

SECTION 16721 – FIRE DETECTION and MASS NOTIFICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. A project addendum may be supplied with this document which details any project-specific additions or deletions to this general specification document.

1.2 SYSTEM DESCRIPTION

- A. Michigan Tech has an existing EST workstation Center located at the Department of Public Safety and Police Services (DPSPS) that will be expanded to monitor and control new EST3 systems with voice communications. The workstation at DPSPS is connected to each building by a dedicated data network connection, and/or fiber optics, and/or an IP network connection.
- B. All system additions/deletions will require any necessary updates to be done at the EST workstation located at DPSPS. At a minimum, all system points and graphics need to be updated and tested.
- C. The workstation at DPSPS will transmit via VOIP to the EST3 network voice messages and manual paging announcements.
- D. EST3 fire alarm control panels with Intelligent Addressable initiating devices and one-way voice communications system with audio paging speakers will be installed. The main control panel shall be located in a secure location with remote annunciators with microphone located at primary and secondary entrances.
- E. Provide connection from the EST3 main control panel to the nearest IP Switch. Coordinate with Michigan Tech's Telecommunications Department for location and final connections.
- F. The mass notification system will consist of one-way audio paging speakers located throughout the facility and tapped at lower wattage, with numerous speakers. Visual notification shall be CLEAR Lens strobe imprinted with the word FIRE for Fire Evacuation and AMBER Lens strobe imprinted with the work ALERT for Mass Notification Events. Visual notification devices shall be WHITE.
- G. The System supplied under this specification shall utilize node to node, direct wired, multi priority peer-to-peer network operations. The system shall utilize independently addressed, input/output modules, audio amplifiers, and voice communications as described in this specification. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, and LCD panels. Each panel shall be an equal, active functional member of the network, which is capable of making all local decisions and generating network tasks to other panels in the event of panel failure or communications failure between panels. Master/slave system configurations shall not be considered as equals.

1.3 BUILDING CODES and STANDARDS

- A. National Fire Protection Association (NFPA):
 - 1. NFPA-70 National Electrical Code (NEC)
 - 2. NFPA-72 National Fire Alarm Code
 - a. Chapter 12 - Emergency Communications
 - 3. NFPA 101 Life Safety Code
 - 4. IBC International Building Code
 - 5. IFC International Fire Code
 - 6. IMC International Mechanical Code
 - 7. State of Michigan Building Codes and Amendments
- B. National Electrical Manufacture's Association (NEMA)
- C. Underwriters Laboratories, Inc. (UL)
 - 1. UL-864 Control Units for Fire Protective Signaling Systems (9th Edition)
 - 2. UL-2572 Control Units for Mass Notification System
 - 3. UL-268 Smoke Detector for Fire Protective Signaling Systems
 - 4. UL-217 Smoke Detectors for Single and Multiple Station
 - 5. UL-521 Heat Detectors for Fire Protective Signaling Systems
 - 6. UL-464 Audible Signaling Appliances
 - 7. UL-1971 Visual Signaling Appliances
 - 8. UL-38 Manually Actuated Signaling Boxes
 - 9. UL-1481 Power Supplies for Fire Protective Signaling Systems

1.4 SUBMITTALS

- A. The Contractor shall purchase no equipment for the system specified herein until the Owner has approved the project submittals in their entirety and has returned them to the contractor. It is the responsibility of the contractor to meet the entire intent and functional performance detailed in these specifications. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications. The Contractor shall submit documentation electronically within 30 calendar days after award of purchase order.
- B. Each submittal shall include a cover letter providing a list of each variation that the submittal may have from the requirements of the Contract Documents. In addition, the Contractor shall provide specific notation on each Shop Drawing, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Architect.
 - 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level II minimum or **Michigan** registered Professional Engineer.
- C. Product Data: Product Data sheets with the printed logo or trademark of the manufacturer of all equipment. Indicated in the documentation shall be the type, size, rating, style, and catalog number for all items proposed to meet the system performance detailed in this specification. The proposed equipment shall be subject to the approval of the Owner.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72.
 2. Include voltage drop calculations for notification appliance circuits.
 3. Include battery-size calculations.
 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- E. Operation and Maintenance Data: For fire-alarm systems and components to be included in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data, include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.
 2. Provide "Record of Completion Documents" according to NFPA72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software database file, hardcopy print-out and CD, with password for delivery to the owner. Proprietary system/service companies will not be acceptable.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals (hardcopy) and electronic on CD.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 7. Copy of NFPA72.
- F. Software and Firmware Operational Documentation:
1. CD of site-specific software database file with password, all product data sheets and AutoCAD files. Provide hard copy print-out of the software program. Proprietary system/service companies will not be acceptable.
 2. Provide a list of global system settings
 3. Provide a list of the contents of each system cabinet and their settings
 4. Provide a list of all addressable devices with their addresses and settings

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Certification: Obtain certification according to NFPA72 in the form of a placard by an approved alarm company.

1.6 WARRANTY and SOFTWARE SERVICE AGREEMENT

- A. The contractor shall warranty all materials, installation and workmanship for **five (5) years** from date of acceptance, unless otherwise specified. A copy of the manufacturers' warranty shall be provided with closeout documentation and included with the operation and installation manuals.
- B. The System Supplier shall maintain a service organization with adequate spare parts stocked within 75 miles of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the Owner notifying the contractor.
- C. Technical Support: Beginning with Substantial Completion, provide software support for **five (5) years**, shall be included in this project.
- D. Detector Sensitivity Testing: During the warranty period, each year the contractor is to perform detector sensitivity testing and provide report to the Owner unless the system is UL Listed to perform automatic sensitivity testing without any manual intervention and should detector fall outside of sensitivity window, the system will automatically indicate a device's trouble. A copy of UL letter is to be provided as proof of system operation.
- E. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within **five (5) years** from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide quantity equal to 2% percent of amount of each type installed, but no fewer than 2 unit of each type.
 - a. Smoke Detectors, heat detectors, manual pull stations, duct smoke detector, monitor modules and control modules:
 - b. Notification appliances; speakers, speaker-strobes and strobes.
 - 2. Keys: Ten extra sets for access to locked and tamper-proof components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling fire alarm system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- B. The Contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply with the requirements of these Specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.
- C. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building Owner. All specified operational features must be met without exception.
- D. All control panel assemblies and connected (new) field appliances shall be provided by the same System Supplier, and shall be designed and tested to ensure that the system operates as specified. All equipment and components shall be installed in strict compliance with the manufacturer's recommendations.
- E. That equipment proposed to be supplied will be considered only if it meets all sections of the performance specification. Any deviations of system performance outlined in this specification will only be considered when the following requirements have been met:
 - 1. A complete description of proposed alternate system performance methods with three (3) copies of working drawings thereof for approval by the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.
 - 2. The supplier of alternate equipment shall furnish evidence that the proposed alternate system performance is equal to or superior than the system operation stated in the specification. Such evidence shall be submitted to the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.
 - 3. The supplier shall submit a point-by-point statement of compliance for all sections in this specification. The statement of compliance shall consist of a list of all paragraphs within these sections. Where the proposed system complies fully with the paragraph as written, placing the word "comply" opposite the paragraph number shall indicate such. Where the proposed system does not comply with the paragraph, as written, and the supplier feels the proposed system will accomplish the intent of the paragraph, a full description of the function as well as a full narrative description of how its proposal will meet its intent shall be provided. Any submission that does not include a point-by-point statement of compliance as described herein shall be disqualified. Where a full description is not provided, it shall be assumed that the proposed system does not comply.
 - 4. The supplier of alternate equipment shall submit a list from the alternate manufacturer on the manufacturer's letterhead indicating the names and addresses of all authorized suppliers in the area. Proprietary products will not be considered.
 - 5. The acceptability of any alternate proposed system shall be the sole decision of the Owner or his authorized representative.
- F. Approved Products: All panels and peripheral devices shall be of the standard product of single manufacturer and shall display the manufacturer's name of each component. The catalog

numbers specified under this section are those of **EST, A UTC Fire & Security Company** and shall constitute the type, product quality, material and desired operating features.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
1. Manual stations.
 2. Heat detectors.
 3. Flame detectors.
 4. Smoke detectors.
 5. Duct smoke detectors.
 6. Verified automatic alarm operation of smoke detectors.
 7. Automatic sprinkler system water flow.
 8. Heat detectors in elevator shaft and pit.
 9. Fire-extinguishing system operation.
 10. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
1. Activate multiple channel pre-recorded voice messages followed by temporal tone.
 2. Continuously operate the visual notification appliances.
 3. Identify alarm at fire-alarm control unit and remote annunciators.
 4. Transmit an alarm signal to the remote alarm receiving station.
 5. Unlock electric door locks in designated egress paths.
 6. Release fire and smoke doors held open by magnetic door holders.
 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 8. Activate stairwell and elevator-shaft pressurization systems.
 9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 10. Recall elevators to primary or alternate recall floors.
 11. Activate emergency shutoffs for gas and fuel supplies.
 12. Record events in the system memory.
 13. Record events by the system printer.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Low-air-pressure switch of a dry-pipe sprinkler system.
 3. Elevator shunt-trip supervision.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
 10. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system.

- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 GLOBAL EVENT GRAPHICAL WORKSTATION

- A. The existing Global Event Graphical Workstation (GEGW) is located at the campus Public Safety and Police Services Building (DPSPS). All new systems shall be connected to the GEGW and shall include all necessary programming to update the system. The system updates shall include all system points, and Node Annunciation.
- B. Provide VOIP communications from the GEGW to the EST3 network being installed as part of the scope of work.
- C. The GEGW shall have a built-in paging microphone to selectively communicate to any building network or level within a building network or multiple selective combination or All Call. This voice paging shall be accomplished by Voice Over IP communications to each network. All manual voice pages from GEGW shall automatically be voice-recorded in a history file and be available for replay.
 - 1. Graphical screens shall be provided to select the manual paging virtual switch panel.
- D. Graphical Maps shall be imported from any of the following formats: DXF, DWG, JPEG, RLE, TIF, BMP, and WMF. The main screen shall be Aerial Photo of the Building or Campus, followed by Photo of the Building Profile, floor plan architectural drawing, and multiple zoom fields on the floor plan.
 - 1. Drawing display shall allow for zoom out to full floor view or zoom in to individual device location. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliasing, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal. Include floor plan Legend to identify location on floor plan key view.
 - 2. There shall be a toggle button on screen for all drawing levels that allow instant migration to the floor above or the floor below the floor currently being displayed on screen.
 - 3. Floor plans shall have the minimum:
 - a. 32 Zoom field views on drawing.
 - b. Door swings.
 - c. Window locations.
 - d. Room number and designation of occupancy.
 - e. All initiating and notification device locations.
 - f. Locations of video camera/view.

2.4 IP CAMPUS NETWORK

- A. Provide connectivity to campus Emergency Communications Ethernet IP Network. The TCP/IP network switches shall be industrial grade auto-negotiating switching hubs. Switch shall be UL864 listed, shall provide four (4)10/100 Mbps shielded RJ-45 connectors for twisted pair (ethernet) connections and two 100 Mbps fiber ports. The switches shall operate on a nominal 24 VDC supplied from a battery backed up fire alarm control panel or booster power supply to insure power to the switch is always available. Switches shall provide LED indicators for data rate, activity/link integrity, power and loop detection. Shall interface into existing campus Ethernet with 10/100 Mbps RJ-45 connector.
 - 1. Shall be EST Model Number:
NETSW-EIS6M Network Interface

Switch/Hubs shall be: (if required and as specified by Michigan Tech Telecommunications)

FW-LANMM Fiber Network Switch - Multi mode, standard distance
FW-LANSM1 Fiber Network Switch - Single mode, standard distance
FW-LANSM2 Fiber Network Switch - Single mode, medium distance
FW-LANSM3 Fiber Network Switch - Single mode, long distance
FW-LANW1 Wireless Network Switch - Wireless, short range
FW-LANW2 Wireless Network Switch - Wireless, long range

- B. Each fire alarm control panel to LAN/WAN network interface shall be an industrial grade 10/100BASE T Ethernet® device server. The interface shall have diagnostic LEDs on the front of the unit make it easy to determine its status, and incorporate flash ROM memory facilitating upgrading the operating firmware. Power shall be supplied directly from the FACP, ensuring a reliable and monitored power source.
 - 1. Shall be EST, model NETCOM-1S.

- C. Each control panel audio source shall be connected to the LAN/WAN network interface shall be Network audio connectivity shall consist of a supervised audio decoder capable of decoding MP3, WMA, G.711 and PCM data streams in either HTTP, UDP, or RTP format. Audio decoder shall operate on filtered-regulated 24 VDC power derived from the panel power supply. Power shall be supplied directly from the FACP, ensuring a reliable and monitored power source.
 - 1. Audio decoder shall be equipped with:
 - a. A RCA jack line-level audio output.
 - b. RJ45 10/100BASE T Mbit Automatic Ethernet port.
 - c. Backlit LCD display
 - d. RS232 DB9 male interface capable of 115,200 baud communication.
 - e. Normally open relay contact rated at 500 mA @ 24 VDC.
 - f. Reset button.
 - g. Aluminum case.
 - h. Shall be EST, mode FVOIP-EX.X

2.5 FIRE-ALARM CONTROL UNIT

- A. The main control panel or remote control panel(s) shall be a multi-processor based networked system designed specifically for detection, and one-way emergency audio communications applications. The control panel(s) shall be listed and approved for the application under the standard(s) as listed. The control panel shall be model EST3.

- B. The control panel(s) shall include all required hardware, software and site-specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any application can be configured, and modified using software provided by a single supplier. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

- C. The network of control panels shall include the following features.
 - 1. Ability to download all network applications and firmware from the configuration computer on the network or at any control panel (network node) location.
 - 2. Each control panel (network node) shall have an LCD display with common controls. The display shall be configurable to display the status of any and all combinations of alarm, supervisory, trouble, monitor, or group event messages.
 - 3. From each LCD display on the system shall be capable of being programmed for control functions of any node or the entire network. The LCD display shall reside on the network as a node and continue to operate with fault on the network. An LCD can be

programmed to be only operation when a node is operational in stand-alone mode, with a network fault.

4. The system program shall have a minimum of 100 system definable Service Groups to facilitate the testing of installed system based on the physical layout of the system. Service groups that disable entire circuits serving multiple floors or fire zones shall not be considered as equal.
5. Advanced Windows based programming with Program Version Reporting to document any and all changes made during system start-up or system commissioning. Time and date stamps of all modifications made to the program must be included to allow full retention of all previous program version data. The operator display shall clearly identify unacknowledged and acknowledged alarm, supervisory, trouble, and monitor status messages. The system shall provide the ability to download data from the analog/addressable detectors to a PC while the system is on-line and operational in the protected premises. The downloaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.
6. Provide system reports that list a detailed description of the status of system parameters for corrective action or for preventive maintenance. Reports shall be displayed on the operator interface or be capable of being sent to a printer.
7. Provide an authorized operator with the ability to operate or modify system functions such as system time, date, passwords, holiday dates, restart the system and clear the control panel event history file.
8. Provide an authorized operator the ability to perform test functions within the installed system.
9. Supervision of system components, wiring, initiating devices and software shall be provided by the control panel. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display. Software and processor operation shall be independently monitored for failure. The system shall provide fail-safe operation, with multiple-levels of system operation

D. Each network control panel shall be capable of:

1. Supporting up to 2500 intelligent analog/addressable points.
2. Supporting up to ten (10) intelligent addressable loops, each loop supporting 125 detectors and 125 modules, total of 250 points.
3. Supporting network connections up to 63 other control panels and annunciators.
4. Supporting up to 124 (security/access control) Keypad/Displays.
5. Supporting up to ten network digital dialers with Contact ID or SIA format and TAP Pager protocol.
6. Supporting multiple RS-232 communication ports and protocol.
7. Supporting up to 1740 chronological history events.
8. Total network response shall not exceed 3 seconds.

E. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, monitor, trouble and component status messages and control menu.

1. The common control switches and with corresponding LEDs provided as minimum will be; Reset Alarm Silence, Panel Silence, and Drill. It shall be able to add additional switches/LEDs as required.
2. The main control panel shall have display that is 24 lines by 40 character graphic LCD and backlit when active.
3. Each point shall have custom event message of up to 40 characters, for total of 80 characters. In addition to instructional text message support a maximum of 2,000 characters each.
4. Provide 8 simultaneous events to be displayed. The first seven (7) highest priority events in addition to the most recent event. The events shall be automatically placed in event types (Alarm, Supervisory, Monitor & Trouble) for easy access and shall be possible to

view the specific event type separately. Having to scroll through a mixed list of event types is not acceptable.

5. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
6. This display shall be an EST 3-LCDXL1.
7. Systems not capable of such a display on the main panel faceplate shall include a CRT/Monitor display meeting the above requirements and battery stand-by.

F. Audio One-Way Voice Communications

1. The voice communication system shall be eight (8) channel audio evacuation systems, to allow the ability to have eight simultaneous announcements/paging. The audio channels shall be designed as such:
 - a. Mass Notification Message (HIGHEST PRIORITY)
 - b. Fire Message
 - c. Alert Message
 - d. Stand-by Message
 - e. Elevator Message
 - f. Stairwell Message
 - g. Security/Weather Threat
 - h. Manual Paging
2. The system custom digital voice message shall provide a minimum of 100 minutes and be created as a .wav file format. All messages shall be able to be created on-site without any special tools or burning of chips. Provide as minimum one twenty (20) watt supervised audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide an internally generated local 3-3-3, 1000 Hz temporal pattern output upon loss of the audio signal from the one-way emergency audio control unit, during an alarm condition.
3. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall be a supervised, dedicated, selectable 25/70 Vrms output.
4. Provide a standby audio amplifier, per node that will automatically sense the failure of any primary amplifier installed in the same panel and replace the function of the failed amplifier.

G. Provide an Emergency Voice Communication System with the following design features:

1. An audio control unit with Microphone for Paging.
2. Provide 3-position switch for each evacuation signaling zone and "All-Call", with "Page FIRE", "Auto" and "Page ALERT" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow.
3. These LED's shall illuminate to indicate respectively:
 - a. Evacuation signals activated (red),
 - b. Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).

H. Provide 2-position switch for manually activate pre-recorded voice messages, with "Message Name" positions identified and one LED status indicators, one red. Provide minimum of 12 selector switches.

1. These LED's shall illuminate to indicate respectively:
 - a. Message activated (red)

I. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions

- J. Circuits Requirements:
1. Signaling Line Circuits for Network Communications:
 - a. Class A, Style 7.
 2. Signaling Line Circuits for Intelligent Analog Addressable Loop:
 - a. Class B, Style 4.
 - b. No more than 100 detectors or 100 modules installed on a loop.
 3. Initiating Device Circuit:
 - a. Class B, Style B
 4. Notification Appliance Circuits:
 - a. Class B, Style Y.
 - b. Maximum circuit loading to 2 amps for visuals.
 5. Activation of alarm notification appliances, smoke control, elevator recall and other functions shall occur within 3 seconds after the activation of an initiating device.
- K. Smoke-Alarm Verification:
1. Initiate an audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- L. Elevator Recall:
1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- M. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- N. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change to alternate settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- O. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, shall be powered by nominal 24-V dc source.

- P. Secondary Power: Shall provide 24 hours supervisory and 15 minutes of alarm with batteries, automatic battery charger, and automatic transfer switch.

2.6 REMOTE ANNUNCIATOR

- A. Annunciator shall match those of fire-alarm control unit LCD display functions for alarm, supervisory, monitor and trouble indications and common system controls including; acknowledging, silencing, resetting, and testing. See section 2.3 E for specific requirements.
 - 1. This display shall be EST, model 3-LCDXL1 or 3-LCDANN.

2.7 NAC Power Supply:

- A. The NAC power supply shall be independent unit that will provide power to visual strobe notification appliances. It shall be possible to configure the NAC's to follow the main panel's NAC or activate from intelligent synchronized modules. The booster NAC's must be configurable to operate independently at any one of the following rates: continuous synchronized, or 3-3-3 temporal. Fault conditions on the power supply shall not impede alarm activation of host NAC circuits or other power supplies. The NAC power supply must be able to provide concurrent power for notification devices, security devices, access control equipment and auxiliary devices such as door holders. . All the NAC Power Supplies shall be synchronized. The power supply shall support up to 24 amp hour batteries.
 - 1. Power supply shall be minimum of 10 amps and UL 864 Listed.
 - 2. Four independent 3amp NAC circuits. Each being configurable as auxiliary power.
 - 3. All circuits shall be synchronized.
 - 4. Shall be EST, model BPS10A

2.8 INTELLIGENT ANALOG SYSTEM SMOKE DETECTORS

- A. General Requirements for Intelligent Analog Detectors
 - 1. Integral Microprocessor: All decision are made at the detector determining if the device is in the alarm or trouble condition.
 - 2. Non-Volatile Memory: Permanently stores serial number and type of device. Automatically updates historic information including hours of operation, last maintenance date, number of alarms and troubles, time of last alarm, and analog signal patterns for each sensing element just before last alarm.
 - 3. Electronic Addressing: Permanently stores programmable system address. It shall be possible to address each intelligent module without the use of DIP or rotary switches. Devices using switches for addressing shall not be acceptable.
 - 4. Automatic Device Mapping: Each detector transmits wiring information regarding its location with respect to other devices on the circuit, creating an As-Built wiring diagram. This will also provide enhanced supervision of the device physical location and the device message shall reside with the location and not the device address. Devices installed in the wrong location will always report the correct message of the physical location.
 - 5. Sensitivity Range: Each analog addressable smoke detector's sensitivity shall be capable of being programmed individually as: most sensitive, more sensitive, normal, less sensitive or least sensitive. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. It shall be possible to program control panel activity to each level.
 - 6. Pre-Alarm: Detector stores 20 pre-alarm sensitivity values to alert local personnel prior to the sensor reaching full evacuation sensitivity. Sensitivity values can be set in 5% increments.

7. Environmental Compensation: The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be compared against its reference value. The detector shall provide a maintenance alert signal when the detector reaches 75% (Dirty) to 99% (More Dirty) compensation has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.
 8. Twin Status LEDs: Flashing Green LED shows normal; flashing RED shows alarm state; steady RED and steady GREEN show alarm state in stand-alone mode, visible from any direction.
 9. UL Sensitivity Testing: The detector shall utilize a supervised microprocessor that is capable of monitoring the sensitivity of the detector. If the detector sensitivity shifts outside of the UL limits, a trouble signal is sent to the panel.
 10. Device Replacement: The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.
- B. Intelligent 4D Multi-sensor Detector (Photo/Ion/Thermal and Time)
1. Provide intelligent analog addressable 4D multi-sensor smoke detectors at the locations shown on the drawings. The 4D Intelligent detector gathers analog information from each of its three fire sensing elements and converts it into digital signals. The detector's on-board microprocessor measures and analyzes these signals separately with respect to a fourth element – Time. It compares the information to historical readings, time patterns and known fire characteristics to make an alarm decision. Digital filters remove signal patterns that are not typical of fires.
 2. Separately mounted combinations of photoelectric detectors, ionization detectors and heat detectors in the same location, clustered at the manufacturer's listed spacing is an acceptable alternative.
 3. Provide EST, model SIGA-IPHS.
- C. Intelligent 3D Multi-sensor Detector (Photo/Thermal and Time)
1. Provide intelligent analog addressable 3D multi-sensor smoke detectors at the locations shown on the drawings. The 3D Intelligent detector gathers analog information from each of its two fire sensing elements and converts it into digital signals. The detector's on-board microprocessor measures and analyzes these signals separately with respect to a third element – Time. It compares the information to historical readings, time patterns and known fire characteristics to make an alarm decision. Digital filters remove signal patterns that are not typical of fires.
 2. Provide EST, model SIGA-PHS.
- D. Intelligent Photoelectric Detector
1. Provide intelligent analog addressable photoelectric smoke detectors at the locations shown on the drawings.
 2. Provide EST, model SIGA-PS.
- E. Intelligent 135 Degree Fixed Temperature / Rate of Rise Heat Detector
1. Provide intelligent combination fixed temperature/rate-of-rise heat detectors at the locations shown on the drawings. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data.

Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135°F (57°C) and a rate-of-rise alarm point of 15°F (9°C) per minute. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.

2. Provide EST, model SIGA-HRS.

F. Fixed Temperature Heat Detector

1. Provide intelligent fixed temperature heat detectors at the locations shown on the drawings. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The heat detector shall have a nominal alarm point rating of 135°F (57°C). The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.
2. Provide EST, model SIGA-HFS.

G. Detector Base Types

1. Provide standard detector mounting bases suitable for mounting on 1-gang, or 4inch octagon box and 4 inch square box. The base shall, contain no electronics and support all series detector types. Bases with electronics or dip-switches are not acceptable.
 - a. Provide EST, model SIGA-SB or SB4.
2. Provide relay detector mounting bases suitable for mounting on 1-gang, or 4" octagon box and 4" square box. The relay base shall support all Signature Series detector types and have the following minimum requirements:
 - a. The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
 - b. The position of the contact shall be supervised.
 - c. The relay shall automatically de-energize when a detector is removed.
 - d. The operation of the relay base shall be controlled by its respective detector processor or under program control as required by the application. Detector relays not capable of operational programming independent of the detector shall not be considered equal. Form "C" Relay contacts shall have a minimum rating of 1 amp @ 30 Vdc and be listed for "pilot duty".
 - e. Removal of the respective detector shall not affect communications with other detectors.
 - f. Provide EST, model SIGA-RB or RB4
3. Provide audible detector mounting bases suitable for mounting on 4" x 4" octagonal concrete ring (mud box) and 4" square x 2-1/8" (54 mm) deep box.
 - a. The base shall support all Signature Series detector types and be capable of single or group operation. The audible base shall emit a temporal alarm tone and be selectable for low or high output.
 - b. The operation of the audible base shall be controlled by its respective detector processor or under program control as required by the application. Detector audible base not capable of operational programming independent of the detector shall not be considered equal.
 - c. The audible bases shall be UL268 and UL464 Listed, and provide a reverberant room sound output per UL464 of 81 dBA at 10ft (3m). and an average anechoic sound output of 90 dBA at 10 ft.(3m).
 - d. Provide EST, model SIGA-AB4G.

H. Intelligent Duct Smoke Detector - Photoelectric

1. Provide intelligent photoelectric duct smoke detector at the locations shown on the drawings.

- a. One form C auxiliary alarm relay rated at 2amps @ 30Vdc.
- b. The operating range shall be 100ft/min to 4,000ft/min air velocity and temperature range of -20 to 158F.
- c. Sample tube can be installed with or without the cover plate and be rotated in 45-degree increments to ensure proper alignment with duct airflow.
- d. Local magnet-activated test switch.
- e. Provide EST, model SIGA-SD
- 2. Provide remote test station with Alarm LED and Key Switch.
 - a. Provide EST, model SD-TRK.
- 3. Relay Fan Shutdown: Rated to interrupt fan motor control circuit. Furnish and install separate device for each motor start. Connect to motor start as required for fan shutdown during alarm condition.
 - a. Provide EST, model SIGA-CR.
- I. Beam Smoke Detectors
 - 1. Provide reflective beam type smoke detectors at the locations shown on the drawings. This detector shall consist of an integrated transmitter and receiver capable of being powered separately or together.
 - 2. The detector shall operate in either a short range of 15 to 160 ft. or a long range of 160 to 330 ft. The detector shall feature a bank of alignment LEDs on both the receiver and transmitter to ensure proper alignment without the use of special tools.
 - 3. The detector shall utilize an automatic gain control to compensate for gradual signal deterioration from dirt accumulation on lenses. The beam smoke detectors shall be powered from the system control panel. Testing shall be carried out using calibrated test filters.
 - 4. Provide a remote key activated remote test station.
 - a. Provide Beam Smoke Detector, model EC-50R or EC-100R with EC-LLT Test Station.

2.9 INTELLIGENT MODULES

- A. It shall be possible to address each intelligent module without the use of DIP or rotary switches. Devices using switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller.
 - 1. Integral Microprocessor: All decisions are made at the module determining if the device is alarm or trouble condition.
 - 2. Non-Volatile Memory: Permanently stores serial number, and type of device. Automatically updates historic information including hours of operation, number of alarms and troubles, time of last alarm.
 - 3. Automatic Device Mapping: Each detector transmits wiring information regarding its location with respect to other devices on the circuit, creating an As-Built wiring diagram. This will also provide enhanced supervision of the device physical location. The device message shall reside with the location and not the device address. Devices installed in the wrong location will always report the correct message of the physical location.
 - 4. Twin Status LEDs: The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status.
 - 5. Input and output circuit wiring shall be supervised for open and ground faults.
 - 6. Two styles of modules shall be available, those designed for gang box mounting, and where multiple modules are required in a single location, plug in modules shall be provided with a Universal Input/Output motherboard.
- B. Intelligent Input Module. The Input Module shall provide one or two supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall

be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types:

- Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
 - Normally-Open Alarm Delayed Latching (Waterflow Switches)
 - Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
 - Normally-Open Active Latching (Supervisory, Tamper Switches)
1. Provide EST model SIGA-CT1 or CT2 or SIGA-MCT2

C. Intelligent Relay Module. Provide addressable control relay circuit modules shall provide one (1) form C dry relay contacts rated at 24Vdc @ 2 amps (pilot duty) to control external appliances or equipment. The position of the relay contact shall be confirmed by the system firmware. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.

1. Provide EST, model SIGA-CR or SIGA-MCR.

D. NAC Control Module: Provide intelligent NAC control module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. The gang box -mounted version shall be suitable for mounting in North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The plug-In version shall plug into a universal multi-module motherboard. The NAC control module shall support the following operations:

- 24volt NAC circuit
 - Audio notification circuit 25v or 70v
 - Telephone Power Selector with Ring Tone (Firefighter's Telephone)
 - Visual Synchronized Output to Genesis appliances or to NAC Power Supply.
1. Provide EST, model SIGA-CC1 or -CC1S or SIGA-MCC1 or MCC1S.

E. FA Elevator Interface Cabinet

1. Provide red metal cabinet enclosure with word FIRE in white letters on the cover. Inside will be four intelligent relays (Primary Recall, Alternate Recall, Fire Hat and Shunt Trip), one monitor input (Shunt Trip AC Power Supervision) and 120vac relay (Shunt Trip AC Power Supv).
2. Label all the relays and input modules for the function.
3. Provide EST, model MFC with SIGA-UIO6, -MCR, MCT2 and MR-101.

2.10 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. The manual pull station will have an intelligent module integral of the unit.
3. Station Reset: key operated switch shall match the control panel key.
4. Manual pull stations that initiated an alarm condition by opening the unit are not acceptable.
5. Provide EST, model SIGA-278.

B. Indoor Protective Shield: Factory-fabricated clear plastic enclosure. Hinged at the top to permit lifting for access to initiate alarm. Lifting the cover actuates an integral battery powered audible horn (when noted on the drawings) intended to discourage false-alarm operation.

- C. Weatherproof manual pull station shall be provided of red metal construction with special weatherproof gasket metal red box.
 - 1. Single-action operation.
 - 2. Station Reset: key operated switch shall match the control panel key.
 - 3. The intelligent monitor module will be located within the building and not with the station
 - 4. Provide EST, model MPSR1.

2.11 NOTIFICATION APPLIANCES

- A. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions.
- B. Any appliances, which do not meet the above requirements, and are submitted, for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers which clearly states that their equipment (as submitted) are 100% compatible with each other for the purposes intended. All appliances shall be UL listed Fire Protective Service. and shall be UL 1971.
- C. Notification Appliances – Visual (Fire – Evacuation)
 - 1. Provide wall or ceiling mounted clear lens strobes with **white body and "FIRE" markings**. Strobes shall provide a smooth light distribution pattern field selectable candela 15 cd, 30 cd, 75 cd, and 110 cd flash output rating, UL1971 listed with in-out screw terminals shall be provided for wiring. The strobe (15, 30, 75, 110) candela rating shall be view from the side window to verify the setting. All strobes shall be synchronized to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules. The strobes shall mount to one-gang electrical box.
 - 2. The device shall have plastic protective cover for during installation.
 - 3. The actual candela setting on the visual shall be marked on the appliance.
 - 4. Provide EST, model Genesis Series devices.
- D. Notification Appliances – Visual (**ALERT – Mass Notification**)
 - 1. Provide wall or ceiling mounted **amber colored lens strobe** with white body and "ALERT" markings. Amber strobe shall provide a smooth light distribution pattern field selectable candela 15 cd, 30 cd, 75 cd, and 110 cd flash output rating UL1638 listed, with in-out screw terminals shall be provided for wiring. The strobe (A, B, C, D) candela rating shall be view from the side window to verify the setting. All strobes shall be synchronized to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules. The strobes shall mount to electrical box.
 - 2. Provide Amber Strobe adapter plate that will allow G4 Speaker-Strobe. The amber strobe shall be located directly below the Fire clear lens strobe.
 - 3. The device shall have plastic protective cover for during installation.
 - 4. Provide EST, model Genesis Series devices.
- E. Notification Appliance - 4" Cone Speaker
 - 1. Speakers shall have a 4" mylar cone, paper cones shall not accept as equal. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 70V systems. The actual speaker wattage & strobe candela setting shall be viewable from the device window to verify the wattage setting without removing the device. To make any changes to the speaker wattage will only require the removal of the cover plate.

2. At the 2-watt setting, the speaker shall provide a 90 dBA sound output over a frequency range of 400-4000 Hz. as measured in reverberation room per UL-1480.
3. Combination speaker strobes shall meet both sections of above.
4. The device shall have plastic protective cover for during installation.
5. The actual wattage setting on the speaker shall be marked on the face of the appliance.
6. Provide EST, model Genesis Series devices.

F. Notification Appliance - Re-entrant Speakers

1. Provide 4" white flush re-entrant speakers at loud ambient locations or for outdoor weatherproof installation. Weatherproof boxes shall be provided for outdoor mounting. Speakers shall provide 2w, 4w, 8w, and 15w power taps. The re-entrant speakers shall utilize a high-efficiency compression driver. Cone type drivers are not acceptable. At the 15 watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480.
2. Combination speaker strobes shall meet both sections of above.
3. Provide EST, model 757 Series devices.

G. Notification Appliance - 8" Cone Speaker

1. Speakers shall have a 8" cone with 5.32oz ceramic magnet. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/2w, 1w, 2w and 4w power taps for use with 70V systems. With response from 100Hz - 8KHz +/- 5dB.
2. At the 2-watt setting, the speaker shall provide an 85 dBA sound output over a frequency range of 100-8KHz. as measured in reverberation room per UL-1480.
3. The baffle shall be steel, baked epoxy powder coat finish - White.
4. Combination speaker strobes shall meet both sections of above.
5. Provide EST, model 965 Series devices.

2.12 GUARDS FOR PHYSICAL PROTECTION

- A. Provide welded mesh of size and shape for the manual pull stations, smoke detectors, notification appliances at location noted on the drawings.

2.13 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 120-V ac, 24-V ac or dc.
4. Provide EST, model 1500 series or DH Series.

2.14 WIRE AND CABLE

- A. Signaling Line Circuits – Network Data: Twisted pair, not less than No. 18Awg or as recommended by the manufacturer.
- B. Signaling Line Circuits – Intelligent Loop: Non-Twisted pair, not less than No. 16Awg or as recommended by the manufacturer.
1. Circuit Integrity Cable: Provide as required to meet NFPA or Local Code requirements.
 2. CI Cable shall meet article 760, power limited fire alarm service.

- C. Notification Appliance Circuits –
1. Audio: Twisted pair, not less than No. 16Awg or as recommended by the manufacturer.
 2. Visual. Twisted pair, not less than No. 14Awg or as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
- C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to existing control panel in existing part of the building.
 - 2. Connect new equipment to existing monitoring equipment at the supervising station.
 - 3. Expand, modify, and supplement existing **control / monitoring** equipment as necessary to extend existing **control / monitoring** functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- D. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A **or** Appendix B in NFPA 72.
 - 5. HVAC: Locate detectors not closer than **5 feet** from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- E. Duct Smoke Detectors: Comply with NFPA72 and NFPA90A. Install sampling tubes so they extend the full width of duct.
- F. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- H. Notification Appliance Devices: Install between 80 and 96 inches on the wall.
- I. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- J. Annunciator: Install with top of panel not more than 56 inches above the finished floor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 8 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
 - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 - 3. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 4. Alarm-initiating connection to elevator recall system and components.
 - 5. Alarm-initiating connection to activate emergency lighting control.
 - 6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 7. Supervisory connections at valve supervisory switches.
 - 8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 9. Supervisory connections at elevator shunt trip breaker.
 - 10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
 - 11. Supervisory connections at fire-pump engine control panel.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."
- B. Install framed instructions in a location visible from fire-alarm control unit.
- C. All initiating devices shall have bar code label installed visibly on the device. This bar code shall be used for digital inspection of the fire alarm system using Building-Reports.Com.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by Architect, Engineer and authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.

- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

- G. Prepare test and inspection reports.

- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

- I. Annual Test and Inspection: During the warranty period, each year test fire-alarm system complying with visual and testing inspection requirements in NFPA72. Use forms developed for initial tests and inspections.

- J. Detector Sensitivity Testing: During the warranty period, each year the contractor is to perform detector sensitivity testing and provide report to the Owner. Unless, the system is UL Listed to perform automatic sensitivity testing without any manual intervention and should detector fall outside of sensitivity window, the system will automatically indicated a devices trouble. A copy of UL letter is to be provided as proof of system operation

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 16721