
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NASA-13852 (May 2004)
NASA - KSC
Superseding NASA-13852
(March 2004)

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DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13852

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05/04

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SECTION 13852

PREACTION CONTROL SYSTEMS
05/04

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers pre-action and detection equipment. Drawings should indicate the location and mounting height of manual alarm stations; automatic fire detectors; bells, speakers, strobes, including the trouble bell (when not contained in the control unit) and the control unit; boundaries and classifications of hazardous locations; system programming information for microprocessor based systems; the number of alarm-initiating, auxiliary control and notification appliance circuits reporting to or supervised by the control unit; a riser diagram of the fire-alarm system including interlocking circuits to air-handling-unit and ventilating-fans; other controllers; and interfaces with fire-protection systems and the central fire monitoring stations.

Point-to-point wiring is defined as wiring from field device with integral terminal strip to next device with integral terminal strip, wiring between modules internal to fire alarm control panels, circuit terminations on terminal strips in fire alarm control panels, and terminal boxes.

Add to Section 01000, "Scope and Description," a description of the scope of the fire alarm work particular to this project.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

The publications listed below form a part of this section to the extent referenced:

FM GLOBAL (FM)

FM 97825 (2003) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2003) Life Safety Code (National Fire Codes, Vol 5)

NFPA 70 (2002) National Electrical Code

NFPA 72 (2002) National Fire Alarm Code

NFPA 75 (2003) Protection of Electronic Computer/Data Processing Equipment

NFPA 90A (2002) Standard for the Installation of Air Conditioning Ventilating Systems

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1016-2 (2003; 8th Ed) Program Detail Manual Fire Alarm Systems

UNDERWRITERS LABORATORIES (UL)

UL 38 (1999; 7th Ed) UL Standard for Safety Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems

UL 268 (1996; Rev thru Jan 1999) Smoke Detectors for Fire Protective Signaling Systems

UL 268A (1998) Smoke Detectors for Duct Application

UL 346 (1994; 4th Ed) UL Standard for Water Flow Indicators for Fire Protective Signaling Systems

UL 464 (1999; 7th Ed) UL Standard for Safety Audible Signal Appliances

UL 497B (1999; 3rd Ed) UL Standard for Safety Protectors for Data Communications and Fire Alarm Circuits

UL 521 (1999) Heat Detectors for Fire Protective Signaling Systems

UL 1449	(1996; Rev thru Nov 2001) Transient Voltage Surge Suppressors
UL 1480	(1998; 4th Ed) UL Standard for Speakers for Fire Protective Signaling Systems
UL 1711	(1994; 3rd Ed) UL Standard for Amplifiers for Fire Protective Signaling Systems
UL 1971	(1999; 3rd Ed) UL Standard for Signaling Devices for the Hearing Impaired
UL 2196	(2001; 1st Ed) UL Standard for Tests for Fire Resistive Cables
UL FPED	(2003) Fire Protection Equipment Directory
U.S. GENERAL SERVICES ADMINISTRATION (GSA)	
FED-STD 595	(Rev B) Colors Used in Government Procurement

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330, "Submittals," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

The following shall be submitted in accordance with Section 01330 SUBMITTALS, in sufficient detail to show full compliance with the specification.

SD-01 Preconstruction Submittals

Evidence of the Contractor's State Certification shall be submitted to the Contracting Officer for approval prior to any work being started on the Preaction System.

Fully verified and dated copies of all Fire Alarm Acceptance test data and results shall be submitted with a copy of the approved test procedure and any factory test information.

Contractor will provide one (1) copy of the test procedure and recording forms for the preliminary tests. For the final acceptance tests, the Contractor will provide 10 copies of the test procedures and recording forms.

SD-02 Shop Drawings

The following shall be submitted for preaction control systems in accordance with the paragraph entitled, "General Requirements."

- Connection Drawings
- Schematics
- Module Schematic Drawings

As-Built Drawings
Revised Programs
Preaction System Acceptance Tests
Fire Service Floor Plans

SD-03 Product Data

Manufacturer's catalog data shall be submitted to the Contracting Officer for approval, prior to any work being started on the preaction system for the following items:

Preaction Control Panel
CFMS Reporting Equipment
Addressable Modules/Devices
Annunciator Panels
Heat-Actuated Detectors
Smoke Detectors
Duct Smoke Detectors
Manual Alarm Stations
Alarm Bells
Strobe Units
Speakers
Fire Resistive Cables
Water Flow Alarm Devices
Valve Tamper Switches
Remote Auxiliary Control Relays
Power Sources
Line Voltage Surge Suppressors
Low Voltage Surge Suppressors
Wiring

SD-05 Design Data

Design Analysis and Calculations

List of Parts and Components shall be submitted in accordance with the paragraph entitled, "General Requirements," of this section.

**NOTE: Coordinate these submittals with Contract
Schedule Section IV, "Inspection Testing
Requirements."**

SD-07 Certificates

Quality Assurance Plan shall be submitted consisting of the following, in accordance with the paragraph entitled, "Quality Assurance" of this section.

Contractor shall submit proof that all components are Underwriter Laboratory (UL FPED) listed or Factory Mutual FM 97825 approved for their intended use and function.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with the paragraph entitled, "Execution," of this section.

1.3 GENERAL REQUIREMENTS

NOTE: Section 16003, "General Electrical Provisions," must be included in the project specifications when this section is used.

Section 16003 GENERAL ELECTRICAL PROVISIONS, applies to work specified in this section.

Connection drawings shall be submitted for approval [30][60][90][_____] days after Notice to Proceed for installation of the Preaction and Detection System(s). Connection drawings shall consist of point-to-point wiring diagrams of internal and external wiring, but not limited to, preaction field devices, panel wiring, and interconnection between other building systems and components.

.DXF or .DWG Format computer generated connection drawings, schematics, As-Built drawings and fire service floor plans shall be submitted.

Schematics shall be submitted for approval for Preaction and Detection Control Systems consisting of the following:

Module schematic drawings (minimum size 8-1/2 by 11 inches 216 by 280 millimeter) to be provided prior to system acceptance testing.

As-Built drawings indicating all field changes shall be submitted for approval 21 days prior to the acceptance testing phase of the project, as described in the paragraph entitled, "Field Testing" of this specification section. Magnetic media and hard copies of all new and revised software and drawings shall be provided with the submittal. As-Built drawings shall document final system configuration including, but not limited to, geographic monitor zone boundaries, location of the preaction control panel, all initiating and auxiliary control devices, signaling line devices, notification appliances, additional cabinets, wet and dry pipe sprinkler risers, dry pipe control panel, smoke and fire dampers, magnetic door holders and all other equipment associated with the preaction system(s). Also, annotate the location and address setting for each multiplexed addressable device (when used), deviations from and amendments to the drawings, and field installation changes, concealed and visible.

Revised programs information (CMS file), both hard copy and disks, for existing Simplex Central Fire Monitoring System. Program information for preaction control panel including program listing, system point summary, and addressable device switch settings shall be submitted for approval 21 days prior to the acceptance testing phase of the project, as described in the paragraph entitled, "Field Testing" of this specification section.

Provide Program Logic and/or a Sequence of Operations which clearly shows the interaction of system components.

Preaction System Acceptance tests shall be conducted in accordance with the paragraph entitled, "Field Testing" of this specification section. Contractor shall prepare a test procedure and test record forms for conducting and recording complete tests on control panels, reporting systems, wiring systems, and field devices installed in accordance with the manufacturer's requirements and these specifications. Contractor shall submit for approval, the test procedure to the Contracting Officer at least

30 days prior to the preliminary system test described in the paragraph entitled, "Field Testing" of this specification section. Test procedure shall identify each device and circuit to be tested, describe the initial condition, each step or function in the test, required test result, and equipment to be employed. Test forms with suitable spaces shall be provided for recording test results on all equipment, devices, and wiring to be tested. Test record forms will also have identified spaces for verification signatures of official witnesses and dates of the test.

Fire Service Floor Plans shall indicate location of the preaction control panel, all initiating and auxiliary control devices, signaling line devices, notification appliances, additional cabinets, detection systems, wet and dry pipe sprinkler risers, dry pipe control panel smoke and fire dampers, magnetic door holders and all other equipment associated with the preaction system(s). Also, annotate the location and address setting for each multiplexed addressable device (when used). There shall be no borders or title blocks on the Fire Service Floor Plans. [Coordinate with the requirements of the Preaction System Fire Service Floor Plans such that all preaction and suppression system devices are combined on a single Fire Service Floor Plans.] Provide a symbol legend which clearly identifies each device shown on the Fire Service Floor Plans. Install a copy of the Fire Service Floor Plans minimum size 18 inches by 24 inches 0.457 by 0.61 meters in a painted metal frame with a plexiglass cover. The floor plan and it's location shall be submitted for approval to the Contracting Officer prior to installation.

Design Analysis and Calculations shall be submitted for approval for the preaction and detection Systems consisting of the battery capacity and loading calculations in accordance with the paragraph entitled, "Preaction Control Panel."

1.4 SYSTEM REQUIREMENTS

Preaction system shall be a fully addressable, modular type, microprocessor based, supervised, non-coded electrical fire alarm system with NFPA 72 Style D initiating device circuits, NFPA 72 Style Z notification appliance circuits, and NFPA 72 Style 7 signaling line circuits. All styles of Class A initiating device, signaling line, notification appliance and control circuits shall use diverse routing in accordance with NFPA 72. The outgoing and return redundant circuit conductors shall not be run in the same cable assembly, enclosure or raceway. System shall be electrically connected to report alarms, silent alarms, troubles, and supervisory signals to the Central Fire Monitoring System; sound the general alarm continuously; and control auxiliary equipment such as smoke fire dampers, air handling units, magnetic door latches, etc., upon operation of one or more initiating devices. Initiating, notification, signal, and auxiliary control circuits shall be 24 Vdc.

System shall conform to all the applicable requirements of NFPA 70, NFPA 72, NFPA 75, NFPA 90A, and NFPA 101.

Preaction systems shall contain all of the equipment, devices, programming and circuits required for system operation in accordance with NFPA Codes and KSC requirements, including remote reporting from existing Central Fire Monitoring System (CFMS) equipment.

Contractor shall provide all additional equipment, cabinets, conduit, and labor to meet the requirements and intent of this specification.

Contract shall provide a list of parts and components for the installed system by manufacturer's name, part number, and nomenclature, and recommended stock level required for normal maintenance and unscheduled repairs.

Components installed under this contract can not be more than one (1) year older than the date of installation.

1.5 QUALITY ASSURANCE

Equipment to be provided under this specification shall be that manufactured preaction equipment which meets the requirements of the section entitled, "System Requirements." It shall be the latest standard design, and shall be listed by Underwriters' Laboratories UL FPED or approved by Factory Mutual and be suitable for it's intended service. All devices installed will function with the control panel and not interfere with the operation of the control panel.

1.6 SERVICES OF A CERTIFIED FIRE ALARM SPECIALIST

Services of a Certified Specialist thoroughly experienced in fire detection and alarm work shall be provided on site to perform or directly supervise the installation, make all necessary adjustments and perform all tests on the preaction system at the site.

Preaction specialist shall be considered certified when the specialist holds a valid Fire Alarm System, Level III Certification from the National Institute for Certification in Engineering Technologies NICET 1016-2 or a valid Level III Fire Alarm Engineering Technician Certification from the International Municipal Signal Association (IMSA), or is licensed by the State of Florida as a Fire Alarm Contractor I in accordance with Florida State Statute, Chapter 489, Part II.

Certification of other recognized agencies with equivalent requirements will be considered. Evidence of the Contractor's State Certification and the basis of certification shall be provided to the Contracting Officer and be approved by the Contracting Officer, prior to any work being performed at Kennedy Space Center.

PART 2 PRODUCTS

2.1 PREACTION CONTROL PANEL

Preaction control panel (PCP) shall contain power-on, alarm, supervisory, and trouble indicating lights plainly visible when the cabinet is closed. It shall also contain the following functions shall be accessible only by unlocking and opening the unit:

- Alarm Silence
- Trouble Silence\
- Supervisory Silence
- Power On-Off (If standard by the manufacturer)
- Alarm/Trouble Acknowledge
- Auxiliary Devices (AHU shutdown relay) Maintenance By-pass Switches
- System Reset

Preaction control panel shall contain all components necessary to monitor and supervise all initiating device circuits. When any detector, manual

alarm station (pull box), water flow switch, pressure switch, etc., connected to the preaction control panel is activated, the control panels visual alarm indication and audible signal shall be activated. This shall cause all notification appliances to be activated, including all associated auxiliary control functions. The control panel shall visually indicate the addressable device or zone in alarm and transmit an alarm condition to the remote Central Fire Monitoring System. Audible and visual notification appliance circuits shall be separated. Audible and visual notification appliance circuits shall have sufficient capacity to operate all devices connected, plus 25 percent minimum spare capacity. Visual notification appliances shall remain operational until the PCP has been reset.

Preaction control panel shall contain all components necessary to monitor and supervise all supervisory device circuits. When any valve tamper switch, pressure switch, or other supervisory device connected to the control panel is activated, the control panel supervisory visual indication and supervisory audible device shall be activated. The control panel shall visually indicate the addressable device or zone in supervisory alarm and transmit a supervisory condition to the remote Central Fire Monitoring System.

Preaction control panel shall contain all components necessary to operate and supervise the circuits for annunciator panels indicated and auxiliary devices controlling equipment such as ventilating fans, air handling units, fan coil units, damper motors, solenoids, magnetic door holders, etc. Circuits for auxiliary control relays shall be supervised to within 3 feet 914 millimeter of the device to be controlled in accordance with NFPA 101. Preaction control panel shall include a maintenance by-pass switch for all auxiliary control devices. By-pass switches shall be supervised to report trouble when in the maintenance by-pass position.

Panel shall monitor and report as trouble, open supervised circuits, ground faulted supervised circuits, removal of detector or device, removal or failure of control panel module, maintenance by-pass switch activated, loss of primary power, power supply trouble, low battery voltage, loss of battery voltage, [preaction control panel enclosure open], and activation of the alarm silence switch. All trouble signals shall be identifies by initiating, notification appliance, auxiliary control, or signaling line device. Trouble signals shall activate the control panel trouble visual indication and trouble audible devices, and send a trouble signal to the remote Central Fire Monitoring System.

Alarm/trouble reset switches shall reset a cleared device in alarm or trouble. Alarm or trouble signals shall not be self-restoring without activating the switch.

Alarm, supervisory, and trouble silence switches shall silence the alarm and trouble audible's. Either switch placed in other than the normal position shall provide the following:

- a. Report as an alarm, supervisory, or a trouble to the Central Fire Monitoring System.
- b. Transfer audible signal to a panel lamp visual indication.
- c. Re-ring the trouble audible if the problem has been cleared, but the switch has been left in the silence position.

When the alarm silencing switches are in th silence position, subsequent

alarms shall reactivate the notification appliances. The strobes shall remain operational until the preaction control panel is reset.

Preaction control panel shall be suitable for use with the detectors and manual alarm stations, and other preaction devices specified in this section.

Preaction control panel shall have a normally closed set of dry contacts single pole, double throw (SPDT) which opens for trouble conditions and a normally open set of dry contacts single pole, double throw (SPDT), which closes under alarm conditions for connection to the Central Fire Monitoring System.

All relays shall be continuous duty and have self-cleaning contacts of silver or an alloy of equivalent performance. Supervisory relays shall be suitably protected against dust by individual covers. All relays that provide external functions, such as remote reporting, control device activation, notification appliance activation shall have at least one set of spare contacts. Relays shall be permanently marked with the coil resistance, operating-current range, and internal pin connections using standard pin numbers.

[A separate terminal cabinet shall be installed adjacent to the preaction control panel for interfacing device field wiring to the control panel. Terminal strips shall be installed for all field wiring circuits plus 25 percent spare. Where a terminal cabinet is installed, terminal strips shall be installed to accommodate remote reporting circuits.]

Preaction control panel, terminal cabinets and battery cabinets (when used) shall be steel, provided with a hinged cover and an integral pin-tumbler cylinder lock (Lock Cylinder No. Best Universal Lock Co. No. A8817-XUS26D-7KSC) with removable core that will accept the key presently in use with other control units existing in the area; lock core will be provided by the government. Cabinets shall be painted with a prime coat and one or more finish coats of scratch-resistant baked enamel. Finish coat shall be red unless otherwise indicated. An etched metal or engraved laminated plastic identification plate labeled, "preaction Control Cabinet," shall be permanently affixed to the cabinet door of the preaction control unit to identify the cabinet as a preaction control system cabinet. For cabinets painted red the identification plate shall have white letters on a black background. For cabinets not painted red the identification plate shall have white letters on a red background.

System shall operate from a power supply with 120 grounded Vac input and 24 Vdc output. System shall operate satisfactorily with power input voltage varying from 85 to 110 percent of nominal value. Power supply output shall be capable of powering all initiation, signaling, annunciation, and control devices during alarm condition with 25 percent minimum spare capacity. [If supplied within the cabinet, the power on-off switch shall disconnect all power sources to the control panel. The on-off switch shall have DC rated contacts.]

Batteries, charger, and power transfer equipment shall provide the means of automatically supplying the entire preaction system with battery backup power in event of a primary power system failure. System shall switch to battery power in event of AC power failure and switch back to AC power upon return of primary power. Control panel shall be able to operate when the backup batteries are disconnected for any reason. System shall control charging currents and floating voltage levels to maintain batteries in

optimum condition. Capability to recharge batteries in event of discharge shall be provided. Wiring shall be fused to protect against battery over-current and polarity reversal. Primary power, battery, or charging equipment failure shall result in a preaction control panel trouble signal and visual indication.

Battery modules shall be sealed (no corrosive fumes) and spill-proof. Batteries shall be listed for preaction service and shall be suitable for high discharge currents required under alarm conditions. Batteries shall be sized to operate the preaction and detection system (including voice evacuation systems and UV/IR flame detectors) in normal supervisory condition for 24 [48][72] hours, minimum, then operate the system in the alarm mode for [5] 10 [15] minutes, minimum.

NOTE: Edit the following paragraph for a pre-action control panel to be used in facilities which do not require voice evacuation systems. Fill in the blanks for the number of zones to fulfill the job requirements and the maximum number of zones anticipated.

2.1.1 Small Capacity PCP

NOTE: Edit the following paragraph for a pre-action control panel to be used in small facilities or suppression systems with 6 zones or less, and 2 CFMS reporting zone. Each automatic sprinkler system flow switch shall report as a separate device. Fill in the blanks for the number of zones to fulfill the job requirements and the maximum number of zones anticipated.

Unit shall be comprised of [_____] active zones, expandable to 6 zones via plug-in modules. It shall have the required number of active zones to perform as indicated and specified herein. Auxiliary function/control devices shall be added as required. Panel shall include all equipment required for connection to the existing Central Fire Monitoring System.

2.1.2 Medium Capacity PCP (Without Voice)

NOTE: Edit the following for a pre-action control panel to be used in facilities which do not required voice evacuation systems. Fill in the blanks for the number of zones to fulfill the job requirements and the maximum number of zones anticipated.

Unit shall be a fully addressable system, comprised of [_____] addressable devices, [2] [_____] notification appliance circuits, and [4] [_____] supervised circuits for auxiliary control relays. Unit shall be expandable to 8 [_____] notification appliance circuits. Construction shall be modular, solid-state microprocessor based electronics. All modules shall be equipped with transient suppression. System shall include non-volatile programmable operating system memory for all operating requirements. Panel

shall include all equipment required for connection to the existing Central Fire Monitoring System.

Preaction control panel shall include all components and modules required for installation of a multiple addressable device network. Network shall utilize polling methods and provide two-way Style 6 supervised communications between the preaction control panel and addressable smoke detectors and monitor, signal, or control addressable modules.

2.1.1.3 Large Capacity Pre-Action Control Panel (With Voice)

NOTE: Select and edit the following paragraphs for a pre-action control panel to be used in a large size facility or facility requiring addressable device, voice evacuation, or fire fighters telephone.

Unit shall be fully addressable system with [_____] addressable points to include addressable monitoring modules, voice evacuation system, fire fighters phone system, addressable input/output relays and supervised circuits to remote auxiliary control relays. Construction shall be modular with solid-state, microprocessor based electronics. Modules shall be equipped with transient suppression. System shall include non-volatile programmable operating system memory for all operating requirements. Panel shall include all equipment required for connection to the existing Central Fire Monitoring System.

Unit shall include all components and modules required for a local facility maintenance and fire fighters phone system. A master telephone set shall be installed at the control panel with remote phone jacks installed in the facility, as indicated on the contract drawings.

Preaction control panels voice evacuation system shall include all components and modules required for a [single] [multiple] channel audio signaling system distributed over [8] [_____] audio signaling device circuits. Audio system shall be capable of accurately reproducing bell tones and pre-programmed voice messages for [staged] building evacuation. Audio amplifier input shall include a dedicated power supply with a primary power input of 120 V(AC) and a battery backup input of 24 V(DC). Audio amplifier output shall be a minimum of 100 watts at 25 V(RMS), with a minimum 25 percent spare capacity provided. A microphone and 4 inch speaker shall be located at the control panel for fire fighter paging and monitoring. Audio system control shall include switching with visual indication for localized facility-wide paging announcements. Messages shall be multi-lingual voice in five (5) languages, followed by temporal three (3) bell tone until silenced. The languages in priority are English, Spanish, French, Japanese, and Russian. The languages shall be approved by the Contracting Officer.

Unit shall include all components and modules required for installation of a multiple addressable device network. Network shall utilize polling methods and provide two-way Style 6 supervised communications between the preaction control panel and addressable smoke detectors and monitor, signal, or control addressable modules.

2.2 CFMS REPORTING EQUIPMENT

2.2.1 Small/Medium Capacity PCP Reporting

NOTE: Edit this paragraph as required for systems of 6 reporting zones or less, without Simplex Model 2120 compatible communications equipment.

A Simplex Model 4100 system is installed at the VABR and CD&SC for monitoring of small systems in the LC-39 or Industrial Area respectively.

Preaction control panel shall report to the Central Fire Monitoring System using the existing Simplex Model 4100 system, located at the [VABR][LCC1P11][CD&SC]. Reporting circuit shall be 2-wire, Style B circuit from the indicated Simplex Model 4100 system zone module to the preaction control panel alarm relay and trouble relay, via base outside cable plant. A 3.3K ohm, 0.5 watt End-of-Line resistor is required at the PCP.

[Preaction control panel shall report to the Central Fire Monitoring System using the existing Digitize Model 3000 system located in Building XY which is connected to the Remote Monitor Terminals located in Building 49750 (Alternate Central Security Building) and the redundant unit located in Building 1708 (Hangar R&D).]

[Reporting circuit shall be a 2 wire, Style 6 circuit from Building XY to preaction control panel alarm relay and trouble relay via base outside cable plant. A 15 K ohm, End-of-Line resistor is required at the PCP.]

2.2.2 Large Capacity PCP Reporting

NOTE: Edit these paragraphs as required for systems installed with Simplex or Siemens network communications interface equipment.

Provide network communication interface which shall permit individual remote reporting of monitor devices and remote control of the preaction control panel from the Central Fire Monitoring System.

2.2.3 Color Graphic Screens for CFMS Reporting System

Update programs for new or modified fire alarm control systems color graphic screens shall be provided and installed in the existing Central Fire Monitoring System [Siemens] [Simplex] multiplexing system by original equipment manufacturer. All modifications and programming changes shall be approved by the Contracting Officer, prior to installation.

2.3 ADDRESSABLE MODULES/DEVICES

NOTE: Select and edit paragraphs as necessary for the multiplex system designs only.

Addressable modules shall be solid state compatible with the preaction

control panel. Modules shall be suitable for individual outlet box mounting or group mounting within a control enclosure. Modules installed outdoors shall be installed in weatherproof enclosures with a neoprene gasket and shall be protected from corrosion.

Modules shall be field addressable to individually communicate with the preaction control panel using multiplexed communication techniques. Communication circuit wiring connections shall be suitable for supervised Style 6 operation. Module power shall be derived from the communication circuit or 24 V(DC) power supply supervised by the preaction control panel. Invalid address setting, component failure, or power failure shall initiate a trouble signal at the preaction control panel.

Enclosures shall be painted with a prime coat and one or more finish coats of red enamel to provide a smooth, hard, and durable finish. Enclosures shall include an engraved phenolic nameplate labeled, "PREACTION MODULES."

Addressable modules for initiation circuits shall be supervised 4-wire Style D type unless otherwise indicated. Addressable modules for notification appliance circuits shall be supervised parallel wired Style Z type unless otherwise indicated. Module shall be suitable for use with bells, strobes, and relays. Addressable modules for control circuits shall include 2 separate fused Form-C contacts rated 2 Amperes at 28 V(DC) at 120 Vac.

2.4 ANNUNCIATOR PANELS

Annunciator panels shall be [LED] [Front lighted] [Back lighted] [LCD Alphanumeric] type, compatible with and supervised from the preaction control panel. Operating power supply shall be 24 V(DC). Lamp color shall be yellow for trouble and red for alarm; a test switch for testing all lamps shall be provided. Each lamp shall have a nameplate with function identified for all lamps. Nameplate shall be engraved phenolic tag.

[Annunciator panel shall include an audible trouble/alarm buzzer with keyed silence switch.]

LED type graphic annunciator panels shall be provided where indicated. Annunciator shall include laminated area display to indicate location and condition (trouble and alarm) of devices connected.

Terminal strips suitable for No. 18 through No. 14 AWG solid copper conductors shall be provided for all annunciator panel wiring connections.

Annunciator panels shall be mounted in manufacturer required enclosures. Where hinged enclosures are used, a lock-set matching that of the preaction control panel shall be provided. All exposed metal parts of annunciator panels shall be painted with a prime coat and one or more finish coats of scratch-resistant baked enamel. Finish coat shall be red unless otherwise indicated.

2.5 HEAT-ACTUATED DETECTORS

Heat-actuated detectors shall be alarm-initiating devices designed for use with automatic/manual preaction systems, in accordance with UL 521.

Heat-actuated detectors shall be rated [136][190] degrees F fixed temperature with 15 degree F per minute rate-of-rise feature. Detectors shall be self-restorable for the rate-of-rise feature and non-restorable

for the fixed temperature feature. Detectors shall have a rate-of-rise principle of operation, which uses an air chamber, a vent and a flexible metal diaphragm. The fixed temperature principle of operation shall be by a fusible solder joint.

Detectors shall have a set of normally open contacts that close to initiate an alarm. Wiring connections shall be suitable for supervised Style D operation, and shall be made with terminal blocks capable of accepting No. 18 through No. 14 AWG solid copper conductors. All components of the detectors shall be rust and corrosion resistant.

Detectors shall be located no closer than 12 inches 300 millimeter from any part of the lighting fixture and no closer than 24 inches 600 millimeter from any supply or return diffuser. Detectors installed in areas subject to moisture or exterior atmospheric conditions shall be UL listed or FM approved for such locations.

Electronic heat detectors shall be located no closer than 6 feet 1829 millimeter from a fluorescent light fixture. Detectors shall be located no closer than 3 feet 914 millimeter from any return air diffuser and no closer than 6 feet 1829 millimeter from any supply diffuser. Detectors installed in areas subject to moisture or exterior atmospheric conditions shall be UL listed or FM approved for such locations.

2.5.1 Line-Type Fixed Temperature Heat Detector

Provide [thermostatic] or [thermistor] line-type heat detection cable [with weather-resistant outer covering] where indicated. Cable shall be nominally rated for a temperature of [155 degrees F 68 degrees C] [190 degrees F 88 degrees C] [280 degrees F 138 degrees C] and shall operate on fixed temperature principle only.

2.5.2 Rate Compensating Heat Detector

Detectors shall be hermetically sealed and automatically resetting type which will operate when ambient air temperature reaches detector setting, regardless of rate of temperature rise. Detector operation shall not be subject to thermal lag.

2.6 SMOKE DETECTORS

Smoke detectors shall be alarm-initiating devices designed for use with automatic/manual preaction systems, in accordance with UL 268.

Smoke detectors shall be [2.5] [_____] percent per foot nominal obscuration (photo-electric) type. Detector shall be listed for use with preaction control panel installed, and shall include all required accessories. Detectors and accessories provided shall be rust and corrosion resistant. Detector head shall be a plug-in unit. Unit shall contain no moving parts, nor shall it require re-adjustment or removal to resume normal operation after an alarm. All detector openings shall be screened to prevent the entry of insects and debris.

Detector base shall include screw terminals suitable for No. 18 through No. 14 AWG solid copper conductors for all wiring connections required. Detector shall be supervised to initiate a trouble signal at the preaction control panel if the detector is removed. A light emitting diode indicator shall provide a visual indication when the detector initiates an alarm.

Detectors shall be located no closer than 6 feet 1829 millimeter from a florescent light fixture. Detectors shall be located no closer than 3 feet 914 millimeter from any return air diffuser and no closer than 6 feet 1829 millimeter from any supply diffuser. Detectors installed in areas subject to moisture or exterior atmospheric conditions shall be UL listed or FM approved for such locations.

Remote annunciator shall be provided in locations readily visible and accessible for detectors installed under raised floors or other locations where the detector is concealed or not readily visible; or the detector shall be of the addressable type. Annunciator panels shall be in accordance with the paragraph entitled, "Annunciator Panels". Remote test/light assemblies shall be installed for installations that are not readily accessible. Where multiple duct smoke detectors are installed, group the remote test switches together at a common location.

**NOTE: Use the following paragraph where addressable
smoke detectors are to be used in lieu of Remote
Annunciator Panels.**

Addressable detector bases shall be provided where indicated, or used in lieu of remote annunciator panels. Base shall include circuitry and user selectable switching required for assigning each detector a unique address on the preaction control panel communication bus. Invalid address switch settings or component failure shall initiate a trouble signal at the preaction control panel.

Detectors shall be the 2-wire Style D type, powered from the panel alarm initiation or communication bus circuit; separate power sources are not acceptable.

2.6.1 Duct Smoke Detectors

Duct smoke detectors shall be alarm-initiating devices designed for use with automatic/manual preaction systems, in accordance with UL 268A.

Duct smoke detectors shall be photoelectric type listed by UL FPED or FM approval guide for duct smoke detector installation. Duct detectors shall be provided with perforated sampling tubes extending across the width of the duct. Activation of duct smoke detectors shall cause shutdown of the associated air handling unit, annunciation at the preaction control panel, and transmit a silent alarm to the Central Fire Monitoring Station, but shall not activate the building evacuation notification appliances. Duct smoke detectors shall be addressable type connected to an addressable PCP, with ability to perform sensitivity testing in accordance with NFPA 72. Provide a single maintenance by-pass switch to isolate each air handling units' duct smoke detectors. Activation of any maintenance by-pass switch shall inhibit reporting and cause a trouble condition at the PCP. When the maintenance by-pass switch is restored to it's normal configuration, the trouble signal at the PCP shall be self-restoring. Where duct smoke detectors are installed outdoors or in high ambient temperature areas, the detector housing shall be installed in an additional PVC enclosure with an additional set of supply and exhaust sampling tubes, to prevent condensation from forming within the detector housing.

A separate remote test/light assembly shall be installed for each duct smoke detector. Where multiple duct smoke detectors are installed, group

the remote test switches together at a common location.

2.7 MANUAL ALARM STATIONS

Manual alarm stations shall be non-coded, addressable type, alarm-initiating devices designed for use with automatic/manual preaction systems, in accordance with UL 38.

Wiring terminals shall be suitable for 2-wire, Style D wiring and shall be capable of accepting No. 18 through No. 14 AWG solid copper conductors.

Manual alarm station door shall have a protected, pulldown operating lever with finger grip which does not project out from the front of the case. When operated, the station shall mechanically latch, break a glass or plastic rod, close one or more sets of contacts, and lock the contacts in the operated position until reset. Stations with a pushbutton which depends upon a spring-loaded device to close the contacts when the handle is pulled are not acceptable. Stations shall not be resettable without the use of a key or tool.

All exposed metal surfaces of enclosing cases shall be painted with a prime coat and one or more finish coats of red enamel to produce a smooth, hard, durable finish. Identification and directions for operating preaction stations shall be provided on the cover in raised or depressed white-enameled letters. Manual alarm stations constructed of plastics or composite material are not acceptable.

Surface mounted stations shall be furnished with matching cast-iron or cast-aluminum back boxes with top and bottom threaded-conduit connections. Stations mounted outdoors shall be weatherproof with a neoprene gasket, and shall be protected against corrosion.

2.8 ALARM BELLS

Preaction bells shall be red, 10 inches 250 millimeter vibrating, under-dome, notification appliances in accordance with UL 464. Bell shall produce at least 87 dB at 10 feet 3000 millimeter and shall conform to NFPA 70.

Alarm bells shall be solenoid-operated plunger sounding devices. Operating mechanism shall be rustproof, protected from dust and insects, and located behind the gong shell.

Alarm bells shall operate from polarized 24 Vdc preaction control panel Style Z parallel wired supervised notification appliance circuits. Wiring connection shall be on terminal blocks suitable for No. 16 through No. 12 AWG 1.25 through 2 millimeter diameter (No. 16 through No. 12 AWG) solid copper conductors.

Strobe portion of combination audible/visual notification appliances shall be in accordance with the applicable provisions of the paragraph entitled, "Strobe Units."

Surface-mounted alarm bells installed in unfinished areas with conduit exposed shall be secured to surface-mounted back boxes. Back boxes shall be cast iron or cast aluminum, with threaded conduit connections. All exposed metal surfaces shall be painted with a prime coat and one or more finish coats of red enamel to provide a smooth, hard, durable finish.

2.9 STROBE UNITS

Strobe units shall be notification appliances designed for use with automatic/manual fire alarm systems, in accordance with UL 1971.

Strobe units shall meet the requirements of the Americans with Disabilities Act (ADA) and shall be constructed of red cast metal housing, clear polycarbonate dome lens with red "FIRE" lettering on two sides, and a xenon flash tube with solid state circuitry. Unit brightness shall be no less than 75 candela, producing approximately 80 to 90 flashes per minute. Unit shall be UL listed or FM approved for fire protective service.

Unit shall operate from polarized 24 Vdc preaction control panel Style Z parallel wired supervised notification appliance circuits. Multiple strobes visible from a single area shall be synchronized. Operating current shall not exceed 0.2 amperes, and unit shall operate over a 20 percent variation in nominal input voltage. Wiring connection terminal blocks shall be suitable for No. 16 through No. 12 AWG 1.25 through 2 millimeter diameter solid copper conductors.

Flush mounted interior units shall be installed using standard electrical backboxes. Surface mounted units shall be installed in cast iron or cast aluminum boxes with threaded conduit hubs.

All metal exposed surfaces shall be painted with a prime coat and one or more finish coats of red enamel to provide a smooth, hard durable finish.

2.10 SPEAKERS

Speakers shall be notification appliances designed for use with auto/manual preaction systems, in accordance with UL 1480 and UL 1711.

Notification appliance speakers shall be UL listed or FM approved for audible signal use, and shall be capable of clearly reproducing voice messages and bell tones over a 400 to 4000 Hz range. Speaker output at 1000 Hz for 1 Watt input power shall be no less than 87 dB at 10 feet 3000 millimeter.

Notification appliance shall consist of sealed speaker and multiple-tap impedance matching transformer suitable for 25 Vdc Style Z parallel wired supervised audio signaling systems. Transformer settings shall include 0.25, 0.5, 1.0, and 2.0 Watt taps unless otherwise indicated. Wiring connections for 4 wire operation shall be screw terminals suitable for No. 16 through No. 12 AWG 1.25 through 2 millimeter diameter conductors.

Speakers housings shall be of red impact resistant polycarbonate or cast metal construction. Flush mounted interior speakers shall be mounted using standard electrical backboxes. Surface mounted speakers shall be mounted using red cast iron or cast aluminum boxes with threaded conduit hubs. Speakers mounted in exterior or wet locations shall be weather-proof with a neoprene gasket and shall be protected from corrosion. All metal exposed surfaces shall be painted with a prime coat and one or more finish coats of red enamel paint to provide a smooth, hard, durable finish.

Strobe portion of combination audible/visual notification appliances shall be in accordance with the applicable provisions of the paragraph entitled, "Strobe Units."

2.11 WATER FLOW ALARM DEVICES

Water flow alarm devices shall be alarm initiating devices designed for use with automatic/manual preaction systems, in accordance with UL 346.

Water flow alarm devices shall conform to UL or FM requirements for the particular type of sprinkler system. Contacts shall have a minimum of 2 single pole, double throw contacts rated 5 amps at 28 V(DC) or 250 V(AC).

2.11.1 Pressure Switch

Pressure switch alarm shall be wired to make or break an alarm circuit depending on rise or fall of water pressure. Switch shall have an instant-recycle pneumatic-retard, or electronic adjustable setting time delay.

2.12 VALVE TAMPER SWITCHES

Valve tamper switches shall be supervisory-initiating devices designed for use with automatic/manual preaction systems, in accordance with UL 346.

Valve tamper switches shall conform to UL or FM requirements for use on the specified valve. Contacts shall have a minimum of 2 single pole, double throw contacts rated 5 amps at 28 Vdc or 250 Vac.

Valve tamper switches installed in hazardous locations shall be UL listed or FM approved for the hazardous location classification indicated. If the beacon is not factory sealed, conduit seal-off fittings suitable for the hazardous location shall be installed at each conduit connection to the explosion-proof enclosure, in accordance with NFPA 70.

2.13 REMOTE AUXILIARY CONTROL RELAYS

Remote control relays shall have continuous duty coils rated 24 Vdc. Where relays are used on Style Z parallel wired supervised circuits, coils shall incorporate supervisory current blocking diode. Relays shall have a minimum of two (2) single pole, double throw contacts rated 10 amps at 28 Vdc or 250 Vac. Where auxiliary control circuits connected to the relay are protected at a higher ampacity than the relay contacts are rated, fusing rated to protect the relay contacts shall be installed in the relay enclosure.

Remote auxiliary control relays shall be mounted in enclosures indicated or, if not indicated, in manufacturer's required enclosure. Relays installed outdoors shall be installed in a weatherproof enclosure with a neoprene gasket and shall be protected against corrosion.

Enclosure shall be painted with a prime coat and one or more finish coats of red enamel to provide a smooth, hard, and durable finish. Enclosure shall be labeled with an engraved phenolic nameplate labeled, "F/A RELAY."

Remote auxiliary control relays must be mounted and supervised within 3 feet 914 millimeter of the controlled device in accordance with NFPA 101.

2.14 POWER SOURCES

Normal power to the local systems for all purposes, including separate powered indicating/alarm devices, shall be 120 volts 60 hertz. System shall operate satisfactorily between 85 and 110 percent of normal voltage.

Preaction system disconnect/protective device shall be a fused switch with a red factory finish as specified herein for manual alarm stations. This disconnect switch shall be mounted adjacent to the fire alarm control panel. In addition, it shall be marked PREACTION CONTROL PANEL DISCONNECT with 1/2-inch 12 millimeter high letters in white paint or engraved phenolic identification plates fastened with sheetmetal screws. Switch shall be capable of being locked in the "on" or "off" position. This feature shall not interfere with the circuit protection capability of the device. Switch shall be equipped with surge suppression for all phase and neutral conductors. Current limiting Class RK1 fuses properly sized to protect the preaction control panel components shall be installed.

2.15 WIRING

Provide wiring in accordance with NFPA 70 and NFPA 72. Conductors shall be copper. Conductors for 120 V(AC) circuits shall be No. 12 AWG minimum.

Conductors installed on fire alarm systems shall be solid copper with an insulation rating of not less than 300 volts. Conductors shall be marked with the size, voltage rating and manufacturer's name permanently marked on the conductor jacket at no less than 2 feet 610 millimeter intervals. Conductor size and color are listed below. Where modifications are made to existing systems, the new or added conductors shall match the size and color-coding of the existing system.

Conductors for multiplexed communication circuits, signaling line circuits, speaker audio circuits, remote phone circuits, and remote reporting circuits shall be solid copper, shielded, twisted pairs meeting UL 2196. Cable shall be listed as Type FPL, Power-Limited Fire Protective Signaling Cable. Conductor size shall be not less than No. 16 AWG diameter. Conductor insulation shall be Type TFN for No. 16 AWG diameter and Type THHN/THWN for No. 14 AWG diameter and larger.

Direct current initiating device (manual pull station) circuits shall be a two loop circuit per NFPA 72, Style D. Conductor size shall be not less than No. 16 AWG diameter. Conductor insulation shall be Type TFN for No. 16 AWG diameter, and Type THHN/THWN for No. 14 AWG diameter and larger.

Power leads from the control panel for product-of-combustion detectors shall be sized accordingly, but not less than No. 14 AWG diameter. Conductor insulation shall be Type THHN/THWN for No. 14 AWG diameter and larger.

Direct current notification appliance circuits (strobes, bells) shall be parallel wired per NFPA 72, Style Z. Conductor size shall be not less than No. 14 AWG diameter. Conductor insulation shall be Type THHN/THWN for No. 14 AWG diameter and larger.

Direct current auxiliary control device (AHU shut down relay) circuits shall be parallel wired per NFPA 72, Style Z. Conductor size shall be not less than No. 14 AWG diameter. Conductor insulation shall be Type THHN/THWN for No. 14 AWG diameter and larger.

Preaction solenoid valve control circuits shall be NFPA 72, Style Y. Conductor size shall be not less than No. 14 AWG 1.6 millimeter diameter. Conductor insulation shall be Type THHN/THWN for No. 14 AWG 1.6 millimeter diameter and larger.

2.15.1 Fire Resistive Cables

Fire resistive cables shall be for notification appliance circuits designed for use with automatic/manual fire alarm systems in accordance with UL 2196.

Provide UL FPED listed Type FPL-CI fire alarm cable for use with power limited fire alarm notification appliance circuits. The CI cable shall have a minimum 2 hour fire resistance rating by having passed the applicable testing requirements of UL 2196. This cable shall be installed in locations required to meet NFPA 72 survivability requirements.

2.16 SURGE SUPPRESSION

Provide line voltage and low voltage surge suppression devices to suppress all voltage transients which might damage the control panel components.

Surge suppression in accordance with UL 497B shall be installed on each conductor of preaction circuits which extend beyond a building. Protection shall be located as close as practical to the point where the circuits leave the building. Protectors shall be installed in enclosures of adequate size, with terminal strips for all wiring connections plus 25 percent spare. Enclosures shall be painted with a prime coat and one or more coats of red baked enamel finish to provide a smooth, hard, and durable finish. Protectors shall be connected to an earth ground electrode system, in accordance with the manufacturer's requirements and NFPA 70.

2.16.1 Line Voltage Surge Suppressors

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, 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.

2.16.2 Low Voltage Surge Suppressors

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 SYSTEM SEQUENCE OF OPERATION

3.1.1 Normal Operation

All switches shall be in the normal position. Available power lamp shall be on and the trouble and detector identification lamps shall be off. All circuits shall be electrically supervised.

3.1.2 Supervisory Condition

System conditions identified in the paragraph entitled, "Fire Alarm Control

Panel" shall transmit a supervisory signal to the Central Fire Monitoring System, provide device indication, activate a supervisory signal in the fire alarm control panel, and provide input to remote annunciators (when used). Supervisory signal in the alarm control unit shall be comprised of visual and audible indications. The supervisory signals shall be self-restoring.

3.1.3 Trouble Condition

System conditions identified in the paragraph entitled, "preaction Control Panel," shall transmit a supervisory signal to the remote reporting device of the Central Fire Monitoring System, provide zone indication, activate a trouble signal in the preaction control panel, and provide input to remote annunciators (when used). Trouble signal in the alarm-control unit shall be comprised of visual and audible indications.

3.1.4 Alarm Condition

Activation of any detectors, manual alarm stations, water flow switches, or other initiating devices shall close a contact that activates the appropriate preaction control panel. Preaction control panel transmits a signal to the remote reporting device of the Central Fire Monitor System; activates the notification appliances; provides zone identification; controls air handling and ventilating units; provides an input to remote annunciators (when used); and provides indication or control to devices or other systems.

3.2 INSTALLATION

3.2.1 Preaction Control Panel(s) and Reporting Equipment

Equipment shall be installed in each protected building, located where indicated, and shall be complete with all indicated accessories and devices. Equipment shall be installed in accessible locations in such a manner as to prevent damage from vibration or jarring. Equipment requires a minimum of 3 feet 914 millimeter clearance directly in front of the panel for maintenance per NFPA 70. With multiple equipment, the 3 feet 914 millimeter clearance is required directly in front of the complete configuration. In addition, a 28 inch 711 millimeter clear aisle way will be provided for access to the equipment.

Wiring within preaction control panel(s) and reporting equipment shall be in accordance with the paragraph entitled, "Installation in Cabinets and Boxes."

Conductors in accordance with the paragraph entitled, "Wiring" shall be installed from the [modem cabinet][code transmitter][preaction control panel] to a new [4][8] point terminal strip labeled "FATB" in the indicated telephone terminal cabinet.

When preaction control panels and reporting equipment are installed flush or semi-flush, three spare 1-inch 25 millimeter conduits in accordance with the paragraph entitled, "Conduit and Raceways," shall be installed from the preaction control panel wiring termination cabinet to an accessible location.

3.2.2 Addressable Modules and/or Devices

Zone addressable modules shall be installed at accessible locations

indicated. Module address switches shall be configured to settings indicated on approved shop submittals. Modules shall be identified individually adjacent to their mounting.

Control zone addressable modules used for smoke control, AHU shutdown, etc. shall be mounted in accessible locations within 3 feet 914 millimeter of the device to be controlled. Control modules connected to separately energized control wiring from auxiliary systems shall not be installed in the same enclosure with initiation and signal zone addressable modules.

Where zone addressable modules are grouped within an enclosure, wiring shall be in accordance with the paragraph entitled, "Installation in Cabinets and Boxes."

3.2.3 Annunciator Panels

Panels shall be installed in accessible locations in such a manner as to prevent damage from vibration or jarring.

Annunciator panels shall be installed in each protected building, located where indicated, and shall be complete with all indicated accessories and devices. Annunciator panels shall be installed in accessible locations in such a manner as to prevent damage from vibration or jarring. Annunciator panels require a minimum of 3 feet 914 millimeter clearance directly in front of the panel for maintenance, per NFPA 70. With multiple panels, the 3 feet 914 millimeter clearance is required directly in front of the complete configuration. In addition, a 28 inch 711 millimeter clear aisle way will be provided for access to the annunciator panels.

Wiring within annunciator panels shall be in accordance with the paragraph entitled, "Installation in Cabinets and Boxes".

3.2.4 Heat-Actuated Detectors

Detectors shall be ceiling-mounted unless otherwise indicated. Location, number, and general arrangement shall be as indicated. Field installation locations shall comply with NFPA 72.

3.2.5 Smoke Detectors

Smoke detector location, number, and general arrangement shall be as indicated; field installation shall be in accordance with NFPA 72. Detectors shall not be installed until the work of other trades is complete.

Duct smoke detectors shall be installed in accordance with the manufacturer's requirements and NFPA 90A. All duct penetrations shall be sealed air- and water-tight.

Addressable smoke detector address switch settings shall be configured as approved on shop drawings and submittals. Detectors shall not be installed until work by other trades is completed.

3.2.6 Manual Alarm Stations

Manual pull stations shall be mounted at locations indicated, within 18 inches 457 meter of the latch side of the door. Mounting height shall be 48 inches above the finished floor, measured from the top of the device.

3.2.7 Alarm Bells/Speakers

Bells and/or audio speaker notification appliances shall be mounted at the approximate locations indicated. Mounting height shall be 90 inches above the finished floor, measured from the top of the bell/speaker, but no less than 6 inches 152 millimeter below the ceiling.

3.2.8 Strobe Units/Combination Audio/Visual

Strobe light notification appliances shall be mounted at the approximate locations indicated. Locations shall be unobstructed and allow viewing by area occupants in accordance with NFPA 72. Mounting height shall be 80 inches 2032 millimeter above the finished floor, measured from the bottom of the strobe, but no less than 6 inches 152 millimeter below the ceiling.

3.2.9 Auxiliary Control Relays

Remote control relays shall be installed and supervised in accessible locations within 3 feet 914 millimeter of the device to be controlled.

3.2.10 Wiring

Wiring shall conform to the requirements of NFPA 70 and the following special requirements:

Preaction system circuits shall be installed in a separate raceway system. Each circuit type (Initiating, Notification, Signaling, and Control) shall be routed through a dedicated separate conduit or raceway system configured to comply with NFPA 72 Class "A" conduit system requirements. 60-hertz power circuits shall not enter enclosures containing preaction circuits, except where required to connect to the preaction system.

Conductors shall be continuous from a terminal point at one device to a terminal point at the next device to the preaction control panel. Break wires at each terminal; wires shall not be looped over a terminal. Solderless ring tongue terminal lugs shall be installed with manufacturer's required tooling on the device wiring connection leads. This ring type lug will be used on stranded wire only. Termination of solid wire will be made on compression or screw type terminals. When screw type terminals are used the conductor must be captured under 80 percent of the screw head surface.

Conductor colors are listed below and shall be in accordance with FED-STD 595. Where modifications are made to existing systems, the new or added conductors shall match the size and color coding of the existing system.

Conductors for multiplexed communication circuits, speaker audio circuits, remote phone circuits, and remote station signaling circuits shall be marked with circuit designation and consistent color coding for the positive and negative loops shall be maintained throughout the cable system.

Direct current initiating device circuits (heat detectors, manual pull station) shall be a two loop circuit per NFPA 72, Style D with the positive loop conductor colored blue, Color No. 15102, and the negative loop conductor colored black, Color No. 17038.

Power leads from the control panel for product-of-combustion detectors shall be one white, Color No. 17877 positive, and one black, Color No. 17038 negative.

Direct current notification appliance circuits (bells, strobes) shall be parallel wired per NFPA 72, Style Z. Positive conductor shall be colored red, Color No. 11105, and the negative conductor shall be colored orange, Color No. 12473.

Direct current auxiliary control device circuits (AHU shutdown relay) shall be parallel wired per NFPA 72, Style Z. Positive conductor shall be colored yellow, Color No. 13591, and the negative conductor shall be colored brown, Color No. 10055.

The solenoid valve safing key switch shall be a Best Lock, Model 1W702-S4D, which opens both the positive and negative conductors. Solenoid positive conductors shall be color-coded yellow, negative conductors shall be violet. Wiring shall comply with standard KSC solenoid valve wiring standards.

3.2.10.1 60-Hertz Power

60-hertz power to the preaction control panel or separately powered devices shall be 120 volts. There shall be one black phase conductor, one white or grey solidly grounded neutral conductor and one green equipment grounding conductor. Conductor size shall be as shown on the drawing with the minimum size No. 12 AWG 2 millimeter diameter (No. 12 AWG) copper. Surge arrestors shall be installed in accordance with NFPA 72 and NFPA 70.

3.2.10.2 Installation in Cabinets and Boxes

Wiring in control cabinets and boxes shall be installed in a neat and orderly manner with wire properly grouped, tie-wrapped, or laced parallel and perpendicular to the major axis, supported and identified. Control wiring shall be continuous from device to device with no splices unless otherwise indicated. All wires entering or leaving control cabinets, boxes, and devices shall be permanently marked and terminated on screw terminals. Marking shall be consistent throughout the preaction system and shall be the same as the identification shown on the connection drawings.

3.2.11 Conduit and Raceways

Minimum size for preaction system initiating, alarm and control circuit conduit and raceways shall be [1/2 inch 13 millimeter] 3/4-inch 19 millimeter. Installation shall be in accordance with NFPA 70.

Rigid galvanized heavywall steel conduit shall be installed in all hazardous (classified) locations, exterior above grade and interior exposed, unless otherwise shown on the drawings. EMT with hexnut expansion gland-type fittings may be installed in all other areas. Flexible metal raceway, maximum length 6 feet 1829 millimeter, shall be used as the final connecting raceway to a preaction system device mounted on vibrating equipment or on a suspended ceiling.

Conduit direct buried in earth shall be Schedule 80 PVC. Portions of underground raceway system that penetrate above finished grade shall be rigid galvanized heavywall steel conduit with a 40 mil PVC coating or painted with a bitumastic compound.

Conduit in interior finished areas shall be concealed. Conduit through fire-resistant rated walls, floors, ceilings, shall be fire-stopped in a manner that maintains the fire-resistant rating of the wall, floor, or ceiling.

Conduit installed in a vertical position shall be parallel with walls and perpendicular with the floor and ceiling. Conduit installed in a horizontal position shall be parallel with the floor and ceiling and be perpendicular with the walls. Changes in direction of runs shall be made with symmetrical bends. Bends of over one inch 25 millimeter in diameter shall be factory made elbows.

Preaction solenoid valve control circuits shall be NFPA 72, Style Y. Positive conductor shall be colored yellow, and the negative conductor shall be colored violet.

3.2.12 Tamper Switches

Provide tamper switches for all fire protection control valves where closure of the valve will impair service. In addition, provide tamper switches for valves that supervise system conditions where closure or opening of the valve would impair the supervisory function.

3.3 FIELD TESTING

After complete installation of the equipment and at such time as directed by the Contracting Officer, tests shall be conducted to demonstrate that the installation requirements of this specification have been met and that the sequential functions of the system comply with the requirements specified herein. Tests covered in the following paragraphs shall be done in two parts:

- a. Preliminary - This will be an "in house" test to verify all the systems and components. This functional test shall be performed in the presence of government inspectors and shall be repeated until the Contractor can perform one full test without device or system malfunction.
- b. Final Acceptance - After the successful completion of the preliminary testing, the systems shall be fully tested formally with full documentation (including As-Built Drawings) using the previously approved recording form. Contracting Officer will witness this test and final acceptance of the system will be based upon his written approval of the test.

On both preliminary and final tests, the approved testing procedures shall be followed.

3.3.1 External System Wiring

The following tests shall be performed on the external system wiring before connection to the control panel:

Continuity of circuits shall be checked with an ohmmeter. Temporary jumpers shall be inserted in appropriate sockets of missing detectors and the end-of line resistor shall be installed when this test is performed. Resistance reading for each circuit shall be the value of the end-of-line resistor, plus or minus 10 percent.

Each wire shall be checked for grounds with a 500-volt insulation resistance test set. Resistance to ground shall not be less than 20 megohms.

3.3.2 Preaction System Acceptance Tests

After completion of the above tests, the external system wires shall be connected to the appropriate terminals in the control panel and the following tests shall be performed:

With the control panel energized, demonstrate the proper operation of all indicating lights and alarms.

Each annunciator panel lamp shall be demonstrated to operate when it's associated device or zone is activated.

Each manual alarm station shall be activated to demonstrate proper operation.

Each smoke detector shall be activated in accordance with the manufacturer's instructions, to demonstrate proper operations; both alarm and trouble.

Each duct smoke detector shall have a static pressure differential test performed to verify that the pressure differential between the inlet and outlet tubes is within the manufacturer's specifications for acceptable operation.

Each time an initiating or supervisory circuit is activated, it shall be verified that the associated device address, notification appliance circuits, auxiliary control circuits, and alarm reporting to the Central Fire Monitoring System is activated and the correct information is displayed by the color graphics units.

One lead at each alarm initiating device, (manual pull station, smoke detector, flame detector, heat actuated detector, etc.), shall be removed and grounded to demonstrate circuit trouble, ground fault, and then alarm over ground fault with an open circuit.

Power to each separately powered panel or device shall be turned off to simulate loss of power and to demonstrate operation of the trouble alarm.

Test the rate-of-rise, (fixed temperature line-type) function on each heat-actuated detector in each zone, by application of heat from a heat lamp or hand held hot air blower. These detectors shall initiate an alarm to the system. Detectors shall sustain repeated tests of the rate-of-rise function without damage to the fixed temperature function. Heat-actuated detectors (HADS) subject to operation from body temperature shall be replaced.

Water suppression system valves requiring tamper switches, shall be opened and closed to demonstrate proper operation.

Pressure switches shall be activated by water flow at the inspectors test valve to demonstrate proper operation.

Each alarm initiating circuit shall be demonstrated to operate its

associated alarm-control and auxiliary control units and remote reporting.

One lead at each notification appliance and auxiliary control device shall be removed and grounded to demonstrate open circuit trouble, ground fault trouble, and then operation over ground fault with an open circuit.

Each alarm control unit shall be demonstrated to operate in all modes.

Capacity and the operation of the battery backup system shall be demonstrated to operate as required by these specifications by disconnecting the 120 volt, 60 Hz power from the preaction (control) panel and operating the system as specified for backup operation.

All circuits interconnecting with other systems fire protection, smoke control, HVAC, security and safety, elevators, etc., shall be demonstrated to operate as specified on alarm from the associated zone or zones.

Multiplex equipment, devices, and wiring shall be tested in accordance with NFPA 70 and manufacturer's requirements.

3.3.3 Re-Acceptance System Tests

Re-acceptance testing shall be performed after system components are added or deleted; after any modification, repair, or adjustment to system hardware or wiring; or after any change to software. All components, circuits, systems operations, or site specific software functions known to be affected by the change or identified by a means that indicates the system operational changes shall be 100 percent tested. In addition, 10 percent of the initiating devices that are not directly affected by the change, shall also be tested and proper system operation shall be verified.

Changes to all control units connected or controlled by the system executive software shall require a 10 percent functional test of the system, including a test of at least one device on each input and output circuit to verify proper system operation.

Upon completion of the modifications, functionally test the existing devices that were reinstalled and test the devices that are on both sides of the point of connection of the new devices. All newly installed devices shall be tested in accordance with the paragraph entitled, "Preaction System Acceptance Tests".

After final acceptance testing has been successfully completed, the Contractor shall submit test data under the terms of the "GENERAL REQUIREMENTS" clause of this contract.

3.4 OPERATION AND MAINTENANCE MANUALS

Operation and maintenance manuals shall be submitted. Information bound in manual format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, procedures, recommended spare parts, recommended test equipment, and safety precautions. This information shall be submitted prior to acceptance tests being performed.

3.5 PAINTING

Manufacturer's standard-finish equipment surfaces damaged during construction shall be brought to as-new condition by touch-up or re-painting to the satisfaction of the Contracting Officer, or replaced with new undamaged equipment at an additional cost to the Government.

All fire alarm equipment and appurtenances shall be painted red, color number 11105 in accordance with FED-STD 595.

-- End of Section --