

**SECTION 26 05 11**  
**REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Drawings, Bidding Requirements, Contract Forms, Conditions of the Contract and Division 1 General Requirements apply to work of this section.
- B. This section applies to all sections of Division 26.
- C. 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, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on drawings.
- 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 SYMBOLS, ABBREVIATIONS, AND ACRONYMS**

Refer to symbols and abbreviations listed on the drawings. Other symbols are in common usage but if uncertainty exists regarding any plan symbols or abbreviations they shall be brought to the attention of the COTR and he shall clarify same.

**1.3 DEFINITIONS**

- A. Where the phrase starts "Provide \_\_\_\_\_", "provide" shall be construed to mean the same as "Furnish and install \_\_\_\_\_".
- B. Where the phrase "Division 21", "Division 22" or "Division 23" is used on the drawings or in this specification, it shall be the responsibility of this Contractor to determine which Contractor doing work under a Division 21, 22, or 23 specification section is the Contractor being referred to (i.e., plumbing, HVAC, temperature controls, etc.)

**1.4 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. This Contractor shall comply with all ordinances, laws, regulations and codes applicable to the work involved. This does not relieve the contractor from furnishing and installing work shown or specified which may be beyond the requirements of such ordinances, laws, regulations and codes.
- C. Regular inspections shall be requested by the Contractor as required by any and all regulations. All charges for the inspections by regulating agencies of installations or plans and specifications shall be paid by the Contractor.
- D. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

#### **1.5 MATERIALS AND WORKMANSHIP**

- A. All material and workmanship must be of the best throughout. All material and equipment must be new and must be adequately protected from damage and dirt at all times. The Contracting Officer reserves the right to reject any material or workmanship not in accordance with the specifications, either before or after installation.
- B. The Contractor will be held responsible for any and all defects in material and workmanship which may appear during guarantee period after the building has been accepted. All such defects must be repaired or defective material replaced by the Contractor at no expense to the Government.

#### **1.6 ADMINISTRATIVE REQUIREMENTS**

- A. Site Mobilization Meeting: Attend meeting at the Project site prior to Contractor occupancy.
- B. Preconstruction Meeting: Attend preconstruction meeting prior to the start of the work of this section.

#### **1.7 INSPECTION OF SITE**

- A. Before submitting a proposal on the work contemplated in this specification and accompanying drawings, each bidder shall examine the site and check as to the means of making connections to services and shall familiarize himself with all the existing conditions and limitations.
- B. No extras will be allowed because of the contractor's misunderstanding as to the amount of work involved or the contractor's lack of knowledge of any site conditions which may affect their work.

- C. Any apparent variance of the plan or specification from the existing conditions at the site shall be called to the attention of the Contracting Officer.

#### **1.8 DRAWINGS**

- A. The drawings are to scale as noted. The Contractor shall refer to architectural and structural drawings for exact location of partitions, walls, beams, shafts, equipment, etc.
- B. The Contractor, before rough-in facilities or installation of any equipment shall consult all drawings, general, structural, mechanical, finishes, locations of ceiling, structural members, pipes, ducts, recessed lighting fixtures, conduits, etc., which may affect the installation.
- C. Discrepancies discovered before or after work has started shall be brought to the attention of Government: COTR. Government reserves the right to require minor changes in the work of any Contractor to eliminate such discrepancies with no change in contract cost.
- D. The plans and specifications are complementary and what is called for in either one shall be as binding as if called for in both.
- E. Where a disagreement exists between the plans and specifications, the item or arrangement of better quality, greater quantity or higher cost shall be used.
- F. Where a disagreement exists between an item on the drawings and another item on the drawings, the item or arrangement of better quality, greater quantity or higher cost shall be used.

#### **1.9 COORDINATION**

- A. This Contractor shall review drawings and specifications from all divisions for conflicts in work for locations of ducts, piping, sprinkler heads, door hardware schedule for devices, ceiling plans, wall elevations, etc. Discrepancies shall be brought to the attention of the COTR prior to beginning the work.
- B. Coordinate with all sub-contractors for locations of all conduit, lighting, devices, door hardware, and ductwork.
- C. Attend Pre-installation and Coordination meetings, if required by individual Section.

#### **1.10 GUARANTEE**

- A. All electrical work specified in Division 26 sections shall be guaranteed to be free from defects in materials and installation for a minimum period of one year from the Date of Acceptance of the Work.

See Division 1 requirements and General Conditions for additional requirements. The Contractor shall repair and/or replace defective work, including materials and labor, discovered during the guarantee period.

- B. See individual specification sections for additional guarantees, which include guarantees that extend beyond one year.

#### **1.11 TEMPORARY CONSTRUCTION LIGHTING AND POWER**

A. Temporary Electricity:

1. Cost: By Government.
2. Connect to Owner's existing power service.
  - a. Do not disrupt Owner's need for continuous service.
  - b. Coordinate and schedule all necessary shutdowns with Government. Schedule all necessary shutdowns 15 days in advance.
  - c. Include actual time and duration of necessary shutdown in scheduled shutdown request.
  - d. Exercise measures to conserve energy.
3. Provide temporary electric branch circuits and feeders, as necessary, from existing on-site electrical service at location as directed.
4. Complement existing power service capacity and characteristics as required.
5. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.
6. Permanent convenience receptacles may be utilized during construction.
7. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.
  - a. Provide 20 ampere duplex outlets, single phase circuits for power tools for every 500 sq ft of active work area.
  - b. Provide 20 ampere, single phase branch circuits for lighting.

B. Temporary Lighting For Construction Purposes:

1. Provide and maintain lighting for construction operations to achieve a minimum average lighting level of 10 fc.
2. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
3. Maintain lighting and provide routine repairs.
4. Permanent building lighting may be utilized during construction.

**1.12 HOLES THROUGH MASONRY**

- A. The Contractor shall provide all holes and openings required for electrical work unless such openings are shown on the architectural and/or structural drawings. The notes on structural drawings are particularly significant when precast and pre-stressed members are used.
- B. Holes made in existing masonry for raceways or other electrical equipment shall be core drilled.
- C. The Contractor shall be responsible for grouting air-tight any openings adjacent to raceways, etc. to seal against passage of air, smoke or vapors.
- D. The Contractor shall be responsible for providing and disposing of water used in the core drilling operation. Work shall be scheduled and other trades coordinated so that damage will not result from the use of water.

**1.13 FIRESTOPPING**

Refer to Section 07 84 00 Firestopping for requirements.

**1.14 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.

#### **1.15 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.

#### **1.16 APPLICABLE PUBLICATIONS**

Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.

**1.17 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.

**1.18 EQUIPMENT REQUIREMENTS**

Where variations from the contract requirements are requested in accordance with 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.

**1.19 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.

#### **1.20 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. Lockout/Tagout: Procedures shall match existing Veterans Administration Standards. Refer to Section 01 00 00 GENERAL REQUIREMENTS; Lockout/Tagout. Submit lockout/tagout procedures to Government.
- D. 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.
- E. 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.
- F. 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.
- G. Coordinate location of equipment and conduit with other trades to minimize interferences.

#### **1.21 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" and "Readily Accessible" are 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.

#### **1.22 EQUIPMENT IDENTIFICATION**

Refer to Section 26 05 53 - Identification for Electrical Systems.

#### **1.23 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Where an individual Section requires more than one identified item for review (i.e. "Shop Drawings", "Product Data", "Calculations", "Warranty", and "Samples"), submit all items concurrently.
- C. Provide tabbed divider separating each item for review included in the submittal (i.e. "Product Data", "Shop Drawings", and "Warranty").

- D. 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.
- E. 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. Mark catalog sheets and drawings to indicate specific items submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
1. Failure to properly identify items included in a submittal may result in the submittal(s) returned to the Contractor for correction and resubmission.
- F. 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.
- G. 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.
- H. Failure to follow submittal instructions does not relieve the Contractor from the requirements of meeting the project schedule.
- I. 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.
    - a. Table of contents shall identify each tabbed divider by Section number and Section name.
  4. First item in manual shall be Section 26 05 11 - Requirements for Electrical Installations. This table shall include Consolidated Maintenance Schedule for all electrical components provided in this project that require routine maintenance or testing.
  5. Submit required information in a three ring binder.
    - a. Submit one (1) binder for review prior to final submittal.
    - b. Submit three (3) binders for final submittal.
    - c. Provide tabbed divider for each Specification Section.
    - d. Provide compact disk (CD) with information required in individual specification sections. Arrange CD with directories that identify each Section number and Section name.
  6. The manuals shall include:
    - a. Maintenance Schedule: Provide a consolidated maintenance schedule. Indicate item or equipment, maintenance or testing requirement and frequency of maintenance or test. Provide in a table format.
    - b. Sample Consolidated Maintenance Schedule: Table below is a sample representing some typical maintenance items, not representative of actual items included in this project.

<b>CONSOLIDATED MAINTENANCE SCHEDULE</b>		
<b>EQUIP ITEM</b>	<b>REQUIRED ACTION</b>	<b>FREQUENCY</b>
GROUNDING CONNECTIONS	INSPECT FOR INTEGRITY	12 MONTHS
PANELBOARD CIRCUIT BREAKERS	EXERCISE: CYCLE OFF/ON 5 TIMES.	12 MONTHS
SWITCHBOARD & PANELBOARD FUSIBLE SWITCHES	INSPECT, CLEAN, LUBRICATE	12 MONTHS
ENCLOSED SWITCHES	INSPECT, CLEAN, LUBRICATE	12 MONTHS
LUMINAIRES IN HANGAR	CLEAN LENS WITH MILD DETERGENT, RINSE, DRY.	24 MONTHS
LENSED LUMINAIRES	CLEAN LENS WITH MILD DETERGENT, RINSE, DRY.	36 MONTHS
EMERGENCY LIGHT UNIT EQUIPMENT	OPERATION AND BATTERY TEST.	12 MONTHS
FIRE ALARM COMPONENTS	INSPECT AND TEST PER NFPA 72 TABLES 14.3.1, 14.4.2.2, AND 14.4.5 ON FOLLOWING PAGES.	PER NFPA 72

- c. Approved product data and shop drawings.
- d. Documentation of Training. For each individual section that requires training: Include date, attendance roster, and outline of training. Include video of training session.
- e. Include test reports.
- f. Include inspector's reports.
- g. Include warranty information.
- h. Include Certificates on Completion.
- i. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
- j. A control sequence describing start-up, operation, and shutdown.
- k. Description of the function of each principal item of equipment.
- l. Installation instructions.
- m. Safety precautions for operation and maintenance.
- n. Diagrams and illustrations.
- o. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
- p. Performance data.
- q. 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.
- r. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

**J. AS-BUILT DRAWINGS**

1. Refer to Specifications Section 01 00 00 General Requirements.

I. Approvals will be based on complete submission of manuals together with shop drawings.

J. 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, 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.

**1.24 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.

**1.25 ACCEPTANCE CHECKS AND TESTS**

The contractor shall furnish the instruments, materials and labor for field tests.

**1.26 TRAINING**

- A. Instructions and training shall be provided in accordance with Article 1.24, 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.

**PART 2 - PRODUCTS - NOT USED****PART 3 - EXECUTION - NOT USED**

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**SECTION 26 05 12  
ELECTRICAL DEMOLITION**

**PART 1 - GENERAL****1.1 SECTION INCLUDES**

Electrical demolition.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 00 00 General Requirements
- B. Section 02 41 00 Demolition.

**PART 2 - PRODUCTS****2.1 MATERIALS AND EQUIPMENT**

Materials and equipment for patching and extending work: As specified in individual sections.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Demolition drawings are based on casual field observation and existing record documents.
- B. Report discrepancies to COTR before disturbing existing installation.
- C. Beginning of demolition Work means installer accepts existing conditions.

**3.2 PREPARATION**

- A. Review lockout/tagout (LOTO) requirements and procedures per Specification Section 01.00 00.1.43.
- B. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- C. Coordinate utility service outages with COTR per Specification Section 01 00 00.
- D. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- E. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Obtain permission from Government at least 15 days before partially or completely disabling system. See also Specifications Section 01 00 00 for additional requirements.
    - a. Contractor must submit a written request to the COTR for permission of any downtime. Contractor can only proceed with the downtime after receipt of written approval from the Contracting Officer.
  - 2. Make temporary connections to maintain service in areas adjacent to work area.
- F. Existing Fire Alarm System: Maintain existing system in service at all times, except for approved temporary outages. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Notify Government before partially or completely disabling system.
  - 2. Notify local fire service.
  - 3. Make notifications at least 15 days in advance.
  - 4. Make temporary connections to maintain service in areas adjacent to work area.

**3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- A. Remove, relocate, and extend existing installations to accommodate new construction.

- B. Salvage fire alarm devices for reinstallation in new construction. Turn over unused devices to Government.
- C. Salvage Nurse Call devices for reinstallation in new construction. Turn over unused devices to Government.
- D. Remove abandoned wiring to source of supply.
- E. Protect and maintain existing electrical, systems, and electronic safety and security circuits passing through areas of demolition and new construction.
- F. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces. Preserve and protect existing conduit penetrations through floor of interstitial spaces, and associated boxes at penetrations.
- G. Disconnect abandoned outlets and remove devices. Remove abandoned outlets and boxes. Fill and patch abandoned outlet locations, prepare for new finishes.
- H. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- I. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- J. Repair adjacent construction and finishes damaged during demolition and extension work.
- K. At construction receiving new finishes, patch and prepare to receive new finishes.
- L. At existing construction not receiving new finishes, patch and provide new finishes to match existing surrounding area.
- M. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- N. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- O. Removal: Remove demolished material from the Project site.
- P. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- Q. Salvaged equipment: Remove and store. Clean, re-lamp, and reinstall if required, otherwise, turn over to owner at end of project.
- R. Dispose of Fluorescent lamps, H.I.D. lamps, and ballasts containing PCB'S in accordance with the applicable laws pertaining to the disposal of hazardous waste.
- S. The Government will remove ceiling-mounted private wireless access points, tag cabling serving the equipment, mark the existing location prior to demolition work commencing. Protect existing connections and coordinate re-installation and connections with the COTR when new ceilings are installed.

#### **3.4 CLEANING AND REPAIR**

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

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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):
  - D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
- C. Federal Specifications (Fed. Spec.):
  - A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed Installation)
- D. National Fire Protection Association (NFPA):



70-2008.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-05.....Thermoset-Insulated Wires and Cables

83-08.....Thermoplastic-Insulated Wires and Cables

467-07.....Grounding and Bonding Equipment

486A-03.....Wire Connectors

486C-04.....Splicing Wire Connectors

486D-05.....Sealed Wire Connector Systems

486E-00.....Standard for Equipment Wiring Terminals for Use  
with Aluminum and/or Copper Conductors

493-07.....Standard for Thermoplastic-Insulated Underground  
Feeder and Branch Circuit Cable

514B-04.....Conduit, Tubing, and Cable Fittings

1479-03.....Standard for Fire Tests of Through-Penetration  
Firestops

## 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.

D. Color Code:

1. Secondary service, feeder and branch circuit conductors shall be Color coded as follows **for BUILDING 70** (contractor to verify):

208/120 volt	Phase	480/277 volt
Black	A	Yellow
Blue	B	Brown
Red	C	Orange
White *	Neutral	Gray *
* white with colored tracer for dedicated neutral, color of tracer to match color of phase conductor.		

2. Multiwire branch circuits are NOT allowed. Each circuit shall have a dedicated neutral conductor. Neutral conductor shall have a tracer of the same color as associated phase conductor.
3. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors.
4. The lighting circuit "switch legs" and 3-way switch "traveling wires" shall have color coding unique and distinct (i.e. pink for 277 volt and purple for 120 volt) 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 VA Project Manager.
5. 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.
6. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

## 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**

Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

### **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 MC cables are permitted. Install raceway systems as far as practically possible before changing over to HCF Type AC or MC cable.
- C. Light fixture whips are permitted to be HCF MC cable in lengths not exceeding 6'.
- D. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- E. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.

- F. 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.
- G. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- H. 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.
- I. 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.
- J. No more than (3) single-phase branch circuits shall be installed in any one conduit.
- K. 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 control wiring from automatic transfer switches to generator control panel. At existing generator control panel, provide new manual/auto toggle with indicating lights to match existing installation. Coordinate placement and labeling with owner.
- B. Install a permanent wire marker on each wire at each termination.
- C. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- D. Wire markers shall retain their markings after cleaning.

### **3.5 FEEDER IDENTIFICATION**

In each interior pullbox and junction box, install metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.

### **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.
- E. Field test results shall be submitted to the VA Project Manager.

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**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This section specifies the general grounding and bonding requirements for electrical equipment and operations 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 made, supplementary, and 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.
- C. Section 26 24 16, PANELBOARDS: Low voltage panelboards.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Conform to requirements of NFPA 70.

**1.4 PERFORMANCE REQUIREMENTS**

Grounding System Resistance: 5 ohms.

**1.5 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Product Data:
  - 1. Provide for grounding electrodes, exothermic weld kits, and mechanical connectors.
- C. Shop Drawings:
  - 1. Clearly present enough information 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.

- D. Test Reports: Provide certified test reports of ground resistance.
- E. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:
  - 1. Certification that the materials and installation are in accordance with the drawings and specifications.
  - 2. Certification by the contractor that the complete installation has been properly installed and tested.
- F. Operation and Maintenance Manual:
  - 1. Include Test Reports.

#### 1.6 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. American Society for Testing and Materials (ASTM):
  - B1-07.....Standard Specification for Hard-Drawn Copper Wire
  - B3-07.....Standard Specification for Soft or Annealed Copper Wire
  - B8-04.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
  - C2-07.....National Electrical Safety Code
- D. National Fire Protection Association (NFPA):
  - 70-08.....National Electrical Code (NEC)
  - 99-2005.....Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
  - 44-05 .....Thermoset-Insulated Wires and Cables
  - 83-08 .....Thermoplastic-Insulated Wires and Cables
  - 467-07 .....Grounding and Bonding Equipment
  - 486A-486B-03 .....Wire Connectors

**PART 2 - PRODUCTS****2.1 GROUNDING AND BONDING CONDUCTORS**

- A. Equipment grounding conductors shall be UL 44 or UL 83 insulated stranded copper, except that sizes No. 10 AWG [6 mm<sup>2</sup>] and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG [25 mm<sup>2</sup>] and larger shall be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes No. 10 AWG [6 mm<sup>2</sup>] and smaller shall be ASTM B1 solid bare copper wire.
- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

**2.2 GROUND CONNECTIONS**

- A. Above Grade:
  - 1. Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
  - 2. Connection to Building Steel: Exothermic-welded type connectors.
  - 3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
  - 4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.

**PART 3 - EXECUTION****3.1 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as specified herein.
- 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.
- 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**

- A. At interior locations: All grounding connections shall be accessible. Provide access panels.

**3.3 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS**

- A. Panelboards:
1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
  2. Provide ground bars, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
  3. Connect metallic conduits that terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.

**3.4 RACEWAY**

- A. Conduit Systems:
1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
  2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
  3. Conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
  4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits. Provide full-size (same size as phase conductors) grounding conductor for each Mammography Equipment branch circuit, as indicated on Drawings.
- C. 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.

D. Wireway Systems:

1. Bond the metallic structures of wireway to provide 100% electrical continuity throughout the wireway system, by connecting a No. 6 AWG [16 mm<sup>2</sup>] bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated No. 6 AWG [16 mm<sup>2</sup>] bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 50 ft [16 M].
3. Use insulated No. 6 AWG [16 mm<sup>2</sup>] bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
4. Use insulated No. 6 AWG [16 mm<sup>2</sup>] bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 49 ft [15 M].

E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

F. Ground lighting fixtures to the equipment grounding conductor of the wiring system.

G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

### 3.5 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.

### 3.6 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, 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.

**3.8 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

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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.
- C. For typical branch circuits use wireway or EMT as far as possible. Flexible metal conduit is to be used only where necessary.

**1.2 RELATED WORK**

- A. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. 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 VA Project Manager four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.
- C. Project Record Documents: Record actual routing through interstitial space for individual conduits installed for Mammography equipment branch circuit and for conduits 2 inch (53 mm) trade size and larger.

**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):

70-08.....National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL):

1-03.....Flexible Metal Conduit

5-01.....Surface Metal Raceway and Fittings

6-03.....Rigid Metal Conduit

50-03.....Enclosures for Electrical Equipment

360-03.....Liquid-Tight Flexible Steel Conduit

467-01.....Grounding and Bonding Equipment

514A-01.....Metallic Outlet Boxes

514B-02.....Fittings for Cable and Conduit

514C-05.....Nonmetallic Outlet Boxes, Flush-Device Boxes and  
Covers

651-02.....Schedule 40 and 80 Rigid PVC Conduit

651A-03.....Type EB and A Rigid PVC Conduit and HDPE Conduit

797-03.....Electrical Metallic Tubing

1242-00.....Intermediate Metal Conduit

D. National Electrical Manufacturers Association (NEMA):

TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and  
Tubing

FB1-03.....Fittings, 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 (1/2 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, in lengths no longer than 6'.

B. Conduit:

1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.

2. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.

3. 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.

4. Flexible galvanized steel conduit: Shall Conform to UL 1.

5. Liquid-tight flexible metal conduit: Shall Conform to UL 360.

6. Surface metal raceway: Prohibited.

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.
- d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
- e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

2. 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.
- 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.

3. Flexible steel conduit fittings:

- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
- b. Clamp type, with insulated throat.

4. Liquid-tight flexible metal conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
5. 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 VA Project Manager 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 VA Project Manager as required by limited working space.

**3.2 INSTALLATION, GENERAL****A. In accordance with UL, NEC, as shown, and as hereinafter specified.****B. Essential Electrical Systems raceway systems shall be entirely independent of other raceway systems, except where specifically "accepted" by NEC Article 517. . Essential Electrical Systems include:**

1. Emergency - Life Safety Branch.
2. Emergency - Critical Branch.
3. Equipment System.

**C. Install conduit as follows:**

1. 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. 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 VA Project Manager.
  3. All J-Boxes shall be labeled with the circuit numbers and panel numbers. See Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS.
- F. FIRESTOPPING systems or devices used for penetrations by plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall have following properties:
1. Classified for use with the particular type of penetrating material used.
  2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using FIRESTOPPING systems that allow unrestricted cable changes without damage to the seal.
  3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and, water sealant.
  4. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.
  5. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- G. Waterproofing systems or devices used for penetrations by plastic pipe or conduits, unenclosed cables, or other non-metallic materials must be nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

**3.3 CONCEALED WORK INSTALLATION**

- A. Furred or Suspended Ceilings and in Walls:
  - 1. Conduit for conductors above 600 volts:
    - a. Rigid steel or rigid aluminum.
    - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
  - 2. 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.
  - 3. Align and run conduit parallel or perpendicular to the building lines.
  - 4. 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.
  - 5. 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, 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 specifically indicated.
- G. Conduit identification: Refer to Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

**3.5 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.

### **3.6 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.

### **3.7 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.

### **3.8 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.

### 3.9 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 labels. See Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

- - - E N D - - -

**SECTION 26 05 53**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Floor marking tape and floor clearance markers.

**1.2 RELATED REQUIREMENTS**

- A. Section 09 91 00 - Painting.
- B. Section 26 05 21 - Low-Voltage Electrical Power Conductors and Cables (600 Volts and Below): Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- C. Section 26 27 26 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.

**1.3 REFERENCE STANDARDS**

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2009.

**1.4 SUBMITTALS**

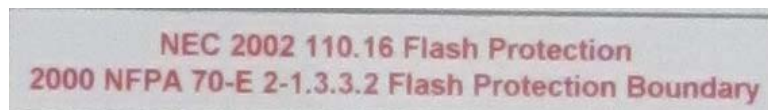
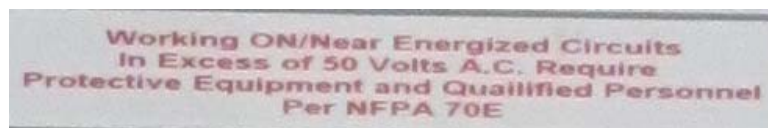
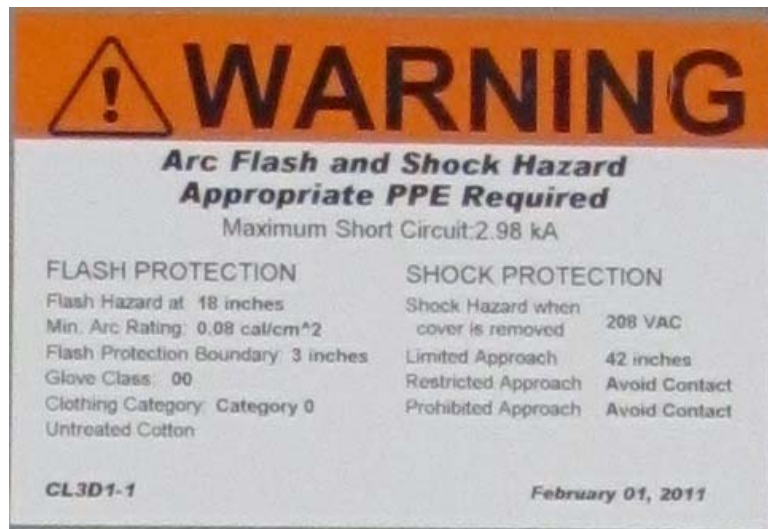
- A. See Section 01 33 23 - Shop Drawings, Product Data, and Samples.
- B. Submit all product data and samples concurrently.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for:
  - 1. Cable and Wire Markers.
  - 2. Voltage Markers, indicate size and text height.
  - 3. Floor Markings.
- D. Samples:
  - 1. Identification Nameplates: One of each type and color specified.
  - 2. Identification Labels: One of each type and color specified.
  - 3. Cable and Wire Markers.

**PART 2 - PRODUCTS****2.1 IDENTIFICATION REQUIREMENTS**

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
  - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    - a. Panelboards:
      - 1) Equipment identification nameplate:
        - (a) Include equipment identification name.
        - (b) Include voltage and phase.
        - (c) Include ampere interrupting capacity (AIC) or short circuit current rating (SCCR).

- (d) Include power source and circuit number. Include location when not within sight of equipment.
- 2) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
- 3) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces.
- 4) For power distribution panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
- 5) For disconnecting means, use identification nameplate to indicate description and power source; i.e.  
STEAM PRESS AGITATOR 402-7-6A9  
SOURCE MCC-7A6
- 6) Use identification label inside door of fusible switch assemblies to identify fuse class installed.
- 7) Field Painting: Provide field painting to match existing Government installations.
  - (a) Exceptions: do not use the term "EMERGENCY". Use terms:  
"EMERGENCY - LIFE SAFETY"; and  
"EMERGENCY - CRITICAL"
- 2. Emergency System Equipment:
  - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
  - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
- 3. Fire Alarm Equipment:
  - a. Comply with Section 28 31 00 Fire Detection and Alarm.
  - b. Use identification nameplate to identify fire alarm control equipment.
  - c. Use identification nameplate to identify fire alarm power supplies.
  - d. Include equipment identification name.
  - e. Include power source and circuit number. Include location.
- 4. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as panelboards, and industrial control panels that are likely to require examination, adjustment, servicing, or maintenance while energized.
  - a. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data:
    - 1) Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
      - (a) Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" beneath header.
    - 2) Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
      - (a) Include the text "NO SAFE PPE EXISTS ENERGIZED WORK PROHIBITED" beneath header.
    - 3) Include the following information:

- (a) Available fault current: Initial RMS 3 Phase bolted fault.
    - (1) Worst case scenario (High Isc).
  - (b) Arc flash protection boundary.
  - (c) Incident energy: Minimum arc rating.
  - (d) Hazard/risk category.
  - (e) PPE (personnel protective equipment) requirements.
  - (f) Nominal voltage.
  - (g) Shock hazard boundaries:
    - (1) Limited approach boundary.
    - (2) Restricted approach boundary.
    - (3) Prohibited approach boundary.
  - (h) Equipment identification.
  - (i) Date calculations were performed.
- b. At locations where a new panel replaces an existing panel; existing feeder and source remains in original state: Populate values on labels to match existing label.
- c. Images of Existing Labels:



5. 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 switchboards and switchgear, panelboards, cabinets, motor controllers (starters),



fused and non-fused safety switches, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

C. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 21.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
  - a. At each source and load connection.
  - b. Within boxes.

D. Identification for Conduit:

1. Definitions:
  - a. Accessible spaces: Spaces above accessible ceiling tile, spaces with access panels, accessible void spaces, accessible attic spaces.
  - b. Finished spaces: Normally occupied spaces that are not defined as unfinished spaces.
  - c. Unfinished spaces: Mechanical rooms, shop spaces, bulk storage, shell space for future construction.
  - d. Concealed: Not visible from within a finished space.
  - e. Exposed: Surface installed, visible.
2. Use voltage markers to identify highest voltage present for accessible conduits over 70 volts at maximum intervals of 10 feet.
  - a. Colors:
    - 1) Normal Power Systems:
      - (a) 277/480 Volt System: Orange, with black text "277/480 VOLTS" on marker.
      - (b) 120/208 Volt System: Orange, with black text "120/208 VOLTS" on marker.
    - 2) Emergency Power Systems: Red with white letters, including voltage, i.e. "EMERGENCY 120/208 VOLTS".
      - (a) Life Safety Branch: Red with white letters, including voltage, i.e. "LIFE SAFETY 120/208 VOLTS".
      - (b) Critical Branch: Red with white letters, including voltage, i.e. "CRITICAL 208/120 VOLTS".
      - (c) Equipment System: Red with white letters, including voltage, i.e. "EQUIPMENT 120/208 VOLTS".
3. Use color-coded bands to identify specified systems for accessible conduits at maximum intervals of 10 feet.
  - a. Color-Coded Bands: Use vinyl color marking tape to mark bands 2 inch(es) wide.
    - 1) Color Code:
      - (a) Life Safety Branch: Red with white letters, including voltage, i.e. "LIFE SAFETY 120/208 VOLTS".
      - (b) Critical Branch: Red with white letters, including voltage, i.e. "CRITICAL 208/120 VOLTS".
      - (c) Equipment System: Red with white letters, including voltage, i.e. "EQUIPMENT 120/208 VOLTS".

- (d) Fire Alarm System: Red.
  - (1) Red colored EMT conduit with black letters "FIRE ALARM EMT" may be used in lieu of colored bands.
- (e) Public Address System: Green and white.
- (f) Telecommunications System: Blue.
- (g) Security System: Blue and orange.
- (h) Nurse Call System: Green.
- (i) Control System: Blue and yellow.
- 2) Vinyl Color Marking Tape: 2 inch wide,  
[www.tapebrothers.com](http://www.tapebrothers.com) or similar.
  - (a) Wrap tape a minimum of 3 times around each individual conduit.
- 4. Use identification labels or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
- E. Identification for Boxes:
  - 1. Use voltage markers to identify highest voltage present.
  - 2. Use voltage markers to identify systems other than normal power system.
    - a. Color-Coded Boxes: Field-painted in accordance with Section 09 9000 per the same color code used for raceways.
  - 3. Use identification labels to identify circuits enclosed.
- F. Identification for Devices:
  - 1. Use identification label to identify fire alarm devices. Comply with Section 28 31 00 Fire Detection and Alarm.
  - 2. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
  - 3. Use identification label to identify fire alarm system devices.
  - 4. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.
  - 5. Use engraved and filled wallplate to identify receptacles, indicating serving panel and branch circuit \_\_\_\_\_.
  - 6. Use engraved and filled wallplate to identify individual wall switches indicating load controlled, and system source where indicated.
- G. Identification for Luminaires:
  - 1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.
- H. Identification for lighting circuit load transfer switches:
  - 1. Lighting system load transfer switches automatically transfer selected lights from normal to life safety or critical branches of the essential electrical system when the devices sense loss of normal power. These load transfer switches also bypass local switching when the device senses loss of normal power.
  - 2. Provide identification labels on transfer devices to indicate "THIS DEVICE IS CONNECTED TO MORE THAN ONE SOURCE. NORMAL: PANELBOARD \_\_\_\_\_ EMERGENCY: \_\_\_\_\_." Identify warning label with normal and emergency panelboard and circuit information.

## 2.2 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
  - 1. Materials:
    - a. Indoor Clean, Dry Locations: Use plastic nameplates.

- b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
  - 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
  - 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
  - 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
  - 5. Text height: 3/16 inches minimum.
  - 6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
- 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
  - 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
- 1. Minimum Size: 1 inch by 2.5 inches.
  - 2. Legend:
    - a. System designation where applicable:
    - b. Equipment designation or other approved description.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height:
    - a. System Designation: 1 inch.
    - b. Equipment Designation: 1/2 inch.
  - 5. Color:
    - a. Normal Power System: White text on black background.
    - b. Emergency Power System:
      - 1) Life Safety Branch: White text on red background.
      - 2) Critical Branch: White text on blue background.
      - 3) Equipment Branch: White text on green background.
    - c. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:
- 1. Minimum Size: 1 inch by 2.5 inches.
  - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 1/4 inch.
  - 5. Color: Black text on white background unless otherwise indicated.
- E. Format for Caution and Warning Messages:
- 1. Minimum Size: 2 inches by 4 inches.
  - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 1/2 inch.
  - 5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Receptacle Identification:
- 1. Minimum Size: 1/4 inch by 1.5 inches.
  - 2. Legend: Power source and circuit number and/or other designation indicated.

3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 3/16 inch.
  5. Colors: Refer to Section 26 27 26 WIRING DEVICES.
- G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
  2. Legend: Load controlled and/or other designation indicated.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 3/16 inch.
  5. Color: Refer to Section 26 27 26 WIRING DEVICES.

### 2.3 WIRE AND CABLE MARKERS

- A. Markers for Branch Circuit Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Feeder Conductors and Cables: Use metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

### 2.4 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl or vinyl snap-around type markers.
1. Seton Identification Products; Model M4883: [www.seton.com](http://www.seton.com).
  2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
  2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
  3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- D. Legend:
1. Markers for Voltage Identification: Highest voltage present.
  2. Markers for System Identification:
    - a. Emergency System - Life Safety Branch: Text "LIFE SAFETY".
    - b. Emergency System - Critical Branch: Text "CRITICAL".
    - c. Equipment System: Text "EQUIPMENT".
- E. Color: Black text on orange background unless otherwise indicated.

### 2.5 FLOOR MARKINGS

- A. Manufacturers:
1. Seton Identification Products: [www.seton.com](http://www.seton.com).
  2. Substitutions: See Section 01 6000 - Product Requirements.

- B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating yellow and white stripes.
- C. Clearance Requirement Floor Marker, 17 inch diameter lexan coated vinyl, yellow background with black letters. Indicate actual clear work space depth required.
  - 1. Product: Seton 9661B (custom for depth required).



### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

#### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
  - 1. Surface-Mounted Equipment: Enclosure front.
  - 2. Flush-Mounted Equipment: Inside of equipment door.
  - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  - 4. Elevated Equipment: Legible from the floor or working platform.
  - 5. Branch Devices: Adjacent to device.
  - 6. Interior Components: Legible from the point of access.
  - 7. Boxes: Outside face of cover.
  - 8. Conductors and Cables: Legible from the point of access.
  - 9. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using stainless steel screws.
  - 1. Do not use adhesives except where substrate cannot be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install arc flash hazard warning labels on electrical equipment.
  - 1. Panelboards with a door: Install on inside surface of door.
  - 2. Power distribution panels with a door: Install inside panel near mains, visible with door open.

### 3.3 FIELD QUALITY CONTROL

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

- - - END - - -

**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: 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 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 for possible ground fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Submit Product Data and Shop Drawings concurrently.
- C. Shop Drawings:
  - 1. Sufficient information shall be clearly presented 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.
  - 3. Indicate circuit breaker and fusible switch arrangement and sizes. Circuit arrangement has been designed by the engineer for optimum phase balance; rearrangement by equipment provider is prohibited.
- D. Product Data:
  - 1. Include overcurrent protective device characteristics for all main devices, branch devices in power distribution panels, and branch

- devices in lighting and appliance panels protecting feeders to downstream panels.
- a. Include time-current curves for overcurrent protective devices.
  - b. Include let-thru current curves for current limiting devices.
  - c. Include coordination charts and tables, and related data.
- E. Test Reports: Indicate satisfactory completion of adjustments and required tests.
1. Panelboard Feeder Balance Test Reports: Provide information in format indicating test results from Part 3 Execution.
- F. Operation and Maintenance Manuals:
1. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets and wiring diagrams.
  2. If changes have been made to the maintenance and operating manuals that were originally submitted, then submit four copies of updated maintenance and operating manuals to the COTR two weeks prior to final inspection.
  3. Include Test Reports.
  4. Maintenance Schedule: Include equipment maintenance or testing requirement and frequency of maintenance or test in consolidated maintenance schedule table as indicated in Section 26 05 11.
- G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- H. Maintenance Materials: Furnish the following for Government's use in maintenance of project:
1. Panelboard Keys: Two of each different key.
- I. Certification: Two weeks prior to final inspection, submit four copies of the following to the COTR:
1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
  2. Certification by the contractor that the materials have been properly installed, connected, 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. National Electrical Manufacturers Association (NEMA):



PB-1-06.....Panelboards

250-08.....Enclosures for Electrical Equipment (1000V  
Maximum)

C. National Fire Protection Association (NFPA):

70-2005 .....National Electrical Code (NEC)

70E-2004.....Standard for Electrical Life Safety in the  
Workplace

D. Underwriters Laboratories, Inc. (UL):

50-95.....Enclosures for Electrical Equipment

67-09.....Panelboards

489-09.....Molded Case Circuit Breakers and Circuit  
Breaker Enclosures

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

A. Source Limitations: To achieve selective coordination, furnish panelboards and associated components produced by the same manufacturer as the existing electrical distribution equipment used in this facility and obtained from a single supplier.

B. Manufacturer: Cutlet-Hammer.

C. Substitutions: Not permitted.

### **2.2 PANELBOARDS**

A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.

B. Panelboards shall be standard manufactured products.

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 only to circuit breaker operating handles, not to energized parts.

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 and integral accessories, as scheduled on the drawings or specified herein. 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. Non-reduced size copper bus bars with current ratings as shown on the panel schedules, rigidly supported on molded insulators.
  2. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
  3. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys of sizes suitable for the conductors to which they will be connected.
  4. Neutral bus shall be 200% rated where indicated on schedules, mounted on insulated supports.
  5. Grounding bus bar shall be equipped with screws or lugs for the connection of grounding wires.
  6. Buses shall be braced for the available short-circuit current. Bracing shall not be less than 10,000 A symmetrical for 120/208 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.
  7. Branch circuit panelboards shall have buses fabricated for bolt-on type circuit breakers.
  8. Protective devices shall be designed so that they can easily be replaced without disturbing adjacent devices.
  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 panelboards, and have cable connections to the second section. Panelboard sections with tapped bus or crossover bus are not acceptable.
  11. Series-rated panelboards are not permitted.
- G. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination. Obtain

information from the COTR on upstream device breaker characteristics and complete a protective device coordination study to ensure selective coordination of installed overcurrent devices and upstream overcurrent devices.

### **2.3 CABINETS AND TRIMS**

#### **A. Cabinets:**

1. Provide galvanized steel cabinets to house panelboards. Cabinets for outdoor panelboards 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.
4. Cabinet Box Dimensions: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards
5. Fronts for Surface-Mounted Enclosures: Same dimensions as cabinets.
6. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
7. Lockable Doors: All locks keyed alike unless otherwise indicated.

### **2.4 LOAD CENTERS:**

#### **A. Prohibited.**

### **2.5 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS**

- A. Circuit breakers shall be per UL 489, in accordance with the NEC, as shown on the drawings, and as specified.
- B. Circuit breakers in panelboards shall be bolt-on type.
- C. Molded case circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
  1. 120/208 V Panelboard: 10,000 A symmetrical.
  2. 120/240 V Panelboard: 10,000 A symmetrical.
  3. 277/480 V Panelboard: 14,000 A symmetrical.
- D. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 A frame or lower. Magnetic trip shall be adjustable from 3x to 10x for breakers with 150 A frames and higher. Factory setting shall be HI, unless otherwise noted.
- E. 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.
8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where indicated.
10. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
11. Do not use tandem circuit breakers.
12. Do not use handle ties in lieu of multi-pole circuit breakers.
13. Provide accessories where indicated, including handled padlock attachments and padlocks all keyed alike. Provide six keys.
14. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. For circuits being removed from service or demolished, label existing circuit breaker as "SPARE". Modify the panel directory accordingly.

### **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. See drawing details and as specified herein for additional requirements for future conduits provisions.
- C. Install a printed schedule of circuits in each panelboard after approval by the COTR. Schedules shall be printed on the panelboard directory cards, installed in the appropriate panelboards, and incorporate all applicable contract changes. Information shall indicate outlets, lights, devices, or other equipment controlled by each circuit, and the final room numbers served by each circuit.
- D. Mount the fully-aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78 in

[1980 mm]. Mount panelboards that are too high such that the bottom of the cabinets will not be less than 6 in [150 mm] above the finished floor.

- E. When installing new panelboard, include:
  - 1. Conduit rack from panelboard into interstitial space above, terminating in a junction box enclosure. Conduit rack shall include two 27 (1") conduits and twelve 21 (3/4") conduits.
  - 2. Junction box enclosure: Minimum 18" x 18" x 4", in accessible location approved by COTR.
- F. Provide grounding and bonding in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems.
- G. Rust and scale shall be removed from the inside of existing backboxes where new panelboards are to be installed. Paint inside of backboxes with rust-preventive paint before the new panelboard interior is installed. Provide new trim and doors for these panelboards. Covers shall fit tight to the box with no gaps between the cover and the box.
- H. Install all field-installed branch devices, components, and accessories.
- I. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- J. Identify panelboards in accordance with Section 26 0553.
- K. Provide arc flash hazard labels in accordance with Section 26 0553.
- L. Provide floor markings to clearly indicate required working clearances where indicated or where required by the authority having jurisdiction.
- M. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **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 appropriate anchorage and required area clearances.
    - d. Verify that circuit breaker sizes and types correspond to approved shop drawings.

- e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
- 2. Test GFCI circuit breakers to verify proper operation.
- 3. Correct deficiencies and replace damaged or defective panelboards or associated components.
- 4. Test Reports: Provide test reports for each panelboard feeder indicating balance of phase loads. Provide a cover sheet listing all deficient items. Correct deficiencies and repeat tests for deficient items. Provide new test report for each panelboard containing a deficient item. Indicate the following:
  - a. Date of test or inspection.
  - b. Deficiency and corrective action taken.
  - c. Repeat test/verification for each panelboard containing a deficient item.

### **3.3 ADJUSTING**

- A. Adjust alignment of panelboard fronts.
- B. Phase Balance Adjustments: Measure steady state load currents at each panelboard feeder; record results in Test Reports. Rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other; repeat measurements and record results in Test Reports. Maintain proper phasing for all circuits sharing the same conduit..

### **3.4 FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

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**SECTION 26 27 17**  
**EQUIPMENT WIRING**

**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Electrical connections to equipment.

**1.2 RELATED REQUIREMENTS**

- A. Section 26 05 21 - Low-Voltage Electrical Power Conductors and Cables (600 V and Below).
- B. Section 26 05 33 - Raceways and Boxes for Electrical Systems.
- C. Section 26 27 26 - Wiring Devices.

**1.3 REFERENCE STANDARDS**

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
- B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2008).
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections; and Government provided equipment.
  - 2. Determine connection locations and requirements.
- B. Sequencing:
  - 1. Obtain coordination requirements prior to rough-in for equipment.
  - 2. Install rough-in of electrical connections before installation of equipment is required.
  - 3. Make electrical connections before required start-up of equipment.

**1.5 SUBMITTALS**

- A. See Section 01 33 23 -Shop Drawings, Product Data, and Samples.
- B. Product Data: Provide information for Contractor installed cords and caps on equipment. Provide information in table format indicating Equipment Designation and Name; Cord Type/Size; Device Configuration.

**1.6 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
  - 1. Colors: Conform to NEMA WD 1.
  - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

- B. Disconnect Switches: As specified in Section 26 28 18.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Wire and Cable: As specified in Section 26 05 21.
- E. Conduit, flexible conduit, and boxes: As specified in Section 26 05 33.

## **2.2 EQUIPMENT CONNECTIONS**

- A. Provide connections, devices, disconnect switches, etc., per schedule on the Drawings:
- B. Provide connections to mammography equipment. Verify that critical circuits and normal circuits are in separate raceways and boxes prior to connections.
  - 1. Notify COTR in writing of discovery of non-compliant factory pre-wired components. Refer to National Electrical Code (NEC) 517.30(C)(1) and 700.10(B).

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Obtain equipment data sheets and electrical wiring, conduit, boxes and connection requirements from COTR for mammography room(s). Examine documents prior to planning electrical rough-in. Report discrepancies between electrical plans and equipment requirements to COTR and obtain direction from COTR to resolve discrepancies.
- B. Verify that equipment is ready for electrical connection, wiring, and energization.

### **3.2 ELECTRICAL CONNECTIONS**

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Provide receptacle outlet to accommodate connection with attachment plug.
- C. Provide cord and cap where field-supplied attachment plug is required.
- D. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- E. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- F. Install terminal block jumpers to complete equipment wiring requirements.
- G. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

- - - END - - -



**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 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 Resident Engineer: 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 Resident Engineer: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, 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 basic designation only.
- B. National Fire Protection Association (NFPA):
  - 70-2008.....National Electrical Code (NEC)

## C. National Electrical Manufacturers Association (NEMA):

WD 1-99.....General Color Requirements for Wiring Devices

WD 6-02 .....Wiring Devices - Dimensional Requirements

## D. Underwriter's Laboratories, Inc. (UL):

5-96.....Surface Metal Raceways and Fittings

20-00.....General-Use Snap Switches

231-98.....Power Outlets

467-01.....Grounding and Bonding Equipment

498-01.....Attachment Plugs and Receptacles

943-06.....Ground-Fault Circuit-Interrupters

**PART 2 - PRODUCTS****2.1 RECEPTACLES**

A. General: All receptacles shall be listed by Underwriters Laboratories, Inc., as hospital grade (green dot identification) and conform to NEMA WD 1. (EXCEPTION - Receptacle types which have no listing as hospital grade but are listed by UL in their respective categories or receptacles indicated on the drawings as "not hospital grade").

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.

3. All receptacles, new or existing, located in the Project Area shall be labeled with the panel and circuit number in a manner specified by the Project Manager.

B. Duplex receptacles shall be 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. Bodies shall be red in color. Wall plates shall be type 302 stainless steel. They shall be labeled with a ½" white label with red lettering indicating panel and circuit number placed on the plate just above the top of the receptacle.

4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit suitable for mounting in a standard outlet box.
  - a. Ground fault interrupter shall be hospital grade and consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. It shall be rated for operation on a 60 Hz, 120 volt, 20-ampere branch circuit. 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. Devices shall meet UL 943.
5. Safety Type Duplex Receptacles:
  - a. Bodies shall be gray in color.
  - b. Shall be hospital grade, as above with the following additional requirements.
    - 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. Shall be installed in the following locations:
    - 1) Housekeeping quarters, buildings, waiting areas and lobbies where children might be present.

## **2.2 SWITCHES AND DIMMERS**

- A. Rocker switches are to be used everywhere unless otherwise noted.
  1. Shall be single unit rocker, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plaster ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
  2. Shall be color coded for current rating, listed by Underwriters Laboratories, Inc., and meet the requirements of NEMA WD 1, Heavy-Duty and UL 20.
  3. Ratings:
    - a. 120 volt circuits: 20 amperes at 120-277 volts AC.
    - b. 277 volt circuits: 20 amperes at 120-277 volts AC.
  4. The switches shall be mounted on the striker plate side of doors.
  5. Incorporate barriers between switches with multigang outlet boxes where required by the NEC.

6. All rocker switches shall be of the same manufacturer and shall match existing rocker switches in the remodeled area.

C. Dimmers: LED modular dimming switch.

1. LED luminaire dimming system shall provide full-range, continuously variable electronic 3-wire control of LED luminaire driver and luminaire intensity. Dimmer switch shall have a large paddle-type on-off switch and small slider-type intensity control. Dimmers shall have built-in transient voltage protection. All dimmers shall be listed by Underwriters Laboratories, Inc. Dimmer shall be compatible with 277V LED luminaire driver without adding additional components or "power pack" -type transformers. Dimmer shall be Lutron Hi-Lume, catalog #DVSCF-103P-277, or approved equal. Match color and finish of adjacent rocker-type lighting switches.

### 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 WD1.
- 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 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. For receptacles, they shall be labeled with a ½" white label with lettering indicating panel and circuit number placed on the plate just above the top of the receptacle. Use black lettering for normal power and red lettering for emergency power.

## 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.

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**SECTION 26 29 21  
DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of low voltage disconnect switches.

**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: 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 for possible ground faults.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
  - 1. Clearly present sufficient information to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, mounting details, materials, enclosure types, and fuse types and classes.
  - 3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.
- C. Manuals:
  - 1. Provide complete maintenance and operating manuals for disconnect switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Deliver four copies to the COTR two weeks prior to final inspection.
  - 2. Terminals on wiring diagrams shall be identified to facilitate maintenance and operation.
  - 3. Wiring diagrams shall indicate internal wiring and any interlocking.

D. Certifications: Two weeks prior to the final inspection, submit four copies of the following certifications to the COTR:

1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
2. Certification by the contractor that the materials have been properly installed, connected, 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. National Electrical Manufacturers Association (NEMA):

FU 1-07.....Low Voltage Cartridge Fuses

KS 1-06.....Enclosed and Miscellaneous Distribution  
Equipment Switches (600 Volts Maximum)

C. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

98-04.....Enclosed and Dead-Front Switches

248-00.....Low Voltage Fuses

977-94.....Fused Power-Circuit Devices

### **PART 2 - PRODUCTS**

#### **2.1 MAUFACTURERS**

A. Cutler-Hammer or approved equivalent.

B. Substitutions: Not permitted for Mammography equipment disconnects, where equipment shall be as indicated on schedule on drawings.

#### **2.2 LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS**

A. In accordance with UL 98, NEMA KS1, and NEC.

B. Shall have NEMA classification General Duty (GD) for 240 V switches and NEMA classification Heavy Duty (HD) for 480 V switches.

C. Shall be HP rated.

D. Shall have the following features:

1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the OFF position.
3. An arc chute for each pole.
4. External operating handle shall indicate ON and OFF position and have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable to permit inspection.
6. Fuse holders for the sizes and types of fuses specified.

7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground lugs for each ground conductor.
9. Enclosures:
  - a. Shall be the NEMA types shown on the drawings for the switches.
  - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions. Unless otherwise indicated on the plans, all outdoor switches shall be NEMA 3R.
  - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

#### **2.3 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS**

Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, but without provisions for fuses.

#### **2.4 MOTOR RATED TOGGLE SWITCHES**

Refer to Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

#### **2.5 LOW VOLTAGE CARTRIDGE FUSES**

- A. In accordance with NEMA FU1.
- B. Motor Branch Circuits: Class RK1, dual element time delay.
- C. Other Branch Circuits: Class RK1, dual element time delay.
- D. Control Circuits: Class CC, time delay.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install disconnect switches in accordance with the NEC and as shown on the drawings.
- B. Fusible disconnect switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuse.

#### **3.2 SPARE PARTS**

Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fusible disconnect switch installed on the project. Deliver the spare fuses to the COTR.

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**SECTION 26 51 00  
INTERIOR LIGHTING**

**PART 1 - GENERAL****1.1 DESCRIPTION:**

- A. This section specifies the furnishing, installation and connection of the interior lighting systems.

**1.2 DEFINITIONS**

- A. Emergency Lighting Unit: A fixture with integral emergency battery power supply and the means for controlling and charging the battery.
- B. Fixture: A complete lighting unit, exit sign. Fixtures include lamps and parts required to distribute the light, position and protect the lamps, and connect lamps to the power supply.
- C. Luminaire: Fixture.
- D. Average Life, Fluorescent: The time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- E. Rated Life, LED: The time at which the output of the luminaire is 70 percent of the initial output.

**1.3 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.

**1.4 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.5 SUBMITTALS**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following. Submit Consolidated Table, Shop Drawings, Product Data, and Samples (where required) concurrently:
- B. Format: Provide binder and with tabs, and electronic file with directory structure as follows:
1. Tab 1: Consolidated Table. Include spares for each ballast and lamp type.



2. Tab 2: Shop drawings. Identify by lighting fixture type. Include ballast manufacturer and model number in product identification code.
  3. Tab 3: Ballast product data: Submit product data for each ballast used in this project. Identify each ballast by the lighting fixture types the ballast will be used. Do not submit identical ballasts multiple times.
  4. Tab 4: Lamp product data: Submit product data for each lamp used in this project. Identify each lamp by the lighting fixture types the lamp will be used. Do not submit identical lamps multiple times.
  5. Incomplete submittals, and/or improperly assembled submittals may result in the submittal returned to the Contractor for correction and resubmission. Partial submittals will not be considered for approval. Incomplete or incorrectly prepared submittals may be returned without review.
- B. Consolidated Table: Submit luminaire information in table format, including in separate columns: Fixture manufacture name and model number; lamp quantity, manufacturer name and model number; ballast manufacturer name and model number; and ANSI input watts.
1. Electrical supplier bill of material is not an acceptable substitute for Consolidated Table.
  2. Sample Consolidated Table:

<b>LUMINAIRES</b>				
	<b>LUMINAIRE</b>	<b>LAMP</b>	<b>BALLAST</b>	<b>ANSI</b>
TYPE	MANUFACTURER AND CATALOG NUMBER	MANUFACTURER AND MODEL NUMBER	MANUFACTURER AND MODEL NUMBER	INPUT WATTS
A2	LITHONIA 2SP8-G-232-FW-A12125-MVOLT	PHILLIPS (2)-F32T8/ADV835/ALTO	ADVANCE IOP-2S32-SC	56
H4	SIMKAR ADJUST-454-S12-UNV/AWG4/CAB472	PHILLIPS (4)-F54T5/ADV841HOEA49W/ALTO	ADVANCE IOP-4PSP542-LSG	208

- C. Shop Drawings: 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

D. Product Data: For each type of LED driver, ballast and lamp provided with lighting fixtures (luminaires) designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of fixture designations, submit the following information.

1. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours) and color temperature (degrees Kelvin). Identify by lighting fixture type(s) for intended use.
2. LED driver or lamp ballast data including driver manufacturer and type, lamp ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts and total harmonic distortion (THD). Identify by lighting fixture type(s) for intended use.

E. 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.

F. 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.

#### 1.6 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):

C62.41-91.....Guide on the Surge Environment in Low Voltage  
(1000V and less) AC Power Circuits

C. National Fire Protection Association (NFPA):

70.....National Electrical Code (NEC)

101.....Life Safety Code

## D. National Electrical Manufacturer's Association (NEMA):

C82.1-97.....Ballasts for Fluorescent Lamps - Specifications

C82.2-02.....Method of Measurement of Fluorescent Lamp

Ballasts

C82.4-02.....Ballasts for High-Intensity-Discharge and Low-

Pressure Sodium Lamps

C82.11-02.....High Frequency Fluorescent Lamp Ballasts

## E. Underwriters Laboratories, Inc. (UL):

496-96.....Edison-Base Lampholders

542-99.....Lampholders, Starters, and Starter Holders for  
Fluorescent Lamps844-95.....Electric Lighting Fixtures for Use in Hazardous  
(Classified) Locations

924-95.....Emergency Lighting and Power Equipment

935-01.....Fluorescent-Lamp Ballasts

1029-94.....High-Intensity-Discharge Lamp Ballasts

1029A-06.....Ignitors and Related Auxiliaries for HID Lamp  
Ballasts

1598-00.....Luminaires

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

**1.7 QUALITY ASSURANCE**

A. Coordination of Fixtures with Ceiling: Coordinate fixtures mounting hardware and trim with the ceiling system.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

**1.8 EXTRA MATERIALS**

A. Supply 20 percent spare lamps for each lamp type, minimum two, for Government's use in maintenance of project.

B. Supply 10 percent spare ballasts for each fluorescent ballast type, minimum one, for Government's use in maintenance of project.

**PART 2 - PRODUCTS****2.1 LIGHTING FIXTURES (LUMINAIRES)**

A. Manufacturers: As indicated per Lighting Fixture Schedule on Drawings.

1. Substitutions: Refer to Division 1 requirements.

2. Where the term "Approved Equal" is used, substitution request shall be submitted for review during the Bidding Period.

B. Shall be in accordance with NFPA 70 and UL 1598, as shown on drawings, and as specified.

C. 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.

D. 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.

E. 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.

F. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

G. 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.

**H. 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 90 percent reflectance, except where otherwise shown on the drawing.
3. Specification Grade: Where indicated "Specification Grade", paint after fabrication.
4. Exterior finishes shall be as shown on the drawings.

**I. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.****J. 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, or greater thickness where indicated on schedules. 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.

**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. All ballasts shall be electronic type unless noted otherwise.
- B. Low Temperature Ballasts: Minus 20 deg C minimum starting temperature.
- C. Conform to UL 935, "Fluorescent-Lamp Ballasts."
  1. Certification: By Electrical Testing Laboratory (ETL).
  2. Labeling: By Certified Ballast Manufacturers Association (CBM).

3. Sound Rating: A rating, except as indicated otherwise.
4. Voltage: Match connected circuits.
- D. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V) electronic, solid-state, 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. Performance: Ballasts for T8 lamps shall be qualifying products for High Performance T8 Systems, manufacturer and model number on the approved list at Consortium for Energy Efficiency: [www.ceel.org](http://www.ceel.org).
  2. Lamp Starting: Programmed start.
    - a. Instant start for low temperature applications.
  3. Minimum Power Factor: 98 percent.
  4. Lamp Wiring: Series wired lamps.
  5. Minimum Operating Frequency: 40-50 kHz, without visible flicker.
  6. Total Harmonic Distortion: Less than 10 percent.
  7. Lamp Current Crest Factor: Less than 1.7.
  8. Lamp end-of-life detection and shutdown circuit (T5 and compact fluorescent lamps only).
  9. Automatic lamp starting after lamp replacement.
  10. Sound Rating: Class A.
  11. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  12. Interference: Comply with 47 CFT 18, Ch.1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
  13. To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
  14. Where three-lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two-lamp ballast to operate the center lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave-lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single-lamp ballast for operation of the center lamp.
  15. Ballast Factor for T8 Lamps: As indicated by ballast type per lighting fixture schedule on drawings.
    - a. Programmed start, low ballast factor (PS-LBF): BF=0.71.
    - b. Programmed start, normal ballast factor (PS-NBF): BF=0.88.
    - c. Programmed start, high ballast factor (PS-HBF): BF = 1.04.
  16. ANSI C82.2 Input Wattage for F25T8 Lamps:
    - a. As indicated on Table at Consortium for Energy Efficiency.

- E. 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 dimming range 5-100% of rated lamp lumens.

## **2.3 LAMPS**

### **A. Linear 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. Lamps shall be low-mercury energy saving type, 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.

#### **T8 type:**

- a. All 48 inch linear T8 lamps shall be qualifying products for High Performance T8 Systems, manufacturer and model number on the approved list at Consortium for Energy Efficiency: [www.ceel.org](http://www.ceel.org)
- b. Lamp temperature: 3500 degree Kelvin, unless noted otherwise.
- c. Color rendering index: Not less than 82.
- d. Average rated life:
  - 1) 48 inch linear: 30,000 hours at 3 hours per start, programmed start.
  - 2) 24 inch linear: 30,000 hours at 3 hours per start, programmed start.
- e. Nominal wattage:
  - 1) 48 inch linear: 25 watts.
  - 2) 24 inch linear: 17 watts.
- f. Luminous intensity - Initial lumens:

- 1) 48 inch linear: 2,500 lumens.
- 2) 24 inch linear: 1450 lumens.

g. Products:

- 1) 48 inch linear: Philips 25W T8.
- 2) 24 inch linear: Philips F17T8ADV835ALTO.
- 4) Substitutions: Refer to Division 1 requirements.

B. Compact Fluorescent Lamps:

1. T4, CRI 80 (minimum), color temperature 3500 K, and suitable for use with dimming ballasts, unless otherwise indicated.

D. Long Twin-Tube Fluorescent Lamps:

1. T5, CRI 80 (minimum), color temperature between 3500° and 4100°K, 20,000 hours average rated life.

## 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. Steel housing shall have baked enamel over corrosion resistant, matte black.

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 5 watts 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: 120-277 volts, unless noted otherwise on Lighting Fixture Schedule on Drawings.



**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. Lighting Fixture Supports:
  - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
  - 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. Hardware for recessed fluorescent fixtures:
    - a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
    - b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall independently support the fixture from the building structure at four points.
  - 5. Hardware for surface mounting fluorescent fixtures to suspended ceilings:
    - a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4 inch [6mm] secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
    - b. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 1/4 inch

[6mm] studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4 inch [6mm] toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.

- c. In addition to the above, the following is required for fixtures exceeding 20 pounds [9kg] in weight.
    - 1) Where fixtures mounted in ASTM Standard C635-69 "Intermediate" and "Heavy Duty" ceilings and weigh between 20 pounds and 56 pounds [9kg and 25kg] provide two 12 gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.
    - 2) Where fixtures weigh over 56 pounds [25kg] they shall be independently supported from the building structure by approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.
  - d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
6. Surface mounted lighting fixtures:
- a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 1/4-20 [6mm] bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 56 pounds [25kg] shall be supported directly from the building structure.
  - b. Where ceiling cross runners are installed for support of lighting fixtures they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
  - c. Fixtures less than 15 pounds [6.8kg] in weight and occupying less than two square feet [600mm x 600mm] of ceiling area may, (when designed for the purpose) be supported directly from the outlet box when all the following conditions are met.

- 1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.
- 2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.
- 3) The outlet box is supported vertically from the building structure.
- d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.
7. 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.
8. 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.

### **3.2 FIELD QUALITY CONTROL**

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- C. 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.

- D. 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.
- E. 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.
- F. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- G. Emergency Lighting Tests: Simulate power outage by turning power off to the circuit providing normal power to the light fixture.
  - 1. Provide a report for each room or space that has emergency lighting installed. Indicate the following for each space:
    - a. Date of test.
    - b. List each type of emergency power transfer device/unit(s) and quantity of each installed.
    - c. Verification that each unit is in working order.
    - d. Verification that lamps have been aimed properly, for units that require aiming.
    - e. Duration of supply.
  - 2. Repeat tests for deficient items. Simulate power outage by turning power off to the circuit providing normal power to the light fixture. Provide a cover sheet listing all deficient items. Provide new test report for each deficient item. Indicate the following:
    - a. Date of test.
    - b. Deficiency and corrective action taken.
    - c. Repeat tests/verifications in the original test report.

### 3.3 ADJUSTING

- A. Aim and adjust directional luminaires as directed, in the field, by the Engineer.
- B. Position exit sign directional arrows as indicated.

### 3.4 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures.
- C. Clean finishes and touch up damage.

### 3.5 SCHEDULES

- A. Lighting Fixture Schedule: See Drawings.

- - - E N D - - -

**SECTION 27 05 11  
REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section, Requirements for Communications Installations, applies to all sections of Division 27.
- B. Furnish and install communications cabling, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable, and other items and arrangements for the specified items are shown on drawings.

**1.2 SYMBOLS, AND ABBREVIATIONS, AND ACRONYMS**

- A. Refer to symbols and abbreviations listed on the drawings. Other symbols are in common usage but if uncertainty exists regarding any plan symbols or abbreviations they shall be brought to the attention of the Contracting Officer and he shall clarify same.

**1.3 DEFINITIONS**

- A. Where the phrase starts "Provide \_\_\_\_\_", "provide" shall be construed to mean the same as "Furnish and install \_\_\_\_\_".
- B. Where the phrase "Division 21", "Division 22" or "Division 23" is used on the drawings or in this specification, it shall be the responsibility of this Contractor to determine which Contractor doing work under a Division 21, 22, or 23 specification section is the Contractor being referred to (i.e., plumbing, HVAC, temperature controls, etc.)

**1.4 MINIMUM REQUIREMENTS**

- A. References to industry and trade association standards and codes are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

**1.5 MATERIALS AND WORKMANSHIP**

- A. All material and workmanship must be of the best throughout. All material and equipment must be new and must be adequately protected from damage and dirt at all times. The Contracting Officer reserves the right to reject any material or workmanship not in accordance with the specifications, either before or after installation.
- B. The Contractor will be held responsible for any and all defects in material and workmanship which may appear during guarantee period after

the building has been accepted. All such defects must be repaired or defective material replaced by the Contractor at no expense to the Government.

#### **1.6 ADMINISTRATIVE REQUIREMENTS**

- A. Site Mobilization Meeting: Attend meeting at the Project site prior to Contractor occupancy.
- B. Preconstruction Meeting: Attend preconstruction meeting [ < > ] prior to the start of the work of this section.

#### **1.7 INSPECTION OF SITE**

- A. Before submitting a proposal on the work contemplated in this specification and accompanying drawings, each bidder shall examine the site and check as to the means of making connections to services and shall familiarize himself with all the existing conditions and limitations.
- B. No extras will be allowed because of the contractor's misunderstanding as to the amount of work involved or the contractor's lack of knowledge of any site conditions which may affect their work.
- C. Any apparent variance of the plan or specification from the existing conditions at the site shall be called to the attention of the Contracting Officer.

#### **1.8 DRAWINGS**

- A. The drawings are to scale as noted. The Contractor shall refer to architectural and structural drawings for exact location of partitions, walls, beams, shafts, equipment, etc.
- B. The Contractor, before rough-in facilities or installation of any equipment shall consult all drawings, general, structural, mechanical, finishes, locations of ceiling, structural members, pipes, ducts, recessed lighting fixtures, conduits, etc., which may affect the installation.
- C. Discrepancies discovered before or after work has started shall be brought to the attention of Government: Contracting Officer.  
Government reserves the right to require minor changes in the work of any Contractor to eliminate such discrepancies with no change in contract cost.
- D. The plans and specifications are complementary and what is called for in either one shall be as binding as if called for in both.

- E. Where a disagreement exists between the plans and specifications, the item or arrangement of better quality, greater quantity or higher cost shall be used.
- F. Where a disagreement exists between an item on the drawings and another item on the drawings, the item or arrangement of better quality, greater quantity or higher cost shall be used.

#### **1.9 COORDINATION**

- A. This Contractor shall review drawings and specifications from all divisions for conflicts in work for locations of ducts, piping, sprinkler heads, door hardware schedule for devices, ceiling plans, wall elevations, etc. Discrepancies shall be brought to the attention of the Contracting Officer prior to beginning the work.
- B. Coordinate with all sub-contractors for locations of all conduit, cable-tray, lighting, devices, door hardware, occupancy sensors.
- C. Attend Preinstallation and Coordination meetings, if required by individual Section.

#### **1.10 GUARANTEE**

- A. All work specified in Division 27 sections shall be guaranteed to be free from defects in materials and installation for a minimum period of one year from the Date of Acceptance of the Work. See Division 1 requirements and General Conditions for additional requirements. The Contractor shall repair and/or replace defective work, including materials and labor, discovered during the guarantee period.
- B. See individual specification sections for additional guarantees, which include guarantees that extend beyond one year.

#### **1.11 TEMPORARY TELECOMMUNICATIONS SERVICES**

- A. Provide, and maintain telephone service to field office at time of project mobilization.
- B. Telecommunications services shall include:
  - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
  - 2. Telephone Land Lines: One line, minimum; one handset per line.
  - 3. Email: Account/address reserved for project use.

#### **1.12 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.

**1.13 APPLICABLE PUBLICATIONS**

- A. Applicable publications listed in all Sections of Division 27 are the latest issue, unless otherwise noted.

**1.14 MANUFACTURED PRODUCTS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:**
1. Components of an assembled unit need not be products of the same manufacturer.
  2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  3. Components shall be compatible with each other and with the total assembly for the intended service.
  4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

**1.15 EQUIPMENT REQUIREMENTS**

- A. 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.

#### **1.16 EQUIPMENT PROTECTION**

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
  - 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
  - 2. Damaged equipment shall be, as determined by the COTR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
  - 3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
  - 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

#### **1.17 WORK PERFORMANCE**

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure communications service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and pathways with other trades to minimize interferences. See the GENERAL CONDITIONS.

#### **1.18 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Inaccessible Equipment:
  - 1. Where the 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 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.

#### **1.19 EQUIPMENT IDENTIFICATION**

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

#### **1.20 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Where an individual Section requires more than one identified item for review (i.e. "Shop Drawings", "Product Data", "Warranty", and "Samples"), submit all items concurrently.
- C. Provide tabbed divider separating each item for review included in the submittal (i.e. "Product Data", "Shop Drawings", and "Warranty").
- D. 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.
- E. 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. Mark catalog sheets and drawings to indicate specific items submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
- F. Failure to properly identify items included in a submittal may result in the submittal(s) returned to the Contractor for correction and resubmission.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.
- G. The submittals shall include the following:
1. Information that confirms compliance with contract requirements.  
Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
  2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
  3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- H. 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.
    - a. Table of contents shall identify each tabbed divider by Section number and Section name.
  4. First item in manual shall be Section 26 0511 - Requirements for Electrical Installations. This tab shall include Consolidated

Maintenance Schedule for all electrical components provided in this project that require routine maintenance or testing.

5. Submit required information in a three ring binder.
  - a. Submit one (1) binder for review prior to final submittal.
  - b. Submit three (3) binders for final submittal.
  - c. Provide tabbed divider for each Specification Section.
  - d. Provide compact disk (CD) with information required in individual specification sections. Arrange CD with directories that identify each Section number and Section name.
6. The manuals shall include:
  - a. Approved product data and shop drawings.
  - b. Documentation of Training. For each individual section that requires training: Include date, attendance roster, and outline of training. Include video of training session.
  - c. Include test reports.
  - d. Include inspector's reports.
  - e. Include warranty information.
  - f. Include Certificates on Completion.
  - g. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
  - h. A control sequence describing start-up, operation, and shutdown.
  - i. Description of the function of each principal item of equipment.
  - j. Installation and maintenance instructions.
  - k. Safety precautions.
  - l. Diagrams and illustrations.
  - m. Testing methods.
  - n. Performance data.
  - o. 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.
  - p. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

#### I. RECORD DRAWINGS

1. The Contractor shall keep a complete set of all drawings in his job site office for the purposes of showing "As-Built" installation of

- electrical systems and equipment. This set of drawings shall be used for no other purpose.
2. Where any material, equipment, or system components are installed differently from that shown on the Contracting Officer's drawings, such differences shall be clearly and neatly shown on this set of drawings using ink or indelible pencil.
  3. The change notations shall be kept up-to-date on a daily basis. When requested, this set of drawings shall be transmitted to the Contracting Officer, and after the Contracting Officer has examined the drawings, the set will be returned to the contractor for further use.
  4. At the completion of the project, the "As-Built" set of drawings shall be turned over to the COTR for review and then shall become the property of the Government.
- J. Approvals will be based on complete submission of manuals together with shop drawings.
- K. 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 and pathway coupling, bushing and termination fitting.
  3. Raceway and pathway hangers, clamps and supports.
  4. Duct sealing compound.
- L. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

#### **1.21 SINGULAR NUMBER**

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

**1.22 ACCEPTANCE CHECKS AND TESTS**

- A. The contractor shall furnish the instruments, materials and labor for field tests.

**1.23 TRAINING**

- A. Training shall be provided in accordance with Article, 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.

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION - NOT USED**

- - - E N D - - -

**SECTION 27 05 26**  
**GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, telecommunications 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 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS:  
General electrical requirements and items that are common to more than one section of Division 27.
- B. Section 27 12 00, TELECOMMUNICATIONS CABLING EXPANSION.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Grounding System Resistance: 5 ohms.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include the location of system existing grounding electrode connections.
- C. 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.

**1.5 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 the basic designation only.

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

B1-2001.....Standard Specification for Hard-Drawn Copper  
Wire

B8-2004.....Standard Specification for Concentric-Lay-  
Stranded Copper Conductors, Hard, Medium-Hard,  
or Soft

## C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983.....IEEE Guide for Measuring Earth Resistivity,  
Ground Impedance, and Earth Surface Potentials  
of a Ground System

## D. National Fire Protection Association (NFPA):

70-2005.....National Electrical Code (NEC)

## E. Telecommunications Industry Association, (TIA)

J-STO-607-A-2002.....Commercial Building Grounding (Earthing) and  
Bonding Requirements for Telecommunications

## F. Underwriters Laboratories, Inc. (UL):

44-2005 .....Thermoset-Insulated Wires and Cables

83-2003 .....Thermoplastic-Insulated Wires and Cables

467-2004 .....Grounding and Bonding Equipment

486A-486B-2003 .....Wire 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 mm<sup>2</sup> (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm<sup>2</sup> (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 mm<sup>2</sup> (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

C.

Telecom System Grounding Riser Conductor: Existing to remain.

**2.2 SPLICES AND TERMINATION COMPONENTS**

A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

**2.3 TELECOMMUNICATION SYSTEM GROUND BUSBARS****EXISTING TO REMAIN. 2.4 GROUND CONNECTIONS**

A. Above Grade:



1.. Rack and Cabinet Ground Bars: Existing to remain..

- A. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

## **2.5 EQUIPMENT RACK AND CABINET GROUND BARS**

- A. Existing to remain.

## **2.6 GROUND TERMINAL BLOCKS**

- A. 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**

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (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. 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.

## **3.2 ACCESSIBLE GROUNDING CONNECTIONS**

- A. At interior locations: All grounding connections shall be accessible. Provide access panels.
- B. At interior locations: All grounding connections shall be accessible. Provide access panels.
- C. Inaccessible grounding connections for communications systems are prohibited.

## **3.3 CORROSION INHIBITORS**

- A. 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.

## **3.4 TELECOMMUNICATIONS SYSTEM**

- A. Bond telecommunications system grounding equipment to the electrical grounding electrode system.

- B. Furnish and install all wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
- C. Provide bonding jumpers between non-continuous portions of metallic raceway systems.
- D. Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.  
Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milli ohms or less.
- F. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.
- G. Bonding Jumpers:
  - 1. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 16 mm<sup>2</sup> (6 AWG) insulated copper wire.
  - 2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
  - 3. Use compression connectors of proper size for conductors specified.
  - 4. Use connector manufacturer's compression tool.
- H. Bonding Jumper Fasteners:
  - 1. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.
  - 2. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
  - 3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.

4. Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

### **3.5 COMMUNICATION ROOM GROUNDING**

#### **A. Telecommunications Ground Busbars:**

1. Existing to remain.

#### **B. Telephone-Type Cable Rack Systems:** aluminum pan installed on telephone-type cable rack serves as the primary ground conductor within the communications room. Make ground connections by installing the following bonding jumpers:

1. Install a 16 mm<sup>2</sup> (6 AWG) bonding between the telecommunications ground busbar and the nearest access to the aluminum pan installed on the cable rack.
2. Use 16 mm<sup>2</sup> (6 AWG) bonding jumpers across aluminum pan junctions.

#### **C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:**

1. When ground bars are provided at the rear of lineup of bolted together equipment racks, bond the copper ground bars together using solid copper splice plates supplied by the ground bar manufacturer.
2. Bond together nonadjacent ground bars on equipment racks and cabinets with 16 mm<sup>2</sup> (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
3. Provide a 16 mm<sup>2</sup> (6 AWG) bonding jumper between the rack and/or cabinet ground busbar and the aluminum pan of an overhead cable tray or the raised floor stringer as appropriate.

#### **D. Backboards:** Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to the aluminum pan in the telephone-type cable tray using an insulated 16 mm<sup>2</sup> (16 AWG) bonding jumper.

#### **E. Other Communication Room Ground Systems:** Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable tray pan or the telecommunications ground busbar, whichever is closer, using insulated 16 mm<sup>2</sup> (6 AWG) ground wire bonding jumpers.

### **3.6 COMMUNICATIONS CABLE GROUNDING**

#### **A. Bond all metallic cable sheaths in multipair communications cables together at each splicing and/or terminating location to provide 100**

percent metallic sheath continuity throughout the communications distribution system.

1. At terminal points, install a cable shield bonding connector provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector to an appropriate ground source like the rack or cabinet ground bar.
2. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or the splice case grounding and bonding accessories provided by the splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to an approved ground source and all other metallic components and equipment at that location.

### **3.7 COMMUNICATIONS RACEWAY GROUNDING**

- A. Conduit: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.
- B. Wireway: use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.
- C. Cable Tray Systems: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 16 meters (50 feet).

### **3.8 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Government. Final tests shall assure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81.

- - - E N D - - -

**SECTION 27 05 33**  
**RACEWAYS AND BOXES FOR COMMUNICATIONS 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, raceway systems. Raceways are required for all communications cabling 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. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- B. Identification and painting of conduit and other devices: Section 26 05 53 Identification for Electrical Systems.
- C. General electrical requirements and items that is common to more than one section of Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

**1.3 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Shop Drawings:
  - 1. Size and location of panels and pull boxes
  - 2. Layout of required conduit penetrations through structural elements.
  - 3. The specific item proposed and its area of application shall be identified on the catalog cuts.
- C. 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):

70-05.....National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL):

1-03.....Flexible Metal Conduit

5-01.....Surface Metal Raceway and Fittings

6-03.....Rigid Metal Conduit

50-03.....Enclosures for Electrical Equipment

360-03.....Liquid-Tight Flexible Steel Conduit

467-01.....Grounding and Bonding Equipment

514A-01.....Metallic Outlet Boxes

514B-02.....Fittings for Cable and Conduit

514C-05.....Nonmetallic Outlet Boxes, Flush-Device Boxes  
and Covers

651-02.....Schedule 40 and 80 Rigid PVC Conduit

651A-03.....Type EB and A Rigid PVC Conduit and HDPE  
Conduit

797-03.....Electrical Metallic Tubing

1242-00.....Intermediate Metal Conduit

D. National Electrical Manufacturers Association (NEMA):

TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and  
Tubing

FB1-03.....Fittings, Cast Metal Boxes and Conduit Bodies  
for Conduit, Electrical Metallic Tubing and  
Cable

**PART 2 - PRODUCTS**

**2.1 MATERIAL**

A. Horizontal Pathway: Conform to TIA/EIA-569-A, using raceway, wireway, and backboards as indicated.

1. Provide back box at all workstation connectors and wall telephone locations.

2. Provide conduit to wireway in interstitial space above occupied floor, with bonding bushing. Wireway in interstitial space: Existing to remain.

B. Conduit Size: In accordance with the NEC, but not less than 21 mm (1 inch) unless otherwise shown.

C. Conduit size from common pull box:

1. One workstation: 1 inch.

2. Two workstations: 1-1/4 inch.

3. Three workstations: 1-1/2 inch

## D. Conduit:

1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
2. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
3. 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.
4. Flexible galvanized steel conduit: Shall Conform to UL 1.
5. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
6. Surface metal raceway: Prohibited.

## E. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and ANSI/NEMA FB1.
  - b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  - d. 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.
  - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
  - f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. 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.
- 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.
- 3. Flexible steel conduit fittings:
  - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp type, with insulated throat.
- 4. Liquid-tight flexible metal conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- 5. 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.
- F. 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.

G. 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.

H. 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 communications 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. 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 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. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. 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.

C. Layout and Homeruns:

1. 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. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors 70 volts and below:
  - a. Rigid steel, IMC, 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.

### **3.4 EXPOSED WORK INSTALLATION**

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.

- B. Conduit for Conductors 70 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.
- H. Provide conduit identification where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between. Refer to Section 26 05 53 Identification for Electrical Systems for identification method.

### **3.5 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.

### **3.6 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.

### **3.7 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. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

### **3.8 COMMUNICATION SYSTEM CONDUIT**

- A. Install the communication raceway system as shown on drawings.
- B. Minimum conduit size of 21 mm (1 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.
- F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.
- G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- H. All empty conduits located in communication closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- I. Conduit runs shall contain no more than two quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

J. Install pull boxes for straight-through pulls only. Cable bends in pull boxes is prohibited.

K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

- - - E N D - - -

**SECTION 27 12 00**  
**TELECOMMUNICATIONS CABLING EXPANSION**

**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections.

**1.2 SUMMARY**

- A. This section includes installation, testing, documentation and training for a fully functional local area network cabling infrastructure.
- B. Furnish and install Horizontal UTP Copper cabling, patch panels, patch cords, termination units, horizontal cross-connects, information outlets, respective cable termination connections, and other items necessary to "terminate" selected information outlets (IO) as shown on the Drawings.
- C. Existing Telecommunication Demolition - Existing cables and jacks scheduled to be removed shall be documented with telecommunication closet location and identification of the termination location in the telecommunication closet.

**1.3 WORK PROVIDED UNDER OTHER SECTIONS**

- A. Data cabling pathways, power wiring devices, lighting, cooling and other work related to the Local Area Network infrastructure will be provided by the Electrical Contractor unless noted otherwise.

**1.4 WORK FURNISHED, INSTALLED, AND CONNECTED BY OTHER**

- A. Electronic data communication equipment is not specified under this contract.

**1.5 SUBMITTALS**

- A. Submit a complete list of all proposed equipment and materials, including manufacturer's specifications and product cut sheets prior to purchase.
- B. Submit a labeling scheme approved by the owner and the Government.
- C. Telecommunications Maintenance Manual: Furnish one (1) complete Telecommunications Maintenance Manual containing the following:
  - 1. Descriptions of network cabling equipment and normal operating procedures.
  - 2. Riser Diagrams showing complete installed UTP and Fiber cabling.
  - 3. Proof of Performance Report outlining the operating parameters tested, complete test results, and a summary of industry standards used for each parameter.
  - 4. Warranty information.

**1.6 APPLICABLE PUBLICATIONS, STANDARDS, CODES, TESTING LABORATORIES, GUIDELINES**

- A. ANSI/EIA/TIA Standard 568B.1, 568B.2, AND 568B.3
- B. ANSI/EIA/TIA Standard 569
- C. ANSI/EIA/TIA Standard 606
- D. ANSI/EIA/TIA Standard 607
- E. Technical Service Bulletins TSB-36, TSB-40, TSB 67
- F. NFPA 70e National Electrical Code.
- G. Provide products specified in this section that are listed and labeled.
  - 1. The terms "listed" and "labeled": As defined in the "National Electrical Code", Article 10G0.

**1.7 GUARANTEES AND WARRANTIES**

- A. Guarantee system, in writing, against defects in workmanship and associated material not covered by cabling infrastructure warranty,

for one year after final acceptance. During this time, the entire infrastructure shall be kept in proper operating condition at no additional labor or material cost to the Owner or Government.

#### **1.8 QUALITY ASSURANCE**

- A. Contractor shall be currently licensed to install low-voltage cabling infrastructures in the state where the facility is located.
- B. Contractor shall meet manufacturer's requirements for the provision and installation of specified equipment.
- C. Contractor shall provide proof of certification as a structured cabling infrastructure installer for the system provided under this bid.
- D. Contractor shall utilize the following test equipment, or better, and shall have operators trained for use of such equipment:
  - 1. Copper Cable Test Equipment:
    - a. Fluke / MicroTest (level 3 tester)
    - b. Agilent WireScope 350 (level 3 tester).
    - c. Prior approved equal.
  - 2. Fiber Optic Cable Test Equipment: (if fiber is included in the installation)
    - a. Approved OTDR.
    - b. Approved OLS/OPM.

#### **1.9 PROJECT/SITE CONDITIONS**

- A. Examine areas and conditions under which the system is to be installed, and notify COTR in writing of conditions detrimental to proper completion of the work. Do not proceed with that portion of the work affected until unsatisfactory conditions have been corrected in an acceptable manner.

#### **1.10 MANUFACTURER**

- A. Subject to compliance with specified requirements, provide specified materials, or prior approved equal to the referenced products included for the design of the Local Area Network Cabling infrastructure.

#### **1.11 UPGRADED PRODUCTS**

- A. Due to the fast-changing technology, products shall be the most current and up-to-date quality and labor-saving versions available for the application, unless otherwise restricted.
- B. Prior to bidding, provide written notification of any discrepancies in model or part numbers specified. Corrections will be clarified by addendum.
- C. Prior to bidding, provide written notification to COTR of announced discontinuation or upgrade replacements of specified materials.
- D. Provide necessary supplies, mounting hardware and accessories required to install specified materials.

#### **1.12 PRODUCT SUBSTITUTION**

- A. **No manufacturer substitutions will be allowed for the structured cabling infrastructure without prior approval from the Government.**

### **Approved Material List**



Category	Item	Part #	Manufacturer	Estimated Quantity
Jack Locations	4 Cable 2V-2D			
	6 Cable 2V-4D			
	1 Cable Cat 3			
Face Plates				
	4 Port	UICFPSE4EI	Panduit	
	6 Port	UICFPSE6EI	Panduit	
	8 Port	UICFPSE8EI	Panduit	
Jacks (angled)				
	Cat 6 Violet	CJ688TVL	Panduit	
	Cat 6 Green	CJ688TGR	Panduit	
	Cat 3 Orange	CJ88UORY	Panduit	
	Cat 3 Red	CJ88URDY	Panduit	
	Wall Jack			
Patch Panels				
	24 Port	CP24WSBLY	Panduit	
	48 Port	CP48WSBLY	Panduit	
Cable supports				
	Cable trays			
	4" J-Hook	181120	Caddy	
	2" J-Hook	181100	Caddy	
Fasteners				
	Velcro 3/4"		Panduit	
Jack Supports				
	Single Gang	LV-1	Arlington	
	Double Gang	LV-2	Arlington	
Cable				
	Cat 6 Blue	7131688	General	
	Cat 6 White	7131689	General	
	25 pair copper			
Fire Stop				

Category	Item	Part #	Manufacturer	Estimated Quantity
Grounding				
	#6 CU 19-Strand Green			
	Lug #6 long Barrel 2 Hole	YA6C-2TC14	Burndy	
	Tag	LTYK	Panduit	
	Bonding Washer	RGW-100-1	Panduit	
	Ground Bar 19"x3/4"x1/4"		Hoffman Electric	
	Main Ground Bar	GB2B0312TPI-1	Panduit	
Cross connect				
	1 Pr Wh/Gn 24 ga Roll 1000'		General	
Patch Cords Cat 6	*Unbooted RJ45			
	Black - 3'			
	Black - 5'			
	White - 3'			
	White - 5'			
	Red- 3'			
	Red- 5'			
Station Cords Cat 6	*Booted RJ45			
	Black 7'			
	Black 14'			
	Black 25'			
	Black 5'			
	Black 7'			

**1.13 MANUFACTURER'S CERTIFICATION**

A. Manufacturer of cabling products shall be ISO9001 Certified.

**1.14 UTP COPPER CABLE LENGTHS, TERMINATIONS, MARKINGS**

- A. Copper Cable runs shall be compliant with EIA/TIA recommended lengths: Horizontal cables shall not exceed 295 feet. Cable runs shall be continuous with no allowance for splicing.
- B. For construction on Mpls VAMC Campus: Copper cable Eight-Position Jack Pin/Pair Assignments shall match the VA Hospital's existing facilities. Coordinate with the COTR prior to installation.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide a certified structured cabling infrastructure by: General Cable or approved equal.
- B. Data Cable: Part Number 7131688, Cat 6, blue.
- C. Voice Cable: Part Number 7131689, Cat 6, white.

**2.2 EQUIPMENT RACK:**

- A. Rack: Existing to remain.

**2.3 CABLE SUPPORT**

- A. Supply velcro straps, length and strength as required to properly organize and bundle cables. Vinyl/plastic tie wraps are prohibited throughout except where allowed in section 2.6.
- B. Install cables in conduit and wireway systems provided by the Electrical Contractor. Coordinate with the Electrical Contractor for specific requirements. Conduit and wireway systems can only contain low voltage cable for VA connections.

**2.4 CATEGORY 6 CHANNEL**

- A. The Category 6 - 4 pair UTP channel consists of all cable and components with up to four connections that comprise the full 100 meter circuit from the LAN Electronics to the work station device. The channel shall support applications such as 10Base-T, 100Base-T, 155 Mbs ATM, 77 channel broadband video, 1.0 Gbps Ethernet, 1.2 Gbps, and proposed 2.4 Gbps ATM technologies.
- B. The channel shall include the patch panels, horizontal cabling, and the station cord, and shall have a positive PSACR across the full frequency range of 1MHz - 250MHz.
- C. All components shall be backward compatible with existing Category 3, 4 and 5 networks.
- D. The cabling channel with specified manufacturers above shall exceed Category 6 requirements.

**2.5 INFORMATION OUTLETS**

- A. Activations: 4 outlets will be required at each location shown on the plans with tabs down.
- B. Modular Faceplates: Ivory, smooth nylon, UL rated 94V-0 high impact, flame-retardant, thermoplastic, integral label card and cover, sized as follows:
  - 1. Data information outlets: Devices shown on plans as data information outlets shall be four position faceplates. Panduit 4 position face plate Part Number UICFPSE4EI.
  - 2. Telephone information outlets: same as data.
- C. Modular Information outlets: Modular single information outlet designed for high-performance networking applications. Panduit gigaspeed information outlet:
  - 1. Data outlet Cat 6 Violet 568B: Panduit CJ688TGVL
  - 2. Voice outlet Cat 6 Green 568B: Panduit CJ688TGGR
- D. Minimum electrical requirements:
  - 1. Insulation resistance: 500 MΩ minimum
  - 2. Dielectric withstand voltage 1,000 VAC RMS, 60 Hz, minimum contact-to-contact and 1,500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface.
  - 3. Contact resistance: 20 MΩ maximum
  - 4. Current rating: 1.5A at 68 degrees F per IEC Publication 512-3, Test 5b
- E. Dust Cover/Blank: Contractor shall provide dust covers for each outlet as required to close all faceplate openings.

- F. Where data/voice jacks are fished into a hollow wall space without a raceway, Arlington LV-1 or approved equal shall be used. Metal types such as Caddy brand are not allowed.

## 2.6 MODULAR PATCH PANELS

- A. Furnish and install Modular Patch Panels, Panduit CPP48WSBLY. The panels shall be 19-in. wide for rack mounting. The panels shall accommodate Panduit CJ88TPVL Cat 6 Violet 568B Data Jack and Panduit CJ8BTPGR Cat 6 Green Voice Jacks. All cables shall be secured to the strain relief bar using vinyl/plastic tie wraps. Provide labeling strip above each jack. Contractor shall be responsible for sizing the modular patch panels according to the following specifications:
1. Number of Modular Patch Panel Ports shall be 125 percent of the total number of terminated information outlets required for the VRT project.
  2. Patch panels shall be 24 port or 48 port.

## 2.7 PATCH CORDS

- A. Provide Patch Cords, Panduit Gigaspeed D8CM, 24 AWG, polyfin, twisted, jacketed, with 8-position Modular Plug at each end.
1. Data Color: Black
  2. Voice Color: White
  3. Printer color: Red
  4. Biomedical color: Purple
- B. Lengths of patch cords shall comply with EIA/TIA 568B recommended lengths: Patch cords shall not exceed 20 feet. Provide varying lengths to suit data closet installation. Coordinate final length selection with COTR prior to ordering.
1. Data Lengths: As specified in parts list
- C. Provide 1 patch cord for each activated information outlet as estimated in parts list.

## 2.8 HORIZONTAL UTP CABLE

- A. Furnish and install copper Unshielded Twisted-Pair (UTP) horizontal cable as follows:
1. General Cable Gigaspeed Part No. 6P4P24BLSGCCPP, plenum rated, 24 AWG bare solid copper conductor. The cable shall conform to UL Type CMP listing for plenum and riser applications.
  2. Each cable sheath shall contain 4 pairs of unshielded copper twisted-pairs with each pair having a different twist ratio of 12 to 24 twists per foot. Each pair shall be separated by a pair isolator.
  3. The cables shall exceed the requirements of:
    - a. EIA/TIA 568B Commercial Building Wiring Standard Horizontal Cable Section for category 6.
    - b. Plenum - UL 910, CMP.
  4. The cables shall meet the following representative electrical and transmission characteristics:
    - a. Mutual Capacitance - nom. = 14 nF/1000 ft.
    - b. DC Resistance - max. = 29 ohms/1000 ft. (9.4 ohms/100m).
    - c. Gbps 4 Pair Cable Performance Characteristics as follows:

Frequency MHz	Attenuation DB/100m	Power Sum NEXT dB	Attenuation to Crosstalk Ratio dB/90m	Structural Return Loss DB
1	2.0	75.3	75.3	23.0
4	3.8	66.3	64.5	23.6

8	5.3	61.8	54.5	25.4
10	5.9	60.3	58.5	26.0
16	7.5	57.3	51.7	26.0
20	8.4	55.8	49.4	26.0
25	9.4	54.3	46.9	25.5
31.25	10.6	52.9	44.3	25.0
62.5	15.3	48.4	35.1	23.5
100	19.7	45.3	27.6	23.0
200	28.8	40.8	14.0	21.0
250	32.6	39.3	8.7	20.5

5. Provide colors for each defined system as follows: Blue

## 2.9 FIBER OPTIC CABLE:

A. Fiber optic cable shall be Government specified. The cable shall have (2) strands of multi-mode fiber. Provide fiber with the following optical characteristics:

1. Multi Mode:

850nm:	Maximum Attenuation	3.5 dB/km
1300nm:	Maximum Attenuation	1.5 dB/km
850 nm	Minimum Bandwidth:	1500 MHz/km
1300 nm	Minimum Bandwidth:	500 MHz/km

2. Supports 10Gb/s Ethernet using 850nm VCSEL to 300m.

3. Fiber tension rating - 600 lbs.

4. Fiber minimum bending radius during installation - 20 x diameter.

5. The fiber cable shall meet the following technical specifications:

a. Multi-Mode Fiber Dimensions: 62.5 micron core  
125 micron cladding  
250 micron coating  
900 micron buffering

6. Fiber Identification: Individually color-coated PVC buffer.

7. Buffer Material: Plenum PVC

8. Jacket Material: Plenum PVC (color as selected by owner).

9. Strength Material: Aramid Yarn

10. Operating Temperature: 0 to + 50 deg. C

11. Storage Temperature: -40 to +70 deg. C

12. EIA Fiber Cable tests:

TEST	REFERENCE
Impact	EIA-RS-455, FOTP-25
Compression	EIA-RS-455, FOTP-41
Flexure	EIA-RS-455, FOTP-104
Tensile Bending	EIA-RS-455, FOTP-33
Temperature Bending	EIA-RS-455, FOTP-37
Twist Testing	EIA-RS-455, FOTP-85
Flame Test (OFNP)	UL 910 (NEC) [CSA OFN-FT4, FT6]

## 2.10 FIBER TERMINATION UNITS:

A. Furnish and install Government specified front access sliding shelf connector panel equipped with SC couplings and cover plate for all Data racks. Units shall provide top or bottom cable entry, fiber termination, cross connection, interconnection, routing, fiber identification labels, fiber storage and radius organizers.

## 2.11 FIBER TERMINATION CONNECTORS: N/A

**2.12 FIBER PATCH AND WORKSTATION CORDS: N/A****PART 3 - EXECUTION****3.1 GENERAL**

- A. Install equipment and components in accordance with manufacturer's written instructions, in compliance with NEC, and with recognized industry practices. Ensure that all work complies with specifications and serves the intent of the construction documents. Cabling and equipment shall be installed in accordance with good engineering practices as established by the EIA/TIA and the NEC.

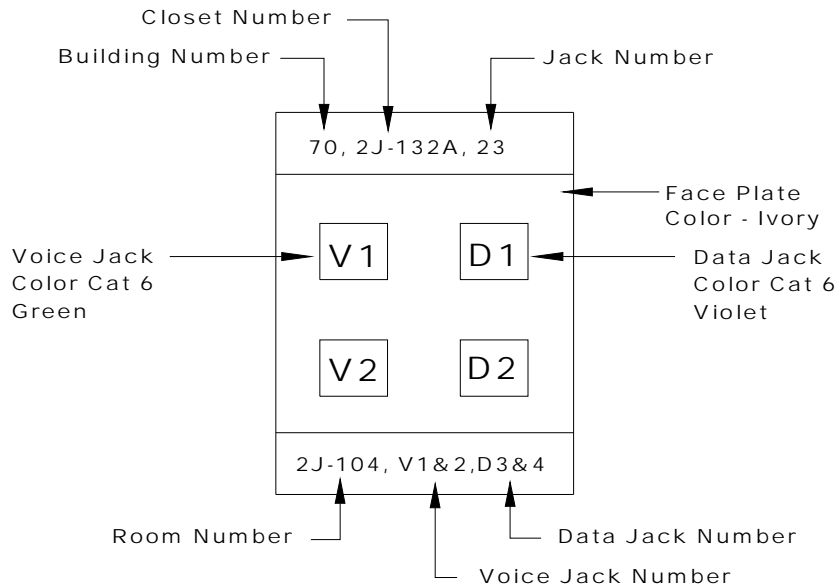
**3.2 INSTALLATION**

- A. Cabling - General:
1. Provide dedicated horizontal cable runs from data closets to all "terminated" information outlets as described above and indicated on the Drawings.
  2. Provide faceplates for all data and voice information outlets.
  3. Where data or voice outlets are shown on plans, this Contractor shall provide jack termination, faceplate, and cabling.
  4. Provide Modular Information Outlets in outlet boxes for all "terminated" data information outlets.
  5. Excess cable behind faceplate connections shall be pulled back into ceiling spaces and secured in such a manner as to prevent damage to cabling or connections.
  6. A minimum 10 foot loop of extra horizontal cable shall be secured in the accessible ceiling space.
  7. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.
  8. Avoid excessive and sharp bends that may damage cabling. Do not exceed manufacturer's recommended pulling tensions for backbone and horizontal cables.
  9. Allow sufficient slack (10 feet) in cable to prevent premature deterioration of cable system components and to assist in the maintenance and servicing of cable and/or other building systems and components.
  10. Provide Cable Trays as necessary to route and support cables from hallways to just above the lockable cabinets. All cables shall be properly supported.
  11. Provide Velcro straps to bundle and organize cabling for a quality and professional installation. **Vinyl/plastic tie wraps are prohibited except where allowed in section 2.6.**
  12. Fittings or connections are allowed only at the input and output of devices. Splicing shall not be accepted in cable runs. Spliced cable runs shall be rejected and replaced with continuous cables, prior to acceptance.
  13. Separation of Wires: Comply with EIA/TIA-568 rules for separation of UTP cables from potential EMI sources.
  14. All cabling outside the data closet shall be routed in conduit or cable tray, installed by the electrical contractor.
    - a. Conduit fill shall not exceed 40%. This applies to both raceways and sleeves. Each conduit end not terminated in a box shall be equipped with a protective insulator or sleeve to cover the conduit end to protect the wire or cable during installation and remaining in the conduit.
  15. Special wiring requirements in addition to the standard wiring from low voltage room to wall plates

- a. Direct cable from demarc room to alarm/security system
  - b. Direct cable from demarc room to emergency phones at reception desk and workroom
  - c. Direct cable from demarc room to multipurpose business machines at designated locations
  - d. 25 pair copper cable from demarc room to low voltage room-cable must be in continuous conduit if it passes through space not leased to the VA. Terminated to 60 block in demarc room and RJ45 patch panel in lockable cabinet in low voltage closet. Length of cable not to exceed 295 feet, including 10 foot service loop at in low voltage closet.
  - e. Two Cat 6 cables with RJ45's from building demarc to low voltage closet with 10 foot service loop at each end.
- B. Sleeving: All cabling penetrating a wall or floor and not in a raceway shall be sleeved. A penetrator sleeve system and method for using same provides an encasement for wires and cables passing through a wall or floor. The system should include appropriate securing devices for tightly retaining the penetrant in place. This will also create a space between the penetrant and surrounding structure, which must be fire stopped in order to restore the fire-resistance rating of the parent assembly. The penetrant shall be one of the following;
1. EMT conduit with bushed ends.
  2. Prefabricated fire-rated pathway. Recommend the following or approved equivalent. Follow manufacturer's conduit fill recommendations.
    - a. EZ-PATH Fire Rated Pathway
    - b. Spec Seal Ready Sleeve
- C. Firestopping: Provide fire stopping after cabling installation at all fire wall/floor penetrations.
- D. Grounding: The general contractor shall be responsible for installing a ground bus adjacent to the cabinets. Ground all cabinets and cable runway to this ground bus. The contractor shall provide a #6 copper conductor from each rack/runway to the ground bus. Ground equipment per manufacturers' instructions and NEC requirements.
- E. Demarc room and extended demarc cable
1. Backboards for the demarc room and the low voltage room(s) shall be 20 mm (3/4 inch) thick, type ACX fire retardant plywood, covered with two coats of fire retardant white paint with a minimum area of 1.2 x 2.4 m (4 x 8 ft)
  2. If space allows, backboard should be positioned with long side horizontal and vertically centered on the wall
  3. Backboard in the demarc room should be as close as possible to the external teleco entry point and separated as much as possible from the electrical boxes
  4. In existing facilities where the demarc room is shared with other occupants a minimum area of approximately 6 sq ft will be needed on wall mounted plywood
  5. One 25-pair cable will be installed from the building demarc to the Government low voltage closet. Adequate service loops will be included on both ends to allow termination and potential moves. If the cable passes through spaces not controlled by the government, it will be in continuous conduit. The maximum length of this cable is 295 feet.

6. Two Cat 6 cables with RJ45 connectors will be installed from the building demarc to the low voltage closet with 10 foot service loops at each end.
  7. Exact placement of backboards and low voltage cabinet will be agreed on by contractor and Government prior to installation
- F. Labeling, in accordance with VA Standards:
1. Use Owner's room numbers for labeling. Confirm room numbers with Owner's Representative prior to labeling. See attached graphical information for labeling of face plates.
  2. Utilize the following labeling scheme:

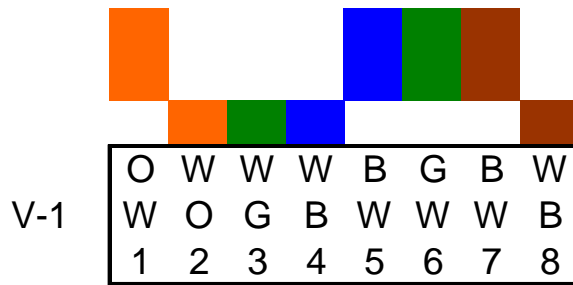
### Face Plate Labeling Conventions



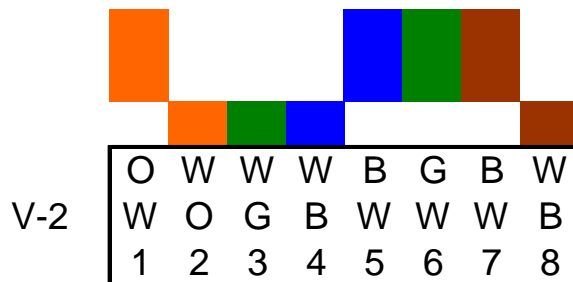
3. Utilize manufacturer designed labeling method at Outlet and Patch Panels. Labeling method shall be permanent and minimally susceptible to vandalism. Labels shall be permanent, and contractor shall replace fallen labels as part of the warranty.



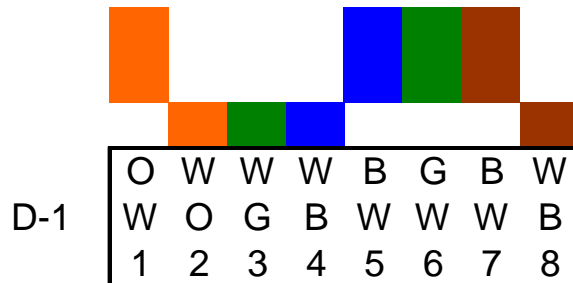
Jack and Block Terminations as follows:



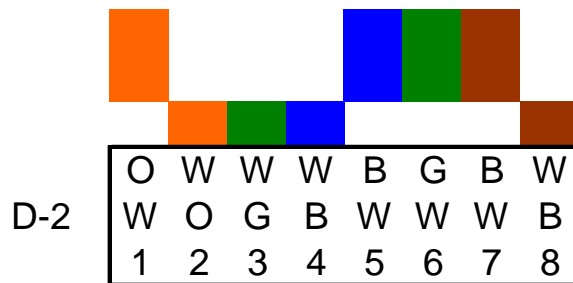
PANDUIT CAT 6 GREEN JACK  
568B



PANDUIT CAT 6 GREEN JACK  
568B



PANDUIT CAT 6 VIOLET JACK  
568B



PANDUIT CAT 6 VIOLET JACK  
568B

4. Label Faceplates for outlet locations. Jack numbering will begin at the first jack on the left hand wall as you enter the room and be labeled clockwise around the room. Continue the numbering sequence throughout the area served by that data closet.
5. Label patch panel terminations with the identical numbers used at the outlets.
6. Label both ends of each cabling run within 6 inches of termination points with Panduit Pan-Ty marker and flag ties, a label machine, or approved equal. Label the room end of the cable with the data closet identification number (closet number and jack number) and label the data closet end of the cable with the room jack number (room number, voice and data jack number).
7. Whenever possible, cross connect riser pairs shall be run sequentially.

### **3.3 COPPER CABLE TESTING**

- A. Testing of all copper wiring shall be performed prior to system cutover.
- B. Cables shall be tested for all Category 6 100% Channel parameters using the specified level 3 tester. Test all Category 6 Channel parameters, including attenuation, NEXT, PS NEXT, FEXT, ELFEXT, return loss, and delay skew.
- C. Patch cord, workstation cord, and cable lengths shall be recorded as part of the testing.
- D. Faults shall be corrected and retested.
- E. Test information along with manufacturer and model number of test equipment shall be recorded and provided to Owner as part of the project Telecommunications Manual.
- F. Provide proof of factory calibration of test meter within 6 months of the beginning of testing.
- G. The "\* pass" option on the test meter must be set to the "on" state. The "\* pass" symbol indicates a channel that is within 1 db of failing.
- H. Provide test data in electronic format with corresponding software for viewing of testing documentation on CD-ROM provided from the test meter. Contractor shall provide one CD-ROM to Owner and one to Engineer.
- I. Provide all cross connect information (X-Conn) to COTR.

### **3.4 GENERAL FIBER OPTIC TEST REQUIREMENTS: N/A**

### **3.5 FIBER TEST PROCEDURES: N/A**

### **3.6 FIBER TRANSMISSION LOSS TEST REPORT: N/A**

---END---

SECTION 27 52 23  
NURSE CALL/CODE BLUE SYSTEMS

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. This document specifies the furnishing, installing, and testing of a complete and operating Audio - Visual, Visual Only, and Code One (Blue) Nurse Call here-in-after referred to as "the System", and associated equipment to be installed in the VA Medical Center, here-in-after referred to as "the Facility".
1. The System shall be capable of interfacing with the two-way radio system and networking more than one nurse call control unit.
  2. The System shall be capable of interfacing with the facility's telephone system and networking more than one nurse call control unit.
- B. The System is microprocessor based and includes: central terminal assemblies; nurse control master stations; bedside patient, duty, and emergency stations; dome lights; combiners, traps and filters; audio distribution amplifiers; uninterruptible power supplies (UPS); conduit, cable duct, and/or cable tray; and necessary passive devices such as, cable, wire, and connectors, cordsets, push-buttons, pillow speakers, and specialized bed connection outlets and connector cables.
- C. The System shall be delivered free of engineering, manufacturing, installation, and operating defects. It shall be engineered and installed for ease of operation, maintenance, and testing.
- D. Updates, additions, and revisions to the existing nurse call System shall be designed and installed so that the installation, interfacing, integration, combining, and/or consolidation of equipment actually employed does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, audio or video hum bars, transients, ghosting, etc.
- E. The System is defined as an Emergency Critical Care Communication System and, the Code One (Blue) System is defined as an Emergency Critical Care Life Support Communication System by the National Fire Protection Association (NFPA). Therefore, its installation and operation shall adhere to all appropriate National and/or Government Local Life Safety and/or Support Codes, whichever are the more stringent for this Facility. Additionally, the original equipment manufacturer's (OEM) recommendations and guidelines shall be followed. The OEM and Contractor shall ensure that all management, sales, engineering, and installation personnel have read and understand the requirements of this specification before the System is designed, engineered, delivered, and provided.
- F. The VA COR is the approving authority for all contractual and operational changes to the System. The Contractor is cautioned to obtain in writing, approvals for System changes relating to the published contract specifications and drawings, from the COR before proceeding with any proposed change.
- G. Equipment Standards and Product Testing:
1. All equipment and materials (other than specific nurse call or code one (blue) equipment items) used in providing the System shall be

listed, labeled and certified by UL or a nationally recognized testing laboratory where such standards have been established for the utilized items. Such listing and labeling shall warrant that the equipment has been tested in accordance with, and conforms to the specified standards.

2. The provided active and passive nurse call and code one (blue) equipment required by the system design and approved technical submittal must conform with each UL standard in effect for the equipment, as of the date the technical submittal (or the date when the COR approved system equipment necessary to be replaced) was technically reviewed and approved by the VA. Where a UL standard is in existence for equipment to be used in completion of this contract, a test must be conducted to certify the equipment meet the published UL standard. This test must be conducted by UL that makes periodic inspections of the production of nurse call equipment. The Contractor's technical submittal shall include UL certification and/or documents supplied by the testing laboratory that indicate each piece of equipment to be furnished conforms to UL standards, where such standards exist:
3. Each item of equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards.
4. At a minimum, the entire system shall meet or exceed UL 1069 Standard and be listed so in UL's published literature. The Contractor shall provide a copy of the entire UL 1069 published listing as a part of the technical submittal.

H. System Performance: The total system shall meet the following performance standards:

Function	Characteristics
Audio Gain	10 decibel (dB) minimum, Sound Pressure Level (SPL)
Signal to Noise (S/N) Ratio	35 dB minimum

## 1.2 RELATED WORK

- A. Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Specification Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Specification Section 27 12 00, TELECOMMUNICATIONS CABLING EXPANSION.
- E. Specification Section 26 27 26, WIRING DEVICES.
- F. Specification Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

## 1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of the System's submittal is technically approved by the VA, shall be enforced.

B. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)
77	RECOMMENDED PRACTICE ON STATIC ELECTRICITY
99	Standard for Health Care Facilities
101	Life Safety Code

C. Underwriters Laboratories, Inc. (UL):

65	Standard for Wired Cabinets
467	Standard for Grounding and Bonding Equipment
1069	Standard for Hospital Signaling and Nurse Call Equipment
1410	Standard for Television Receivers and Video Products
1778	Standard for Uninterruptable Power Supply

D. U.S. National Archives and Records Administration (NARA):

47 CFR 15	Radio Frequency Devices
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E. Electronic Industries/Telecommunications Industries Associations (EIA/TIA):

568	Commercial Building Telecommunications Wiring Standard
569	Commercial Building Telecommunications Pathways and Spaces Standard
606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

607	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
RS-270	Tools, Crimping, Solderless Wiring Devices Recommended Procedures for User Certification

F. Joint Commission on Accreditation of Health Care Organization (JCAHCO): Comprehensive Accreditation Manual for Hospitals

G. National and/or Government Life Safety Codes(s): The more stringent of each listed code.

#### 1.4 QUALITY ASSURANCE

- A. The authorized representative of the System's OEM shall be responsible for the design, satisfactory total operation of the System, and its certification.
- B. The OEM shall meet the minimum requirements identified in paragraph 2.1.A. Additionally, the OEM shall have had experience with three or more installations of systems of comparable size and complexity as regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Each of these installations shall have been in successful operation for at least three years after final acceptance by the user. These installations shall be provided as a part of the submittal identified in paragraph 1.5.
- C. The System Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- D. The Contractor's Communications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the COR before being allowed to commence work on the System.

#### 1.5 SUBMITTALS

- A. Provide submittals in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The COR shall retain one copy for review and approval.
  - 1. If the submittal is approved the COR shall retain one copy for Official Records and return three (3) copies to the Contractor.
  - 2. If the submittal is disapproved, three (3) copies will be returned to the Contractor with written explanation attached indicating the areas the submittal deviated from the System specifications. The COR shall retain one copy for Official Records.

- B. The submittal shall be separated into sections for each sub-system and shall contain the following:
1. Title page to include:
    - a. Facility name
    - a. VA Project Name
    - c. Contractor's name, address, and telephone (including FAX) numbers
    - d. Date of Submittal
    - e. VA Project Number
  2. A list containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:
    - a. Facility location and name
    - b. Owner's or User's name, address, and telephone (including FAX) numbers
    - c. Date of Project Start and Date of Final Acceptance by Owner
    - d. System Project Number
    - e. Brief (three paragraphs minimum) description of each system's function, operation and installation
  3. Narrative Description of the system as it is expected to be installed.
  4. A list of the equipment to be furnished. The quantity, make and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the System.

The following are the minimum equipment required by the System:

QUANTITY	UNIT
Existing	Central Terminal Equipment and Cabinet
As required	Power Amplifiers
As required	Nurse Control Master Station
As required	Staff/Duty Station
As required	Corridor Dome Lights
As required	Intersectional Dome Lights
As required	Code One (Blue) Patient Station
As required	Remote Annunciator Panel
As required	Wires and Cables

As required	General Station Connectors
As required	Emergency Station
As required	Push-buttons
1 ea.	Installation Kit
As identified	Separate List of each Equipment Spare(s)

5. Central terminal cabinet layout drawing, including existing-to-remain equipment and connections, items removed as part of demolition, and modifications and new equipment and connections, as it is expected to be installed at/in the existing cabinet which will serve the Mammography Suite 1R work area.
6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
7. Engineering drawings of the existing and new modifications to the System, with information to determine compliance with contract drawings and specifications.
8. List of test equipment per paragraph 1.5.C.
9. Letter certifying that the Contractor understands the requirements of the SAMPLES paragraph 1.5.D.
10. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning tests.

C. Test Equipment List:

1. The Contractor is responsible for furnishing all test equipment required to test the System in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the System. The Contractor shall furnish test equipment of accuracy better than the parameters to be tested.
2. The test equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
  - a. Spectrum Analyzer
  - b. Signal Level Meter
  - c. Volt-Ohm Meter
  - d. Sound Pressure Level (SPL) Meter



- e. Sound Pressure Level (SPL) Calibrator
  - f. Random Noise Generator
  - g. Audio Amplifier with External Speaker
- D. A sample of each of the following items shall be furnished to the COR for approval prior to installation.
- 1. 610 mm (2 foot) section of each cable to be used with connectors installed and OEM cable sweep compliance and/or certification tags as specified in paragraph 2.3.F.
  - 2. Back boxes for the nurse call emergency stations, dome lights, staff stations, duty stations, annunciator panels, and junction boxes.
  - 3. Cover plates used for patient stations, staff stations duty stations, annunciator panels, emergency stations, and code one (blue).
  - 4. UPS equipment (if required by system design).
  - 5. Electrical supervision panels for code one (blue) sub-systems
- E. Certifications
- 1. Submit written certification from the OEM indicating that the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
  - 2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL 1066, this specification, and JCAHCO requirements and the instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA will not approve any submittal without this certification.
  - 3. Preacceptance Certification: This certification shall be made in accordance with the test procedure paragraph 3.2.B.
- F. Equipment Manuals: Ten (10) working days prior to the scheduled acceptance test, the Contractor shall deliver four (4) complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the COR. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.
- G. Record Wiring Diagrams:
- 1. Ten (10) working days prior to the acceptance test, the Contractor shall four (4) complete sets of the record wiring diagrams of the System to the COR. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, equipment and room/area locations. The diagrams shall show the existing System and additions to the existing system, and clearly reflect System modifications by the Contractor.
  - 2. The record wiring diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility's current operating version of Computer Aided Drafting (AutoCAD) system, and

- match standards, symbols, and annotation of the existing system drawings Coordinate to ensure possession of the most-current existing System drawings prior to production of the record drawings and diagrams. The COR shall verify and inform the Contractor of the current version of AutoCAD being used by the Facility.
- H. Ten (10) days prior to the start of the intermediate test, provide a typewritten detailed description of the System testing plan that meets this specification's performance standards as indicated in paragraph 2.1.C including illustrations and utilizes the test equipment specified in paragraph 1.5.C. The test plan will need to be evaluated and approved by the COR before intermediate testing begins.
  - I. Provide two (2) copies of an OEM developed training video tape presentation (reference paragraph 3.3.B) for evaluation and approval by the COR.
  - J. Provide a typewritten document that details the complete record program in memory for all associated station assignments. PART 2 - PRODUCTS

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT AND MATERIALS

- A. Manufacturer: Rauland Responder 4.
  - 1. Substitutions: Not permitted.
- B. System Requirements:
  - 1. The System shall receive the specified system signals and shall process and distribute them to the designated outlet, control and/or remote locations shown on the drawings. The System shall be designed to minimize cross talk, background processor noise and other signal interference.
  - 2. The central control equipment is existing, located in the central equipment terminal cabinet ensuring that test port(s) is provided for access to each system function without the need to disconnect distribution cables or equipment. Provide additional equipment and cabinets as required. Extend existing power and communication circuits/cabling as required.
  - 3. Each floor or ward distribution system shall be a "buss" design where each room's nurse call equipment is fed from centrally located lateral trunk line cables. Each signal closet mounted terminal cabinet shall be capable of connection to vertical trunk line riser cables in the associated signal closet and as shown on the drawings and recommended by the OEM.
  - 4. Each floor or ward distribution system shall be installed in conduit.
  - 5. The Contractor shall provide verification in writing that the type wire/cable being furnished and installed is recommended and approved by the OEM and will provide a total system free of defects.
  - 6. Central Terminal Cabinet Location: The cabinet shall be provided, protected, and located at the most central distribution system signal closet location to insure optimum origination, reception and control of all system signals. Each cabinet shall be provided with a internal active 120 Volts Alternating Current (VAC) quad receptacles connected by conduit to the Facility's Critical Branch Emergency

Power Distribution Panel as shown on plans or if not shown on plans consult with COR regarding a suitable circuit location, prior to bidding. Each cabinet shall be installed to allow working clearances per NEC Article 110, paragraph 110.26 and as recommended by the equipment manufacturer. Each cabinet shall be provided, as required to meet the single audio and data channel requirements, and system performance standards.

7. Central Terminal Cabinet and Master Control Station Selection:

- a. The cabinet(s) shall be provided, as required, and protected in existing signal closets as shown on the drawings.
- b. The master control station(s) shall be provided and protected in the Mammography Suite reception area and existing remote nurses stations as shown on the drawings.

B. Visual Nurse Call System:

1. A System shall be provided, protected and located in the VA Medical Center Area 1R Mammography Suite . .
2. The System shall also include a interface with an existing remote visual display panel in a location to be determined.. The visual display panel shall generate audible and visual emergency signals to indicate the location of a placed call.

C. Code One (Blue) System:

1. The code one (blue) system shall consist of a code one (blue) master control station with associated alarm and control units, bedside stations, duty stations, dome lights, existing and expansion of central equipment cabinet(s), and interface with existing remote annunciator panels in the emergency room. Local code one (blue) annunciation shall be provided at the associated reception area, remote existing emergency room, and as required..
2. Each code one (blue) system shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. dome light bulbs [each light will be considered supervised if they use any one or a combination of Underwriters Laboratory, Inc. (UL) approved electrical supervision alternates, as identified in UL-1069, 1992 revision], wires, contact switch connections, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the nurse control station and all remote locations.
3. Provide the System with the following minimum equipment:
  - a. Code one (blue) alarm unit with push-button/switch reset device, code one amber (or other like Life Safety approved) lamp, silencing device, test/fault alarm push-button/switch with an alarm lamp. The unit is to be installed at the reception area or or master control station.

- b. Local and remote annunciator panels with visual annunciators which will visually identify each unit placing a call, and a silencing device.
  - c. Code one (blue) nurse call master stations, local, and remote annunciator panels shall be capable of displaying each area that has a code one (blue) system.
  - d. Staff/Duty stations with an amber (or other like Life Safety approved) lamp, and silencing device.
  - e. Mammography and Ultrasound room stations with a push-button, amber (or other like Life Safety approved) lamp, and reset button.
  - f. Provide one single code one (blue) station for the Ultrasound , and each of two Mammography Rooms plus one spare stations.
  - g. A code one (blue) dome light for each station equipped with an amber (or other like Life Safety approved) lamp, minimum, to identify code one calls.
  - h. One push-button cordset for each station, plus one spare cordset.
4. The System shall provide the following minimum operational functions that compliments and operates in conjunction with the minimum electrical or electronic supervision requirements identified in paragraph 2.H.3:
- a. Code one (blue) calls shall be cancelable at the calling station only. The code one (blue) or nurse call master station shall not have the ability to cancel code one (blue) calls.
  - b. Each code one (blue) system shall be able to receive audio calls from all stations simultaneously.
  - c. Calls placed from any code one (blue) station shall generate emergency type audible and visual signals at each associated nurse control and duty station, and all local and remote annunciator panels. Calls placed from a bedside station shall generate emergency type visual signals at the bedside station and associated dome light(s) in addition to the previous stated stations and panels.
  - d. Activating the silencing device at any location, while a code one (blue) call or system fault is occurring shall mute the audible signals at the alarm location. The audible alarm shall regenerate at the end of the selected time-out period until the call or fault is corrected. The visual signals shall continue until the call is canceled and/or a fault is corrected. When the fault is corrected, all signals generated by the fault shall automatically cease, returning the System to a standby status. Audible signals shall be regenerated in any local or remote annunciator panel that is in the silence mode, in the event an additional code (blue) one call is placed in any code one (blue) system. The additional code one (blue) call shall also generate visual signals at all annunciators to identify the location of the call.
5. It is permissible to utilize an audio visual microprocessor nurse call system for code one (blue) functions providing the System is designed and UL approved to function as an integrated nurse call and code one (blue) system that employs code one (blue) operational

qualities as described herein for all system locations, and equipped with the following functions and capabilities, at a minimum:

- a. A station must be able to place a code one (blue) call in addition to, and at the same time, a regular nurse call is placed, or be provided with a code one (blue) station separate from the nurse call bedside station.
- b. Must be able to generate audible and visual signals to code one (blue) duty stations, local and remote annunciating panels as specified herein for code one (blue) placed calls.
- c. Possess built-in diagnostics to locate and service components.
- d. Perform continuous electrical supervision circuitry as defined in herein for code one (blue) and associated nurses call functions.

D. General:

1. All equipment to be supplied under this specification shall be new and the current model of a standard product of an OEM of record, and be of the existing System manufacturer's approved equipment. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
  - a. Maintains a stock of replacement parts for the item submitted.
  - b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
  - c. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.
2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, that item of equipment shall meet or exceed the specification for that item of equipment.
3. The Contractor shall provide written verification, to the COR that the type of wire/cable being provided is recommended and approved by the OEM. Cabling shall meet the interconnecting wiring requirements of UL 1069; and the requirements of NFPA 70 (NEC). The Contractor is responsible for providing the proper size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.
4. Active electronic component equipment shall consist of solid state components and be rated for continuous duty service in the areas where provided.
5. All passive distribution equipment and cables shall meet or exceed - 80 dB radiation shielding specifications.
6. All signaling and communication circuits shall be solid state except for audio switching relays.
7. The System shall utilize microprocessor components for all signaling and programming circuits and functions. Program memory shall be non-volatile or protected from erasure from power outages for a minimum of five minutes.

8. The System shall provide the continuous polling (not to be substituted for electrical supervision) of each station sequentially to determine change of status and to assist in trouble shooting faults.
9. All voltages, except for the primary power to the power supply circuits, shall not exceed 30 VAC Root Mean Squared (RMS) or 41.2 V direct current (DC).
10. Color code all distribution wiring to conform to the Nurse Call Industry standard, EIA/TIA, and this document, and match the existing System, whichever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance. Reference Specification Section 27 12 00, TELECOMMUNICATIONS CABLING EXPANSION.
11. Maintain connection of the primary input AC power to the Facility's Critical Branch of the Essential AC Power Distribution System as required and extend to new equipment, as necessary. Consult with COR regarding a suitable circuit location and connection requirements.
12. Maintain connection to the existing UPS for the System to operate and function normally (as if there was no AC power failure) in the event of an AC power failure for a minimum of 15 minutes.
13. All equipment shall function and operate normally from the furnished power source, and also, during input power fluctuations or loss of power for a minimum of 15 minutes.
14. Plug-in connectors shall be provided to connect all stations, except emergency stations and corridor lights. Emergency stations and corridor lights shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are an acceptable alternate as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts or solder type connections are unacceptable and will not be approved.
15. All equipment face plates utilized in the System shall be stainless steel, anodized aluminum or UL approved cycolac plastic that matches the equipment item it is installed. All faceplates shall be constructed of the same material throughout the facility.
16. All equipment trim plates utilized in the System shall be stainless steel, anodized aluminum or UL approved cycolac plastic that matches the equipment item and the areas where provided. Trim plates are not authorized to bear the UL label for the station unless specifically approved by UL. All trim plates shall be constructed of the same material throughout the facility.
17. Noise filters and surge protectors shall be provided for each equipment control cabinet, nurse call master station, local, and remote locations to ensure protection from input primary AC power surges and noise glitches are not induced into low voltage data circuits.
18. Passive and electronic components and cabling shall be provided under the OEM's recommendations and guidance, to prevent damage to

any system equipment from electrostatic discharges of a minimum of 25,000 Volts, at a relative humidity of a maximum of 20 percent (%) or less. The Contractor shall detail in the technical submittal the method and equipment to be utilized to protect the system components from a minimum 25,000 Volt electrostatic discharge.

E. Patient Equipment shall include, but not be limited to, the following:

1. One single audio-visual station shall be provided for the Ultrasound room, and each of two Mammography rooms in the units listed in paragraph 1.1.E. Provide one spare for each 40 single station and portion thereof.

F. Master Station Nurse Call and Code One (Blue) Equipment shall include, but not be limited to, the following:

1. Provide one station, including monitor, computer processing unit (CPU), keyboard, mouse, and UPS at the reception area..
2. One telephone type handset shall be provided per station.

G. Dome Lights:

1. Corridor dome lights shall be provided as shown on the drawings and identified in the equipment list. Provide one spare dome light.
2. Code one (blue) dome lights shall be provided as shown on the drawings and/or identified in the equipment list. Provide one spare dome light.

H. Local and Remote Annunciator Panel Equipment shall be provided in the locations shown on the drawings and/or identified in the equipment list. Provide one spare panel.

I. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
Power Line Frequency	60 Hertz (Hz), $\pm 2.0$ Hz
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 %, minimum rating

## 2.2 CENTRAL TERMINAL ASSEMBLIES

A. Equipment Cabinet:

1. The provided equipment cabinet is existing to remain, and currently serves other areas of the facility. Provide additional equipment cabinet, as required.

B. Central Terminal Equipment:

1. The provided sub-systems shall be balanced so that when the system volume level is adjusted to maximum, no pulsating noise or data noise is audible, when communicating between the nurse control station and the most distant station.

2. Each power amplifier unit shall be provided with separate power overload protection circuits and shall provide self-limiting audio compression without distortion. The amplifiers shall have a common volume control for regulation of intercom audio for all associated stations. The amplifiers shall be adjusted/balanced to provide normal system audio levels between the master station and all remote locations when system audio levels are adjusted to approximately mid-range. Provide one spare amplifier circuit board and/or module.

C. Product: Rauland NC Series. Substitutions not permitted.

## 2.3 EQUIPMENT SPECIFICATIONS

### A. Nurse Call Station:

1. Each single station shall be provided with a microphone/speaker, call answered/monitor lamp, call placed annunciator lamp, reset/cancel button and a receptacle for cordset.
2. Placement of a call at the station shall generate routine placed call visual signals in the corridor dome light.
3. Product: Rauland NCBSS1. Substitutions not permitted.

### B. Duty Station: Each staff/duty station shall be provided with:

1. Two-way voice communications with the nurse control master station.
2. A call placed annunciator and a device to generate audible signals.
3. A call origination device, call placed annunciator, cancel device, and incoming call/privacy annunciator indicator.
4. The capability to indicate all patient normal calls placed in the System with audible and visual signals.
5. The capability to indicate all patient/emergency calls with audible and visual signals.
6. Each staff/duty station shall be mounted on a six-gang back box, minimum. A trim plate constructed of stainless steel or a material similar to the staff/duty station shall be provided to cover the back box opening and frame the cover plate.
7. Product: Rauland NCDUTY. Substitutions not permitted.

### C. Supervised Code Station:

1. Tactile membrane call point with call-assurance LEDs.
3. Tactile membrane reset touchpoint.
4. Local Code Blue supervision.
5. Code Blue timer output.
6. Supervised by associated call station.
7. Product: Rauland NCBACB. Substitutions not permitted.

### D. Emergency Station:

1. A pullcord emergency station shall be provided in each toilet. Each station shall be equipped with a rubber gasket between the face plate and wall or be rated by UL as waterproof.
2. The gasket shall cover and water seal the entire back box opening and not extend beyond the sides of the associated face plate by



- 6.4 mm (1/4 inch) maximum. If the wall is tile or other uneven type material the gasket and associated face plate shall be provided to completely seal the opening and uneven material surface.
3. Each emergency station shall be mounted on a double-gang back box, minimum. A trim plate constructed of stainless steel or a material similar to the emergency station shall be provided to cover the back box opening and frame the cover plate.
  4. Emergency stations shall be provided with:
    - a. A ten-pound test smooth, non-porous PVC pull cord, red color, and pendant which shall be connected to a positive action on/off switch at the emergency station. The cord with pendant shall terminate 150 mm (6 inches) AFF.
    - b. A minimum of one pound pull to activate the switch.
    - c. A reset/cancel function on the face plate of the emergency station.
    - d. "EMERGENCY NURSE CALL" or similar approved wording stamped or permanently affixed on the face plate. The emergency wording letters shall be a minimum of 3.2 mm (1/8 inch) high.
    - e. A red lamp which shall flash at a rate of one second on and one second off upon initiation of a call from the emergency station. The lamp shall continue to flash until the station is reset.
  5. Product: Rauland NCPCS1. Substitutions not permitted.
- E. Corridor Door Dome Lights:
1. Provide light covers that are translucent and shall not deform, discolor or craze from heat or use of normal hospital cleaning agents.
  2. Corridor door dome lights shall be provided for patient bedrooms and shall contain sufficient lamps to permit distinguishing the following type placed calls:
    - a. Routine placed calls from bedside stations
    - b. Emergency placed calls from emergency stations, if the room has such facilities
    - c. Emergency placed calls from stations that are programmed in the emergency/priority mode
    - d. The visual signals for routine and emergency/priority placed calls shall be distinctly different from each other
  3. Each dome light shall be mounted on a dual-gang back box, minimum. A trim plate constructed of stainless steel or a material similar to the dome light shall be provided to cover the back box opening and frame the cover plate.
  5. Product: Rauland NCLED6. Substitutions not permitted.
- F. Corridor Intersectional Dome Lights:
1. Provide corridor intersectional lights that contain a minimum of two lamps to identify any placed call in the System. The visual signals for routine and emergency placed calls shall be distinctly different from each other.

2. Provide the light at each intersecting point of corridors that display visual signals simultaneously at all corridor intersectional lights for calls placed in the System.
  3. Each light shall be mounted on a dual-gang back box, minimum. A trim plate constructed of stainless steel or a material similar to the light shall be provided to cover the back box opening and frame the cover plate.
  4. Product: Rauland NCLED6. Substitutions not permitted.
- G. Nurse Control Master Station: Each nurse control station shall be provided:
1. As an audiovisual type, except for the Radiology Clinic and Day Hospital nurse call system.
  2. As desk mounted: With 1.2 meters (4 feet) of interconnecting cable (from the central equipment to the master station) to allow for convenient placement of the nurse control station on the desktop.
  3. With the following features:
    - a. Microphone/speaker and telephone handset with a 910 mm (3 foot) coiled cord. The handset shall be able to conduct two-way voice communication between the nurse and the selected calling station. Lifting the handset shall mute the microphone/speaker.
    - b. Digital readout touch screen to visually announce the location of incoming calls placed in the System including room and bed number and priority of the call. Identify each calling station with an individual display. If a digital readout touch screen standard is not submitted or approved by the Facility during the project design phase, an alpha - numeric scheme shall be provided that identifies the: ward, room and bed (i.e. Ward 2a, Room 201, Bed A (or 1) shall read 2A201A -or- 2A201-1. Equivalent readouts are acceptable as long as the Facility approves the readout).
      - 1) It shall display a minimum of four incoming calls. Additional placed calls shall be stored in order of placement and priority.
    - c. Nurse follower function. All calls placed in the System shall be visually or audibly announced at the selected bedside stations when selecting the nurse follower mode of operation and the bedside stations to be visited. It is acceptable for the nurse follower mode to be activated inside rooms containing bedside stations.
    - d. Automatic answering function or selective answering device.
    - e. Incoming call priority function. The visual or audible signals shall indicate if a routine or emergency (and/or code) call has been placed and shall continue until the call is canceled. The emergency calls shall be capable of being canceled only at the originating station. Provide for the programming to two levels of priority, minimum, for incoming calls from each associated bedside station.
    - f. Reminder function. Shall temporarily store a placed call and generate visual signals in the corridor dome light associated with the calling bedside station by activating the reminder function/circuitry. The visual signals shall terminate and the

stored call is eliminated from memory when the call is canceled at the originating station.

- g. The ability to generate visual and audible signals to indicate incoming calls from associated stations which:
  - 1) Shall silence or attenuate the audible signals through muting/attenuation circuits while the control station is being used to answer or place a call. The audible signals for incoming calls not answered shall be automatically reenergized when the nurse control station is returned to the standby mode.
  - 2) The visual signals for incoming calls shall remain displayed at all times until each call is answered or canceled at the calling station.
  - 3) The visual and audible signals for routine and emergency calls shall be distinctly different. The audible signals shall be generated at the same rate as the corresponding visual signals for each emergency calls. Audible signals for routine calls shall be generated at the same rate as the visual signals, or by repeating an audible signal every five to ten seconds until the call is answered or canceled.
  - 4) The visual display to indicate the location of a placed call shall appear on the control station within two seconds, maximum, after initiation of a call.
- h. Touch pad, or equal, to permit the nurse to selectively place calls to and conduct two-way voice communication with, all system station, staff and duty stations and associated nurse stations. The touch pad shall also provide for the programming of priority status and any other function capable of being programmed from the nurse control station.
- i. The ability to monitor a station. The wiring and/or equipment used shall assure that, when a station is being monitored or called by the nurse control station, the call answered/monitor lamp station shall be lighted.
- j. The capability of paging a minimum of 10 stations simultaneously.
- k. The ability to receive calls from a minimum of 10 associated stations simultaneously.
- l. The ability for answering placed calls by either:
  - 1) Picking up the handset or by activating an answer next call function, which will automatically permit the nurse to communicate with the station that is next in sequence of placed calls by priority and time of placement, or
  - 2) By being able to selectively answer any placed call displayed in the order of priority and time of placement.
- m. Accommodate a minimum of 10 percent expansion of additional patient, emergency, staff and duty stations within each master nurse control station as installed without any additions to the central equipment.
- n. Nurse control master stations that require AC power and/or have video type (or CRT) display units associated with them, shall be

connected to the same Emergency Critical Care Distribution System AC power panel that supplies AC power to its associated central terminal cabinet. A UPS shall be provided at the reception station location to supply battery back up power to the station and CRT equipment if they are not powered from the central terminal equipment battery backup system.

4. Product: Rauland NCLD Standard Console. Substitutions not permitted.

H. Cordsets: Cordsets shall be designed for medical gas environments.

1. General - each cordset cable shall be provided with:

- a. 1.8 m or 2.4 m (6 or 8 foot) long, heavy-duty, flexible cable.
- b. A non-corrosive, non-tarnishing metal or molded composition clip. The clip shall be used to fasten the cordset to sheets or blankets without tearing or damage to the sheet/blanket material. Do not attach the clip to a PBPU unless the COR has received written permission from the PBPU OEM directing the acceptable method of attachment.
- c. When a cordset is disconnected, an emergency call shall automatically be initiated to the nurse control and duty stations. The audible and visual signals shall remain activated until the cordset is reinserted or a dummy plug or other technically approved devices shall be provided that will deactivate the automatic call feature when pillow speakers are removed. It is acceptable that dummy plugs be equipped with a push-button or other device to place calls when substituted for a pillow speaker or cordset.
- d. The ability to place a call by applying a minimum of one pound of pressure on the envelope.
- e. Shall not discolor as a result of exposure to medical or sterilization gas.

2. Cordsets with Momentary Action Push-buttons: Each cordset shall be provided:

- a. And designed for connection to the bedside station cordset receptacle.
- b. With and contain a momentary action call originating button on the end of the cordset.

3. Product: Rauland NCDS Series. Substitutions not permitted.

## 2.4 DISTRIBUTION SYSTEM

Each wire and cable used in the System shall be specifically OEM certified by tags on each reel and recommended and approved for installation in the Facility. The Contractor shall provide the COR a 610 mm (2 foot) sample of each wire and/or cable actually employed in the System and each certification tag for approval before continuing with the installation as described herein.

## 2.5 INSTALLATION KIT

The kit shall be provided that at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder,

hangers, clamps, bolts, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or wiring block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the COR all unused and partially opened installation kit boxes, coaxial cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware. This is an acceptable alternate to the individual spare equipment requirement as long as the minimum spare items are provided in this count. The following are the minimum required installation sub-kits:

A. System Grounding:

1. The grounding kit shall include all cable and installation hardware required. All A/V nurse call equipment shall be connected to earth ground via internal building wiring, according to the NEC.
2. This includes, but is not limited to:
  - a. Coaxial Cable Shields
  - b. Control Cable Shields
  - c. Data Cable Shields
  - d. Equipment Racks
  - e. Equipment Cabinets
  - f. Conduits
  - g. Cable Duct
  - h. Power Panels
  - i. Connector Panels

B. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, wiring blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.

C. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit installation in accordance with the NEC and this document.

D. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface Systems and sub-systems according to the OEM requirements and this document.

E. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each sub-system according to the OEM requirements, record drawings, and this document.

F. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

## A. Product Delivery, Storage and Handling

1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name, equipment model and serial identification numbers, and UL logo. The COR may inventory the nurse call equipment at the time of delivery and reject items that do not conform to this requirement.
2. Storage and Handling: Store and protect equipment in a manner that will preclude damage as directed by the COR.

## B. System Installation

1. Do not install nurse call and fire alarm systems in the same conduit, raceway or cable trays.
2. For VA Facilities, it is permissible to include non-powered RED and MATV cables with nurse call cables provided each signal is directly controlled by its system and each cable is 100% shielded and bundled as described herein.
3. The Contractor shall provide suitable filters, traps and pads for minimizing interference and for balancing the amplifiers and distribution system(s). Items used for balancing and minimizing interference shall be able to pass audio, data and control signals in the speeds and frequency bands selected, in the directions specified, with low loss, and high isolation and with minimum delay of the system poling or subcarrier frequency(s).
4. Back up power supplies (e.g., batteries, UPS) shall be installed in the central equipment cabinet or in a separate metal cabinet equipped with a hinged door and lock. If a separate cabinet is installed, it shall be provided adjacent to the central equipment cabinet. Where the backup power supply is already self-contained in a housing, the unit can be mounted adjacent to the respective equipment cabinet. In all cases, backup power supplies must be permanently mounted. Each UPS and/or backup power supply shall be provided with full electrical supervision as described herein.
5. All passive equipment shall be connected according to the OEM's specifications to insure correct termination, isolation, impedance match, and signal level balance at each speaker.
6. Install all equipment for each location specified herein and as identified on the drawings.
7. All trunk, distribution and interconnecting lines shall be terminated in a suitable manner to facilitate future expansion of the System by adding center terminal equipment only.
8. Terminating resistors shall be used to terminate all unused branches, outlets, unused equipment ports of the System and shall be devices designed for the purpose of terminating audio cables carrying audio signals in nurse call systems.

## C. Conduit and Signal Ducts:

## 1. Conduit:

- a. The Contractor shall employ the latest installation practices and materials. The minimum conduit size shall be 25 mm (1 inch) in diameter for primary signal distribution and 19 mm (3/4 inch) for remote connections (i.e. dome lights, emergency station, , etc.).
- b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow nurse call cables to be installed in partitioned cable tray with RED and MATV cables, shall be granted in writing by the COR if requested.) The mixing of nurse call and fire alarm cables and/or systems is not authorized and will not be approved. (See caution identified in paragraph 3-1b.3.e.). Conduit shall be provided in accordance with Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, at a minimum.
- c. Conduit fill shall not exceed 40 percent.
- d. Cable runs shall be splice free between conduit junction and interface boxes and equipment locations.

## 2. Signal Duct, Cable Duct, or Cable Tray:

- a. The Contractor shall use existing signal duct, cable duct and/or cable tray, when identified and approved by the COR.
- b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 inch x 4 inch) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides, or barriers are required on all sharp corners, openings, anchors, bolts, or screw ends, junction, interface and connection points.
- c. Do not pull wire or cable through any box, fitting or enclosure where change of approved conduit, cable tray, signal, or cable duct alignment or direction occurs. Ensure the proper bend radius is maintained for each wire or cable as specified by its OEM.
- d. Employ temporary guides, sheaves, rollers, and other necessary items to protect the wire or cable from excess tension or damaging bending during installation. Abrasion to wire or cable jackets is not acceptable and will not be allowed. Replace all cables whose jackets has been abraded the discovery of any abraded and/or damaged cables during the proof of performance test shall be grounds for declaring the entire system unacceptable and the termination of the proof of performance test. Completely cover edges of wire or cable passing through holes in chassis, cabinets or racks, enclosures, pull or junction boxes, conduit, etc., with plastic or nylon grommetting.
- e. All cable junctions and taps shall be accessible. Do not install junction blocks, multi distribution connections or other distribution equipment (active or passive) items inside signal ducts. Use a 150 mm x 150 mm x 100 mm (6 inch x 6 inch x 4 inch) minimum covered junction box attached to the signal duct fixed side for distribution system passive equipment installation. Ensure all equipment and connection assembly junctions are accessible.

## D. Distribution System Signal Wires and Cables

1. Wires and cables shall be provided in the same manner and use like construction practices as Fire Protective and other Emergency Systems that are identified and outlined in NFPA 101, Life Safety Code, Chapters 7, 12, and/or 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions. The wires and cables shall be able to withstand adverse environmental conditions location without deterioration. Wires and cables shall enter each equipment enclosure, console, cabinet, or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
2. Routing and Interconnection:
  - a. Wires or cables routed between consoles, cabinets, racks, and other equipment shall be installed in an approved conduit, signal duct, cable duct, or cable tray that is secured to building structure.
  - b. Wires and cables shall be insulated to prevent contact with signal or current carrying conductors and be 100% shielded. Wires or cables used in assembling consoles, panels, equipment cabinets and racks shall be formed into harnesses that are bundled and tied. Harnessed wires or cables shall be combed straight, formed and dressed in either a vertical or horizontal relationship to equipment, controls, components or terminations.
  - c. Harnesses with intertwined members are not acceptable. Each wire or cable that breaks out from a harness for connection or termination shall have been tied off at that harness or bundle point, and provided with a neatly formed service loop.
  - d. Wires and cables shall be grouped according to service (i.e.: AC, grounds, signal, DC, control, etc.). DC, control and signal cables may be included with any group. Wires and cables shall be neatly formed and shall not change position in the group throughout the conduit run. Wires and cables in approved signal duct, conduit, cable ducts, or cable trays shall be neatly formed, bundled and tied off in 600 mm to 900 mm (24 to 36 inch) lengths and shall not change position in the group throughout the run. Concealed splices are not allowed.
  - e. Separate, organize, bundle, and route wires or cables to restrict channel crosstalk or feedback oscillation inside any enclosure. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC, and speaker wires or cables on the left; coaxial, control, microphone, and line level audio and data wires or cables, on the right. This installation shall be accomplished with ties and/or fasteners that will not damage or distort the wires or cables. Limit spacing between tied off points to a maximum of 150 mm (6 inches).
  - f. Distribution cables shall be installed and fastened without causing sharp bends or rubbing of the cables against sharp edges. Cables shall be fastened with hardware that will not damage or distort them.
  - g. Cables shall be labeled with permanent markers at the terminals of the electronic and passive equipment and at each junction



point in the System. The lettering on the cables shall correspond with the lettering on the record diagrams.

- h. Completely test all of the cables after installation and replace any defective cables.
  - i. Provide system input and output polarity as recommended by the OEM. Insure each color coded wire or cable is connected and terminated to maintain system polarity to be at least the same quality of professional audio systems. Reflect all color codes, wire and cable terminations on the System's record drawings as required herein.
- E. Outlet Boxes, Back Boxes, and Face Plates
1. Outlet Boxes: Signal, power, interface, connection, distribution, and junction boxes shall be provided as required by the system design, on-site inspection, and review of the contract drawings.
  2. Back Boxes: Back boxes shall be provided as directed by the OEM as required by the approved system design, on-site inspection, and review of the contract drawings.
  3. Face Plates (or Cover Plates): Face plates shall be of a standard type, stainless steel, anodized aluminum or UL approved cyclac plastic construction and provided by the Contractor for each identified system location. Connectors and jacks appearing on the face plate shall be clearly and permanently marked.
- F. Connectors: Circuits, transmission lines and signal extensions shall have continuity, correct connection, and polarity. Polarity shall be maintained between all points in the System.
1. Wires:
    - a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable and will not be approved.
    - b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Wiring blocks are approved for signal, not AC wires. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.
  2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system cable connectors include; but, are not limited to: Audio spade lug, wiring block, wirewrap, etc.
- G. AC Power: AC power wiring shall be run separately from signal cable.
- H. Grounding:
1. General: The Contractor shall ground all Contractor installed equipment to eliminate all shock hazard and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less:

- a. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.
  - b. The use of conduit, signal duct, or cable trays as system or electrical ground is not acceptable and will not be permitted. These items may be used only for the dissipation of internally generated static charges [not to be confused with externally generated lightning] that may be applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.
3. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.
  4. Equipment: Equipment shall be bonded to the cabinet ground bus with copper braid equivalent to at least #12 AWG. Self grounding equipment enclosures, racks or cabinets, that provides OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternates.
  5. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, face plates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.

I. Equipment Assembly:

1. Cabinets:

- a. Each enclosure shall be: floor or wall mounted with standard knockout holes for conduit connection or cable entrance; provide for ventilation of the equipment; have front and rear locking doors (except wall mounted cabinets that require only a front locking door); power outlet strip(s) and bulkhead connector panel(s).
- b. Each cabinet shall be equipped with a quiet fan and nondisposable air filter.
- c. Enclosures shall be installed plumb and square. Each shall be permanently attached to the building structure and held firmly in place as approved by the RE.
- d. Signal equipment, patch or bulkhead connector panels (i.e.: audio, data, control, etc.) shall be connected so that output for from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front, which will be called "input". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front, which will be called "output".

J. Labeling: Abbreviations may be used as long as they are symbol(s) or acronyms designated for the System or equipment by accepted industry standards and each abbreviation is used on the appropriate system and sub-system "record" drawing.

1. Cable and Wires (Hereinafter referred to as "Cable"): The Contractor shall install labels on all cables at each side of all connections. The labeling shall be permanent, with contrasting identification alpha or numeric, identifying each cable according to the System "as record" drawings. Labels shall be installed adjacent to each mechanical connector, pull box or break in the cable run.
2. Equipment: The Main Nurse Call Control Panel, amplifying, control, switching, and routing equipment inputs and outputs shall be permanently labeled with contrasting plastic laminate or bakelite material. System equipment shall be permanently labeled on the face of the unit corresponding to its source. Remote control equipment shall be labeled according to the unit or system being controlled. Equipment labels shall be permanently affixed to the equipment with metal screws, permanent mounting devices or cement.
3. AC Power: The AC Power Panel Directory shall identify which equipment console, cabinet or enclosure that it serves. Each equipment console, cabinet or enclosure shall be labeled to identify which AC power panel provides power to it. These labels shall be permanently affixed to the equipment with metal screws, permanent mounting devices or cement.
4. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct, and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum every 3 meters (10 feet) identifying it as the System. Also, each enclosure shall be labeled according to this standard.

### 3.2 PROOF OF PERFORMANCE TESTS

#### A. Intermediate Testing:

1. After completion of the installation of a central control cabinet and equipment, nurse control master station, local and remote enunciation stations (code one [blue] systems only), the first ward (maximum of two wards), and prior to any further work, this portion of the System must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed, NFPA, Life Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
2. The inspection and test will be conducted by a factory-certified representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the COR, until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 80% point of the system construction phase, at the direction of the COR.

## B. Pretesting:

1. Upon completing installation of the System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
2. Pretesting Procedure:
  - a. During the System pretest the Contractor shall verify (utilizing approved spectrum analyzer and test equipment) that the System is fully operational and meets all the System performance requirements of this standard.
  - b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
    - 1) Central Control Cabinets
    - 2) Nurse Control Stations
    - 3) Patient Stations
    - 4) Staff Stations
    - 5) Local and Remote Enunciation Panels (code one [blue] only)
    - 6) All Networked locations
    - 7) System interface locations (i.e. two way radio, PA, etc.)
    - 8) System trouble reporting
    - 9) System supervision
    - 10) UPS operation
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the COR.

## C. Acceptance Test:

1. After the System has been pretested and the Contractor has submitted the pretest results and certification to the COR, then the Contractor shall schedule an acceptance test date and give the COR 30 days written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a Government Representative and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance. The test shall verify that the total System meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed System does comply with all requirements of this specification under operating conditions. The System shall be rated as either acceptable or unacceptable at the conclusion of the test.

Failure of any part of the System that precludes completion of system testing, and which cannot be repaired in four (4) hours, shall be cause for terminating the acceptance test of the System. Repeated failures that result in a cumulative time of eight (8) hours to effect repairs, shall cause the entire System to be declared unacceptable. Retesting of the entire System shall be rescheduled at the convenience of the Government.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

- a. The Government Representative will tour all major areas where the System is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
- b. The System diagrams, record drawings, equipment manuals, Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
- c. Failure of the System to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

- a. After the Physical and Mechanical Inspection, the central terminating and nurse call master control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this requirement.
- b. Following the central equipment test, a pillow speaker (or on board speaker) shall be connected to the central terminating and nurse call master control equipment's output tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
- c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last intersectional, room, and bed dome light in each leg to verify that the nurse call distribution system meets all system performance standards.
- d. Each MATV outlet that is controlled by a nurse call pillow speaker shall be functionally tested at the same time utilizing the Contractor's approved hospital grade TV receiver and TV remote control cable.
- e. The RED system and volume stepper switches shall be checked to insure proper operation of the pillow speaker, the volume stepper and the RED system.
- f. Additionally, each installed emergency, patient, staff, duty, panic station, intersectional, and corridor dome light, power supply, code (blue) one , and remote annunciator panels shall be checked insuring they meet the requirements of this specification.

- g. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system. The typical functions are: nurse follower, three levels of emergency signaling (i.e. flashing red emergency, flashing white patient emergency, flashing white or combination lights for staff emergency, separate flashing code blue), minimum of ten minutes of UPS operation, memory saving, minimum of ten station audio paging, canceling emergency calls at each originating station only, and storage and prioritizing of calls.
- h. Individual Item Test: The Government Representative will select individual items of equipment for detailed proof of performance testing until 100% of the System has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

### 3. Test Conclusion:

- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the COR. Any retesting to comply with these specifications will be done at the Contractor's expense.
- b. If the System is declared unacceptable without conditions, all rescheduled testing expenses will be born by the Contractor.

### 3.3 TRAINING

- A. Furnish the services of a factory-trained engineer or technician for two two-hour periods to instruct the Facility's maintenance personnel. Instruction shall include corrective and preventive maintenance of the nurse call equipment. Training shall be accomplished before the VA can accept the System. Additionally, training will be scheduled at the convenience of the Facility's, Chief Engineering Service.
- B. Furnish the services of a representative of the nurse call and code one OEM, familiar with the functions and operation of the equipment, for two eight-hour periods to train nursing personnel. Instructions shall be provided for staff personnel in each ward where new nurse call and code one (blue) equipment is provided under this contract. When multiple wards are involved, classes will be grouped. Periods of training shall be coordinated with the Chief of Nursing Service for the Facility to ensure all nursing shifts receive the required training. Each session shall include instructions utilizing a factory prepared and COR approved vertical - horizontal system (VHS) format video tape presentation and "hands-on" operation of the nurse call and code one (blue) equipment on a hospital ward. The tape presentation shall be sufficient in detail to stand-alone as a training aid for initial utilization and familiarization of the System. Additionally, the Contractor shall provide two (2) copies of the video presentation to the Chief of Nursing Service.

### 3.4 GUARANTEE PERIOD OF SERVICE

#### A. Contractor's Responsibility:

- 1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the System

- by the VA. The Contractor shall provide OEM's equipment warranty documents, to the COR, certifying each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
  3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
  4. Additionally, the Contractor shall accomplish the following minimum requirements during the one year guaranty period.
- B. Response Time During the One Year Guaranty Period:
1. The COR or Facility Contracting Officer is the Contractor's reporting and contact official for nurse call system trouble calls, during the guaranty period.
  2. A standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal Holidays.
  3. The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
    - a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes a pillow speaker or cordset, master nurse control station, patient station, emergency station, or dome light to be inoperable.
    - b. An emergency trouble call within four hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or code one system to be inoperable at anytime.
  4. If a nurse call and/or code one (blue) component failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate nurse call equipment. The alternate equipment/system shall be operational within a maximum of four hours after the four hour trouble shooting time and restore the effected location operation to meet the System performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the System or sub-system to full operational capability, as described herein, until repairs are complete.
- C. Required On-Site Visits During the One Year Guaranty Period
1. The Contractor shall visit, on-site, for a minimum of eight hours, once every 12 weeks, during the guaranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this document.

2. The Contractor shall arrange all Facility visits with the COR or Facility Contracting Officer prior to performing the required maintenance visits.
3. Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the COR or Facility Contracting Officer and Contractor.
4. The preventive maintenance schedule, functions and reports shall be provided to and approved by the COR or Facility Contracting Officer.
5. The Contractor shall provide the COR or Facility Contracting Officer a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the COR with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
  - a. The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to COR or Facility Contracting Officer by the fifth working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
  - b. The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.
6. The COR or Facility Contracting Officer shall convey to the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
  - a. The COR or Facility Contracting Officer shall ensure a copy of these reports is entered into the System's official acquisition documents.
  - b. The Facility Chief Engineer shall ensure a copy of these reports is entered into the System's official technical record documents.
- D. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the COR or Facility Contracting Officer in writing upon the discovery of these incidents. The COR or Facility Contracting Officer will investigate all reported incidents and render findings concerning any Contractor's responsibility.

- - - END - - -



**SECTION 28 05 00**  
**COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.
- B. Furnish and install communication cabling, systems, equipment and accessories in accordance with the specifications and drawings. All necessary cabling for connection to active equipment shall be provided by this subcontractor to provide a complete and working system. Unless noted otherwise, junction boxes, back-boxes, and conduit rough-in for devices have been provided by the Division 26 subcontractor as defined in the specifications of Division 26. However, any special back-boxes required for Division 28 equipment shall be furnished by the Division 28 contractor. Refer to Division 26 documents for system rough-in coordination items.
- C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.
- D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, duress alarms, delayed egress, personal protection system, intercommunication system, fire alarm interface, uninterruptible power supplies (UPS) interface. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals

as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.

- E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.
- F. Section Includes:
1. Communications equipment coordination and installation.
  2. Common communications installation requirements.
  3. Cutting and patching for communications and electronic safety and security construction.
  4. Touchup painting.

## **1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation
- D. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- E. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- F. Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure
- G. Section 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATION SYSTEMS. Requirements for grounding of equipment.

H. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). For physical access control integration.

### 1.3 DEFINITIONS

F. 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.
5. Provide: The term "provide" means "to furnish and install, ready for the intended use and in complete operating condition."
6. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
7. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.
8. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications and requests, is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contracts.
9. Indicated: The term "indicated" refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled" and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
10. Contractor: The term "Contractor" shall carry the same meaning as "Electrical Contractor"

11. Or Equal: The term "Or equal" shall carry the same meaning as "approved as equal by the Engineer"
12. Owner: All references here-in and on drawings to "Owner" shall be the same as "Veterans Administration - Minneapolis".

#### 1.4 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. 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.
- D. 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, quantity of parts, current price and availability of each part.
  4. All shop drawings shall be bound neatly in four separate hard cover, 3-ring binders. Submit the following and refer to each Section for specific requirements. Tab and index each Section, sequenced in order of section.
  5. Refer to drawings for the additional required equipment that is to be submitted as part of the shop drawing submittals.

E. Maintenance and Operation 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. The manuals shall include:
  - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
  - b. Description of the function of each principal item of equipment.
  - c. Installation and maintenance instructions.
  - d. Safety precautions.
  - e. Diagrams and illustrations.
  - f. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
  - g. Performance data.
  - h. 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.
  - i. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certified qualifications.

G. Record Documents:

1. Prepare and record 'as-built' documents in accordance with the requirements in Division 1 Section "Project Closeout."
2. Maintain a separate set of electrical drawings at the job site which is not used for construction purposes. This set shall be

kept updated by neatly marking all changes and deviations made during construction. Use a color that contrasts with the drawings. This same set of drawings shall be made available at all times during construction for review at any time by the Architect/Engineer.

3. In addition to the requirements specified in Division 1, indicate actual installed and 'as-built' conditions for:
  - a. Major raceway systems, size and location, for both exterior and interior.
  - b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  - c. Approved changes and actual equipment and materials installed.
  - d. Contract modifications, including deviation of branch circuit numbering where circuit breaker arrangements have been adjusted.
- H. Approvals will be based on complete submission of manuals together with shop drawings.
- I. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:

#### **1.5 SINGULAR NUMBER**

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

#### **1.6 Acceptance Checks and Tests**

- A. The contractor shall furnish the instruments, materials and labor for field tests.

#### **1.7 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 Resident Engineer at least 30 days prior to the planned training.

**1.9 PERMITS**

A. Obtain and pay for licenses and permits required, for fees and charges for use of outside services (i.e. inspecting agencies or delivery services) and use of property other than the site of the Work for storage of materials or other purposes.

**1.10 INSPECTIONS**

A. Secure regular inspections as required by regulations. Pay charges by regulating agencies for the inspections of installations or Drawings and Specifications.

**1.11 WARRANTY**

A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COTR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contractor received written notification of final acceptance from the COTR. Demonstration and training shall be performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COTR's satisfaction, and at the Contractor's expense

**PART 2 - PRODUCTS (NOT APPLICABLE)****PART 3 - EXECUTION****3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to

facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

### **3.2 FIRESTOPPING**

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 00 "Firestopping."

### **3.3 FIELD QUALITY CONTROL**

A. Inspect installed components for damage and faulty work, including the following:

1. Supporting devices for electrical components.
2. Electrical identification.
3. Cutting and patching for electrical construction.
4. Touchup painting.

- - - E N D - - -



**SECTION 28 13 00**  
**PHYSICAL ACCESS CONTROL AND PERSONNEL PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification of an extended, complete and fully operating Physical Access Control and Personnel Protection System, hereinafter referred to as the PACPPS.
- B. This Section includes a Physical Access Control and Personnel Protection System consisting of an existing system server, existing networked workstation computers, operating system and application software, and field-installed Controllers connected by a high-speed electronic data transmission network. The PACPPS shall have the following:
  - 1. Physical Access Control:
    - a. Regulating access through doors.
    - b. Credential card readers
    - c. Monitoring of field-installed devices
  - 2. Personnel Protection:
    - a. Pushbutton duress alarm switches
- C. System Architecture:
  - 1. Criticality, operational requirements, and/or limiting points of failure may dictate the development of an enterprise and regional server architecture as opposed to system capacity. Provide server and workstation configurations with all necessary connectors, interfaces and accessories as shown.
- D. PACPPS shall provide secure and reliable identification of Federal employees and contractors by utilizing credential authentication per FIPS-201.
- E. Physical Access Control and Personnel Protection System (PACPPS) shall consist of:
  - 1. Existing head-End equipment server,
  - 2. Existing networked PC-based workstations,
  - 3. Existing Physical Access Control System and Database Management Software,

4. Field installed controllers,
5. Card readers,
6. Power supplies.
7. Interfaces with:
  - a. Video Surveillance and Assessment System,
  - d. Intrusion Detection System,
- F. PACPPS system shall support:
  1. Multiple credential authentication modes,
  2. Bidirectional communication with the reader,
- G. All security relevant decisions shall be made on "secure side of the door". Secure side processing shall include;
  1. Challenge/response management,
  2. PKI path discovery and validation,
  3. Credential identifier processing,
  4. Authorization decisions.
- H. For locations where secure side processing is not applicable the tamper switches and certified cryptographic processing shall be provided per FIPS-140-2.

## **1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- D. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- E. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- F. Section 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- G. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general requirements that are common to more than one section in Division 28.

## **1.3 QUALITY ASSURANCE**

- A. The Contractor shall be responsible for extending the operation of the PACPPS as shown. The Contractor shall also provide certification as required.

- B. The security system will be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. 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.
- D. Product Qualifications:
  - 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.
- E. Contractor Qualifications:
  - 1. The Contractor shall utilize, for all system, cable, and connection work; a security sub-contractor authorized to do work at the Facility. The subcontractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACPPS) manufacturer. The Contractor or security subcontractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACPPS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with

- this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COTR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
- a. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
- F. 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.

#### **1.4 SUBMITTALS**

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, Section 02 41 00, DEMOLITION, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.
- D. Shop drawing and as-built packages shall include, but not be limited to:
  1. Index Sheet that shall:
    - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a complete list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
      - 1) Outline all general and job specific work required within the design package.

- 2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
2. A detailed diagram for each applicable security subsystem shall:
    - a. Indicate the sequence of operation.
    - b. Relationship of integrated components on one diagram.
    - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
    - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
  - E. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
  - F. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS.
  - G. General: Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:
    1. The Contractor shall schedule submittals in order to maintain the project schedule.
    2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.

3. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for COTR and Contractor review stamps.
4. Operation and Maintenance Manual: In each manual include information specified in the individual Specification section, and the following information for each major component of building equipment and controls:
  - 1) General system or equipment description.
  - 2) Design factors and assumptions.
  - 3) Copies of applicable Shop Drawings and Product Data.
  - 4) System or equipment identification including: manufacturer, model and serial numbers of each component, operating instructions, emergency instructions, wiring diagrams, inspection and test procedures, maintenance procedures and schedules, precautions against improper use and maintenance, repair instructions, sources of required maintenance materials and related services, and a manual index.
5. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.

#### H. FIPS 201 Compliance Certificates

1. Provide Certificates for all device types utilizing credential verification. Provide certificates for:
  - b. Card Readers

#### I. Record Drawings:

The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner

J. Approvals will be based on complete submission of manuals together with shop drawings.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) 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)/ Security Industry Association (SIA):
  - AC-03.....Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards
  - TVAC-01.....CCTV to Access Control Standard - Message Set for System Integration
- C. American National Standards Institute (ANSI)/ International Code Council (ICC):
  - A117.1.....Standard on Accessible and Usable Buildings and Facilities
- D. Department of Justice American Disability Act (ADA)
  - 28 CFR Part 36.....ADA Standards for Accessible Design 2010
- E. Department of Veterans Affairs (VA):

F. Government Accountability Office (GAO):  
GAO-03-8-02 Security Responsibilities for Federally Owned and Leased Facilities

G. National Electrical Contractors Association  
303-2005.....Installing Closed Circuit Television (CCTV) Systems

H. National Electrical Manufacturers Association (NEMA):  
250-08.....Enclosures for Electrical Equipment (1000 Volts Maximum)

I. National Fire Protection Association (NFPA):  
70-11..... National Electrical Code

J. Underwriters Laboratories, Inc. (UL):  
294-99.....The Standard of Safety for Access Control System Units  
305-08.....Standard for Panic Hardware  
639-97.....Standard for Intrusion-Detection Units  
752-05.....Standard for Bullet-Resisting Equipment  
827-08.....Central Station Alarm Services  
1076-95.....Standards for Proprietary Burglar Alarm Units and Systems  
1981-03.....Central Station Automation System  
2058-05.....High Security Electronic Locks

K. Homeland Security Presidential Directive (HSPD):  
HSPD-12.....Policy for a Common Identification Standard for Federal Employees and Contractors

L. Federal Communications Commission (FCC):  
(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

M. Federal Information Processing Standards (FIPS):  
FIPS-201-1.....Personal Identity Verification (PIV) of Federal Employees and Contractors

N. National Institute of Standards and Technology (NIST):



- IR 6887 V2.1.....Government Smart Card Interoperability  
Specification (GSC-IS)
- Special Pub 800-63.....Electronic Authentication Guideline
- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-73-3....Interfaces for Personal Identity Verification  
(4 Parts)
  - .....Pt. 1- End Point PIV Card Application  
Namespace, Data Model & Representation
  - .....Pt. 2- PIV Card Application Card Command  
Interface
  - .....Pt. 3- PIV Client Application Programming  
Interface
  - .....Pt. 4- The PIV Transitional Interfaces & Data  
Model Specification
- Special Pub 800-76-1....Biometric Data Specification for Personal  
Identity Verification
- Special Pub 800-78-2....Cryptographic Algorithms and Key Sizes for  
Personal Identity Verification
- Special Pub 800-79-1....Guidelines for the Accreditation of Personal  
Identity Verification Card Issuers
- Special Pub 800-85B-1...DRAFTPIV Data Model Test Guidelines
- Special Pub 800-85A-2...PIV Card Application and Middleware Interface  
Test Guidelines (SP 800-73-3 compliance)
- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-37.....Guide for Applying the Risk Management  
Framework to Federal Information Systems
- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-104A....Scheme for PIV Visual Card Topography
- Special Pub 800-116.....Recommendation for the Use of PIV Credentials  
in Physical Access Control Systems (PACPPS)
- O. Institute of Electrical and Electronics Engineers (IEEE):
  - C62.41.....IEEE Recommended Practice on Surge Voltages in  
Low-Voltage AC Power Circuits
- P. International Organization for Standardization (ISO):

7810.....Identification cards - Physical characteristics

7811.....Physical Characteristics for Magnetic Stripe  
Cards

7816-1.....Identification cards - Integrated circuit(s)  
cards with contacts - Part 1: Physical  
characteristics

7816-2.....Identification cards - Integrated circuit cards  
- Part 2: Cards with contacts -Dimensions and  
location of the contacts

7816-3.....Identification cards - Integrated circuit cards  
- Part 3: Cards with contacts - Electrical  
interface and transmission protocols

7816-4.....Identification cards - Integrated circuit cards  
- Part 11: Personal verification through  
biometric methods

7816-10.....Identification cards - Integrated circuit cards  
- Part 4: Organization, security and commands  
for interchange

14443.....Identification cards - Contactless integrated  
circuit cards; Contactless Proximity Cards  
Operating at 13.56 MHz in up to 5 inches  
distance

15693.....Identification cards -- Contactless integrated  
circuit cards - Vicinity cards; Contactless  
Vicinity Cards Operating at 13.56 MHz in up to  
50 inches distance

19794.....Information technology - Biometric data  
interchange formats

Q. Uniform Federal Accessibility Standards (UFAS) 1984

R. ADA Standards for Accessible Design 2010

S. Section 508 of the Rehabilitation Act of 1973

## 1.6 DEFINITIONS

A. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.

- B. Access Control List: A list of (identifier, permissions) pairs associated with a resource or an asset. As an expression of security policy, a person may perform an operation on a resource or asset if and only if the person's identifier is present in the access control list (explicitly or implicitly), and the permissions in the (identifier, permissions) pair include the permission to perform the requested operation.
- C. Access Control: A function or a system that restricts access to authorized persons only.
- D. API Application Programming Interface
- E. Assurance Level (or E-Authentication Assurance Level): A measure of trust or confidence in an authentication mechanism defined in OMB Memorandum M-04-04 and NIST Special Publication (SP) 800-63, in terms of four levels: [M-04-04]
  - 1. Level 1: LITTLE OR NO confidence
  - 2. Level 2: SOME confidence
  - 3. Level 3: HIGH confidence
  - 4. Level 4: VERY HIGH confidence
- F. Authentication: A process that establishes the origin of information, or determines an entity's identity. In this publication, authentication often means the performance of a PIV authentication mechanism.
- G. Authenticator: A memory, possession, or quality of a person that can serve as proof of identity, when presented to a verifier of the appropriate kind. For example, passwords, cryptographic keys, and fingerprints are authenticators.
- H. Authorization: A process that associates permission to access a resource or asset with a person and the person's identifier(s).
- I. BIO or BIO-A: A FIPS 201 authentication mechanism that is implemented by using a Fingerprint data object sent from the PIV Card to the PACPPS. Note that the short-hand "BIO (-A)" is used throughout the document to represent both BIO and BIO-A authentication mechanisms.
- J. Biometric: An authenticator produced from measurable qualities of a living person.
- K. CAC EP - CAC End Point with end point PIV applet
- L. CAC NG - CAC Next Generation with transitional PIV applet

- M. Card Authentication Key (CAK): A PIV authentication mechanism (or the PIV Card key of the same name) that is implemented by an asymmetric or symmetric key challenge/response protocol. The CAK is an optional mechanism defined in NIST SP 800-73. [SP800-73] NIST strongly recommends that every PIV Card contain an asymmetric CAK and corresponding certificate, and that agencies use the asymmetric CAK protocol, rather than a symmetric CAK protocol, whenever the CAK authentication mechanism is used with PACPPS.
- N. CCTV: Closed-circuit television.
- O. Central Station: A PC with software designated as the main controlling PC of the PACPPS. Where this term is presented with initial capital letters, this definition applies.
- P. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- Q. CPU: Central processing unit.
- R. Credential: Data assigned to an entity and used to identify that entity.
- S. File Server: A PC in a network that stores the programs and data files shared by users.
- T. FIPS Federal Information Processing Standards
- U. FRAC - First Responder Authentication Credential
- V. HSPD Homeland Security Presidential Directive
- W. I/O: Input/Output.
- X. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- Y. IEC International Electrotechnical Commission
- Z. ISO International Organization for Standardization
- AA. KB Kilobyte
- BB. kbit/s Kilobits / second
- CC. LAN: Local area network.
- DD. LED: Light-emitting diode.

- EE. Legacy CAC - Contact only Common Access Card with v1 and v2 applets
- FF. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- GG. NIST: National Institute of Standards and Technology
- HH. PACPPS: Physical Access Control System
- II. PC/SC: Personal Computer / Smart Card
- JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.
- KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- MM. PIV: Personal Identification Verification
- NN. PIV-I - PIV Interoperable credential
- OO. PPS: Protocol and Parameters Selection
- PP. RF: Radio frequency.
- QQ. ROM: Read-only memory. ROM data are maintained through losses of power.
- RR. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- SS. RS-485: An TIA/EIA standard for multipoint communications.
- TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- UU. TPDU: Transport Protocol Data Unit
- VV. TWIC - Transportation Worker Identification Credential
- WW. UPS: Uninterruptible power supply.
- XX. Vcc: Voltage at the Common Collector
- YY. WAN: Wide area network.
- ZZ. WAV: The digital audio format used in Microsoft Windows.

AAA. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

BBB. Windows: Operating system by Microsoft Corporation.

CCC. Workstation: A PC with software that is configured for specific limited security system functions.

#### **1.7 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

#### **1.8 MAINTENANCE & SERVICE**

- A. General Requirements
  - 1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall 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. See also General Project Requirements.
- B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The COTR shall be advised in writing of the name of the designated service representative, and of any change in personnel. The COTR shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays. These inspections shall include:
  - a) The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
    - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
    - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics

and correct all problems; and resolve any previous outstanding problems.

E. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.

- a. For system failures, the Contractor within eight (4) hours with a defect correction time not to exceed 24 hours from notification.

F. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

G. 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.

H. 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.



#### I. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COTR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

#### J. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. 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".

#### 1.9 PERFORMANCE REQUIREMENTS

- A. PACPPS shall provide support for multiple authentication modes and bidirectional communication with the reader.
- B. All processing of authentication information must occur on the "safe side" of a door
- C. Physical Access Control System shall provide access to following Security Areas:
  1. Controlled
  2. Limited
  3. Exclusion

- D. Field equipment shall include Controllers, sensors, and controls.  
Controllers shall serve as an interface between the Central Station and sensors and controls.
- E. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.
- F. Door Hardware Interface: Coordinate with Division 08 Sections that specify door hardware required to be monitored or controlled by the PACPPS. The Controllers in this Section shall have electrical characteristics that match the signal and power requirements of door hardware. Integrate door hardware specified in Division 08 Sections to function with the controls and PC-based software and hardware in this Section.
- G. References to industry and trade association standards and codes are minimum installation requirement standards.
- H. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

#### **1.10 EQUIPMENT AND MATERIALS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

#### **1.11 WARRANTY OF CONSTRUCTION.**

- A. Warrant PACPPS work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

#### **1.12 GENERAL REQUIREMENTS**

- A. General requirements applicable to this section include:
  - 1. General Arrangement Of Contract Documents,
  - 2. Delivery, Handling and Storage,
  - 3. Project Conditions,
  - 4. Electrical Power,
  - 5. Lightning, Power Surge Suppression, and Grounding,

6. Electronic Components,
7. Substitute Materials and Equipment, and
8. Like Items.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All equipment and materials for the system will be compatible to ensure correct operation as outlined in FIPS 201, March 2006 and HSPD-12.
- B. All components of the extended CACPPS shall connect to the existing Lenel System.
- C. The security system characteristics listed in this section will serve as a guide in selection of equipment and materials for the PACPPS. If updated or more suitable versions are available then the Contracting Officer will approve the acceptance of prior to an installation.
- D. PACPPS equipment shall meet or exceed all requirements listed below.
- E. PACPPS shall be comprised of, but not limited to, the following components:
  1. Physical Access Control System - modification of existing System.
  2. Application Software - existing.
  3. System Database - existing. Modifications required for demolished, relocated, and new devices.
  4. Surge and Tamper Protection - Existing.
  5. Standard Workstation Hardware - Existing.
  6. Communications Workstation - Existing.
  7. Controllers (Data Gathering Panel)
  8. Secondary Alarm Annunciator. Existing.
  9. Keypads
  10. Card Readers
  11. Credential Cards - Existing.
  12. Biometric Identity Verification Equipment - N/A.
  13. Enrolment Center - Existing.
  14. System Sensors and Related Equipment
  15. Push Button Switches
  16. Interfaces
  17. Door interface
  18. RS-232 ASCII Interface

19. Floor Select Elevator Control - Existing.
20. After-Hours HVAC Control - Existing.
21. Real Time Guard Tour - Existing.
22. Video and Camera Control - Existing.
23. Cables
24. Transformers - Existing.

## **2.2 APPLICATION SOFTWARE**

### **A. Alarms:**

#### **1. System Setup:**

- a. Assign manual and automatic responses to incoming point status change or alarms.
- b. Automatically respond to input with a link to other inputs, outputs, operator-response plans, unique sound with use of WAV files, and maps or images that graphically represent the point location.

### **B. Alarm Monitoring: Monitor sensors, Controllers, and DTS circuits and notify operators of an alarm condition.**

1. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and Controllers.
2. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.

## **2.3 SURGE AND TAMPER PROTECTION**

### **A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.**

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."

### **B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially**

disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

#### **2.4 CONTROLLERS**

- A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the Central Station or workstation for controlling its operation.
- B. Subject to compliance with requirements in this Article, manufacturers may use multipurpose Controllers.
- C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.
- D. Alarm Annunciation Controller:
  - 1. The Controller shall automatically restore communication within 10 seconds after an interruption with the field device network [with dc line supervision on each of its alarm inputs].
    - a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.
    - b. Alarm-Line Supervision:
      - 1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal [and for conditions as described in UL 1076 for line security equipment] [by monitoring for abnormal open, grounded, or shorted conditions] using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of [5] [10] percent or more for longer than 500 ms.
      - 2) Transmit alarm-line-supervision alarm to the Central Station during the next interrogation cycle after the abnormal current condition.
    - c. Outputs: Managed by Central Station software.
  - 2. Auxiliary Equipment Power: A GFI service outlet inside the Controller enclosure.
- E. Entry-Control Controller:

1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personal identity verification devices, door strikes, magnetic latches, gate and door operators, and exit push-buttons.
  - a. Operate as a stand-alone portal Controller using the downloaded database during periods of communication loss between the Controller and the field-device network.
  - b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
    - 1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
    - 2) Privileges shall include, but not be limited to, time of day control, day of week control, group control, and visitor escort control.
  - c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
2. Inputs:
  - a. Data from entry-control devices; use this input to change modes between access and secure.
  - b. Database downloads and updates from the Central Station that include enrollment and privilege information.
3. Outputs:
  - a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
  - b. Grant or deny entry by sending control signals to portal-control devices.

- c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the Central Station.
- 4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.
- 5. Data Line Problems: For periods of loss of communications with Central Station, or when data transmission is degraded and generating continuous checksum errors, the Controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
  - a. Store up to [1000] <Insert number> transactions during periods of communication loss between the Controller and access-control devices for subsequent upload to the Central Station on restoration of communication.
- 6. Controller Power: NFPA 70, Class II power supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
  - a. Backup Battery: Premium, valve-regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full 1-year warranty and a pro rata 19-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
  - b. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
  - c. Backup Power Supply Capacity: [5] [90] minutes of battery supply. Submit battery and charger calculations.
  - d. Power Monitoring: Provide manual dynamic battery load test, initiated and monitored at the control center; with automatic disconnection of the Controller when battery voltage drops below Controller limits. Report by using local Controller-mounted LEDs and by communicating status to Central Station. Indicate normal

power on and battery charger on trickle charge. Indicate and report the following:

- 1) Trouble Alarm: Normal power off load assumed by battery.
  - 2) Trouble Alarm: Low battery.
  - 3) Alarm: Power off.
- e. Control Board: Lenel 1300-u, no substitutions.
- f. Enclosure: 8" x 8" x 8", NEMA 4.

## **2.5 CARD READERS**

- A. Power: Card reader shall be powered from its associated Controller, including its standby power source.
- B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the Controller.
- C. Enclosure: Suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
1. Indoors, controlled environment.
  2. Indoors, uncontrolled environment.
- D. Contactless Smart Cards and Readers
1. Smart card readers shall read credential cards whose characteristics of size and technology meet those defined by ISO/IEC 7816, 14443, 15693.
  2. The readers shall have "flash" download capability to accommodate card format changes.
  3. The card reader shall have the capability of reading the card data and transmitting the data to the main monitoring panel.
  4. Product: HID Model RPK40D 921P.
  5. Substitutions: Not permitted.

## **2.6 SYSTEM SENSORS AND RELATED EQUIPMENT**

- A. The PACPPS and related Equipment provided by the Contractor shall meet or exceed the following performer specifications:
- B. Door Status Indicators:
1. Shall monitor and report door status to the SMS.
  2. Door Position Sensor:
    - a. Shall provide an open or closed indication for all doors operated on the PACPPS and report directly to the SMS.



- b. Shall also provide alarm input to the Intrusion Detection System for all doors operated by the PACPPS and all other doors that require monitoring by the intrusion detection system.
- c. Switches for doors operated by the PACPPS shall be double pole double throw (DPDT). One side of the switch shall monitor door position and the other side if the switch shall report to the intrusion detection system. For doors with electromagnetic locks a magnetic bonding sensor (MBS) can be used in place of one side of a DPDT switch, in turn allowing for the use of a single pole double throw (SPDT) switch in it place of a DPDT switch.
- d. Switches for doors not operated by the PACPPS shall be SPDT and report directly to the IDS.
- e. Shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

## 2.7 PUSH BUTTON SWITCHES

- A. Duress Alarm Push-Button Switches: Momentary-contact back-lighted push buttons, with stainless-steel switch enclosures.
  - 1. Electrical Ratings:
    - a. Minimum continuous current rating of [10] <Insert number> A at 120 V ac or [5] <Insert number> A at 240-V ac.
    - b. Contacts that will make 720 VA at [60] <Insert number> A and that will break at 720 VA at [10] <Insert number> A.
  - 2. Enclosures: Flush mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
  - 3. Enclosures shall additionally be suitable for installation in the following locations:
    - a. Indoors, controlled environment.
    - b. Indoors, uncontrolled environment.
- B. Station Patch Cords: Provide station patch cord permanently connected to undercounter bush-button switches, to plug into connector outlet:
  - 1. Product: Panduit Cat 5e Orange UTPCH\*\*ORY. Provide length required plus 10 feet of service loop, no substitutions.
- C. Patch Cord Protection: Provide station patch cord permanently connected to undercounter bush-button switches, to plug into connector outlet:

1. Product: Surface Mount Raceway, 7/8 inches wide x 7/16 inches deep, white, with snap-on cover and self-adhesive tape along entire length of base, no substitutions.

D. Connector Outlet: Modular single information outlet designed for high-performance networking applications:

1. Product: Panduit CJ688TPVL Cat 6 Orange CJ688TPOR, no substitutions.

E. Face Plate: Plastic cover plate, color electric ivory:

1. Product: Panduit CFP1E, no substitutions.

## **2.8 SECONDARY ALARM ANNUNCIATOR**

A. Existing to remain.

## **2.9 WIRES AND CABLES**

A. PVC-Jacketed, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

1. NFPA 70, Type CM.

2. Flame Resistance: UL 1581 Vertical Tray.

B. Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

1. NFPA 70, Type CMP.

2. Flame Resistance: NFPA 262 Flame Test.

C. RS-485 communications require 2 twisted pairs, with a distance limitation of 4000 feet (1220 m).

D. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.

E. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.

1. NFPA 70, Type CMP.

2. Flame Resistance: NFPA 262 Flame Test.
- F. Multiconductor, Readers and Wiegand Keypads Cables: No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.
1. NFPA 70, Type CMG.
  2. Flame Resistance: UL 1581 Vertical Tray.
  3. For TIA/EIA-RS-232 applications.
- G. Paired Readers and Wiegand Keypads Cables: Paired, 3 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
1. NFPA 70, Type CM.
  2. Flame Resistance: UL 1581 Vertical Tray.
- H. Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
1. NFPA 70, Type CMG.
  2. Flame Resistance: UL 1581 Vertical Tray.
- I. Plenum-Type, Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation,

workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

- B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

### **3.2 CURRENT SITE CONDITIONS**

- A. The Contractor and security system subcontractor shall become familiar with the existing System components, control panels, power supply capacity, and space available for expansion to accommodate project-required additional equipment, and include in his bid all labor and materials required to provide an the extension to the existing System, as shown on the Drawings and described herein.
- B. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.

### **3.3 EXAMINATION**

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.4 PREPARATION**

- A. Comply with recommendations in SIA CP-01.

- B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."
- C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
  - 1. Record setup data for control station and workstations.
  - 2. For each Location, record setup of Controller features and access requirements.
  - 3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
  - 4. Set up groups, linking, and list inputs and outputs for each Controller.
  - 5. Assign action message names and compose messages.
  - 6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
  - 7. Prepare and install alarm graphic maps.
  - 8. Develop user-defined fields.
  - 9. Develop screen layout formats.
  - 10. Propose setups for guard tours and key control.
  - 11. Discuss badge layout options; design badges.
  - 12. Complete system diagnostics and operation verification.
  - 13. Prepare a specific plan for system testing, startup, and demonstration.
  - 14. Develop acceptance test concept and, on approval, develop specifics of the test.
  - 15. Develop cable and asset management system details; input data from construction documents. Include system schematics and Technical Drawings.
- D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

### 3.5 CABLING

- A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."

- B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- D. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.
- E. Install cables without damaging conductors, shield, or jacket.
- F. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- G. Install end-of-line resistors at the field device location and not at the Controller or panel location.

### **3.6 CABLE APPLICATION**

- A. Comply with EIA/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
- C. RS-232 Cabling: Install at a maximum distance of 50 feet (15 m).
- D. RS-485 Cabling: Install at a maximum distance of 4000 feet (1220 m).
- E. Card Readers and Keypads:
  - 1. Install number of conductor pairs recommended by manufacturer for the functions specified.
  - 2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from Controller to the reader is 250 feet (75 m), and install No. 20 AWG wire if maximum distance is 500 feet (150 m).
  - 3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the Controller.

- 4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.
- F. Install minimum No. 16 AWG cable from Controller to electrically powered locks. Do not exceed [250 feet (75 m)] [500 feet (150 m)] <Insert distance>.
- G. Install minimum No. 18 AWG ac power wire from transformer to Controller, with a maximum distance of [25 feet (8 m)] <Insert distance>.

### **3.7 GROUNDING**

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Signal Ground:
  - 1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
  - 2. Bus: Mount on wall of main equipment room with standoff insulators.
  - 3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

### **3.8 INSTALLATION**

- A. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a operable system.
- B. The PACPPS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a network.
- C. For integration purposes, the PACPPS shall be integrated where appropriate with the following associated security subsystems:

1. IDS:
  - a. Be able monitor door control sensors.
  - b. Be able to monitor and control the IDS on a 24 hours basis.
  - c. Be programmed to go into an alarm state when an IDS device is put into an alarm state, and notify the operator via an audible alarm.
2. Emergency Personnel Protection:
  - a. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated, and notify the Physical Access Control System and Database Management of an alarm event.
- D. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.
- E. Existing Equipment:
  1. The Contractor shall connect to and utilize existing door equipment, control signal transmission lines, and devices as outlined in the design package. Door equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
  2. The Contractor shall perform a field survey, including testing and inspection of all existing door equipment and signal lines intended to be incorporated into the PACPPS, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
  3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.



4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or improper installation of equipment.
  5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.
- F. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.
- G. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- H. Card Readers:
1. Connect all signal inputs and outputs as shown and specified.
  2. Terminate input signals as required.
  3. Program and address the reader as per the design package.
  4. Readers shall be surface or flushed mounted and all appropriate hardware shall be provided to ensure the unit is installed in an enclosed conduit system.
- I. Door Status Indicators:
1. Install all signal input and output cables as well as all power cables.
  2. RTE's shall be surface mounted and angled in a manner that they cannot be compromised from the non-secure side of a windowed door,

- or allow for easy release of the locking device from a distance no greater than 6 feet from the base of the door.
3. Door position sensors shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

J. System Start-Up:

1. The Contractor shall not apply power to the PACPPS until the following items have been completed:
  - a. PACPPS equipment items and have been set up in accordance with manufacturer's instructions.
  - b. A visual inspection of the PACPPS has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
  - c. System wiring has been tested and verified as correctly connected as indicated.
  - d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
  - e. Power supplies to be connected to the PACPPS have been verified as the correct voltage, phasing, and frequency as indicated.
2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.

K. Supplemental Contractor Quality Control:

1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed PACPPS; and are approved by the Contracting Officer.
2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed

is fully operational as all construction document requirements have been fulfilled.

### **3.9 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect[, test, and adjust] field-assembled components and equipment installation, including connections[, and to assist in field testing]. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.
  - 2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
  - 3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

### **3.10 PROTECTION**

- A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured, with an activated burglar alarm and access-control system reporting to a Central Station complying with UL 1610, "Central-Station Burglar-Alarm Units," during

periods when a qualified operator in the employ of Contractor is not present.

### **3.11 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications.
- C. Develop training modules for the following:
  - 1. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
  - 2. Security personnel.
  - 3. Hardware maintenance personnel.
  - 4. Corporate management.
- D. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

-----END-----

**SECTION 28 31 00**  
**FIRE DETECTION AND ALARM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, existing control units, fire safety control devices, existing annunciators, existing power supplies, and wiring as shown on the drawings and specified. The fire alarm system shall not be combined with other systems such as building automation, energy management, security, etc.
- B. Fire alarm systems shall comply with requirements of the most recent VA FIRE PROTECTION DESIGN MANUAL and NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the COTR or his authorized representative. Installers shall have a minimum of 2 years experience installing fire alarm systems.
- C. Fire alarm signals:
1. Building 70 has an existing automatic digitized voice fire alarm signal with emergency manual voice override to notify occupants to evacuate. The digitized voice message shall identify the area of the building (smoke zone) from which the alarm was initiated.
- D. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit.
- E. The main fire alarm control unit automatically transmits alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

**1.2 SCOPE**

- A. A fully addressable fire alarm system as an extension of an existing addressable fire alarm system shall be designed and provided in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.
- B. All existing fire alarm devices in the area of demolition shall be disconnected, removed with care, and prepared for re-use in new construction. Field verify, prior to bid, the total number of each type of device that . All existing fire alarm equipment, wiring, devices and sub-systems that are not reused shall be removed. All existing fire alarm conduit not reused shall be removed.
- C. Existing fire alarm bells, chimes, door holders, 120VAC duct smoke detectors, valve tamper switches and waterflow/pressure switches may be reused only as specifically indicated on the drawings and provided the equipment:
  - 1. Meets this specification section
  - 2. Is UL listed or FM approved
  - 3. Is compatible with new equipment being installed
  - 4. Is verified as operable through contractor testing and inspection
  - 5. Is warranted as new by the contractor.
- D. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.
- E. Basic Performance:
  - 1. Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
  - 2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed 5 seconds.
  - 3. The existing signaling line circuits (SLC) between building fire alarm control units are wired Class A Style 7 in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.
  - 4. Extensions to existing signaling line circuits (SLC) within buildings shall be wired Class B Style 4 in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering

22,500 square feet (2,090 square meters) of floor space or 3 floors whichever is less.

5. Extensions to existing notification appliance circuits (NAC) shall be wired Class B Style Y in accordance with NFPA 72. Each strobe circuit shall have a minimum of 20 percent spare capacity.

### **1.3 RELATED WORK**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.  
Requirements for procedures for submittals.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for fire proofing wall penetrations.
- C. Section 26 05 21 LOW VOLTAGE POWER CONDUCTORS AND CABLES (600 VOLT AND BELOW).
- D. 26 05 26 - GROUNDING AND BONDING FRO ELECTRICAL SYSTEM.
- E. 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

### **1.4 SUBMITTALS**

- A. General: Submit 5 copies in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Drawings:
  1. Prepare drawings using AutoCAD 2012 software and include all contractors information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (COTR). Bid drawing files on AutoCAD will be provided to the Contractor. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.
  2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.
  3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and

number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.

4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
5. Two weeks prior to final inspection, the Contractor shall deliver to the COTR 3 sets of as-built drawings and one set of the as-built drawing computer files (using AutoCAD 2012 or later, verify exact version with the COTR). As-built drawings (floor plans) shall show all new and/or existing conduit used for the fire alarm system.

C. Calculations:

1. Standby Power Supply: Calculations for each fire alarm control unit and notification appliance circuit power supply, indicated connected load for each circuit, total connected load, and required standby power requirements.
2. Voltage Drop: Calculations for each notification appliance circuit indicating length of circuit, total connected load, source voltage, voltage at end of line, and percent voltage drop. Each circuit shall have a minimum of 20 percent spare capacity, include future additional devices at end of line for calculation purposes.

D. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
  - a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.



- b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
  - c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
  - d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
  - e. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
  - f. Include information indicating who will provide emergency service and perform post contract maintenance.
  - g. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
  - h. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.
  - i. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.
  - j. A print out for all new devices proposed on each existing signaling line circuit, with existing devices indicated and spare capacity indicated.
2. Two weeks prior to final inspection, deliver 4 copies of the final updated maintenance and operating manual to the COTR.
- a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.

- b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
  - c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
  - d. Certificate of Installation as required by NFPA 72, using NFPA 72 Record of Completion and Testing forms.. Alternate forms are prohibited. The certificate shall identify any variations from the National Fire Alarm Code.
  - e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.
- E. Certifications:
- 1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
  - 2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
  - 3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

#### **1.5 WARRANTY**

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer.

#### **1.6 GUARANTY PERIOD SERVICES**

- A. Complete inspection, testing, maintenance and repair service for the fire alarm system shall be provided by a factory trained authorized

representative of the manufacturer of the major equipment for a period of 5 years from the date of acceptance of the entire installation by the Contracting Officer.

- B. Contractor shall provide all necessary test equipment, parts and labor to perform required inspection, testing, maintenance and repair.
- C. All inspection, testing, maintenance and permanent records required by NFPA 72, and recommended by the equipment manufacturer shall be provided by the contractor. Work shall include keeping operational all sprinkler system alarm and supervisory devices as well as all reused existing equipment connected to the fire alarm system. It shall include keeping operation all existing interfaced equipment including but not limited to elevators, HVAC shutdown, and extinguishing systems.
- D. Maintenance and testing shall be performed in accordance with NFPA 72. A computerized preventive maintenance schedule shall be provided and shall describe the protocol for preventive maintenance of equipment. The schedule shall include a systematic examination, adjustment and cleaning of all equipment.
- E. Non-included Work: Repair service shall not include the performance of any work due to improper use, accidents, or negligence for which the contractor is not responsible.
- F. 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 the work performed and parts replaced shall be provided to the VA COTR or his authorized representative.
- G. Emergency Service:
  - 1. Warranty Period Service: Service other than the preventative maintenance, inspection, and testing required by NFPA 72 shall be considered emergency call-back service and covered under the warranty of the installation during the first year of the warranty period, unless the required service is a result of abuse or misuse by the Government. Written notification shall not be required for emergency warranty period service and the contractor shall respond as outlined in the following sections on Normal and Overtime Emergency Call-Back Service. Warranty period service can be required during normal or overtime emergency call-back service time periods at the discretion of the COTR or his authorized representative.

2. Normal and overtime emergency call-back service shall consist of an on-site response within 2 hours of notification of a system trouble.
  3. Normal emergency call-back service times are between the hours of 7:30 a.m. and 4:00 p.m., Monday through Friday, exclusive of federal holidays. Service performed during all other times shall be considered to be overtime emergency call-back service. The cost of all normal emergency call-back service for years 2 through 5 shall be included in the cost of this contract.
  4. Overtime emergency call-back service shall be provided for the system when requested by the Government. The cost of the first 40 manhours per year of overtime call-back service during years 2 through 5 of this contract shall be provided under this contract. Payment for overtime emergency call-back service in excess of the 40 man hours per year requirement will be handled through separate purchase orders. The method of calculating overtime emergency call-back hours is based on actual time spent on site and does not include travel time.
- H. The contractor shall maintain a log at each existing fire alarm control unit. The log shall list the date and time of all examinations and trouble calls, condition of the system, and name of the technician. Each trouble call shall be fully described, including the nature of the trouble, necessary correction performed, and parts replaced.

#### **1.7 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only and the latest editions of these publications shall be applicable.
- B. National Fire Protection Association (NFPA):
- NFPA 13 .....Standard for the Installation of Sprinkler  
Systems, 2010 edition
- NFPA 14 .....Standard for the Installation of Standpipes and  
Hose Systems, 2010 edition
- NFPA 20 .....Standard for the Installation of Stationary  
Pumps for Fire Protection, 2010 edition
- NFPA 70.....National Electrical Code (NEC), 2010 edition
- NFPA 72.....National Fire Alarm Code, 2010 edition

NFPA 90A.....Standard for the Installation of Air  
Conditioning and Ventilating Systems, 2009  
edition

NFPA 101.....Life Safety Code, 2009 edition

C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment  
Directory

D. Factory Mutual Research Corp (FM): Approval Guide, 2007-2011

E. American National Standards Institute (ANSI):  
S3.41.....Audible Emergency Evacuation Signal, 1990  
edition, reaffirmed 2008

F. International Code Council, International Building Code (IBC), 2009  
edition

## **PART 2- PRODUCTS**

### **2.1 EQUIPMENT AND MATERIALS, GENERAL**

A. All equipment and components shall be new and the manufacturer's current model, except where specifically indicated for relocate, salvage, or reinstall. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.

### **2.2 CONDUIT, BOXES, AND WIRE**

A. Conduit shall be as follows:

1. All new conduits shall be installed in accordance with NFPA 70.
2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
3. All new conduits shall be 3/4 inch (21 mm) minimum.

B. Wire:

1. Wiring shall be in accordance with NEC article 760, and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.
2. Fire Alarm Power Branch Circuits: Building wire as specified in Section 26 05 21 with type THHN or TFFN stranded.

3. Initiating Device and Audible and separate Visual Indicating Appliance Circuits: Power limited fire-protective signaling cable, copper conductor, 300 volts insulation rated 105 degrees C.
4. Addressable circuits and wiring used for the extension to existing multiplex communication loop(s) shall be twisted and shielded unless specifically accepted by the fire alarm equipment manufacturer in writing.

C. Junction Boxes:

1. Shall be galvanized steel in accordance with UL requirements.
2. All boxes shall be sized and installed in accordance with NFPA 70.
3. covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4 inch (19 mm) high.

**2.3 FIRE ALARM CONTROL UNIT (FACU OR FACP)**

A. General:

1. Fire alarm control unit is existing Gamewell-FCI by Honeywell.
1. Fire alarm control unit shall operate as a supervised zoned fire alarm system.
2. Each power source shall be supervised from the other source for loss of power.
3. All circuits shall be monitored for integrity.
4. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
5. Transmit digital alarm information to the main fire alarm control unit.

B. Power Supply:

1. The existing control unit derives its normal power from a 120 volt, 60 Hz dedicated supply connected to the Emergency System - Life Safety Branch. Standby power shall be provided by a 24 volt DC battery as hereinafter specified.
3. Power supply for smoke detectors shall be taken from the existing initiating device addressable loop serving the area, connected to the existing fire alarm control unit.

- C. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.
- . Trouble signals:
  - 1. Arrange the trouble signals for automatic reset (non-latching).
  - 2. System trouble switch off and on lamps shall be visible through the control unit door.

#### **2.4 STANDBY POWER SUPPLY**

- A. Batteries: Existing to remain.
  - 1. Battery shall be of the sealed, maintenance free type, 24-volt nominal.
  - 2. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure.
- B. Battery Charger: Existing to remain.

#### **2.5 ANNUNCIATION**

- A. Remote annunciator is existing to remain.

#### **2.6 VOICE COMMUNICATION SYSTEM (VCS)**

- A. General:
  - 1. An existing emergency voice communication system shall be extended.
  - 2. Upon receipt of an alarm signal from the building fire alarm system, the existing VCS shall automatically transmit a pre-recorded fire alarm message throughout the floor in alarm, the floor above, and the floor below.
  - 3. A digitized voice module shall be used to store each prerecorded message.
  - 4. The VCS shall supervise all speaker circuits, control equipment, remote audio control equipment, and amplifiers.
- B. Speaker Circuit Arrangement:
  - 1. The existing speaker circuits are arranged such that there is one speaker circuit per smoke zone.
  - 2. The existing audio amplifiers and control equipment are electrically supervised for normal and abnormal conditions.

3. The existing speaker circuits are either 25 VRMS or 70.7 VRMS with a minimum of 50 percent spare power available.
4. The existing speaker circuits and control equipment shall be arranged such that loss of any one speaker circuit will not cause the loss of any other speaker circuit in the system.

C. Audio Amplifiers: Existing to remain.

1. Audio Amplifiers shall provide a minimum of 50 Watts at either 25 or 70.7 VRMS output voltage levels.
2. Amplifiers shall be continuously supervised for operational status.
3. Amplifiers shall be configured for either single or dual channel application.
4. Each audio output circuit connection shall be configurable for Style X.
5. A minimum of 50 percent spare output capacity shall be available for each amplifier.

D. Tone Generator(s): Existing to remain.

1. Tone Generator(s) shall be capable of providing a distinctive 3-pulse temporal pattern fire alarm signal as well as a slow whoop.
2. Tone Generator(s) shall be continuously supervised for operational status.

## **2.7 NOTIFICATION APPLIANCE CIRCUIT POWER SUPPLY (NACPS)**

A. General:

1. Each existing power source shall be supervised from the other source for loss of power.
2. All circuits shall be monitored for integrity.
3. Visually and audibly annunciate any trouble condition to the FACU or FACP including, but not limited to main power failure, grounds and system wiring derangement.
4. Receive digital alarm information from the main fire alarm control unit.

B. Enclosure: Existing to remain.

C. Power Supply: Existing to remain.

D. Circuit Supervision: Each existing alarm notification appliance circuit shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.



**2.8 ALARM NOTIFICATION APPLIANCES****A. Speakers:**

1. Shall operate on either 25 VRMS or 70.7 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the 1/2 watt tap. Speakers shall provide a minimum sound output of 80 dBA at 10 feet (3,000 mm) with the 1/2 watt tap.
2. Frequency response shall be a minimum of 400 HZ to 4,000 HZ.
3. Ceiling mounted: Four inches (100 mm) or 8 inches (200 mm) cone type speakers with white colored baffles in areas with suspended ceilings.
  - a. Product: Gamewell-FCI SPCW-P series.
4. Wall mounted: Red body with white letters "FIRE".
  - a. Product: Gamewell-FCI SPR series.

**B. Strobes:**

1. Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
2. Wall mount: Backplate shall be red with 1/2 inch (13 mm) permanent white letters. Lettering to read "FIRE", be oriented on the wall properly, and be visible from all viewing directions.
  - a. Product: Gamewell-FCI SR Series.
3. Ceiling mount: Devices to be white with red lettering "FIRE".
  - a. Product: Gamewell-FCI SCW Series.
4. Strobes may be combined with the audible notification appliances specified herein.
  - a. Products:
    - 1) Wall Mount Speaker-Strobe: Gamewell-FCI SPSR Series.
    - 2) Ceiling Mount Speaker Strobe: Gamewell-FCI SPSCW Series.
    - 3) Wall Mount Horn-Strobe: Gamewell-FCI P2R Series.

**2.9 ALARM INITIATING DEVICES****A. Manual Fire Alarm Stations:**

1. Shall be non-breakglass, address reporting type.
2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.

3. Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE."
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.

**B. Smoke Detectors:**

1. Smoke detectors shall be photoelectric type and UL listed for use with the fire alarm control unit being furnished.
2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NFPA 72.
3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.
4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.
7. Accessories: Provide tamper alarm for smoke detectors in toilets. Program at fire alarm control unit for supervision only.
8. Product: Gamewell-FCI ASD-PL2F Series.

**2.10 ADDRESS REPORTING INTERFACE DEVICE**

- A. Shall have unique addresses that reports directly to the building fire alarm panel.

- B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.
- C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.
- D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.
- E. Shall be mounted in weatherproof housings if mounted exterior to a building.

#### **2.11 SPARE AND REPLACEMENT PARTS**

- A. Provide spare and replacement parts as follows:
  - 1. Fire alarm strobes - 2
  - 3. Fire alarm speakers - 2
  - 4. Smoke detectors - 5
- 6
- B. Spare and replacement parts shall be in original packaging and submitted to the COTR.
- C. Provide to the VA, all hardware, software upgrades, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

#### **2.12 INSTRUCTION CHART:**

- A. Provide typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the COTR before being posted.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION:**

- A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment

manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with, Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY, and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.

- B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
- C. All new and reused exposed conduits shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas. See Section 26 05 53 Identification for Electrical Systems.
- D. All existing accessible fire alarm conduit not reused shall be removed.
- E. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.
- F. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations are to be approved by the COTR.
- G. Speakers shall be ceiling mounted and fully recessed in areas with suspended ceilings. Speakers shall be wall mounted and recessed in finished areas without suspended ceilings. Speakers may be surface mounted in unfinished areas.
- H. Strobes shall be flush wall mounted with the bottom of the unit located 80 inches (2,000 mm) above the floor or 6 inches (150 mm) below ceiling, whichever is lower. Locate and mount to maintain a minimum 36 inches (900 mm) clearance from side obstructions.
- I. Manual pull stations shall be installed not less than 42 inches (1,050 mm) or more than 48 inches (1,200 mm) from finished floor to bottom of device and within 60 inches (1,500 mm) of a stairway or an exit door.
- J. Connect flow and tamper switches installed under Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS.

- K. Connect combination closer-holders installed under Section 08 71 00, DOOR HARDWARE.

### 3.2 TYPICAL OPERATION

- A. Activation of any manual pull station, water flow or pressure switch, heat detector, kitchen hood suppression system, gaseous suppression system, or smoke detector shall cause the following operations to occur:
1. Operate the emergency voice communication system in Building. For sprinkler protected buildings, flash strobes continuously only in the zone of alarm. 3. Release only the magnetic door holders associated with the smoke zone from which alarm was initiated.
  2. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
  3. Unlock the electrically locked exit doors within the zone of alarm.
- B. Operation of a smoke detector at a corridor door used for automatic closing shall also release only the magnetic door holders in that smoke zone. Operation of a smoke detector at a shutter used for automatic closing shall also release only the shutters associated with that smoke zone.
- C. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.
- D. Operation of any sprinkler or standpipe system valve supervisory switch, high/low air pressure switch, or fire pump alarm switch shall cause a system supervisory condition.
- E. Alarm verification shall not be used for smoke detectors installed for the purpose of early warning.

### 3.3 TESTS

- A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COTR.
- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COTR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract

requirements. After the system has passed the initial test and been approved by the COTR, the contractor may request a final inspection.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

#### **3.4 FINAL INSPECTION AND ACCEPTANCE**

- A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.
- B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

#### **3.5 INSTRUCTION**

- A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:
  1. Six 1-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. Two sessions at the start of installation, 2 sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
  2. Four 2-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and 2 sessions 3 months after the completion of installation.

3. Three 8-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one 8-hour refresher session 3 months after the completion of installation.
- B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.
- C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

**PART 4 - SCHEDULES****4.1 SMOKE ZONE DESCRIPTIONS:**

- A. Connect to existing smoke zone serving recommissioned area.

**4.2 DIGITIZED VOICE MESSAGES:**

- A. Connect to existing digitized message serving recommissioned area.

- - END - -