

SECTION 28 31 74.00 20

INTERIOR FIRE DETECTION AND ALARM SYSTEM

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.15 (2006) Closer Holder Release Devices

FM GLOBAL (FM)

FM P7825 (2005) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1 (2002) IEEE Guide on the Surges Environment in Low-voltage (1000V and Less) AC Power Circuits

IEEE C62.41.2 (2002) IEEE Recommended Practice on Characterization of Surges in Low-voltage (1000V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C80.1 (2005) Standard for Electrical Rigid Steel Conduit (ERSC)

NEMA C80.3 (2005) Standard for Electrical Metallic Tubing (EMT)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical Code - 2008 Edition

NFPA 72 (2006) National Fire Alarm Code

NFPA 90A (2002; Errata 2003; Errata 2005) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 1242 (2006; Rev thru Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel

UL 1449 (2006) Surge Protective Devices

UL 1971	(2002; Rev thru May 2006) Signaling Devices for the Hearing Impaired
UL 497B	(2004) Protectors for Data Communication and Fire Alarm Circuits
UL 514A	(2004; Rev thru Aug 2005) Standard for Metallic Outlet Boxes
UL 514B	(2004; Rev thru Apr 2006) Standard for Conduit, Tubing and Cable Fittings
UL 6	(2004) Standard for Electrical Rigid Metal Conduit-Steel
UL 797	(2004) Standard for Electrical Metallic Tubing -- Steel
UL Fire Prot Dir	(2009) Fire Protection Equipment Directory

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.3 DESCRIPTION OF WORK

The work includes providing new interior fire alarm system including design, material, tools, equipment, installation, and testing necessary for and incidental to the provision of a complete and usable standard system conforming to the applicable requirements of NFPA 70, NFPA 72, and NFPA 90A and this specification. In referenced NFPA publications, the advisory provisions shall be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the EMWD. Materials and equipment to be furnished under this contract shall be essentially the current design products of manufacturers regularly engaged in production of such equipment and shall be listed by the Underwriters' Laboratories, Inc. in the UL Fire Prot Dir, or approved by Factory Mutual System and listed in FM P7825.

1.4 SYSTEM DESCRIPTION

1.4.1 Design Requirements

1.4.1.1 Power Calculations

Submit design calculations for the new work specified herein to substantiate that the battery capacity exceeds supervisory and alarm power requirements. Show comparison of the detector power requirements per zone versus the control panel smoke detector power output per zone in both the standby and alarm modes. Show comparison of the notification appliance circuit alarm power requirements with the rated circuit power output.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

- System floor plans; G
- System wiring diagrams; G
- Conductor wire marker schedule; G

SD-03 Product Data

- Control panel and modules; G
- Storage batteries; G
- Battery charger; G
- Manual pull stations; G
- Heat detectors; G
- Open-area (spot-type) smoke detectors; G
- Duct smoke detectors; G
- Alarm bells; G
- Alarm horns; G
- Visible appliances; G
- Main annunciator; G
- Electro-magnetic door holder-releases; G
- Valve tamper switches; G
- Wiring; G
- Surge suppression devices; G

Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Submit one original for each item and clear, legible, first-generation photocopies for the remainder of the specified copies. Incomplete or illegible photocopies will not be accepted. Partial submittals will not be accepted.

SD-05 Design Data

- Power calculations; G

SD-06 Test Reports

- Open-area (spot-type) 2-wire heat and smoke detectors; G

Preliminary testing; G

Final acceptance testing; G

Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

SD-07 Certificates

Qualifications of installer; G

SD-10 Operation and Maintenance Data

Fire alarm system, Data Package 5; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

System as-built drawings; G

1.6 QUALITY ASSURANCE

1.6.1 Qualifications of Installer

The Contractor or installer shall have satisfactorily installed fire alarm systems of the same type and design as specified herein and shall be UL certified for the installation and testing of fire alarm systems.

Prior to commencing fire alarm system work, submit data showing that the Contractor or installer has satisfactorily installed three fire alarm systems of the same type and design as specified herein within the past three years and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit proof of UL certification and a list of installer's personnel.

For each system installed, submit the following:

- a. A detailed summary of the type and design of the system;
- b. The contract name or number, completion date of the project and total cost of the system;
- c. The name and telephone number of the facility or installation for whom the work was performed; and,
- d. The name and telephone number of a supervisory level point of contact at the facility or installation who has knowledge of the performance of the Contractor's or installer's work.

1.6.2 Manufacturer's Representative

Provide the services of a representative or technician from the manufacturer of the system, experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Government personnel.

1.6.3 Qualifications of System Technician

Installation drawings, shop drawings and as-built drawings shall be prepared by, or under the supervision of, a qualified technician. Qualified technician shall be an individual who is experienced with the types of work specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level III certification in fire alarm system program. Contractor shall submit data showing the name and certification of the technician at or prior to submittal of drawings.

1.6.4 Drawing Requirements

1.6.4.1 System Floor Plans

Submit shop drawings of the system floor plans showing locations of initiating and indicating appliances and end-of-line supervisory devices. Show wire color coding, wire counts, and device wiring order. Show candela rating of each visible notification appliance.

1.6.4.2 System Wiring Diagrams

Submit complete wiring diagrams of the system showing points of connection and terminals used for all electrical connections in the system. Show all modules, relays, switches and lamps in the control panel.

1.6.4.3 System As-Built Drawings

Upon completion, and before final acceptance of the work, furnish to the Contracting Officer 6 complete sets of as-built drawings, including complete as-built circuit diagrams, of the system. The as-built drawings shall be "D" size 34 by 22 inches reproducible drawings on mylar film drawn to the same scale as the contract drawings and with title block similar to contract drawings. The as-built drawings shall be furnished in addition to the record drawings required by Division 01.

1.6.5 UL Listing or FM Approval

Submit copies of UL listing or FM approval data showing compatibility of the heat and smoke detector model being provided with the control panel being provided, if 2-wire detectors are proposed for use.

1.7 MAINTENANCE

1.7.1 Spare Parts

Furnish the following spare parts:

- a. 5 complete sets of system keys
- b. 1 of each type of audible and visual alarm device installed
- c. 2 of each type of fuse required by the system
- d. 5 spare zone modules for modular type control panels in addition to those installed in the panel
- e. 2 of each type of heat detector installed

- f. 2 of each type of smoke detector base and head installed
- g. 1 smoke detector manufacturer's test screen, card or magnet for each 10 detectors, or fraction thereof, installed in the system
- h. 2 of each type of heat detector base installed if different from smoke detector.

1.7.2 Manuals

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the location of the building, the name of the Contractor, system manufacturer and the contract number. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: circuit drawings; wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shutdown instructions; installation instructions; maintenance instructions; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list.

PART 2 PRODUCTS

2.1 SYSTEM DESIGN

2.1.1 Operation

Provide a complete, electrically supervised, code 3 temporal common coded, manual and automatic, zoned, annunciated, fire alarm system as described herein, and as shown on the drawings. Provide separate circuits from the control panel to each zone of initiating devices as specified herein. Transmission of signals from more than one zone over a common circuit to the control panel is prohibited.

2.1.1.1 Fire Alarm Signal Initiation

Operation shall be such that actuation of any:

- a. Manual station
- b. Heat detector
- c. Smoke detector
- d. Automatic fire sprinkler system
- e. Fire extinguishing system
- f. Fire standpipe system

Shall cause all of the following actions:

- a. All building evacuation alarm devices (notification appliances) to operate continuously;
- b. The annunciator(s) to properly register;
- c. A coded signal to be transmitted over the station fire alarm

system;

- d. Heating, ventilating, and air conditioning equipment to shut down;
- e. Electro-magnetic door holders to de-energize.
- f. Off-site telephone dial callout to monitoring service
- g. Notification to plant SCADA system and security systems

All operations shall remain in the alarm mode (except alarm notification appliances if manually silenced) until the system is manually restored to normal.

2.1.1.2 Supervisory Signal Initiation

Operation of a sprinkler or standpipe control valve tamper or low air pressure supervisory switch or fire pump controller remote supervisory contact shall not cause an alarm, but shall cause operation of common system audible trouble signal, and display of a visual indication distinct from that displayed to indicate a fire alarm or a fault in the supervisory circuit , and transmission of a distinct supervisory signal to fire alarm headquarters.

2.1.1.3 Monitoring Integrity of Installation Conductors

All system circuits shall be electrically monitored for integrity including the following:

- a. Initiating circuits.
- b. Evacuation alarm (notification appliance) circuits (including both audible and visual notification appliances).
- c. Battery power supply (low and no voltage across the standby battery terminals and open battery circuit).

Provide Class B initiating device circuits, and Class B notification appliance circuits as defined by [NFPA 72](#). A ground fault condition or single break in any other circuit shall cause operation of the system trouble signals. Loss of AC power, abnormal AC voltage, a break in the standby battery power circuit, or low battery voltage shall also cause operation of system trouble signals. The abnormal position of any switch in the control panel shall also cause operation of the system trouble signals. Audible and visual equipment for supervision of the AC power supply shall be energized from the auxiliary DC power supply and vice versa. Trouble signals shall sound continuously until manually silenced or the system has been restored to normal. Electrical monitoring for integrity of wiring external of control panel for mechanical equipment shut down and magnetic door holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shutdown.

2.1.1.4 Walk-Test Mode

Provide system with walk-test mode to allow one person to test alarm and supervisory features of initiating devices. Walk-test mode shall be enabled from the control panel by authorized service personnel. Control panel shall display a unique visual indication when system is in walk-test

mode. If testing ceases while in walk-test mode, after a preset delay system shall automatically return to normal standby mode.

2.1.1.5 Alarm Verification Feature

System shall have a heat and smoke detector alarm verification feature. Upon activation of any area heat or smoke detector, system shall institute an alarm verification process prior to enabling of the alarm functions as specified herein. Activation of any initiating device other than an area smoke detector shall cause immediate enabling of system into alarm mode. If an alarm input from a smoke detector on the initial zone in alarm is present at the end of an initial delay period not exceeding 20 seconds, all alarm functions as specified herein shall be immediately enabled. If a smoke detector alarm input is not present at the end of the initial delay period, a second-stage confirmation period of one minute shall be initiated. If a smoke detector alarm input is received during the second-stage confirmation period, all alarm functions shall be immediately enabled. During the verification process, activation of any area smoke detector on any zone other than the initial zone in alarm shall also cause system to go into alarm mode immediately. If no smoke detector alarm input occurs within the second-stage confirmation period, system shall reset to normal. Any alarm input received from an area smoke detector after the second-stage confirmation period has elapsed shall cause system to institute a new verification process.

2.1.2 Primary Power

Primary power source shall be 120 volts AC service, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all initiating device, notification appliance, signaling line, trouble signal and tripping circuits. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the rated output of the system power supply module(s). Obtain AC operating power as shown on contract drawings. Provide an independent properly fused safety switch, with provisions for locking the cover and operating handle in the "POWER ON" position for this connection located adjacent to main distribution panel. Paint the switch box red and identify it by the lettered designation "FIRE ALARM SYSTEM POWER".

2.1.3 Auxiliary Power

Provide secondary DC power supply for operation of system in the event of failure of the AC source. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm. Loss of AC power shall not prevent transmission of a signal to station fire alarm headquarters upon operation of any initiating circuit.

2.1.3.1 Storage Batteries

Provide sealed lead calcium or sealed lead acid batteries and charger. Drycell batteries are not acceptable. House batteries in the control panel or in a well constructed vented steel cabinet with cylinder lock, non-corrosive base, and louvered vents. Provide batteries of adequate ampere-hour rating to operate the system, including audible trouble signal devices, and tripping circuits under supervisory conditions for 60 hours, at the end of which time batteries shall be capable of operating the entire system in a full alarm condition for not less than 15 minutes. Provide calculations substantiating the battery capacity. Provide reliable

separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts. When a separate battery cabinet is used, provide a fuse block for battery leads within the cabinet. Finish the cabinet on the inside and outside with enamel paint. Locate the top of the batteries not more than 4 feet above floor level.

2.1.3.2 Battery Charger

Provide completely automatic high/low charging rate type capable of recovery of the batteries from full discharge to full charge in 24 hours or less. Provide an ammeter to indicate rate of charge and a voltmeter to indicate the state of battery charge under load. Meters shall be factory installed, or factory-supplied plug-in modules. Field installation of meters other than the panel manufacturer's plug-in modules is prohibited. Provide a trouble light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided. House charger in the control panel or battery cabinet.

2.2 COMPONENT DESIGN

2.2.1 Fire Alarm (FACP)

2.2.2 Control Panel

Provide modular addressable type panel installed in a surface, semi-surface or flush mounted steel cabinet with hinged door and cylinder lock. Mount with panel centerline 5 feet above finished floor elevation. Switches and other controls shall not be accessible without the use of a key. The control panel shall be a neat, compact assembly containing all parts and equipment required to provide specified operating and supervisory functions of the system. Each control panel component shall be UL listed or FM approved and approved by the control panel manufacturer for use in the control panel. Panel cabinet shall be finished on the inside and outside with factory-applied enamel finish. Provide main annunciator located on the exterior of the cabinet door or visible through the cabinet door. Provide audible trouble signal. Provide permanent engraved rigid plastic or metal identification plates, or silk-screened labels attached to the rear face of the panel viewing window, for all lamps and switches. Provide one set of Form C dry alarm contacts per zone, a common system Form C dry alarm contact, and a common system Form C dry trouble contact. The set/unset condition of master box shall be indicated by the control panel. Permanently label all switches. Provide panel with the following switches:

- a. Trouble silencing switch which silences audible trouble signals (including remote trouble devices, if provided) without extinguishing trouble indicating lamp(s). For non-self-resetting type switch, upon correction of the trouble condition, audible signals will again sound until the switch is returned to its normal position. For silencing switch of the momentary action, self-resetting type, the trouble signal circuit shall be automatically restored to normal upon correction of the trouble condition.
- b. Evacuation alarm silencing switch which when activated will silence all alarm notification appliances without resetting the panel, and cause operation of system trouble signals. Subsequent alarm(s) from additional zone(s) not originally in alarm shall cause activation of the notification appliances even with the alarm silencing switch in the "silenced" position.

- c. Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of the system and zone trouble signals.
- d. Reset switch which when activated will restore the system to normal standby status after the cause of the alarm has been corrected, and all activated initiating devices reset. Operation of reset switch shall restore activated smoke detectors to normal standby status.
- e. Lamp test switch.
- f. Drill switch which will enable test of notification appliances and restoration to normal without tripping the master box.
- g. Master box disconnect switch which when activated will disconnect the coded device and cause operation of the system trouble signal.
- h. HVAC shutdown bypass switch. Operation of the switch shall allow HVAC system to operate with detectors in alarm and shall cause operation of system trouble signals.

2.2.2.1 Main Annunciator

Provide integral with the control panel. Provide separate alarm and trouble lamps for each zone (initiating circuit) as indicated below and 5 spares, located on the exterior of the cabinet door or visible through the cabinet door. Lamps shall be Light Emitting Diode (LED) type. Zone modules for spare zones shall be provided in the control panel. Supervision will not be required provided a fault in the annunciator circuits results only in loss of annunciation and will not affect the normal functional operation of the remainder of the system. Each lamp shall provide specific identification of the device by means of a permanent label. Provide engraved, silk screened, or machine-made labels. Handwritten labels are prohibited. In no case shall zone identification consist of the words "Zone 1," "Zone 2," etc., but shall consist of the description of the device.

2.2.2.2 Initiating Zones

Arrange as shown on the drawings.

2.2.2.3 Initiating and Supervisory Devices

All initiating and supervisory devices to be addressable.

2.2.2.4 Trouble Bell

Provide a remote system trouble 4 inch bell arranged to operate in conjunction with the panel's integral trouble signal. Locate remote trouble bell as indicated. Provide trouble bell with a rigid plastic, white on red engraved identification sign which reads "FIRE ALARM SYSTEM TROUBLE". Lettering on identification sign shall be a minimum one inch high.

2.2.3 Manual Pull Stations

Provide noncoded single action type with mechanical reset features.

Stations shall be surface mounted and interior or weatherproof type as indicated. For surface mounting provide station manufacturer's approved back box. Back box finish shall match station finish. Equip each station with a terminal strip with contacts of proper number and type to perform functions required. Stations shall be a type not subject to operation by jarring or vibration. Break-glass-front stations are not permitted; however, a pull-lever break-rod type is acceptable provided presence of rod is not required to reset station. Station color shall be red. Station shall provide visible indication of operation. Restoration shall require use of a key. Keys shall be identical throughout the system for all stations and control panel(s). Mount stations with operating lever not more than 4 feet above finished floor. Where weatherproof stations are required, provide stations with cast metal, weatherproof (NEMA 3R) housings with hinged access doors; finish housings with red enamel paint and provide permanently affixed engraved or raised-letter plastic or metal identification signs reading "FIRE ALARM" with white letters a minimum of 3/4 inch high.

2.2.4 Heat Detectors

Provide detectors designed for detection of fire by combination fixed temperature rate-of-rise principle. Locate detectors in accordance with their listing by UL or FM and the requirements of NFPA 72, except provide at least two detectors in all rooms of 600 square feet or larger in area. For mounting heights greater than 10 feet above floor level, reduce actual detector linear spacing from listed spacing as required by NFPA 72; for heights greater than 30 feet space detectors no farther apart than 34 percent of their listed spacing. Mount detectors at the underside of ceiling or deck above unless otherwise indicated. Temperature rating of detectors shall be in accordance with NFPA 72. No detector shall be located closer than 12 inches to any part of any lighting fixture nor closer than 24 inches to any part of an air supply or return diffuser. Detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, shall be types approved for such locations. Provide with terminal screw type connections. Removal of detector head from its base shall cause activation of system trouble signals if detectors are provided with separable heads and bases. Detector head shall be removable from its base without disconnecting any wires.

2.2.4.1 Combination Fixed Temperature Rate-Of-Rise Detectors (Spot Type)

Designed for surface or semi-flush outlet box mounting and supported independently of conduit, tubing or wiring connections based on location in room or area. Contacts shall be self-resetting after response to rate-of-rise actuation. Operation under fixed temperature actuation shall result in an external indication. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only.

2.2.5 Open-Area (Spot-Type) Smoke Detectors

Provide detectors designed for detection of abnormal smoke densities by the ionization or photoelectric principle. Detectors shall be 4-wire or 2-wire type. Provide necessary control and power modules required for operation integral with the control panel. Detectors and associated modules shall be compatible with the control panel and shall be suitable for use in a supervised circuit. Malfunction of the electrical circuits to the detector or its control or power units shall result in the operation of the system

trouble signals. Each detector shall contain a visible indicator lamp that shall flash when the detector is in the normal standby mode and shall glow continuously when the detector is activated. Remote indicator lamp shall be provided for each detector that is located above suspended ceilings, beneath raised floors, or otherwise concealed from view. Each detector shall be the plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which the detector base contains screw terminals for making all wiring connections. Detector head shall be removable from its base without disconnecting any wires. Removal of detector head from its base shall cause activation of system trouble signals. Each detector shall be screened to prevent the entrance of insects into the detection chamber(s).

2.2.5.1 4-Wire Smoke Detectors

Detector circuits shall be of the 4-wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Provide a separate, fused, power circuit for each smoke detection initiating circuit (zone). Failure of the power circuit shall be indicated as a trouble condition on the corresponding initiating circuit.

2.2.5.2 2-Wire Heat and Smoke Detectors

Detector circuits of the 2-wire type whereby the detector operating power is transmitted over the initiating circuit are permitted, provided the detectors used are approved by the control panel manufacturer for use with the control panel provided and are UL listed or FM approved as being compatible with the control panel (copies of the UL or FM listings showing compatibility shall be submitted as specified in paragraph entitled "Submittals"). The total number of detectors on any detection circuit shall not exceed 80 percent of the maximum number of detectors allowed by the control panel manufacturer for that circuit. Additional zones above those specified in the paragraph titled "Initiating Zones" shall be provided if required to meet the above requirements. Calculations showing compliance with the power consumption limitation requirements shall be submitted with the calculations required by the paragraph entitled "Design Data." The manufacturer's data submitted under the paragraph entitled "Manufacturer's Catalog Data" shall clearly indicate the compatibility of the detectors with the control panel provided and the maximum number of detectors permitted per zone.

2.2.5.3 Ionization Detectors

Multiple chamber type which is responsive to both invisible and visible particles of combustion. Detectors shall not be susceptible to operation by changes in relative humidity.

2.2.5.4 Photoelectric Detectors

Operate on the light scattering principle using a LED light source. Detector shall respond to both flaming and smoldering fires.

2.2.5.5 Detector Spacing and Location

Detector spacing and location shall be in accordance with the manufacturer's recommendations and the requirements of [NFPA 72](#), except provide at least two detectors in all rooms of [600 square feet](#) or larger in area. In no case shall spacing exceed [30 by 30 feet](#) per detector, and [30 linear feet](#) per detector along corridors. Detectors shall not be placed

closer than **5 feet** from any air discharge or return grille, nor closer than **12 inches** to any part of any lighting fixture. In areas without finished ceilings, mount detectors at the underside of deck above unless otherwise indicated. Detectors installed beneath raised floors shall be mounted with the base within **2 inches** of the underside of the raised floor, with the detector facing downward. Where the space under the raised floor is less than **12 inches** in height, detectors shall be mounted with their bases either horizontal or vertical, with the detection chamber(s) located in the upper half of the underfloor space. Under no circumstances shall detectors be mounted facing upward. Detector spacing beneath raised floors shall not exceed **15 by 15 or 20 by 20 feet** per detector. Detectors shall be installed where they can be accessed for maintenance and replacement.

2.2.6 Duct Smoke Detectors

Provide detectors installed in ducts of the ionization or photoelectric type and listed by UL or FM for duct installation. Control and power modules required for operation shall be integral with the main control panel. Detectors and associated modules shall be compatible with the main control panel and shall be suitable for use in a supervised circuit. Detector circuits can be of the 2-wire or 4-wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Malfunction of the electrical circuits to the detector or its control or power modules shall cause operation of the system trouble signals. Provide a separate, fused power circuit for each smoke detection initiating circuit (zone). Failure of the power circuit shall be indicated as a trouble condition on the corresponding initiating circuit. Provide duct detectors in accordance with **NFPA 90A**. Provide duct detectors with an approved duct housing, mounted exterior to the duct, with perforated sampling tubes extending across the width of the duct. Activation of duct detectors shall cause shutdown of the associated air handling unit, annunciation at the control panel, and tripping of the master box and sounding of building evacuation alarms. Each detector shall have a visible indicator lamp that shall flash when the detector is in the normal standby mode and shall glow continuously when the detector is activated. Provide remote indicator lamp for each detector. Permanently label remote indicator with description or number of associated air handling unit(s). Provide each detector with a remote test switch. Mount switch not more than **6 feet** above finish floor. Permanently label test switch with description or number of associated air handling unit(s).

2.2.7 Projected Beam Smoke Detector

Provide projected beam smoke detectors to protect the spaces indicated. Detectors and associated controls shall be compatible with the main control panel and shall be suitable for use in a supervised circuit. Detector circuits can be of the 2-wire or 4-wire type, whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Provide a separate, fused power circuit for each smoke detection initiating circuit. Failure of the power circuit shall be indicated as a trouble condition on the initiating circuit. Malfunction of the detector or its control unit or blockage of the projected beam shall cause operation of the system trouble signals. Install detectors in accordance with **NFPA 72**, the manufacturer's instructions, and UL listing or FM approval, with project beams parallel to ceilings. Beam length and distance between adjacent beams, and distance between beams and walls, shall not exceed the maximum permitted by the equipment listing. Do not use mirrors to alter the direction of the projected beam.

2.2.8 Notification Appliances

Provide in accordance with **NFPA 72** and as indicated. Do not exceed 80 percent of the listed rating in amperes of any notification appliance circuit. Additional circuits above those shown shall be provided if required to meet this requirement. Submit calculations showing compliance with the above power consumption requirements with the calculations required by the paragraph titled "Design Data". Effective sound levels shall comply with **NFPA 72**. Provide appliances in addition to those shown if required in order to meet **NFPA 72** sound level requirements. Provide appliances specifically listed for outdoor use in locations exposed to weather. Finish appliances in red enamel. For surface mounting provide appliance manufacturer's approved back box. Back box finish shall match appliance finish.

2.2.8.1 Alarm Bells

Surface-mounted, 10 inch diameter with matching mounting back box. Bells shall be of the vibrating type suitable for use in an electrically supervised circuit. Bells shall be of the underdome type and produce a sound output rating of at least 90 decibels at 10 feet.

2.2.8.2 Alarm Horns

Surface-mounted, single or double projector, vibrating type suitable for use in an electrically supervised circuit and shall have a sound output rating of at least 90 decibels at 10 feet.

2.2.8.3 Visible Appliances

Surface -mounted assembly of the stroboscopic type suitable for use in an electrically supervised circuit and powered from the notification appliance circuit(s). Appliances shall provide a minimum of 30 candela measured in accordance with **UL 1971**, but in no case less than the effective intensity required by **NFPA 72** for the appliance spacing and location shown. Lamps shall be protected by a thermoplastic lens and labelled "FIRE" in letters at least 1/2 inch high. Provide visible appliances within 12 inches of each audible appliance and as indicated. Visible appliances may be part of an audio-visual assembly. Where more than two appliances are located in the same room or corridor, provide synchronized operation.

2.2.9 Fire Extinguishing Systems

Activation shall cause complete functional operation of the control panel. System contacts are specified in other sections.

2.2.10 Electro-Magnetic Door Holder-Releases

BHMA A156.15. Provide where shown. The armature portion shall be mounted on the door and shall have an adjusting screw for setting the angle of the contact plate. Mount the electro-magnetic release on the wall or in a wall recess behind the door. The activation of the fire alarm system shall release all doors on the circuit to close. Total projection of the door holder-release shall not exceed 4 inches. Door holders shall not require battery backup power.

2.2.11 Valve Tamper Switches

Provide switches to monitor the open position of valves controlling water

supply to sprinkler systems. Switch contacts shall transfer from the normal position to the off-normal position during the first two revolutions of the hand wheel or when the stem of the valve has moved not more than one-fifth of the distance from its normal position. Provide switch with tamper resistant cover. Removal of the cover shall cause switch to operate into the off-normal position.

2.2.12 Conduit (Red Colored)

2.2.12.1 Rigid Steel Conduit (Zinc-Coated)

NEMA C80.1 or UL 6.

2.2.12.2 Intermediate Metal Conduit (IMC) (Red Colored)

UL 1242, zinc-coated steel only.

2.2.12.3 Electrical Metallic Tubing (EMT) (Red Colored)

NEMA C80.3 or UL 797.

2.2.13 Outlet Boxes (Red Colored)

UL 514A, zinc-coated steel.

2.2.14 Fittings for Conduit and Outlet Boxes (Red Colored)

UL 514B, zinc-coated steel.

2.2.15 Wiring

NFPA 70 and NFPA 72. Wire for 120V circuits shall be No. 12 AWG minimum solid copper conductor. Wire for low voltage DC circuits shall be No. 14 AWG minimum solid copper conductor. Insulation shall be 75 degree C minimum with nylon jacket and approved for wet locations. Color code all wiring.

2.3 SURGE SUPPRESSION

Provide line voltage and low voltage surge suppression devices to suppress all voltage transients which might damage the control panel components. Mount suppressors in separate enclosure(s) adjacent to control panel unless suppressors are specifically UL listed or FM approved for mounting inside the control panel provided and approved for such use by the control panel manufacturer.

2.3.1 Line Voltage Surge Suppressor

Suppressor shall be UL 1449 listed with a maximum 330 volt clamping level and a maximum response time of 5 nanoseconds. Suppressor shall also meet IEEE C62.41.1 and IEEE C62.41.2 category B tests for surge capacity. Suppressor shall be a multi-stage construction which includes inductors and silicon avalanche zener diodes. Suppressor shall have a long-life indicating lamp (light emitting diode or neon lamp) which extinguishes upon failure of protection components. Fuses shall be externally accessible. Wire in series with the incoming power source to the protected equipment using screw terminations.

2.3.2 Low Voltage Surge Suppressor

Provide for all circuits which leave the building shell and as shown on the contract drawings. When circuits interconnect two or more buildings, provide an arrester at the circuit entrance to each building. Suppressor shall be [UL 497B](#) listed with a maximum 30 volt clamping level and a maximum response time of 5 nanoseconds. Suppressor shall have multi-stage construction and both differential/common mode protection.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the requirements of [NFPA 70](#), [NFPA 72](#) and [NFPA 90A](#). Each conductor used for the same specific function shall be distinctively color coded. Each function color code shall remain consistent throughout the system. Use colors as directed by the Contracting Officer to match existing base color coding scheme. All wiring shall be in steel conduit or electrical metallic tubing. All circuit conductors shall be identified within each enclosure where a tap, splice or termination is made. Conductor identification shall be by plastic coated self sticking printed markers or by heat-shrink type sleeves. The markers shall be attached in a manner that will not permit accidental detachment. Control circuit terminations shall be properly identified. Wire devices so that their removal will activate system trouble signals. Pigtail or "T" tap connections are prohibited. Wiring for DC circuits shall not be permitted in the same conduit or tubing as wiring for AC circuits. Paint all junction box covers red or provide them with permanent labels reading "FIRE ALARM CIRCUIT." Electrical metallic tubing shall not be installed in exterior or wet locations and shall not be imbedded in masonry or concrete. Provide a written schedule of conductor markings identifying each wire marker, the purpose, the origin, and termination point of each conductor. The [conductor wire marker schedule](#) shall be turned over to the Contracting Officer at the time of preliminary testing with as built drawings.

3.1.1 Additional Installation Requirements

Pull all conductors splice free. Make all conductor connections under screw terminals. Provide insulated barrier type terminal strips at junction points. Use of wire nuts, crimped connectors, or twisting of conductors is prohibited. All control panels shall be dressed out in a professional manner with all wires running in the vertical or horizontal plane, cut to exact length, making all turns at 90 degree angles, and tightly bundled and wire wrapped. Conduit may not enter the top of control panel cabinet. Provide panel in the manufacturer's NEMA 4 enclosure for panels subject to water spray/runoff and/or located in damp/dirty locations or relocate to a suitable dry location at the direction of the Contracting Officer. Provide conduit seals for all raceway terminating at the control panel cabinet.

3.2 FIELD QUALITY CONTROL

3.2.1 Preliminary Testing

Notify Contracting Officer prior to performing preliminary testing. Contractor shall conduct the following tests during installation of wiring and system components. Any deficiency pertaining to these requirements shall be corrected by the Contractor prior to final acceptance testing of

the system. Record results of testing. Submit all test results to the Contracting Officer.

- a. Ground Resistance: Prior to connecting control panel, test grounds for ground resistance value. Use a portable ground testing megger to test each ground or group of grounds. Make ground resistance measurements in normally dry weather, not less than 48 hours after a rainfall. Follow the directions provided by the equipment manufacturer for proper use of the equipment. Measure resistance of each connection to ground. Resistance of each connection to ground shall not exceed 10 ohms.
- b. Operation of Entire System. Operate all initiating and indicating devices.
- c. Operation of Supervisory Systems: Operate all portions to demonstrate correctness of installation.
- d. Smoke Detector Test: Clean the smoke detectors in accordance with the manufacturer's recommended procedures. Test smoke detectors using magnet-activated test switch, manufacturer-provided test card, or smoke. Use of aerosol sprays to test smoke detectors is prohibited. When 2-wire smoke detectors are provided, prior to formal inspection and tests, perform sensitivity tests on each smoke detector. Perform voltage activation sensitivity test on each detector and record the results. Remove detectors with a sensitivity level above or below the UL accepted sensitivity range for that detector and replace with new detectors having the UL accepted sensitivity range. Present recorded data at the formal inspection for verification. Approved copies shall become part of the operation and maintenance manual for the fire alarm system.
- e. Duct Detector Differential Pressure Test: Measure and record the observed differential pressure between sampling tubes with completed HVAC system operating normally to verify airflow requirements through detector housing. Perform test on smoke detector heads as specified above for smoke detectors.

3.2.2 Final Acceptance Testing

The Contractor shall notify the Contracting Officer when the system is ready for final acceptance testing. Request scheduling for final acceptance testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Contracting Officer, and written certification to this effect has been received by the Fire Protection Engineer. The system shall be in service at least 15 calendar days prior to final acceptance testing. The Contractor shall allow at least 15 calendar days between the date final testing is requested and the date the final acceptance testing takes place. The Contractor shall furnish all appliances, equipment, instruments, devices and personnel for this test. Furnish a minimum of three two-way radios plus one additional radio for each remote annunciator, all operating on the same frequency. The system shall be tested for approval in the presence of representatives of the manufacturer, the Contracting Officer, and the Fire Protection Engineer. All necessary tests shall be made including the following, and any deficiency found shall be corrected and the system retested.

3.2.2.1 Entire System

Test the entire system by operating all fire alarm initiating, notification, and signaling devices. Perform tests with the system operating on primary power and repeat the test with the system operating on battery power only. Provide necessary equipment to test smoke detectors and heat detectors.

3.2.2.2 Supervisory Systems

All aspects of the supervisory functions of the systems shall be operated. Introduce faults in each circuit at random locations as directed by the Fire Protection Engineer. Verify proper trouble annunciation at the control panel.

3.2.3 Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Contracting Officer shall be notified when the additional work has been completed, to arrange a new inspection and test of the fire alarm system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

-- End of Section --