and install all necessary cabling, conduits/raceways, cable terminations, controls, systems, equipment, materials, devices, components, electrical power, equipment racks/cabinets and software as well as all appurtenances, programming, commissioning and testing necessary to deliver complete and fully operational systems as indicated by the appropriate division 27 specification sections and related contract drawings.
 1. The installation, performance, features, functions, software and programming criteria as specified herein as well as all related Division 27 specification sections have been designed to offer the maximum system efficiency, ease of operation, occupant safety and the protection of equipment as recommended by the Veterans Administration (VA) and Design Professional.
 - a. Any deviations from the specified criteria shall be documented, reviewed and agreed to in writing by VA's Contracting Officer and Design Professional prior to submission of bids. Refer to Division 1, and all related Division 27 specification sections for any substitutions and/or project deviation requests.
 - 1) The required information shall include but not limited to: reason for deviation, all differences in performance, operation and function from the herein specified requirements, all benefits and added features to the Government as a result of the deviations and any additional incurred costs to the Government for maintenance and long term ownership.

- 2) Failure to provide the VA's Contracting Officer and Design Professional with the required information shall result in any shop drawing submissions being returned for non-conformance with the contract requirements.
- b. The contractor and all sub-contractors for this work shall have read all of the General Conditions, Special Requirements, General Requirements and all related specification sections and in the execution of all work shall be bound by all of the conditions and requirements therein.
 - c. Prior to the submission of the Bid any discrepancies or inconsistencies noted within these specifications and/or the project drawings shall be brought to the immediate attention of the VA's Contracting Officer and Design Professional.
2. Architectural room numbers and names as indicated on the contract documents may be used for the initial system design and shop drawing submission. However, prior to final system application, design and programming, it shall be the Contractor's responsibility to verify and confirm all final room numbers and names and shall be reviewed and approved by the VA's Contracting Officer and Design Professional.
 - a. Only architectural approved room numbers and names shall be used for all system programming and shall be reflected in all as-built documentation. Failure to obtain final approval of architectural room numbers and names prior to final programming shall result in all system to be reprogrammed at no additional cost to the project.
3. All device symbols are defined by the appropriate symbol schedules as indicated by the symbol and abbreviation drawing sheets for each discipline. The Contractor shall coordinate exact locations with all architectural, mechanical, electrical, reflected ceiling, furniture drawings and door hardware specifications as well as all affected trades prior to submittal of bids.
4. All symbols are shown on the contract drawings as close as possible to their intended location. Contractor shall coordinate the installation of all equipment, devices, controls, components, cabling conduits/raceways and integration of other systems with all affected trades and specified system integrators. The contractor shall document all coordination requirements at the time of shop drawing submission.
 - a. Drawings for this work are diagrammatic and intended to convey the extent, general arrangement and locations of the work. Because of the scale of the drawings, certain basic items such as access panels, conduits, cabinet sizes, penetration sleeves, pull boxes, back-boxes and junction boxes may or may not be shown on the contract drawings. Include all items where required by code and related specification sections for proper installation of all work.

- b. Where ambiguity exists between the project specifications and the contract drawings, the superior in system performance regardless of cost shall prevail and shall be delivered by the Contractor at no additional expense to the project.
- 5. Project specifications and drawings may not deal individually with every part, control, device, component, or appurtenance which may be required to produce the equipment performance for the specified system and/or as required for compliance with all specified systems integration.
 - a. Include such items and components, as required, for complete operational systems as defined by the project documents, whether or not specifically indicated. The contractor shall be responsible for providing conduits/raceways, cable terminations, controls, systems, equipment, materials, devices, components, electrical power, equipment racks/cabinets, software, programming, commissioning, testing and all appurtenances as well as the integration of any ancillary systems or Government provided equipment/components/systems.
 - b. Coordinate with other applicable trades in submittal of shop drawings and the installation of all systems. All shop drawings shall detail space conditions in order to accommodate other concerned trades, all equipment locations are subject to final review by the VA's Contracting Officer and Design Professional.

1.3 REFERENCES

- A. References to industry and trade association standards as well as all building codes are minimum installation requirements. The codes, standards and agencies listed below shall form a part of this specification section and all work shall comply with the latest adopted standards.
- B. Where the contract drawings and specifications mandate a greater requirement or performance than those specified by any of the below referenced codes and standards, the Contract Documents shall then be the governing requirements for this project. The minimum codes and standards to be applied for this project shall be the following;
 - 1. All applicable requirements of NFPA 70 "National Electrical Code" including, but not limited to:
 - a. Article 250, Grounding
 - b. Article 300, Part A. Wiring Method
 - c. Article 310, Conductors for General Wiring
 - d. Article 725, Remote Control, Signaling Circuits
 - e. Article 800, Communication Systems
 - 2. National Fire Protection Association:
 - a. NFPA-72: National Fire Alarm and Signaling Code
 - b. NFPA-75: Standard for the Protection of Electronic Computer/Data Processing Equipment
 - c. NFPA-99: Standard for Health Care Facilities
 - d. NFPA-101: Life Safety Code

3. EIA Compliance: Comply with the following Electronics Industries Association Standards:
 - a. EIA/TIA-568: "Commercial Building Telecommunication Standard"
 - b. EIA/TIA-569: "Commercial Building Standard for Telecommunications Pathways and Spaces"
 - c. EIA/TIA-455: "FOTP-61, Measurement of Fiber or Cable Attenuation Using An OTDR"
 - d. EIA/TIA-606: "The Administration Standard for the Telecommunications Infrastructure of Commercial Building"
 - e. EIA/TIA-607A: "Commercial Building Grounding and Bonding Requirements for Telecommunications"
 - f. EIA/TIA-492A: "Detail Specification for 850-nm Laser Optimized 50- μ m Core Diameter/125 μ m Cladding Diameter Class 1a Graded Index Multi-Mode Optical Fibers"
 - g. EIA/TIA-1179: "Healthcare Facility Telecommunications Infrastructure Standard"
4. Underwriters Laboratories, Inc.:
 - a. UL 486A: "Wire connectors and soldering lugs for use with copper conductors"
 - b. UL 1449: "Transient voltage surge suppressors"
 - c. UL 1581: "Standard for Electrical Wires, Cables, and Flexible Cords"
 - d. UL 478: "Standard for Electronic Data-Processing Units and Systems"
 - e. UL 83: "Thermoplastic-Insulated Wires and Cables,"
 - f. UL 910: "Test Method for Fire and Smoke Characteristics of Cables Used in Air-Handling Spaces." Provide products which are UL-listed and labeled.
 - g. UL 1069: Hospital Signaling and Nurse Call Equipment
5. Federal Communications Commission:
 - a. FCC Regulations Part 15 Title 47.
6. Institute of Electrical and Electronic Engineers (IEEE)
 - a. IEEE 802.3 - "Carrier Sense Multiple Access with Collision Detection," and all applicable supplements a through af".
 - b. IEEE 802.3.u-100-"Base T/100-Base-TX, Fast Ethernet"
 - c. IEEE 802.3.z-"Gigabit Ethernet"
 - d. IEEE 802.3.ab-"1000 Base T"
 - e. IEEE 802.3.ae-"10 Gigabit Ethernet"
 - f. IEEE 802.3.af-"Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI) that"
 - g. IEEE 802.11.b/g/n-"Wireless Transmission Standard"
 - h. IEEE 802.11.af-"Power over Ethernet"
7. ISO/TC - International Organization for Standardization's (ISO) Technical Committee (TC)

- a. 21730 - Health informatics - Use of mobile wireless communication and computing technology in healthcare facilities.
8. NEMA/ICEA Compliance:
- a. WC-5 - "Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy,"
 - b. WC30 - "Color Coding of Wires and Cables," pertaining to control and signal transmission media.
9. Internet Networking Standards: Network hardware and software shall be able to communicate with the Internet and provide for the creation of IP based networks for the Agency. All supplied hardware shall comply with the following minimum standards and RFC's as appropriate.
- a. MIL-STD - 1777, RFC 971 - Internet Protocol
 - b. MIL-STD - 1778, RFC 793 - Transmission Control Protocol
 - c. MIL-STD - 1780, RFC 959 - File Transfer Protocol
 - d. MIL-STD - 1781, RFC 821 - Simple Mail Transfer Protocol
 - e. MIL-STD - 1782, RFC 854 - TELNET Protocol
 - f. RFC 950 - Internet Standard Sub-netting Procedure
 - g. RFC 1140 - Official Protocol Standards
 - h. RFC 1156 - MIB Base for IP Networks
 - i. RFC-1213 - MIB-II
 - j. RFC-1757 - Remote Monitoring (RMON)
 - k. RFC 1157 - Simple Network Management Protocol
 - l. RFC 1720 - TCP/IP, OSI Compliant
 - m. RFC 1918 - Address Allocation for Private Subnets
 - n. RFC 1583 - OSPF, Version II
 - o. RFC 1723 - RIP -II
10. ASTM Compliance: Comply with applicable requirements of D-2219 and D-2220. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).
11. NECA (National Electrical Contractors Association) Standard of Installation
12. BICSI -TDMM 12th edition
13. ADA Standards for Accessible Design
14. Veterans Health Administration (VHA) Telecommunications Support Services
15. The Joint Commission (TJC) formally - Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
16. Local Authority Having Jurisdiction
17. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS

- A. In addition, to all submittal requirements as stipulated by Division 01 specifications sections, the Contractor shall provide all shop drawing submittals in accordance with the following:

1. The VA's Contracting Officer and Design Professional approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.
2. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
3. Submittals shall be provided as a complete submission; no partial submissions will be accepted. Failure to provide a complete submission shall result in all submittals being returned for resubmission.
4. No substituted equipment shall be reviewed without prior approval in accordance with the requirements of "substitutions" under Division 1 specification section.
5. Mark the submittals, "SUBMITTED UNDER SECTION_____".
 - a. Submittals shall be marked to show specification reference including the section and paragraph numbers.
6. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination requirements refer to Division 01 Specification Sections, which outline basic submittal requirements and coordination. All Division 01 Specification Sections requirements shall be used in conjunction with this specification section.
7. Prior to any submission the contractor shall be responsible for performing the following quality control items to ensure compliance with all project requirements:
 - a. Review all Shop Drawings and Product Data
 - b. Review all field measurement criteria.
 - c. Review all field construction criteria and methodologies.
 - d. Review all catalog numbers and similar data.
 - e. Review all coordination requirements of affected trades.
 - f. Review conformance to all appropriate specification sections.
1. All shop drawings shall be prepared using latest version of AutoCAD, drawn accurately, and in accordance with the VA's CAD Standards "CAD Standard Application Guide". The Contractor shall not reproduce the Contract Documents or copy standard information as the basis of the technical data, hand drawn mark-ups of the original project drawings shall not be acceptable. Failure to provide a complete set of "contractor prepared" installation drawings at the time of submittal shall result in all submittals being returned for resubmission.
2. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.

- a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - 1) Where two (2) or more binders are required to accommodate data; correlate the data in each binder into related groupings according to the Project Manual table of contents. Cross-reference other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
 - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
 - b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
 - c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
 - d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
 - e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
 - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
 - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
 - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
8. The ITSI shall have a registered RCDD professional review and seal shop drawings related to all system designs, installations, testing, certifications and structured cabling layouts for communications systems. Failure to provide RCDD sealed shop drawings shall result in all shop drawings being returned for resubmission without any reviews taking place.

9. The VA's Contracting Officer and Design Professional's review of the shop drawings and/or samples does not relieve the Contractor from compliance with the requirements of the project documents. Unless the Contractor has informed the VA's Contracting Officer and Design Professional in writing of such deviation at the time of submission, has noted the deviation on the shop drawings, and the VA's Contracting Officer and Design Professional has given written approval of the specific deviation to the project document all project requirements shall stand. The VA's Contracting Officer and Design Professional's review also does not relieve the Contractor from responsibility for any errors of omission in the submission of shop drawings and/or samples.
10. Submit all system testing and startup procedures to be employed. Include all estimated times for performance of all tests, all test equipment and manpower necessary for testing.
11. Submit all integrator qualifications and certifications in accordance with the requirements as specified elsewhere in this specification section.
12. Submit project schedule outlining the time frames for all equipment with long lead times for equipment deliveries; include all system commissioning, testing and training time expectations. Project schedule shall be submitted as CPM schedule and shall utilize a software based project management program.
13. The system integrator shall have a registered RCDD professional review and seal the designs, installation and testing certification of all structured cabling networks. Failure to provide RCDD sealed shop drawings shall result in all shop drawings being returned for resubmission without any reviews taking place.
14. The Government and Design Professional's review of the shop drawings and/or samples does not relieve the Contractor from compliance with the requirements of the project documents. Unless the Contractor has informed the Agency representative and Design Professional in writing of such deviation at the time of submission, has noted the deviation on the shop drawings, and the Design Professional has given written approval of the specific deviation to the project document all project requirements shall stand. The Design Professional's review also does not relieve the Contractor from responsibility for any errors of omission in the submission of shop drawings and/or samples.
15. Submit all system testing and startup procedures to be employed. Include all estimated times for performance of all tests, test equipment and manpower necessary for testing.
16. Submit all integrator qualifications and certifications in accordance with the requirements as specified elsewhere in this specification section.
17. Submit project schedule outlining the time frames for all equipment with long lead times for equipment deliveries; include all system commissioning, testing and training time expectations. Project schedule shall be submitted as CPM schedule and shall utilize a software based project management program.

B. Shop Drawings:

1. All shop drawings shall include sufficient information, clearly presented, to determine full compliance with all project drawings and specifications. Include the following information for review, failure to provide all information listed below shall result in all shop drawing submittals being returned for resubmission:
 - a. Include manufacturer's name(s), model numbers,
 - b. All equipment /device electrical ratings and power requirements
 - c. All equipment /device performance ratings.
 - d. All equipment /device battery calculations,
 - e. All equipment /device voltage drop calculations,
 - f. All db losses for all passive video devices and cabling,
 - g. All Speaker taps, voltages and zoning
 - h. All equipment rack/cabinet layouts and rack/cabinet sizes.
 - i. All device-mounting elevations.
 - j. All device wiring details.
 - k. Complete point-to-point-wiring diagrams for all systems. Include all equipment and wiring termination schedules and/or matrixes.
2. Provide a complete set of "contractor prepared" installation drawings. Drawings at the minimum shall consist of floor plans indicating all; passive and active electronic component locations, field devices, device identifications, distribution racks, patch panels, control panels, auxiliary control panels, power supplies, conduit and cable requirements as well as all 120 volt electrical circuit locations and designations.
 - a. Drawings shall include at the minimum the following;
 - 1) Detailed equipment layouts for all communications rooms. Coordinate all room layouts with affected trades.
 - 2) Floor plan drawings showing locations of all equipment, devices, equipment cabinets and/or rack locations. Identify type and sizes of all equipment cabinets and/or racks.
 - 3) All cable tray layouts, and conduit routing of all conduits 2 inches in diameter or greater.
 - 4) All electrical power and grounding connections.
 - 5) System riser diagrams and single line drawings
 - 6) Equipment wattage for each location and estimated BTU production.
 - 7) Detailed equipment layouts for all equipment consoles. Indicate all equipment locations, power connections and installation details.

- 8) All equipment mounting hardware/brackets and installation details, Identify type size, load capacities of all mounting hardware/brackets; include all mounting and installation details, all space requirements, any special architectural modifications required.
 - 9) Outline drawings of all equipment cabinets/racks showing the relative position of all major components, all-wiring and grounding terminations. Include all panel, cabinet and/or rack dimensions.
3. Provide a complete termination schedule of all communications device outlet locations; indicate on the installation drawings all device outlets' unique identification which shall correspond with schedule and drawings.
 4. All shop drawing submissions shall have a registered RCDD professional review and seal all shop drawings confirming that the proposed network infrastructure is in conformance with all stipulated standards and requirements as herein specified.

C. Equipment Submittals:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - a. Include all equipment data sheets pertinent to equipment provided. All data sheets shall be highlighted indicating specific equipment supplied. Failure to provide the proper annotation of all equipment shall result in submittals being returned for resubmission.
2. Submit complete technical data necessary to evaluate the material and equipment. Include a complete technical specification for the submitted equipment, noting differences and adherence to this Section. Failure to provide the required data will result in all submittals being returned for resubmission.
3. Submit performance data, equipment ratings, cable requirements, control sequences, GUI based control panels, programming matrixes, logic diagrams and all other descriptive data necessary to describe the installation and operations of the system being provided. Failure to provide the required data will result in all submittals being returned for resubmission.
4. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

D. Maintenance and Operation Manuals: Submit in accordance with all requirements of Division 01 specification sections and as herein specified.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "Maintenance and Operations Manual", include the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation and maintenance instructions.
 - e. Safety precautions.
 - f. Diagrams and illustrations.
 - g. Testing methods.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - j. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
5. Approvals will be based on complete submission of manuals together with shop drawings.
6. After approval and prior to installation, furnish the COTR with one sample of each of the following:
 - a. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
 - b. Each type of conduit and pathway coupling, bushing and termination fitting.
 - c. Raceway and pathway hangers, clamps and supports.
 - d. Duct sealing compound.

1.5 QUALITY ASSURANCE

- A. Integrator Qualifications: The projects' Information Technology System (ITS) integrator and/or Audio/Visual System (AVI) Integrator shall be an accredited and authorized distributor of the appropriate equipment manufacturer and shall be fully certified in the installation, testing and programming of all equipment being provided.
1. The ITS integrator shall be capable of providing documented successful work experience of at least three (3) facilities of equivalent size and technical requirements utilizing the proposed equipment being provided. The system integrator shall have on staff a minimum of one full time individual that holds a current RCDD registration.
 - a. All information technology system work shall be certified in writing to the VA's Contracting Officer and Design Professional by a RCDD professional asserting that all communications network system shop drawings and structured cabling is in conformance with all appropriate NEC requirements, EIA/TIA standards; BICSI recognized installation practices and all related specification sections.
 2. Cable Installer Qualifications: The cable installation contractor shall demonstrate not less than three (3) years' experience in the installation of structured cabling systems and shall have on staff a minimum of one full time member that holds a current BICSI level II installer credential.
 - a. NOTE: The installation of all communications structured cabling shall be under the direct supervision of a current BICSI level II installer who shall be knowledgeable in the following technical applications:
 - 1) The Routing and installation of shielded, unshielded, twisted pair, coaxial and fiber optic cables.
 - 2) Bonding and grounding of cable tray and equipment racks.
 - 3) Fusion splicing of fiber optic cabling.
 - 4) Testing copper conductors for electrical continuity.
 - 5) Testing and Certifying of UTP structured cabling for attenuation and worst case near end cross talk.
 - 6) Testing and Certifying of ALL fiber optic cabling employing an Optical Time Domain Reflectometer (OTDR) in accordance with TIA/EIA protocols.
 - 7) Testing and Certifying of coaxial cable networks for RF leakage
 - 8) Termination, connection, and testing of shielded and unshielded twisted pair cable, coaxial cabling and fiber optic cabling on all specified connectors, electrical protection blocks, termination blocks and patch panels.
 - 9) Generally accepted industry standards, as well as manufacturers written installation instructions, will be used for in-process quality control and final acceptance of the work installation.

3. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval
 - a. Experience shall be defined as the completion of the specific system being provided, with that system being successfully operated by the Owner for its intended purpose for at least three (3) years.
 - b. In addition to the above "Experience" shall also be defined as the completion of modifications and renovations to any associated system being provided in any existing occupied facility of this size and magnitude.
 - c. For each facility submit the following:
 - 1) Name and location of facility
 - 2) Date of Occupancy or beneficial use by Owner
 - 3) Owner's representative to contact and telephone number
 - 4) Construction Manager or General Contractor
 - 5) Project Architect or Engineer
 - 6) Provide information on the installed locations with operational equipment
 - 7) Registration number and expiration date of RCDD professional
 - 8) Registration number and expiration date of Level II installer.
4. Service Qualifications: The ITS integrator shall be a permanent service organization maintained and/or trained by the product manufacturer on the products being provided for this project.
 - a. The integrator shall be (where required) properly licensed by the governing municipality to provide the services and work for the specific system being installed. In addition all integrators shall be capable of providing full service for the entire warranty period within an 8-hour response time upon notification of a service emergency.
- F. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and materials specified for this project, and shall have manufactured the items for at least three years.
 1. Product Qualification: The Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 - a. The manufacturers shall submit the appropriate documentation certifying that the project integrator is a qualified service provider of all manufacturers' products being provided for this project.

G. Pre-installation Conferences: The Contractor and all systems Integrators shall include provisions to attend all pre-installation conferences at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to installation and operations of all communications systems, including, but not limited to, the following:

1. Inspect and discuss electrical power, equipment and component rough-ins as well as other preparatory work required to be performed by other trades related to the proper installation and performance of all communications systems.
2. Review integration to any systems and/or equipment provided by other trades
3. Review and finalize construction schedule and verify availability of materials, installation personnel, equipment, and any preparatory work by other trades needed to make progress and avoid delays.
4. Review required start-up, testing, commissioning and certifying procedures to be employed for each system and any impacts these scopes of service has to final turnover of the systems and/or other trades.

1.6 RECORD DOCUMENTS

A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections include the following project requirements;

1. Provide complete set of finalized copies of record documents prior to final acceptance of the project by VA's Contracting Officer and Design Professional in accordance with all requirements of Division 01 specification sections. At the minimum the record documents shall contain all information, data and drawings as described in Chapter 1.4 "Submittals" of this specification section.
 - a. As-built documents shall be submitted in both paper and electronic media formats in the quantities as specified by Division 1 specification requirements.
 - 1) All electronic record drawings shall be prepared and submitted utilizing an AutoCAD based program as manufactured by Autodesk. Where electronic documents are prepared using other than an AutoCAD program manufactured by Autodesk, the contractor shall provide to the VA's Contracting Officer and Design Professional the necessary software to electronically view the submitted documents.
 - 2) All electronic data sheets, control sequences, programming matrixes and other descriptive data shall be provided in PDF formatted documents.
 - 3) Copies of all current system programming and associated software shall be provided on downloadable media formatted for the use in restoration all system operations and functionality in the event of a catastrophic failure.

1.7 SOFTWARE AGREEMENT

- A. Included as part of the scope of work for this project the Government shall retain the ownership and access rights of ALL system programs and software associated with all systems installed and/or modified as part of this project.
1. The contractor shall provide to VA's Contracting Officer complete copies of all current software programming and software licenses related to the operation of each system prior to final acceptance of the related Contract scopes of work.
 - a. All programming shall include but not be limited to all device identifications, device descriptions, Programming Logic Matrixes, all program access level passwords as well as all function and sub-function routines.
 2. Programming and software copies shall be provided to the VA's Contracting Officer on CD or DVD digital formatted media. In addition, the contractor shall provide a complete hard copy printout of all system programming and shall be included as part of closeout documentation for review by the VA's Contracting Officer and Design Professional.
- B. Software and firmware upgrade provisions shall be included as part of this specification requirement and shall include the automatic upgrades as required to maintain all software and firmware to the manufacturers most current revision on all system components installed and or modified as part of this project for duration of the warranty period. This upgrade policy shall require the contractor to install, test and certify all software and firmware upgrades that become available from manufacturer for a period of one year from date of final acceptance to the expiration of the warranty.
1. Upgrading of software shall include all revised/new software, labor, testing certification as well as all licenses, software and all programming copies as described in Chapter 1.6 of this section associated with the installation of all revised software.
 2. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations\maintenance and software documentation manuals.
 - a. One (1) scheduled final update shall be provided near the end of the warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software and firmware for all systems installed and\or modified for this project.
 - b. All software changes shall be recorded in a log maintained in the unit control. An electronic copy of the most current software update shall be maintained within the log.
- 1) At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "Software Change Log".

3. Provide not less than thirty days' notice to the VA's Contracting Officer and Design Professional to allow scheduling and access to system and to allow the Government to upgrade computer equipment if necessary.

1.8 EXTRA MATERIAL

- A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections refer to related specification sections "Extra Material" for specific requirements.
- B. All Extra materials shall be provided at the time of final acceptance of the project and a signed packing list shall be obtained at the time of delivery. At no time is the contractor to use the extra materials provided for this project to replace malfunctioning or damaged equipment and or components.

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, that meet and/or exceed the specified performance and features of the equipment and/or systems and for which replacement parts shall be readily available to the system integrator and/or using agency.
 1. When more than one unit, device or component of the same class of equipment is required, such units, devices or components shall be the product of a single manufacturer.
 2. Acceptable manufacturers for each system shall be as specified and shall be provided in full compliance with the requirements of this and all related specification sections and contract drawings.
 - a. Manufacturers listed as acceptable shall not negate the contractors' responsibility for providing all equipment, devices, components and/or systems, in accordance with all functions and performance requirements of the Contract Documents.
 - b. Where manufacturer and/or manufacturer model numbers reference specific system components in the related specification sections, it is to establish the performance requirements and quality of the systems and components only.
 - 1) It is in no way an inference that the referenced model numbers are the manufacturer's current product and are the only acceptable components for this project unless specifically referenced as "no substitutions".
 - c. The Contractor shall provide the manufacturers' most current product that shall meet and/or exceed the specified performance and features of the equipment and/or systems.

- d. Equivalent UL- listed equipment may be substituted for the approved manufacturers unless stipulated by other specification sections as "No Substitutions". All substitutions shall be submitted for approval by VA's Contracting Officer and Design Professional in accordance with all requirements of Division 01 specification sections and Chapter 1.4 "Submittals" of this specification section.
 - 1) Where systems and/or components are referenced as "no substitutions" the specific system and/or components shall be provided.
 - 2) All substitutions shall comply with all requirements as specified above and all system performance standards shall be maintained.
 - 3) The contractor shall stipulate the following information impacted by such a substitution.
 - a) Any and all extensions in time impacted by the substitution.
 - b) Any changes to the architectural or structural elements to the project
 - c) Differences in operation and/or performance from intended system criteria.
 - 4) Failure to provide the required substitution information shall result in "without consideration" the immediate rejection of the substituted equipment and/or systems.

B. Equipment Assemblies and Components:

- 1. Components of an assembled unit need not be products of the same manufacturer.
 - a. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - b. Components shall be compatible with each other and with the total assembly for the intended service.
 - c. Constituent parts which are similar shall be the product of a single manufacturer.
 - d. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

C. Where Factory or Off-Premises Testing of any equipment, product or assembly is recommended by the product manufacturer or where specified as part of this section and/or any related specification section:

- 1. The VA's Contracting Officer, Design Professional and/or Government representatives shall have the option of witnessing all factory tests. The Contractor shall notify the VA's Contracting Officer and Design Professional at a minimum of thirty (30) working days prior to the performance of any factory or off-premises tests.

- a. Where the factory or assembly point for all off-premises testing is not within two (2) hours driving time from the project location, the system integrator shall include as part of this project all per diem costs (travel, meals and lodging) for a minimum of two representatives from the using agency and the project Design Professional to witness all testing.
2. Provide four (4) copies of certified test reports containing all preliminary test data and testing procedures shall be furnished to the VA's Contracting Officer and Design Professional prior to any final testing and not more than ninety (90) days after completion of any tests.
3. When equipment, product or assembly fails to meet any factory or off-premises tests, retesting of equipment, product or assembly shall be mandated, the manufacturer/integrator shall be liable for all additional expenses, including all expenses incurred by the VA's Contracting Officer and Design Professional for witnessing the retesting of any equipment, product or assembly.

PART 3 - EXECUTION

3.1 EQUIPMENT PROTECTION

- A. Protect all materials, equipment, devices or components permanently installed and/or stored on the job site. Protect all materials, equipment, cabling, devices or components during construction and after installation, provide appropriate protection of all materials, equipment, components and/or devices until time of substantial completion. All materials, equipment, components and/or devices shall be protected during shipment and storage against any physical damage, dirt, moisture, cold, snow or rain:
 1. During installation, enclosures, racks\cabinets, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of any foreign matter; and shall be vacuum cleaned both inside and outside before testing and operating and repainting if required.
 2. Any materials, equipment, components and/or devices, stored on site which have been deemed by the VA's Contracting Officer or Design Professional to exhibit any indications of damage or exposure dust or moisture shall not be installed and shall returned to the source of supply for immediate replacement.
 - a. The use of spare parts or the return of defective equipment for repair to mitigate the damage of defective materials, equipment, components and/or devices shall not be acceptable. All materials, equipment, components and/or devices shall be new and unused until final acceptance by the Design Professional.
 3. Provide and apply protective material immediately upon receiving the products and maintain throughout the construction process.
 - a. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.

- b. Any damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas is not obvious or detectable.
- 4. Failure to properly protect all materials, equipment, components and/or devices prior to final acceptance shall constitute sufficient cause for rejection of materials, equipment, components and/or devices should any defects, damage or degradation in performance is observed.
- B. Immediately replace all malfunctioning materials, equipment, components and/or devices with new unused products up until the time the Design Professional issues final acceptance of the system. The returning of any malfunctioning equipment, devices and/or components to the manufacturer for repair and then reinstallation at the project site shall not be acceptable.
 - 1. All replacement materials, equipment, components and/or devices shall be factory new and not scavenged from the Project's spare parts inventory or factory recycled products unless expressly identified by contractor prior to replacement and approved beforehand by the Design Professional.

3.2 WORK PERFORMANCE

- A. Installation, final termination, testing, start-up and commissioning of all systems, system components and cabling infrastructures shall be under the direct supervision of the appropriate system integrator. The integrator shall be an accredited and authorized distributor of the appropriate equipment manufacturer and shall be fully certified in the installation, testing, commissioning and programming of all equipment, devices, components and/or systems being provided as part of this project.
- B. Job site safety and worker safety is the responsibility of the Contractor. Ensure that safe access and egress from all work areas is maintained during movement and installation of materials. Clean up all debris generated by installation activities. Keep all communications equipment rooms free of debris at all times.
- C. Pre-installation Conferences: Include provisions to attend all pre-installation conferences at Project site in compliance with all requirements in Division 01 specification section and as herein specified. Review methods and procedures related to installation and operations of all communications systems, including, but not limited to, the following:
 - 1. Inspect and discuss electrical and equipment roughing-in related to all communications systems as well as other preparatory work required to be performed by other trades.
 - 2. Review sequence of operations for each type of system, control, cabling and/or integration to any systems and/or equipment provided by other trades

3. Review and finalize construction schedule and verify availability of materials, installation personnel, equipment, and any preparatory work by other trades needed to make progress and avoid delays.
 4. Review required start-up, testing, commissioning and certifying procedures to be employed for each system and any impacts to other trades.
- D. For work on existing facilities, arrange, phase and perform work to assure the operation of all communications systems for other buildings and contiguous spaces at all times. Refer to Division 1 specification section for additional information.
- E. All new work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Division 1 specification sections.
- F. Coordinate the installation of all cabling, conduits/raceways and cable trays and equipment with applicable trades to ensure proper operation and function of all integrated systems in accordance with all related specification sections. Refer to Division 1 specification section for additional project coordination requirements.
1. Coordinate with all trades at the time of shop drawing submission detailing all space and/or room conditions. The contractor shall coordinate with the appropriate trade all conditions impacting the installation of any system, conduit or cable tray including but not limited to all equipment locations, ceilings, lighting fixtures, fire protection piping and ductwork layouts to the satisfaction of all concerned trades, subject to final review by the Design Professional.
 - a. Coordinate exact location of all desktop/counter/wall mounted equipment with the VA's Contracting Officer, Design Professional and all affected trades prior to the installation of any equipment and/or cabling.
 - b. Coordinate exact location(s) of all ceiling mounted cable, conduits, equipment and/or devices with all architectural plans, reflected ceiling plans and affected trades prior to installation.
 - c. Equipment installations requiring coordination with other trades the contractor shall provide all templates, back-boxes and equipment anchor bolts for mounting or flush mounting preparation, (e.g. pedestals or other devices requiring mounting on walls, concrete pads or other materials). Coordinate delivery of templates and equipment anchor bolts to preclude any delay in the construction schedule or the work of the affected trade.
 - d. If installation of equipment, devices, cabling, raceways, cable trays and/or conduit is performed prior to coordination with other trades, which interferes with work of other trades or operation and maintenance of the facility, make necessary changes to correct the condition at no additional cost to the Government.

- e. Prior to the final programming of any systems review with VA's Contracting Officer and Design Professional all system features, functions, system operations, network mapping, system integrated responses and all related programming as required for the proper operation of the respective communications systems.
- G. The Contractor shall maintain a complete set of current and up to date set of shop drawings and equipment submissions at the job site at all times. The Shop drawings and all other submissions shall be marked up to reflect all as-built conditions and shall be made available for review by the Design Professional at request.

3.3 EQUIPMENT/CABLE INSTALLATION AND REQUIREMENTS

- A. All system wiring and equipment installation shall be in accordance with good engineering practices and by all IEEE, EIA, NEC and manufacturer's requirements. Wiring shall comply with all state and local electrical codes. All wiring shall test free from all grounds, shorts, stray voltages and EMI.
- B. Follow manufacturers' instructions for installing, components and adjusting all equipment and cabling. Submit two (2) copies of such instructions to the VA's Contracting Officer and Design Professional before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.
- C. Ensure that all communications systems cabling supports (conduits, support grips, cable tray and J-hooks) are fully installed before proceeding with cable installation. At no times shall any cables be installed and left unsupported. At no times shall cables be tie-wrapped to any other supporting structure in lieu of specified cable supports. Do not bundle or tie-wrap the cables even within the approved cable supports.
 - 1. Do not leave any system cabling unprotected on the floor at any time. If cables must be left on any floor, protect the cables so that they may not be walked on or have any material or equipment placed or rolled on top. Replace all damaged cables from demarcation to termination point; no splicing of damaged cables shall be permitted.
 - 2. Maintain manufacturers recommended minimum bend radiuses of all cabling. Do not stretch, stress, tightly coil, bend or crimp the backbone, horizontal, patch or workstation cables. The Contractor shall keep all cabling out of the way of other trades during staging of any work. The contractor at the contractor's expense will replace all severely stressed or damaged cables, equipment and materials as determined by the VA's Contracting Officer and Design Professional.
- D. Equipment location shall be as close as practical to locations as indicated on the contract drawings.

1. Provide all equipment clearances in accordance with NEC requirements. Arrange equipment to facilitate unrestricted access for maintenance and service around all equipment, components and/or cable terminations.

E. Inaccessible Equipment:

1. Where the VA's Contracting Officer and Design Professional determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the project.
 - a. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

F. Cabling Requirements

1. Communications cabling and equipment installations shall be in accordance with good engineering practices as established by the EIA, IEEE and the NEC. All cabling shall meet all state and local electrical codes. All cabling shall test free from all grounds, shorts and EMI.
 - a. Contractors shall have the option to combine all cable home runs and conductors of same type and voltage "class" in accordance with NEC requirements unless specified elsewhere. Size all conduits and install all conductors in accordance with NEC requirements and manufacturers recommendations.
 - b. All TCP/IP based communications cabling located above accessible suspended ceilings may be installed without conduit and shall be supported by "J" hooks.
 - 1) Cabling installed above inaccessible ceiling spaces shall be installed in dedicated conduits.
 - 2) No exposed cabling will be acceptable in finished or occupied spaces of the facility without approval by the VA's Contracting Officer and Design Professional.
 - 3) Any communications system cabling installed exterior to the building and/or all cabling being routed from the facility to any remote location external to the project location shall be installed in OSP rated fiber optic cable.
2. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between indicated terminations, taps, or junction points. Remove and discard cable where damaged during installation and replace it with new cable.

3. Data Network UTP Cabling

- a. All data network UTP cabling is to be Category-6 and concealed above suspended ceilings, bundled and supported to the building structure. All cabling bundles shall be plenum rated and shall not contain any AC carrying conductors or non-associated communications network cables. All TCP/IP based communications cabling located above accessible suspended ceilings may be installed without conduit and shall be supported by "J" hooks.
 - 1) All horizontal data drops shall be Category-6 and shall be terminated on patch panels installed on the 19" equipment racks\cabinets.
 - 2) Copper station cabling may be run outside of conduits and above suspended ceilings only when between the cable tray and the conduit wall stub-up.
 - 3) All data drops and backbone cable installed above accessible ceilings shall be installed on J-hooks, cable trays, dedicated conduits, or in cable chases and/or a combination thereof as indicated contract drawing or specified. In no case shall cable be supported on ceiling tiles, T-bars, or tie- wrapped to any conduit or pipes.
 - a) Category-6 cables shall not be cinched too tightly, cable ties at patch panel locations shall be VELCRO type tie-wraps only. Plastic wire ties shall not be accepted on any Category-6 cabling.
 - 4) Each network drop shall be a dedicated Category-6 cable and shall not exceed a maximum distance of 294 feet from the associated MDF/IDF to the furthestmost data port for that network address.
 - 5) Cable Support: Securely secure to the permanent building structure where not installed in raceway. Provide "J" hooks at regular intervals appropriate to the cable and wire size.
 - 6) Cable and wiring shall not lay loose on ceiling tiles or grids. Cable must be supported in all areas. Bridle rings and tie-wrapped supporting methods are not acceptable j-hooks must be used between conduit stub-ups and cable trays for support.
 - 7) Install all cabling parallel to building lines and follow building structure. Use cable support equipment/hardware recommended by the manufacturer and/or as herein specified.
 - 8) Provide all terminations, cross-connects, wire management, surge protectors, etc. for a complete and operational system.

4. Telephone Network UTP Cabling

- a. All telecommunications network UTP cabling is to be Category-6 and concealed above suspended ceilings, bundled and supported to the building structure. All cabling bundles shall be plenum rated and shall not contain any AC carrying conductors or non-associated communications network cables. All TCP/IP based communications cabling located above accessible suspended ceilings may be installed without conduit and shall be supported by "J" hooks.
 - 1) All horizontal telephone drops shall be Category-6 and shall be terminated on patch panels installed on the 19" equipment racks\cabinets.
 - 2) Copper station cabling may be run outside of conduits and above suspended ceilings only when between the cable tray and the conduit wall stub-up.
 - 3) All telephone drop and backbone cable installed above accessible ceilings shall be installed on J-hooks, cable trays, dedicated conduits, or in cable chases and/or a combination thereof as indicated contract drawing or specified. In no case shall cable be supported on ceiling tiles, T-bars, or tie- wrapped to any conduit or pipes.
 - a) Category-6 cables shall not be cinched too tightly, cable ties at patch panel locations shall be VELCRO type tie-wraps only. Plastic wire ties shall not be accepted on any Category-6 cabling
- 4) Cable Support: Securely secure to the permanent building structure where not installed in raceway. Provide "J" hooks at regular intervals appropriate to the cable and wire size.
- 5) Cable and wiring shall not lay loose on ceiling tiles or grids. Cable must be supported in all areas. Bridle rings and tie-wrapped supporting methods are not acceptable j-hooks must be used between conduit stub-ups and cable trays for support.
- 6) Install all cabling parallel to building lines and follow building structure. Use cable support equipment/hardware recommended by the manufacturer and/or as herein specified.
- 7) Each telephone drop shall be a dedicated Category-6 cable and shall not exceed a maximum distance of 294 feet from the associated MDF/IDF to the furthestmost telephone port for that network address.
- 8) Provide all terminations, cross-connects, wire management, surge protectors, etc. for a complete and operational system.
- 9) All Category-3 backbone terminations located in communications equipment rooms (IDF) shall be terminated on 110 punch block installed on the 19" equipment racks and shall patch to the modular patch panels with 8 pin modular (568B pin-out) to 110 type patch cords, with one pair or two pair patch cord as required per phone type.

- 10) In the main communications equipment room (MDF) provide a sufficient number of 110 type terminations on the 19" racks to cross-connect to voice station drops and to connect to the 19" rack overhead to the PBX switch field with 25 pair cable/connectors.
- 11) All Category-3 backbone multi-pair cable terminated in the MDF (from the IDF's and the demarcation room locations) shall terminate on the wall to 110 blocks adjacent to the PBX switch field and connect with 25 pair connectors.
- 12) Surge protection for all incoming telecommunications service shall be provided by this contractor as required, to protect every incoming pair with a 25% spare and shall be design to handle surges of greater than 300 volts with a response of 3-4 nanosecond clamp down speed and shall type that provide a positive temperature coefficient (PTC) self-resetting current limiter. The surge protector shall be manufactured by Circa Telecom model # 4BIS-300. Locate surge protection at the main entrance point for incoming services (demark of MDF rm as indicated on drawings) NOTE: Contractor shall strictly adhere to NEC Article 800 fifty foot rule for unbroken cable runs to point of termination.
- 13) Auxiliary Equipment: The Contractor shall install cross-connect wire (minimum Category-3 rated), D-rings, wire distribution spools, 110 block labeling, organizer rings, and other appurtenances for a complete, neat and functional system.
- 14) Use methods and lubricating compounds on cables and wires to prevent damage to material and products during pulling-in. Provide compounds that are not injurious to the cable and wire jackets that do not harden or become adhesive.
- 15) Cable Pulling: Do not exceed manufacturers 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.
- 16) Wiring within Enclosures: Bundle, lace, and trim the conductors to terminal points with no excess. Provide and use lacing bars and distribution spools.

5. Intercommunications Cabling

- a. All wiring for analog intercommunications systems is to be provided in accordance with all manufacturers' requirements and shall be concealed above suspended ceilings in dedicated conduits and supported above ceiling tiles to the building structure. All intercommunication systems conduits shall not contain any AC carrying conductors or non-associated intercommunication systems cables.
- 1) Cabling installed above inaccessible ceiling spaces shall be installed in dedicated conduits. No exposed cabling will be acceptable in finished or occupied spaces of the facility without approval by the VA's Contracting Officer and Design Professional.

- 2) Intercommunications system conductors shall be twisted shielded pairs, minimum 18 AWG unless otherwise noted.
- 3) Twisted pair, minimum 14 AWG wire unless otherwise noted, and shall be utilized for all control wiring
- b) NOTE: Any intercommunications system employing TCP\IP based architecture shall be installed and tested in accordance with all requirements as specified herein for UTP cabling and in accordance with specification section 27 11 00:
 - (1) All structured cabling associated with the installation of any intercommunications system shall comply with all requirements of EIA\TIA standards for the proper installation, termination and testing of all fiber optic and UTP cabling.
- 4) Use methods and lubricating compounds on cables and wires to prevent damage to material and products during pulling-in. Provide compounds that are not injurious to the cable and wire jackets that do not harden or become adhesive.
- 5) Cable Pulling: Do not exceed manufacturers 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.
- 6) Wiring within Enclosures: Bundle, lace, and trim the conductors to terminal points with no excess. Provide and use lacing bars and distribution spools.
- 7) Refer to related specification sections for additional information for additional information related to cabling types, sizes and requirements.

6. Nurse Call\Code Blue Cabling

- a. All wiring for analog based Nurse Call\Code blue systems is to be provided in accordance with all manufacturers' requirements and shall be concealed above suspended ceilings in dedicated conduits and supported above ceiling tiles to the building structure. All intercommunication systems conduits shall not contain any AC carrying conductors or non-associated Nurse Call\Code blue systems cables.
 - 1) Cabling installed above inaccessible ceiling spaces shall be installed in dedicated conduits. No exposed cabling will be acceptable in finished or occupied spaces of the facility without approval by the VA's Contracting Officer and Design Professional.
 - 2) Nurse Call\Code blue systems conductors shall be twisted shielded multi pair cable, minimum 18 AWG unless otherwise noted.
 - 3) Twisted pair, minimum 14 AWG wire unless otherwise noted, and shall be utilized for all control wiring.

a) NOTE: Any nurse call\code blue system employing TCP\IP based architecture shall be installed and tested in accordance with all requirements as specified herein for UTP cabling and in accordance with specification section 27 11 00:

- (1) All structured cabling associated with the installation of any nurse call\code blue system shall comply with all requirements of EIA\TIA standards for the proper installation, termination and testing of all fiber optic and UTP cabling.
- 4) Use methods and lubricating compounds on cables and wires to prevent damage to material and products during pulling-in. Provide compounds that are not injurious to the cable and wire jackets that do not harden or become adhesive.
- 5) Cable Pulling: Do not exceed manufacturers 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.
- 6) Wiring within Enclosures: Bundle, lace, and trim the conductors to terminal points with no excess. Provide and use lacing bars and distribution spools.
- 7) Refer to related specification sections for additional information for additional information related to cabling types, sizes and requirements.

7. MATV Cabling

- a. All wiring for analog based video distribution systems is to be concealed above suspended ceilings, bundled and supported above ceiling tiles to the building structure. All cabling shall be plenum rated and shall not contain any AC carrying conductors or non-associated video distribution cables. All video system cabling located above accessible suspended ceilings may be installed without conduit and shall be supported by "J" hooks.
 - 1) Cabling installed above inaccessible ceiling spaces shall be installed in dedicated conduits. No exposed cabling will be acceptable in finished or occupied spaces of the facility without approval by the VA's Contracting Officer and Design Professional.
 - 2) Analog video cable shall be UL Listed, NEC type CL2 or CATV, Quad Shield, 75-Ohm coaxial cable. Cables installed above accessible ceiling spaces shall be NEC type CMP.
 - 3) Cable Pulling: Do not exceed manufacturers 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.

- 4) Wiring within Enclosures: Bundle, lace, and trim the conductors to terminal points with no excess. Provide and use lacing bars and distribution spools.
- 5) Refer to related specification sections for additional information for additional information related to cabling types, sizes and requirements.

8. Fiber Optic Cabling

- a. All fiber optic cabling shall be provided to meet the communications requirements for all network communications and audio\video systems, at the minimum all fiber optic cabling shall be sized in accordance with the project documents. All fiber optic cabling shall be minimum 50/125 micron / 8.9/125 micron, hybrid type cabling containing both multi and single mode fiber strands.
 - 1) All fiber optic cabling shall be a continuous segment from demarcation to termination point and shall be installed above accessible ceilings wherever possible. All fiber shall supported to the building structure and shall be plenum rated armored type cabling installed on "J" hooks or in cable trays or shall be standard type fiber optic cable which shall be installed in dedicated conduits.
 - a) Installation of all fiber optic cabling shall be in accordance with all guidelines established by the product manufacturer and all referenced industry standards.
 - b) Installation of the fiber cable segments when installed in conduits, special care shall be taken to avoid damage to the cable. While under pulling tension, the cable shall not be bent into a curve with a radius of less than twenty (20) times the cable diameter, or no less than manufacturers minimum.
 - (1) Pulling tension shall not exceed manufacturer's recommended maximum tensile load. Contractor shall utilize a winch with tension control or a "break-away" link designed to break away at or below the recommended maximum pulling tension.
 - (2) Use methods and lubricating compounds on cables and wires to prevent damage to material and products during pulling-in. Provide compounds that are not injurious to the cable and wire jackets that do not harden or become adhesive.
 - c) Category-6 "J"-hooks," supporting fiber optic cabling shall not exceed a maximum of 2 armored fiber cables per 2" "J"-hook, or 4 per 4" "J"-hook.
- 2) All exterior fiber optic cabling shall be armored type cable rated for exterior (OSP) applications and installed in dedicated conduits. Outside plant cable shall not extend more than fifty (50) feet into a building interior unless enclosed in RGS or IMC steel conduits.

- 3) Fiber optic cabling shall be provided as the primary media for all exterior and remote building communications and A\V systems, as well as all network communications links for all data\telecommunications systems. Each fiber optic link shall be comprised of dedicated transmitter and receiver shall be capable of providing all communication transmissions at a minimum of 1,280 feet.
 - a) The contractor shall be responsible for the determination of actual segment lengths. Actual quantities will be calculated by the routing as indicated on the contract drawings and/or in the field based on existing conditions.
- 4) Conductive fiber optic cable shall be provided for all exterior system components requiring control and/or power capabilities in the support of their operation, include all necessary surge protection and grounding for conductive cabling.
- 5) Refer to related specification sections for additional information for additional information related to cabling types, sizes and testing requirements.

9. Analog Cable Terminations:

- a. Splice, Taps and Terminations of all analog cabling: 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.
- b. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque-tightening values for equipment connectors.
- c. Rack and terminal cabinet wiring shall be neatly routed or bundled 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.

B. Environmental Conditions

1. Systems, components, devices materials and equipment shall be capable of withstanding the environmental conditions of the space without mechanical or electrical damage or degradation of operating capabilities or performance.
 - a. Interior, Controlled Environment: System components, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall utilize NEMA 250, Type 1 enclosures.

- b. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall utilize NEMA 250, Type 4X enclosures.
- c. Exterior Environment: System components, conduits and back-boxes installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rated for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick shall utilize NEMA 250, Type 4X enclosures.
- d. Hazardous Environment: System components, conduits and back-boxes located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
- e. Corrosive Environment: System components, conduits and back-boxes subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, shall utilize NEMA 250, Type 4X enclosures.
- f. Submersible Environment: System components, conduits and back-boxes subjected to prolonged submersion in water, shall utilize NEMA 250, Type 6P enclosures.
- g. Areas where equipment and devices may be subject to damage by the general population shall be installed in vandal resistant enclosures, all fire alarm devices shall be provided with wire guards.
- h. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

C. Conduits/raceway/Cable Trays:

- 1. Provide conduit and raceway systems for all Data, Telephone, A\V, Nurse Call and MATV network systems as indicated below. Refer to all related specification sections for additional conduit and raceway information.
 - a. Accessible suspended ceilings: Provide conduit stub-up from each outlet location to plenum space above ceiling.
 - b. Exposed structure: Provide conduit run from each outlet to a height of 12 feet to cable tray where provided.
 - c. Use Vertical Wire runway to support any /all risers between floors in closets or accessible locations; in no case shall any cable risers be unsupported.
 - d. Cables entering all communications equipment rooms shall be supported with Cable tray from entrance to rack/cabinet location as indicated on the contract drawings and/or herein specified.

e. Wire basket cable tray system shall be provided in all corridors as indicated on the contract drawings and installed as herein specified.

2. All conduits/raceways shall be concealed and shall be installed above accessible finished ceilings and/or in walls. Any conduits/raceways installed in areas requiring installation to be exposed, shall be installed tight to ceilings at right angles to walls and shall not obstruct any access hatches, equipment service panels, lighting or other equipment and/or devices. No exposed conduits/raceways shall be installed without prior approval of the VA's Contracting Officer and Design Professional.

a. Where conduits cannot be concealed above ceilings or in walls and must be installed in finished or occupied areas of the building, all conduits shall be finished wire-mold type raceways or approved equal. Finished wire-mold type raceways shall not be installed without prior approval in writing by the VA's Contracting Officer and Design Professional.

b. Where any equipment and/or junction boxes are installed above non-accessible finished ceilings, the contractor shall provide access hatches listed for the intended application. Access hatches shall be located so that service access to the equipment and/or junction boxes is unimpeded.

1) Access hatches shall not obstruct any equipment, service panels, lighting equipment, devices or any architectural elements of the ceiling. At the time of submittals the contractor shall submit all proposed access hatch locations for review by the Design Professional.

c. All conduits/raceways shall be supported in accordance with NEC requirements and shall be affixed in such a manner that tampering and/or removal without the use of specialized tools shall be prevented.

d. All conduits/raceways shall be installed in a manner that prevents tampering or removal when installed in areas exposed to the general population.

1) Provide tamper-resistant installation utilizing "torx with peg" security-fastening devices for all conduits/raceways, equipment, devices and appurtenances in all areas accessible to the general population and/or areas subjected to tampering or vandalism.

e. Interior raceways shall be a minimum 1 inch unless otherwise noted. Exterior raceways shall be a minimum 1 1/4-inch. Size all raceways and install conductors in accordance with NEC requirements. Fill ratio shall not exceed 40 percent for indoor raceways or exterior raceways.

1) EMT conduit with compression fittings and/or MC cabling may be utilized in all inaccessible ceiling areas unless otherwise restricted by code.

- 2) Threaded Rigid metal conduit shall be used on all exterior applications, stub-ups and all interior areas where concealed conduit requirements cannot be met and are exposed to tampering or damage by the general population.
 - a) All areas considered being of high risk due to the nature of the occupancy or the need to protect and maintain the integrity of the cabling shall be installed in rigid threaded conduits.
- 3) PVC schedule 40 conduit shall be utilized in all underground applications. The conduit shall be buried at a minimum 36" below grade. Warning flagging tape shall be buried 12" below grade to indicate the conduit routing location.
 - a) The Contractor shall have the option to utilize the same trench/routing location as other utilities. In no case shall any system conduits or duct banks be combined with other electrical utilities without providing the required separation between conduits as necessary to ensure the minimal transmission or conduction of any RF and/or EMI signals.
- f. Outlet Boxes: shall be 4 x4 x 2-1/8 inches deep for all data outlet locations and single gang for wall mounted telephone locations.
 - 1) All outlet boxes shall be provided with single or dual gang device mud-rings flush to finished wall as required based on type and configuration of outlet and type of wall construction.
 - 2) Use deep masonry boxes at masonry construction. T-Bar hangers or other appropriate mounting hardware shall be utilized to support boxes mounted in the ceiling.
1. Cable Trays (Ladder Type): Provide cable trays for routing horizontal distribution and backbone riser cables in all communications equipment rooms and closets. All cable trays shall be constructed of aluminum with two side rails and 9" rung spacing. Cable tray shall be complete with all materials, miscellaneous hardware and all appurtenances required for a complete cable distribution and support system.
 - a. All cable tray widths shall be sized according to the total number of cables to be supported within the various trays plus an additional 100% spare capacity for future expansion capability. At the minimum all cable trays installed in communications equipment rooms and closets shall be a minimum of 24" wide by 1" deep.
 - b. Install cable tray in a manner ensuring that all circuits fully comply with all ANSI/TIA/EIA standards.
 - 1) Maintain a minimum clearance of 24" between top of cable tray and ceiling structure or other equipment or raceway.

- 2) Maintain a minimum clearance of 6" between bottom of cable tray and top ceiling grid or other equipment or raceway.
- 3) Maintain a minimum clearance of 24" from all conduits or cables used for electrical power distribution.
- 4) Maintain a minimum clearance of 12" between bottom of cable tray and top of equipment racks and/or cabinets
- 5) Maintain a minimum clearance of 24" from fluorescent lighting. All Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.
- 6) Cable tray supports shall be attached to the structural ceiling or walls with hardware or other installation and support aids specifically designed for the cable tray and designed to support the cable tray's weight and required cable weight and volume.
- 7) Do not attach cable tray supports to ceiling support system or other mechanical support systems.
- 8) Load span criteria: Install tray supports in accordance with the load criteria of L/240.
- 9) Cable Trays shall be supported at 6-foot intervals.
- 10) All Cable trays shall be installed without burrs, sharp edges, or projections, which may damage cable insulation.
- 11) All lengths or sections of cable tray shall be bonded and grounded in accordance with NEC, EIA/TIA and IEEE.

- c. NOTE: Where telecommunications equipment and security equipment share the same equipment room this Contractor shall coordinate with the Division 28 integrator the installation of all cable trays.

D. Penetrations of Walls and Floors

1. All wall/floor penetrations are to be sleeved and fire stopped with approved fire stopping material. Coordinate all cable and conduit penetrations of the structure with all trades.
 - a. All penetrations of walls and floors shall be fire stopped in accordance with the ASTM and NFPA standards. Refer to related specification sections for additional information.
 - b. Floor penetrations shall be sleeved with a minimum sleeve diameter of 4 inches. An additional penetration shall be provided for future use, sleeved and capped and fire stopped as required.
 - c. Coordinate size of wall penetration with conduit size, number of conductors. Comply with all NEC requirements.
 - d. The fire rating of all penetrated walls, floors, and ceiling structures shall be strictly maintained. All penetrations shall be fire-stopped and sealed by the Contractor.
 - e. Install fire-stopping in open penetrations and in the annular space of penetrations for fire rated barriers.
 - f. Installation of fire-stops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.

- g. Installation of all fire-stopping shall be in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer's recommendations, local fire and building authorities, and applicable codes and shall be installed in a manner acceptable to the authority having jurisdiction.

3.4 ELECTRICAL POWER DISTRIBUTION

- A. Electrical power of 120 Volts (VAC) shall be provided by this Contractor. Coordinate with VA's Contracting Officer and Design Professional for nearest electrical distribution panels. Additional locations requiring primary electrical power as required by the specific products and/or integrator selected equipment shall be the responsibility of this Contractor to include as part of this project.
 - 1. Primary power for all communications equipment, central processors, telephone switches, audio amplifiers, UPS units and power injectors shall be configured to switch to emergency backup power sources automatically when primary power is interrupted without degradation of any critical system functions.
- B. Uninterruptible power supply units shall be provided for all communications equipment where required and shall have the capacity to furnish total power for a the specified minimum period of time in the event of failure of normal and/or emergency power source in accordance with the requirements of the related specification sections.
 - 1. Note: Contractor shall coordinate all required system electrical connections to the building emergency power circuits with the electrical drawings and\or the VA's Contracting Officer and Design Professional. Refer to all related specification sections for additional information on uninterruptible power supplies to be provided as part of all communications systems.
 - a. No functions, alarms or indications shall be lost during switch over from normal to emergency power.
 - b. At the minimum the following equipment shall be connected to UPS units, refer to appropriate system specification sections for additional system requirements:
 - 1) Layer II Data Switches
 - 2) Layer III Core Switches
 - 3) Fiber Optic Channel Switches
 - 4) 24\48 volt Power Injectors
 - 5) Telephone Exchange Switches
 - 6) Telephone and Voice Mail Servers

3.5 TRANSIENT VOLTAGE SUPPRESSION

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communications, control, or signaling circuits shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection.

1. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator.
2. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be acceptable for surge protection applications. All inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference at the minimum surge suppression test shall meet the following criteria.
 - a. All system power supplies serving exterior system components or devices shall be provided with the appropriate transient surge suppression protection on both the line side as well as the load side.
 - 1) A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.
 - 2) An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.
 - 3) Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equal.
 - 4) Operating Temperature and Humidity: -40 to 85 degrees C (-40 to 185 degrees) shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.

3.6 GROUNDING AND BONDING

- A. All electronic equipment, conduits, cable trays, racks/cabinets and cable shields shall be properly grounded and bonded in accordance with all requirements of EIA/TIA 607-A, NEC 250 and IEEE 1100. Where identified as applicable to the project, all equipment grounding shall be in accordance with Motorola R56 Standards and Guidelines for Communications Sites.
 1. A Telecommunications Grounding System shall be installed in all communications equipment rooms in order to provide equalization of the grounding potentials between the building power system and the telecommunications main grounding busbar (TMGB) as well as all telecommunications grounding bus-bars (TGB) in order to provide the diversion of electrical transients from the telecommunications cables and to provide a safety ground for all equipment racks/cabinets, conduits, cable trays and cable shields as well as providing the required coupling to cancel and/or reduce transients.

- a. The TMGB and each TGB shall be provided where indicated on the drawings and shall provide an effective bonding connection to the nearest approved building grounding electrode (e.g., structural steel) as well as to the local power distribution panel grounding system (e.g., ac branch circuit panel board's equipment grounding busbar).
 - 1) The minimum bonding shall be #6 AWG copper conductor connected to the TMGB and all TGB's. Connections shall be 2-hole NEMA type compression or exothermic welded connections.
2. All grounding connections shall provide the equalization of all grounding potentials between the building power system and the grounding terminations at the communications equipment in order to provide the diversion of electrical transients as well as providing the necessary coupling in order to cancel and/or reduce any voltage transients.
 - a. Equipment Grounding: Metallic structures, equipment racks, cabinets and enclosures as well as all raceways, cable trays, junction boxes, outlet boxes, machine frames, and other conductive items shall be bonded and grounded.
 - b. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing any voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the grounding bus, to all manhole hardware and ground rods, to the cable shielding grounding provisions for all cable splices, terminations and equipment enclosures.
 - c. Metallic Fences equipped with communications equipment: Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.
 - 1) Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence.
 - 2) Each gate section shall be bonded to its gatepost by a 3 by 25 mm (1/8 by one inch) flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.
3. All connections of grounding conductors to ground rods, bus bars, rebar, structural members, pipes and fences, as well as splices of any ground conductors, shall be made by exothermic welds except where otherwise noted. All connections to bar lugs shall be exothermic weld or compression type connections. Bolted type connection of ground conductors may only be made where terminal lugs or blocks have been furnished and installed in equipment by the manufacturer.

- a. Equipment grounding conductors shall be insulated stranded copper, except for sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be permitted to be identified per the NEC.
 - 1) At the minimum bonding connection shall be a #6 AWG copper conductor. All grounding shall provide an effective bonding connection between the protected equipment to the nearest approved building grounding electrode (structural steel) as well as to the local power distribution panel grounding system (e.g., ac branch circuit panel board's equipment grounding busbar). All bonding and grounding connections shall be NEMA type compression or exothermic welded connections.
4. Refer to related specification sections for any additional grounding and bonding requirements.

3.7 EQUIPMENT IDENTIFICATION

- A. Identify all system controls, components and equipment cabinets using plastic laminate engraved labels, or approved equal. Firmly affix to the panel, device and/or component.
 1. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item or where other method of identification is herein specified. Dymo or Kroy tap adhesive backed lettering shall not be acceptable.
 2. Color-code all junction boxes and enclosures per NEC recommendations. At the minimum provide all communications junction boxes as follows:
 - a. Color for Data\Telecommunications circuits - Yellow.
 - b. Color for Audio\Visual circuits - White
 - c. Letter all pull boxes and junction boxes located in service areas, tunnels, above accessible ceilings and pipe chases with laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws.
 - 1) Example: Telecommunications "TEL" Circuit Number TEL-126. Engraved laminated plastic tags shall be used for identification and securely fastened in accordance with all project requirements.
 3. Permanently label all cabling at both ends with self-adhering plastic labels.

- a. Labeling: hand written labels are not acceptable. All labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or type written onto adhesive labels. The font shall be at least one-eighth inch (1/8") in height, block characters, and legible.
 - 1) The text shall be of a color contrasting with the label such that it may be easily read. If labeling tape is utilized, the width of the tape shall not exceed 3/8," and the font color shall contrast with the background.
 - 2) All data\telecommunications patch panels shall exhibit workstation numbers, in sequential order, for all workstations served by the associated communications equipment room.
 - (a) All telecommunications outlet shall be labeled with its respective telephone instrument number (machine labels only). Workstation and Telephone instrument numbers shall be comprised of a sequential numbering scheme that meets the TIA/EIA-606 requirements, (i.e. "1-1-DJ-52"(IDF #1-rack 1-data patch panel-port #52); Each workstation and telephone cable shall be labeled, using a machine based net permanent labeling medium, at each end with its respective workstation number.
 - 3) Each fiber optic cable segment shall be labeled at each end with its respective communications room identifier.
 - (a) Each copper backbone cable shall be machine labeled at each end with its respective communications room number. Each binder group shall be tied off with its respective identifying ribbon at each breakout point.
 - 4) Warning Tags: At each location where the fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall be yellow or orange in color, and shall contain the warning: "CAUTION FIBER OPTIC CABLE." The text shall be permanent, black, block characters, and at least 3/16" high.
 - (a) A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not more than five (5) feet. Any section of exposed cable which is less than five (5) feet in length shall have at least one warning tag affixed to it.
4. Provide typewritten circuit directories installed in 3-ring binders with transparent page protectors in each control and sub control cabinet and/or equipment rack.

3.8 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain the all communications systems associated with this project in fully operational state as specified after formal written acceptance of the system.
 - a. Provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. Refer to Division 1 specification section for additional information.
 - b. The adjustment and repair of the communications systems shall include all software and firmware up-dates on all computers, CPU's, HMI terminals, devices, communications and data transmission medias' (DTM), facility interface processors, signal transmission equipment, telephone system software and processors.
 - c. Test, inspect and service each system on a semi-annual basis at six month intervals during the warranty period from the time of final acceptance. The contractor shall compare each six month test results with the test results at the time of final acceptance.
 - 1) The contractor shall include as part of the semi-annual test the calibration and/or adjustment of any device, component and/or system that has deviated from the original test results at the time of final acceptance.
 - d. For each semi-annual maintenance period, provide written notification to the VA's Contracting Officer of the systems condition before and after service, the exact components that were tested and serviced, and overall status of the system.

B. Personnel

1. Service personnel shall be manufacturer certified in the maintenance, testing and repair of the type of system and equipment provided for the project. Provide the VA's Contracting Officer and Design Professional the name of the designated service representative, and of any change in personnel.
 - a. The VA's Contracting Officer and Design Professional shall be provided copies of system manufacturer certifications for all designated service representatives.
2. Schedule of all work to be performed during regular working hours, Monday through Friday, excluding federal holidays.

C. Emergency Service

1. The Government shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the VA's Contracting Officer with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Government shall have sole authority for determining catastrophic and non-catastrophic system failures.
 - a. For catastrophic system failures, the Contractor shall provide same day eight (8) hour service response with a defect correction time not to exceed sixteen (16) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Government determines will place the facility(s) at increased risk.
 - b. For non-catastrophic failures, the Contractor within 1 business day with a defect correction time not to exceed 48 hours from time of notification.

D. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

E. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion.
2. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

F. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the Design Professional. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Design Professional. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and all related documentation.

3.9 WARRANTY

- A. Warrant material and workmanship for a period as specified in Division 1 of the contract documents and all related specification sections. The warranty period shall commence from the date the Contactor received written notification of final acceptance from the Design Professional. At the minimum the contractor shall provide warranty provisions:
1. Warrant the replacement of defective components/materials and/or correct defective work when given notice by the Government during the warranty period.
 2. Warranty excludes liability for consequential incidental, or special damages due to vandalism, misuse, or acts of God.
 3. Onsite warranty response time by qualified technician shall be within 8 hours upon receipt of request from Government.
 4. Warranty repairs shall be provided to the Government at no cost. This shall include but not limited to all repairs and/or replacement of defective components/materials, all labor charges, all travel costs and all vehicle charges.
 5. Response time shall be 7 days a week / 24 hours a day / 365 days a year.
 6. Provide test, inspection and service of each system on a semi-annual basis at six month intervals.
 7. Contractor must provide verification that they maintain their principle base of operation along with the personnel that will be responsible for providing service within 3 hours driving time to the project site. This tenet of the warranty shall remain in effect for the life of the warranty.
 8. All TCP/IP based communications systems cabling and related appurtenances shall be provided with the manufacturers 25 year extended warranty in addition to all requirements above.
- B. The Contractor shall, as a condition of final payment, execute a written warranty certifying all contract requirements have been completed according to all requirements of the Contract Documents.
1. All system testing, commissioning, demonstration and training shall be performed prior to final system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the satisfaction of the VA's Contracting Officer and Design Professional, at the Contractor's expense.
 - a. The contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty.
 - b. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of its failure during the warranty period, the warranty period for any replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work.

2. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

3.10 FIELD SERVICES

- A. Notify the VA's Contracting Officer and Design Professional in writing, prior to the closing of any ceilings and ten (10) days advance of testing all system cabling to prevent delays in construction schedules.

1. Test all cabling to confirm that no grounds, shorts, sneak currents, RFI and EMI conditions exist prior to start-up and commissioning of all, components, devices, equipment and/or systems.
 - a. Before requesting a final inspection, the Contractor shall perform a series of end to end installation performance tests. The Contractor shall submit for approval by the VA's Contracting Officer and Design Professional all test procedures to be employed, test result forms, and timetable for testing all fiber optic and copper plant wiring.
 - b. Acceptance of the simple test procedures discussed below is predicated on the Contractor's use of the recommended products including but not limited to twisted pair cable, cross-connect blocks, and outlet devices specified and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.

- B. UTP Cable Testing

1. Minimum Test Parameter requirements for Category-6 horizontal cabling.
 - a. Category-6: Each wire/pair shall be tested at both ends for the following utilizing Contractor generated test results forms:
 - 1) Wire Map.
 - 2) Length.
 - 3) Insertion Loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT).
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay Skew.
 - 11) Power Sum ACR.
 - b. All cable testing described herein shall exceed Category-6 transmission requirements of ANSI/TIA/EIA-568-B.2-1. In addition all cable and component transmission performance parameters shall exceed 10 Gb/s transmission requirements for connecting hardware, per the requirements of TSB-155.

- 1) Additionally, the installed channel system shall exceed IEEE 802.3 DTE Power specification to (4) times the rated current limits with no degradation of performance or materials and shall be error free Gigabit Ethernet performance to the referenced standard. (All performance requirements shall be verified and documented by a RCCD technician at the time of testing)
- c. Channel system shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 - 250 MHz when configured in a 4-connector channel. The 4-connector channel test configuration shall utilize a Category-6 jack, patch panel, optional 6-110 block, and patch cords, all from the same manufacturer, with qualified Category-6 cable.
- d. The 4-connector Category-6 channel performance margins in the table below shall be guaranteed provided the configuration satisfies above requirements

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to Category-6 Channel Specifications
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB
ELFEXT	4 dB
PSELFEXT	5 dB
Return Loss	2 dB

2. When errors are found, the source of each error shall be determined, corrected, and the cable re-tested. All defective components shall be replaced and retested. Defective components not corrected shall be reported to the VA's Contracting Officer and Design Professional with explanations of the corrective actions attempted.
3. Test records shall be maintained using the approved test result forms. The form shall record closet number, riser pair number or outlet ID, outcome of test, indication of errors found (e.g., a, b, c, d, or e) cable length, re-test results after problem resolution and signature of the technician completing the tests.
4. Test results for each 4 pair, Category 6, UTP cable must be submitted with identification to match labels on all patch panel ports and 8 position modular jacks, and identification to match as-built drawings associated with that cable.
5. VA's Contracting Officer and Design Professional shall observe and verify the accuracy of test results submitted.
6. Contractor shall submit both hardcopy printouts and electronic copy of all trace test results.

C. Fiber Optic Testing

1. Contractor shall test each fiber strand and each pair of each twisted-pair copper cable. The VA's Contracting Officer and Design Professional reserve the right to have a representative present during all or a portion of the testing process.

- a. If the VA's Contracting Officer and Design Professional elect to be present during testing, test results will only be acceptable when conducted in the presence of the VA's Contracting Officer and Design Professional.
2. Fiber Optic Cable: Each fiber strand shall undergo bi-directional testing for signal attenuation losses.
 - b. Test Equipment:
 - 1) Multimode: Light Source and Power Meter.
 - 2) Single mode: Light Source and Power Meter.
 - 3) OTDR.
 - c. Tests:
 - 1) Multi-mode: Signal attenuation at 850 and 1300 nm.
 - 2) Single-mode: Bi-directional signal attenuation at 1310 and 1550 nm.
 - 3) Test all Fiber cable on the reel before installation, with an optical light meter, to ensure fiber continuity and no factory defects.
 - 4) Test Criteria: Signal loss of less than (3.6 dB for 1000 Base-SX @ 850NM for 50 uM fiber) through entire passive fiber path, including cable, couplers and jumpers.

3. Fiber Optic Testing Specifications

- a. All testing shall be performed by factory trained and certified personnel.
- b. For all installed fiber optic cable EIA 455-171 Method D procedures will be adhered to (Bi-directionally).
- c. Connector loss shall not exceed 0.75 dB per connector pair.
- d. The Fiber Optic Cable shall not exceed 1.0 dB kilometer tested at 1310nm and 1550nm for single mode cable.
- e. The Fiber Optic Cable shall not exceed 3.5dB per kilometer tested at 850 nm and 1.5dB per kilometer tested at 1300nm for multi-mode 50/125 fiber.
- f. The contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer's specifications.
- g. Pre-installation tests of Inter-plant fiber- pre-test each reel:
 - 1) Test each reel of fiber each strand for continuity with a light source. If continuity is not achieved:
 - 2) Then test with an OTDR to determine the nature and location of the defect: Measure end-to end attenuation and the distance to a high attenuation point.
 - 3) If it is determined by Design Professional that the fiber is defective the contractor shall contact the manufacturer and provide a completely new fiber reel.
- h. Tests for installed Inter-plant and Intra-plant fiber optic cable:

- 1) Intra-plant and Inter-plant Multi-mode: Bi-directional signal attenuation at 850 and 1300 nm. power meter.
- 2) Intra-plant and Inter-plant Single-mode: Bi-directional signal attenuation at 1310 and 1550 nm. power meter.
- 3) Inter-plant Multi-mode: Bi-directional OTDR trace at 850 and 1300 nm. OSP ONLY
- 4) Interplant Single-mode: Bi-directional OTDR trace at 1310 and 1550 nm. OSP ONLY

NOTE: Obtain the actual index of refraction from the cable Manufacturer before testing.

4. Test Criteria.

- a. Total signal loss must not exceed the maximum Attenuation Coefficient plus the maximum Connector Attenuation as listed in TIA/EIA 568-B.
- b. Maximum Link Attenuation shall be as calculated below:
 - 1) Link attenuation is calculated as:
 - 2) Link Attenuation = Cable Attn + Connector Attn + Splice Attn
 - 3) Cable Attn (db) = Attenuation coefficient (db/km) Length(Km)
 - 4) Attenuation Coefficient
 - a) 3.5 dB/km @ 850 nm for 50/125 um
 - b) 1.5 dB/km @ 1300 nm for 50/125 um
 - c) 0.5 dB/km @ 1310 nm for single-mode outside plant cable
 - d) 0.5 dB/km @ 1550 nm for single-mode outside plant cable
 - e) 1.0 dB/km @ 1310 nm for single-mode inside plant cable
 - f) 1.0 dB/km @ 1550 nm for single-mode inside plant cable
 - 5) Connector Attn (db) = number of connector pairs connector loss (dB)
 - a) =2 x 0.75 dB
 - b) =1.5 dB
 - 6) Splice Attn (dB) = number of splices (S) splice loss (dB)
 - a) =2 x 0.75 dB
 - b) =1.5 dB
- c. "Measured" Link Attenuation shall be compared to "Calculated" Link Attenuation to determine acceptance. The Contractor at no additional cost shall correct any Links that fail.
- d. Single-mode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper. 50/125 um backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method A.1, One Reference Jumper.
- e. Submit all test reports for approval; an OTDR signature report for every OSP cable by strand and a fiber optic link attenuation record report for every cable by strand.

- D. Notify the VA's Contracting Officer and Design Professional in writing, ten (10) days advance of testing of all equipment and/or components to prevent delays in construction schedules.
1. Perform all tests, as required, by authorities having jurisdiction throughout the facility.
 2. Test system for grounds to demonstrate that the ground resistance does not exceed the requirements of the National Electric Codes (NEC).
 3. Test all cabling to confirm that no grounds, shorts, sneak currents, RFI and EMI conditions exist prior to start-up and commissioning of all, components, devices, equipment and/or systems.
 4. Test all systems and components for proper function and operation; certify that all systems are in proper working operation in accordance with the Contract Documents prior to scheduling any system demonstrations.
 5. Test all fiber optic cabling with Optical Time Domain Reflectometer (OTDR) in accordance with all TIA/EIA protocols.
 6. Testing of all communications systems shall be in the presence of the VA's Contracting Officer and Design Professional as well as all appropriate representatives of the authorities having jurisdiction.
 - a. All completed communications systems shall be fully tested in accordance with all requirements of EIA/TIA. Upon completion of a successful testing, the contractor shall so certify in writing to the VA's Contracting Officer and Design Professional that all testing was completed, certified and left in first class operational condition, include all completed copper and fiber testing read-outs, certifications and test reports.
 - b. The service of a competent, factory-trained engineer or technician authorized by the equipment manufacturer shall be provided to technically supervise installation and participate during initial system programming, start-up, final testing, assist in the final acceptance testing and Government demonstrations.
 - c. At the minimum all acceptance testing, demonstrations and training shall include, but not be limited to the following:
 - 1) Data Communications Systems Network
 - 2) Telephone Communications Systems Network
 - 3) Intercommunications Systems
 - 4) MATV\Media Distribution Systems
 - 5) Nurse Call\Code Blue Systems
 - 6) UPS and Battery Back-up Functions.
 - 7) Integration of all Auxiliary Systems
 7. In addition provide all testing, commissioning and certifications as specified by Division 1 specification sections and any manufacturer's recommendations or requirements.

E. Training

1. In addition to all demonstration and training as specified by Division 1 specification section and all related Division 27 specification sections, system demonstrations and training shall be provided in accordance with all requirements of this section.
2. Prior to acceptance of the work, the System Integrator shall demonstrate to the VA's Contracting Officer and Design Professional, all systems and sub-systems all features and functions of each system, and shall instruct the Government Representatives in the proper operation, event sequences, programming and maintenance of all systems and sub-systems.
3. The System Integrator shall furnish the necessary trained personnel to perform all demonstrations and instructions and arrange to have the manufacturer's representatives present to assist with the demonstrations.
4. Training time shall include, as a minimum, the total time determined by the sum of the times per system as specified in this and related specification sections, for performing the prescribed demonstrations/training. Refer to related specification sections for additional training requirements.
 - a. Allow a minimum of 16 hours' time for each system provided for performing the prescribed demonstrations/training.
 - 1) Provide a minimum of (4) four 4-hour training classes performed at the project location and spaced over a three week interval. Training classes shall be scheduled not less than 48 hours apart to allow the Government User\Operators to familiarize themselves with all system operations.
5. Provide operation, parts and maintenance manuals defining operation and troubleshooting methods of all systems and review with Government User\Operators as part of training demonstrations.
6. Provide detailed video recordings in high quality digitally formatted media of all demonstration and training of all systems and system operations.
 - a. Utilize remote microphones as may be required to ensure high quality audio of the recorded demonstrations.
 - b. Permanently and professionally label all recorded materials and provide self-sealing plastic cases.

F. Inspections

1. At the completion of the project and prior to final acceptance of the Work, provide evidence of final inspections and approvals to the VA's Contracting Officer and Design Professional, in accordance with all requirements of the Contract Documents as well as required by the authorities having jurisdiction.

End of Section

SECTION 27 11 00
NETWORK COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Division 26 Specification Sections shall apply to this and all related Division 27 specification sections.
- B. Related Sections:
1. 07 08 00 - Fire Stopping
 2. 08 31 13 - Access Doors
 3. 26 05 00 - Requirements for Electrical Installations.
 4. 26 05 21 - Low Voltage Electrical Power Conductors and Cables.
 5. 26 05 26 - Grounding and Bonding for Electrical Systems
 6. 26 05 33 - Raceways and Boxes for Electrical Systems
 7. 27 05 00 - Common Work Results for Communications Systems
 8. 27 52 23 - Nurse Call and Code Blue Systems
- C. Reference Symbols:
1. All device symbols are defined by the appropriate symbol schedules. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location.
 - a. Contractor shall coordinate exact locations with all architectural drawings, reflected ceiling plans, furniture plans, mechanical and electrical drawings as well as all affected trades prior to submittal of any shop drawings.
- D. Abbreviations:
1. Refer to Specification Section 27 05 00 for additional information.
 2. 10base2 - 10 Mbps data throughput over coaxial wire medium.
 3. 10baseT - 10 Mbps data throughput over twisted pair medium.
 4. 10baseF1 - 10 Mbps data throughput over fiber optic medium.
 5. 100baseT - 100 Mbps data throughput over twisted pair medium.
 6. 100baseF1 - 100 Mbps data throughput over fiber optic medium.
 7. ACR - Attenuation to Crosstalk Ratio.
 8. AP- Wireless Access Transceiver.
 9. AUI - Attachment Unit Interface.
 10. CATV - Cable TV.
 11. CSU - Channel Service Unit.
 12. dB - Decibel.
 13. DSU - Data Service Unit.
 14. ELFEXT - Equal Level Far End Crosstalk.
 15. FEXT - Far End Crosstalk.
 16. IDF - Intermediate Distribution Frame.

- 17. IR – Infrared.
- 18. Lab – Computer, Science and/or Education Laboratory.
- 19. Mbps – Megabits per second.
- 20. MDF – Main Distribution Frame.
- 21. NMM – Network Management Module.
- 22. NEXT – Near End Crosstalk.
- 23. O.T.D.R. – Optical Time Domain Reflectometer.
- 24. TIA – Telecommunications Industry Association.
- 25. TSB – Technical Service Bulletin.

E. Definitions:

- 1. Refer to Specification Section 27 05 00 for additional information.

1.2 SUMMARY

- A. The intent of this specification is to establish a standard of quality, overall system configuration and equipment requirements for the installation and extension of the existing data telecommunications network. The contractor shall be responsible for providing all design, installation, programming, commissioning, testing and certifications as necessary to provide complete infrastructure to support all Data, and Voice over IP (VoIP) telephone cabling networks in accordance with the Contract Drawings and/or as herein specified. (Telecommunications servers, voice mail servers, wireless access points and telephone instruments to be provided Government).
- 1. The installation, performance, features, functions, software and programming criteria as specified herein as well as all related specification sections have been designed to offer the maximum system efficiency ease of operation, occupant safety and the protection of equipment as recommended by the design Professional.
 - a. Any deviations from the specified criteria shall be documented, reviewed and agreed to in writing by the VA's Contracting Officer and Design Professional prior to submission of bids. Refer to Division 01, Division 27 and all related specification section for product substitutions.
- 2. It is the responsibility of the contractor to ensure that the installed system meets or exceeds every standard set forth in these specifications. The contractor shall provide all cabling, communications outlets, conduits, electrical power, system components, termination equipment, racks/cabinets, electrical power, software, programming, and all appurtenances as well as all necessary testing, commissioning and certifications as necessary to provide a complete and fully operational data and telecommunications networks whether specifically included in this section or not.

- B. The contractor shall furnish all labor, equipment, materials, testing, commissioning, programming and certification in connection with the installation of a complete premise data and telephone communications networked systems as indicated on the drawings and as herein specified.
1. The systems shall be complete with all equipment as indicated on the contract drawings and/or described herein. The contractor shall turn over to Government a complete and fully operational data communications and telephone network infrastructures in full compliance with the contract documents.
- a. The systems shall include at the minimum but not limited to the following;
- (1) Category-6 Plenum rated cabling. (Data)
 - (2) Category-6 Plenum rated cabling. (Wireless Access)
 - (3) Category-6 Plenum rated cabling. (Telephone)
 - (4) Distribution/Patch Panels
 - (5) Communications Outlets/Jacks w/cover plates
 - (6) Integration of Security, Fire, Intercommunications, A/V and Building Automation systems
- C. The contractor and all sub-contractors for this work shall have read all of the General Conditions, Special Requirements, General Requirements and all applicable related specification sections and in the execution of all work shall be bound by all of the conditions and requirements therein.
- D. Prior to the submission of the Bid, any discrepancies or inconsistencies noted within these specifications and/or the project drawings shall be brought to the immediate attention of the VA's Contracting Officer and Design Professional
1. Project specifications and drawings may not deal individually with every component, control, device, or appurtenance, which may be required to produce the specified system configuration, and/or as necessary to meet the equipment and cabling requirements. Coordinate all integration requirements with the VA's Contracting Officer and Design Professional and all appropriate systems providers.
2. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location. The contractor shall coordinate the installation of all cabling, materials, equipment, devices, jacks, cable trays and conduits with all affected trades and document all coordination at the time of shop drawing submittals.
- E. This contractor shall assume total responsibility for coordinating all inter-building wiring, any common carrier provided network equipment, and/or Government provided equipment as it relates to the operation of these systems.

1.3 SCOPE OF WORK

- A. The contractor shall furnish all labor, equipment, materials, cabling, and the performance of all testing, commissioning and certification in connection with the installation of a complete premise data communications network and telecommunications infrastructure in accordance with all requirements of the project drawings and/or as herein specified.
1. Provide and install all equipment described herein, including, but not limited to all, jacks/outlets, Category-6 cabling, distribution hardware, as well as all conduits, outlet boxes and appurtenances necessary to provide complete and fully operating data communications network system.
 - a. Data Communication Network Architecture:
 - (a) 100 Base TX, Fast Ethernet (IEEE802.3u).
 - (b) 1000 Base SX, Gigabit Ethernet (IEEE802.3z).
 - (c) 1000 Base -T, GigE over copper (IEEE802.3 ab).
 - (d) 1000 Base LX, Gigabit Ethernet (IEEE802.3z).
 - (e) Wireless IEEE 802.11n
 - (f) Power over Ethernet (IEEE802.11af)
 - (g) Protocols: TCP/IP (RFC1720)-OSI Compliant, AppleShare IP
 2. Provide and install all equipment described herein, including, but not limited to all telephone jacks, punch blocks, patch panels Category-6 communications cabling, distribution hardware, conduits, outlet boxes, and all appurtenances necessary to provide complete and fully operating telecommunications infrastructure as indicated on the contract drawings and/or as herein specified.
 - a. All Telecommunications servers, voice mail servers and telephone instruments to be provided Government. Contractor shall coordinate all telephone cabling and equipment requirements with Government's telephone equipment provider. Refer to related specification sections for additional information.
 - b. Telephone Communications Network Architecture:
 - (1) 100 Base TX, Fast Ethernet (IEEE802.3u).
 - (2) 1000 Base SX, Gigabit Ethernet (IEEE802.3z).
 - (3) 1000 Base -T, GigE over copper (IEEE802.3 ab)
 - (4) 1000 Base LX, Gigabit Ethernet (IEEE802.3z).
 - (5) Power over Ethernet (IEEE802.11af)
 - (6) Protocols: TCP/IP (RFC1720)-OSI Compliant, SIP (RFC 2543), RTP and RTCP
 - B. Provide integration of all systems where indicated on drawings and/or herein specified. Provide interconnection between telephone switching equipment (provided by Government). Provide all equipment racks, 110 punch blocks and Category-6 patch panels as required to support all horizontal, telecommunications, fiber optic and multi-pair UTP backbone cabling.

- C. Integrate all data, telephone; intercommunications and A/V cabling at all jack locations as indicated on the contract drawings. Coordinate with the appropriate equipment providers for all network integration requirements of all telephone, security, fire, intercommunications, A/V, and building automation systems.
- D. Design Requirements:
1. Provide a complete Data communications network infrastructure including but not limited to all cabling, jacks, and distribution and termination components as indicated on the contract drawings and as herein specified.
 - a. All horizontal network connections shall utilize Category-6 copper cabling and hardware for distribution to all offices, rooms, spaces and within modular furniture as indicated on the contract drawings. All horizontal cabling shall be bundled and routed through the facility on "J" hooks sized to support the network cabling requirements and shall terminate on Category-6 patch panels on the existing data equipment racks at the nearest communications room.
 - 1) NOTE: Category-6 cables shall not be cinched too tightly, cable ties at patch panel locations shall be VELCRO type tie-wraps only. Plastic wire ties shall not be accepted on any Category-6 cabling.
 2. Provide a complete Telephone Network Infrastructure with all phone outlets, panels, 110 punch blocks, and Category-6 cabling in accordance with the contract drawings and as herein specified. All Voice over IP (VoIP) telephone switching equipment and telephone instruments shall be provided by Government.
 - a. The telephone network shall utilize Category-6 copper cabling and hardware for distribution to all offices, rooms, spaces and within modular furniture as indicated on the contract drawings. All horizontal cabling shall be bundled and routed through the facility on "J" hooks sized to support the network cabling requirements and shall terminate on Category-6 patch panels and then connect to 110 punch blocks installed on the existing telephone equipment racks at the nearest communications room. Patch cables shall be provided at the 110 punch blocks and routed to the patch panels located on the communications equipment racks.
 - 1) NOTE: Category-6 cables shall not be cinched too tightly, cable ties at patch panel locations shall be VELCRO type tie-wraps only. Plastic wire ties shall not be accepted on any Category-6 cabling.

3. Provide all standard analog telephone circuits and jacks for the connection to fax machines, fire, security and BAS modems/communicators. All analog telephone lines shall utilize Category-6 cabling and shall terminate on Category-6 patch panels and then patch corded to 110 punch blocks located at all communications equipment racks for connection to the PSTN. (all analog telephone circuits shall be connected from Category-6 patch panels to EIA standard 110 punch blocks by RJ-45 to 110 patch cords provide by this contractor)
4. All data cabling shall be terminated at both ends of the basic link at all jack locations and fiber optic and Category-6 patch panels.
5. All VoIP telephone cabling shall be terminated at both ends of the basic link at all telephone jacks locations to telephone patch panels. .
6. The Contractor is responsible for the entire infrastructure installation: including all workmanship, standards of quality, adherence to the contract documents, certification testing, as-built documentation, labeling, and final warranty in relationship to the performance and installation of the data and telephone structured cabling systems in accordance with the contract drawings and/or as herein specified:

- a. Note: The Contractor must certify in writing that the structured cabling system(s) are installed in accordance to the project documents, the referenced standards as well as all manufacturer requirements. In addition, the contractor shall provide in writing all extended manufacturers' warranties for matching compatibility of the structured cabling system as well as all as-built drawings and field test reports for both the fiber and copper cabling systems before the VA's Contracting Officer and Design Professional will accept the installation.

E. Performance Requirements:

1. The intended function of the data communications cable system is to transmit data signals from a central location to several individual data outlet locations. Upon completion of the work in accordance with the contract documents, the system shall be capable of transmitting data signals at a rate of 1000 Mbps minimum over Category-6 cable as well as over all single and multi-mode fiber optic cables. Both single and multi-mode fiber optic cables shall also be capable of transmitting a minimum of 10Gbps based upon the transmitting distance and number of links.
 - a. The 50/125 micron multi-mode optical fiber cable shall be capable of transmitting signals with a minimum modal bandwidth of 500 MHz-km at both 850 and 1300 nm (i.e. 500/500) This will allow nominal 600 meters @ 1GBPS and 82 meters @ 10GBPS.
 - b. The single-mode 8.3/125 micron (nominal) optical fiber cable shall be capable of transmitting signals at both 1310 and 1550 nm. This will allow nominal 5km @ 1GBPS @1000 Base LX and nominal 10km @ 10GBPS @10GBASE-LX4.

1.4 REFERENCE STANDARDS

- A. Refer to Specification Section 27 05 00 for additional information.

1.5 SUBMITTALS

- A. Refer to Specification Section 27 05 00 for additional information.

1.6 RECORD DOCUMENTS

- A. Provide Owner with complete set of record drawings in accordance with the requirements of section 27 05 00.

1.7 EXTRA MATERIAL

- A. In addition to all requirements as specified by specification section 27 05 00 the following extra materials shall be provided as part of this project:
 - 1. Five (5) data outlets each type utilized in each system as a spares.
 - 2. Five (5) Outlet face plates for each type utilized in each system as spares.
- B. All extra materials shall be delivered at the time of final acceptance of the system(s). At no time is the contractor to use the extra materials provided for this project to replace malfunctioning equipment and or components prior to final acceptance.

PART 2 - PRODUCTS

2.1 General

- A. Manufacturers listed as acceptable or equal shall not negate the contractor's responsibility for providing all systems in accordance with all functions and performance requirements of the Contract Documents.
- B. Where manufacturer and/or model numbers reference specific system components in this specification, it is to establish the performance requirements and quality of the systems and components only.
 - 1. It is in no way an inference that the referenced model numbers are the manufacturer's current product and are the only acceptable components for this project unless specifically referenced as "no substitutions".
 - 2. Contractor shall provide the manufacturers' most current product that shall meet and/or exceed the specified performance and features of all data, and telecommunications equipment and/or systems.
 - 3. Equivalent UL- listed equipment may be substituted for the approved manufacturers in accordance with all requirements of Division 1 specification section titled "Substitutions" and/or General Conditions to the Construction Contract and where

approved equal is referenced in the specific specification section.

- a. Where systems and/or components are referenced as "no substitutions" the specific system and/or components shall be provided.
- b. All substitutions shall comply with all requirements as specified in related specification sections and all system performance standards shall be maintained.
- c. The contractor shall stipulate at the time of submission of bid the following information impacted by such a substitution.
 - 1) Any and all extensions in time impacted by the substitution.
 - 2) Any changes to the architectural or structural elements to the project.
 - 3) Differences in operation and/or performance from intended system criteria.
- d. Failure to provide the required substitution information shall result in "without consideration" the immediate rejection of the substituted equipment and/or systems.

C. Unless specified otherwise, the equipment furnished shall fall into six classes, and with the exception of Class 6, all of the material within a single class shall be the standard product of one manufacturer. Exceptions are annotated (Class Exempt). The six classes are as follows:

1. CLASS ONE: Fiber Optic Cable, Category-6 and Category-3 UTP copper cable (both station and backbone), fiber optic jumpers, Category-6 patch cords, blocking kits, interconnection devices, connectors (fiber and copper), wiring blocks, patch panels, and telecommunications outlets. Refer to applicable specification paragraphs for acceptable product manufacturers.
 - a. Note: All material covered in "Class One" shall conform to all manufacturers' cable/component matching connectivity requirements for the connection of all communications outlets, patch panels and cabling appurtenances provided as part of this project.
 - b. Other cabling systems meeting the listed performance and warranty requirements will be considered following compliance with all substitution requirements in accordance with Division 1 specification section titled "Substitutions".
2. CLASS TWO: Inner-duct systems. All material covered in "Class Two" shall be equal in quality and performance to that manufactured by Pyramid, Carlon or Endot or approved equal..
3. CLASS THREE: Equipment racks, Wire Management Systems and Cable Trays. All material covered in "Class Three" shall be equal in quality and performance to that manufactured by B-Line, CPI or approved equal.

4. CLASS FOUR: Communications Equipment Cabinets and Wire Management Panels. All material covered in "Class Four" shall be manufactured by Hubbell Premise Wiring, B-Line E2, or CPI Mega-frame or approved equal..
5. CLASS FIVE: Velcro wire ties/cable wraps, storage rings, labels, "D" rings (metal only), nuts, bolts, screws, and other miscellaneous and appurtenant hardware or approved equal.
6. CLASS SIX: Government Provided Systems/Equipment/Hardware-PROPRIETARY
 - a. All active electronics (Layer II Data switches, UPS Units, Severs, Telephone Instruments and wireless access transceivers)

D. All equipment and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.

2.2 EQUIPMENT AND COMPONENTS

A. Data Communications Outlets (Wall /Ceiling Mount).

1. Data/Telephone Faceplates: 4 pair, 110 connecting blocks, T568B pinning, Category-6 compliant, office white or as selected the VA's Contracting Officer and Design Professional. Acceptable manufacturers for this project shall be Hubbell, Ortronics, Leviton or Systimax. (All communications outlets, patch panels and cabling appurtenances shall conform to manufacturers' cable matching requirements).
 - a. Modular Outlet Jacks & Faceplates: Hubbell (Xcelerator™) XJ6 Series Category-6 modular in Hubbell IFP Series rear load faceplates. Standard 8-position, RJ-45 style, un-keyed, designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable, 26-22 AWG solid or stranded conductors. Provide data plate configuration in accordance with project drawings.
2. Accessories: Hubbell XJ6 Category-6 Jacks or approved equal include a translucent stuffer cap for wire retention and to permit visual inspection. Jacks accept optional hinged dust covers and snap-on icons blue for data and light gray for voice, 'phone icon' for voice and 'computer icon' for data/video, quantities in accordance with contract drawings. Hubbell XJ6 Series jacks are available in various colors to meet specific customer applications. Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 - a. Modular Mounting Frames: Hubbell, Part #IFP12OW or approved equal, two-port, supplied with mounting screws, clear screw covers and paper labels, and color matched screw covers. Office White - flush mounted with screws.
 - b. Modular Mounting Frames: Hubbell, Part #IFP14OW or approved equal, four-port, supplied with mounting screws, clear screw covers and paper labels, and color matched screw covers. Office White - flush mounted with screws.

- c. Modular Mounting Frames: Hubbell, Part #IFP160W or approved equal, six-port, supplied with mounting screws, clear screw covers and paper labels, and color matched screw covers. Office White - flush mounted with screws
- d. Modular Outlet Jacks: Hubbell HXJ Series Jacks or approved equal, 8 wire, T568B pinning, Category-6, 110 insulation displacement type modular jack. Provide Hubbell multimedia connectors in accordance with contract drawings.
 - (1) Category-6 jack
 - (2) DB-15 Connector
 - (3) RCA Audio/Video adapter
 - (4) Blank inserts for unused port.
 - (5) Icons same as data drops (i.e. Data, Phone, Video).

B. Equipment Racks/Patch Panels/Appurtenances (Communications Rooms)

- 1. Provide four post frame racks where indicated on the contract drawings in quantities and size to provide sufficient capacity to install all necessary components and cabling as required to fulfill the system requirements and shall be provided with a minimum of 30% spare capacity for the installation of additional components or future expansion.
- 2. Equipment racks shall be at the minimum 19"w X 72"h X 30"d open frame floor mounted units with both a vertical management system providing a minimum of 1.45 inches of cable capacity per side and horizontal cable management systems as well as all appurtenances necessary to properly support the intended applications. The rack unit shall have a minimum static load rating of 2,000 lbs. A 24-inch ladder cable tray shall be supplied and installed Provide cable tray radius drops as required over all equipment racks.
 - a. Provide open frame wall-mounted racks with swing-out rear access where indicated on the contract drawings. The rack shall be a minimum 19"w X 72"h X 25"d. The wall-mounted rack shall be provided with both vertical and horizontal cable management systems and all appurtenances necessary to properly support the intended application. A 24 inch ladder cable tray supplied and installed Provide cable tray radius drops as required over all equipment racks. Note: All equipment racks shall be surface mounted unless indicated otherwise on the contract drawings.
- 3. Provide floor mounted equipment cabinets where indicated on the contract drawings in quantities and size to provide sufficient capacity to install all necessary components and cabling as required to fulfill the system requirements and shall be provided with a minimum of 30% spare capacity for the installation of additional components or future expansion. Each cabinet shall include separate locks on the center swing frame section and the front viewing door. All cabinets shall be provided with the following minimum requirements:
 - a. Rear housing with removable top and bottom covers
 - b. Two vertical system bars
 - c. Cable collecting rail and wire management system
 - d. Center swing frame with lock and two adjustable 19" rails

- e. Smoked glass front viewing door with lock
 - f. Adjustable 19" rails
 - g. Wall mounting brackets/standoffs
 - h. Grounding busbar
 - i. Power Strips.
 - j. Air circulation fans with filters
- (1) Contractor shall size fans to maintain manufacturers recommended operating temperatures for all electronic components installed in cabinet. At the minimum provide a one dual 114 cfm fan.
4. Fiber Optic Patch Panels (FOPP's): Hubbell FCR Series rack mount fiber enclosure PART # FCR525SPR or approved equal, 72 port, rack mount fiber patch panel- Provide hybrid Single /Multi Mode fiber optic cable where indicated on the project drawings entering each IDF or MDF. Rack in sufficient quantities to support the project requirements or approved equal.
5. Modular Patch Panels HUBBELL NEXTSPEED® Part #P6E48U or approved equal. 48-port T568B wired Enhanced Category-6 Patch Panel or approved equal.
- a. Provide One (1) Port for each data and telephone drop to a workstation or telephone instrument served by the MDF/IDF with a minimum of 48 spare ports. If the number of data/telephone drops, plus required spare count (48) is greater than 48, then a second 48 port patch panel shall be provided.
 - b. Provide as many patch panels in the MDF/IDF's locations as required to support all data/telephone cable drops plus the required spare count. Install adhesive backed designation strip labels for administrative labeling provided with panel.
6. Patch Cables, Category-6, high performance: Hubbell NEXTSPEED® Part # PCX6 or approved equal.
- a. Lengths shall be three (03), five (05), seven (07), or ten (10) feet; and cord colors shall be gray for all network cabling, yellow for all phone cabling and green for crossover cables. All remaining colors shall be as identified by the VA's Contracting Officer and Design Professional auxiliary and security system connections.
 - b. Provide Two (2) patch cables for each populated patch panel port; one seven foot long in the closet and one ten foot long at the workstation PC end. All patch cables shall be 568-B approved and meet all product matching criteria. Supply minimum 7-foot and ten-foot lengths and cord colors as directed by the VA's Contracting Officer and Design Professional. Provide ten spare patch cords for each MDF/IDF location.
 - c. Provide One (1) Voice-110 to 8-pin modular jack patch cord for each telephone drop feeding 110 punch block to telephone patch panel port, Hubbell Part # PC110C5E1 or approved equal.
 - d. Provide a quantity of one patch cord for each terminated voice outlet jack, plus five spare for each MDF/IDF location.

- e. All Category-6 Patch cord must be provided by the same manufacturer as part of a certified structured cabling system.
7. Punch Blocks: (voice): Hubbell part #110BLK100FTK4 or approved equal. Individual 100-pair wall mount wiring block, 110-field termination kit, (number of wiring blocks as required to terminate all 4-pair station cables plus 25% spare capacity).
- a. All station field blocks and riser field blocks shall be provided at all MDF/IDF' locations with cross-connect patch cords in sufficient quantities to cross-connect all station pairs. For rack mounted 110 kits Provide Hubbell Part# 110RM24 200-pair rack mount kit with cable management troughs.
 - b. All patch cables shall be provided to cross connect all telephone drops of going from a Category-6-patch panels to a 110 block instead in lieu of providing the standard 'hard' punch-down connecting means.
8. Required Accessories and Quantities:
- a. Provide Hubbell FSP Series or approved equal adapter panels for the FCR525SPR rack mount enclosure panel - 24 2-port simplex SC Coupler Bezels, colors as selected by the VA's Contracting Officer and Design Professional - Eight (8) packages of 6-port ST coupler bezels are required for each FOPP installed.
 - b. Fiber patch cords: Hubbell, part #DFPCSTSCD3MM or approved equal. 9.8 ft. (3.0 m) - Duplex, multi mode 50.0 micron, ST-SC Fiber patch cords. Provide One Fiber Jumper for each two strands of multi-mode fiber originating in the MDF, as well as all IDF locations.
 - c. Provide all wire management: Hubbell part #HC219ME3N-19 or approved equal. 3.5" or equal. front cord manager; Rear Cord Manager velcro tie cable managers; B-LINE, CPI PART #02006-201 or approved equal, 4"or 6" cable bundle as required;
 - (1) Provide one Rear Cord Management Panel for each patch panel; One front cord manager panel between each set of patch panels; number of velcro hook and loop tie-wraps as required for neat and tidy rear cable management.
 - (2) Provide Vertical Cable Manager 6"Wx14.94"Dx7'H for all 19-inch Equipment Racks as required; B-LINE, CPI PART #40098-703 or approved equal.

C. Category-6 Cable

1. Acceptable Cable Manufacturers pending full compliance with the performance requirements herein specified and meeting CISCO systems standards:
- a. Hubbell Xcelerator 6 with Hubbell Category-6 C6ESRGY series cable.
 - b. General Cable GenSpeed 6600 with Hubbell Xcelerator connectivity.

- c. Mohawk/CDT: GigaLan Enhanced with Hubbell Xcelerator connectivity.
 - d. Berk-Tek: LanMark 2000 with Ortronics Clarity or Siemon connectivity.
 - e. Superior Essex: NextGain with Leviton eXtreme connectivity.
- 2. Acceptable telephone Cable Manufacturers pending full compliance with the performance requirements herein specified:
 - a. Horizontal Drop Station Voice Cable: 4 pair, #24 AWG, solid conductors, Category-6 compliant minimum, jacket shall be stamped with 'UL' or 'ETL' verified to Category-6," color shall be light gray. Hubbell model C6SRGY.
 - b. Backbone Voice Riser Cable: 50 pair, plenum rated, type CMP, Category-3 compliant to EIA/TIA 568A requirements, #24 AWG solid copper conductors with PE insulation and PVC jacket. Provide General Cable Part# 2131757, AT&T ComCode #107766057 or approved equal.

2.3 ACTIVE ELECTRONIC COMPONENTS

A. Provided By Government

- 1. Layer II and Layer III Switches, Servers, PC's, Telephone Switch, and Telephone Instruments

PART 3 - EXECUTION

3.1 EQUIPMENT PROTECTION

- A. Comply with all requirements of specification section 27 05 00.
 - 1. Examine all physical and environmental conditions, equipment and device locations, auxiliary system connectivity requirements impacting the installation of all network systems and report any unsatisfactory conditions in writing to the VA's Contracting Officer and Design Professional.

3.2 WORK PERFORMANCE

- A. In addition to all requirements as specified by Specification Section 27 05 00 the network communications systems shall also be provided in accordance with the following requirements:
 - 1. Prior to the final commissioning and/or programming of any network communications components, the Contractor shall provide a review with the VA's Contracting Officer and Design Professional addressing all network integrations, programming and related operational connectivity.
 - a. Failure to provide this review and get final sign-off prior to final programming shall result in any costs related to changes requested by the VA's Contracting Officer and Design Professional shall be borne by the Contractor and not charged to the project.

3.3 EQUIPMENT/CABLE INSTALLATION AND REQUIREMENTS

- A. All system cabling shall be of the type, size and specification as required by all contract documents as well as stipulated by all codes and standards as specified by specification section 27 05 00.
 - 1. All network communications cabling shall utilize Category-6 UTP cables and installed in accordance with the requirements of specification section 27 05 00. All network cabling bundles shall not contain any AC carrying conductors or non-associated network communications cables within the cable raceways\conduits or cable bundles.
 - a. In addition, all structured cabling associated with the installation of any network communications system shall comply with all requirements of EIA\TIA standards for the proper installation, termination and testing of all fiber optic and Category-6 UTP cabling.
 - b. Contractor shall provide all equipment, components, devices, hardware, equipment racks\cabinets, patch panels and all appurtenances necessary to provide fully operational network communications systems utilizing a UTP cabling topography. Coordinate all structured cabling with all trades and contractors prior to shop drawing submission.
- B. Electrical power shall be provided as stipulated in specification section 27 05 00 and all related Chapters of this specification section. All 120-Volt power for all Contractor and Government provided communications network components and\or devices shall be supplied from the nearest appropriate emergency electrical distribution panel. System components employing the use of plug-in transformers for power shall not be acceptable.
 - 1. All system power supplies serving system components or devices shall be provided with the appropriate transient surge and lightening suppression protection on both the line side as well as the load side. Refer to specification section 27 05 00 for additional requirements.
- C. Installation of all equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate trade contractors.

3.4 ELECTRICAL POWER DISTRIBUTION

- A. Comply with all requirements of specification section 27 05 00.

3.5 TRANSIENT VOLTAGE SUPPRESSION

- A. Comply with all requirements of specification section 27 05 00.

3.6 GROUNDING AND BONDING

- A. Comply with all requirements of specification section 27 05 00.

3.7 EQUIPMENT IDENTIFICATION

- A. Comply with all requirements of specification section 27 05 00.

3.8 MAINTENANCE & SERVICE

- A. Comply with all requirements of specification section 27 05 00.

3.9 WARRANTY

- A. Comply with all requirements of Specification Section 27 05 00
 - 1. Provide all manufacturers extended cable warranties based on matching wire to component compatibility requirements. All cable warranties shall be in effect for a period of not less than 20 years.
 - 2. The warranty must include the following statements regarding the cabling system:
 - a. "That all communications networks have been certified and will support and conform to TIA/EIA-568-B specifications covering any current or future application which supports transmission over a properly constructed and horizontal cabling system premises network which meets the channel and/or basic link performance as described in TIA/EIA-568-B."
 - b. "That all communications networks are free from defects in material or faulty workmanship."

3.10 FIELD SERVICES

- A. Comply with all requirements of specification section 27 05 00.
- B. Documentation:
 - 1. Contractor shall provide documentation to include all test results and as-built drawings, test results shall be computer generated and shall include all trace reports indicating each pair tested in accordance with all requirements of specification section 27 05 00.
 - a. One Hard Copy shall also be provided to the VA's Contracting Officer and Design Professional. Software for viewing the test results shall also be provided in the soft copy package.
- C. Final Acceptance
 - 1. Acceptance of all network communications systems, by the VA's Contracting Officer and Design Professional, shall be based on the results of testing, functionality, and the receipt of documentation. The testing, of all UTP cabling, fiber segments and all workstation data cables must meet the criteria established in the Sections above.
 - 2. The Contractor must demonstrate to the VA's Contracting Officer and Design Professional that 1000 Mbps data signals can be successfully transmitted, bi-directionally, from the MDF to and from a minimum of 10% of individual data outlets on each floor, witness tested by the VA's Contracting Officer and Design Professional. The number of

outlet locations to be tested shall be determined by VA's Contracting Officer and Design Professional. With regard to documentation, all required documentation shall be submitted to VA's Contracting Officer and Design Professional.

D. Training

1. Comply with specification section 27 05 00.

E. Inspections

1. Comply with specification section 27 05 00.
 - a. At the completion of the project and prior to final acceptance of the Work, provide evidence of final inspections and approvals to the VA's Contracting Officer and Design Professional, in accordance with all requirements of the Contract Documents as well as required by the authorities having jurisdiction.

F. As-Built Documentation:

1. Contractor shall provide clean copies of the technology drawings depicting all as-built conditions for all data outlet locations, cable routing and identification, communications room layouts, component layouts and all information as required by division 1 specification section.

END of SECTION

27 41 31
MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Division 26 Specification Sections shall apply to this and all related Division 27 specification sections.
- B. Related Specification Sections:
 - 1. 07 08 00 - Fire Stopping
 - 2. 08 31 13 - Access Doors
 - 3. 26 05 00 - Requirements for Electrical Installations.
 - 4. 26 05 26 - Grounding and Bonding for Electrical Systems
 - 5. 26 05 33 - Raceways and Boxes for Electrical Systems
 - 6. 27 05 00 - Common Work Results for Communications Systems
- B. Reference Symbols:
 - 1. All device symbols are defined by the appropriate symbol schedule on drawing ET0.01. Not all device symbols as indicated may be required for the project.
 - a. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location. Contractor shall coordinate exact locations with architectural drawings and all affected trades prior to submittal of shop drawings.
- C. Abbreviations:
 - 1. Refer to Specification Section 27 05 00 for additional information.
- D. Definitions:
 - 1. Refer to Specification Section 27 05 00 for additional information.

1.2 SUMMARY

- A. The intent of this specification is to establish a standard of quality, function and performance requirements for the expansion of the existing Television Distribution (MATV) system and the installation of new Media Systems. It shall be the responsibility of the Contractor to insure that all proposed products meet or exceed every standard set forth in these specifications.

1. The installation, performance, features, functions, software and programming as specified herein as well as all related specification sections have been designed to offer the maximum system efficiency ease of operation, occupant safety and the protection of equipment as recommended by the design Professional.
 - a. Any deviations from the specified criteria shall be documented, reviewed and agreed to in writing by Architect. At the time of shop drawing submission the contractor shall specify in detail all deviations from this specification section.
 - (1) The required information shall include but not limited to: reason for deviation, all differences in performance, operation and function from the herein specified requirements, all benefits and added features to owner as a result of the deviations and any additional incurred costs to owner for maintenance and long term ownership.
 - (2) Failure to provide the Professional with the required information shall result in all shop drawing submissions being returned for non-conformance with the contract requirements.
 2. The contractor shall include, but not limited to all, outlet boxes, conduits, cabling, splitters, TV jacks, TV distribution equipment, amplifiers, electrical power and equipment racks as well as all programming and appurtenances as required to provide a fully operational MATV\Media system.
 3. The media contractor shall assume responsibility in coordinating the installation of all inter-building wiring, system modifications and integration with existing MATV system as it relates to the operation of these systems.
- B. Equipment specifications may not deal individually with every part, control, or device, which may be required to produce the specified systems performance, or as required to meet equipment and cabling requirements:
1. The contractor shall include such items, as required, for a complete operational systems including but not limited to all necessary components, cabling, software and programming whether or not specifically indicated.
- C. The contractor and all sub-contractors for this work shall have read all of the General Conditions, Special Requirements, General Requirements and all applicable related specification sections and in the execution of all work shall be bound by all of the conditions and requirements therein

1. Prior to the submission of the Bid, any discrepancies or inconsistencies noted within these specifications or contract drawings shall be brought to the immediate attention of the Architect. Failure to identify any discrepancies or inconsistencies within the context of the contract documents prior to submission of bid shall nullify the Contractor's claim for any change in scopes of work and/or any additional incurred costs for products, materials or services.
2. The Contract Documents may not deal individually with every component, control, device, or software programming, which may be required to deliver the specified system performance and/or as necessary to meet the equipment and cabling requirements. Coordinate all integration requirements with the appropriate systems providers.
 - a. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location. The contractor shall coordinate the installation of all cabling, materials, equipment, devices, jacks, electrical power, equipment racks and conduits with all affected trades and document all coordination at the time of shop drawing submissions.
3. The Contract Drawings for this work are diagrammatic and intended to convey the extent, general arrangement and locations of the work. Because of the scale of these drawings, certain basic items such as access panels, conduits, cabinet sizes, penetration sleeves, pull boxes, backboxes and junction boxes may not be shown.
 - a. The contractor shall include all equipment, materials, components, and appurtenances where required by code, by manufacturers' recommendations, as well as all related Contract Documents in order to ensure proper installation operation and integration of all components, equipment, devices and/or systems.
 - b. The contractor shall be responsible for providing all wiring, connections to all equipment, circuits and devices as well as all coordination and programming for the integration of all ancillary systems impacting the operation of intercom/paging system.

1.3 REFERENCES

- A. The codes and standards listed below form a part of this specification. The system shall comply with the latest adopted standards.
 1. All applicable requirements of National Fire Protection Association NFPA 70 "National Electrical Code" including, but not limited to:
 - a. Article 250, Grounding.
 - b. Article 300, Part A. Wiring Method.
 - c. Article 310, Conductors for General Wiring.

- d. Article 725, Remote Control, Signaling Circuits.
- e. Article 800, Communication Systems.
- 2. EIA Compliance: Comply with the following Electronics Industries Association Standards:
 - a. Racks, Panels, and Associated Equipment, EIA310-A.
 - b. Commercial Building Telecommunications Wiring Standards EIA 568-91
- 3. Underwriters Laboratories, Inc.:
 - a. UL 486A-91: Wire connectors and soldering lugs for use with copper conductors.
 - b. UL 1449-85: Transient voltage surge suppressors.
 - c. Comply with UL 1863.
- 4. Federal Communications Commission:
 - a. FCC Regulations Part 15 Title 47

1.4 SYSTEM DESCRIPTION

- A. The contractor shall provide the expansion of the existing TV distribution system. The expansion of the system shall be a broadband distribution system based on drop tap topography. The system shall conform to the following minimum requirements:
 - 1. Provide all distribution cabling to all TV outlet locations as indicated on the contract drawings. Signal level at each outlet shall be at least 4 dB and no more than 10 dB
 - 2. The installed system shall meet FCC and FAA radiation shielding requirements.
 - 3. Provide all amplifiers, taps, and splitters as necessary distribute all broadband CATV signals to TV outlet locations.

1.5 SUBMITTALS

- A. Comply with all requirements of Specification Section 27 05 00, "Submittals" paragraph. Failure to provide the required data will result in all submittals being returned for resubmission.
- B. In addition to the above submit the following information for the MATV system expansion for review by Professional:
 - 1. Provide a complete set of construction drawings. Drawings at the minimum shall consist of floor plans indicating all cable sizes, TV jacks, splitters and tap locations. Distribution panels, racks, auxiliary panels and termination locations.

2. Include manufacturer's name(s), model numbers, power requirements, db signal loss calculations, voltage drop calculations, cable size and types, splitters/tap, TV distribution layout, device-mounting elevations, device wiring details, and complete point-to-point-wiring diagrams. Show directional coupler attenuation values and all calculations used to engineer these taps,
 3. Wiring diagrams shall indicate wiring for each device and all interconnections between components and equipment.
 4. Include detailed panel layouts for all intercommunications equipment racks. Indicate all components, equipment cabinets and/or rack locations, all power and grounding connections. In addition, provide total equipment wattage for each location and estimated BTU production.
 5. Submit outline drawing of all system control cabinets showing the relative position of all major components. Include all panel dimensions and cabinet or rack sizes
 6. Shop drawings shall detail space conditions to accommodate other concerned trades, subject to final review by the Professional.
- C. In addition to the requirements stipulated by specification section 27 05 00 the contractor shall also submit the following information for the sound reinforcement systems for review by Professional:
1. Include manufacturer's name(s), model numbers, power requirements, device wiring typicals, and complete point-to-point-wiring diagrams.
 2. Wiring diagrams shall indicate wiring for each device, component system and all interconnections between outlets, termination locations, components and/or equipment.
 3. Submit outline drawing of all system control cabinets showing the relative position of all, components and termination points. Include all panel dimensions and cabinet or rack dimensions.
 4. Provide a complete termination and programming schedule of all paging zones, indicate on the construction drawings all zone unique identifications corresponding with schedule.
 5. Identify type and sizes of all equipment cabinets and/or racks. Coordinate all room layouts with affected trades. Failure to provide a complete set of coordinated installation drawings at the time of submittal shall result in all submittals being returned for resubmission.
 6. Submit outline drawing of all system control cabinets showing the relative position of all major components. Include all panel dimensions and cabinet or rack sizes.

1.6 QUALITY ASSURANCE

- A. Comply with all requirements of Specification Section 27 05 00.
- B. Installation and start up of the system shall be under the direct supervision of the equipment supplier. The supplier shall be an accredited and authorized distributor of the equipment manufacturer of all equipment being provided and be prepared to

offer a service contract for system maintenance at completion of the guarantee period.

- C. The media systems integrator (MSI) shall be an established communications and electronics distributor specializing in this type work for at least five (5) years. In addition the supplier shall:
1. Is an authorized distributor for all equipment supplied and capable of supporting all manufacturers' warranty provisions.
 2. Maintain a fully equipped service organization capable of providing full maintenance and service of the installed system within 24 hours.
 3. Maintain the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being installed.
 4. Utilize equipment that has a record of successful in-service performance
- D. The communications equipment manufacturer shall be an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Comply with all requirements of Specification Section 27 05 00.

1.8 PROJECT RECORD DOCUMENTS

- A. Comply with all requirements of Specification Section 27 05 00.
1. Complete project record drawings identifying system architecture and component distribution shall be provided prior to final acceptance of the systems.

1.9 OPERATION TRAINING AND MAINTENANCE DATA

- A. In addition to all requirements as specified by Specification Section 27 05 00 the MATV system shall also be provided in accordance with the following requirements:
1. Demonstrate to the Agency's designated representatives and Professional the features and functions of the system and subsystems. Instruct the Agency and designated representatives in the proper operation and maintenance of the system.

1.10 WARRANTY

- A. Comply with all requirements of Specification Section 27 05 00, "

1.11 MAINTENANCE SERVICE

- A. In addition to all requirements as specified by Specification Section 27 05 00 the MATV and Media systems shall also be provided in accordance with the following requirements:
 - 1. Test and service the system on a quarterly basis during the warranty period.
 - 2. For each quarterly maintenance period, provide written notification to the Owner of the systems condition before and after service, the exact components that were tested and serviced, and overall status of the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable MATV manufacturer's for this project, providing compliance with the requirements of these specifications are as follows:
 - 1. TV Distribution
 - a. Blonder Tongue
 - b. Holland Electronics
 - c. Toner
- B. Manufacturers listed as acceptable or equal shall not negate the contractor's responsibility for providing all systems in accordance with all functions and performance requirements of the Contract Documents.
- C. Where manufacturer and/or model numbers reference specific system components in this specification, it is to establish the performance requirements and quality of the systems and components only.
 - 1. It is in no way an inference that the referenced model numbers are the manufacturer's current product and are the only acceptable components for this project unless specifically referenced as "no substitutions".
 - 2. Contractor shall provide the manufacturers' most current product that shall meet and/or exceed the specified performance and features of the surveillance equipment and/or systems.
 - 3. Equivalent UL- listed equipment may be substituted for the approved manufacturers in accordance with all requirements of Division 1 specification section titled "Substitutions" and/or General Conditions to the Construction Contract and where approved equal is referenced in the specific specification section.
 - a. Where systems and/or components are referenced as "no substitutions" the specific system and/or components shall be provided.

- b. All substitutions shall comply with all requirements as specified in related specification sections and all system performance standards shall be maintained.
- c. The contractor shall stipulate the following information impacted by such a substitution.
 - 1) Any and all extensions in time impacted by the substitution.
 - 2) Any changes to the architectural or structural elements to the project.
 - 3) Differences in operation and/or performance from intended system criteria.
- d. Failure to provide the required substitution information shall result in "without consideration" the immediate rejection of the substituted equipment and/or systems.

2.2 MATV SYSTEM COMPONENTS

A. Combiners:

1. Combiners shall conform to the following:

- a. Number of Inputs: 8
- b. Frequency Range: 5-1000 MHz
- c. Flatness -Relative to Slope: 0.4 dB
- d. Insertion Loss -Individual Port: 40 to 450 MHz: 11.5 dB
450 to 1000 MHz: 13 dB
- e. Isolation -Adjacent Ports: 40 to 450 MHz: 25 dB, 450 to 1000 MHz: 25 dB
- f. Isolation -Non-Adjacent Ports: 40 to 1000 MHz: 40 dB
- g. Test Port Level: -20 dB
- h. Impedance -All Ports: 75
- i. Input Return Loss: 40 to 450 MHz: 20 dB, 450 to 1000 MHz: 19 dB
- j. Output Return Loss: 40 to 450 MHz: 20 dB, 450 to 1000 MHz: 19 dB

B. Amplifiers:

1. Amplifiers shall conform to the following:

- a. Frequency Range: 47-750 MHz
- b. Channel Loading: 110
- c. Flatness $\pm 0.75 \pm 1.00$ dB
- d. Gain: 31 dB
- e. Noise Figure (a): 09.0dB
- f. Output Level +44 dBmV
- g. Test Port Level : Input -30, ± 2 dB, Output -30, ± 2 dB
- h. Gain Control Range: 15 dB
- i. Slope Control Range: 10 dB
- j. Composite Triple Beat -CTB (b) -60 dB
- k. Cross Modulation -XMOD (b) -61 dB
- l. Composite Second Order -CSO (b) -61dB
- m. Hum Modulation: -70dB
- n. Number Of Hybrids: 2

- o. Hybrid Technology: Push-Pull
- p. Impedance -All Ports: 75 ohm
- q. Return Loss: Input: 13 dB, Output: 13 dB

C. Directional Couplers:

1. Directional Couplers shall conform to the following:
 - a. RF Shielding: 120dB
 - b. Frequency Range: 50-1000 MHz
 - c. Isolation Tap to tap: 10-450 MHz: 26 dB, 450-750 MHz: 25 dB, 5-10 MHz & 750-1000MHz: 22 dB
2. Splitters shall conform to the following:
 - a. Input Return Loss: 17dB min.
 - b. Isolation between outputs: 27dB min.
 - c. RFI Shielding: 80 dB

D. Video Jacks (TV Outlets):

1. Provide all video jacks where indicated on drawings. The wall plate shall consist of one "F" type connector to interface the TV. In addition, the any TV outlet shall be capable of interfacing with room A/V outlets with RCA and VGA connectors. Refer to specification section 271100 for additional information related to TV jacks and faceplates.

2.3 WIRING

- A. Comply with the NEC and applicable EIA/TIA standards. Use plenum rated cabling wherever not installed in conduit:
 1. Use RG-6/U cable for horizontal cable distribution drops to TV drop locations or as recommended by manufacturer
 2. Use RG-11/U cable for drops to TV locations or as recommended by manufacturer.
 3. All coaxial cabling must be UL Listed, NEC type CL2 or CATV, Quad Shield, 75-Ohm cable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Comply with all requirements of specification section 27 05 00.

3.2 COORDINATION

- A. Comply with all requirements of Specification Section 27 05 00, "Coordination" paragraph.

3.3 PROTECTION OF EQUIPMENT

- A. Comply with all requirements of specification section 27 05 00 "Protection of Equipment" paragraph.

3.4 INSTALLATION

- A. In addition to all requirements as specified by specification section 27 05 00 the all systems shall also be provided in accordance with the following requirements:
 - 1. All the MATV system wiring shall be installed in dedicated conduits or raceways. Refer to specification section 27 05 00 and related Division 26 specification sections for additional information.
 - 2. Installation of all equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate trade contractors.
 - 3. Power for all amplifiers shall be obtained from dedicated 120 VAC power located in the security electronics room.

3.5 EQUIPMENT INSTALLATION

- A. Comply with all requirements of specification section 27 05 00 "Equipment Installation" paragraph.

3.6 Field Services

- A. Comply with all requirements of specification section 27 05 00 "Field Services" paragraph.

END OF SECTION

SECTION 27 52 23
NURSE CALL AND CODE BLUE SYSTEMS (NCS\CB)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 and all related specification sections shall apply to this section.
- B. Related Sections:
 - 1. 07 08 00 - Fire Stopping
 - 2. 08 31 13 - Access Doors
 - 3. 26 05 00 - Requirements for Electrical Installations.
 - 4. 26 05 21 - Low Voltage Electrical Power Conductors and Cables.
 - 5. 26 05 26 - Grounding and Bonding for Electrical Systems
 - 6. 26 05 33 - Raceways and Boxes for Electrical Systems
 - 7. 27 05 00 - Common Work Results for Communications Systems
 - 8. 27 11 00 - Network Communications Systems
- C. Reference Symbols:
 - 1. All device symbols are defined by the appropriate symbol schedules. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location.
 - a. Contractor shall coordinate exact locations with all architectural drawings, reflected ceiling plans, furniture plans, mechanical and electrical drawings as well as all affected trades prior to submittal of any shop drawings.
- D. Abbreviations:
 - 1. Refer to Specification Section 27 05 00 for additional information.
- E. Definitions:
 - 1. Refer to Specification Section 27 05 00 for additional information.

1.2 SUMMARY

- A. The intent of this specification is to establish a standard of quality; functions and features for the installation of microprocessor based Audio\Visual Nurse Call and Code Blue (NCS\CB) communications systems in accordance with the project drawings and/or as herein specified.

B. The communications systems shall be a fully enterprise based system and shall include all work, materials, infrastructure, equipment, power supplies, electrical power, software and programming as required to provide fully operational system in accordance with the Contract Documents.

1. The installation, performance, features, functions, software and programming modifications as specified herein as well as all related specification sections have been designed to offer the maximum system efficiency ease of operation, occupant safety and the protection of equipment as recommended by the design Professional.
 - a. Any deviations from the specified criteria shall be documented, reviewed and agreed to in writing by the VA's Contracting Officer and Design Professional prior to submission of bids. Refer to Division 1, Division 27 and all related specification sections for product substitutions.
2. It is the responsibility of the contractor to insure that the installed systems meet or exceeds every standard set forth in these specifications. The contractor shall be responsible for providing complete functional systems, including all necessary components, devices, annunciators, indicators, equipment cabinets, UPS units, electrical power, software, programming, commissioning, testing and all appurtenances as necessary to provide complete and fully operational nurse call\code blue systems whether specifically included in this section or not.
 - a. The system shall microprocessor based and consist of but not limited to all; central processors, master stations; bedside, staff, staff/duty, duty, and emergency call stations; as well as dome lights; audio distribution amplifiers; uninterruptible power supplies (UPS); conduits, cabling, cord-sets, push-buttons, pillow speakers, software, programming and all appurtenances necessary to provide a complete fully operating NCS\CB communications systems in accordance with the contract documents.
 - 1) Note: Integrators wishing to provide a TCP/IP enterprise based nurse call\code blue communications system shall be responsible for providing all necessary Layer II network data switches, patch panels, all peripheral network components as well as all Category-6 UTP cabling and appurtenances.
 - 2) The utilization of the facility's data network to support the distribution, performance and/or operation of a TCP/IP enterprise based call\code blue communications systems shall be strictly forbidden (other than where herein specified).
 - 3) Refer to and comply with all requirements of all Division 27 specification sections related to the installation, equipment, materials, testing and commissioning of all TCP\IP network structured cabling systems.

- C. The installation of the nurse call\code blue communications systems shall comply with the applicable sections of NFPA-70 National Electrical Code (Article 725 and 800). The system shall be electrically supervised and monitor the integrity of all conductors.
1. The contractor and all sub-contractors for this work shall have read all of the General Conditions, Special Requirements, General Requirements and all applicable related specification sections in the execution of all work and shall be bound by all stipulations and requirements therein.
- D. Prior to the submission of the Bid, any discrepancies or inconsistencies noted within these specifications and/or project drawings shall be brought to the immediate attention of the VA's Contracting Officer and Design Professional.
1. All equipment symbols are shown on drawings as close as possible to their intended location. Contractor shall coordinate the installation of all equipment, devices, controls, cabling and integration of any systems with all affected trades and system integrators. The Contractor shall document all coordination requirements at the time of shop drawing submissions.
 2. The Contract Drawings for this work are diagrammatic and intended to convey the extent, general arrangement and locations of the work. Because of the scale of these drawings, certain basic items such as access panels, conduits, cabinet sizes, penetration sleeves, pull boxes, backboxes and junction boxes may not be shown.
 - a. The contractor shall include all equipment, materials, components, devices, controls and appurtenances where by mandated by code, required by manufacturer, or specified by related Contract Documents in order to ensure proper installation operation and integration of all components, equipment, devices and/or systems.
- E. The Contract drawings and specifications may not deal individually with every part, control, device, software or programming, which may be required to produce the operations and/or system performance specified or as necessary for the installation and integration of all components and systems in accordance with the requirements of all Contract Documents.
1. The Contractor shall include all such items and components, as required, for the complete and operational installation of all system components as defined by the Contract Documents, whether or not specifically indicated and/or specified.
 - a. Include such items, as required, for a complete operational system, whether or not specifically indicated.
 - b. Coordinate with other applicable trades in submittal of shop drawings and the installation of all systems.
 - c. Shop drawings shall detail space conditions to accommodate other concerned trades, subject to final review by the VA's Contracting Officer and Design Professional.

- d. If installation of equipment, raceways, cable trays and/or conduit is performed prior to coordination with other trades, which interferes with work of other trades, make necessary changes to correct the condition at no additional cost to the Government.
- e. The contractor shall be responsible for providing all wiring, connections to all equipment, circuits and devices as well as all coordination and programming for the integration of all electronic door hardware, ancillary systems impacting the operation of nurse call\code blue communications systems. Refer to the contract drawings and related specification sections for additional information.

1.3 REFERENCES

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
 - 1. Health, (Public Law 96-88), CFR, Title 42, Chapter IV Health & Human Services, CFR, Title 46, Subpart 1395(a)(b)
 - a. Guidelines as stipulated for Life, Personal and Public Safety; and, Essential and Emergency Communications.
- B. All references to industry and trade association standards as well as all building codes are minimum installation requirements for this system. The codes, standards and agencies listed in specification section 27 05 00 shall also form a part of this specification section and all work shall comply with the latest adopted standards.
 - 1. The publications listed in specification section 27 05 00 (including all amendments, addenda, revisions, supplement, and errata) shall form a part of this specification section to the extent referenced. The publications are referenced in the aforementioned specification section by the basic designation only.
 - a. Where the contract drawings and\or specification sections mandate a greater requirement or performance than those specified by the referenced applicable codes and standards, the requirements of the contract drawings and\or specification sections shall be the governing requirements for this project and shall be delivered accordingly.

1.4 SUBMITTALS

- A. In addition to all requirements as specified by Specification Section 27 05 00 the nurse call\code blue communications systems shall also be provided in accordance with the following requirements:
 - 1. Provide a complete termination schedule of all device locations; indicate on the construction drawings all component and device identifications corresponding with schedule.

2. Provide point to point wiring diagrams for all communications edge devices, central processors, annunciator's, signaling dome lights and related interface components.
 - a. Wiring diagrams shall indicate all wiring for each field device as well as all wiring interconnections between each device and all controls and/or associated equipment, In addition, all electrical power connections with electrical circuit numbers shall be indicated to all equipment requiring electrical power.
3. All shop drawing submissions for system employing TCP\IP based protocols shall have a registered RCDD professional review and seal all shop drawings confirming that the proposed network infrastructure and structured cabling system is in conformance with all stipulated standards and related specification sections as herein specified.

1.5 RECORD DOCUMENTS

- A. Comply with all requirements of specification section 27 05 00.

1.6 SOFTWARE AGREEMENT

- A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections Comply with all requirements of specification section 27 05 00.

1.7 EXTRA MATERIAL

- A. In addition to all requirements as specified by specification section 27 05 00 the following extra materials shall be provided as part of this project:
 1. Three-(3) Patient Stations of each type utilized in the project.
 2. Three-(3) Lavatory Emergency Stations of each type utilized in the project.
 3. Three-(3) Staff/Duty Stations of each type utilized in the project.
 4. Three-(3) Corridor Lights of each type utilized in the project.
 5. Three-(3) Corridor Zone Lights of each type utilized in the project.
 6. Six-(6) Pillow Speakers of each type utilized in the project.
 7. Six-(6) "Side-com" bed adaptor cables of each type utilized in the project.
- B. All extra materials shall be delivered at the time of final acceptance of the system(s). At no time is the contractor to use the extra materials provided for this project to replace malfunctioning equipment and or components prior to final acceptance.

1.8 SOFTWARE AGREEMENT

- A. Comply with all requirements of specification section 27 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

- A. Comply with all requirements of specification section 27 05 00.

2.2 MANUFACTURERS

- B. Acceptable manufacturer's for this project shall be as follows, providing full compliance with this section, specification section 27 05 00 and all related specification sections:
- C. Acceptable Manufacturers:
 - 1. Rauland-Borg Responder V
 - 2. No Substitutions shall be accepted
- D. Manufacturers listed as acceptable or equal shall not negate the contractor's responsibility for providing all systems in accordance with all functions and performance requirements of the Contract Documents.

2.3 SYSTEM DESCRIPTION

- A. The contractor shall provide fully operational microprocessors based audio\visual NCS\CB system employing a topography that seamlessly integrates all system components to deliver the minimum system performance, functions and operations as herein specified.

2.4 SYSTEM OPERATION

- A. General:
 - 1. Provide two-way voice communication between any master station and patient and staff/duty stations with audible and visual annunciation of all calls with a minimum of sixteen (16) programmable levels of priority, and assignment of up to any one of eight (8) possible service groups.
 - a. All code blue, staff emergency, emergency, patient emergency, patient priority, cord out, patient normal, and staff normal, shall be capable of being assigned to any one of eight levels for each station and/or to patient bed. All levels shall be indicated at the master and all duty stations.
 - b. Priority level names shall be displayed as a minimum of four (4) alpha characters, and the room numbers shall be user programmable from four (4) to eight (8) digits in length.
 - 1) The room numbers shall be a combination of eight numbers and/or programmable alpha characters for room and bed designations.
 - c. Visible annunciation shall be by corridor and zone lights associated with each call.

2. Failure of voice intercom portion of system shall not interfere with visual signal system.
3. System shall permit operator to open a listen-in function to any station and/or to patient bed and permit the audible detection of the slightest whisper or movement of the patient.
4. System shall use multiplex technology, requiring no unique wiring on a per station basis.
5. System shall have automatic supervision of associated patient, staff, duty stations, couplers, and master station, with an indication at the master of which station or stations failed.
6. System shall provide for transfer of one or more individual or groups of stations from one master station to another without mechanical switches or additional predetermined wiring of the stations.
7. System shall the ability to configure by call priority level to allow the attendant to set any of three levels of staff reminder on a manual basis or be automatically set on answering the call from the master station.
 - a. When a priority call reminder is set automatically, the call shall be deleted from the pending call list and shall appear in the reminder list until the call is canceled at the room location.
 - b. Priority calls not configured for automatic reminder shall remain on the pending call list when answered until canceled from the room location. The remaining call shall be indicated to the attendant as answered and shall not interfere with new calls or reminder recalls being displayed first or automatically answered in order of priority and time of placement.
8. The system shall have the expandable capability to create a list of staff, using a minimum of 250 random 3 to 9-digit ID numbers, for the purpose of individual assignment to each patient/bed as a primary or alternate caregiver. Once assigned by shift, calls placed by the patient may be automatically directed to the assigned staff currently on duty, alerting them of the pending call.
9. The system shall include a supplemental HMI touch screen and computer to enhance the informational and operational activities of the master station.
10. Master station, including the patient's name and up to 511 assignable staff member names shall be provided.
11. System shall provide for audio paging to individual stations or groups of stations assigned to any one of up to 100 possible duty areas.
 - a. General paging to all stations under the current control of the master station.
 - b. Group paging by selecting any one of eight predetermined groups, each consisting of any one or up to eight areas having one or more stations assigned to each duty area.
 - c. Corridor paging for general announcements to staff and patients with priority override of speakers normally connected to the primary paging system.

- d. All call paging to all rooms and corridor speakers under the control of the master stations within any one of eight local groups through an external amplifier, depending on groupings and any presence restrictions.
12. The television integration and interfaces shall be provided for the on/off control, channel selection and volume control of all patient TV's from the pillow speaker.
13. The on/off functions of indirect and direct bed lighting shall be controlled from the patient pillow speaker shall be provided. The interface device and power source shall be provided by the lighting manufacturer to provide the necessary 12 to 24Vdc, not to exceed 750mA control to a designated button on the pillow speaker for sequential operation of the lights as follows:
 - a. 1 on / 2off
 - b. 2 on / 1off
 - c. 1 on / 2on
 - d. 1 off / 2off
 - e. Proper protection of the patient communications system circuitry and operations shall be the responsibility of the nurse call system provider. Coordinate with lighting manufacturer for all integration requirements.
14. The nurse-to-patient communications shall take place through the pillow speaker, interrupting the entertainment audio. If the pillow speaker is accidentally removed from the patient station, communication with the nurse master station shall transfer automatically to the patient station speaker and a "cord out" priority call for the station bed shall be displayed at the master station. Simultaneous communications over both the station speaker and the pillow speaker shall not be acceptable.
15. A Side-com [Hill-Rom] [Stryker] [Amedco] communications capability through the bed rail system shall connect directly into the face of each patient station without the necessity of a separate 37-pin bed receptacle. The patient station shall allow both the simultaneously connection of the side-com bed and the pillow speaker connection to the patient station to function at the same time.
 - a. The nurse call system provider shall provide one minimum 8-foot (2.4 m) interconnecting cable between the patient station and the bed connection from the patient station.
 - b. One "Smart" pillow speaker per bed shall be provided for use in conjunction with the electronic bed.
16. The system shall include the ability to seamlessly integrate with an optional pocket paging system as recommended by the manufacturer.
17. All code blue calls placed from any room shall be annunciated on a centralized digital code blue display panel.
18. The system shall support the optional capability to notify the assigned staff of a call on a priority and/or placement basis and provide the staff with a path to communicate with the calling station from any DTMF telephone.

- a. When notified by the system monitor feature of a call placed, the staff member may use any nearby telephone to answer the call by dialing the system access code and the staff ID number assigned to the station.
19. The system shall be provided with an the appropriate interfaces and software capable of recording all patient calls and related time-based activities and provide for recall, summary reporting, and printing of statistical information from a dedicated computer and HMI terminal. The computer or shall be provided by the nurse call system provider based on the unit as recommended by the manufacturer.

B. Master Station:

1. A master station shall be located at each nursing station. It shall include at minimum 16-character LCD display, with keypad, a control panel containing permanently designated rubber-conductive pushbuttons sealed to resist moisture, and a combination speaker/microphone, volume control, and telephone handset for voice communications with patient, duty, and staff stations. The master station shall include the following functions and operations:

a. Answering a Call:

- 1) When a patient places a call, the calling station's 3 to 8 digit, programmable, architectural, alphanumeric room number, including a programmable bed designation and the type of call (normal, emergency, etc.), shall be displayed in priority order and in order of being placed.
 - a) The quantity of any additional pending calls shall be indicated and, if desired, the attendant may review all the calls in rotation, displaying the room/bed number, priority, and position in queue.
 - b) Systems that display the priority level using a number or a single-letter designation shall not be acceptable.
- 2) When the answer button (* ANS) is pressed on the keypad, the displayed calling station shall be connected to the master station. Any call may be answered out of order, without the need to dial the room/bed number, by reviewing the pending calls and pressing the answer button.
- 3) It shall then be possible to converse with the remote station by using the speaker/microphone and the TALK/LISTEN button or by using the keyless handset. Systems using a handset-mounted PUSH TO TALK switch or pushbutton shall not be acceptable.
- 4) On completion of the conversation it shall be possible to cancel the call by pressing the disconnect button (# CNCL) on the dial pad, hanging up the handset, if used, or answering the next pending call in the system by again pressing the answer button.

- a) Lavatory emergency, staff emergency, code blue, and room auxiliary calls placed by the patient or staff shall function as listed above but all lights shall continue to flash and the tone shall continue to sound until the call is canceled at the originating station.
 - 5) The system shall have the capability to be configured on a priority basis to automatically set a staff reminder when the priority call is answered; otherwise it shall continue to be displayed on the pending call list until answered (canceled) at the room. The call shall be transferred from the pending call display window to the reminder display window whenever manually set on reminder.
- b. Placing a Call:
- 1) As the room and bed number of a station are dialed, the digits of the room number shall be displayed on the LCD display window.
 - 2) Provisions shall be available to program up to eight specific rooms for single-digit speed dialing purposes.
 - 3) Connection with the room station shall be established on dialing the last digit, and the LCD display shall indicate the successful connection. If not, an error or busy tone shall sound.
 - 4) Conversation with the patient shall occur through the speaker/microphone by the attendant pressing the talk switch to converse and releasing it to listen, or through the use of the keyless handset.
 - 5) On completion of the conversation, the call shall be canceled by pressing the cancel button (# CNCL) on the dial pad.
 - 6) When using the handset, the call shall be canceled by replacing the handset.
- c. Staff Reminder:
- 1) By first establishing communication, answering or calling a patient station, and pressing the reminder button (REMIND), instructions shall be displayed to press the appropriate numbered key for one of three levels of reminders.
 - 2) Pressing the appropriate dial number key (1 for red, 2 for amber, 3 for green) shall cause the red, amber, or green section of the corridor light outside the room to flash slowly.
 - 3) The master station shall acknowledge the valid request and the window shall again display the room number and current talk state.
 - 4) Communication with the room station shall then be canceled by answering the next call or pressing the cancel button on the dial pad.
 - 5) The call shall reappear as a recall at the master station after a predetermined time if the reminder is not canceled

from the room. The time-out shall be user programmable by priority level.

- 6) The corridor light outside the patient room and the zone light shall flash the appropriate color at a rate of 15 ppm until canceled from the room.
- 7) Each level of reminder set may be reviewed at any time, displaying the room number of the station currently set on reminder and the total number of rooms set on that level of reminder.

d. Staff Locator:

- 1) Pressing the locator button (LOCATE) shall display instructions to press the appropriate numbered key for each of three levels of staff.
- 2) Pressing the appropriate dial number key (1 for red, 2 for amber, 3 for green) shall display the first room number in which a staff member of the requested level is located.
- 3) Pressing the connect button (* ANS) shall select the room number displayed. Additional rooms in which other staff members of the same level are located shall be selected by first scrolling the list to display the preferred room, then pressing the connect button. Systems that require dialing of the room shall not be acceptable.

e. Priority Setting:

- 1) While the room and bed number of a patient are selected and appear in the display window, the system program shall allow the attendant to set any one of three groups of priority types by pressing the priority button (PRIORITY).
- 2) Patient Call Group - For assignment of one of three levels (Normal, Priority, and Emergency) to be displayed at the master station as a four-character priority name when a patient places a call from the patient station.
 - a) Bed Auxiliary I - For assignment of one of seven preprogrammed levels by a four-character bed device name matching the device currently connected to the first bed auxiliary input, to be displayed at the master station by name when the device is alarmed.
 - b) Bed Auxiliary II - For assignment of one of seven preprogrammed levels by a four-character bed device name matching the device currently connected to the second bed auxiliary input, to be displayed at the master station by name when the device is alarmed.
- 3) Selecting the desired priority shall cause the new priority to replace the old one, and the system shall acknowledge the successful change. The next time a call is placed by the patient or automatically placed by the device when optional plug-in auxiliary ports are plugged into the patient station, the new priority (device name) shall be displayed at the master station.

f. Capture/Share Stations:

- 1) The master station shall include the ability to capture (take control of) any other group of patient, emergency, code blue, or staff/duty stations assigned to another master station within the same LAG. Calls from the original area shall display at both master stations and can be answered from both master stations. Calls from the controlling (capturing) master station's area shall only appear at that master station.
- 2) The master station shall include the ability to share (parallel operation) any other group of patient, emergency, code blue, or staff/duty stations assigned to another master station. Calls from either area shall display at both master stations and can be answered from both master stations.
- 3) The master station shall include the ability to gain control of specific rooms (swing rooms). Calls from the rooms shall be displayed and answered only from the controlling master station.
- 4) The system shall include the ability to audibly and visually indicate a successful transfer of stations and master station coverage.

g. Tone (Incoming Calls):

- 1) Pressing the tone button (TONE) shall cause Ts (tone silenced) to appear and flash in the call status section of the display. The next call placed on the system shall cause the tone to return and the Ts to be removed from the display until the tone button is pressed again.
- 2) The tone level shall automatically be adjusted based on the master being in the ON or OFF duty mode.
- 3) It shall be possible to defeat the tone silencing feature. When set, the tone cannot be silenced at the master station.
- 4) The tone level shall be adjustable by the attendant in audio metrically spaced steps from a predetermined maximum to a predetermined minimum. The attendant shall not be able to be turn-off the tone completely or permanently.
- 5) The incoming call tone pattern (time on/time off each in 50 ms increments), the on and off frequencies (2,000Hz/n), the number of on/off cycles, and the time between cycles shall be programmable by priority level.
- 6) All other tones, such as error, supervisory (fail), input acceptance, etc., shall also be programmed to tone differently than the incoming call tones.

h. Area Audio Page:

- 1) Area audio paging functions shall be provided to allow the attendant at each base master station to page groups of one or more duty areas, each consisting of assigned room stations (patient, staff, and duty) within its group.

- 2) A minimum of ten (10) room/bed numbers assigned to each area master station shall be programmable by the user. Up to eight areas per master station may be part of any or all groups. For example, it shall be possible for one or more staff stations assigned to an area to be paged any time any other areas of stations are paged.
- 3) It shall be possible for any room to be removed, added, or changed from one duty area to another without involvement of technical staff.

i. Menu Key Functions:

- 4) All base system operational and program functions shall be made available to the user through a MENU key. The system features shall be protected by an administrative password.
- 5) The operational features shall be included in the basic system, functionally shall only be available to the attendant, dependent on the user requirements and preferences.
 - a) Auto Dial - Speed dialing of selected room numbers used most often.
 - b) On and Off Duty function - Automatic two-step control of the incoming tone level, pocket page, and other modes of operation.
 - c) Assignments - The sharing and capturing of other area groups of stations or individual stations, and assignment of the primary and alternate staff to the patient rooms.
 - d) Audio Page - Assignments and operational functions related to the area audio paging interface capabilities.
 - e) Pocket Page - Assignments and operational functions related to the pocket page interface capabilities.
 - f) Settings - System operational tone range, time, and date.
 - g) Error Scan - Listing of any system errors or malfunctions.
 - h) Test Program - Gateway to the system functions. Protected by a password.

j. HMI Touch Screen Terminal:

- 1) Provide supplemental HMI display unit with touch screen shall be supported at each base master station.
- 2) The unit shall include a 15-inch flat color display and a desktop computer, complete with enhanced 102-character keyboard and serial mouse.
- 3) Each unit shall have the operational factory-installed software, based on Microsoft Windows™, in the computer's memory ready for user configuration for system operation.
- 4) Each complete unit shall operate independently of every other unit and each shall provide the following operational capabilities:

- a) Provisions for one or more master stations to respond to and control the same and/or selected groups of remote stations. Provisions shall also be made for selected master stations to delay displaying calls of any or all priorities unless the calls are not answered within a user-programmable time limit.
 - b) The ability to capture individual rooms, as needed, or groups of stations normally under the control of other master stations.
- 5) Simultaneously and visually indicate up to 25 incoming calls from remotely located stations and beds under the control of the master station. The number of calls displayed shall depend on the size of the Pending Calls window as configured by the attendant. The calls shall be listed by color-coded priority in call placement order. Calls may be displayed in two different user-programmable formats for quantity display or for easy direct (touch) attendant selection. Each format shall contain any one or more of the following descriptive elements selected by the user:
- a) Room/Bed Number
 - b) Patient Name
 - c) Area Name
 - d) Priority of Call
 - e) Transaction Time
 - f) Original Event Time
 - g) Event
 - h) Staff Level
 - i) Primary Staff (Name and ID Num
 - j) Alternate Staff (Name and ID N
 - k) Patient Data - Area I
 - l) Patient Data - Area II
 - m) Patient Data - Area III
- 6) It shall be possible to answer calls by any one of the following methods:
- a) Automatic - The highest priority call, or the first call placed, shall be selected by touching the Auto Answer button. That call is then automatically connected. Each additional touch of the button shall automatically disconnect the current call and select/connect the remaining calls in order of priority and/or call placement.
 - b) Line Selection - The attendant can answer a call in any order desired by highlighting any call displayed in the Pending Calls window and touching the Connect button.
 - c) Direct Selection - Calls may be answered by the attendant in any order desired by directly touching any portion of the line displaying the call.

- 7) It shall be possible to originate calls for two-way voice communications to any individual patient station on a bed basis or to any staff/duty station by any one of the following methods:
 - a) Direct Dial - Any station under control of the master station may be connected to the master station by displaying the Dial Pad window on the screen and touch-dialing the assigned room/bed numbers. Numerals 0 through 9 and eight optional user-assigned alpha keys shall be available for room/bed number assignments.
 - b) Room List Selection - A list of the rooms and bed numbers, along with associated patient names, and staff/duty stations (on an area coverage basis), can be displayed in the Room List window. Highlighting the name of the desired room, then touching the Connect button or touching the highlighted line directly will connect the master station to that room.
 - c) Direct Selection - Touching (selecting) any displayed station line located in the pending calls, reminder, or staff location window shall connect the selected station to the master station for two-way voice communications.
 - d) Remote Station - The TELCO interface shall be provided to allow a staff member to use any DTMF telephone to dial and connect to any patient room or staff/duty station having a numeric-only ID number.
- 8) When a call is answered or originated, a Connect window shall appear. It shall inform the attendant the selection was successful by displaying the room number of the connected station and additional informational elements, chosen specifically to help the attendant communicate with the patient and direct the proper staff assistance to the patient.
- 9) While the Connect window is displayed, additional patient information may be accessed by touching the Data button. The current personal communications and medical patient data shall be displayed in two (2) different formats which may be changed or deleted. Additional patient information, optionally password protected, may be keyboard-entered in free-form text into three (3) separate groupings by the attendant as required. This information may, if so programmed, appear in the Connect window.
- 10) Patient call requests that require follow-up by staff members shall be placed on reminder, either selectively or automatically by priority, as required by the user.
 - a) Three reminder levels shall be provided for selection by the attendant, depending on the staff level required to respond to that patient.

- b) Any one of the three reminder levels may be preprogrammed to each priority level, except patient normal or staff normal, and shall be automatically selected on answering the call.
 - c) The color of the reminder level displayed in the Reminder window shall correspond to the color of the flashing corridor light outside the patient's room.
- 11) A list of all rooms/beds that have been placed on reminder shall be displayed in a Reminder window. This window can be continuously displayed on the screen, or it can be opened or closed by the attendant. In addition to the room number, any or all the information fields may be displayed in two different formats depending on the attendant's needs or preferences.
- 12) Any call placed on reminder and not answered within a user-determined time limit shall reappear in the Pending Calls window as a recall and be placed ahead of any other unanswered call equal priority. Touching the Recall station line within the Pending Calls window, or any call line within the Reminder window, shall automatically connect the station for communications. The time limit for recall purposes will be reset until the reminder is canceled at the station that originated the call.
- 13) Any combination of control buttons may be individually chosen to control each window, depending on the available features selected by the user and the logical operational sequences required to be performed by the attendant.
- a) The control buttons can be arranged in order of user preference, and optionally positioned on the left, right, or bottom of the HMI screen.
 - b) The text of the buttons may be edited to accommodate specific user preferences.
 - c) The text of the buttons shall be highlighted when that function is usable for the current operational sequence.
- 14) Separate application windows shall be available for the following assignments or changes in assignments. Minimum touch screen action or mouse operation shall be required of the attendant.
- a) Assign individual or groups of patient bed numbers to an active staff name and ID (pager) number, depending on the primary or alternate staff responsibility level and work shift.
 - b) Add, delete, or activate names and ID numbers from a list of available staff for assignment to one of three shifts as a primary or alternate member, or deactivate names and ID numbers, placing them on the available list for reassignment.

- c) Select, change, or review (scan) the patient call priorities (normal, priority/locking, and emergency), or current assignment of the one or two monitor devices for each bed with separate auxiliary inputs.
 - d) Select, transfer (swing room), or review individually selected room/bed numbers in an area of coverage by master station ID number.
 - e) Select, change, or review rooms assigned to areas for audio paging purposes and duty station assignment. Any number of room numbers shall be assigned to each area name without duplication. A minimum of up to eight areas may be randomly selected, regardless of station assignments, at any time for audio paging.
 - f) Select, change, or review the current coverage on a master station basis and allow the attendant to capture, share, or return the control of stations normally assigned to other designated master stations.
- 15) Separate application windows shall be available for the data entry listed below. Minimum touch screen action or keyboard input shall be required of the attendant.
- a) Current staff names and staff ID numbers for selection and assignment by room/bed number and degree of responsibility, regardless of the priority of calls.
 - b) Patient names for assignment to a room/bed number with provisions for admission, transfer, and discharge.
 - c) Patient information relating to his/her current condition and specific requirements or needs of the patient to be displayed by the attendant, when requested, or during communications between the master station attendant and the patient.
- 16) The Pocket Page control button and window shall be available for the attendant to select staff members by name and to select, if required, a message consisting of a room number and a specific predetermined instruction or priority level. This message shall be transmitted to the staff via a UL 1069 Listed interface that is connected to a manufacturer's recommended data-type pocket pager system. The message format shall be dependent on the system in use.
- a) While a station is connected and the control window is selected, the window shall display and automatically highlight (select) the assigned primary staff member and the room/bed number of the connected station.
- 17) The attendant needs only to select the message before automatically signaling the pager carried by the primary staff member of the displayed room number.
- 18) The alternate staff member may be selected for paging purposes in place of the primary staff member in the same manner.

- a) A minimum of 99 separate preprogrammed messages as determined by the user for selection and display on the pager receiver in numerical or full alpha character format shall be provided as dependent on the capabilities of the manufacturers' recommended pager system.
 - b) Automatic pocket paging of the primary staff member when a call is placed from a patient station/bed shall be provided on a priority basis. This function shall be predetermined by the user depending on the priority level and whether the master is on duty or off duty.
 - c) A call not answered or canceled by the primary staff within a predetermined length of time after the initial page shall automatically be directed to the assigned alternate staff or, again, to the primary staff. If again not canceled after the predetermined time limit the "charge nurse," if assigned, shall be paged.
 - d) High priority calls shall also be assigned to groups for pocket paging purposes. Up to four groups of stations may be assigned by priority level to individual or group pocket pager ID numbers, with a maximum of 24 numbers depending on the pocket pager system's capabilities.
- 19) The Wireless Page control button and window shall [in addition to the pocket page option] be available for the master station attendant to select staff members carrying a wireless telephone by name and to select, if required, a message consisting of a room number and an optional specific predetermined instruction or priority level. This message shall be transmitted to the staff via a centralized event subscription manager PC platform. Depending on the telephone/pager device number assigned to the staff, the message shall be passed onto the pocket pager system or directed to the wireless telephone system to the wireless telephone.
- a) While a station is connected and the Wireless Page control window is selected, the window shall display and automatically highlight (select) the assigned primary staff member and the room/bed number of the connected station.
- 20) The attendant shall only need to select the message before automatically signaling the wireless telephone carried by the primary staff member assigned to the displayed room number.
- 21) The alternate staff member may be selected for signaling purposes in place of the primary staff member in the same manner.

- a) Up to 99 separate preprogrammed messages may be prerecorded by the user for master station attendant selection and for voice reproduction at the wireless telephone when the staff answers.
- 22) The staff, on answering and receiving the voice message, shall have the opportunity to either go directly to the room or connect directly with the patient for two-way voice communications without the need to enter the room/dial number.
- 23) Once connected, the staff shall be able to set any of the three levels of reminder.
 - a) Automatic ringing of the telephone assigned to the primary or alternate staff member when a call is placed from a patient station/bed shall be provided on a priority basis. This function shall be predetermined by the user depending on whether the master is on duty or off duty.
 - b) If a call is not answered by the primary staff and canceled within a predetermined time limit of being signaled, the call shall automatically be directed to the assigned alternate staff, or, again, to the primary staff. If again not canceled within the predetermined time limit the "charge nurse," if assigned, shall be signaled.
- 24) The staff, on answering, shall be informed from what room and bed the call was placed and the priority of the call. The staff then shall have the opportunity to either converse directly with the patient to determine their needs, without the need to enter the room/dial number, or to go directly to the room.
- 25) When connected, the staff shall be able to determine the patient's needs, and set any of the three levels of reminder for "recall" if desired. The staff then may go to the room, if required, or on disconnect, cancel a normal call only.
 - a) High priority calls shall also be able to be assigned to a group of telephones. Up to four groups may be assigned by priority level to individual or group telephone numbers, with a maximum of 24 numbers, depending on the wireless system's capabilities.
- 26) The Audio Page control button and window shall be available so the attendant can select the following types of paging for transmitting announcements to staff members or to the general public.
 - a) STAFF paging shall be available by selecting, at random, one or more of up to eight staff members by name from a list of names currently on duty at each master station, and audio paging the rooms to which those staff are assigned.

- b) AREA paging shall be available by selecting, at random, one or more of up to eight predetermined areas of defined room stations.
 - c) MASTER paging shall be available to audio page, from a predetermined list, all stations covered by one or more master stations by selecting, at random, the desired master stations. If any master area selected is already in use, a busy tone shall alert the attendant that the audio page to the areas has been blocked.
 - d) CORRIDOR paging with priority override of local area speakers normally connected to the primary paging systems shall be available.
 - e) ALL-PAGE shall be available to audio page all room stations covered by all master stations within the local area group (LAG), with an option to include the corridor speakers through an external amplifier. If any area selected is already in use, a busy tone shall alert the attendant that the audio page to the areas has been blocked.
 - f) Any master station shall be able to page the programmed areas of stations of another captured master station. If the channel is in use, the paging master shall receive a busy signal.
- C. A HMI integrated PC\Touch Screen terminal shall be provided consisting of a standalone slim panel computer with integral 22-inch 300 nits high brightness WSXGA LCD touch screen display with a minimum resolution of 1680 x 1050. The integrated panel PC\Touch Screen terminal shall be manufactured by Broadax Systems, Inc (BSI) approved equal. At the minimum integrated panel PC\Touch Screen terminal' shall include the following;
- 1. PC processor: Intel Core Duo/Celeron M processor powered by an Intel GM45+ICH9M core logic chipset with 256 MB sharing graphics memory, (2) x DDR3 SO-DIMM 4 GB of memory and a 2.5" SATA 160GB HDD.
 - a. Video Processor:
 - 1) On-board 32-bit graphics system type processor.
 - 2) IBM or equivalent emulation modes - SVGA.
 - 3) Capable of High Color (16 bit) with a minimum output resolution of 1680 x 1050 pixels, non-interlaced.
 - 4) 256MB Video RAM, minimum.
 - 5) The Touch Screen 22" LCD display shall utilize the full graphics resolution and color Capabilities of the graphic video co-processor.
 - 6) Run all SVGA compatible software using high definition system fonts in all text modes.
 - b. Sound system: Sound Blaster Audio PCI 128D
 - c. Touch Screen: 22 inch, resistive type, 80% Light transmission and Touch life 35 million touches
 - d. (1) - 24x CD/DVD-RW Drive

- e. (2) - 10/100/1000Mbps Ethernet Ports
- f. (2) - RS-232 (COM 2/3) Ports
- g. (1) - RS-232/422/485 (COM 1) Port
- h. (4) - USB 2.0 ports
- i. (1) - VGA Port
- j. Audio: (1) mic in\out
- k. Power: 12 VDC w\ AC\DC Adaptor
- l. Watchdog timer 255 level, 0-255 sec
- m. Mounting: Versa Table Stand
- n. Keyboard: 104+ keyboard
- o. Mouse: MS IntelliMouse w/ mouse pad
- p. Operating System: Microsoft Windows XP

D. Patient Station:

1. The patient bedside station shall contain all the necessary electrical components to support all stations within the room, including up to five (5) lavatory stations, up to five (5) remotely located code blue stations, up to five remotely located staff emergency stations, manual or automatic presence stations, and four-section corridor lights, capable of providing the following functions:
 - a. The patient shall be able to originate any one of three types of calls, as determined by the attendant at the master station, by pressing the call button on the cord set, pillow speaker, or patient station. These calls shall be answered at the master station automatically on a priority basis and the order in which they were placed, or selectively out of order.
 - b. A normal call shall perform the following functions:
 - 1) The call assurance LED on the patient station and pillow speaker shall light.
 - 2) The white section of the corridor light shall light steadily.
 - 3) The white section of the assigned zone lights, if used, shall light steadily.
 - 4) The system monitor LEDs on all duty stations within the selected area of coverage shall flash at a slow rate, indicating that a normal patient call has been registered on the system.
 - 5) The patient's room number (up to seven digits), the bed designation (a number or one of eight programmable letter designations), and a call priority (NORMAL) shall appear in the call window on the base master station, depending on the number of previously placed calls of equal or higher priority.
 - a) If a call of equal or higher priority is already displayed, this call and all subsequent calls shall be held in memory and not displayed until the preceding or higher priority calls are answered and cleared or set on reminder.

- b) Any additional call and its position in the queue of calls waiting to be answered may be displayed by scrolling the display one at a time.
- 6) The HMI touch screen shall simultaneously display up to 25 pending calls, dependent on the size of the window configured by the user, by priority configured color, and the order of placement. Any call displayed or additional calls not in view may be reviewed and directly answered out of order without dialing the room number.
- 7) An electronic tone shall sound at a rate and pattern as programmed by the user, based on the priority of call, at all base master stations associated with the established area of coverage.
- 8) On answering the normal call, all associated lights shall extinguish, the call shall be canceled, and the room and bed number shall be displayed to indicate that the audio path has been established with the station.
- 9) The HMI touch screen terminal shall be connected in parallel to the master station and shall display a Connect window and provide additional information regarding staff assignments and patient information as programmed by the user.
- 10) If a patient requires personal attention from a staff member, the attendant at the master station shall visually remind one or more of the three levels of staff to attend to the patient by activating and flashing the red, amber, or green sections of the corridor light outside the patient's room at a slow rate.
- 11) The system shall have the optional capability for the user to automatically wireless page the currently assigned primary or alternate staff member based on the color of reminder assigned to the staff.
- 12) All lights on reminder shall be held in memory for future review by the attendant and can only be canceled from the room location.
- 13) Any call requests that are not answered within a predetermined time limit shall automatically reappear as a recall at the master station.
- 14) Patient priority calls shall be the same as the normal calls except:
 - a) The white section of the corridor light and associated zone lights, when used, shall slowly flash at a rate of 15 ppm.
 - b) The patient's room and bed number, followed by the call priority, shall appear on the display of the master station in relative order to other priorities of calls already placed.

- c) The call, if and when answered from the master station, shall, at the discretion of the user, remain displayed and indicate it was answered or, if programmed to do so based on the priority level, be removed from the pending calls list and automatically be placed on red, amber, green, or any combination of reminder.
 - 15) The system shall have the optional capability for the user to automatically wireless page the currently assigned primary or alternate staff member based on the color of reminder assigned to the staff.
 - 16) It shall only be possible to cancel the call at the room\bed location.
- c. Patient emergency calls shall be the same as patient priority calls except:
- 1) The white section of the corridor light and associated zone lights, when used, shall rapidly flash at a rate of 60 ppm.
 - 2) The tone shall sound at a different rate at the master station as determined and programmed by the user.
- d. The attendant at the master station, on originating a call to a station or answering a call from a station, shall be able to communicate with that station through a pillow speaker or wall speaker, with the master station in control of the conversation.
- 1) A 2-1/2 inch (6.4 cm) diameter speaker/microphone shall be provided for hands-free two-way voice communications in absence of a pillow speaker or when a pushbutton or air activated call cord is used in place of the pillow speaker. The speaker communication shall be achieved without the staff or patient directing his/her voice toward the station panel or operating any controls.
 - 2) Pillow speakers, when used, shall automatically replace the station speaker communications and shall temporarily suspended the entertainment (TV and/or radio) audio and remove the volume control from audio circuitry during communications.
 - 3) Any time communication is established, an alert tone shall sound and privacy LED on the patient station and the pillow speaker shall light and remain lit until communication is discontinued.
 - 4) Accidental or intentional removal of the cord set or pillow speaker from its receptacle shall place a call in the same manner as a patient (bed) priority call except CORD OUT priority shall appear on the master station display in relative order to other priorities, and the communications function shall automatically transfer to the wall speaker.

- 5) A "Cancel" button, when momentarily touched, shall cancel any type of call placed from the patient station and/or cancel any level of reminder. The LED associated with the CANCEL button shall light any time the station is being monitored by, or in communication with, the master station.
- e. Staff emergency calls shall be originated from the patient station by momentarily touching the "Staff Emergency" button. This call shall temporarily suspend, but not cancel, any other lower priority call already placed from the room. Systems requiring a separate station to perform this function shall not be acceptable.
- 1) When a staff member is registered in the room by a manual or automatic presence station or through the system monitor function, the system shall allow a staff emergency call to also be originated by touching the call button on the cord set or pillow speaker two times.
 - 2) The staff emergency call shall automatically and simultaneously perform the following functions:
 - a) Flash the green section of the corridor light at a rate of 60 ppm.
 - b) Sound a repetitive electronic tone at a rate of 60 ppm at all duty stations and, at the base master station, at a rate pattern determined by the user for the area of coverage.
 - c) Flash the green section of all appropriate zone lights, if used, at a rate of 60 ppm.
 - d) Flash the system monitor LED on all duty stations at a rate of 60 ppm.
 - e) The patient's room and bed number, followed by the call priority, shall appear on the master station display in relative order to other priorities as configured by the user.
 - f) The call, if and when answered from the master station shall, at the discretion of the VA's Contracting Officer and Design Professional, remain displayed and indicate it was answered or, if programmed to do so based on the priority level, be removed from the pending calls list and automatically placed on red, amber, green, or any combination of reminder.
 - g) It shall only be possible to cancel the staff emergency call from the station originating the call and the reminder, if set, only from the patient station.
- f. Code blue calls shall be originated from any patient room by momentarily touching the "Code Blue" button on the patient station. Systems requiring a separate station to perform this function shall not be acceptable.
- 1) Placing a code blue call shall perform the same function as the staff emergency call, except:

- a) The amber section of the corridor light shall flash at a rate of 60 ppm.
 - b) A repetitive electronic tone shall sound at a rate of 240 ppm at all duty stations and, as determined by the user, at the master stations within the area coverage.
 - c) The amber section of all appropriate zone lights, if used, shall flash at a rate of 60 ppm.
- 2) A station call button shall be provided to allow placement of normal calls in parallel or in the absence of a call cord or pillow speaker.
- a) Two connections shall be provided and located on the face of the patient station, one for a plug-in connection of a pillow speaker for two-way communications with the master station and control of the TV entertainment audio and station selection or a pushbutton or air activated call cord and a second connection to accept a "Side-com" bed adaptor cable. Both the pillow speaker and "side-rail" communication on the bed shall be able to simultaneously initiate a call in the nurse call system as well as have complete TV control capability.
 - b) It shall be possible, on a station-by-station basis, to plug-in an optional auxiliary monitor adaptor that connects and monitors portable patient medical equipment for alarm condition through the nurse call system.

E. Emergency Stations:

1. The emergency station shall be provided in a touch pad version, equipped with a "Cancel" button and call assurance LED, all mounted on a single-gang, non-conductive chassis. When a call is originated, the following shall occur:
 - a. The LED shall light to indicate that the call has been placed.
 - b. The red section of the corridor light associated with the room shall flash at a rate of 60 ppm.
 - c. The red section of all associated zone lights shall flash at a rate of 60 ppm.
 - d. The system monitor LED shall flash on duty stations at a rate of 60 ppm.
 - e. The tones shall sound at the master station and all associated duty stations at a rate of 60 ppm, and continue to sound unless the call is canceled from the room by momentarily touching the "Cancel" button on the station originating the call.
 - f. The room number and programmed priority shall be displayed at the master station. This call may be acknowledged in the same manner as answering any other priority call, and shall automatically be placed into reminder or remain in the pending calls queue, if programmed to do so, until canceled at the station originating the call.

- g. The shower emergency station shall be provided in a pull cord version, equipped with a "Cancel" button and call assurance LED, all mounted on a single-gang, non-conductive chassis with a rubber gasket. The unit shall be located on the shower head wall above the shower head, between the shower head and shower door. It shall function in parallel and in the same manner as the lavatory emergency station.

F. Staff/Duty Station:

- 1. The staff/duty station shall be located in non-patient rooms and where staff members normally perform their duties, and when shown on the floor plans, shall be located inside the entrance of each patient's room. The station shall be physically and electronically similar to the patient station except that no call cord receptacle shall be provided.
 - a. A staff call shall be placed by momentarily touching the CALL button, causing the following to occur:
 - b. The LED associated with the button shall steadily illuminate.
 - c. The white section of the corridor light shall steadily illuminate.
 - d. The white section of all associated zone lights shall steadily illuminate.
 - e. The tone at the master station shall sound at a rate of 7.5 ppm.
 - f. The room number, followed by the priority name, shall appear in the "Pending Calls" display window at the master station, depending on the quantity of equal or higher priority calls already placed.
 - g. The "Staff Emergency", "Code Blue", "Cancel", and "Programmable Aux" buttons, along with their associated LEDs, shall be provided and function in the same manner as on the patient station.

G. Corridor Lights:

- 1. Multi-sectional corridor lights, suitable for wall or ceiling mounting, shall be provided outside the entrance to each patient room and all staff/duty rooms, and shall be clearly visible from all directions.
- 2. The chassis, similar in design and material to the patient station, shall accommodate one, two, three, or four long-life, color-coded lamps, separated by snap-in metal barriers to meet the functional requirements of each room.
- 3. Each colored lamp shall function as follows:
 - a. Red (Nurse) Presence—steady red
 - b. Amber (LPN) Presence—steady amber
 - c. Green (Aide) Presence—steady green
 - d. Red Required (reminder)—15 ppm flashing red
 - e. Amber Required (reminder)—15 ppm flashing amber
 - f. Green Required (reminder)—15 ppm flashing green
 - g. Normal Patient Call—steady white
 - h. Bed Auxiliary (programmable)—steady white

- i. Priority Patient Call-15 ppm flashing white
 - j. Bed Auxiliary (programmable)-15 ppm flashing white
 - k. Bed Auxiliary (programmable)-15 ppm flashing white
 - l. Bed Auxiliary (programmable)-15 ppm flashing white
 - m. Emergency Patient Call-60 ppm flashing white
 - n. Bed Auxiliary (programmable)-60 ppm flashing white
 - o. Bed Auxiliary (programmable)-60 ppm flashing white
 - p. Bed Auxiliary (programmable)-60 ppm flashing white
 - q. Lavatory Call-60 ppm flashing red
 - r. Staff Emergency Call-60 ppm flashing green
 - s. Code Blue Call-60 ppm flashing amber
 - t. Room Auxiliary-strobe red, amber, green
4. The single-piece lens, suitable for room number designations, shall snap onto the chassis, allowing quick and easy lamp replacement without the use of any tools.

H. Corridor Zone Lights:

- 1. Corridor zone lights shall be provided at the intersection of the corridors or as shown on the floor plans.
 - a. The four sections shall duplicate all the lighting functions of the room corridor lights for which it has been programmed.
 - b. The single-piece lens, suitable for zone number designations, shall snap onto the chassis, allowing quick and easy lamp replacement without the use of any tools.

I. Pillow Speakers:

- 1. A combination nurse call/entertainment "Smart" pillow speaker shall be provided for each bed and plug into the receptacle of each patient station. It shall be able to withstand a 6-foot (1.8 m) drop to a hard tiled floor without damage, and shall have provisions for remote control of TV entertainment as well as calling and communication functions with the master station. They shall allow the patient to scroll "up or down" on the TV channels, instead on only moving through channels in one direction.
- 2. All control buttons shall be non-mechanical conductive rubber switches with a permanently designated overlay to identify the function of each pushbutton, mounted into a high-impact, Cyclooy® C2800 plastic housing with no sharp or protruding corners.
 - a. At the minimum a large, 1-1/2 inch (3.8 cm) by 1-inch (2.5 cm), raised and clearly designated pushbutton shall be provided for placing a call to the master station.
 - b. A light green call assurance LED shall illuminate when a call is placed from the pillow speaker. If staff reminder is set, the LED shall flash slowly.
 - c. A red privacy LED shall illuminate whenever communication is established with the room station.
 - d. Pushbuttons for turning the TV on, changing channels, close caption, and turning the TV off shall be provided.

- e. A pushbutton for controlling reading and indirect lights shall be provided. The lighting fixture manufacturer shall be responsible for providing the control unit and power supplies as required to sequentially control the lights from a single closure contact, and guarantee proper operation of the communications system.
- 3. The speaker shall be 2-1/2 inches (6.4 cm) or larger in diameter and include a moisture-resistant Mylar® cone capable of reproducing quality audio from both the master station and the television set. It shall also act as a microphone for two-way communications with the master station.
- 4. A large 2-inch (5.1 cm) diameter edge-mounted volume control for adjustment of the TV audio by dexterity-impaired patients. The control shall be electronically and automatically removed during two-way voice communications with the master station, silencing the TV audio.
- 5. The connecting 8-foot (2.5 m) flexible modular cord shall have a multi-pin plug molded at both ends.
 - a. One end shall be capable of being easily removed from the patient's station receptacle without damage to the cord, station or pillow speaker, and shall contain a standard jack receptacle to accept special call cords for operation in parallel with the station controls and/or pillow speaker.
 - b. The other end shall plug into the pillow speaker control unit for ease of replacement in case of damage.
- 6. A wall-mounted storage bracket shall be provided and mounted near the patient's station to hold the pillow speaker when not in use.
- 7. An adjustable breakaway cord clamp shall be provided in addition to the standard bed sheet clamp to secure the pillow speaker to the bed for the patient's convenience.
- 8. If the pillow speaker is removed from the station receptacle, the entertainment and lighting control shall become inoperable, a "cord out" call shall be placed, and if the call is answered, the communications shall automatically be transferred to the wall speaker.

J. Code Blue System:

- 1. The ability to initiate a code blue call shall be provided in each patient and treatment room.
 - a. When the code blue station is touched, the LED shall illuminate to indicate the call is placed.
 - b. The associated amber section of the corridor light shall flash at a rate of 60 ppm.
 - c. All associated zone lights, when used, shall flash the amber section at a rate of 60 ppm.

- d. The system monitor LED on all duty stations within the zone shall flash at a rate of 60 ppm and the tones at the master and duty stations shall sound at a rate of 240 ppm until the call is canceled at the room by momentarily touching the CANCEL button or, if programmed to do so, by answering the call (acknowledged) at the master station.
- e. The room and bed number, followed by the call priority, shall appear on the master station's display in relative order to other priorities as configured by the user.
- f. The call, when acknowledged, shall remain displayed on the pending call list or shall automatically, if programmed, be placed on reminder. It shall only be possible to cancel the call and reminder from the station originating the call.
- g. Optionally, the emergency team pocket page receivers shall be signaled automatically.
- h. The unit shall have the capability to start a local elapsed time when a call is placed.

2. Code Blue Display:

- a. A code blue digital display panel shall be located at the PBX areas with a maximum of eight (8) per power supply, as shown on the floor plans.
- b. Each display panel shall provide the following features and functions:
 - 1) Digital displays with capability to display six code blue calls.
 - 2) Call display by a numerical room and bed number in same format as that programmed at the master station covering the calling room.
 - 3) Programmable coverage.
 - 4) Built-in lamp and tone test.
 - 5) Supervised operation.
 - 6) Contacts for starting an elapsed timer or control of other UL listed devices.

K. Central Processor Equipment:

- 1. All system functions shall be controlled dedicated NCS\CB central processors installed in wall mounted enclosures located in local communications equipment as shown on the floor plans. All components shall be mounted to individual circuit boards that are identified by function for plug-in replacement. The control unit and all remote stations shall be capable of operating within the temperature range of 40 degrees F (5 degrees C) to 100 degrees F (38 degrees C) at a non-condensing humidity range of 5 percent to 85 percent.
 - a. The central processor shall have the capability to support a minimum of 150 dual and single patient, staff/duty, and independent non-intercom stations.

- b. All zone and master station control circuits shall be designed on microprocessor circuit boards utilizing slot-independent card cage, capable of providing easy system assembly, configuration, and service. Each circuit board shall include independent supervision LEDs displaying the operational and fault status of each processor board.
 - c. Each zone of up to 32 stations shall be assigned by room/bed number to one or more master stations, minimum of 16 master stations, each with the capability to transfer one or more stations, individually or as a group, from one master station to another shall be supported by the system.
 - d. Each zone or group of zones shall be assigned an audio amplifier/voice control on a per master station basis for a minimum of up to six communication paths within each control cabinet and two communication paths between multiple cabinets. Each voice link shall be designed for clarity of speech and wide separation of signal-to-noise levels.
 - e. Each group of rooms predetermined to be transferred on a regular needed-bed basis between one or more master stations shall be assigned a separate audio amplifier to reduce the probability of busy links. The master stations shall be notified of the busy condition when attempting to connect to a station that is part of a zone already connected to another master station.
 - f. The system shall be capable of maintaining programmed information such as dial number assignments, priority assignments, reminders, and call registration in case of momentary or prolonged primary power loss. Also, all calls originated before power failure shall be restored, illuminating all affected corridor lights.
2. The system shall provide a file server with outputs for future connection of the pocket page integration, wireless telephone integration, activity reporting, code blue display units, and/or system configuration and diagnostic terminals.

L. Uninterruptable Power Supply (NCS\CD Processors)

- 1. Provide dedicated UPS units in conformance with the performance requirements of all NCS\CB central processors and servers. The UPS unit shall be provided where indicated and in accordance with all manufacturer recommendations in order to meet all system performance requirements.
- a. The system shall be rack mounted unit providing a minimum of 3000VA/2400 watt max power with integral batteries sized to provide 14 minutes half load runtime and 5 minutes full load. The unit shall be UL listed for use on communications equipment and capable of providing protection against of blackouts, voltage fluctuations and transient surges. The unit shall include a total 8 output receptacles (2 L6-20 and 6-15/20R). The unit shall provide two switchable 6-15/20R load banks (bank 1 - two outlets, bank 2 - four outlets)

- b. The unit shall support remote monitoring and simultaneous communications of UPS and site power conditions via serial port and SNMP/Web card and shall include Power-Alert UPS monitoring and unattended shutdown software with complete cabling. In addition the unit shall be equipped with built-in audible alarm and 14 front panel LEDs indicate status of line power, battery power, battery low/replace, voltage regulation and load level.
- c. In addition to above the UPS shall be provided with the following minimum configuration:
 - 1) Input Voltage: 208VAC/30A @ 60 Hz
 - 2) Output volt amp capacity (VA): 3000
 - 3) Output watt capacity (watts): 2500
 - 4) Output nominal voltage: 208V AC
 - 5) Output voltage regulation (line mode) +/- 2%
 - 6) Output voltage regulation (battery mode) +/- 2%
 - 7) Output voltage regulation: LINE MODE: Sine wave output within 208V (-6% +20%) plus 120V nominal (600VA max @ 120V)
 - 8) Output frequency regulation: LINE MODE: Passes line frequency of 60Hz +/-10%
 - 9) Outlet quantity / type: 2 NEMA L6-20R and 6 NEMA 15/20R
 - 10) Overload protection: Re-settable circuit breaker
 - 11) Maximum input amps: 14.3A/2400 watts @208V
 - 12) Input connection type: NEMA L6-20P
 - 13) Full load runtime: 5 min (3000VA)
 - 14) Half load runtime: 14 min (1500VA)
 - 15) Battery recharge rate: 2-4 hours to 90%
 - 16) Voltage regulation description: Automatic Voltage Regulation (AVR) circuits maintains clean, regulated computer-grade
 - 17) 208/120V nominal output, without using battery power, during brownouts to 167V and over voltages to 260V
 - 18) Over voltage correction: Input voltages between 228V and 260V are reduced by 12%
 - 19) Brownout correction: Input voltages between 167V and 194V are boosted by 12%
 - 20) Front panel LEDs: 14 LEDs indicate line power, online mode, bypass mode, on-battery, overload, battery low, replace battery and fault status information; 4-LED meter displays load and battery charge levels; LED panel rotates for viewing in rack/tower formats
 - 21) Alarms: Audible alarm indicates UPS startup, power-failure, low-battery, overload, UPS fault and remote shutdown conditions
 - 22) Switches: 2 front panel mounted push button switches for system enable, self-test and alarm cancel functions
 - 23) AC surge suppression: 2670 joules
 - 24) AC suppression response time: Instantaneous
 - 25) EMI / RFI AC noise suppression: Yes

2. Rack Mounted Power Distribution Unit

- a. Provide rack mounted power distribution switch with surge protection for the distribution of all UPS connected power for each rack. The unit shall consist of 12 AC power outlets (4 Front, 8 Rear), rated at 15 amps each and shall be equipped with integral surge protection circuitry (with bypass switch) capable of auto-resetting over-voltage and under-voltage protection.
- b. The unit shall include a front mounted power switch (with guard) which shall control all 12 outlets. The four front mounted power outlets shall be spaced as transformer convenience outlets. The overall unit shall be single-height rack mountable chassis (1U) with three front panel indicator lights: (Power, Ground OK and Unsafe Voltage) and shall include front panel circuit breaker for protect or disconnect circuitry and 10-foot power cord for UPS connectivity. The rear panel grounding lug shall be provided.
- c. In addition to the above requirement the power distribution unit shall meet the following minimum requirements:
 - 1) Integral Surge Protection Circuitry (with by-pass switch): Yes
 - 2) Protect or Disconnect Circuitry: Yes
 - 3) Thermal Fusing: Yes
 - 4) Catastrophic Surge Circuit: Yes
 - 5) Over/Under voltage Protection: Yes
 - 6) Overvoltage Shutoff Gate: 144V \pm 11V
 - 7) Under voltage Shutoff Gate: 84V \pm 6V
 - 8) Single Pulse Energy Dissipation: 1350 Joules
 - 9) Peak Impulse Current: 32,000A
 - 10) EMI/RFI Noise Filtration: 50db (99.7%)
 - 11) Line Voltage: 120VAC, 50/60Hz
 - 12) Initial Clamping Level: 200V Peak, 141 Rms
 - 13) UL 1449 Rating: 500V L-N, 500V L-G, 400V N-G
 - 14) Protection Modes: L-N, L-G, N-G
 - 15) Maximum Current Rating: 15A (1800W)
 - 16) Response Time: 1-5 Nanoseconds
 - 17) Plug Configuration: Straight
 - 18) Number of Outlets: 12 (4 front, 8 rear)
 - 19) Switched Outlets: All

3. Maintenance Bypass and Power Distribution Switch

- a. Provide rack mounted maintenance bypass and power output distribution switch for UPS unit. The bypass switch shall permit the manual transfer of connected UPS loads to utility power via a maintenance bypass switch, permitting scheduled maintenance or UPS replacement without discontinuing power to the critical load. Transferring the unit back to UPS power shall be accomplished turning the switch to the load position and transferring the protected back to UPS service.

- b. The UPS maintenance bypass and power output distribution switch shall provide hardwired connections rated at 120V or 208V and include all brackets and hardware for rack mounting. The maintenance bypass and power output distribution switch shall be Liebert model MicroPOD or approved equal.

M. Uninterruptable Power Supply (HMI Terminals)

- 1. Provide dedicated UPS units in conformance with the performance requirements of the HMI integrated panel PC\Touch Screen terminal locations. The UPS shall be provided in accordance with all manufacturer recommendations in order to meet all system performance requirements.
- 2. The system shall be a small footprint desk mounted unit providing a minimum of 800VA / 450 watt power with integral batteries sized to provide 15 minutes half load runtime and 7 minutes full load. The unit shall be UL listed for use on telecommunications equipment and capable of providing protection against of blackouts, voltage fluctuations and transient surges. The unit shall include a total of 6 UPS supported NEMA 5-15R outlets.
- 3. The unit shall support remote monitoring of UPS and site power conditions via built-in USB monitoring port and shall include Power-Alert UPS monitoring and unattended shutdown software with complete cabling. In addition the unit shall be equipped with built-in audible alarm and 5 front panel LEDs indicate status of line power, battery power, battery low/replace, voltage regulation and load level.
- 4. In addition to above the UPS shall be provided with the following minimum configuration:
 - a. Voltage compatibility: 120V AC
 - b. Frequency compatibility: 60Hz OUTPUT
 - c. Output nominal voltage: 120V AC
 - d. Output voltage regulation: LINE MODE: Sine wave line voltage 120V (-18% / +8%)
 - e. Output frequency regulation: LINE MODE: Passes line frequency of 60Hz +/-10%
 - f. Maximum input amps: 4.4A / 490 watts
 - g. Input connection type: NEMA 5-15P
 - h. Electrical service: 15A 120V (Emergency) BATTERY
 - i. Full load runtime: 7 minutes (800VA)
 - j. Half load runtime: 15 minutes (450VA)
 - k. DC system voltage: 12 VDC
 - l. AC surge suppression: 480 joules
 - m. AC suppression response time: Instantaneous
 - n. EMI/RFI suppression: Yes
 - o. Battery recharge rate: 2-4 hours to 90%
 - p. Voltage regulation: Automatic Voltage Regulation (AVR) circuits maintain clean, regulated computer-grade 120V nominal output, without using battery power, during brownouts to 75V w/over-voltage to 147V
 - q. Over-voltage correction: Input voltages between 128 and 147V AC are reduced by 12%
 - r. Direct pass through: Input voltages between 108 and 127V AC are passed on to connected equipment unchanged

- s. Brownout correction: Input voltages between 93 and 107V AC w/14% boost
 - t. Severe brownout correction: Input voltages between 75 and 92V AC w/30% boost. TCHES
 - u. AC power to battery transfer: 2-4 milliseconds
 - v. Low voltage transfer to battery power: Switches to battery power as line voltage decreases to 75 volts or less. Resets back to line power mode as line voltage increases to 79V or higher.
 - w. High voltage transfer to battery power: Switches to battery power as line voltage increases to 147 volts or higher. Resets to line power mode as line voltage decreases to 143V or less.
- CERTIFICATIONS
- x. Alarms: Audible alarm with 15 second delay sounds to indicate loss of utility power with re-sound when approximately 2 minutes runtime remain.
 - y. Cooling: Convection
 - z. Cold Start: Yes,

PART 3 - EXECUTION

3.1 EQUIPMENT PROTECTION

- A. Comply with all requirements of specification section 27 05 00.
 - 1. Examine all physical and environmental conditions, equipment and bed locations, auxiliary system connectivity requirements impacting the installation of the systems and report any unsatisfactory conditions in writing to the VA's Contracting Officer and Design Professional.

3.2 WORK PERFORMANCE

- A. In addition to all requirements as specified by Specification Section 27 05 00 the video surveillance system shall also be provided in accordance with the following requirements:
 - 1. Prior to the final programming of any systems, the Contractor shall provide a review with the VA's Contracting Officer and Design Professional addressing all system features, functions, operations, integrated system responses, graphic maps and related operational programming.
 - a. Failure to provide this review and get final sign-off prior to programming shall result in any costs related to changes requested by the VA's Contracting Officer and Design Professional as not being charged to the project.

3.3 EQUIPMENT/CABLE INSTALLATION AND REQUIREMENTS

- A. All system cabling shall be of the type, size and specifications as required by: the system Manufacturer; the configuration of all installed equipment provided; the system applications, design and cabling shall meet all requirements of UL 1069; as well as all stipulated codes and standards as specified by specification section 27 05 00.
 - 1. The size and type of all system cabling shall be calculated in accordance the Manufacturer's recommendations and system power requirements. Provide at the time of shop drawing submission all cabling requirements, voltage calculations and appropriate design data.
- B. NOTE: Any NCS\CB system employing TCP\IP based architecture in addition to all requirements as specified by sections 27 05 00 and 27 11 00 shall be provided in accordance with the following requirements:
 - 1. All NCS\CB system cabling shall utilize Category-6 UTP cables and installed in accordance with the requirements of all related Division 27 specification sections. All cabling shall not contain any AC carrying conductors or non-associated system cables within the cable raceways\conduits or cable bundles.
 - a. In addition, all structured cabling associated with the installation of any NCS\CB system shall comply with all requirements of EIA\TIA standards for the proper installation, termination and testing of all fiber optic and Category-6 UTP cabling.
 - b. Contractor shall provide all equipment, components, devices, hardware, UPS units, equipment racks\cabinets, patch panels and all appurtenances necessary to provide fully operational systems utilizing a UTP cabling topography. Coordinate all system cabling with the NCS\CB system provider prior to shop drawing submission.
- C. Electrical power shall be provided as stipulated in specification section 27 05 00 and all related Chapters of this specification section, all electrical power for remote system components shall be obtained from dedicated power supplies located at the nearest communications equipment room. All 120-Volt power for all NCS\CB system components and\or devices shall be supplied from the nearest appropriate emergency electrical distribution panel. System components employing the use of plug-in transformers for power shall not be acceptable.
 - 1. All system power supplies serving system components or devices shall be provided with the appropriate transient surge and lightening suppression protection on both the line side as well as the load side. Refer to specification section 27 05 00 for additional requirements.

- D. Installation of all equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate trade contractors.

3.4 ELECTRICAL POWER DISTRIBUTION

- A. Comply with all requirements of specification section 27 05 00.

3.5 TRANSIENT VOLTAGE SUPPRESSION

- A. Comply with all requirements of specification section 27 05 00.

3.6 GROUNDING AND BONDING

- A. Comply with all requirements of specification section 27 05 00.

3.7 EQUIPMENT IDENTIFICATION

- A. Comply with all requirements of specification section 27 05 00.

3.8 MAINTENANCE & SERVICE

- A. Comply with all requirements of specification section 27 05 00.

3.9 WARRANTY

- A. Comply with all requirements of specification section 27 05 00.

3.10 Field Services

- A. Testing
 - 1. In addition to all requirements as specified by Division 1 and Specification Section 27 05 00 the nurse call\code blue systems shall also comply with the following requirements:
 - a. The completed NCS\CD systems shall be fully tested in accordance with all requirements as herein specified, Division 1, specification section 27 05 00 and all manufacturers' recommendations. Upon completion of successful testing, the contractor shall so certify in writing to the VA Contracting Officer and Design Professional that all was completed, tested, certified and left in first class operational condition, include all completed certification and test reports.
 - b. The service of a competent, factory-trained engineer or technician authorized by the equipment manufacturer shall be provided to technically supervise installation and participate during initial system programming, start-up, final testing, assist in the final acceptance testing and Government user demonstrations.
 - c. At the minimum all acceptance testing, demonstrations and training shall include, but not be limited to the following:
 - 1) Central Processor Control Cabinets.

- 2) Nurse Control Stations.
 - a) Master Stations
 - b) Patient Stations
 - c) Staff Stations
 - d) Emergency Stations
 - e) Code Blue Stations
 - 3) Dome Lights.
 - a) Patient Rooms
 - b) Corridors
 - c) Intersectional
 - 4) Local and Remote Annunciator Panels
 - 5) Electrical Supervision Panels/Functions/locations
 - 6) All Network Integrations and Interfaces
 - a) MATV
 - b) Wireless Access and Pager Systems
 - c) Public Address (PA)
 - d) Telephone System
 - 7) System Supervision and Trouble Enunciations
 - 8) UPS Operations
 - 9) Primary / Emergency AC Power Requirements
 - 10) All programming and operational functions and features as herein specified.
- d. Demonstrate each system and subsystem. The demonstration shall include, but not be limited to the following:
- 1) Designate actual location of each component of a system or subsystem and demonstrate its function and its relationship to other components within the system.
 - 2) Demonstrate the operation of all client servers, HMI operations, GUI based graphics, system functions, and administration set-up, configurations and all system operations, emergency operations and system reboot procedures.
 - 3) Demonstrate all systems and subsystems operations by actual cycling through system features demonstrating how to work controls, how to reset devices, how to replace fuses and emergency operating/operations procedures.
- e. Upon final inspection a factory-trained and certified representative of the equipment manufacturer shall demonstrate to the VA's Contracting Officer and Design Professional that all systems function properly in every respect and is in full compliance with the contract documents. This requirement is in addition, to all testing requirements listed in specification section 27 05 00 and all related specification sections.

- 1) Provide a minimum of (4) four 4-hour training classes performed at the project location and spaced over a two week interval. Training classes shall be scheduled not less than 48 hours apart to allow Government Users\Operators to familiarize themselves with all system operations.
- 2) Include all training manuals, video instructions and hands-on demonstrations in the operation of all system components. Provide to the VA's Contracting Officer and Design Professional in advance lesson plans outlying training procedures, course outlines and objectives. Coordinate with the VA's Contracting Officer and Design Professional in advance all training dates and schedules.

A. Training

1. Comply with all requirements of specification section 27 05 00.

END OF SECTION

SECTION 28 05 00
COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Division 26 Specification Sections shall apply to this and all related Division 28 specification sections.

B. Related Specification Sections:

1. 07 08 00 - Fire Stopping
2. 08 31 13 - Access Doors
3. 26 05 00 - Requirements for Electrical Installations.
4. 26 05 21 - Low Voltage Electrical Power Conductors and Cables.
5. 26 05 26 - Grounding and Bonding for Electrical Systems
6. 26 05 33 - Raceways and Boxes for Electrical Systems
7. 28 13 00 - Physical Access Control System (PACS)
8. 28 31 00 - Fire Alarm and Signaling System

C. Reference Symbols:

1. All device symbols are defined by the appropriate symbol schedule on the symbols and abbreviations sheet in the communications system drawing package. Not all device symbols as indicated may be required for the project.

- a. Because of the scale of the drawings, symbols are shown on the drawings as close as possible to the mounting location.
Contractor shall coordinate exact locations with architectural drawings and all affected trades prior to submittal of shop drawings.

D. Abbreviations:

1. ASIS: American Society Industrial Security (International)
2. AP: Wireless Access Point
3. A/V: Audio Visual Systems - For purposes of this specification section A/V systems shall include all Media Management, Video Broadcasting, Intercommunications (Paging/Public Address, Clock, Auxiliary Sound), Nurse Call\Code Blue, Video Intercom, Master Antenna (MATV) and Distance Learning Systems
4. AVI Audio Visual Systems Integrator: Shall be a qualified contractor experienced in the installation and certification of A/V systems. The AVI contractor shall be responsible for the design, testing and certification of all audio/visual systems including but not limited to Intercommunications, Nurse Call\Code Blue, TV Distribution, Audio/Visual, Master Antenna and Bi-Directional Antenna systems as well as all structured cabling systems supporting these technologies.

- 5. BACnet: A communications protocol for building automation and control networks as outlined in ISO 16484-5 and ASHRAE/ANSI Standard 135.
- 6. BAS: Building Automation System
- 7. BICSI: Building Industry Consultant Services International - International organization whose primary objective is to enhance the reputation and skills of companies and individuals employed in the telecommunications and security industries by ensuring that current and developing standards are maintained.
- 8. CATV: Community Antenna Television System - Cable TV Network
- 9. CCD: Charge-coupled device.
- 10. CCTV: Closed Circuit Television Surveillance System.
- 11. CMOS: Complementary metal-oxide-semiconductor
- 12. CP: Consolidation Point - Local Interconnection Point between horizontal cables from the building IDF/MDF rooms and horizontal cables for the furniture drops.
- 13. CPU: Central Processing Unit
- 14. DP: Demarcation Point - The point of interface between the Communications Networks, MATV, any Auxiliary Systems, and the associated Service Providers or Public Utilities. Also known as Entrance Facility. Shall also serve as the primary termination point for all incoming OSP cabling as well as the primary main grounding bus-bar for all communications systems. Refer to project documents for exact location and termination requirements.
- 15. DVR: Digital Video Recorder.
- 16. DGP: Data Gathering Panel- component of the Physical Access Control System (PACS) which provides the portal at the door location to communicate, store and process information received from readers, reader modules, input modules, output modules with the Security Management System CPU and software.
- 17. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
- 18. DVT: Remote digital viewing terminal which shall serve as the video surveillance systems' operator HMI terminal remote from the primary rack mounted HMI.
- 19. EMI: Electromagnetic interference.
- 20. EMT: Electric Metallic Tubing.
- 21. ESS: Electronic Security Systems - Including but not limited to; intrusion detection, physical access control, CCTV video surveillance, electronic perimeter detection, duress alarm, programmable logic controllers (PLC), supervisory control and data acquisition (SCADA), integrated security management platforms and electronic screening systems.
- 22. ESSI: Electronic Security Systems Integrator - Shall be a qualified contractor experienced in the design, programming, installation, testing and certification of all Intrusion Alarm, Access Control, CCTV Surveillance and Security Management Systems. The ESSI shall have a registered RCDD professional review and seal the designs, installations and certifications of all structured cabling networks related to the installation of any IP based electronic security system.

- 23. EVAC: UL Listed Emergency Voice Evacuation System. Not to be confused with the building; Public Address/Intercom, Intercommunications and/or Mass Notification systems.
- 24. FASS: Fire Alarm and Signaling System
- 25. FASI: Fire Alarm System Integrator - Shall be engaged in the full time business of providing the installation of life safety systems and shall employ on staff a minimum of one NICET Level III certified contractor experienced in the installation, programming, testing and certification of Rescue Assistance, Protected Premises and Central Station Signaling Fire Alarm Systems as defined by NFPA 72.
- 26. GAP: Graphic Annunciator Panel - A custom fabricated fixed display panel providing operational control and visual display of all alarm and system functions related to the operation of the FAS and/or ESSM as described in related specification sections.
- 27. GFI: Ground fault interrupter.
- 28. GUI: Graphic User Interface - A specialized program employing graphical display maps of a facility and/or site which, also provides a manual user interface for all system functions and operations by utilizing control and annunciation ICON's from dedicated human machine interface terminals.
- 29. HMI: Human Machine Interface - A Computer-operated, video control terminal complying with FCC Part 15 CFR Title 47, Subparts A and B, and shall utilize multiple dynamic GUI based displays for annunciation and control LCD flat panel computer monitor or display screen as defined by related specification sections.
- 30. ICS: Intercommunications system - Shall include but not limited to all intercoms, public address, clock, program, and auxiliary sound or emergency communications systems as defined by related specification sections.
- 31. IDF: Intermediate Distribution Frame - The room/space that shall serve as the local termination point for all horizontal and backbone cabling. Also shall be known as Equipment Room (ER), Horizontal Cross-Connect (HC) or Floor Distribution (FD).
- 32. IDS: Intrusion Detection System.
- 33. I/O: Input/Out - Commonly associated with dry/contact relay based digital integration.
- 34. ITS: Information Transport Systems - For purposes of this specification section ITS shall include all data and telecommunications communications systems including but not limited to all Data, Telephone, Intercommunications (Paging/Public Address), TV Distribution Systems (MATV) and Audio Visual Systems (A/V) and IP based CCTV Surveillance Systems.
- 35. ITSI: Information Technology System Integrator - Shall be a qualified contractor experienced in the installation and certification of all data, telecommunications and A/V systems. The ITSI shall be responsible for the design, testing and certification of Data, Telephone communications systems and all structured cabling systems supporting these technologies.

- 36. LAN: Local Area Network
- 37. LCD: Liquid-crystal display.
- 38. LED: Light Emitting Diode.
- 39. LV: Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- 40. MATV: Master Antenna System - Shall include all TV and media management distribution cabling, termination jacks, head-end components, control, equipment racks, amplifiers, projection equipment and video monitoring devices as defined by the project drawings and related specification sections.
- 41. MDF: The Main Distribution Frame - The room/space that shall serve as the primary termination point for all backbone cabling to each IDF locations and horizontal connection point for local communication drops. May also serve as a local IDF location as well as the cross-connection and interconnection of all entrance cables from the DP for all PSTN and WAN connections. Also shall be known as Main Cross Connect (MC), Telecommunications Room (TR) and/or Campus Distributor (CD)
- 42. M-JPEG: Motion - Joint Photographic Experts Group.
- 43. MNS: Mass Notification System
- 44. MPEG: Moving picture experts group.
- 45. NEC: National Electric Code
- 46. NEMA: National Electrical Manufacturers Association
- 47. NFPA: National Fire Protection Association
- 48. NTSC: National Television System Committee.
- 49. NRTL: Nationally Recognized Testing Laboratory.
- 50. NVR: Network Video Recorder
- 51. NVS: Network Video Server
- 52. OTDR: Optical Time Domain Reflectometer
- 53. OSP: Outside Plant - All cabling associated with building services supporting the incoming service connections to Service Providers, Public Utilities and Wide Area Networks.
- 54. PA: Public Address or Building Intercommunications System.
- 55. PACS: Physical Access Control System.
- 56. PIDS: Perimeter Intrusion Detection System
- 57. PIR: Passive Infrared
- 58. POTS: Plain Old Telephone Service - Analog Telephone Circuit used for the connection of FAX machines, BAS and FAS communications devices and shall be wired upstream of the facility's telephone switch.
- 59. PSP: Physical Security Professional as registered by the American Society of Industrial Security-International (ASIS)
- 60. PSTN: Public Switched Telephone Network - Connection to local telephone utility providing local telephony communications service.
- 61. RCDD: BICSI accredited Reregistered Communications Distribution Designer
- 62. RFI: Radio-frequency interference.
- 63. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.

- 64. RS-232: A TIA/EIA standard for asynchronous serial data communications protocol between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- 65. RS-485: A TIA/EIA standard for multipoint communications protocol.
- 66. SCADA: Supervisory Control and Data Acquisition - A system used in to monitor and control plant status of facilities scattered over wide geographic areas.
- 67. SMS: Security Management System - A system incorporating security alarms, door controls, emergency intercoms/paging, duress alarms and surveillance systems all integrated through a single operating platform, providing centralized command and control capability for the various systems via dedicated human machine interface terminals.
- 68. TCP/IP: The standard communications protocol that implement protocol stack on which the Internet and data communications networks operate
- 69. TGB: Telecommunications Grounding Busbar - Located in each IDF
- 70. TMGB Main Grounding Busbar - Located at the building DP/MDF
- 71. TP: Transition Point - A location in the horizontal cabling where flat under-carpet cable transitions to a horizontal cabling consolidation point (CP).
- 72. TVSS: Transient voltage surge suppressor
- 73. VLAN: Virtual LAN - A technique made possible by switching technologies that permits the logical grouping of any number of network devices into one or more sub- networks.
- 74. UPS: Uninterruptible Power Supply
- 75. UTP: Unshielded Twisted Pair
- 76. VMS: Video Management Software which shall software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- 77. VoIP: Voice Over IP telephone Network
- 78. WAN: Wide Area Network
- 79. WLAN: Wireless Local Area Network

E. Definitions:

- 1. Contract Documents: The documents consisting of the Form of Agreement between Owner and Contractor, Conditions of the Contract, (General, Supplementary, and other Conditions), Drawings, Specifications and all Addenda issued prior to the execution of the Contract.
- 2. Contract Drawings: The drawings that form a part of the Contract Documents that provides the graphical representation of the project requirements intended design and/or performance criteria to be delivered by the Contractor.
- 3. Reference Drawings: A drawing and/or set of drawings produced by a proprietary supplier, manufacturer, subcontractor, or fabricator included in the Contract Documents for informational purposes, providing specific information related to the installation of related appurtenances, components, devices, hardware, products and/or systems. Reference Drawings shall also include any Contract Drawings from prior bid packages that may have pertinent information or require coordination of trades related to this contract.

4. Shop Drawings: A drawing and/or set of drawings produced by the contractor, supplier, manufacturer, subcontractor, or fabricator as a detailed representation of the proper installation of the related, appurtenance, component, device, hardware, product and/or system to be delivered in conformance to the requirements of the Contract Documents.

1.1 Summary

- A. This Section contains the overall requirements associated with all Division 28 Specification Sections, and includes the project design intent for all electronic security systems (ESS), fire alarm and signaling systems (FASS) and rescue assistance systems as well as all requirements for submittals, quality assurance, product handling, record documents, project conditions, installation, system performance, demonstrations, testing, training and certifications for all scopes of work related to these systems. Refer to related specification sections and contract drawings for additional information.
 1. The Contractor shall have overall responsibility for all work related to all Division 27 scopes of work and shall ensure full coordination of all work with relationship to the VA's Contracting Officer, Design Professional and all trades as required to provide fully operational communications systems as herein specified and in accordance with all requirements of related specification sections and contract drawings.
 - a. All Division 28 system integrators shall be responsible for providing all equipment, devices, system components, final cable terminations, programming, commissioning and testing in accordance with the appropriate and related specification sections.
 - b. All integrators shall meet the minimum technical capabilities, certifications and licensing requirements as defined by the "Quality Assurance" chapters in all related specification sections.
- B. It shall be the responsibility of the Contractor to furnish and install all necessary cabling, conduits/raceways, cable terminations, controls, systems, equipment, materials, devices, components, electrical power, equipment racks/cabinets and software as well as all appurtenances, programming, commissioning and testing necessary to deliver complete and fully operational systems as indicated by all division 28 specification sections and related contract drawings.
 1. The installation, performance, features, functions, software and programming criteria as specified herein as well as all related Division 28 specification sections have been designed to offer the maximum system efficiency, ease of operation, occupant safety and the protection of equipment as recommended by the Veterans Administration (VA) and Design Professional.

- a. Any deviations from the specified criteria shall be documented, reviewed and agreed to in writing by VA's Contracting Officer and Design Professional prior to submission of bids. Refer to Division 1, and all related Division 28 specification sections for any substitutions and/or project deviation requests.
 - 1) The required information shall include but not limited to: reason for deviation, all differences in performance, operation and function from the herein specified requirements, all benefits and added features to the Government as a result of the deviations and any additional incurred costs to the Government for maintenance and long term ownership.
 - 2) Failure to provide the VA's Contracting Officer and Design Professional with the required information shall result in any shop drawing submissions being returned for non-conformance with the contract requirements.
 - b. The contractor and all sub-contractors for this work shall have read all of the General Conditions, Special Requirements, General Requirements and all related specification sections and in the execution of all work shall be bound by all of the conditions and requirements therein.
 - c. Prior to the submission of the Bid any discrepancies or inconsistencies noted within these specifications and/or the project drawings shall be brought to the immediate attention of the VA's Contracting Officer and Design Professional.
2. All device symbols are defined by the appropriate symbol schedules as indicated by the symbol and abbreviation drawing sheets for each discipline. The Contractor shall coordinate exact locations with all architectural, mechanical, electrical, reflected ceiling, furniture drawings and door hardware specifications as well as all affected trades prior to submittal of bids.
3. All symbols are shown on the contract drawings as close as possible to their intended location. Contractor shall coordinate the installation of all equipment, devices, controls, components, cabling conduits/raceways and integration of other systems with all affected trades and specified system integrators. The contractor shall document all coordination requirements at the time of shop drawing submission.
- a. Drawings for this work are diagrammatic and intended to convey the extent, general arrangement and locations of the work. Because of the scale of the drawings, certain basic items such as access panels, conduits, cabinet sizes, penetration sleeves, pull boxes, back-boxes and junction boxes may or may not be shown on the contract drawings. Include all items where required by code and related specification sections for proper installation of all work.
 - b. Where ambiguity exists between the project specifications and the contract drawings, the superior in system performance regardless of cost shall prevail and shall be delivered by the Contractor at no additional expense to the project.

4. Architectural room numbers and names as indicated on the contract documents may be used for the initial system design and shop drawing submission. However, prior to final system application, design and programming, it shall be the Contractor's responsibility to verify and confirm all final room numbers and names and shall be reviewed and approved by the VA's Contracting Officer and Design Professional.
 - a. Only architectural approved room numbers and names shall be used for all system programming and shall be reflected in all as-built documentation. Failure to obtain final approval of architectural room numbers and names prior to final programming shall result in all system to be reprogrammed at no additional cost to the project.
5. Project specifications and drawings may not deal individually with every part, control, device, component, or appurtenance which may be required to produce the equipment performance for the specified system and/or as required for compliance with all specified systems integration.
 - a. Include such items and components, as required, for complete operational systems as defined by the project documents, whether or not specifically indicated. The contractor shall be responsible for providing conduits/raceways, cable terminations, controls, systems, equipment, materials, devices, components, electrical power, equipment racks/cabinets, software, programming, commissioning, testing and all appurtenances as well as the integration of any ancillary systems or Government provided equipment/components/systems.
 - b. Coordinate with other applicable trades in submittal of shop drawings and the installation of all systems. All shop drawings shall detail space conditions in order to accommodate other concerned trades, all equipment locations are subject to final review by the VA's Contracting Officer and Design Professional.

1.2 REFERENCES

- A. References to industry and trade association standards as well as all building codes are minimum installation requirements. The codes, standards and agencies listed below shall form a part of this specification section and all work shall comply with the latest adopted standards.
- B. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this and all related division 28 specification sections to the extent referenced. The publications are referenced in the text by the basic designation only.
- C. Where the contract drawings and specifications mandate a greater requirement or performance than those specified by any of the below referenced codes and standards, the Contract Documents shall then be the governing requirements for this project. The minimum codes and standards to be applied for this project shall be the following;

1. American National Standards Institute (ANSI)/ International Code Council (ICC):
 - a. A117.1 - Standard on Accessible and Usable Buildings and Facilities
2. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
 - a. AC-03 - Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards
 - b. CP-01-00 - Control Panel Standard-Features for False Alarm Reduction
 - c. PIR-01-00 - Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity
 - d. TVAC-01 - CCTV to Access Control Standard - Message Set for System Integration
3. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
 - a. 330-09 - Electrical Performance Standards for CCTV Cameras
 - b. 375A-76 - Electrical Performance Standards for CCTV Monitors
4. American National Standards Institute (ANSI):
 - a. ANSI S3.2-99 - Method for measuring the Intelligibility of Speech over Communications Systems
5. American Society for Testing and Materials (ASTM)
 - a. B1-07 - Standard Specification for Hard-Drawn Copper Wire
 - b. B3-07 - Standard Specification for Soft or Annealed Copper Wire
 - c. B8-04 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - d. C1238-97 (R03) - Standard Guide for Installation of Walk-Through Metal Detectors
 - e. D2301-04 - Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
6. Architectural Barriers Act (ABA), 1968
7. Department of Justice: American Disability Act (ADA)
 - a. 28 CFR Part 36-2010 - ADA Standards for Accessible Design
8. Department of Veterans Affairs:
 - a. VHA National CAD Standard Application Guide, 2006
 - b. VA BIM Guide, V1.0 10
9. Federal Communications Commission (FCC):
 - a. (47 CFR 15) Part 15 - Limitations on the Use of Wireless Equipment/Systems

10. Federal Information Processing Standards (FIPS):

- a. FIPS-201-1 - Personal Identity Verification (PIV) of Federal Employees and Contractors

11. Federal Specifications (Fed. Spec.):

- a. A-A-59544-08 - Cable and Wire, Electrical (Power, Fixed Installation)

12. Government Accountability Office (GAO):

- a. GAO-03-8-02 - Security Responsibilities for Federally Owned and Leased Facilities

13. Homeland Security Presidential Directive (HSPD):

- a. HSPD-12 - Policy for a Common Identification Standard for Federal Employees and Contractors

14. Institute of Electrical and Electronics Engineers (IEEE):

- a. 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- b. 802.3af-08 - Power over Ethernet Standard
- c. 802.3at-09 - Power over Ethernet (PoE) Plus Standard
- d. C2-07 - National Electrical Safety Code
- e. C62.41-02 - IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
- f. C95.1-05 - Standards for Safety Levels with Respect to Human Exposure in Radio Frequency Electromagnetic Fields

15. International Building Code (IBC), 2009

16. International Mechanical Code (IMC), 2009

17. International Organization for Standardization (ISO):

- a. 7810 - Identification cards - Physical characteristics
- b. 7811 - Physical Characteristics for Magnetic Stripe Cards
- c. 7816-1 - Identification cards - Integrated circuit(s) cards with contacts - Part 1: Physical characteristics
- d. 7816-2 - Identification cards - Integrated circuit cards - Part 2: Cards with contacts - Dimensions and location of the contacts
- e. 7816-3 - Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols
- f. 7816-4 - Identification cards - Integrated circuit cards - Part 11: Personal verification through biometric methods
- g. 7816-10 - Identification cards - Integrated circuit cards - Part 4: Organization, security and commands for interchange
- h. 14443 - Identification cards - Contactless integrated circuit cards; Contactless Proximity Cards Operating at 13.56 MHz in up to 5 inches distance

- i. 15693 - Identification cards -- Contactless integrated circuit cards - Vicinity cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 inches distance
 - j. 19794 - Information technology - Biometric data interchange formats
- 18. The Joint Commission (TJC) formally - Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
- 19. National Electrical Contractors Association
 - a. 303-2005 - Installing Closed Circuit Television (CCTV) Systems
- 20. National Electrical Manufacturers Association (NEMA):
 - a. 250-08 - Enclosures for Electrical Equipment (1000 Volts Maximum)
 - b. TC-3-04 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - c. FB1-07 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
- 21. National Fire Protection Association (NFPA):
 - a. 13-2011 - Standard for the Installation of Sprinkler Systems
 - b. 70-2011 - National Electrical Code (NEC)
 - c. 72-2010 - National Fire Alarm and Signaling Code
 - d. 90A-2009 - Installation of Air Conditioning and Ventilating Systems
 - e. 101-2009 - Life Safety Code
 - f. 731-2008 - Standards for the Installation of Electric Premises Security Systems
 - g. 90A-2009 - Installation of Air-Conditioning and Ventilating Systems
 - h. 92A-2009 - Recommended Practice for Smoke-Control Systems
 - i. 92B-2009 - Guide for Smoke Management Systems in Malls, Atria, and Large Areas
 - j. 99-2005 - Health Care Facilities
- 22. National Institute of Justice (NIJ)
 - a. 0601.02-03 - Standards for Walk-Through Metal Detectors for use in Weapons Detection
 - b. 0602.02-03 - Hand-Held Metal Detectors for Use in Concealed Weapon and Contraband Detection
- 23. National Institute of Standards and Technology (NIST):
 - a. IR 6887 V2.1 - Government Smart Card Interoperability Specification (GSC-IS)
 - b. Special Pub 800-37 - Guide for Applying the Risk Management Framework to Federal Information Systems
 - c. Special Pub 800-63 - Electronic Authentication Guideline
 - d. Special Pub 800-73-3 - Interfaces for Personal Identity Verification (4 Parts)

- 1) Pt. 1- End Point PIV Card Application Namespace, Data Model & Representation
 - 2) Pt. 2 - PIV Card Application Card Command Interface
 - 3) Pt. 3 - PIV Client Application Programming Interface
 - 4) Pt. 4 - The PIV Transitional Interfaces & Data Model Specification
- e. Special Pub 800-76-1 - Biometric Data Specification for Personal Identity Verification
 - f. Special Pub 800-78-2 - Cryptographic Algorithms and Key Sizes for Personal Identity Verification
 - g. Special Pub 800-79-1 - Guidelines for the Accreditation of Personal Identity Verification Card Issuers
 - h. Special Pub 800-85B-1 - DRAFT-PIV Data Model Test Guidelines
 - i. Special Pub 800-85A-2 - PIV Card Application and Middleware Interface Test Guidelines (SP 800-73-3 compliance)
 - j. Special Pub 800-96 - PIV Card Reader Interoperability Guidelines
 - k. Special Pub 800-104A - Scheme for PIV Visual Card Topography
24. Occupational and Safety Health Administration (OSHA):
- a. CFR 1910.97 - Nonionizing radiation
25. Section 508 of the Rehabilitation Act of 1973
26. Security Industry Association (SIA):
- a. AG-01 - Security CAD Symbols Standards
27. Underwriters Laboratories, Inc. (UL):
- a. 1-05 - Flexible Metal Conduit
 - b. 5-04 - Surface Metal Raceway and Fittings
 - c. 6-07 - Rigid Metal Conduit
 - d. 44-05 - Thermoset-Insulated Wires and Cables
 - e. 50-07 - Enclosures for Electrical Equipment
 - f. 83-08 - Thermoplastic-Insulated Wires and Cables
 - g. 294-99 - The Standard of Safety for Access Control System Units
 - h. 305-08 - Standard for Panic Hardware
 - i. 360-09 - Liquid-Tight Flexible Steel Conduit
 - j. 444-08 - Safety Communications Cables
 - k. 464-09 - Audible Signal Appliances
 - l. 467-07 - Electrical Grounding and Bonding Equipment
 - m. 486A-03 - Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - n. 486C-04 - Splicing Wire Connectors
 - o. 486D-05 - Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
 - p. 486E-00 - Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
 - q. 493-07 - Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
 - r. 514A-04 - Metallic Outlet Boxes
 - s. 514B-04 - Fittings for Cable and Conduit

- t. 51-05 - Schedule 40 and 80 Rigid PVC Conduit
 - u. 609-96 - Local Burglar Alarm Units and Systems
 - v. 634-07 - Standards for Connectors with Burglar-Alarm Systems
 - w. 636-01 - Standard for Holdup Alarm Units and Systems
 - x. 639-97 - Standard for Intrusion-Detection Units
 - y. 651-05 - Schedule 40 and 80 Rigid PVC Conduit
 - z. 651A-07 - Type EB and A Rigid PVC Conduit and HDPE Conduit
 - aa. 752-05 - Standard for Bullet-Resisting Equipment
 - bb. 797-07 - Electrical Metallic Tubing
 - cc. 827-08 - Central Station Alarm Services
 - dd. 864-08 - Standard for Control Units and Accessories for Fire Alarm Systems
 - ee. 1037-09 - Standard for Anti-theft Alarms and Devices
 - ff. 1635-10 - Digital Alarm Communicator System Units
 - gg. 1076-95 - Standards for Proprietary Burglar Alarm Units and Systems
 - hh. 1242-06 - Intermediate Metal Conduit
 - ii. 1479-03 - Fire Tests of Through-Penetration Fire Stops
 - jj. 1981-03 - Central Station Automation System
 - kk. 2058-05 - High Security Electronic Locks
 - ll. 60950 - Safety of Information Technology Equipment
 - mm. 60950-1 - Information Technology Equipment/Safety/Part 1:
28. Uniform Federal Accessibility Standards (UFAS) 1984
29. United States Department of Commerce:
- a. Special Pub 500-101 - Care and Handling of Computer Magnetic Storage Media
30. Local Authorities Having Jurisdiction

1.3 SUBMITTALS

- A. In addition, to all submittal requirements as stipulated by Division 01 specifications sections, the Contractor shall provide all shop drawing submittals in accordance with the following:
- 1. The VA's Contracting Officer and Design Professional approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.
 - 2. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
 - 3. Submittals shall be provided as a complete submission; no partial submissions will be accepted. Failure to provide a complete submission shall result in all submittals being returned for resubmission.
 - 4. No substituted equipment shall be reviewed without prior approval in accordance with the requirements of "substitutions" under Division 1 specification section.
 - 5. Mark the submittals, "SUBMITTED UNDER SECTION_____".

- a. Submittals shall be marked to show specification reference including the section and paragraph numbers.
6. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination requirements refer to Division 01 Specification Sections, which outline basic submittal requirements and coordination. All Division 01 Specification Sections requirements shall be used in conjunction with this specification section.
7. Prior to any submission the contractor shall be responsible for performing the following quality control items to ensure compliance with all project requirements:
 - a. Review all Shop Drawings and Product Data
 - b. Review all field measurement criteria.
 - c. Review all field construction criteria and methodologies.
 - d. Review all catalog numbers and similar data.
 - e. Review all coordination requirements of affected trades.
 - f. Review conformance to all appropriate specification sections.
1. All drawings shall be prepared using latest version of AutoCAD, drawn accurately, and in accordance with the VA's CAD Standards "CAD Standard Application Guide". The Contractor shall not reproduce the Contract Documents or copy standard information as the basis of the technical data, hand drawn mark-ups of the original project drawings shall not be acceptable. Failure to provide a complete set of "contractor prepared" installation drawings at the time of submittal shall result in all submittals being returned for resubmission.
2. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
 - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - 1) Where two (2) or more binders are required to accommodate data; correlate the data in each binder into related groupings according to the Project Manual table of contents. Cross-reference other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
 - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
 - b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
 - c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.

- d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
 - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
 - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
 - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- 8. The system integrator shall have a registered RCDD professional review and seal all system shop drawings, installations and testing certification for all systems employing any TCP/IP based technology and/or UTP associated structured cabling. Failure to provide RCDD sealed shop drawings shall result in all shop drawings being returned for resubmission without any reviews taking place.
- 9. The VA's Contracting Officer and Design Professional review of the shop drawings and/or samples does not relieve the Contractor from compliance with the requirements of the project documents. Unless the Contractor has informed the VA's Contracting Officer and Design Professional in writing of such deviation at the time of submission, has noted the deviation on the shop drawings, and the VA's Contracting Officer and Design Professional has given written approval of the specific deviations to the project documents, all project requirements shall stand. The VA's Contracting Officer and Design Professional review also does not relieve the Contractor from responsibility for any errors of omission in the submission of shop drawings and/or samples.
- 10. Submit all system testing and startup procedures to be employed. Include all estimated times for performance of all tests; all test equipment and manpower necessary for testing.
- 11. Submit all integrator qualifications, certifications and licenses in accordance with the requirements as specified elsewhere in this specification section.
- 12. Submit project schedule outlining the time frames for all equipment with long lead times for equipment deliveries; include all system commissioning, testing and training time expectations. Project schedule shall be submitted as CPM schedule and shall utilize a software based project management program.

B. Shop Drawings:

- 1. All shop drawings shall include sufficient information, clearly presented, to determine full compliance with all project drawings and specifications. Include the following information for review, failure to provide all information listed below shall result in all shop drawing submittals being returned for resubmission:

- a. All Building Floor and Site Plans
 - b. All equipment with manufacturer's name(s), model numbers,
 - c. All equipment /device electrical ratings and power requirements
 - d. All equipment /device performance ratings.
 - e. All standby battery and wiring voltage drop calculations
 - f. All surge and/or transient protection devices and device locations
 - g. All equipment rack, panels and cabinet layouts, rack/cabinet sizes.
 - h. All equipment and device-mounting elevations.
 - i. Complete point-to-point-wiring diagrams for all devices, components, panels, controls and ancillary systems. Include all equipment and wiring termination schedules and programming matrixes.
2. Provide a complete set of "contractor prepared" installation drawings. All drawings at the minimum shall consist of floor plans indicating all device locations, device identifications, control panels, auxiliary control panels, power supplies, annunciation panels, conduit and cabling requirements as well as all 120 volt electrical circuit locations and designations.
- a. Drawings shall include at the minimum the following;
 - 1) Detailed equipment layouts for all equipment rooms. Coordinate all room layouts with affected trades.
 - 2) Floor plan drawings showing locations of all control panels, sub- panels, ancillary controls, equipment cabinets and/or racks, annunciator panels, HMI terminals, auxiliary power supplies, devices and sensors, electrical power and grounding terminations as well as all device\sensor identifications
 - 3) Conduit routing of all conduits 2 inches in diameter or greater.
 - 4) System riser diagrams and single line drawings representing interconnections of all system control panels, sub- panels, ancillary controls, equipment cabinets and/or racks, annunciator panels, HMI terminals, auxiliary power supplies, devices, sensors and components, include all cable types and sizes, electrical power connections and circuits, grounding connections, surge and/or transient protection devices and all field device\sensor identifications.
 - 5) Block diagrams and Logic flow charts representing all systems architecture and interconnection of the security management systems (SMS) and fire management systems (FMS) all related integrated subsystems. Include detailed information on all system component integrations, data transmission and media conversions as well as logical functional data and performance criteria.
 - 6) Equipment wattage for all equipment room locations and estimated BTU production.
 - 7) Detailed equipment layouts for all equipment consoles. Indicate all equipment locations, power connections and installation details.

- 8) All equipment mounting hardware/brackets and installation details, Identify type size, load capacities of all mounting hardware/brackets; include all mounting and installation details, all space requirements, any special architectural modifications required.
- 9) Outline drawings of all equipment cabinets/racks showing the relative position of all major components, all-wiring and grounding terminations. Include all panel, cabinet and/or rack dimensions.
- 10) Door Schedules for each door equipped with electronic security components. At a minimum, the door schedules shall be coordinated with Division 08 work and include the following information:
 - a) Door Number (Extracted from Architectural Drawings)
 - b) Door location on security floor plan drawing
 - c) Installation Details
 - d) Door Description (Extracted from alarm programming matrixes)
 - e) Data Gathering Panel Input Number
 - f) Door Position or Monitoring Device Type & Model Number
 - g) Lock Type, Model Number & Power Input/Draw (standby/active)
 - h) Card Reader Type & Model Number
 - i) Shunting Device Type & Model Number
 - j) Sounder Type & Model Number
 - k) Delayed Egress Type & Model Number
 - l) Intercom (video or standard)
 - m) Camera ID# associated with camera call-up (Extracted from alarm programming matrixes)
 - n) Type of Electric Transfer Hinge
 - o) Electric Pass-through device
 - p) Remarks Column for Camera
- 11) Camera Schedules for all interior and exterior cameras. Note: camera schedule shall be coordinated with the VA's Contracting Officer and Design Professional for determination of camera numbers and naming conventions. At a minimum, the camera schedules shall include the following information:
 - a) Camera Number
 - b) Camera Naming Convention
 - c) Description of Camera Coverage
 - d) Camera Location description
 - e) Camera location on Floor Plan drawings (include sheet and grid number)
 - f) Camera Type & Model Number
 - g) Mounting Type & Model Number
 - h) Installation Details
 - i) Cable Sizes, Types, Conductors, and Color
 - j) Power Input & Current Draw
 - k) Power Supply Location and electrical circuit number

- 1) Automatic Camera Call input (Extracted from alarm programming matrixes)
 - m) Remarks Column for Camera
3. All shop drawing submissions shall have a registered RCDD professional review and seal all shop drawings confirming that the proposed structured cabling infrastructures and terminations for all TCP/IP based systems or components are in conformance with all stipulated standards and requirements as herein specified or in related specification sections.
4. NOTE: Failure to provide all required documentation in accordance will ALL related specification requirements at the time of shop drawing submission shall result in all submittals to be returned for non-compliance to the contract requirements.

C. Equipment Submittals and Data Sheets:

- 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - a. Include all equipment data sheets pertinent to equipment provided. All data sheets shall be highlighted indicating specific equipment supplied. Failure to provide the proper annotation of all equipment shall result in submittals being returned for resubmission.
- 2. Submit complete technical data necessary to evaluate the material and equipment. Include a complete technical specification for the submitted equipment, noting differences and adherence to this Section. Failure to provide the required data will result in all submittals being returned for resubmission.
- 3. Submit performance data, equipment ratings, cable requirements, control sequences, GUI based control panels, programming matrixes, logic diagrams and all other descriptive data necessary to describe the installation and operations of the system being provided. Failure to provide the required data will result in all submittals being returned for resubmission.
- 4. Provide a complete termination schedule of all system devices, sensors, components, equipment and controls, identify all locations as indicated on the installation drawings, include all unique identification numbers which correspond with shop drawing floor plans.
 - a. Include point to point wiring terminations and programming matrixes for all control panels, sub-control-panels, and access control DGP's and camera alarm input panels associated with the project. Include all input and output modules and all I/O termination points for all panels
 - b. All Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by Veterans Administration. A separate spreadsheet file shall be generated for each associated panel.

- 1) All access control system DGP point to point wiring terminations and programming matrixes shall include at the minimum the additional information:
 - a) DGP panel number
 - b) First Reader Number
 - c) First Monitor Point Number
 - d) First Relay Number
 - e) DGP, input or output Location
 - f) DGP Chain Number
 - g) DGP Cabinet Tamper Input Number
 - h) DGP Power Fail Input Number
 - i) Number of Monitor Points Reserved For Expansion Boards
 - j) Number of Control Points (Relays) Reserved For Expansion Boards
- 2) The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
 - a) System Numbers for Card Readers
 - b) System Numbers for Monitor Point Inputs
 - c) System Numbers for Control Points (Relays)
 - d) Next DGP or input module First Monitor Point Number
 - e) Next DGP or output module First Control Point Number
- 3) The DGP spreadsheet shall provide the following information for each card reader:
 - a) DGP Reader Number
 - b) System Reader Number
 - c) Cable ID Number
 - d) Description Field (Room Number)
 - e) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
 - f) Description Field
 - g) DGP Input Location
 - h) Date Test
 - i) Date Passed
 - j) Cable Type
 - k) Camera Numbers (of cameras viewing the reader location)
- 4) The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
 - a) DGP Monitor Point Input Number
 - b) System Monitor Point Number
 - c) Cable ID Number
 - d) Description Field (Room Number)
 - e) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
 - f) DGP or input module Input Location
 - g) Date Test

- h) Date Passed
 - i) Cable Type
 - j) Camera Numbers (associated alarm event preset call-ups)
 - 5) The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
 - a) DGP Control Point (Relay) Number
 - b) System (Control Point) Number
 - c) Cable ID Number
 - d) Description Field (Room Number)
 - e) Description Field (Device: Lock Control, Local Sounder, etc.)
 - f) Description Field
 - g) DGP and Output Module Location
 - h) Date Test
 - i) Date Passed Cable Type
 - j) Camera Number (of associated alarm event preset call-ups)
 - 6) The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
 - a) Header
 - (1) DGP Input and Output Worksheet
 - (2) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
 - b) Footer
 - (1) File Name
 - (2) Date Printed
 - (3) Page Number
- 5. FIPS-201 Compliance Certificates for all PACS systems and associated system components.
- 6. Provide a clear and concise sequence of operation that gives, in detail, all information required to properly operate all equipment and systems. Include detailed programming matrixes, indicating at the minimum all manual and automatic functions for all system, components and devices comprising the system being provided.
- 7. Provide copies of all preliminary graphic screens for all HMI configurations for this project. Graphic maps shall indicate all site plans, floor plan maps, utility screens, camera/monitor interface screens all door control functions, intercom activation's, alarm indications, door interlock functions and ancillary controls.
- 8. Provide a listing of all recommended time zone and alarm shunting functions.
- 9. Provide a preliminary list of all on screen emergency response instructions and help menus.

10. Provide system parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
 11. Failure to provide all required documentation in accordance with ALL related specification requirements at the time of shop drawing submission shall result in all submittals to be returned for non-compliance to the contract requirements.
- D. Maintenance and Operation Manuals: Submit in accordance with all requirements of Division 01 specification sections and as herein specified.
1. Maintenance and Operation Manuals shall be submitted for all systems and equipment specified in the technical sections. Furnish the number of copies as specified by Division 1, all manuals shall be bound in hardback binders, (manufacturer's standard binders) or an approved equivalent prior to the commissioning, testing and final acceptance of each system.
 - a. The Contractor shall also furnish one complete set of manuals as specified herein at the time of shop drawing submission for Design Professional s' use in the review of all submittals.
 2. Inscribe the following identification on the cover: "Maintenance and Operational Manual" include the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
 - a. The Maintenance and Operation Manuals at the minimum shall include:
 - 1) Copy of approved shop drawing and equipment submittals Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of all equipment, components, devices and servers.
 - 2) A complete control sequence describing start-up, operation, and shutdown of all equipment, components, devices and servers.
 - 3) Description of the function of each principal item of equipment.
 - 4) Installation and maintenance instructions
 - a) Safety precautions
 - b) Diagrams and illustrations.
 - c) Testing methods.
 - d) Performance data.
 - e) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.

f) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

b. Failure to provide all required documentation in accordance with ALL related specification requirements at the time of shop drawing submission shall result in all submittals to be returned for non-compliance to the contract requirements.

1.4 QUALITY ASSURANCE

A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections include the following project requirements;

1. Integrator Qualifications: The projects' Electronic Security System Integrator (ESSI) and the Fire Alarm System Integrator shall be an accredited and authorized distributor of the appropriate equipment manufacturer and shall be fully certified in the installation, testing and programming of all equipment being provided in accordance with the following.

- a. Electronic Security - The ESSI shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity capable of providing documented successful work experience of at least three (3) facilities of equivalent size and technical requirements utilizing the proposed equipment being provided.
- b. TCP/IP Based Electronic Security - The ESSI shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity capable of providing documented successful work experience of at least three (3) facilities of equivalent size and technical requirements utilizing the proposed equipment being provided. The ESSI shall have on staff a minimum of one full time individual that holds a current RCDD registration.
- c. Fire Alarm and Signaling System - The FSI shall be a licensed Fire Alarm Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity capable of providing documented successful work experience of at least three (3) facilities of equivalent size and technical requirements utilizing the proposed equipment being provided. The FSI shall have on staff a minimum of one full time individual that holds a current NICET registration.

1) The ESSI shall provide the following documentation:

- a) All electronic security systems and related work shall be certified in writing to the VA's Contracting Officer and Design Professional asserting that all electronic security system shop drawings and cabling is in conformance with all appropriate NEC requirements, EIA/TIA standards, NFPA 731 recommended practices and all related specification sections.

- b) In addition, all TCP\IP based electronic security systems and related work shall be certified in writing to the VA's Contracting Officer and Design Professional by an RCDD professional asserting that all electronic security system structured cabling is in conformance with all appropriate NEC requirements, EIA/TIA standards; NFPA 731 recommended practices, BICSI recognized installation practices and all related specification sections.
- 2) The FSI shall provide the following documentation:
 - a) All fire alarm and signaling systems and related work shall be certified in writing to the VA's Contracting Officer and Design Professional asserting that all fire alarm shop drawings and associated cabling is in conformance with all appropriate NEC requirements, NFPA 72 requirements and all related specification sections.
- 2. Cable Installer Qualifications: The cable installation contractor shall demonstrate not less than three (3) years' experience in the installation of structured cabling systems and shall have on staff a minimum of one full time member that holds a current BICSI level II installer credential.
 - a. NOTE: The installation of all cabling shall be under the direct supervision of a current BICSI level II installer who shall be knowledgeable in the following technical applications:
 - 1) The Routing and installation of shielded, unshielded, twisted pair, coaxial and fiber optic cables.
 - 2) Bonding and grounding of cable tray and equipment racks.
 - 3) Fusion splicing of fiber optic cabling.
 - 4) Testing copper conductors for electrical continuity.
 - 5) Testing and Certifying of Category-6 cabling for attenuation and worst case near end cross talk.
 - 6) Testing and Certifying of ALL fiber optic cabling employing an Optical Time Domain Reflectometer (OTDR) in accordance with TIA/EIA protocols.
 - 7) Testing and Certifying of coaxial cable networks for RF leakage
 - 8) Termination, connection, and testing of shielded and unshielded twisted pair cable, coaxial cabling and fiber optic cabling on all specified connectors, electrical protection blocks, termination blocks and patch panels.
 - 9) Generally accepted industry standards, as well as manufacturers written installation instructions, will be used for in-process quality control and final acceptance of the work installation.
 - b. Provide registration number and expiration date of BICSI level II installer assigned to the project.

3. The VA's Contracting Officer and Design Professional reserve the right to require the Contractor to submit a list of installations where the products have been in operation before approval of shop drawings.
 - a. Experience shall be defined as the completion of the specific system being provided, with that system being successfully operated by the Owner for its intended purpose for at least three (3) years.
 - b. In addition to the above "Experience" shall also be defined as the completion of modifications and renovations to any associated system being provided in any existing occupied facility of this size and magnitude.
 - c. For each facility submit the following:
 - 1) Name and location of facility.
 - 2) Date of Occupancy or beneficial use by Owner.
 - 3) Owner's representative to contact and telephone number.
 - 4) Construction Manager or General Contractor.
 - 5) Project Architect or Engineer.
 - 6) Provide detailed information on the installed locations with operational equipment.
4. Service Qualifications: The ESSI shall be a permanent service organization maintained and/or trained by the product manufacturer on the products being provided for this project.
 - a. The integrator shall be properly licensed by the governing municipality (where required) certified to provide the services and work of the specific system being provided.
 - b. In addition all integrators shall be capable of providing full service for the entire warranty period within an 8-hour response time upon notification of a service emergency.
 - c. Provide registration number and expiration date of RCDD professional.
5. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and materials specified for this project, and shall have manufactured the items for at least three years.
 - a. Product Qualification: The Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 - b. The equipment manufacturer shall submit the appropriate documentation certifying that the project integrator is a qualified service provider and certified in the installation and programming of all manufacturers' products being provided for this project.

1.5 RECORD DOCUMENTS

- A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections include the following requirements;
1. Provide complete set of finalized copies of record documents prior to final acceptance of the project by VA's Contracting Officer and Design Professional in accordance with all requirements of Division 01 specification sections. At the minimum the record documents shall contain all information, data and drawings as described in Chapter 1.4 "Submittals" of this specification section.
 - a. As-built documents shall be submitted in both paper and electronic media formats in the quantities as specified by Division 1 specification requirements.
 - 1) All electronic record drawings shall be prepared and submitted utilizing an AutoCAD based program as manufactured by Autodesk. Where electronic documents are prepared using other than an AutoCAD program manufactured by Autodesk, the contractor shall provide to the VA's Contracting Officer and Design Professional the necessary software to electronically view the submitted documents.
 - 2) All electronic data sheets, control sequences, programming matrixes and other descriptive data shall be provided in PDF formatted documents.
 - 3) Copies of all current system programming and associated software shall be provided on downloadable media formatted for the use in restoration all system operations and functionality in the event of a catastrophic failure.

1.6 SOFTWARE AGREEMENT

- A. Included as part of the scope of work for this project the Government shall retain the ownership and access rights of ALL system programs and software associated with all systems installed and/or modified as part of this project.
1. The contractor shall provide to VA's Contracting Officer complete copies of all current software programming and software licenses related to the operation of each system prior to final acceptance of the related Contract scopes of work.
 - a. All programming shall include but not be limited to all device identifications, device descriptions, Programming Logic Matrixes, all program access level passwords as well as all function and sub-function routines.
 2. Programming and software copies shall be provided to the VA's Contracting Officer on CD or DVD digital formatted media. In addition, the contractor shall provide a complete hard copy printout of all system programming and shall be included as part of closeout documentation for review by the VA's Contracting Officer and Design Professional.

- B. Software and firmware upgrade provisions shall be included as part of this specification requirement and shall include the automatic upgrades as required to maintain all software and firmware to the manufacturers most current revision on all system components installed and or modified as part of this project for duration of the warranty period. This upgrade policy shall require the contractor to install, test and certify all software and firmware upgrades that become available from manufacturer for a period of one year from date of final acceptance to the expiration of the warranty.
1. Upgrading of software shall include all revised/new software, labor, testing certification as well as all licenses, software and all programming copies associated with the installation of all revised software in accordance with all requirements of chapter 3.8 of this section.
 2. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations\maintenance and software documentation manuals.
 - a. One (1) scheduled final update shall be provided near the end of the warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software and firmware for all systems installed and\or modified for this project.
 - b. All software changes shall be recorded in a log maintained in the unit control. An electronic copy of the most current software update shall be maintained within the log.
 - 1) At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "Software Change Log".
 3. Provide not less than thirty days' notice to the VA's Contracting Officer and Design Professional to allow scheduling and access to system and to allow the Government to upgrade computer equipment if necessary.

1.7 EXTRA MATERIAL

- A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections refer to related specification sections "Extra Material" for specific requirements.
1. All Extra materials shall be provided at the time of final acceptance of the project and a signed packing list shall be obtained at the time of delivery. At no time is the contractor to use the extra materials provided for this project to replace malfunctioning or damaged equipment and or components.

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, that meet and/or exceed the specified performance and features of the equipment and/or systems and for which replacement parts shall be readily available to the system integrator and/or using agency.
1. When more than one unit, device or component of the same class of equipment is required, such units, devices or components shall be the product of a single manufacturer.
 2. Acceptable manufacturers for each system shall be as specified and shall be provided in full compliance with the requirements of this and all related specification sections and contract drawings.
 - a. Manufacturers listed as acceptable shall not negate the contractors' responsibility for providing all equipment, devices, components and/or systems, in accordance with all functions and performance requirements of the Contract Documents.
 - b. Where manufacturer and/or manufacturer model numbers reference specific system components in the related specification sections, it is to establish the performance requirements and quality of the systems and components only.
 - 1) It is in no way an inference that the referenced model numbers are the manufacturer's current product and are the only acceptable components for this project unless specifically referenced as "no substitutions".
 - c. The Contractor shall provide the manufacturers' most current product that shall meet and/or exceed the specified performance and features of the equipment and/or systems.
 - d. Equivalent UL- listed equipment may be substituted for the approved manufacturers unless stipulated by other specification sections as "No Substitutions". All substitutions shall be submitted for approval by VA's Contracting Officer and Design Professional in accordance with all requirements of Division 01 specification sections and Chapter 1.4 "Submittals" of this specification section.
 - 1) Where systems and/or components are referenced as "no substitutions" the specific system and/or components shall be provided.
 - 2) All substitutions shall comply with all requirements as specified above and all system performance standards shall be maintained.
 - 3) The contractor shall stipulate the following information impacted by such a substitution.
 - a) Any and all extensions in time impacted by the substitution.
 - b) Any changes to the architectural or structural elements to the project

c) Differences in operation and/or performance from intended system criteria.

4) Failure to provide the required substitution information shall result in "without consideration" the immediate rejection of the substituted equipment and/or systems.

B. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.

- a. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
- b. Components shall be compatible with each other and with the total assembly for the intended service.
- c. Constituent parts which are similar shall be the product of a single manufacturer.
- d. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

C. Where Factory or Off-Premises Testing of any equipment, product or assembly is recommended by the product manufacturer or where specified as part of this section and/or any related specification section:

- 1. The VA's Contracting Officer, Design Professional and/or Government representatives shall have the option of witnessing all factory tests. The Contractor shall notify the VA's Contracting Officer and Design Professional at a minimum of thirty (30) working days prior to the performance of any factory or off-premises tests.
 - a. Where the factory or assembly point for all off-premises testing is not within two (2) hours driving time from the project location, the system integrator shall include as part of this project all per diem costs (travel, meals and lodging) for a minimum of two representatives from the using agency and the project Design Professional to witness all testing.
- 2. Provide four (4) copies of certified test reports containing all preliminary test data and testing procedures shall be furnished to the VA's Contracting Officer and Design Professional prior to any final testing and not more than ninety (90) days after completion of any tests.
- 3. When equipment, product or assembly fails to meet any factory or off-premises tests, retesting of equipment, product or assembly shall be mandated, the manufacturer/integrator shall be liable for all additional expenses, including all expenses incurred by the VA's Contracting Officer and Design Professional for witnessing the retesting of any equipment, product or assembly.

PART 3 - EXECUTION

3.1 EQUIPMENT PROTECTION

- A. Protect all materials, equipment, devices or components permanently installed and/or stored on the job site. Protect all materials, equipment, cabling, devices or components during construction and after installation provide appropriate protection of all materials, equipment, components and/or devices until time of substantial completion. All materials, equipment, components and/or devices shall be protected during shipment and storage against any physical damage, dirt, moisture, cold, snow or rain:
 - 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of any foreign matter; and shall be vacuum cleaned both inside and outside before testing and operating and repainting if required.
 - 2. Any materials, equipment, components and/or devices, stored on site which have been deemed by the Design Professional to exhibit any indications of damage or exposure dust or moisture shall not be installed and shall returned to the source of supply for immediate replacement.
 - a. The use of spare parts or the return of defective equipment for repair to mitigate the damage of defective materials, equipment, components and/or devices shall not be acceptable. All materials, equipment, components and/or devices shall be new and unused until final acceptance by the Design Professional.
 - 3. Provide and apply protective material immediately upon receiving the products and maintain throughout the construction process.
 - a. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 - b. Any damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas is not obvious or detectable.
 - 4. Failure to properly protect all materials, equipment, components and/or devices prior to final acceptance shall constitute sufficient cause for rejection of materials, equipment, components and/or devices should any defects, damage or degradation in performance is observed.
- B. Immediately replace all malfunctioning materials, equipment, components and/or devices with new unused products up until the time the Design Professional issues final acceptance of the system. The returning of any malfunctioning equipment, devices and/or components to the manufacturer for repair and then reinstallation at the project site shall not be acceptable.

1. All replacement materials, equipment, components and/or devices shall be factory new and not scavenged from the Project's spare parts inventory or factory recycled products unless expressly identified by contractor prior to replacement and approved beforehand by the Design Professional.

3.2 WORK PERFORMANCE

- A. Installation, final termination, testing, start-up and commissioning of all systems, system components and cabling infrastructures shall be under the direct supervision of the appropriate system integrator. The integrator shall be an accredited and authorized distributor of the appropriate equipment manufacturer and shall be fully certified in the installation, testing, commissioning and programming of all equipment, devices, components and/or systems being provided as part of this project.
- B. Job site safety and worker safety is the responsibility of the contractor. Ensure that safe access and egress from all work areas is maintained during movement and installation of materials. Clean up all debris generated by installation activities. Keep all security electronic and fire alarm equipment rooms free of debris at all times.
- C. Pre-installation Conferences: Include provisions to attend all pre-installation conferences at Project site in compliance with all requirements in Division 01 specification section and as herein specified. Review methods and procedures related to installation and operations of all fire alarm and security systems, including, but not limited to, the following:
 1. Inspect and discuss electrical and control system roughing-in related to all safety and security systems as well as other preparatory work required to be performed by other trades.
 2. Review sequence of operations for each type of system, controls and/or integration to any systems and/or equipment provided by other trades
 3. Review and finalize construction schedule and verify availability of materials, installation personnel, equipment, and any preparatory work by other trades needed to make progress and avoid delays.
 4. Review required start-up, testing, commissioning and certifying procedures to be employed for each system and any impacts to other trades.
- D. For work on existing facilities, arrange, phase and perform work to assure the operation of all fire alarm and security systems for other buildings and contiguous spaces at all times. Refer to Division 1 specification section for additional information.
- E. All new work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Division 1 specification sections.

- F. Coordinate the installation of all cabling, conduits/raceways and cable trays and equipment with applicable trades to ensure proper operation and function of all integrated systems in accordance with all related specification sections. Refer to Division 1 specification section for additional project coordination requirements.
1. Coordinate with all trades at the time of shop drawing submission detailing all space and/or room conditions. The contractor shall coordinate with the appropriate trade all conditions impacting the installation of any system, conduit or cable tray including but not limited to all equipment locations, ceilings, lighting fixtures, fire protection piping and ductwork layouts to the satisfaction of all concerned trades, subject to final review by the Design Professional.
 - a. Coordinate exact location of all desktop/counter/wall mounted equipment with the VA's Contracting Officer and Design Professional and affected trades prior to the installation of any equipment and/or cabling.
 - b. Coordinate exact location(s) of all ceiling mounted cable, conduits, equipment and/or devices with all architectural plans, reflected ceiling plans and affected trades prior to installation.
 - c. Equipment installations requiring coordination with other trades the contractor shall provide all templates, back-boxes and equipment anchor bolts for mounting or flush mounting preparation, (e.g. pedestals or other devices requiring mounting on walls, concrete pads or other materials). Coordinate delivery of templates and equipment anchor bolts to preclude any delay in the construction schedule or the work of the affected trade.
 - d. If installation of equipment, devices, cabling, raceways, cable trays and/or conduit is performed prior to coordination with other trades, which interferes with work of other trades or operation and maintenance of the facility, make necessary changes to correct the condition at no additional cost to the Government.
 - e. Prior to the final programming of any systems review with VA's Contracting Officer and Design Professional all system features, functions, system operations, network mapping, system integrated responses and all related programming as required for the proper operation of the respective fire alarm and security systems.
- G. The Contractor shall maintain a complete set of current and up to date set of shop drawings and equipment submissions at the job site at all times. The Shop drawings and all other submissions shall be marked up to reflect all as-built conditions and shall be made available for review by the Design Professional at request.

3.3 EQUIPMENT/CABLE INSTALLATION AND REQUIREMENTS

- A. All system wiring and equipment installation shall be in accordance with good engineering practices and by all IEEE, EIA, NEC and manufacturer's requirements. Wiring shall comply with all state and local electrical codes. All wiring shall test free from all grounds, shorts, stray voltages and EMI.
- B. Follow manufacturers' instructions for installing, components and adjusting all equipment and cabling. Submit two (2) copies of such instructions to the VA's Contracting Officer and Design Professional before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.
- C. Ensure that all systems cabling supports (conduits, support grips, cable tray and J-hooks) are fully installed before proceeding with cable installation. At no times shall any cables be installed and left unsupported. At no times shall cables be tie-wrapped to any other supporting structure in lieu of specified cable supports. Do not bundle or tie-wrap the cables even within the approved cable supports.
 - 1. Do not leave any system cabling unprotected on the floor at any time. If cables must be left on any floor, protect the cables so that they may not be walked on or have any material or equipment placed or rolled on top. Replace all damaged cables from demarcation to termination point; no splicing of damaged cables shall be permitted.
 - 2. Maintain manufacturers recommended minimum bend radiuses of all cabling. Do not stretch, stress, tightly coil, bend or crimp the backbone, horizontal, patch or workstation cables. The Contractor shall keep all cabling out of the way of other trades during staging of any work. The contractor at the contractor's expense will replace all severely stressed or damaged cables, equipment and materials as determined by the VA's Contracting Officer and Design Professional.
- D. Equipment location shall be as close as practical to locations as indicated on the contract drawings.
 - 1. Provide all equipment clearances in accordance with NEC requirements. Arrange equipment to facilitate unrestricted access for maintenance and service around all equipment, components and/or cable terminations.
- E. Inaccessible Equipment:
 - 1. Where the VA's Contracting Officer and Design Professional determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the project.

- a. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

F. Cabling Requirements

1. Contractors shall have the option to combine all cable home runs and conductors of same type and voltage "class" in accordance with NEC requirements unless specified elsewhere. Size all conduits and install all conductors in accordance with NEC requirements and manufacturers recommendations.
 - a. All TCP/IP based security system cabling is to be Category-6 and concealed above suspended ceilings, bundled and supported to the building structure. All cabling bundles shall be plenum rated and shall not contain any AC carrying conductors or non-associated security network cables. All TCP/IP based security cabling located above accessible suspended ceilings may be installed without conduit and shall be supported by "J" hooks.
 - 1) Cabling installed above inaccessible ceiling spaces shall be installed in dedicated conduits.
 - 2) No exposed cabling will be acceptable in finished or occupied spaces of the facility without approval by the VA's Contracting Officer and Design Professional.
 - 3) Any CCTV, intercom or PACS system cabling installed exterior to the building and/or all cabling being routed from the facility to any remote location external to the project location shall be installed in OSP rated fiber optic cable.
 - 4) Refer to related specification sections for additional information for additional information related to cabling types, sizes and testing requirements.
 - b. All analog based security system cabling is to be provided in accordance with manufacturers requirements and shall be concealed above suspended ceilings installed in dedicated conduits and supported above ceiling tiles to the building structure. All analog based security system conduits shall not contain any AC carrying conductors or non-associated security system cables.
 - 1) All analog security cabling shall be installed in dedicated conduits.
 - 2) Security conductors shall be twisted pair, minimum 18 AWG unless otherwise noted.
 - 3) Twisted pair, minimum 14 AWG wire unless otherwise noted, and shall be utilized for all control wiring on electrically controlled motorized doors and gates.
 - 4) Refer to related specification sections for additional information for additional information related to cabling types, sizes and testing requirements.

- c. All fire alarm, rescue assistance and signaling systems (life safety) cabling is to be provided in accordance with manufacturers requirements and shall be concealed above suspended ceilings installed in dedicated conduits and supported above ceiling tiles to the building structure. All system conduits shall not contain any AC carrying conductors or non-associated life safety system cables.
 - 1) All life safety (fire alarm and rescue assistance) cabling shall be installed in dedicated conduits.
 - 2) Life safety imitating circuits shall be twisted shielded pair, minimum 18 AWG unless otherwise noted.
 - 3) Twisted pair, minimum 14 AWG wire unless otherwise noted, and shall be utilized for all alarm signaling notification appliance circuits and control circuits.
 - 4) Life safety audio circuits shall be twisted shielded pair, minimum 18 AWG unless otherwise noted.
 - 5) Refer to related specification sections for additional information for additional information related to cabling types, sizes and testing requirements.
- d. All fiber optic cabling shall be provided to meet the communications requirements for all network security and life safety systems, at the minimum all fiber optic cabling shall be sized in accordance with the project documents. All fiber optic cabling shall be minimum 50/125 micron / 8.9/125 micron, hybrid type cabling containing both multi and single mode fiber strands.
 - 1) All fiber optic cabling installed above suspended ceilings shall supported to the building structure and shall be plenum rated armored type cabling or shall be standard fiber optic cable installed in dedicated conduits.
 - 2) All exterior fiber optic cabling shall be armored type cable rated for exterior (OSP) applications and installed in dedicated conduits.
 - 3) Fiber optic cabling shall be provided as the primary communications and control media for all exterior and remote building surveillance cameras, as well as all network communications links for security and life safety systems. Each fiber optic link shall be comprised of dedicated transmitter and receiver shall be capable of providing all communication transmissions at a minimum of 1,280 feet. Refer to related specification sections for all additional Fiber optic-cabling requirements.
 - 4) Conductive fiber optic cable shall be provided for all exterior system components requiring control and/or power capabilities in the support of their operation, include all necessary surge protection and grounding for conductive cabling.
 - 5) Refer to related specification sections for additional information for additional information related to cabling types, sizes and testing requirements.

G. Environmental Conditions

1. Systems, components, devices materials and equipment shall be capable of withstanding the environmental conditions of the space without mechanical or electrical damage or degradation of operating capabilities or performance.
 - a. Interior, Controlled Environment: System components, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall utilize NEMA 250, Type 1 enclosures.
 - b. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall utilize NEMA 250, Type 4X enclosures.
 - c. Exterior Environment: System components, conduits and back-boxes installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rated for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick shall utilize NEMA 250, Type 4X enclosures.
 - d. Hazardous Environment: System components, conduits and back-boxes located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
 - e. Corrosive Environment: System components, conduits and back-boxes subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, shall utilize NEMA 250, Type 4X enclosures.
 - f. Submersible Environment: System components, conduits and back-boxes subjected to prolonged submersion in water, shall utilize NEMA 250, Type 6P enclosures.
 - g. Areas where equipment and devices may be subject to damage by the general population shall be installed in vandal resistant enclosures, all fire alarm devices shall be provided with wire guards.
 - h. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

H. Conduits/raceway/Cable Trays:

1. All conduits/raceways shall be concealed and shall be installed above accessible finished ceilings and/or in walls. Any conduits/raceways installed in areas requiring installation to be exposed, shall be installed tight to ceilings at right angles to

walls and shall not obstruct any access hatches, equipment service panels, lighting or other equipment and/or devices. No exposed conduits/raceways shall be installed without prior approval of the VA's Contracting Officer and Design Professional.

- a. Where conduits cannot be concealed above ceilings or in walls and must be installed in finished or occupied areas of the building, all conduits shall be finished wire-mold type raceways or approved equal. Finished wire-mold type raceways shall not be installed without prior approval in writing by the VA's Contracting Officer and Design Professional.
- b. Where any equipment and/or junction boxes are installed above non-accessible finished ceilings, the contractor shall provide access hatches listed for the intended application. Access hatches shall be located so that service access to the equipment and/or junction boxes is unimpeded.
 - 1) Access hatches shall not obstruct any equipment, service panels, lighting equipment, devices or any architectural elements of the ceiling. At the time of submittals the contractor shall submit all proposed access hatch locations for review by the Design Professional.
- c. All raceways shall be supported in accordance with NEC requirements and shall be affixed in such a manner that tampering and/or removal without the use of specialized tools shall be prevented.
- d. All conduits/raceways shall be installed in a manner that prevents tampering or removal when installed in areas exposed to the general population.
 - 1) Provide tamper-resistant installation utilizing "torx with peg" security-fastening devices for all conduits/raceways, equipment, devices and appurtenances in all areas accessible to the general population and/or areas subjected to tampering or vandalism.
- e. Interior raceways shall be a minimum 3/4 inches unless otherwise noted. Exterior raceways shall be a minimum 1-inch. Size all raceways and install conductors in accordance with NEC requirements. Fill ratio shall not exceed 40 percent for indoor raceways or exterior raceways.
 - 1) EMT conduit with compression fittings and/or MC cabling may be utilized in all inaccessible ceiling areas unless otherwise restricted by code.
 - 2) Threaded Rigid metal conduit shall be used on all exterior applications, stub-ups and all interior areas where concealed conduit requirements cannot be met and are exposed to tampering or damage by the general population.
 - a) All areas considered being of high risk due to the nature of the occupancy or the need to protect and maintain the integrity of the cabling shall be installed in rigid threaded conduits.

- 3) PVC schedule 40 conduit shall be utilized in all underground applications. The conduit shall be buried at a minimum 36" below grade. Warning flagging tape shall be buried 12" below grade to indicate the conduit routing location.
 - a) The Contractor shall have the option to utilize the same trench/routing location as other utilities. In no case shall any system conduits or duct banks be combined with other electrical utilities without providing the required separation between conduits as necessary to ensure the minimal transmission or conduction of any RF and/or EMI signals.
- f. All raceways shall be supported in accordance with NEC requirements and shall be affixed in such a manner that tampering and/or removal by the general population without the use of specialized tools shall be prevented.
- g. Outlet Boxes: shall be 4 x4 x 2-1/8 inches deep and/or single gang box as recommended by the manufacturer for all wall mounted device locations.
 - 1) All outlet boxes shall be provided with single or dual gang device mud-rings flush to finished wall as required based on type and configuration of the type of wall construction.
 - 2) Use deep masonry boxes at masonry construction. T-Bar hangers or other appropriate mounting hardware shall be utilized to support boxes mounted in the ceiling.
 - 3) All devices installed as semi-surface or surface mounted the Contractor shall utilize the appropriate manufacturer's finished backbox as listed for that device.
2. Cable Trays (Ladder Type): Provide cable trays for routing horizontal distribution and backbone riser cables in all security equipment rooms and closets. All cable trays shall be constructed of aluminum with two side rails and 9" rung spacing. Cable tray shall be complete with all materials, miscellaneous hardware and all appurtenances required for a complete cable distribution and support system.
 - a. All cable tray widths shall be sized according to the total number of cables to be supported within the various trays plus an additional 100% spare capacity for future expansion capability. At the minimum all cable trays installed in security equipment rooms and closets shall be a minimum of 24" wide by 1" deep.
 - b. Install cable tray in a manner ensuring that all circuits fully comply with all ANSI/TIA/EIA standards.
 - 1) Maintain a minimum clearance of 24" between top of cable tray and ceiling structure or other equipment or raceway.
 - 2) Maintain a minimum clearance of 6" between bottom of cable tray and top ceiling grid or other equipment or raceway.

- 3) Maintain a minimum clearance of 24" from all conduits or cables used for electrical power distribution.
- 4) Maintain a minimum clearance of 12" between bottom of cable tray and top of equipment racks and/or cabinets
- 5) Maintain a minimum clearance of 24" from fluorescent lighting. All Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.
- 6) Cable tray supports shall be attached to the structural ceiling or walls with hardware or other installation and support aids specifically designed for the cable tray and designed to support the cable tray's weight and required cable weight and volume.
- 7) Do not attach cable tray supports to ceiling support system or other mechanical support systems.
- 8) Load span criteria: Install tray supports in accordance with the load criteria of L/240.
- 9) Cable Trays shall be supported at 6-foot intervals.
- 10) All Cable trays shall be installed without burrs, sharp edges, or projections, which may damage cable insulation.
- 11) All lengths or sections of cable tray shall be bonded and grounded in accordance with NEC, EIA/TIA and IEEE.

- c. NOTE: Where security equipment and telecommunications equipment share the same equipment room this Contractor shall coordinate with the Division 27 integrator the installation of all cable trays.

I. Penetrations of Walls and Floors

1. All wall/floor penetrations are to be sleeved and fire stopped with approved fire stopping material. Coordinate all cable and conduit penetrations of the structure with all trades.
 - a. All penetrations of walls and floors shall be fire stopped in accordance with the ASTM and NFPA standards. Refer to related specification sections for additional information.
 - b. Floor penetrations shall be sleeved with a minimum sleeve diameter of 4 inches. An additional penetration shall be provided for future use, sleeved and capped and fire stopped as required.
 - c. Coordinate size of wall penetration with conduit size, number of conductors. Comply with all NEC requirements.
 - d. The fire rating of all penetrated walls, floors, and ceiling structures shall be strictly maintained. All penetrations shall be fire-stopped and sealed by the Contractor.
 - e. Install fire-stopping in open penetrations and in the annular space of penetrations for fire rated barriers.
 - f. Installation of fire-stops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.

- g. Installation of all fire-stopping shall be in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer's recommendations, local fire and building authorities, and applicable codes and shall be installed in a manner acceptable to the authority having jurisdiction.

3.4 ELECTRICAL POWER DISTRIBUTION

- A. Electrical power of 120 Volts (VAC) shall be provided by this Contractor. Coordinate with VA's Contracting Officer and Design Professional for nearest electrical distribution panels. Additional locations requiring primary electrical power as required by the specific products and/or integrator selected equipment shall be the responsibility of this Contractor to include as part of this project.
 - 1. Primary power for all security, fire alarm and rescue assistance system controls, sub-control panels, processors, amplifiers, UPS units and power supplies shall be configured to switch to emergency backup power sources automatically when primary power is interrupted without degradation of any critical system functions.
- B. Uninterruptible power supply units shall be provided for all security equipment and shall have the capacity to furnish total power for a the specified minimum period of time in the event of failure of normal and/or emergency power source in accordance with the requirements of the related specification sections.
 - 1. Note: Contractor shall coordinate all required system electrical connections to the building emergency power circuits with the electrical drawings and\or the VA's Contracting Officer and Design Professional. Refer to all related specification sections for additional information on uninterruptible power supplies to be provided as part of all security, fire alarm and rescue assistance systems.
 - a. No functions, alarms or indications shall be lost during switch over from normal to emergency power.
 - b. At the minimum the following equipment shall be connected to UPS units, refer to appropriate system specification sections for additional system requirements:
 - 1) Security System Central Processing Units (CPU)
 - 2) HMI Terminals
 - 3) 24 VDC Power Rectifiers
 - 4) Layer II Data Switches
 - 5) Layer III Core Switches
 - 6) Video surveillance system network servers
 - 7) Video surveillance system network recording equipment
 - 8) Any security, fire alarm and rescue assistance system specific equipment not supported by battery back-up or any equipment requiring rebooting upon initial loss of primary power.

3.5 TRANSIENT VOLTAGE SUPPRESSION

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communications, control, or signaling circuits shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection.
1. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator.
 2. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be acceptable for surge protection applications. All inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference at the minimum surge suppression test shall meet the following criteria.
 - a. All system power supplies serving exterior system components or devices shall be provided with the appropriate transient surge suppression protection on both the line side as well as the load side.
 - 1) A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.
 - 2) An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.
 - 3) Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equal.
 - 4) Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg) shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.

3.6 GROUNDING AND BONDING

- A. All electronic equipment, conduits, cable trays, racks/cabinets and cable shields shall be properly grounded and bonded in accordance with all requirements of EIA/TIA 607-A, NEC 250 and IEEE 1100. Where identified as applicable to this project, all equipment grounding shall be in accordance with Motorola R56 Standards and Guidelines for Communications Sites.

1. All grounding connections shall provide the equalization of all grounding potentials between the building power system and the grounding terminations at the security, fire alarm and rescue assistance equipment in order to provide the diversion of electrical transients as well as providing the necessary coupling in order to cancel and/or reduce any voltage transients.
 - a. Equipment Grounding: Metallic structures, equipment racks, cabinets and enclosures as well as all raceways, cable trays, junction boxes, outlet boxes, machine frames, and other conductive items shall be bonded and grounded.
 - b. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing any voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the grounding bus, to all manhole hardware and ground rods, to the cable shielding grounding provisions for all cable splices, terminations and equipment enclosures.
 - c. Metallic Fences equipped with Electronic Security: Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.
 - 1) Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence.
 - 2) Each gate section shall be bonded to its gatepost by a 3 by 25 mm (1/8 by one inch) flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.
2. All connections of grounding conductors to ground rods, bus bars, rebar, structural members, pipes and fences, as well as splices of any ground conductors, shall be made by exothermic welds except where otherwise noted. All connections to bar lugs shall be exothermic weld or compression type connections. Bolted type connection of ground conductors may only be made where terminal lugs or blocks have been furnished and installed in equipment by the manufacturer.
 - a. Equipment grounding conductors shall be insulated stranded copper, except for sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be permitted to be identified per the NEC.

- 1) At the minimum bonding connection shall be a #6 AWG copper conductor. All grounding shall provide an effective bonding connection between the protected equipment to the nearest approved building grounding electrode (structural steel) as well as to the local power distribution panel grounding system (e.g., ac branch circuit panel board's equipment grounding busbar). All bonding and grounding connections shall be NEMA type compression or exothermic welded connections.
3. Refer to related specification sections for any additional grounding and bonding requirements.

3.7 EQUIPMENT IDENTIFICATION

- A. Identify all system controls, components and equipment cabinets using plastic laminate engraved labels, or approved equal. Firmly affix to the panel, device and/or component.
 1. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item or where other method of identification is herein specified. Dymo or Kroy tap adhesive backed lettering shall not be acceptable.
 2. Color-code all junction boxes and enclosures per NEC recommendations. At the minimum provide all junction boxes as follows:
 - a. Color for Security circuits - Orange.
 - b. Color for CCTV circuits - Green
 - c. Color for Fire - Red.
 - d. Letter all pull boxes and junction boxes located in service area tunnels, above accessible ceilings and pipe chases with laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws.
 - 1) Example: Security system "SS," Circuit Number SS-126.
Engraved laminated plastic tags shall be used for identification and securely fastened in accordance with the project requirements.
 3. Permanently label all wiring at both ends with self-adhering plastic labels.
 4. Provide typewritten circuit directories installed in 3-ring binders with transparent page protectors in each control and sub control cabinet and/or equipment rack.

3.8 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain all electronic security and fire alarm systems associated with this project in fully operational state as specified after formal written acceptance of the system.
 - a. Provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. Refer to Division 1 specification section for additional information.
 - b. The adjustment and repair of systems shall include all software and firmware up-dates on all computers, CPU's, HMI terminals, devices, communications and data transmission medias' (DTM), facility interface processors, signal transmission equipment, amplifiers, video surveillance and security management software and processors.
 - c. Test, inspect and service each system on a semi-annual basis at six month intervals during the warranty period from the time of final acceptance. The contractor shall compare each six month test results with the test results at the time of final acceptance.
 - 1) The contractor shall include as part of the semi-annual test the calibration and/or adjustment of any device, component and/or system that has deviated from the original test results at the time of final acceptance.
 - d. For each semi-annual maintenance period, provide written notification to the VA's Contracting Officer of the systems condition before and after service, the exact components that were tested and serviced, and overall status of the system.

B. Personnel

1. Service personnel shall be manufacturer certified in the maintenance, testing and repair of the type of system and equipment provided for the project. Provide the VA's Contracting Officer and Design Professional the name of the designated service representative, and of any change in personnel. The VA's Contracting Officer and Design Professional shall be provided copies of system manufacturer certification for the designated service representative.
 - a. Schedule of work to be performed during regular working hours, Monday through Friday, excluding federal holidays.

C. Emergency Service

1. The Government shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the VA's Contracting Officer with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Government shall have sole authority for determining catastrophic and non-catastrophic system failures.
 - a. For catastrophic system failures, the Contractor shall provide same day eight (8) hour service response with a defect correction time not to exceed sixteen (16) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Government determines will place the facility(s) at increased risk.
 - b. For non-catastrophic failures, the Contractor within 1 business day with a defect correction time not to exceed 48 hours from time of notification.

D. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

E. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

F. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the Design Professional. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Design Professional. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and all related documentation.

3.9 WARRANTY

- A. Warrant material and workmanship for a period as specified in Division 1 of the contract documents and all related specification sections. The warranty period shall commence from the date the Contactor received written notification of final acceptance from the Design Professional. At the minimum the contractor shall provide warranty provisions:
1. Warrant the replacement of defective components/materials and/or correct defective work when given notice by the Government during the warranty period.
 2. Warranty excludes liability for consequential incidental, or special damages due to vandalism, misuse, or acts of God.
 3. Onsite warranty response time by qualified technician shall be within 8 hours upon receipt of request from Government.
 4. Warranty repairs shall be provided to the Government at no cost. This shall include but not limited to all repairs and/or replacement of defective components/materials, all labor charges, all travel costs and all vehicle charges.
 5. Response time shall be 7 days a week / 24 hours a day / 365 days a year.
 6. Provide test, inspection and service of each system on a semi-annual basis at six month intervals.
 7. Contractor must provide verification that they maintain their principle base of operation along with the personnel that will be responsible for providing service within 3 hours driving time to the project site. This tenet of the warranty shall remain in effect for the life of the warranty.
- B. The Contractor shall, as a condition of final payment, execute a written warranty certifying all contract requirements have been completed according to all requirements of the Contract Documents.
1. All system testing, commissioning, demonstration and training shall be performed prior to final system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the satisfaction of the VA's Contracting Officer and Design Professional, at the Contractor's expense.
 - a. The contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty.
 - b. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of its failure during the warranty period, the warranty period for any replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work.

2. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

3.10 FIELD SERVICES

- A. Notify the VA's Contracting Officer and Design Professional in writing, prior to the closing of any ceilings and ten (10) days advance of testing all system cabling to prevent delays in construction schedules.

1. Test all cabling to confirm that no grounds, shorts, sneak currents, RFI and EMI conditions exist prior to start-up and commissioning of all, components, devices, equipment and/or systems.
 - a. Before requesting a final inspection, the Contractor shall perform a series of end to end installation performance tests. The Contractor shall submit for approval by the VA's Contracting Officer and Design Professional all test procedures to be employed, test result forms, and timetable for testing all fiber optic and copper plant wiring.
 - b. Acceptance of the simple test procedures discussed below is predicated on the Contractor's use of the recommended products including but not limited to twisted pair cable, cross-connect blocks, and outlet devices specified and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.

B. UTP Cable Testing

1. Minimum Test Parameter requirements for all Category-6 horizontal cabling.
 - a. Category-6: Each wire/pair shall be tested at both ends for the following utilizing Contractor generated test results forms:
 - 1) Wire Map.
 - 2) Length.
 - 3) Insertion Loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT).
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay Skew.
 - 11) Power Sum ACR.

- b. All cable testing described herein shall exceed Category-6 transmission requirements of ANSI/TIA/EIA-568-B.2-1. In addition all cable and component transmission performance parameters shall exceed 10 Gb/s transmission requirements for connecting hardware, per the requirements of TSB-155. Additionally, the installed channel system shall exceed IEEE 802.3 DTE Power specification to (4) times the rated current limits with no degradation of performance or materials and shall be error free Gigabit Ethernet performance to the referenced standard. (All performance requirements shall be verified and documented by a RCCD technician at the time of testing)
- c. Channel system shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 - 250 MHz when configured in a 4-connector channel. The 4-connector channel test configuration shall utilize a Category-6 jack, patch panel, optional 6-110 block, and patch cords, all from the same manufacturer, with qualified Category-6 cable.
- d. The 4-connector Category 6 channel performance margins in the table below shall be guaranteed provided the configuration satisfies above requirements

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to Category-6 Channel Specifications
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB
ELFEXT	4 dB
PSELFEXT	5 dB
Return Loss	2 dB

- 2. When errors are found, the source of each error shall be determined, corrected, and the cable re-tested. All defective components shall be replaced and retested. Defective components not corrected shall be reported to the VA's Contracting Officer and Design Professional with explanations of the corrective actions attempted.
- 3. Test records shall be maintained using the approved test result forms. The form shall record closet number, riser pair number or outlet ID, outcome of test, indication of errors found (e.g., a, b, c, d, or e) cable length, re-test results after problem resolution and signature of the technician completing the tests.
- 4. Test results for each 4 pair, Category-6, UTP cable must be submitted with identification to match labels on all patch panel ports and 8 position modular jacks, and identification to match as-builts associated with that cable.
- 5. VA's Contracting Officer and Design Professional shall observe and verify the accuracy of test results submitted.
- 6. Contractor shall submit both hardcopy and electronic floppy disc format of all test results.

C. Fiber Optic Testing

1. Contractor shall test each fiber strand and each pair of each twisted-pair copper cable. The VA's Contracting Officer and Design Professional reserve the right to have a representative present during all or a portion of the testing process. If the VA's Contracting Officer and Design Professional elect to be present during testing, test results will only be acceptable when conducted in the presence of the VA's Contracting Officer and Design Professional.
2. Fiber Optic Cable: Each fiber strand shall undergo bi-directional testing for signal attenuation losses.

a. Test Equipment:

- 1) Multimode: Light Source and Power Meter.
- 2) Single mode: Light Source and Power Meter.
- 3) OTDR.

b. Tests:

- 1) Multi-mode: Signal attenuation at 850 and 1300 nm.
- 2) Single-mode: Bi-directional signal attenuation at 1310 and 1550 nm.
- 3) Test all Fiber cable on the reel before installation, with an optical light meter, to ensure fiber continuity and no factory defects.
- 4) Test Criteria: Signal loss of less than (3.6 dB for 1000 Base-SX @ 850NM for 50 uM fiber) through entire passive fiber path, including cable, couplers and jumpers.

3. Fiber Optic Testing Specifications

- a. All testing shall be performed by factory trained and certified personnel.
- b. For all installed fiber optic cable EIA 455-171 Method D procedures will be adhered to (Bi-directionally).
- c. Connector loss shall not exceed 0.75 dB per connector pair.
- d. The Fiber Optic Cable shall not exceed 1.0 dB kilometer tested at 1310nm and 1550nm for single mode cable.
- e. The Fiber Optic Cable shall not exceed 3.5dB per kilometer tested at 850 nm and 1.5dB per kilometer tested at 1300nm for multi-mode 50/125 fiber.
- f. The contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer's specifications.
- g. Pre-installation tests of Inter-plant fiber- pre-test each reel:
 - 1) Test each reel of fiber each strand for continuity with a light source. If continuity is not achieved:
 - 2) Then test with an OTDR to determine the nature and location of the defect: Measure end-to end attenuation and the distance to a high attenuation point.

- 3) If it is determined by the VA's Contracting Officer or Design Professional that the fiber is defective the contractor shall contact the manufacturer and provide a completely new fiber reel.

h. Tests for installed Inter-plant and Intra-plant fiber optic cable:

- 1) Intra-plant and Inter-plant Multi-mode: Bi-directional signal attenuation at 850 and 1300 nm. power meter.
- 2) Intra-plant and Inter-plant Single-mode: Bi-directional signal attenuation at 1310 and 1550 nm. power meter.
- 3) Inter-plant Multi-mode: Bi-directional OTDR trace at 850 and 1300 nm. OSP ONLY
- 4) Interplant Single-mode: Bi-directional OTDR trace at 1310 and 1550 nm. OSP ONLY

NOTE: Obtain the actual index of refraction from the cable Manufacturer before testing.

4. Test Criteria.

- a. Total signal loss must not exceed the maximum Attenuation Coefficient plus the maximum Connector Attenuation as listed in TIA/EIA 568-B.
- b. Maximum Link Attenuation shall be as calculated below:

- 1) Link attenuation is calculated as:
- 2) $\text{Link Attenuation} = \text{Cable Attn} + \text{Connector Attn} + \text{Splice Attn}$
- 3) $\text{Cable Attn (db)} = \text{Attenuation coefficient (db/km)} \times \text{Length(Km)}$
- 4) Attenuation Coefficient

- a) 3.5 dB/km @ 850 nm for 50/125 um
- b) 1.5 dB/km @ 1300 nm for 50/125 um
- c) 0.5 dB/km @ 1310 nm for single-mode outside plant cable
- d) 0.5 dB/km @ 1550 nm for single-mode outside plant cable
- e) 1.0 dB/km @ 1310 nm for single-mode inside plant cable
- f) 1.0 dB/km @ 1550 nm for single-mode inside plant cable

- 5) $\text{Connector Attn (db)} = \text{number of connector pairs} \times \text{connector loss (dB)}$

- a) $= 2 \times 0.75 \text{ dB}$
- b) $= 1.5 \text{ dB}$

- 6) $\text{Splice Attn (dB)} = \text{number of splices (S)} \times \text{splice loss (dB)}$

- a) $= 2 \times 0.75 \text{ dB}$
- b) $= 1.5 \text{ dB}$

- c. "Measured" Link Attenuation shall be compared to "Calculated" Link Attenuation to determine acceptance. The Contractor at no additional cost shall correct any Links that fail.

- d. Single-mode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper. 50/125 um backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method A.1, One Reference Jumper.
 - e. Submit all test reports for approval; an OTDR signature report for every OSP cable by strand and a fiber optic link attenuation record report for every cable by strand.
- D. Notify VA's Contracting Officer and Design Professional in writing, ten (10) days advance of testing of all equipment and/or components to prevent delays in construction schedules.
- 1. Perform all tests, as required, by authorities having jurisdiction throughout the facility.
 - 2. Test system for grounds to demonstrate that the ground resistance does not exceed the requirements of the National Electric Codes (NEC).
 - 3. Test all cabling to confirm that no grounds, shorts, sneak currents, RFI and EMI conditions exist prior to start-up and commissioning of all, components, devices, equipment and/or systems.
 - 4. Test all systems and components for proper function and operation; certify that all systems are in proper working operation in accordance with the Contract Documents prior to scheduling any system demonstrations.
 - 5. Testing of all electronic security and life safety systems shall be in the presence of the VA's Contracting Officer and Design Professional as well as all appropriate representatives of the authorities having jurisdiction.
- a. All completed electronic security systems shall be fully tested in accordance with all requirements of NFPA 731. Upon completion of a successful testing, the contractor shall so certify in writing to the VA's Contracting Officer and Design Professional that all testing was completed, certified and left in first class operational condition, include all completed NFPA 731 certification and test reports.
 - b. All completed the life safety systems shall be fully tested in accordance with all requirements of NFPA 72. Upon completion of a successful testing, the contractor shall so certify in writing to the VA's Contracting Officer and Design Professional that all testing was completed, certified and left in first class operational condition, include all completed NFPA 72 certification and test reports.
 - c. The service of a competent, factory-trained engineer or technician authorized by the equipment manufacturer shall be provided to technically supervise installation and participate during initial system programming, start-up, final testing, assist in the final acceptance testing and Government demonstrations.
 - d. At the minimum all acceptance testing, demonstrations and training shall include, but not be limited to the following:
 - 1) Security Monitoring/Control Systems
 - 2) HMI Operations

- 3) Remote Security Monitoring/Control Systems
- 4) Fire Alarm and Signaling Systems
- 5) UPS and Battery Back-up Functions
- 6) Integration of all Auxiliary Systems

6. In addition provide all testing, commissioning and certifications as specified by Division 1 specification sections and any manufacturer's recommendations or requirements.

E. Training

1. In addition to all demonstration and training as specified by Division 1 specification section and all related Division 28 specification sections, system demonstrations and training shall be provided in accordance with all requirements of this section.
2. Prior to acceptance of the work, the System Integrator shall demonstrate to the VA's Contracting Officer and Design Professional, all systems and sub-systems all features and functions of each system, and shall instruct the Government Representatives in the proper operation, event sequences, programming and maintenance of all systems and sub-systems.
3. The System Integrator shall furnish the necessary trained personnel to perform all demonstrations and instructions and arrange to have the manufacturer's representatives present to assist with the demonstrations.
4. Training time shall include, as a minimum, the total time determined by the sum of the times per system as specified in this and related specification sections, for performing the prescribed demonstrations/training. Refer to related specification sections for additional training requirements.
 - a. Allow a minimum of 16 hours' time for each system provided for performing the prescribed demonstrations/training.
 - 1) Provide a minimum of (4) four 4-hour training classes performed at the project location and spaced over a three week interval. Training classes shall be scheduled not less than 48 hours apart to allow the Government User\Operators to familiarize themselves with all system operations.
5. Provide operation, parts and maintenance manuals defining operation and troubleshooting methods of all systems and review with Government User\Operators as part of training demonstrations.
6. Provide detailed video recordings in high quality digitally formatted media of all demonstration and training of all systems and system operations.
 - a. Utilize remote microphones as may be required to ensure high quality audio of the recorded demonstrations.
 - b. Permanently and professionally label all recorded materials and provide self-sealing plastic cases.

F. Inspections

1. At the completion of the project and prior to final acceptance of the Work, provide evidence of final inspections and approvals to the VA's Contracting Officer and Design Professional, in accordance with all requirements of the Contract Documents as well as required by the authorities having jurisdiction.

End of Section

SECTION 28 13 00
PHYSICAL ACCESS CONTROL SYSTEM (PACS)

PART 1 GENERAL

1.1 DESCRIPTION

A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 and all related specification sections shall apply to this section.

B. Related Sections:

1. 07 08 00 - Fire Stopping
2. 08 31 13 - Access Doors
3. 26 05 00 - Requirements for Electrical Installations.
4. 26 05 21 - Low Voltage Electrical Power Conductors and Cables.
5. 26 05 26 - Grounding and Bonding for Electrical Systems
6. 26 05 33 - Raceways and Boxes for Electrical Systems
7. 28 05 00 - Common Work Results for Safety and Security Systems
8. 28 31 00 - Fire Alarm and Signaling System

C. Reference Symbols:

1. All device symbols are defined by the appropriate symbol schedules. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location.

- a. Contractor shall coordinate exact locations with all architectural drawings, reflected ceiling plans, furniture plans, door hardware specifications, mechanical and electrical drawings as well as all affected trades prior to submittal of any shop drawings.

D. Abbreviations:

1. Refer to Specification Section 28 05 00 for additional information.

E. Definitions:

1. Refer to Specification Section 28 05 00 for additional information.

1.2 SUMMARY

A. The intent of this specification is to establish a standard of quality; functions and features for the installation and modification of the existing Physical Access Control System (PACS) as indicated on the Contract drawings and/or herein specified. The PACS shall be a fully enterprise based system and shall include all work, materials, infrastructure, equipment, software and programming as required to provide a fully operational system as herein specified.

1. The installation, performance, features, functions, software and programming modifications as specified herein as well as all related specification sections have been designed to offer the maximum system efficiency ease of operation, occupant safety and the protection of equipment as recommended by the design Professional.
 - a. Any deviations from the specified criteria shall be documented, reviewed and agreed to in writing by the VA's Contracting Officer and Design Professional prior to submission of bids. Refer to Division 1, Division 28 and related specification section for product substitutions.
 2. It is the responsibility of the contractor to insure that the installed system meets or exceeds every standard set forth in these specifications. The contractor shall be responsible for providing a complete functional enterprise based system, including all necessary components, devices, servers, cabinets, electrical power, software, programming, commissioning, testing and all appurtenances as necessary to provide a complete and fully operational system whether specifically included in this section or not.
 - a. The system shall consist of but not limited to all, equipment, devices, servers, client workstations, network servers, remote data gathering panels (DGP), power supplies, printers, conduits, cabling, software, programming, integration to door hardware and all appurtenances necessary to provide a complete operating networked access control system in accordance with the contract documents.
- B. The installation of the PACS shall comply with the applicable sections of NFPA-70 National Electrical Code (Article 760). The system shall be electrically supervised and monitor the integrity of all conductors. The system in addition shall meet all applicable requirements of NFPA Standard 72 for the integration to Protected Premises Signaling Systems and NFPA Standard 731 for the Installation of Electronic Premises Security Systems.
1. The contractor and all sub-contractors for this work shall have read all of the General Conditions, Special Requirements, General Requirements and all applicable related specification sections and in the execution of all work shall be bound by all of the conditions and requirements therein.
- C. Prior to the submission of the Bid, any discrepancies or inconsistencies noted within these specifications and/or project drawings shall be brought to the immediate attention of the VA's Contracting Officer and Design Professional.
1. All equipment symbols are shown on drawings as close as possible to their intended location. Contractor shall coordinate the installation of all equipment, devices, controls, cabling and integration of any systems with all affected trades and system integrators. The Contractor shall document all coordination requirements at the time of shop drawing submissions.

2. The Contract Drawings for this work are diagrammatic and intended to convey the extent, general arrangement and locations of the work. Because of the scale of these drawings, certain basic items such as access panels, conduits, cabinet sizes, penetration sleeves, pull boxes, backboxes and junction boxes may not be shown.
 - a. The contractor shall include all equipment, materials, components, device, controls and all appurtenances where required by code, by manufacturers' recommendations, and all related Contract Documents in order to ensure proper installation operation and integration of all components, equipment, devices and/or systems.
- D. The Contract drawings and specifications may not deal individually with every part, control, device, software or programming, which may be required to produce the equipment and/or system performance specified or as necessary for the installation and integration of all door hardware and systems in accordance with all requirements of the Contract Documents.
 1. The Contractor shall include all such items and components, as required, for the complete and operational installation of all system components as defined by the Contract Documents, whether or not specifically indicated and/or specified.
 - a. Include such items, as required, for a complete operational system, whether or not specifically indicated.
 - b. Coordinate with other applicable trades in submittal of shop drawings and the installation of all systems.
 - c. Shop drawings shall detail space conditions to accommodate other concerned trades, subject to final review by the VA's Contracting Officer and Design Professional.
 - d. If installation of equipment, raceways, cable trays and/or conduit is performed prior to coordination with other trades, which interferes with work of other trades, make necessary changes to correct the condition at no additional cost to the Government.
 - e. The contractor shall be responsible for providing all wiring, connections to all equipment, circuits and devices as well as all coordination and programming for the integration of all electronic door hardware, ancillary systems impacting the operation of PACS. Refer to the contract drawings and related specification sections for additional information.
- E. The PACS shall be modular in construction for ease of expansion and service. The system shall be a full enterprise based system and shall include all necessary equipment, components, modules, software and programming necessary to provide the complete integration of all access control network servers, (ACNS), remote data gathering panels (DGP) and HMI client workstations. In addition the PACS shall be fully capable of remote communications employing TCP/IP protocols over Station's data network for remote campus operations via a single dedicated IP connection.

1. The PACS shall include the full operational integration of all doors, garage doors, gates, vehicle loop detectors and parking control systems where indicated on the contract drawings and/or as herein specified.
 2. The PACS shall include an integrated photo badging system with badging printer capable of printing dual sided laminated photo proximity access control cards employing "I-Class" 13.56 MHz contact-less smart card technology.
- F. All system components shall be on replaceable panels and/or modules to accommodate functional changes when required. All system wiring and components shall be supervised so as to annunciate a trouble signal if removed or disconnected.
- G. The contractor shall assume total system responsibility for providing all inter-building wiring, any connections to the campus local and wide area networks (for remote off premises communications by Government), any common carrier provided network equipment, and integration of any Government provided systems, equipment, and/or databases as it relates the operation of the access control system.
1. Prior to final programming of the access control system coordinate with the VA's Contracting Officer and Design Professional, all GUI based graphic screens, all systems alarm functions and all operational features for the entire system. The contractor shall provide to the VA's Contracting Officer and Design Professional a functional demonstration of all system graphics and operational functions prior to final programming.
 - a. This demonstration shall be performed on site and shall include an operational demonstration of the system for this facility. The functional demonstration shall include but not limited to, all door alarm and control functions, alarm call-ups as well as all automatic and manual threat level system responses.
 - b. Failure to provide the required coordination with the VA's Contracting Officer and Design Professional shall require the contractor to provide any and all system modifications and programming changes necessary to meet the requirements of the Governments Agency security procedures.
- H. The HMI for the system operation shall include GUI based graphic floor and/or site plans of the facility, and shall display all alarm origins, threat level responses complete with emergency response instructions.
1. The security management programming for the system shall provide the security operator the information needed to properly assess and respond to situations without the need to manually access information. Security Operators will manage the entire system from the client workstation(s).

1.3 REFERENCES

- A. All references to industry and trade association standards as well as all building codes are minimum installation requirements for this system. The codes, standards and agencies listed in specification section 28 05 00 shall also form a part of this specification section and all work shall comply with the latest adopted standards.
1. The publications listed in specification section 28 05 00 (including all amendments, addenda, revisions, supplement, and errata) shall form a part of this specification section to the extent referenced. The publications are referenced in the aforementioned specification section by the basic designation only.
 - a. Where the contract drawings and/or specification sections mandate a greater requirement or performance than those specified by the referenced applicable codes and standards, the requirements of the contract drawings and/or specification sections shall be the governing requirements for this project and shall be delivered accordingly.

1.4 SUBMITTALS

- A. In addition to all requirements as specified by Specification Section 28 05 00 the physical access control systems shall also be provided in accordance with the following requirements:
1. Provide a complete termination schedule of all door locations; indicate on the construction drawings door identifications corresponding with schedule.
 2. Provide a complete alarm matrix for all door locations, indicate all associated alarm call-ups and camera pre-sets for every camera indicated on the contract drawings, include the related device activation and/or event for each pre-set and alarm call-up.
 3. All integration protocols, communications connectivity and interface components to the building's PACS, fire alarm and any ancillary systems.
 - a. Wiring diagrams shall indicate all wiring for each field device as well as all wiring interconnections between each device and all controls and/or associated equipment, In addition, all electrical power connections with electrical circuit numbers shall be indicated to all equipment requiring electrical power.
 4. All shop drawing submissions for system employing TCP/IP based protocols shall have a registered RCDD professional review and seal all shop drawings confirming that the proposed network infrastructure and structured cabling system is in conformance with all stipulated standards and related specification sections as herein specified.

1.5 QUALITY ASSURANCE

- A. In addition to all requirements as specified by Specification Section 28 05 00 the Access Control system shall also be provided in accordance with the following requirements:
1. The physical access control system equipment manufacturer shall be an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQ Q9001-1997.
 2. All control equipment must have transient protection to comply with UL864 requirements. Where security circuits leave the building, additional transient protection must be provided for each circuit. Devices must be UL listed under standard #497B (Isolated Loop Protectors).
 - a. Refer to specification section 28 05 00 for additional information related to the installation of all surge and transient protection requirements.
 3. The Electronic Security Systems Integrator (ESSI) shall be an established security alarm provider, dully licensed to provide security systems within in the municipality of the project location and is an authorized distributor of the equipment supplied for this project with full manufacturer's warranty privileges.
 4. Installation and start-up of all systems shall be under the direct supervision of the Electronic Security Systems Integrator (ESSI). This system supplier shall be an accredited and authorized distributor of the equipment manufacturer of all equipment being provided and be prepared to offer a service contract for system maintenance at completion of the guarantee period.
 5. The contractor shall show satisfactory evidence, upon request, that the equipment supplier maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The supplier shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.
 6. Electronic Security System Integrator shall coordinate the installation and wining terminations for all applicable door hardware associated with all doors equipped with electronic security protection. Refer to related electronic security system drawings and related all Division 08 and 28 specification sections related for all electronic door security measures.
 - a. It shall be the responsibility of the ESSI and door hardware equipment provider prior to the submission of any bids to review all related Contract documents and ensure that all door hardware related to the electronic security measures are properly coordinated.
 7. NOTE: The electronic security drawings and specifications shall be the governing set of documents for all security protection requirements for this project. Any modifications and/or changes to the door hardware as a result of not conformance with the coordination of all the above referenced documents shall be provided at no additional cost to this project.

1.6 RECORD DOCUMENTS

- A. Comply with all requirements of specification section 28 05 00.

1.7 SOFTWARE AGREEMENT

- A. Comply with all requirements of specification section 28 05 00.

1.8 Extra material

- A. In addition to all requirements as specified by specification section 28 05 00 the following extra materials shall be provided as part of this project:
 - 1. One Hundred (100) Dual Sided Proximity cards (Coordinate with VA's Contracting Officer and Design Professional for all authorization rights and site code requirements)
- B. All extra materials shall be delivered at the time of final acceptance of the system(s). At no time is the contractor to use the extra materials provided for this project to replace malfunctioning equipment and or components prior to final acceptance

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

- A. Comply with all requirements of specification section 28 05 00.

2.2 MANUFACTURERS

- A. Acceptable manufacturer's for this project, providing full compliance with this specification section and all requirements of specification 28 05 00 shall be as follows:
 - 1. RS-2 Systems as provided by Condortech Services, Inc. Milvale, PA. Contact Mr. Shane Levdansky @ 412-200-5307.
 - 2. Above manufacturer has been approved as an extension of the existing facility system in order to maintain continuity of operation. No Substitutions shall be accepted.
- B. Manufacturers listed as acceptable shall not negate the contractor's responsibility for providing the PACS system in accordance with all functions and performance requirements of this specification.

2.3 SYSTEM DESCRIPTION

- A. The contractor shall provide a fully operational microprocessor-based enterprise based physical access control system (PACS). The scope of work shall include but not limited to the installation of all, access control network servers, (ACNS), remote data gathering panels (DGP), auxiliary power supplies, client work stations, cabling, conduits, badging system, printers, badging camera/tripod/screen, proper connection and integration of all proximity card readers and door hardware as well as all appurtenances as required to meet the design

and performance requirements as indicated on the contract drawings and/or as herein specified.

1. In addition provide the necessary integration of all door hardware and fire alarm systems, as well as all system programming and training required to provide a fully operating system as indicated on the contract drawings and/or as herein specified.
 2. Provide all required access control network servers (ACNS), remote data gathering panels (DGP), components, client workstations, software, programming, commissioning, testing, certification and all appurtenances as required for the full network integration of the access control system for this facility as well as the capability for expansion and/or future integration of additional remote client servers and/or premises.
- B. The PACS shall have an open architecture design. It shall be a true open architecture design and support the downloading of third party industry standard databases such as tab/space/comma-delimited formats, JPEG images, SQL server, ID card printers, and video cameras.
1. No customized or proprietary ID badge creation software or hardware shall be required to operate the Access Control system. The system shall be both scalable and portable to provide the capability to increase the system performance based on Government requirements. Where systems provided are not capable supporting the importing of third party industry standard databases, the contractor shall include provisions for manually importing any Government provided databases.
- C. The PACS shall communicate with all network servers (ACNS), data gathering panels (DGP), client workstations residing on the access control systems' dedicated network by LAN/WAN connections utilizing TCP/IP communications protocol. Contractor shall coordinate with the project's data systems contractor for all fiber optic cable connections to the campus wide area network for full communication capability to the facility's wide area network. The system shall also include the ability to communicate with all system ACNS located at this facility through a remote dial up capability.
- D. The communication baud rate for the Access Control system shall be selectable from 1,200 to 38,400 bits per second. The system software shall take full advantage of its multi-tasking capabilities, allowing downloads of cardholder data as well as any ACNS information to occur simultaneously while monitoring and receiving alarms from the field hardware.
1. Downloading database changes shall not interfere with any output control, access decisions, alarm monitoring, traces, or any other required function of the field hardware and alarm monitoring client workstation. Communications between the system client workstation(s) and the ACNS(s) shall be interleaving so that all alarms will still report to any client workstation while downloads are occurring.
 2. In the event of loss and then restoration of communications between the ACNS and the system database, database synchronization between the main ACNS system database and the local database in each remote ACNS and DGP's shall be fast and efficient.

- a. Every change made to the ACNS database shall establish a time/date stamp for the change. Once communications has been restored, database synchronization shall occur immediately and without System Operator intervention. The time-date stamp shall be compared with any changes in the system database, hardware configuration, events, or output control commands and the system shall log which changes occurred after the off-line event.
 - b. Any changes made to the Access Control system database while the system was off-line shall also be simultaneously downloaded to all ACNS databases configured in the system.
- E. The PACS shall be provided with dual path communications between the access control network servers (ACNS) and any database servers. This shall allow for two paths of communication: a primary and secondary path. The primary path shall communicate between all database servers and all access control network servers (ACNS) by RS-485, 20ma, or RS-232 EIA standards via a dedicated LAN/WAN utilizing TCP/IP communications protocol. The secondary path shall communicate via remote dial up capable modems.
- F. The PACS shall allow access to authorized personnel within pre-determined areas of the site, based on time and/or authority level. The basis of this design is to incorporate a CPU driven system with proximity card access, and to accommodate multiple door locations as well as future expansion.
- G. The PACS shall provide all functions as herein specified by this document, including but not limited to the following capabilities:
 1. Provide the ability to regulate access through specific doors and gates to secured areas of the facility and provide computer generated color employee and visitor credentials.
 2. Shall be provided with the ability to disarm/shunt the building intrusion detection devices and related system components through the use of programmed card reader locations by authorized users at all primary and secondary building entrances.
 3. Shall be provided be with the functional capability to automatically and/or manually call-up pre-selected CCTV cameras, record and store digital video of activities occurring within the facility (independent of the CCTV digital recording system).
 4. Shall utilize a single seamlessly integrated relational database for all functionality. This integration shall be provided with one operating environment. The systems operating environment shall be the fully multi-tasking multi-threading and compatible with Microsoft Windows XP, UNIX, and LINUX operating systems.
 5. The PACS shall utilize web enabled client applications capable of running on independent client operating systems including Windows XP, UNIX, and LINUX platforms. The web-enabled applications shall utilize the same common database as the other system modules.
 6. The system shall be written so that all system modules (access control, alarm monitoring, ID Management, visitor management, digital video, etc.) are at the minimum developed and built from a unified 32-bit source code set. There absolutely shall not be separate source code bases for the individual modules of the system.

7. The PACS shall perform all Security Management Systems (SMS) functions utilizing Human Machine Interface (HMI) terminals or Client Workstations. The HMI shall provide the principle operation platform for the control and monitoring of individual security devices and all associated doors/gates.
8. All Client Workstations shall employ Graphic User Interface based software (GUI) that graphically indicates all building floor/site plans and depicts all access controlled doors, intrusion alarmed doors. The security management systems programming shall facilitate simple user-friendly operation and allow operators to graphically interact with the PACS.
 - a. The PACS shall also include a Threat Level Management feature that allows an operator to make system-wide security changes by simply changing one parameter based on pre-set threat levels.
 - b. The Threat Level feature shall provide a minimum of 5 levels that can be custom configured to change from any level to any other level shall cause execution of a series of commands to make changes to security settings including, but not limited to: door lock and unlock status; multi-factor user authentication i.e. card, card+PIN, etc.); disabling certain readers or reader groups; triggering outputs or output groups; etc.
 - c. The Threat Level feature shall provide an option that requires authorized operators to input their username and password to elevate to selected levels.
 - d. The Threat Level feature shall provide an option that allows an authorized operator to select an ICON on the HMI will release magnetic hold open device on all PACS doors and automatically lock down the facility.
 - 1) In addition, this same Threat Level feature shall also be accessed from the selected Master Video Intercom station. The integration shall be through connections to I/O boards residing on the PACS network.
9. Any client workstation residing on the network and all remote locations shall connect to, and monitor, all field hardware devices, such as card readers, access control network servers (ACNS) and Data Gathering Panels (DGP). Administrative tasks including but not limited to: defining asset information, access groups, time zones, configuring digital video devices, generating reports, configuring graphic maps and etc. All client workstations shall be capable serving as both the credential creation (badging) and data input client workstations for the ID management module of the system. In addition any workstation on the network shall also be capable serving as the visitor management workstation to allow for the enrollment of visitors and the scheduling of visits.
 - a. Any off-site client workstations shall allow for any combination of system functions and operations to be available or from any remote IP and/or dial-up client workstation that is licensed to do so. All system data must reside on a single database on the network and must be accessible in real time to all system workstations connected

to the network. This shall allow for automatic change propagation to all client workstations on the system as well as a common database to consolidate all information and allow for better disaster recovery.

10. The PACS shall be fully expandable to support an unlimited number of individual modules or integrated client workstations. All access control field hardware, including access control network servers (ACNS), shall be connected to all access control system workstations on the network. All workstations shall utilize Windows XP, UNIX, or LINUX based software as their principle operating system.
 11. The PACS shall be designed to support any industry standard thermal dye transfer ID card printer with a certified industry standard Windows XP, UNIX, or LINUX drivers. The system shall also support any ink jet, laser, or dot matrix printer with a Microsoft certified industry standard drivers for the operating system being provided.
- H. Any user programmed alarm event shall cause the access control system client workstation(s) to provide an audible and visual alarm requiring the operator to acknowledge the event and enter via the keyboard to generate a historical entry and a print-out a report of the event and cause.
- I. All remote client workstation(s) and servers shall be provided where indicated on the contract drawings and/or herein specified and shall meet or exceed the requirements specified herein as well as all requirements of the access control system manufacturer.
1. All primary and remote client workstation(s) and servers shall be connected to dedicated UPS units sized to provide a minimum of 15 minutes operating time.
- J. Coordinate the interface to life safety systems with the appropriate trades. Electronic locks shall not inhibit egress in the event of an emergency.
- K. All PACS remote Data Gathering Panels (DGP) shall integrate with the access control network servers (ACNS). In addition, the remote Data Gathering Panels (DGP) shall integrate all associated door position switches, egress devices and integral proximity card reader and electric door locking hardware, as well as any hydraulic Barricades, parking Gates, garage doors and vehicle loop detectors. The programming at the access control network servers (ACNS) shall make the final determination of access granted and denials. All system output programs assigned via control-by-event interlock programming to be activated by valid access indication shall be executed, and the associated system outputs shall be activated.
- L. All remote Data Gathering Panels (DGP) shall be equipped at a minimum with 4 MEG of on board memory and shall support 2 door, 4 door, 8 door or 16 door configurations as well as providing a standalone dry contact remote I/O capabilities. All Intelligent System Controllers (ISC) and remote Data Gathering Panels (DGP) shall be provided with an integral power supply and battery charger designed to charge required amp hour

batteries in order to support 60-hour standby with 15 minutes of system operation.

M. The PACS must be designed to perform a wide variety of functions as part of a Total Security Management Solution.

1. Provide the at the minimum the following system modules and/or functions shall be provided as part of the system installation:

- a. Access Control.
- b. Alarm Monitoring.
- c. ID Management.
- d. Digital Video.
- e. Remote Access Level Management.
- f. Third Party Interfaces.
- g. System Administration.
- h. Importation of Third Party Data Bases and Photographs
- i. Screen/Forms Creation.
- j. Graphical Map Creation.
- k. Application Programming Interfaces.
- l. Data Import.
- m. Bi-Directional Data Exchange.
- n. Threat Management Functionality.

N. The system shall be capable of logging and storing minimum of 800 events in an alarm log and 800 events in trouble log. These events shall be stored in a battery protected random access memory.

1. The Historical Event Recording printer shall include at the minimum the following functions:

- a. Printer and memory are to record access control and use selected change-of-state activity.
- b. The invalid card transactions and alarm conditions are to produce an audible signal when reported to the printer and memory.
- c. The historical data shall include the month, date, day of week, hours, and minutes to identify the time of occupancy, and reader location identification.
- d. In addition, at the minimum the following alarm events shall also be displayed on the system printer and shall be stored in the system Historical Alarm Log.
- e. Alarms.
- f. Alarm Acknowledgment.
- g. Alarm Silence.
- h. Alarm Historical log cleared.

2. The minimum trouble events shall also be displayed on the system printer and shall be stored in the system Historical Trouble Log

- a. Trouble conditions.
- b. Trouble Acknowledgment.
- c. Invalid Attempt.
- d. Door Ajar Time out Indication.
- e. Trouble Historical log cleared.

O. Time Schedule Operations:

1. Provide a minimum 256 time schedules. Time schedules are to be used for:
 - a. Arm/disarming of any input.
 - b. On/off state of any output.
 - c. Instructional text in response to alarms.
 - d. Change in state/status of any previous operator commands.
 - e. Enable/disable card readers and/or PIN keypads.
 - f. Authorized access periods.

P. User Data Base:

1. Provide as a minimum the following fields and character space for card user identification:
 - a. Card Number: 9 digits.
 - b. Keypad PIN: Up to 4 digits.
 - c. User Time Zone: Minimum of 63.
 - d. Facility Office Code: 0-99.
 - e. User Number: 9 alphanumeric.
 - f. User Name: 32 alphanumeric.
 - g. User Address: Street - 25 alphanumeric.
 - h. User Address: City and Street - 25 alphanumeric.
 - i. Issue Date: MMDDYY.
 - j. Card Activation Date: MMDDYY.
 - k. Card Deactivation Date: MMDDYY.
 - l. Department/Division: 4 alphanumeric.
 - m. Work-Shift Number: 1, 2, 3.
 - n. Telephone Number: 12 numeric.
 - o. Car Tag Number: 12 numeric.
 - p. Personnel Status: 1 alphanumeric (employee, visitor, contractor, maintenance).
 - q. A minimum of 50 user definable personal data fields.

Q. Event Levels:

1. As a minimum the system shall be capable of no less than six (6) different event levels.

R. Site Coding:

1. Cards shall be manufactured with a site code unique to this facility.

S. Auto-Lock-Up:

1. The System shall support a Bulk Cardholder functionality that will allow a administrator to sort and select multiple cardholders, after selection various data fields including access codes, inactive date, badge type, etc. can be edited, saved and downloaded to DGP's, in order to facilitate the possibility of zeroing out the user time zones voiding card access entries.

2.4 PERFORMANCE REQUIREMENTS

- A. The Access Control System shall provide five (5) area control features: Hard Anti-passback, Soft Anti-passback, Timed Anti-passback, Two Person Control, and Occupancy Limit. Area control shall be a security method of preventing a person from passing their badge to another person for dual entry into a single location utilizing one card.

1. Hard Anti-passback

- a. The Hard Anti-passback feature shall require that a badge always be used to enter and exit an area. The controlled areas shall have both entry and exit card readers at all portals. Areas shall be logically defined under the system, and area control shall not be required at all areas of the facility to be utilized.
- b. Hard Anti-passback shall work in the following manner. A cardholder must present his/her badge at the entry card reader of the area that the person wishes to enter. Once access has been granted into the area, the cardholder cannot present the badge to another entry card reader within the same area without first presenting his/her badge to the respective exit card reader of that area. Should a cardholder attempt to use any other card reader in the same area besides the occupied area's exit card reader once access has been granted to that area, the cardholder shall be denied access and an alarm shall be reported to the alarm monitoring client workstation.
- c. Nested control areas (areas inside areas) shall be definable with a minimum of 64 entry and exit card readers. It shall be possible to have an area within an area and/or multiple areas that are independent of each other in which Hard Anti-passback rules shall apply.

2. Soft Anti-passback

- a. The Soft Anti-passback feature shall require that a badge be used to enter and exit an area. The controlled areas shall have both entry and exit card readers at all portals. Areas shall be logically defined under the system, and area control shall not be required at all areas of the facility to be utilized. Soft Anti-passback shall work in the following manner. A cardholder must present his/her badge at the entry card reader of the area that the person wishes to enter. Once access has been granted into the area, the cardholder cannot present the badge to another entry card reader within the same area without first presenting his/her badge to the respective exit card reader of that area.
- b. It shall be possible to have an area within an area and/or multiple areas that are independent of each other.

- 1) Should a cardholder attempt to use another card reader in the same area besides the occupied area's exit card reader, the cardholder shall be allowed access. (if that cardholder has the appropriate authorizations to the new area), and an alarm shall be reported to the alarm monitoring client workstation.
 - 2) The following summary criteria shall apply under Hard or Soft Anti-passback:
 - (a) Initially (Time 0) all cardholders are reset to Area 0.
 - (b) Any cardholder shall enter a controlled area any time after Time 0 by presenting a badge to a system entry card reader.
 - (c) A cardholder shall not exit the controlled area unless he has entered the area presenting a badge to the system entry card reader.
 - (d) A cardholder shall not enter the controlled area a second time unless the cardholder has exited that area previously.
 - (e) A cardholder shall be able to enter through any entry card reader and exit through any exit card reader of a single controlled area.
 - (f) These options include a "forgiveness" feature that will allow the System Administrator to reset the anti-passback of all cardholders to Time 0 Area 0, either through a manual override or a time zone command.
 - (g) The system shall provide an anti-passback exempt option for privileged or VIP cardholders. Cardholders with this option will not have anti-passback rules applied to them.
 - (h) The system shall also have a "forgiveness" feature that will allow the System Administrator to assign "one free pass" to an individual cardholder. This will allow the System Administrator to reset the anti-passback of an individual cardholder to Time 0 Area 0.
3. Timed Anti-passback
- a. Timed Anti-Passback shall allow the System Administrator to decide how long after a cardholder has swiped their badge that they will have to wait before the same badge will be accepted again at the same card reader. This helps prevent multiple swipes by an individual to allow access to others through turnstile doors.
4. Two Person Control
- a. Two Person Rule shall be provided to restrict access to certain areas unless there are two (2) cardholders present. This restricts individuals from being alone in restricted or highly secure areas. When an area is configured for Two Person Rule, the following criteria shall prevail:

- 1) The card reader will grant access only if two valid cardholders (with authorized access levels) swipe their badges one after the other. In the event that a second authorized card is not presented within 10 seconds of the first authorized badge, the card reader shall reset and the first card will have to be swiped again.
- 2) Once 2 people occupy an area, individual access shall be granted.
- 3) Individual exit shall be permitted until an area is occupied by only 2 cardholders at which point the Two Person Rule applies for exit.

5. Occupancy Limit

- a. Occupancy Limit shall restrict the number of cardholders that will be present in an area at any given time. The Occupancy Limit area shall be able to be defined by the System Administrator to limit up to 999,999 cardholders to be in that area at any given time. Once the occupancy limit has been reached, a cardholder must swipe out of the exit card reader before the next cardholder may enter. Each area for which Occupancy Limit is enabled shall be definable with up to 64 entry/exit card readers.
- A. A valid read at any door, shall provide a valid access indication on the client workstation(s) and cause the door to unlock with the following exceptions:
 1. A heightened security condition exists within the facility.
 2. Individual does not have authorization to enter the protected space.
 - B. A valid read at selected exterior door locations shall provide a valid access indication on the client workstation(s), cause the door to unlock and the intrusion detection system to disarm, with the following exceptions:
 1. A heightened security condition exists within the facility.
 2. Individual does not have authorization to enter the facility after hours.
 - C. At a predetermined time according to the days of the week, excluding holidays the access control system shall have the capability to automatically disarm the intrusion detection system open and close parking garage doors. All selected door-locking mechanisms shall remain functional. Coordinate with Government User Agency all operational requirements for this feature.
 - D. Each individual door must have the capability of being assigned a Door Open Too Long (DOTL) Program that will initiate an alarm to the operator that the door has been left unsecured or has remained open longer than the user defined and programmed time interval.
 - E. Make provisions to permit operator to "shunt" an individual door alarm if appropriate operator level is utilized for reasons of frequent use or trouble; cause the following to occur:

1. Client workstation(s) will display door as zoned out of system.
2. Historical data logger will record to memory: time, date, location, operator that is signed on, and event as "shunted."
3. Journal printer will print activity.

- F. Any user programmed alarm event shall cause the access control system, Client workstation(s) to provide an audible and visual alarm requiring the operator to acknowledge the event and enter via the keyboard a report of the event and cause.

2.5 CARD/KEY DATA

- A. The system shall utilize card products designed specifically for security applications. The Proximity cards shall be industry standard and designed to feed through direct card printers.

1. Proximity shall be an access control/identification technology that utilizes radio frequency (RF) circuits in microchip form. The microchips are encoded and transmit the encoded information when activated. The proximity card shall be used with its associated proximity and bio-metric card readers. The system shall be provided with the following proximity card design:
2. The proximity card shall be a PVC dual technology card that employs proximity, technologies as well as support bar-code and magnetic applications. It shall comply with ISO 14443 and 15693 standards. Maximum thickness shall be 30 mil. The card shall permit the printing of cardholder record fields including photo directly on the card and on the reverse print bar-code encryption data. Cards must be durable and insensitive to magnetic fields and dirt.
3. Maximum Card Dimensions: 3-3/8 inches by 2-1/8 inches.
4. Cards shall be capable of being printed by Government User Agency with custom artwork, laminated photo ID, and shall include slot punching for strap or chain.
5. Proximity cards shall be "I-Class" 13.56 MHz contact-less smart cards technology as manufactured by HID. No Substitutions shall be accepted.

2.6 AUXILIARY POWER SUPPLIES

- A. Provide as required UL listed auxiliary power supplies with battery backup in sufficient quantities to ensure proper operation of the entire system. Power supplies shall be 12/24 volts as required to support all power requirements associated with all electronic door locking mechanisms, ancillary system controls and all manufacturers recommendations. The auxiliary power supply units shall at the minimum meet the following requirements

1. The power supplies shall sized to provide power for all access control system communications equipment, electronic door locks and/or remote ancillary panels.

2. The power supply shall be rated at a minimum of 6.0 amps continuous of regulated 12/24-volt power as required by the manufacturer recommendations. It shall include an integral charger designed to charge required amp hour batteries in order to support 60-hour standby with 15 minutes of system operation for alarms and door lock operations
3. The auxiliary power supplies shall include power limited circuitry, per 2003 UL standards and shall be UL listed for fire alarm system integration.

2.7 DOOR CONTROL DEVICES

A. Card Readers (Standalone Device)

1. Card readers to be supplied, installed and wired be Division 26 Contractor shall be provided at all elevators, gates, vehicle pedestals and overhead garage doors as indicated by the contract documents. The Contractor shall review all door hardware specification and coordinate with the door hardware provider for all doors requiring standalone card readers. At the minimum these reader locations be configured as follows:
 - a. All card readers shall utilize "I-Class 13.56 MHz proximity protocols and shall utilize proximity and/or proximity/biometrics technologies with Wiegand output. All proximity readers shall be manufactured by HID no substitution no approved equal.
 - b. Card readers at all elevator and gate locations shall have a maximum dimension of 8 inches square, and have a minimum read range of 6 inches. Coordinate with the appropriate trade and card reader manufacturer the installation requirements for optimum read range and operation. All proximity readers shall be manufactured by HID no substitution no approved equal.
 - c. Card readers at all gates, vehicle pedestals and overhead garage door locations shall not exceed 12x12 inches, and have a minimum read range of 12 inches. Coordinate with the appropriate trade and card reader manufacturer the installation requirements for optimum read range and operation. All proximity readers shall be manufactured by HID no substitution no approved equal.
 - a. All exterior readers shall be weatherproof and capable of operating in the anticipated environmental conditions for the region. Seal all openings and penetrations with manufacturer approved sealant.

B. Card Readers (Integral to Door Locking Hardware)

1. Card readers to be supplied and installed under the Door Hardware specification section 08 71 00 and wired by the division 26 contractor shall be provided at all building, room and space egress doors where indicated on the Security drawings. These readers shall be integral to the electronic locking hardware and provided under door hardware specification. At the minimum the integral door lock and proximity reader shall be configured as follows:

- a. Reader shall be proximity type with Wiegand output and shall utilize "I-Class PIV" 13.56 MHz proximity protocol.
- b. Integral request to exit device.
- c. Integral request door position switch.

2. NOTE: The ESSI shall review the door hardware specification and coordinate with door hardware provider for exact device types, quantities, wiring requirements and locations.

C. Request to Exit Device

1. Supplied under the Door Hardware specification section 08 71 00. Installed and wired by the division 26 contractor. Coordinate with door hardware provider for exact device type, quantities, wiring requirements and locations.
2. In addition to causing the release of the door lock, the unit shall cause the bypassing of the door contact for a period of time as determined by the Department.

D. Door By-Pass Switches

1. Supplied under the Door Hardware specification section 08 71 00. Installed and wired by the division 26 contractor. Coordinate with door hardware provider for exact device type, quantities, wiring requirements and locations.
2. The Door by-pass switches shall be mounted at 48 inches on center AFF and within 5 feet of the door. Coordinate with hardware contractor, VA's Contracting Officer and Design Professional for exact location.
 - a. Note door by pass switches shall be provided at all access controlled door locations regardless of the type of Request to Exit Device provided in accordance with all requirements of IBC-2009 Chapter 10.

E. Door Position Switch/Door Contact

1. Supplied under the Door Hardware specification section 08 71 00. Installed and wired by the division 26 contractor. Coordinate with door hardware provider for exact device type, quantities, wiring requirements and locations.

F. Magnetic Door Locks (MAG Lock)

1. Supplied under the Door Hardware specification section 08 71 00. Installed and wired by the division 26 contractor. Coordinate with door hardware provider for exact device type, quantities, wiring requirements and locations.

G. Electric Door Strike

1. Supplied and installed under Door Hardware specifications section 08 71 00 and wired by the division 26 contractor. Coordinate with hardware contractor for exact device type, location and wiring requirements.

H. Door Lock Power Supplies

1. Supplied under the Door Hardware specification section 08 71 00. Installed, wired and powered by the division 26 contractor. Coordinate with door hardware provider for exact device type, quantities, wiring requirements and locations.

PART 3 - EXECUTION

3.1 EQUIPMENT PROTECTION

- A. Comply with all requirements of specification section 28 05 00.
 1. Examine all physical and environmental conditions, door hardware specifications, equipment locations and wide area network connectivity requirements impacting the installation of the systems and report any unsatisfactory conditions in writing to the VA's Contracting Officer and Design Professional.

3.2 WORK PERFORMANCE

- A. In addition to all requirements as specified by Specification Section 28 05 00 the Access Control system shall also be provided in accordance with the following requirements:
 1. Prior to the final programming of any systems, the Contractor shall provide a review with the VA's Contracting Officer and Design Professional addressing all system features, functions, operations, integrated system responses, graphic maps and related operational programming.
 - a. Failure to provide this review and get final sign-off prior to programming shall result in any costs related to changes requested by the VA's Contracting Officer and Design Professional at no additional costs to the project.

3.3 EQUIPMENT/CABLE INSTALLATION AND REQUIREMENTS

- A. In addition to all requirements as specified by specification section 28 05 00 the PACS shall also be provided in accordance with the following requirements:
 1. Where it is the intention of the ESSI to provide a TCP/IP based physical access control system all cabling shall utilize Category-6 UTP cables and installed in accordance with the requirement of specification section 28 05 00. All cabling shall not contain any AC carrying conductors or non-associated system cables within the cable raceways\conduits or cable bundles.

- a. In addition, all structured cabling associated with the installation of the PACS shall comply with all requirements of related specification sections for the proper installation, termination and testing of Category-6 UTP cabling.
 - b. All PACS cabling installed on the exterior to the building and/or all cabling being routed from the facility to any remote location external in the project shall be utilize fiber optic cable and installed in dedicated conduits.
 - c. Contractor shall provide equipment, components, devices, hardware, patch panels and all appurtenances necessary to provide a fully operational system utilizing a UTP cabling topography. Coordinate all system cabling with system provider prior to shop drawing submission.
 2. In addition to all power requirements stipulated in specification section 28 05 00 and the related Chapters of this specification sections, all electrical power for remote system components shall be obtained from dedicated power supplies located at the nearest security electronics room. All 120-Volt power for any PACS components and\or devices shall be supplied from the nearest appropriate emergency electrical distribution panels. Systems components employing the use of plug-in transformers for power shall not be acceptable.
 - 1) All system power supplies serving exterior system components or devices shall be provided with the appropriate transient surge and suppression protection on both the line side as well as the load side. Refer to specification section 28 05 00 for additional requirements.
 - B. Installation of all equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate trade contractors.
- 3.4 ELECTRICAL POWER DISTRIBUTION**
- A. Comply with all requirements of specification section 28 05 00.
- 3.5 TRANSIENT VOLTAGE SUPPRESSION**
- A. Comply with all requirements of specification section 28 05 00.
- 3.6 GROUNDING AND BONDING**
- A. Comply with all requirements of specification section 28 05 00.
- 3.7 EQUIPMENT IDENTIFICATION**
- A. Comply with all requirements of specification section 28 05 00.
- 3.8 MAINTENANCE & SERVICE**
- A. Comply with all requirements of specification section 28 05 00.

3.9 WARRANTY

- A. Comply with all requirements of specification section 28 05 00.

3.10 Field Services

A. TESTING

1. In addition to all requirements as specified by Specification Section 28 05 00 the physical access control system shall also comply with the following requirements:
 - a. The completed access control system shall be fully tested in accordance with all requirements of NFPA 731. Upon completion of a successful testing, the contractor shall so certify in writing to the VA's Contracting Officer and Design Professional all was completed, tested, certified and left in first class operational condition, include all completed NFPA 731 certification and test reports.
 - b. The service of a competent, factory-trained engineer or technician authorized by the equipment manufacturer shall be provided to technically supervise installation and participate during initial system programming, start-up, final testing, assist in the final acceptance testing and Government Agency demonstrations.
 - c. At the minimum all acceptance testing, demonstrations and training shall include, but not be limited to the following:
 - 1) UPS Power and Secondary Power Distribution Capabilities
 - 2) Security Device Monitoring/Control Functions.
 - 3) Door Monitoring/Control Functions.
 - 4) HMI GUI map Integration and Functionality
 - 5) Automatic and Manual Threat Level Operations.
 - 6) Access Card Development and Printing.
 - 7) Third Party Database Import Functions.
 - 8) Remote System Access (LAN\WAN) and Dial up Functions.
 - 9) All programming and operational functions and features as herein specified.
 - 10) Cable Supervision System (random points to be selected by the VA's Contracting Officer and Design Professional).
 - d. Demonstrate each system and subsystem. The demonstration shall include, but not be limited to the following:
 - 1) Designate actual location of each component of a system or subsystem and demonstrate its function and its relationship to other components within the system.
 - 2) Demonstrate the operation of all client servers, door interlock and bypass functions, camera call-up operations, graphic map functions, administration set-up, configurations and operations, badging functions and operations, emergency operations and system reboot procedures.

- 3) Demonstrate all systems and subsystems operations by actual "LOCK/UNLOCK, ARM/DISARM" cycling showing how to work controls, how to reset devices, how to replace fuses and emergency operating/operations procedures.
- e. Upon final inspection a factory-trained and certified representative of the equipment manufacturer shall demonstrate to the VA's Contracting Officer and Design Professional that the system functions properly in every respect and is in full compliance with the contract documents. This requirement is in addition, to all testing requirements listed in specification section 28 05 00 and related specification sections.
 - 1) Provide a minimum of (4) four 4-hour training classes performed at the project location and spaced over a two week interval. Training classes shall be scheduled not less than 48 hours apart to allow Government Agency operators to familiarize themselves with all system operations.
 - 2) Include all training manuals, video instructions and hands-on demonstrations in the operation of all system components. Provide to the VA's Contracting Officer and Design Professional in advance lesson plans outlining training procedures, course outlines and objectives. Coordinate with VA's Contracting Officer and Design Professional in advance all training dates and schedules.

END OF SECTION

SECTION 28 31 00
FIRE ALARM AND SIGNALING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Division 26 Specification Sections shall apply to this and all related Division 28 specification sections.
- B. Related Sections:
 - 1. 07 08 00 - Fire Stopping
 - 2. 08 31 13 - Access Doors
 - 3. 26 05 00 - Requirements for Electrical Installations.
 - 4. 26 05 21 - Low Voltage Electrical Power Conductors and Cables.
 - 5. 26 05 26 - Grounding and Bonding for Electrical Systems
 - 6. 26 05 33 - Raceways and Boxes for Electrical Systems
 - 7. 28 05 00 - Common Work Results for Safety and Security Systems
 - 8. 28 13 00 - Physical Access Control System (PACS)
- C. Reference Symbols:
 - 1. All device symbols are defined by the appropriate symbol schedules. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location.
 - a. Contractor shall coordinate exact locations with all architectural drawings, reflected ceiling plans, furniture plans, mechanical and electrical drawings as well as all affected trades prior to submittal of any shop drawings.
- D. Abbreviations:
 - 1. Refer to Specification Section 28 05 00 for additional information.
- E. Definitions:
 - 1. Refer to Specification Section 28 05 00 for additional information.

1.2 SUMMARY

- A. This Section includes basic design requirements for the extension and modification of the existing Addressable Fire Alarm and Voice Evacuation Signaling System as specified herein and as shown on the contract drawings; the system shall be wired, connected, and left in first class operating condition.

1. The contractor shall include all labor, materials, cabling, system control panel(s), remote annunciator(s), remote transponder panels (DGP), manual stations, automatic fire detectors, smoke detectors, alarm notification appliances, cable terminations, electrical power, backboxes, and appurtenances. In addition, all software, programming, testing, commissioning and modifications to the existing facility's fire alarm and voice evacuation system shall be provided as necessary for a complete fully operating system as herein specified.
 - a. The installation, performance, features, functions, software and programming criteria as specified herein as well as all related specification sections have been designed to offer the maximum system efficiency ease of operation, occupant safety and the protection of equipment as recommended by the VA's Contracting Officer and Design Professional.
 - 1) Any deviations from the specified criteria shall be documented, reviewed and agreed to in writing by VA's Contracting Officer and Design Professional prior to submission of bids. Refer to Division 1, and all related specification section for product substitutions.
 2. The fire alarm and signaling system shall comply with requirements of NFPA Standard 72 for protected premises signaling systems except as modified and supplemented by this specification. The complete installation shall conform to the applicable sections of NFPA-70 National Electrical Code (Article 760). The system shall be electrically supervised and monitor the integrity of all conductors.
- B. Prior to the submission of the Bid, any discrepancies or inconsistencies noted within these specifications and/or the project drawings shall be brought to the immediate attention of the VA's Contracting Officer and Design Professional.
1. All equipment symbols are shown on drawings as close as possible to their intended location. Contractor shall coordinate the installation of all equipment, devices, controls, cabling and integration of any systems with all affected trades and system integrators. The Contractor shall document all coordination requirements at the time of shop drawing submissions.
 - a. The Contract Drawings for this work are diagrammatic and intended to convey the extent, general arrangement and locations of the work. Because of the scale of these drawings, certain basic items such as access panels, conduits, cabinet sizes, penetration sleeves, pull boxes, backboxes and junction boxes may not be shown.

- 1) The contractor shall include all equipment, materials, components, and appurtenances where required by code, by manufacturers' recommendations, as well as all related Contract Documents in order to ensure proper installation operation and integration of all components, equipment, devices and/or systems.
- C. The Contract drawings and specifications may not deal individually with every part, control, device, software or programming, which may be required to produce the equipment and/or system performance specified or as necessary for the installation and/or integration of any systems in accordance with any requirements of the Contract Documents.
1. The Contractor shall include all such items and components, as required, for the complete and operational installation of all system components as defined by the Contract Documents, whether or not specifically indicated and/or specified.
 - a. Include such items, as required, for a complete operational system.
 - b. Coordinate with all architectural drawings, reflected ceiling plans, furniture plans, mechanical and electrical drawings as well as all applicable trades in submittal of shop drawings and the installation of all systems.
 - c. Shop drawings shall detail space conditions to accommodate other concerned trades, subject to final review by the VA's Contracting Officer and Design Professional.
 - 1) If installation of equipment, raceways, cable trays and/or conduit is performed prior to coordination with all architectural drawings, reflected ceiling plans, furniture plans, mechanical and electrical drawings and other trades, which interferes with work of other trades, disciplines or systems this contractor shall make necessary changes to correct the condition at no additional cost to the Project.
 - d. The contractor shall be responsible for providing all wiring, connections to all equipment, circuits and devices as well as all coordination and programming for the integration of all ancillary systems impacting the operation of surveillance system. Refer to the contract drawings and related specification sections for additional information.

1.3 REFERENCES

- A. All references to industry and trade association standards as well as all building codes are minimum installation requirements for this system. The codes, standards and agencies listed in specification section 28 05 00 shall form a part of this specification section and all work shall comply with the latest adopted standards.

1. The publications listed in specification section 28 05 00 (including all amendments, addenda, revisions, supplement, and errata) shall form a part of this specification section to the extent referenced. The publications are referenced in the aforementioned specification section by the basic designation only.
 - a. Where the contract drawings and/or specification sections mandate a greater requirement or performance than those specified by the referenced applicable codes and standards, the requirements of the contract drawings and/or specification sections shall be the governing requirements for this project and shall be delivered accordingly.

1.4 SUBMITTALS

- A. In addition, to all submittal requirements as specified by Division 1, Specification Section 28 05 00 and all related specification sections, the shop drawing submittals shall also be provided in accordance with all requirements as herein specified.
 1. The contractor shall also provide an identical submission to authorities having jurisdiction. Include copies of annotated Shop Drawings sealed by reregistered engineer if necessary indicating all information as defined by Specification Section 28 05 00 in order to facilitate proper review. Resubmit if required to make requested clarifications or revisions to obtain approval.
 - a. On receipt of comments from authority and prior to the start of any construction, submit to the VA's Contracting Officer and Design Professional for review a copy of all AHJ approved drawings. Failure to comply with this requirement shall extend all liabilities to this contractor for any modifications necessary to the system in order to obtain a Certificate of Occupancy.

1.5 QUALITY ASSURANCE

- A. Conform to all requirements as specified by Division 1, Specification Section 28 05 00 and all related specification sections.

1.6 RECORD DOCUMENTS

- A. In addition, to all requirements as specified by Division 1, Specification Section 28 05 00 all record documents shall also be provided in accordance with all requirements as herein specified.
 1. Provide (2) two complete and current copies of the system programming in accordance with all requirements of the paragraph 1.7 of this specification.
 2. Provide (2) two complete and current copies of all smoke detector test and calibration results

1.7 SOFTWARE AGREEMENT

- A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections Comply with all requirements of specification section 28 05 00.

1.8 EXTRA MATERIAL

- A. In addition to all requirements of specification section 28 05 00 provide the following extra material;
 - 1. Two (2) Addressable Smoke Detectors w/Bases
 - 2. Two (2) Addressable Heat Detectors w/Bases
 - 3. Two (2) Addressable Duct Smoke Detectors w/Housings & Sampling Tubes
 - 4. Three (3) Addressable Monitor Modules
 - 5. Three (3) Addressable Control Modules
 - 6. Three (3) ADA Horn/Strobe Units 75 Candela w/Surface Boxes
 - 7. Three (3) ADA Strobe Units 75 Candela w/Surface Boxes
- B. All extra materials shall be delivered at the time of final acceptance of the system(s). At no time is the contractor to use the extra materials provided for this project to replace malfunctioning equipment and or components prior to final acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

- A. Comply with all requirements of specification section 28 05 00.

2.2 MANUFACTURER

- A. Acceptable manufacturer's for this project, providing full compliance with this specification section and specification 28 05 00 requirements shall be as follows:
 - 1. EST. UTC (United Technologies Co.) as provided by Intelligent Electronic Systems (IES) Bridgeville, Pa 15017. Contact Mr. Thomas White @ 412-206-0400
 - 2. Above manufacturer has been approved as an extension of the existing facility system in order to maintain continuity of operation. No Substitutions shall be accepted.
- B. Manufacturers listed as acceptable shall not negate the contractor's responsibility for providing the fire alarm system in accordance with all functions and performance requirements of this specification.
 - 1. Equivalent UL - listed equipment "May Not" be substituted for the specified manufacturer. Refer to specification section 28 05 00 for additional information.

- C. Each and all items of the Fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriter's Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable.
 - 1. The fire alarm equipment manufacturer shall be an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

2.3 SYSTEM DESCRIPTION

- A. This Section includes basic design requirements for the installation and expansion of the existing Addressable Fire Alarm System as specified herein and as shown on the contract drawings; to be wired, connected, and left in first class operating condition. Include sufficient control panel(s), remote annunciator(s), remote transponder panels (DGP), manual stations, automatic fire detectors, smoke detectors, alarm notification appliances, wiring terminations, electrical boxes, and appurtenances as well as all necessary material and labor for a complete operating fire alarm system as herein specified.
 - 1. Note: It is the scope of this project that all new fire alarm control panels to be fully intergrate to the existing networked campus fire alarm system.
 - a. The Contractor shall include all necessary cabling, equipment, componets, fiber trancivers modules, and modifications to the existing fiber optic network as well as all changes and testing to the existing campus wide network programming to ensure a fully operating network based fire alarm.
- B. The fire alarm system shall be an active/interrogative type system where each remote transponder and/or addressable device is repetitively scanned, causing a signal to be transmitted to the main fire alarm control panel (FACP) indicating that all DGP's, field devices and/or all associated circuit wiring is functional. Loss of this signal at the main FACP shall result in a trouble indication as specified hereinafter for the particular input.
- C. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory. Alarm signals arriving at the main FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
- D. Full flexibility for selective input/output control functions based on ANDing, ORing, NOTing, timing, and special coded operations shall also be incorporated in the resident software programming of the system.

- E. Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate changes in system function and performance. Resident software shall also allow for configuration of indicating appliance and control circuits so that additional hardware shall not be necessary to accommodate changes.
- F. The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event in history.
- G. Each Initiating Device Circuit (IDC) and/or Signaling Line Circuit (SLC) shall be sized up to 75% of their rated capacity and wired as NFPA 72 Style 4 (Class B) circuits. All Notification Appliance Circuits (NAC) shall be sized up to 75% of their rated capacity and wired as NFPA Style Y (Class B) circuits.

2.4 SYSTEM OPERATION

- A. The system fire alarm operation subsequent to the alarm activation of any manual station, automatic detection device, or sprinkler flow switch shall be as follows:
 - 1. Display all alarm location information at the local Fire Alarm Control Panel.
 - 2. Display all alarm location information on all remote LCD annunciators, network command terminals and printers where existing and/or where provided as part of this project.
 - 3. Display all alarm location information at the main FACP.
 - 4. All alarm notification appliances shall sound in a temporal ringing manner, throughout the protected premises, until silenced by the appropriate switch at the fire alarm control panel.
 - 5. All visual notification appliances, (Xenon Strobes) shall operate throughout the protected premises, in a synchronized cadence until the system is reset.
 - 6. An alarm signal shall be transmitted to main FACP for the facility.
 - 7. The activation of any alarm-initiating device shall cause the release of all magnetically held open or electronically locked doors.
 - 8. The alarm activation of any duct-mounted smoke sensor shall initiate all smoke control functions in accordance with NFPA 72.
 - 9. Alarm activation of any automatic smoke detector sprinkler water flow switch and/or kitchen suppression system, in addition to above sequence of operations, shall also transmit an automatic signal to the appropriate mechanical equipment to initiate all smoke control functions for the zone of alarm in accordance with all NFPA 92A recommendations and all operations specified herein.
 - a. The fire alarm system shall provide all capabilities for manual override, control and status indication of all fans and dampers associated with all smoke control functions at the FFCS panel location which shall be provided by the fire alarm system supplier. Refer to division 23 specification sections and Mechanical drawings for coordination of the smoke control system configurations and operations.

10. Display all system activities along with time and date of occurrence on all system printers and network command center terminals where provided as part of this project.
 11. System activity on the FACP shall retain the information, along with time and date of occurrence in history storage log.
- B. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs shall be activated.
- C. The fire alarm system shall monitor the following alarm and supervisory conditions: PUMP RUNNING, PUMP FAIL and PHASE REVERSAL for all electric fire pumps provided as part of this project and/or PUMP RUNNING, PUMP FAIL and Low Fuel for all diesel fire pumps provided as part of this project.
1. The contractor shall coordinate with fire protection contractor for the proper integration of the fire alarm system and fire pump controller in accordance with NFPA 72 and NFPA 20 requirements. Refer to fire protection drawings for exact location and number of fire pump controllers.
- D. Where permitted by the authority having jurisdiction the activation of any system smoke sensor shall initiate an Alarm Verification operation, whereby the panel will reset the activated detector and wait for a second alarm activation. If, within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute the system shall resume normal operation. The Alarm Verification shall operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately. Device, zone or group of zones shall select the alarm verification operation.
1. The control panel shall have the capability to display the number of times (tally) a zone has gone into a verification mode. Should this smoke verification tally reach a pre-programmed number, a trouble condition shall occur.
 2. Alarm verification zones shall be able to be divided into separate groups whereby only verification zones from the same group will confirm the first activation and cause the alarm sequence to occur.
- E. The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.
- F. The activation of any standpipe, PIV valve or sprinkler valve supervisory (tamper) switch shall activate the systems supervisory audible signal and illuminate the LED at the control panel, remote annunciators and printers. Differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring shall be provided.
1. Pressing the Supervisory Service Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory Service LED "on" indicating the off-normal condition.
 2. Restoring the valve to the normal position shall cause the Supervisory Service LED to extinguish, indicating restoration to normal.

3. All supervisory location information shall be displayed on all remote LCD annunciators, network command terminals and printers where existing and/or provided as part of this project.
 4. A supervisory signal shall be transmitted to the main FACP for the facility.
- G. The activation of any pre-action supervisory function (low air pressure) switch shall activate the systems supervisory audible signal and illuminate the LED at the control panel, remote annunciators and printers. Differentiation between low pressure indication and opens and/or grounds on the initiation circuit wiring shall be provided.
1. Pressing the Supervisory Service Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory Service LED "on" indicating the off-normal condition.
 2. Restoration air pressure to the normal PSI shall cause the Supervisory Service LED to extinguish, indicating restoration to normal.
 3. All supervisory location information shall be displayed on all remote LCD annunciators, network command terminals and printers where existing and/or provided as part of this project.
 4. A supervisory signal shall be transmitted to the main FACP for the facility.

2.5 SYSTEM SUPERVISION

- A. The system shall contain addressable inputs/outputs. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.
1. There shall be a supervisory initiation circuit for connection of all sprinkler supervisory valves (tamper). Device activation shall cause a supervisory alarm condition at the control panel.
 2. There shall be the required number of independently supervised and independently fused indicating appliance circuits for audible alarm devices and visual alarm strobes. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
 3. Each independently supervised circuit shall include a discrete LCD readout to indicate disarrangement conditions per circuit.
 4. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.
 5. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel.
 6. All system modules shall be electrically supervised for module placement. Should a module become disconnected the system trouble indicator shall illuminate and the audible trouble signal shall sound.
 7. The system shall have provision for disabling and enabling all circuits, and/or devices individually for maintenance or testing purposes.

8. All trouble indications in addition to above shall display all trouble location information on all remote LCD annunciators, network command terminals and printers where provided as part of this project and a supervisory signal shall be transmitted to an approved central monitoring station.

2.6 SYSTEM POWER REQUIREMENTS

- A. In addition, to all power requirements as specified by Specification Section 28 05 00 system power shall also be provided in accordance with all requirements as herein specified
 1. All control panels, transponder panels and remote auxiliary power supplies shall receive 120 VAC emergency power via a dedicated fused disconnect circuit from the nearest emergency power distribution panel.
 2. All control panels and remote auxiliary power supplies shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120VAC power in a normal supervisory mode for a period of (60) sixty hours, with (5) five minutes of alarm activation available at the end of the 24 hour period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operation shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70% capacity in 12 hours.
 3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control panel.
 4. All control equipment must have transient protection to comply with UL864 requirements. Where Fire Alarm circuits leave the building, additional transient protection must be provided for each circuit. Devices must be UL listed under standard #497B (Isolated Loop Protectors).

2.7 FIRE ALARM CONTROL PANEL

- A. Control Panel construction shall be modular with solid state, microprocessor based electronics. It shall display only that primary controls and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the fire alarm control during a fire alarm condition.
- B. At a minimum the following primary controls shall be visible through a front access panel:
 1. Eighty-character liquid crystal display.
 2. Individual red system alarm LED.
 3. Individual yellow supervisory service LED.
 4. Individual yellow trouble LED.
 5. Green "power on" LED.
 6. Alarm Acknowledge Key.
 7. Supervisory Acknowledge Key.
 8. Trouble Acknowledge Key.
 9. Alarm Silence Key.
 10. System Reset Key.
- C. The following secondary control switches shall be available behind the access panel:

1. City Box disconnect/switch (Central Station Connection)
 2. Manual evacuation (drill)
 3. Elevator Shunt Trip bypass
 4. Spare
- D. At a minimum the control panel shall provide the following:
1. Setting of time and date.
 2. Lamp Test.
 3. Alarm, trouble, and abnormal condition listings.
 4. Enabling and disabling of each monitor point separately.
 5. Activation and deactivation of each control point separately.
 6. Multiple operator access levels.
 7. Walk Test enable/disable.
 8. Running diagnostic functions.
 9. Displaying software revision level.
 10. Displaying historical logs.
 11. Displaying card status.
 12. Point listing.
- E. For maintenance purposes the following lists shall be available from the point lists menu.
1. All points list by address.
 2. Monitor point list.
 3. Auxiliary control list.
 4. Scrolling through menu options or lists shall be accomplished in a self-directing manner. These controls shall be located behind an access panel.
- F. Primary Keys, LED's and LCD Display
1. The control panel shall have at the minimum a 2 line x 80-character liquid crystal display, which shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
 2. The display shall support both upper and lower case letters. Lowercase letters shall be used for soft key titles and prompting the user. Uppercase letters shall be used for system status information. A cursor shall be visible when entering information.
- G. The control panel shall automatically perform a daily self-test on each sensor. Checking the electronics in the sensor's base ensures the accuracy of the values being transmitted to the control panel. A sensor which fails the self-test will cause a "Self Test Abnormal" trouble condition at the control panel. Systems requiring a manually initiated self-test by an operator shall not be acceptable.
- H. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each sensor:
1. primary status
 2. device type
 3. present average value

4. present sensitivity selected
 5. peak detection values
 6. sensor range (normal, dirty, etc.)
- I. If the proposed system does not have the capabilities defined in paragraphs 2.2A through 2.2H, a maintenance and testing service program providing the following shall be included with the base bid:
1. Bi-annual sensitivity reading and logging for each sense. This is to be accomplished by use of a UL listed sensitivity calibration device per the requirement of NFPA-72.
 2. Schedule bi-annual threshold adjustments to maintain proper sensitivity for each smoke detector.
 3. Threshold adjustments to any smoke detector that has alarmed the system without the presence of particles of combustion. This service shall be performed within 4 hours of any such occurrence.
 4. Schedule bi-annual cleaning or replacement of each smoke detector or sensor within the system.
 5. If any device alarms the system without the presence of particles of combustion twice within 30 days, it shall be cleaned or replaced.
 6. Semi-annual functional testing of each detector using the manufacturers calibrated test tool (Unmeasured smoke or aerosol injection shall not be permitted).
 7. Written documentation of all testing, cleaning, replacing, threshold adjustment, and sensitivity reading for each automatic smoke-sensing device within the system.
 8. The initial service included in the bid price shall provide the above listed procedures for a period of five years after acceptance of system VA's Contracting Officer and Design Professional.
- J. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor.
1. Clear peak detection values
 2. Enable or disable the point
 3. Clear verification tally
 4. Control a sensor's relay driver output
- K. It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week. (For example, to be more sensitive during unoccupied times and less sensitive during occupied periods.) There shall be seven sensitivity settings available for each sensor.
- L. Under normal condition the front panel shall display a "System is Normal" message and the current time and date.
- M. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- N. The LCD shall display the following information relative to the abnormal condition of a point in the system.

1. 80-character custom location label.
 2. Type of device (i.e. smoke, pull station, water flow).
 3. Point status (i.e. alarm, trouble).
- O. Acknowledgment for each abnormal condition shall be (PER NFPA 72 Requirements).
1. Pressing the appropriate acknowledge button shall display the first unacknowledged condition in the appropriate list (either alarm, supervisory, or trouble), and require another acknowledge button. Press to acknowledge only the displayed point.
 2. After all points have been acknowledged, the LCD's shall glow steady and the Sonalert will be silenced. The total number of alarms, supervisory and trouble conditions shall be displayed along with a prompt to review each list chronologically. An end of list message "END of LIST" shall indicate the end of the list.
- P. Alarm Silencing
1. Should the "Alarm Silence" button be pressed all audible alarm signals shall cease operation.
- Q. System Reset
1. The SYSTEM RESET button shall be used to return the system to its normal state after an alarm condition has been remedied. The LCD display shall step the user through the reset process with simple English Language messages. Messages, "SYSTEM RESET IN PROGRESS" will first be displayed followed by the message, "SYSTEM RESET COMPLETED", and finally, "SYSTEM IS NORMAL", should all alarm conditions be cleared.
 2. Should the alarm condition continue the message, "SYSTEM RESET IN PROGRESS", will be followed by the message, "SYSTEM RESET ABORTED", and the system will remain in an abnormal state. System control relays shall not reset. The Sonalert and the Alarm LED will be on. The display will indicate the total number of alarms and troubles present in the system along with a prompt to use the ACK keys to review the points. These points will not require acknowledgment if they were previously acknowledged.
- R. Function Keys
1. Additional function keys shall be provided to access status data for the following points:
 - a. Initiating device circuits.
 - b. Indicating appliance circuits.
 - c. Auxiliary Relays.
 - d. All other input/output points.
 2. The following data shall be available:
 - a. Primary State of point
 - b. Zone, PID, and Card type information
 - c. Current priority of outputs
 - d. Disable/enable status

- e. Verification tallies of initiating devices
- f. Automatic/Manual Control Status of output points
- g. Acknowledge status

S. History Logging

1. The system shall be capable of logging and storing 300 events in an alarm log and 300 events in trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence.
2. The following Historical Alarm Log events shall be stored:
 - a. Alarms
 - b. Alarm Acknowledgment
 - c. Alarm Silence
 - d. System Reset
 - e. Alarm Historical log cleared
3. The following Historical Trouble Log events shall be stored:
 - a. Trouble conditions
 - b. Supervisory Alarms
 - c. Trouble Acknowledgment
 - d. Supervisory Acknowledgment
 - e. Alarm Verification tallies
 - f. Walk Test Results
 - g. Trouble Historical log cleared

T. LED Supervision

1. All slave module LED's shall be supervised for burnout or disarrangement. Should a problem occur the LCD shall display the module and LED location numbers to facilitate location of that LED.

U. System Trouble Reminder

1. Should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at preprogrammed time intervals to act as reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable to suit the facility's application.

V. Access Levels

1. There shall be a minimum of four (4) access levels with level 4 being the highest level. Level 1 action shall not require a pass code. Pass codes shall consist of up to ten (10) digits. Changes to pass codes shall only be made by authorized personnel.
2. In order to maintain security when entering a pass code the digits entered will not be displayed but a cursor will move along filling the position with an x to indicate that the digit has been accepted. All key presses will be acknowledged by a local audible sound.

3. When a correct pass code is entered, the message "Access Granted" shall be displayed. The new access level shall be in effect until the operator manually logs out or the keypads have been inactive for (10) minutes.
4. Should an invalid code be input, the operator shall be notified with the message, "ERROR...INCORRECT PASS CODE", and shall be allowed up to three chances to enter a valid code. After three unsuccessful tries, the message, "ACCESS DENIED", shall be displayed. The level shall not be altered, and the operator shall no longer be in the menu option.
5. Access to a level will only allow the operator to perform all actions within that level plus all actions of lower levels, not higher levels.
6. The following keys/switches shall have access levels associated with them:
 - a. Alarm Silence
 - b. System Reset
 - c. Set Time/Date
 - d. Manual Control
 - e. On/Off/Auto Control
 - f. Disable/Enable
 - g. Clear Historical Alarm Log
 - h. Clear Historical Trouble Log
 - i. Walk Test
 - j. Change Alarm Verification
7. Acknowledge keys shall also require privileged access to acknowledge points. If the operator presses an (ACK) key with insufficient access, an error message will be displayed. The points will scroll with (ACK) key presses to view the points on the list, but the points will not get acknowledged in the database.

2.8 ADDRESSABLE PERIPHERAL NETWORK

- A. Communication with addressable devices.
 1. The system must provide communication with initiating and control devices individually. All of these devices will be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
 - a. Alarm
 - b. Trouble
 - c. Open
 - d. Short
 - e. Device missing/failed
 - f. Device Type
- B. All addressable devices shall have the capability of being disabled or enabled individually from the main fire alarm control panel and all remote annunciator panels.

- C. Up to a maximum of 127 addressable devices may be multi-dropped from a single Initiating Device Circuit. Systems that do not support field reprogramming to add or delete devices are unacceptable.
- D. Format
 - 1. The communication format must be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address coded and check sum routines for the data transmission portion of the protocol. Systems that do not utilize full digital transmission protocol are not acceptable.
- E. Identification of Addressable Devices
 - 1. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. Systems requiring special device programming instruments are acceptable providing a spare programming instrument is provided to the Government at no additional cost. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable. The system must verify that the proper type device is in place and matches the desired software configuration.
- F. Wiring Type, Distances, Survivability, and Configurations.
 - 1. Wiring types will be approved by the equipment manufacturer. Existing wiring may be utilized in retrofit applications. The system shall allow at a minimum a line distance of up to 2,500 feet to the furthest addressable device on a Class B circuit. To minimize wire routing and to facilitate future additions t-tapping of the communications channel will be supported.
- G. Alphanumeric Remote Annunciator (FAA):
 - 1. Provide Remote Fire Alarm Annunciator Panel(s) where indicated on drawings and/or as required by the authority having jurisdiction.
 - a. At the minimum the contractor shall provide fire alarm annunciator panels at the main building entrance and main office unless otherwise indicated by the contract drawings.
 - 2. The remote fire alarm annunciator panel shall be a supervised, backlit LCD alphanumeric display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
 - 3. The remote annunciator shall display all alarm and trouble conditions from either the network node or the complete network.
 - 4. A minimum of 10 remote annunciator panels may be connected to a specific (terminal mode) EIA 485 interface. To total number remote annunciator panels shall not reduce the annunciation capacity of the system. Each LCD shall include vital system wide functions such as, system acknowledge, silence and reset.

5. LCD display annunciator shall mimic the local control panel 80-character display or network annunciator and shall not require special programming.
6. All LCD annunciators installed shall be provided with locking door or keyed enable switch. All LCD annunciators installed, as surface mounted devices shall also be mounted on a color-coordinated manufacturer's listed surface back-box.

H. Transponders: (Remote Data Gathering Panels - DGP)

1. The contractor shall provide all remote fire alarm transponders panels where indicated by the contract drawings or as required by the manufacturer in order to meet all system performance requirements as herein specified.
2. All Transponders shall be listed under UL category UOJZ as an independent, local fire alarm control unit as well as being listed as a critical component in a multiplex fire alarm system. All Transponders panels shall be capable of being incorporated to the existing fire alarm control panel without the need of any additional modules and or control panel modifications. The Transponder shall serve as the interface between addressable initiating fire alarm devices, conventional initiating fire devices, controlled notification appliances and the FACP. The supervised multiplex communication port shall be an integral part of the transponder.
3. Each Transponder shall be powered from a local Power Supply, and shall provide all power necessary for its own operation, including standby power in accordance with project specifications.
4. Transponders shall be capable of housing all batteries, power supplies and/or amplifiers to allow a true distributed processing and amplification.
5. Each transponder shall have the following indicators and operator controls:
 - a. Alarm Acknowledge/Signal Silence/Reset Switch
 - b. Power LED
 - c. System alarm LED
 - d. System trouble LED
 - e. Local piezoelectric signal
 - f. Red alarm per Initiating Device Circuit
 - g. Green on/off LED per notification appliance circuit or relay
6. Each transponder will be capable of expansion of up to 24 field circuits of the following types in any mix:
 - a. Addressable Initiating Device Circuits (IDC): Up to 24.IDC's may be added to the transponder
 - b. Initiating Device Circuits (IDC): IDCs may be added to the transponder in groups of 8 Style B (Class B), or 4 Style D (Class A) circuits. Each circuit shall be capable of monitoring up to 30 compatible 2-wire smoke detectors, and/or any number of contact type initiating devices.

- c. Auxiliary Control Relay Outputs: Auxiliary relay outputs may be added to the transponder in groups of eight individually controlled single Form-C circuits. Alternately, the eight independent relays may be configured as four dual Form-C. All relay contacts shall be rated 2 A @ 30 VDC. Notification Appliance Circuits: Notification Appliance Circuit outputs may be added to the transponder in groups of 8 Class B (Style Y), or 4 Class A (Style Z) circuits. Each circuit shall be capable of being configured as a Telephone, Horn, Strobe or Speaker Circuit.

I. Field Charging Power Supply: (FCPS)

- 1. The FCPS shall be designed for use as an auxiliary power supply listed for use as a remote 24-volt power supply and/or as a remote Notification Appliance power supply. The contractor shall provide all FCPS panels where indicated by the contract drawings or as required in order to meet all system performance requirements as herein specified.
 - a. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support (60) sixty hours standby with (5) five minutes of alarm.
 - b. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
 - c. The Field Charging Power Supply shall include the ability to delay the AC fail delay per 1993 NFPA requirements.
 - d. The FCPS include power limited circuitry, per 1995 UL standards.

2.9 PERIPHERAL DEVICES

A. Addressable Device Types

1. General

- a. The system control panel must be capable of communicating with the types of addressable devices specified below. Addressable devices will be located as shown on the drawings. The system shall have "individual" device addressability. Each system device shall have its own address.
- b. All smoke/heat sensors shall be listed to UL Standard 268 and shall be documented compatible with the control equipment to which they are connected. The sensors shall be listed for both ceiling and wall mount applications.

- c. Each smoke/heat sensor base shall contain an LED that will flash each time it is scanned by the control panel (once every 4 seconds). When the control panel determines that a sensor is in an alarm or a trouble condition, the control panel shall command the LED on that sensor's base to turn on steady indicating the abnormal condition. Sensors, which do not provide a visible indication of an abnormal condition, shall not be acceptable.
- d. All smoke/heat sensor bases, where shown on the plans as required, shall be provided with a relay driver and/or local sounder base output that is to be controlled either automatically or manually from the control panel.
- e. Each smoke/heat Sensor shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
- f. All sensors shall be scanned by the control panel for its type identification to prevent inadvertent substitution of another sensor type. The control panel shall operate with the installed device but shall initiate a "Wrong Device" trouble condition until the proper type is installed or the programmed sensor type is changed.
- g. All sensors' electronics shall be immune from false alarm caused by EMI and RF.

B. Addressable Pull Box (manual station)

- 1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
- 2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset. Stations that utilize a special wrench or Allen key shall not be accepted.
- 3. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger. Manual stations where indicated on the contract drawings, as institutional type stations shall be UL listed for that type of application.
- 4. Furnish and install clear Lexan protective covers w/self contained horn on all manual pull stations where indicated on contract drawings as "protected with wire guards". All protective covers shall be UL listed for the application.
- 5. All manual pull stations installed, as surface mounted devices shall be mounted on a color-coordinated manufacturer's listed surface back-box. All manual pull stations installed in locations exposed to the weather or installed in wet/damp locations shall be listed for that application and mounted on manufacturer's back-box listed for weatherproof applications.

C. Intelligent Photoelectric Smoke Detector

1. The intelligent smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
 - a. Furnish and install integral audible base on all smoke detectors, where indicated on contract integral audible bases. The audible base shall include a built-in microprocessor that is capable of controlling the temporal signal timing and automatically synchronize the temporal output of all bases connected to the same 24 Vdc power supply. When the smoke detector senses an alarm condition, the audible base shall emit a localized alarm signal for occupant notification.
 - 1) All audible bases connected on separate initiating data loops shall remain silent. For applications such as in multi-room suites, or building wings all smoke detectors within the contiguous space or wing shall be connected by an addressable reversing relay to activate all sounder bases on same notification appliance circuit. All addressable reversing relays shall be supervised by the installation of an end of line addressable supervising module.
 - b. Furnish and install wire guards on all smoke detectors, where indicated on contract drawings. All wire guards shall be UL listed for the application.

D. Intelligent Duct Smoke Detectors

1. The intelligent duct smoke detectors shall be photoelectric and listed by Underwriters' Laboratories, Inc. Each smoke sensor and air duct housing shall be self-compensating for the effects of air velocity (from 300 to 4,000 FM), temperature, humidity and atmospheric pressure. It shall not be necessary to field adjust the sensitivity to compensate for the above effects. Each smoke sensor shall utilize solid state components and be equipped with an integral alarm indicating LED, which shall flash when the smoke sensor is activated. In addition each duct smoke detector shall be equipped with a programmable form "C" remote relay with contacts rated at 3 AMPS, 120 VAC resistive or 24 VDC resistive and wired for fan shut down requirements and or other related smoke control functions as required by code.
2. Duct smoke detectors shall be capable of a programming format that permits a supervisory signal to be transmitted to the fire alarm control panel while providing a latched relay state on the fan control interface until reset of the fire alarm control panel.

3. Each duct-smoke detector shall be provided with a remote test station and remote alarm-indicating lamp in accordance with all requirements of NFPA 72. All remote test stations shall be key operated and shall be installed at 5 feet above finished floor. Remote indicating lamps can be integral to the remote test or can be stand-alone devices. Remote indicating lamps that are stand-alone devices shall be listed for use with the duct smoke detector and can be mounted on wall or ceilings.
4. Duct-smoke detectors shall be provided and wired by the Division 26 contractor and installed by the Division 23 contractor. Refer to Division 23 documents for additional information regarding location and quantities of detectors.

E. Weather Proof Duct Smoke Detectors

1. Provide weather proof duct smoke detectors as indicated. The weather proof duct smoke detectors shall be photoelectric and listed by Underwriters' Laboratories, Inc for exterior environments from 32 F to 155 F at a relative humidity of 10% to 85% condensation. Each smoke sensor shall be self-compensating for the effects of air velocity (from 100 to 4,000 FM). Each smoke sensor shall utilize solid state components and be equipped with an integral alarm indicating LED, which shall flash when the smoke sensor is activated. In addition each duct smoke detector shall be equipped 2 sets of form C Alarm contacts rated at 10A and 1 set of form C Trouble contacts rated at 10A. The duct smoke detector shall be wired to an addressable monitor module which shall provide all alarm and trouble indications to the main fire alarm control panel. All fan shut functions shall be accomplished by the installation of a dedicated addressable control module. Smoke detector shall be model SSU-SL02000-P or approved equal.
2. Duct smoke detector housing shall be a NEMA 3R weather proof enclosure UL listed for that application. The duct-smoke detector housing shall be provided integral heater listed for use with duct detector housing and required air sampling tubes sized for the application. The integral heater kit shall be module OP-001 as manufactured by Space Age Electronics. The weather proof duct detector housing shall be model SSU-WP-2000 as manufactured by Space Age Electronics or approved equal
3. Duct-smoke detectors shall be provided and wired by the Division 26 contractor and installed by the Division 23 contractor. Refer to ES series drawings and Division 23 documents for additional information regarding location and quantities of detectors.

F. Intelligent Thermal Detectors

1. Thermal detectors where indicated on the drawings shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.
2. Furnish and install wire guards on all heat detectors, where indicated on contract drawings. All wire guards shall be UL listed for the application.

G. Conventional Thermal Detectors

1. Thermal detectors were indicated on the drawings as conventional detectors shall be rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F per minute. It shall connect via an addressable zone module to the fire alarm control panel signaling line circuit. Maximum number of devices permitted any single IDC circuit shall be 15 devices per addressable zone module and shall be provided in only areas indicated by the contract documents or identified as zoned conventional devices on the fire alarm riser diagram.
2. Thermal detectors were indicated as conventional detectors fixed temperature on the drawings shall be rated at 194 degrees Fahrenheit. It shall connect via an addressable zone module to the fire alarm control panel signaling line circuit. Maximum number of devices permitted on any single IDC circuit shall be 15 devices per addressable zone module and shall be provided in only areas indicated by the contract documents or identified as zoned conventional devices on the fire alarm riser diagram.

H. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices such as sprinkler water flow switches, pressure switches, sprinkler control valves and conventional heat detectors and/or any N.O. dry contact device to fire alarm system SLCs.
2. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
3. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
4. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

I. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The two-wire monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box or with an optional surface back-box.
3. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

J. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of conventional NACs of compatible, 24 VDC polarized audio/visual notification appliances and/or fan shutdown and other auxiliary control functions, in which case the control module shall be configured to operate as a dry contact relay.
2. The control module shall mount in a standard 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box, or to a surface mounted back-box.
3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
 - a. A separate supervised power circuit from the main fire alarm control panel or from a supervised shall provide Audio/visual power, UL listed remote power supply.
 - b. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

K. Combination Speaker/Strobe Assembly (Wall Mounted):

1. Furnish and install where indicated on drawings combination "synchronized" speaker/strobe notification appliances. The strobe lens shall be clear and the housing engraved "FIRE". The strobe candela rating shall be provided in accordance with NFPA 72 and UL 1971 requirements (minimum 15cd). Speaker units where indicated shall be flush wall mounted units and operate on 25/70 VRMS with field selectable output taps from 0.5 to 2.0 Watts. All speakers shall produce a nominal sound output of 84 dBA at 10 feet (3m). Frequency response shall be a minimum of 400 HZ to 4000 HZ. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.
2. Speaker units indicated as wall mounted non-strobe units indicated shall be flush wall mounted units and operate on 25/70 VRMS with field selectable output taps from 0.5 to 2.0 Watts. All speakers shall produce a nominal sound output of 84 dBA at 10 feet (3m). Frequency response shall be a minimum of 400 HZ to 4000 HZ. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.
3. Furnish and install wire guards on all speaker/strobe units, where indicated on contract drawings.
4. All speaker/strobe devices installed, as surface mounted devices shall be mounted on a color-coordinated manufacturer's listed surface backbox. All speaker/strobe devices installed in locations exposed to the weather or installed in wet/damp locations shall be listed for that application and mounted on manufacturer's backbox listed for weather proof applications.

5. Proper installation and spacing shall be in accordance with all NFPA 72 requirements and manufacturers recommendations. In addition to the locations indicated on the contract documents the contractor shall be responsible for determining exact placement of all devices and shall locate and install all devices based on NFPA 72 requirements for voice intelligibility.

L. Combination Speaker/Strobe Assembly (Ceiling Mounted):

1. Furnish and install where indicated on drawings combination "synchronized" speaker/strobe notification appliances. The strobe lens shall be clear and the housing engraved "FIRE". The strobe candela rating shall be provided in accordance with NFPA 72 and UL 1971 requirements (minimum 177cd). Speaker units where indicated shall be flush ceiling mounted units and operate on 25/70 VRMS with field selectable output taps from 0.5 to 2.0 Watts. All speakers shall produce a nominal sound output of 84 dBA at 10 feet (3m). Frequency response shall be a minimum of 400 HZ to 4000 HZ. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.
2. All speaker/strobe devices installed, as surface mounted ceiling devices shall be mounted on a color-coordinated manufacturer's listed surface backbox. All speaker/strobe devices installed in locations exposed to the weather or installed in wet/damp locations shall be listed for that application and mounted on manufacturer's backbox listed for weather proof applications.
3. Proper installation and spacing shall be in accordance with all NFPA 72 requirements and manufacturers recommendations. In addition to the locations indicated on the contract documents the contractor shall be responsible for determining exact placement of all devices and shall locate and install all devices based on NFPA 72 requirements for voice intelligibility.

M. Speaker Assembly (Wall Mounted):

1. Speaker units indicated as wall mounted non-strobe units indicated shall be flush wall mounted units and operate on 25/70 VRMS with field selectable output taps from 0.5 to 2.0 Watts. All speakers shall produce a nominal sound output of 84 dBA at 10 feet (3m). Frequency response shall be a minimum of 400 HZ to 4000 HZ. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.
2. Furnish and install wire guards on all speaker/strobe units, where indicated on contract drawings.
3. All speaker devices installed, as surface mounted devices shall be mounted on a color-coordinated manufacturer's listed surface backbox. All speaker devices installed in locations exposed to the weather or installed in wet/damp locations shall be listed for that application and mounted on manufacturer's backbox listed for weather proof applications.
4. Proper installation and spacing shall be in accordance with all NFPA 72 requirements and manufacturers recommendations. In addition to the locations indicated on the contract documents the contractor shall be responsible for determining exact placement of all devices and shall locate and install all devices based on NFPA 72 requirements for voice intelligibility.

N. Speaker Assembly (Ceiling Mounted):

1. Speaker units indicated as ceiling mounted non-strobe units indicated shall be flush ceiling mounted units and operate on 25/70 VRMS with field selectable output taps from 0.5 to 2.0 Watts. All speakers shall produce a nominal sound output of 84 dBA at 10 feet (3m). Frequency response shall be a minimum of 400 HZ to 4000 HZ. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.
2. All speaker devices installed, as surface mounted ceiling devices shall be mounted on a color-coordinated manufacturer's listed surface backbox. All speaker devices installed in locations exposed to the weather or installed in wet/damp locations shall be listed for that application and mounted on manufacturer's backbox listed for weather proof applications.
3. Proper installation and spacing shall be in accordance with all NFPA 72 requirements and manufacturers recommendations. In addition to the locations indicated on the contract documents the contractor shall be responsible for determining exact placement of all devices and shall locate and install all devices based on NFPA 72 requirements for voice intelligibility.

O. Visual Flashing Strobe

1. Furnish and install where indicated on drawings "synchronized" strobe notification appliances. The strobe lens shall be clear and the housing engraved, "FIRE". The contractor shall be responsible for providing the required candela rating for each strobe light based on the device location in accordance with all requirements of NFPA 72 and UL 1971.
2. Furnish and install wire guards on all Strobe units, where indicated on contract drawings.
3. All strobe devices installed, as surface mounted devices shall be mounted on a color-coordinated manufacturer's listed surface back-box. All strobe devices installed in locations exposed to the weather or installed in wet/damp locations shall be listed for that application and mounted on manufacturer's back-box listed for weatherproof applications.

P. Batteries:

1. The batteries shall be sealed Gel Cell type, 12-volt nominal.
2. The battery shall have sufficient capacity to power the complete fire alarm system and all ancillary control units in their entirety for not less than (60) sixty hours plus (5) five minutes of continuous operation of all system notification appliances upon any loss of normal AC power.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Comply with all requirements of specification section 28 05 00.

3.2 PROTECTION OF EQUIPMENT

- A. Comply with all requirements of specification section 28 05 00.

3.3 INSTALLATION

- A. In addition to all requirements as specified by specification section 28 05 00 the fire alarm system shall also be provided in accordance with the following requirements:
1. All fire alarm system wiring shall be installed in strict compliance with all the provisions of NEC-Article 760 A and C, Power-Limited Fire Protective Signaling Circuits or if required may be reclassified as non-power limited and wired in accordance with NEC-Article 760. Upon completion, the contractor shall so certify in writing to the VA's Contracting Officer and Design Professional of such compliance.
 2. All fire alarm system wiring shall be installed in dedicated conduits or raceways. Refer to specification section 28 05 00 and related Division 26 specification sections for additional information.
 3. Installation of all equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate trade contractors. Coordinate with the VA's Contracting Officer and Design Professional for connection and location to the building's PSTN circuits and location of RJ31-X phone jacks for the proper connection and programming to Government's alarm monitoring service.
 4. The contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.

3.1 EQUIPMENT PROTECTION

- A. Comply with all requirements of specification section 28 05 00.
1. Examine all physical and environmental conditions, door hardware specifications, equipment locations and wide area network connectivity requirements impacting the installation of the systems and report any unsatisfactory conditions in writing to the Owner and Design Professional.

3.2 WORK PERFORMANCE

- A. In addition to all requirements as specified by Specification Section 28 05 00 the fire alarm and signaling system shall also be provided in accordance with the following requirements:
1. Prior to the final programming of any systems, the Contractor shall provide a review with VA's Contracting Officer and Design Professional addressing all system features, functions, operations, integrated system responses, graphic maps and related operational programming.

- a. Failure to provide this review and get final sign-off prior to programming shall result in any costs related to changes requested by Owner and Design Professional as not being charged to the project.

3.3 EQUIPMENT/CABLE INSTALLATION AND REQUIREMENTS

- A. Comply with all requirements of specification section 28 05 00.

3.4 ELECTRICAL POWER DISTRIBUTION

- A. Comply with all requirements of specification section 28 05 00.

3.5 TRANSIENT VOLTAGE SUPPRESSION

- A. Comply with all requirements of specification section 28 05 00.

3.6 GROUNDING AND BONDING

- A. Comply with all requirements of specification section 28 05 00.

3.7 EQUIPMENT IDENTIFICATION

- A. Comply with all requirements of specification section 28 05 00.

3.8 MAINTENANCE & SERVICE

- A. Comply with all requirements of specification section 28 05 00.

3.9 WARRANTY

- A. Comply with all requirements of specification section 28 05 00.

3.10 FIELD SERVICES

- A. Testing

- 1. In addition to all requirements as specified by Specification Section 28 05 00 the fire alarm system shall also comply with the following requirements:

- a. The completed fire alarm system shall be fully tested in accordance with all NFPA 72 testing and certification requirements. Upon completion of a successful testing, the contractor shall so certify in writing to the VA's Contracting Officer and Design Professional all testing was completed, certified and left in first class operational condition, the contractor shall submit to the VA's Contracting Officer and Design Professional for review all completed NFPA 72 certification, calibration and test reports prior to final acceptance..
- b. In addition the contractor shall provide to the VA's Contracting Officer and Design Professional written documentation of all testing, cleaning, threshold settings, and sensitivity readings for each automatic smoke-sensing device within the system.

- c. The service of a competent, factory-trained engineer or NICET Level III technician authorized by the equipment manufacturer and licensed by the state shall be provided to technically supervise installation and participate during initial system start-up, final testing and assist the Authority Having Jurisdiction during final acceptance testing.
- d. At the final inspection, a factory-trained representative of the equipment manufacturer shall demonstrate to the VA's Contracting Officer and Design Professional that the system functions properly in every respect and is in full compliance with the contract documents. This requirement is in addition, to all testing requirements listed in specification section 28 05 00 and related specification sections.
- e. Provide a minimum of two 4-hour training classes at the project location. Include training manuals, video instructions and hands-on demonstrations in the operation of all system components. Resubmit to the VA's Contracting Officer and Design Professional in advance all lesson plans outlining training procedures, course outlines and objectives. Coordinate with the VA's Contracting Officer and Design Professional in advance of all training dates and schedules.
- f. The contractor shall provide a typewritten framed "Sequence of Operation." Posted at the main fire alarm control panel and at all remote annunciator panel locations.
- g. Provide written notification to the VA's Contracting Officer and Design Professional of the systems condition before and after service, exact components that were tested, detector sensitivity readings, battery conditions and overall status of the system.

2. Inspections

- a. At the completion of the project and prior to final acceptance of the Work, provide evidence to the VA's Contracting Officer and Design Professional of all final tests, inspections, certifications and approvals of the Authorities Having Jurisdiction (where required by the governing municipality).

END OF SECTION