

## SECTION 16721 FIRE ALARM SYSTEMS

## PART 1 GENERAL

## 1.1 SUMMARY:

- A. All applicable State and Local codes shall be adhered to including but not limited to NFPA 70, NFPA 72, NFPA 90, NFPA 101, IFC and ADA.
- B. Extent of fire alarm systems work is indicated by drawings, schedules, and riser diagrams.
- C. Provide system suitable for type and occupancy as defined by local Building Code (and as approved by local Fire Marshal)(and as approved by the Director of Facilities Development).
- D. All existing electrical equipment to be reused must comply with current codes and standards and be tested as part of this project.
- E. The system to be provided shall be an Analog/Addressable System which is defined as a system in which initiating devices and interface modules transmit their address via a binary or multiplex code over a common pair of wires. This address is converted to an English language display giving a custom description for each reporting device. In addition, the system will provide analog information about the sensitivity of each ionization, photoelectric, and heat sensing device. The system control panel will maintain a log of this information which can be reviewed on demand. The system will also provide a maintenance alert when the sensitivity of any detector has been outside of a preset range for a period of 24 hours.
- F. The existing system shall be retrofit with an analog addressable system and shall include the addition and replacement of initiating devices, indicating devices, and interface modules as well as the replacement of the control panels. The existing initiating device zones shall be monitored by the new system via monitor modules and the existing devices such as door holders, dampers, fans etc., shall be controlled by the new system via control modules.
- G. Fire alarm drawings and specifications shall be reviewed by LPS prior to fire department review for permit.
- H. Fire alarm work shall not be performed without permit.

## 1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with fire alarm systems work similar to that required for this project.
  - 1. Firm with manufacturer's factory trained personnel.
  - 2. Firm with factory authorized service organization and spare parts stock within 50 miles of the project and with a 24 hour response time.
  - 3. NICET level 2 or equivalent State qualifications
- C. Codes and Standards
  - 1. Each and every item of the fire alarm system shall be listed as the product of a single fire alarm system manufacturer under the appropriate category by Underwriters

Laboratory, Inc. (UL) and shall bear the UL label on all devices, appliances and panels comprising the system. All control equipment shall be listed under the category UOJZ as a single control unit. Partial listings shall be unacceptable.

2. The complete installation shall conform to the applicable sections of NFPA and Local Code Requirements, and the National Electrical Code with particular attention to article 760. All control equipment must have transient protection to comply with UL 864 requirements or Standard #497B as applicable.
3. FM Compliance: Provide fire alarm systems and accessories which are FM approved.
4. The fire alarm system and devices shall comply with ADA 1990 and UL 1971 requirements.
5. Fire alarm installations taking place in any and all LPS buildings shall be performed by an electrical contractor. All installers working under the electrical contractor must possess a State of Colorado Electrical license.

### 1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data including specifications, data sheets, wiring diagrams, equipment ratings, dimensions, finishes, and description of system operation.
- B. Shop Drawings: Provide shop drawings showing system components, including panels and cabinets, locations, quantities, and full schematic of system wiring showing conductor routings and quantities, and connection details. Room names and numbers shown on the contract documents are not necessarily those that will be used in the building. Before final testing, confirm room names and numbers. All conduit routing must be submitted to, and accepted by, the Architect/Engineer. Shop drawing documents must be submitted simultaneously with sprinkler system documents and prior to installation.

This information shall be submitted on 1/8 inch = 1foot scale building floor plans. No other systems shall be included on these plans. Reproduction of contract drawing will not be acceptable. The following information shall be included in the shop drawings:

1. Occupancy group and use.
  2. Number of stories.
  3. Indicate extent of building sprinkler system.
  4. Indicate addition to/modifications of existing system.
  5. One-line diagram showing number of devices and appliances per zone/circuit.
  6. Wire sizes, color coding, type(s) and voltage drop calculations.
  7. Indicate annunciation method and include drawing of graphic zone map.
  8. Indicate sequence of operation using an input/output matrix per NFPA 72.
  9. Submit back-up battery calculations.
  10. Indicate whether fire alarm system is required or non-required and list code sections required by and applicable to.
  11. List all variances and attach as required.
  12. Include brief description of scope of work.
  13. Submit Zone schedule.
  14. Sequence of Operation
- C. Submit manufacturer's installation instructions, including outlet or back box requirements for each piece of equipment.

- D. Submit manufacturer's certificate that system meets or exceeds specified requirements.
  - E. Submit verification of system operation by manufacturer or his authorized representative.
  - F. All shop drawings, battery and voltage drop calculations shall be submitted to the authority having jurisdiction for review after review by the Architect/Engineer.
  - G. Submit three copies of test results and data to Architect/Engineer no later than seven days after conclusion of tests described in this section.
  - H. Submit graphic annunciator and/or map layouts for review by the Architect/Engineer prior to fabrication.
  - I. Maintenance Data: Submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.
- 1.4 DELIVERY, STORAGE, AND HANDLING:
- A. Handle fire alarm equipment carefully to prevent damage or breakage. Do not install damaged equipment or components; replace with new.
  - B. Store fire alarm equipment in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- 1.5 EXTRA MATERIALS:
- A. General: Provide extra materials as listed below in addition to that required to complete the work. The additional stock shall not be used unless specifically authorized by the Owner's Representative.
  - B. Lamps: Furnish spare lamps and LED's amounting to not less than three (3) lamps of each type and of each color.
  - C. Devices:
    - 1. Furnish spare detection bases amounting to 5 percent of the quantity installed by this work, but not less than two (2) of each type.
    - 2. Furnish spare/replacement detectors amounting to 5 percent of the quantity installed by this work, but not less than two (2) of each type.
    - 3. Furnish spare adaptor modules and relays amounting to 5 percent of the quantity installed by this work, but not less than one (1) of each type.
    - 4. Furnish spare speakers/horns, combination speaker/horn/strobe units, and strobe units amounting to 5 percent of the quantity installed by this work but not less than one (1) of each type.
  - D. Fuses:
    - 1. Furnish spare fuses amounting to not less than five (5) fuses of each type and of each rating.

- E. Provide an additional addressable device communication card in the FACP which can be programmed for connection to future initiating devices.

#### 1.6 OPERATION:

- A. The system alarm operation subsequent to the alarm activation of any manual station, automatic detection device, or sprinkler flow switch shall be as follows:
  - 1. All audible alarm notification appliances shall sound a distinctive and continuous fire alarm signal until silenced by the alarm silence switch at the control panel or at the remote annunciator. Use of temporal tone #3 shall be utilized.
  - 2. All visible alarm notification appliances shall flash continuously until the system is reset. Visual alarm devices shall continue to operate when audible devices are silenced. Any subsequent zone alarm shall reactivate the alarm notification appliances.
  - 3. All doors normally held open by door control devices shall release.
  - 4. A supervised signal to notify the monitoring center shall be activated. Signal shall indicate separately, a fire detector zone in alarm, fire alarm system trouble, sprinkler tamper (supervisory), sprinkler flow OR individual alarm point address and description, including system troubles and other monitored signals.
  - 5. Activation of a sprinkler flow device shall cause the exterior horn/light to operate continuously until the flow has ceased. AHU shall shutdown on automatic alarm.
- B. Kitchen range hood extinguishing systems shall be connected to the fire alarm panel. Associated fan and dampers shall be operated or shutdown under alarm conditions in accordance with local code authority.
- C. The alarm shall be displayed on an 80 character LCD display. The top line of 40 characters shall be the point label and the second line shall be the device type identifier. The system alarm LED shall flash on the control panel and the remote annunciator until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the control panel and remote annunciator. The LCD display shall show the new alarm information.
- D. A pulsing alarm tone shall occur within the control panel until the event has been acknowledged.
- E. The alarm activation of any elevator lobby, top of shaft, bottom of shaft, or elevator equipment room smoke detector, in addition to the operations listed above, shall cause the elevator cabs to be recalled according to the following sequence:
  - 1. If the alarmed detector is on any floor other than the primary level of egress, the elevator cabs shall be recalled to the primary level of egress.
  - 2. If the alarmed detector is on the primary egress level, the elevator cabs shall be recalled to the predetermined alternate recall level as determined by the local authority having jurisdiction.
  - 3. If the alarmed detector is located in the elevator shaft it shall cause the shaft ventilation damper to open in addition to recalling the elevator to the primary level of egress.
  - 4. Provide a fire hat in the elevator for use by the fire department.

- F. Annunciators shall emulate the fire alarm control panel for all alarms.
- G. The activation of any thermal detector located in the elevator equipment room, top of shaft, or bottom of shaft shall cause the power to the elevator equipment and power to all lighting and receptacles in the equipment room to be disconnected from their source.
- H. The activation of any system addressable smoke detector shall initiate an Alarm Verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute the system shall resume normal operation. The Alarm Verification shall operate only on addressable smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation shall be selectable by zone.
  - 1. The control panel shall have the capability to display the number of times (tally) a zone has gone into a verification mode. Should this mode verification tally reach a pre-programmed number, a trouble condition shall occur.
- I. The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.
  - 1. The activation of any standpipe or sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED control panel and the remote annunciator. Differentiation between valve tamper activation and opens and/or ground on the initiation circuit wiring shall be provided.
  - 2. The activation of duct detector shall activate the system supervisory service audible signal and illuminate the LED on the control panel and the remote annunciator.
  - 3. Pressing the Supervisory Service Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory Service LED "ON" indicating the off-normal condition.
  - 4. Restoring the valve or the duct detector to the normal condition shall cause the Supervisory Service LED to extinguish, indicating restoration to normal.
- J. A manual evacuation (drill) switch shall be provided to operate the alarm notification appliances without causing other control circuits to be activated. However, should a true alarm occur, all alarm functions would occur as described previously.
- K. The system shall have a single key that will allow the operator to display all alarms, troubles, and supervisory service conditions including the time of each occurrence.
- L. All doors normally held open by door control devices shall release upon AC power failure.
- M. The actuation of the "enable walk test" program at the control panel shall activate the "Walk Test" mode of the system which shall cause the following to occur:
  - 1. The city circuit connection shall be bypassed.
  - 2. Control relay functions shall be bypassed.
  - 3. The control panel shall show a trouble condition.
  - 4. The alarm activation of any initiation device shall cause the audible signals to code a number of pulses to match the zone number.
  - 5. The panel shall automatically reset itself after signaling is complete.

6. Any momentary opening of an initiating or indicating appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating a trouble condition.
  7. The system shall have the capacity of 8 distinctive walk test groups, such that only a portion of the system need be disabled during testing.
- N. Handicapped Refuge Area Occupancy: Activation of a handicapped refuge area occupancy device shall cause the following to occur.
1. Sound a supervisory alarm at the control panel and on the graphic annunciator.
  2. Display the location and type of alarm on the LCD display on the control panel.
  3. Activate a flashing green LED on the remote annunciator and a flashing green remote LED at the occupancy device location.
  4. The alarm can be acknowledged from the control panel. When the alarm is acknowledged, the audible alarm will be silenced and the LED's will latch on.
  5. The LED's shall remain lit until the occupancy device has been reset. If the device is not reset within 2 minutes after the alarm is acknowledged, the alarm will resound.
  6. A supervised signal to notify the Fire Command Center shall be activated.
- O. Preaction system control panels shall be monitored by the FACP as a system trouble alarm identified by "preaction system" and room name or location to match other detector nomenclature on system. Monitor module shall be connected to preaction system, system control panel, and panel auxiliary alarm contacts. The FACP shall provide control module connection to preaction system control panel after alarm verification is received from any detector in the preaction system area. FACP shall be UL listed for release.

#### 1.7 SUPERVISION:

- A. There shall be supervisory service initiation device circuits for connection of all sprinkler valve supervisory (tamper) switches. Device activation shall cause a supervisory alarm at the control panel.
- B. There shall be independently supervised and independently fused notification appliance circuits for alarm speakers and flashing alarm lamps. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
- C. Auxiliary manual control shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble.
- D. Each independently supervised circuit shall include a discrete LCD readout to indicate disarrangement conditions per circuit.
- E. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green "power on" LED shall be displayed continuously while incoming power is present.
- F. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel.
- G. The System Modules shall be electrically supervised for module placement. Should a module become disconnected the system trouble indicator shall illuminate and the audible trouble signal shall sound.
- H. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

## PART 2 PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide a UL listed fire alarm systems by the following:
- B. Fire Alarm Cable
  - 1. West Penn
  - 2. Belden
  - 3. Annixter

## 2.2 FIRE ALARM AND DETECTION SYSTEMS:

- A. General: Provide complete fire alarm products of types, sizes and capacities indicated, which comply with manufacturer's standard design, materials, components; construct in accordance with published product information, and as required for complete installation. Provide fire alarm and detection systems for applications indicated.
- B. Wiring System Materials: Provide basic wiring materials which comply with Division-16 sections; "Raceways", Wires and Cables" and "Electrical Boxes and Fittings".
  - 1. Provide wire and cable in accordance with requirements of manufacturer. Wire insulation shall comply with NEC Article 760.
  - 2. Provide individual solid copper conductor sizes AWG #14, or larger.
  - 3. Provide multiconductor cables for wire sizes smaller than AWG #16.
  - 4. Provide conductors which are UL listed for the installation and location, and approved for fire alarm usage.
  - 5. Initiating and notification circuits shall be color coded red for positive, black for negative.
  - 6. All conductors shall be numbered and their numbers shall correspond to the terminal block numbering they are connected to. Provide conductor wiring and terminal block numbering.
  - 7. Wiring styles shall be as follows: Style B-IDC, Style 4-SLC, Style Y-NAC within buildings. Style D-IDC between buildings.
  - 8. Existing notification appliances are to remain/be replaced. Intercept existing circuits, extend to new control panel, and terminate on new indicating circuit.
- C. Power Requirements:
  - 1. The control panel shall receive 120 VAC power via a dedicated emergency circuit. The system shall include an integral, transient voltage surge suppression device (TVSS) on the incoming 120-volt power. TVSS device shall be UL 1449 rated for 380 volts/Type B.
  - 2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system

shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.

3. All external circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.

### 2.3 FIRE ALARM CONTROL PANEL:

- A. Control Panel construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm condition.
- B. A local audible device shall sound during Alarm, Trouble or Supervisory conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This audible device shall also sound during each keypress to provide an audible feedback to ensure that the key has been pressed properly.
- C. The following primary controls shall be visible through a front access panel:
  1. Eighty character liquid crystal display
  2. Individual red system alarm LED
  3. Individual yellow supervisory service LED
  4. Individual yellow trouble LED
  5. Green "power on" LED
  6. Alarm acknowledge Key
  7. Supervisory Acknowledge Key
  8. Trouble Acknowledge Key
  9. Alarm Silence Key
  10. System Reset Key
- D. The following secondary control switches and LED's shall be available behind an access door:
  1. City disconnect/switch
  2. Manual evacuation (drill)
  3. Elevator bypass
  4. Door holder release bypass
  5. Smoke damper control switches
- E. The control panel shall provide the following:
  1. Setting of time and date
  2. LED testing
  3. Alarm, trouble, and abnormal condition listing
  4. Enabling and disabling of each monitor point separately
  5. Change in operator access levels
  6. Walk Test enable and disable
  7. Running diagnostic functions
  8. Displaying software revision level
  9. Displaying historical logs
  10. Displaying card status
  11. Point listing
- F. For maintenance purposes the following lists shall be available from the point lists menu.

1. All points list by address
  2. Monitor point list
  3. Signal/speaker list
  4. Auxiliary control list
  5. Feedback point list
  6. LED/switch status list
  7. Device sensitivity points list
- G. Scrolling thru menu options or lists shall be accomplished in a self-directing manner in which prompting messages shall direct the user. These controls shall be located behind an access door.
- H. The Control Panel shall have a 2 line x 40 character liquid crystal display which shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
- 2.4 SYSTEM FRONT PANEL OPERATION AND CAPABILITIES:
- A. Under normal condition the front panel shall display a "System Normal" message and the current time and date.
- B. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory condition.
- C. The LCD shall display the following information relative to the abnormal condition of a point in the system.
1. 40 character custom location label
  2. Type of device (i.e., smoke, pull station, water flow)
  3. Point status (i.e., alarm, trouble)
- D. Pressing the appropriate acknowledge button shall globally acknowledge every point in the list. These acknowledge functions may be pass-code protected if the user has insufficient privilege to acknowledge such conditions. A message shall indicate insufficient privilege but allow the user to view the points without acknowledging them. Should the user have sufficient privilege to acknowledge, a message will be displayed informing the user that the condition has been acknowledged.
- E. After all points have been acknowledged, the LED's shall glow steady and the audible alarm will be silenced. The total number of alarms, supervisory and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated by an end of list message "END OF LIST."
- F. Alarm Silencing: Should the "Alarm Silence" button be pressed, all audible alarm signals shall cease operation.
1. Signals shall not be silenced during alarm silence inhibit mode.
- G. System Reset: The SYSTEM RESET button shall be used to return the system to its normal state after an alarm condition has been remedied. The LCD display shall step the user thru the reset process with simple English Language messages.

1. Should an alarm condition continue to exist, the message, "SYSTEM RESET IN PROGRESS" will be followed by the message "SYSTEM RESET ABORTED", and the system will remain in an abnormal state.
  2. Should the Alarm Silence Inhibit function be active, the "SYSTEM RESET" key press will be ignored. The message, "SYSTEM RESET INHIBITED" will be displayed for a short time to indicate the action was not taken.
- H. History Logging: The system shall be capable of logging and storing 300 events in an alarm log and 300 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence.
- I. Silent Walktest with History Logging (Field Selectable): The system shall be capable of being tested by one person. While in testing mode the alarm activation of an initiating device circuit shall be silently logged as an alarm condition in the historical data file. The panel shall automatically reset itself after logging of the alarm. The momentary disconnection of an initiating or indicating device circuit shall be silently logged as a trouble condition in the historical data file. The panel shall automatically reset itself after logging of the trouble condition. After testing is considered complete, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.
1. Should the walk test feature be on for an inappropriate amount of time, it shall revert to the normal mode automatically.
  2. The control panel shall be capable of supporting up to 8 separate testing groups whereby one group or points may be in a testing mode and the other (non-testing) groups may be active and operate as programmed per normal system operation.
  3. Should an alarm condition occur from an active point, not in walk test mode, it shall perform operations described in Paragraph 1.6.
- J. LED Supervision: All slave module LED's shall be supervised for burnout or disarrangement. Should a problem occur, the LCD shall display the module and LED location numbers to facilitate location of that LED.
- K. System Trouble Reminder: Should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at preprogrammed time intervals to act as reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable to suit the Owner's application.
- L. Access Levels: There shall be four (4) access levels with level 4 being the highest level. Level 1 actions shall not require a passcode. Changes to passcodes shall only be made by authorized personnel. Access to a level will only allow the operator to perform all actions within that level plus all actions of lower levels, not higher levels. All keys, switches, and buttons shall have levels associated with them.
- M. RS-232-C Output: Fire Alarm Control Panel shall be capable of operating remote CRT's and/or printers; output shall be ASCII format and EIA RS-232-C connection with an adjustable baud rate. System shall be networked with (2) owner workstations.
- N. Auxiliary Devices:

1. Fire alarm auto dialer, call box, serial line, etc., and connections shall be coordinated and provided per owner requirements for interface to owner monitoring or local fire department.
- O. Equipment Enclosures: Provide cabinets of sufficient size to accommodate the aforementioned equipment. Cabinet shall be equipped with locks and transparent door panel providing freedom from tampering yet allowing full view of the various lights and controls.
- 2.5 ADDRESSABLE COMMUNICATION NETWORK:
- A. The system must provide communication with addressable initiating and control devices individually. Each of these devices will be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
1. Alarm
  2. Trouble
  3. Open
  4. Short
  5. Device missing/failed
- B. All addressable devices shall have the capability of being disabled or enabled individually.
- C. Up to 127 addressable devices may be multiplexed from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.
- D. The communication format must be a completely digital poll/response protocol to allow tapping of the circuit wiring.
- E. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable.
- F. There shall be no limit to the number of detectors, zone adapter modules, or stations which may be activated or "IN ALARM" simultaneously.
- G. All devices shall be supervised for trouble conditions. The system control panel will display the type of trouble condition in plain English. Should any device fail, it will not prevent the operation of other devices.
- H. Spare capacity shall be provided to allow for 20 percent more addressable points to be added to the fire alarm system without adding additional components after system is complete.
- 2.6 ADDRESSABLE DEVICE TYPES:
- A. General: Devices will be located as shown on the drawings. The location of addressable devices will be selected to optimize the system layout in order to provide the level of protection, zone identification and control as shown on the drawings.
- B. Environmental Compensation Analog Sensors:
1. Smoke sensors shall be a smoke density measuring device having no self contained alarm set point. The alarm decision for each sensor shall be determined by the control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to stored values. The control panel shall maintain a moving average of

the sensors smoke chamber value. Systems that do not automatically maintain constant smoke obscuration sensitivity for each sensor by compensating for environmental factors are deemed unacceptable.

2. The control panel shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value, a "Dirty Sensor" trouble condition shall be audibly and visually indicated at the control panel. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. If a "Dirty Sensor" is left unattended, and its average value increases to a second predetermined value, an "Excessively Dirty Sensor" trouble condition shall be indicated at the control panel for the individual sensor.
  3. The control panel shall automatically perform a daily self-test on each sensor. Checking the electronics in the sensor's base ensures the accuracy of the values being transmitted to the control panel. A sensor that fails the self-test will cause a "Self-Test Abnormal" trouble condition at the control panel. A sensor self-test which must be manually initiated by the operator shall not be acceptable.
- C. Addressable Detector Bases: All addressable smoke and heat detector heads will plug into their bases. The base will contain electronics that communicate the detector status (normal, alarm, trouble) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Detector heads (smoke or heat) must be interchangeable. Upon removal of the head, a trouble signal will be transmitted to the control panel.
- D. Photoelectric Detector Head: Photoelectric type detectors shall be of the solid state photoelectric type and shall contain no radioactive material. They will use a pulsed infrared LED light source and be sealed against rear air flow entry. The detector shall fit into an addressable base that is common with both the thermal and ionization type detectors.
- E. Thermal Detector Head: Thermal detector heads must be UL listed. They will be a combination rate-of-rise and fixed temperature (135 degrees F) type, automatically restorable unless fixed temperature (190 degrees F.) type is specifically required. The detector shall fit into an addressable base that is common with both the photoelectric and ionization type detectors. Provide addressable module for automatic restoring detectors that are not addressable.
- F. Pull Stations: Pull stations shall contain electronics that communicate the station's status (alarm, or normal) to the control panel over two wires which also provide power to the pull station. The address will be set on the station. They will be manufactured from high impact red Lexan. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations will be single/double action. The front of the station is to be hinged to a backplate assembly and must be opened with a key to reset the station. The addressable manual station shall be Underwriters' Laboratories Inc. listed for operation with the control panel. Manual pull stations shall function in a manner as to not send an alarm when opened for routine maintenance.
- G. Addressable Duct Smoke Detectors: The detector shall be non-polarized 24VDC type which is compatible with the fire alarm panel and obtains its operating power from the supervisory current of the addressable loop. The detector head shall be the same as the addressable photoelectric detector heads used in the rest of the system. Provide duct detectors compatible with the air velocities within the duct to be installed (ie. for low velocity ducts, provide an in-duct style detector). It shall be possible to test the detector by use of a remote alarm test switch. The duct detector housing shall contain the addressable electronics necessary to communicate with the control panel. For maintenance purposes, it shall be possible to clean the sampling tubes by access through the detector housing. To minimize

false alarms, voltage and transient suppression techniques shall be employed as well as automatic alarm verification circuitry and insect screens.

1. Each duct detector shall be provided with a remote alarm LED indicator and a key test switch.
  2. Programmable control module for interface with air handling equipment
  3. Provide access door(s) for in-duct style duct detectors.
- H. Adaptor Module: Adapter Modules shall be used for monitoring of waterflow, valve tamper, non-addressable detectors, and for control of smoke dampers, door holders, and other output control functions. Adapter Modules will be capable of mounting in a standard electric outlet box. Adapter Modules will include cover plates to allow surface or flush mounting. Adapter Modules will receive their 24VDC power from a separate two wire pair running from an appropriate power supply. There shall be two types of devices: Type 1; Monitor Adapter Modules - for conventional 2-wire thermal detector and/or contact device monitoring with Class B or Class A wiring supervision. Type 2; Control Adapter Modules - for signals, speakers, fire fighter phone jacks and other device control with Class B or Class A wiring supervision.
1. Provide modules as required for monitor of air sampling smoke detection points as follows:
    - a. Fire Alarm
    - b. Alert/Action
    - c. Trouble
  2. Provide modules as required for monitor and control of AC units such that the AC unit shall shut down upon detection of smoke at the unit or from any detector alarm within the space. Provide relays as required.
  3. Provide modules as required to monitor existing hardwired zones. Existing zone quantities and configurations shall remain, unless otherwise indicated or shown on the plans.

## 2.7 ALARM SIGNAL DEVICES:

- A. Fire Alarm Speaker Horn/Strobe Combination: Provide high impact resistant red Lexan speaker horn/strobe combination devices as shown on the plans. Each assembly shall consist of two independent devices which are manufactured as compatible with each other and with the control equipment. Each assembly shall provide a terminal strip or wire leads for true in-out wiring connections. The strobe unit shall have a candela-second rating in compliance with ADA requirements and be rated at 24 VDC. Strobes shall be clear with red letters "FIRE" on two sides.
  1. Provide wall mounting as shown on the plans. Verify manufacturer mounting requirements prior to rough in.
- B. Individual Strobe Unit: Provide strobe units mounted where shown. Units shall match those used in the combination horn/strobe or speaker/strobe specified.
- C. Where multiple strobe units are visible from a single location and the potential visible flash rate is 5 hz or more, provide synchronizing modules and strobes compatible for synchronizing as required. Provide additional wiring, conduit, and power supplies as necessary.

- D. Speakers/Horns have been located on the drawings. It is the Contractor's responsibility to provide adequate coverage to achieve 70 dBA at all locations throughout the building. If locations shown are inadequate, show additional speakers /horns on shop drawing submittal. Additional speakers/horns will be added at no additional cost to the contract including conduit wiring, power supplies, etc.
  - E. Bells: Provide vibrating, direct current, 10 inches gong with strobe, suitable for exterior mounting; manufacturers standard bells at sprinkler entries.
- 2.8 AUXILIARY DEVICES/EQUIPMENT:
- A. Magnetic Door Holder Devices: Provide door holders as shown on the plans. Release of doors shall occur on a verified alarm or after a general AC power failure in the building. Coordinate with Architect's Hardware schedule.
  - B. Remote test switches: Provide key type remote test switches at locations indicated on plans.
- 2.9 ONE-WAY VOICE COMMUNICATION:
- A. Provide one-way voice communication and tone generating capabilities at the control panel location.
  - B. A central audio control module shall be provided for the necessary alarm message/tone generation, main and remote microphone connections, music inputs and mixer/pre-amplifier circuits. Continuous supervision shall be provided. Audio outputs shall have individual gain control.
  - C. A hand-held, push-to-talk microphone shall be provided recessed within a protective panel-mounted enclosure. The microphone shall be a dynamic communication type with a frequency range of 200 Hz to 4000 Hz and shall be equipped with a self-winding five foot coiled cable. An LED indicator shall be provided to indicate microphone push-to-talk button has been pressed and speaker circuits are ready for transmission. Microphone shall be supervised from disconnection.
  - D. An audio control switch module shall be furnished to provide manual control of the audio functions. These switches and associated LED indicators shall be supervised from disarrangement or failure.
  - E. Audio power amplifiers shall be furnished with self-contained filtered 24VDC power supply, transformer and amplifier monitor circuits. Amplifiers shall provide a 25 VRMS output with a frequency response of 120 Hz to 12,000 Hz. Provide a sufficient quantity of amplifiers to operate all system speakers simultaneously plus ten (10) percent space capacity. In addition, provide at least one back-up amplifier capable of automatically replacing any failed amplifier.
  - F. Speaker circuits shall be supplied which are capable of supplying audio signals at 25 VRMS supplied by the system amplifiers. Supervision for open, short or ground fault conditions shall be provided. Individual and distinct trouble indications shall be provided for each fault. Provide one circuit for each zone or area of distinct communication.
  - G. Tones: 3-Tone Temporal Pattern:
    - 1. Temporal Pattern
  - H. A pre-recorded digitized voice message capability shall be provided for automatic transmission to building occupants during alarm conditions. Three (3) messages shall be

provided, one for alarm evacuation, one for testing and one as designated by the Owner for Owner's use. This message player shall not rely on a tape or other mechanical means of transmitting the evacuation message. Those systems that do use tape players must provide a backup player designed to automatically operate should the primary device jam or otherwise fail to operate. A standard evacuation message shall be provided under this contract, however, the message player must be capable of transmitting a customized message of up to 4 minutes long. A self-contained speaker will provide testing of the message(s) without disturbing the occupants of the facility. The Owner must provide the manufacturer with the messages in transcript form.

- I. Automatic Voice Evacuation Sequence: The audio alarm signal shall consist of an alarm tone for a maximum of 10 seconds followed by automatic pre-selected voice evacuation messages. At the end of each voice evacuation message, the alarm tone shall resume. The alarm tones shall sound until the alarm silence switch at the fire alarm control panel has been operated. All audio alarm operations (speaker circuit selection and alarm tone/voice message timing variations) shall be activated by the system software so that any required future changes to the evacuation sequence can be facilitated by authorized personnel without any component rewiring.
- J. Manual Voice Paging Sequence: The system shall be configured to allow selective voice paging. Upon activation of any speaker manual control switch, two (2) seconds of tone shall sound over the speakers indicating an impending voice message will occur. If any speaker manual control switches are activated, the control panel operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers. Facility for total building evacuation and paging shall be provided to allow for activation of speakers. This shall be accomplished by the means of an "All Circuit" switch.

#### 2.10 PRINTER AND VISUAL DISPLAY:

- A. Provide a portable printer and visual display. Printer shall receive English language text from the fire alarm control panel in an industry standard ASCII format via an EIA RS-232-C connection.
- B. All printed information shall include time and date.
- C. The printer shall be 80 column and provide a hardcopy record of system events. Printer shall support the following features:
  - 1. 120 VAC input power
  - 2. Impact dot matrix
  - 3. Cartridge type ribbon
  - 4. Friction feed for cut forms
  - 5. Tractor feed for continuous 9-1/2 inches wide pin-to-pin fanfold paper
  - 6. UL 864 listed (UOXX)
- D. A portable visual display with keyboard shall provide an English language display with time and date of system events. Display shall display a minimum of 24 lines of information. Information on the screen shall not scroll off until an acknowledge key is pressed. Display shall be easy-to-read, non-glare. Include a composite video output to drive slave CRT's. Keyboards shall provide the following functionality:
  - 1. Acknowledgement of alarms, troubles and supervisory conditions.
  - 2. Alarm silence
  - 3. System reset
  - 4. Time & Date

5. Alarm, Trouble, and Supervisory service condition summary screens.

#### 2.11 GRAPHIC ANNUNCIATOR (POINT ANNUNCIATOR):

- A. General: Replace or modify the existing annunciator as required. The annunciator shall consist of a building floor plan display mounted on a backbox enclosure with LEDs to indicate alarm status of the fire alarm system including location of a device in alarm. The graphic annunciator shall be Underwriters Laboratory listed. Mounting location shall be approved by the local Fire Marshall or the authority having jurisdiction.
  1. The annunciator shall communicate with the control panel via one twisted shielded pair of wires. Operating power shall be 24 VDC and shall be fused at the control panel.
- B. Display: Replace or modify the existing laminate within the display panel. The display panel shall be a full color acrylic laminate with ultraviolet coating. The image shall be a full color image on a white, 1/8 inch acrylic backing. The graphic image shall include, but not be limited to, the following information:
  1. Building outline, including address and adjacent streets.
  2. All exterior doors.
  3. Fire alarm control panel.
  4. Sprinkler control valves.
  5. Utility controls (electrical, natural gas, water).
  6. Fire department connection.
  7. Main area separations.
  8. Compass direction reference (orient the map).
  9. Map location ("YOU ARE HERE" with arrow).
  10. Map location, fire alarm control panel, sprinkler valves and Fire Department connections must be highlighted in RED.
  11. Room names and numbers as labeled in the building.
  12. At each duct detector: indicate HVAC unit designation and function (i.e. supply or return).
  13. Legend of devices and other symbology.
  14. Each fire detection and alarm device with addresses at each addressable device.
  15. Indicate all floor levels, interstitial levels, shafts, attic spaces, etc.

#### 2.12 GRAPHIC MAP:

- A. Replace or modify the existing graphic map as required. The graphic map shall be a full color image on a white background mounted on a rigid backing and shall have an ultraviolet inhibitor laminated on the front. Provide a clear, anti-glare, Lexan panel cover and mount map within a black anodized aluminum frame. Provide a concealed secured hanging system. Location of map shall be approved by the local Fire Marshall or the authority having jurisdiction. The graphic map shall include, but not be limited to, the following information:
  1. Building outline, including address and adjacent streets.
  2. All exterior doors.
  3. Fire alarm control panel.
  4. Sprinkler control valves.
  5. Utility controls (electrical, natural gas, water).
  6. Fire department connection.
  7. Main area separations.
  8. Compass direction reference (orient the map).
  9. Map location ("YOU ARE HERE" with arrow).
  10. Map location, fire alarm control panel, sprinkler valves and Fire Department connections must be highlighted in RED.

11. Zone area separations and designations.
  12. Room names and numbers as labeled in the building.
  13. Each duct detector; indicate HVAC unit designation and function (i.e., supply or return).
  14. Legend of devices and other symbology.
  15. Location of all individual devices.
  16. Each fire detection and alarm device with addresses at each addressable device.
- B. Provide building zone map showing each floor at each remote annunciator and include essential escape information unless otherwise specified.
- C. Provide a building graphic map at the main control panel.
- 2.13 REMOTE ANNUNCIATOR:
- A. Where shown on the plans, provide a Serial LCD annunciator. Annunciator shall include 40 character LCD display, alarm silence, system reset, programmable control switches, and be supervised from the FACP panel.
1. Annunciator shall indicate each alarm initiating device or zone by address and description. Alarm conditions shall be indicated for each addressable alarm initiating device.
  2. The annunciator shall communicate with the control panel over one twisted shielded pair of wires. Operating power shall be 24 VDC and shall be fused at the control panel.
- B. Provide remote annunciators at the main entrance lobby and at each elevator lobby for multiple floor buildings, and where shown.

### PART 3 EXECUTION

- 3.1 EXAMINATION:
- A. Examine areas and conditions under which fire alarm systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- B. Prior to the execution of any work, it shall be the contractor's responsibility to perform a complete function test and provide a point report to identify any and all deficiencies in the existing system.
1. Test results shall be documented and reported to LPS, including smoke detector contamination levels.
- 3.2 IDENTIFICATION:
- A. Provide electrical identification in accordance with Division-16 section on Electrical Identification.
- 3.3 INSTALLATION OF BASIC WIRING SYSTEM MATERIALS:
- A. Install wiring, raceways, and electrical boxes and fittings in accordance with Division 16 sections; "Raceways", "Wires and Cables", and "Electrical Boxes and Fittings".
- B. Install all wiring in concealed and exposed spaces in raceway. Wiring above accessible ceilings may be wild-run, plenum rated cable. All wild-run, plenum rated cable shall be

supported by bridged rings. Any and all fire alarm cable shall be run separately and independently supported.

- C. Cable above accessible ceilings shall be run on a separate, dedicated J-hook on the cable management system.
- D. Install wires and cables without splices. Make connections at terminal strips in cabinets or at equipment terminals. Make soldered splices in electronic circuits in control cabinets.
- E. T-taps will not be allowed unless specifically authorized by LPS Property Management Services.
- F. LPS wire standards shall be followed.
- G. Junction box covers shall be red in color and clearly labeled to identify conductors within.

#### 3.4 INSTALLATION OF FIRE ALARM SYSTEMS:

- A. Fire alarm work shall in no way disrupt or impede the educational activity by students.
- B. Install fire alarm system as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "Standard of Installation."
- C. Provide dedicated primary power source and clearly identify panel and circuit designation at the fire alarm panel.
  - 1. Where available, the primary power source shall be emergency.
  - 2. Fire alarm system sequence of operation and zone allocation shall be defined by LPS.
  - 3. Provide a manual pull station within 6'-0" of FACP and programmed with no delay.
- D. Wiring: Wiring of fire alarm system is not specifically detailed on drawings. Refer to the manufacturer's shop drawings for detailed wiring and connection information.
  - 1. Complete wiring in accordance with manufacturer's requirements. Color code wiring and install per manufacturer's point-to-point wiring diagram. Determine exact number of wires for each fire area zone from number and types of devices installed. Connect each device with sufficient wiring to complete its intended operation.
  - 2. Where there are a number of power requiring devices such as smoke detectors, fan relays, door holders and smoke damper operators installed in a circuit, group in numbers so power required does not exceed 80 percent of manufacturer's power supply rating. Provide extra wiring, or extra power supplies required to fulfill that requirement. In addition, provide extra or larger size wiring to alleviate voltage drops which makes device operate beyond voltage limits for which it was designed. Determine above with manufacturer's representative while equipment is being installed.
  - 3. Where an existing system is present it shall remain in operation while the new system is being installed, tested, and accepted.
  - 4. Mount audible and visual devices per NFPA 72, 2002 requirements.
  - 5. Provide "green" tape label of all fire alarm cabling entering a device. Do not provide a tape label on cabling leaving the device.

- E. Duct smoke detectors shall not be installed outside the building envelope.
- F. All fire alarm devices shall be installed in accessible locations and clearly marked with LPS approved labels to identify device address, circuit and function.
- G. Remove all unused portions of existing fire alarm systems.
- H. Upon completion of construction, existing portions of the fire alarm system to be restored to original or better condition.
- I. Levels of contamination within smoke detectors shall not exceed levels found prior to construction activity.

### 3.5 FIELD QUALITY CONTROL:

- A. Installation Supervisor shall hold a Colorado State Journeyman Electrical license; have a minimum of five years installation and/or NICET level two or better certification.
- B. Connection and Supervision: Make connections to panel under manufacturer's supervision. Complete connections from this cabinet to panel utilizing Manufacturer's technicians.
- C. Where work consists of additions or extensions to existing system, prior to starting work, establish that system is in proper working order. If condition exists which prevents normal operation of specified additions and extensions, bring this fact to Architect/Engineer's attention prior to doing work affecting existing system. Where work is done without such notification, it is assumed that connections have been made to a working system, and performance requirements and guarantee will apply to entire system.
- D. System Test and Approval: Submit shop drawings for function and operation only, pre-approved by authority having local jurisdiction.
  - 1. Prior to final acceptance of system, manufacturer shall, in presence of Contractor and Owner's Representative, test each sensing or detection and alarm device including devices and equipment interlocks such as equipment shutdown and smoke dampers. Schedule test with Architect/Engineer prior to testing.
  - 2. The completed fire alarm system shall be fully tested in accordance with NFPA 72 by the contractor in the presence of the Owner's representative and the Local Fire Marshal. Upon completion of a successful test, the contractor shall so certify in writing to the owner and general contractor using forms recommended by NFPA 72.
  - 3. The contractor shall coordinate the testing of each fire alarm detector installed under this project with the fire department and forward a completed checklist showing each detector operated properly and that proper indication of detector operation occurred at all control panels, annunciator panels, remote indicators, remote test switches, etc. In addition, proper interlocks, door release, etc. shall be documented with specific equipment affected listed by identifier.
  - 4. Submit copy of test results in duplicate after signed by Owner's Representative to Architect/Engineer, Owner, and local Fire Protection Authority. Mount copy of inspection record in Lexan enclosed frame assembly on control panel.

- E. Under no circumstances shall the fire alarm system be accepted until LPS Property Management Services signs off stating it has accepted the system in its entirety. Until that time the installer shall remain responsible for the system.
- 3.6 MAINTENANCE CONTRACT:
- A. The equipment manufacturer shall make available to the owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA 72 guidelines.
- 3.7 WARRANTY:
- A. The Contractor shall guarantee all equipment and wiring free from inherent mechanical and electrical defects for a period of one year beginning after one month of trouble free service and upon receipt of all construction documents including but not limited to; accurate record drawings, graphic maps, fire alarm program, software, operation and maintenance (O & M) manuals and test records.
- 3.8 OPERATING AND MAINTENANCE INSTRUCTIONS:
- A. Contact LPS personnel to schedule pre-test and final testing.
  - B. On completion of the work, the equipment manufacturer shall provide training for two maintenance personnel to a level equal to a "Factory-Certified Technician". The training shall be conducted at the vendor's local office or the Factory.
  - C. Provide three (3) copies of Operating and Maintenance Instructions in hardback, three-ring binders covering all equipment furnished. Manuals shall include the following information:
    - 1. Name, address and telephone number of authorized service organization to be contacted for each equipment item. The local fire alarm supplier shall have a 24 hour telephone response service. An answering machine shall not be considered acceptable.
    - 2. Parts list and wiring diagram, operating and maintenance instructions for each piece of equipment.
    - 3. Shop drawings corrected to show as-built conditions.
    - 4. Record of voltage sensitivity for each ionization detector head as recorded during final calibration.
    - 5. All wiring diagrams shall show color coding of all connections and mounting dimensions of equipment.
  - D. Fire alarm system will not be considered as functional until Fire Department and LPS approvals have been received.
  - E. Provide an NFPA 72 "Record of Completion" form to document fire alarm system final acceptance.
  - F. Contractor shall update log book(s) for existing fire alarm systems.
  - G. Engineer shall provide final "Record Drawings" in AutoCAD format for LPS use.

3.9 DEMOLITION:

- A. Upon completion of new fire alarm system, after final connections have been made, this contractor shall carefully remove all existing fire alarm apparatus where indicated, including fire alarm control panel, manual stations, audible signals, etc., and turn all such equipment over to Owner.

3.10 PAINTING AND PATCHING:

- A. Contractor shall paint all exposed conduit to match adjacent surfaces. All surfaces or finishes damaged as a result of this work shall be properly patched, painted and/or repaired by trained craftsmen of the trade involved.
- B. Contractor shall patch and paint where old devices are removed unless the old devices are in block walls or in concrete, where the Contractor shall provide blank plates on boxes. Blank plates shall be painted to match adjacent surfaces.

END OF SECTION 16721