

## SECTION 16620

### FIRE ALARM SYSTEM

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
1. Complete fire alarm system equipment for all existing Juvenile Hall campus facilities.
  2. Fire alarm control panel (FACP).
  3. Initiating devices.
  4. Notification devices.
  5. HVAC shutdown wiring via dry contacts in duct mounted smoke detector.
  6. Reconnection of existing smoke control panels.
  7. Fire alarm auxiliary equipment control.
  8. Shop drawings and permit submittal.
  9. Record drawings.
  10. Pretesting and final testing.
- B. Work furnished and installed under another Section, but connected under this section:
1. Fire sprinkler alarm system flow switches, valve monitors and post indicating valves.
  2. Door hold-open/closure devices without integral smoke detectors.
  3. Fire barrier roll-down doors and shutters.
  4. Fire/smoke dampers.
- C. Work furnished, wired and connected to alarm system under this Section:
1. Duct mounted smoke detectors.
  2. In-duct mounted smoke detectors for fire/smoke damper control.

##### 1.02 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
1. American National Standards Institute, Inc. (ANSI):
    - a. ANSI C62.41; Guide for Surge Voltage in Low-Voltage AC Power Circuits.

2. National Fire Protection Association (NFPA):
  - a. NFPA 72; National Fire Alarm Code.
  - b. NFPA 101; Life Safety Code.
3. Underwriters Laboratories, Inc. (UL):
  - a. UL 38; Manually Actuated Signal Boxes for Use with Fire-Protective Signaling Systems.
  - b. UL 268; Smoke Detectors for Fire Protective Signaling Systems.
  - c. UL 268 A; Smoke Detectors for Duct Application.
  - d. UL 464; Audible Signal Appliances.
  - e. UL 521; Heat Detectors for Fire Protective Signaling Systems.
  - f. UL 864; Control Units for Fire Protective Signaling Systems.
  - g. UL 1638 Visual Signaling Appliances Standard.
  - h. UL 1971 Signal Devices for Hearing Impaired.
4. Factory Mutual System (FM) approval guide.
5. State of California
  - a. CBC California Building Code, Title 24
  - b. CFC California Fire Code
  - c. CEC California Electric Code

### 1.03 DEFINITIONS

- A. Alarm signal: A signal that indicates a state of emergency requiring immediate notification of the fire department and building occupants.
- B. Supervisory signal: A signal that indicates the impairment of a fire protection system, which may prevent its normal operation.
- C. Trouble signal: A signal that indicates that a fault, such as an open circuit or ground, has occurred in the fire alarm system or in a separate subsystem monitored by the fire alarm system.
- D. Initiating device: A system component that originates transmission of a change of state condition, which initiates an appropriate response via the fire alarm system.
- E. Notification device circuit: A circuit to which notification devices are connected to visually and audibly indicate an alarm signal.
- F. Signaling line circuit: A circuit to which any combination of circuit interfaces, control units, or transmitters are connected and over which multiple system input signals or output signals are carried.
- G. Class B wiring: A circuit that is monitored for integrity such that a single break, a single wire-to-wire short, or a single loss of carrier condition will be indicated by a trouble signal on the FACP no matter where the break,

short or loss of carrier condition occurs, but which would prohibit devices beyond the fault, short or carrier loss from remaining operational. This would be Style 3 wiring for signaling line circuits, Style B for initiating device circuits, and Style Y for notification device circuits.

#### 1.04 SYSTEM DESCRIPTION

- A. The fire alarm system shall provide point identification of all networked devices. It shall be 24V DC closed circuit, electronically supervised, common signaling, device indicating, automatic alarm type; operating from manual pull stations, smoke detectors, heat detectors and sprinkler system switches.
- B. Provide system with the following circuit functions:
  - 1. Style B for initiating device circuits.
  - 2. Style 3 for signaling line circuits interconnecting the riser loop or network.
  - 3. Style Y for notification device circuits.
- C. Activation of any alarm initiating device shall:
  - 1. Cause all audible and visible evacuation alarm devices to sound and/or pulse throughout the system until silenced at the central control operator's station. Provide coverage as indicated on the plans.
  - 2. Release all door hold-open/closure devices, roll-down doors and smoke dampers.
  - 3. Indicate the zone of the initiating device in alarm at the FACP.
  - 4. Transmit alarm signal to central control annunciator panel.
- D. Activation of smoke detectors in HVAC ducts shall shut down associated air handling equipment.
- E. Activation of smoke detectors at fire/smoke dampers shall cause associated dampers to close.
- F. System shall provide supervisory signals for the following:
  - 1. System trouble, consisting of:
    - a. Removal of an initiating device from any circuit.
    - b. An open or ground fault in any initiating circuit.
    - c. An open, short or ground fault in an annunciation circuit.
    - d. A ground fault on any DC line.
    - e. Removal of system input, output, or control modules.
    - f. Improper condition of battery or charger.
  - 2. Sprinkler valve monitor (tamper) switch.
  - 3. Post indicating valve.
- G. Failure of any circuit supervised by the FACP shall:
  - 1. Cause the trouble buzzer at the FACP to sound continuously until silenced.

2. Cause the offending device to illuminate the trouble light on the FACP.
3. Transmit a trouble signal to remote annunciator at the central control operator's station.

H. Failure of AC Power shall:

1. Cause the trouble buzzer at the FACP to sound continuously until silenced.
2. Cause automatic transfer to standby battery. All system functions shall be operational during power failure.

1.05 SUBMITTALS

A. Submit the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
2. Describe system operation, equipment, and dimensions and indicate features of each component.
3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
4. Shop drawings to include:
  - a. Plot plans and building floor plans.
  - b. Point-to-point wiring diagram in block or riser format showing all fire alarm components, conduit and wire types and sizes with cable legend.
  - c. Provide 1/4" scale plan of equipment layout in FACP control room, adjoining central control room.
  - d. Include elevations of control panel and remote annunciator panel(s).
5. Battery standby calculations showing total standby power needed to meet the specified system requirements.
6. Submit manufacturer's installation instructions.
7. Complete Bill of Material listing all components. Provide state fire marshal listing number for each device.
8. Warranty.
9. Annual service proposal with separate pricing for 3 one year periods starting year 3 of installation.

B. Contractor shall submit approved shop drawings for review by local fire marshal prior to the purchase and installation of equipment.

C. Record Drawings:

1. Furnish Record Drawings, utilizing shop-drawing submissions with updated field conditions. These drawings shall include but not be limited to the following:
  - a. Plot plans and building floor plans, showing point-to-point wiring location of and conduit routing to all devices.

b. Block Diagram/Riser Diagram showing the FACP, system components and all wire type/sizes between each.

2. Drawings shall be incorporated into the Record Drawing submission.

3. Final acceptance will not be made until the owner has approved the Record Drawings.

#### 1.06 OPERATION AND MAINTENANCE MANUAL

A. Supply operation and maintenance manuals in accordance with the requirements of Section 16010: Basic Electrical Requirements, to include the following:

1. A detailed explanation of the operation of the system.

2. Instructions for routine maintenance.

3. Pictorial parts list and part numbers.

4. Schematic drawings of wiring system, including all initiation and annunciation devices, control panel, annunciators, etc.

5. Telephone numbers for the authorized parts and service distributors.

6. Final testing report.

#### 1.07 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein, shall be new and unused, and of current manufacture.

B. Only products and applications listed in this section may be used on the project unless otherwise submitted.

#### 1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Fire alarm system components shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no cost to Owner.

B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation.

C. Handling: Handle in accordance with manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

#### 1.09 WARRANTY

A. Units and components offered under this Section shall be covered by a 2 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the owner.

B. The warranty package shall include, but not be limited to the following:

1. Emergency maintenance service.

2. Service by factory trained service representative of system manufacturer.

3. Replacement of any defective components.

#### 1.10 SYSTEM START-UP

- A. Upon completion of each installation, a factory trained dealer service representative shall perform initial start-up of the fire alarm system. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the owner's witnessed test shall begin.

#### 1.11 MAINTENANCE

- A. Extra Material:
  1. Provide the following fire alarm system components as extra materials, matching the products installed and packaged for storing.
    - a. Manual pull station: Furnish a quantity equal to 10 percent of the number installed.
    - b. Detectors: Furnish a quantity equal to 10 percent, for each type of the number installed.
    - c. Strobe and Horn/strobes: Furnish a quantity equal to 10 percent of the number installed.
- B. Maintenance Service:
  1. For a period of two years following acceptance the equipment supplier shall have a person(s) familiar with this project attend four quarterly inspections and meetings with the Owner's representative to review system performance, operation and any system problems. That person shall provide a written summary of the items discussed in each meeting and a schedule of when the system problems will be corrected. The report is due within 7 working days after each meeting.
  2. During the eleventh month following system acceptance, on off hours acceptable to the facility, the equipment supplier shall perform a complete test of the system, in a manner similar to the acceptance test. A written report shall be submitted to the Owner certifying that each initiating device has been tested. A copy of these test forms shall be submitted to the owner for review and acceptance.
  3. Provide service proposal with bid alternate pricing for this maintenance for 3 one year periods starting year 3 of installation. (For total of 5 years.)

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
  1. EST.
  2. Fire Control Instruments (FCI).
  3. Notifier.
  4. Siemens.
- B. Substitutions: Under provisions of construction contract.

## 2.02 CONTROL PANEL (FACP)

- A. Control panel: Shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a neat, compact assembly containing all components and equipment required providing the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic or metal identification plates for all lamps, zones, controls, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble lamp shall be provided for each individual addressable device alarm initiating circuit located on exterior of cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices. Lamps shall be plainly visible when the cabinet of the control unit is closed. Initiating circuits shall have plug-in cards or modules for ease of servicing. Modules or cards shall be removable without disconnecting wiring. Signals shall be provided to indicate by individual addressable device any alarm, supervisory or trouble condition on the system. Each initiating circuit shall be powered and supervised so that a signal on one device does not prevent the receipt of signals from other devices. Loss of power, including any or all batteries, shall not require the reloading of a program from any source. Upon restoration of power, start-up shall be immediate, automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Enclosures shall be provided with ample gutter space to allow proper clearance between the enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single enclosure large enough to accommodate all units. Provide capability to expand system (future) by 30%.
- B. Power supply: Adequate to serve control panel modules, initiating devices, annunciating devices, remote annunciators.
- C. Storage batteries: Shall be provided and shall be the sealed type. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 24 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm annunciating devices in the total alarm mode for a period of 5 minutes. Batteries shall be sized to deliver 50 percent more ampere/hours than required for the calculated capacities. Battery cabinet shall be a separate compartment within the control panel cabinet.
- D. Battery charger: Shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 8 hours. Pilot light shall indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided
- E. Auxiliary relays: Provide sufficient SPDT auxiliary relay contacts for each initiating device to provide accessory functions specified.

## 2.03 INITIATING DEVICES

- A. System alarm initiation devices shall be furnished and installed where indicated on the drawings.
  - 1. Detectors not listed for sensitivity testing from the control panel shall not be deemed acceptable due to the additional maintenance expense involved in the required removal, calibrated smoke generation and testing as described by N.F.P.A 72.
  - 2. Sensitivity testing performed from the control panel shall be logged by the system printer or stored in system memory as specified, as a permanent record of the performance of code mandated testing.
  - 3. Detectors shall be operational with addressable relay bases, addressable audible bases and remote indicating LED's, programmable by the control panel and controlled by the detector electronics. They shall be supplied and installed with one of these options where required by the operational requirements of this specification.

4. Detector shall be readily disassembled without the requirement for special tools to gain access to the detection chamber for cleaning and maintenance.
  5. Detectors shall be assigned a sensitivity level for alarm threshold by the central controller, if not programmed to respond to a specific fire occupancy profile, based on environment, time of day or other programmable functions as required by the system user and shall respond at that level whether in the online mode or default mode.
- B. Manual pull stations: Shall conform to the applicable requirements of UL 38. Manual stations shall be connected into alarm initiating circuits. Stations shall be double action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable; however, stations employing glass rods are acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they shall operate. Stations shall have a separate screw terminal for each conductor.
- C. Heat detectors: Shall conform to the applicable requirements of UL 521. Detectors shall be designed for detection of fire by combination fixed temperature and rate-of-rise principle. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication that is readily visible. Rating for fixed temperature portion shall be 135 degrees F. Detectors shall have screw terminals for making all wiring connection. Detectors shall be of the low profile type.
- D. Smoke detectors: Shall conform to the applicable requirements of UL 268:
1. Ionization detectors: Containing a dual chamber shall be responsive to both invisible and visible particles of combustion. One chamber shall be a reference chamber and the second a sampling chamber. Detectors containing radium shall not be provided. Detectors shall not cause an alarm condition due to anticipated fluctuations in relative humidity. The sensitivity of the detector shall be field adjustable to compensate for operating conditions. Detector shall require no replacement or readjustment to restore it to normal operation after an alarm condition. All components shall be corrosion resistant. Detectors shall have at least a two-stage sensitivity setting, with detectors initially set for normal sensitivity. A lower sensitivity shall be available for each detector. The lower sensitivity shall be within the limits established for that detector by UL or FM.
  2. Photoelectric detectors: Shall be designed for detection of abnormal smoke densities. Detectors shall consist of separate transmitter and receiver units. The transmitter unit shall emit an infrared beam to the receiver unit. When the signal at the receiver falls below a preset sensitivity, the detector shall initiate an alarm. The receiver shall contain an LED that is powered upon an alarm condition. Long-term changes to the received signal caused by environmental variations shall be automatically compensated. Detectors shall incorporate features to assure that they are operational; a trouble signal shall be initiated if the beam is obstructed, the limits of the compensation circuit are reached, or the housing cover is removed. Detectors shall have multiple sensitivity settings in order to meet UL listings for the different distances covered by the beam.
  3. Duct smoke detectors: Shall have a duct housing, mounted exterior to the duct, and with perforated sampling tubes. Activation of a detector shall cause shutdown of the associated air-handling unit via auxiliary contact base. Detectors shall be rated for the air velocity to be expected.
  4. In-duct smoke detector: Shall have external mounted box with relay output and sensor head mounted within duct. Activation of detector shall cause associated fire/smoke damper to close via auxiliary contact base.

## 2.04 NOTIFICATION DEVICES

- A. Horns, strobes and combination horn/strobes:
1. Shall be flush-mounted in all finished areas and surface mounted in all equipment areas.

2. Horn: Wall mounted, 24 volt DC, and minimum 92dB sound level at 10 feet.
  3. Strobe: Wall mounted, 24 volt DC, 15, 30, 75, 110 candela at a rate of 1 flash per second, white Lexan lens.
  4. Combination horn/strobes shall operate simultaneously from one power supply.
- B. Annunciator panel: Shall be part of the FACP. Provide LCD annunciator.
1. LCD Annunciator shall have a two line by 40-character LCD display. Dedicated LED lamps shall light upon activation of any alarm, supervisory or trouble condition and a tone-alert shall sound. The backlit alphanumeric liquid crystal display (LED) shall indicate type of alarm, number of alarms, supervisory conditions, and troubles in the system, and a custom location designation. Annunciator shall include control switches for system acknowledgments, alarm silence and system reset. Each addressable device on the system shall be displayed at the control panel display.
- C. Remote Annunciator: Provide remote LCD annunciator at central control operator's station.
1. Remote LCD annunciator: Shall have a two line by 40-character LCD display. Dedicated LED lamps shall light upon activation of any alarm, supervisory or trouble condition and a tone-alert shall sound. The backlit alphanumeric liquid crystal display (LED) shall indicate type of alarm, number of alarms, supervisory conditions, and troubles in the system, and a custom location designation. Annunciator shall include control switches for system acknowledgments, alarm silence and system reset. Information is transmitted to the annunciator over a single twisted, shielded pair cable. Annunciator shall be flush mounted in NEMA 1 enclosure for interior applications. Each addressable device on the system shall be displayed at the control panel display.

## 2.05 AUXILIARY EQUIPMENT CONTROL

- A. Under this Section, provide connections to the following equipment to activate control sequence of operation:
1. Door hold-open/closure devices: Provide dry contacts to each door hold-open/closure device for power to and release of doors.
  2. Roll-down fire doors and shutters: Provide a set of dry contacts in the FACP to each roll-door fire door or shutter for release of door.
  3. Fire/smoke dampers: Provide dry contacts to each fire/smoke damper for automatic closure of dampers. If required by code or local fire marshal, provide a hand-off-auto with in FACP for manual control of dampers with LED lights to indicate when each damper is opened or closed. Additional wiring is required to each damper limit switch monitor status.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Contractor shall thoroughly examine site conditions for acceptance of fire alarm system installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### 3.02 INSTALLATION

- A. General:

1. Install fire alarm system in accordance with manufacturer's written instructions, as shown on the drawings and as specified herein.
2. The 120-volt, 3 wire, 60 cycles AC required to power the system shall be connected as shown on the Drawings. Connect to red colored circuit breaker(s) in panelboard. Identify circuit as "Fire Alarm Circuit Control."

B. *Wiring (If required in addition to existing wiring):*

1. Wiring for shielding certain conductors from others or routing in separate raceways, shall be as recommended by the manufacturer's current requirements.
2. All wiring shall be installed in a continuous steel conduit system and shall be of the size recommended by the equipment supplier.
3. Wire color-coding shall remain the same throughout the system.
4. No wiring other than that directly associated with fire alarm detection, alarms, or auxiliary fire protection functions (no 120 VAC), shall be permitted in fire alarm conduits.
5. Make conduit and wiring connections to sprinkler flow switches, P.I.V., sprinkler valve monitors, door hold-open/closure devices, smoke dampers.
6. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.
7. All fire alarm junction boxes shall be color-coded and marked.
8. Wire nut splices are not allowed.
9. Wires shall be numbered at each connection, termination and junction point. Wire numbering tags shall be Brady Perma-Code, Westline, or equal wire makers. Each group of wires shall be tagged with its destination at each panel, terminal box or junction box.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's field service: Contractor shall arrange and pay for the services of a factory-authorized service representative to:
1. Attend a preconstruction meeting to coordinate equipment and device locations, power, fire smoke damper, duct detector, HVAC unit shutdown, etc. requirements and interfaces with other equipment.
  2. Supervise the initial start-up, pretesting and adjustment of the fire alarm system.
  3. Facility inspector witnessed testing.
  4. Fire Marshal witnessed testing.
  5. Owner training.
- B. At least three weeks prior to any testing, notify the owner's representative so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the engineer's witnessed test.
- C. Pre-functional testing:

1. Provide testing agency with contract documents and manufacturer instructions for installation and testing.
  2. Visual and mechanical inspection:
    - a. Inspect for physical damage, defects alignment and fit.
    - b. Perform mechanical operational tests in accordance with manufacturer's instructions.
    - c. Compare nameplate information and connections to contract documents.
    - d. Check tightness of all control and power connections.
    - e. Check that all covers, barriers, and doors are secure.
  3. Electrical tests:
    - a. The system shall be completely tested prior to final acceptance testing. All points shall be tested from point of initiation to the final point or points of annunciation. All circuits shall be tested for continuity and ability to transmit the required signal correctly to the FACP. Any problem due to wrong wire type, wire twist, impedance, mismatches, noise filtering or shielding shall be completely corrected during pretesting and prior to any final acceptance tests.
    - b. Testing shall include each and every device in the system. Coordinate with other trades as necessary for testing.
      - 1) Sprinkler flow switches: Record time delay from water flow to alarm and adjust as necessary for a 30-50 second delay.
      - 2) Tamper switches: Verify "trouble" signal is received and alarmed on closing of each valve.
      - 3) Smoke detectors and duct smoke detectors: Test with actual or approved artificial smoke. Verify that reset does not occur when devices are cleared of smoke. Verify supervisory circuit function. Perform pressure differential test on all duct mounted smoke detectors.
    - c. Test Report:
      - 1) Provide a complete report listing every device, the date it was tested, the results and the date retested (if failure occurred during the previous test). The test report shall indicate that every device tested successfully.
      - 2) Submit two typed copies of the test report on 8-1/2" x 11" paper in a neatly bound folder for approval. Failure to comply with this will result in a delay of final testing and acceptance.
- D. Functional performance testing:
1. Coordination of the Final Test dates with all parties shall be the sole responsibility of the Contractor. If a party is required to be present during any phase of testing to activate a device, ensure that the party or a qualified representative of the party is present throughout that phase of the testing.

- E. In the event that the system fails to function properly during the testing as a result of inadequate pretesting or preparation. The contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the engineer's hourly rate.
- F. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- G. Contractor shall submit the testing agency's final report for review prior to project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

#### 3.04 TRAINING

- A. Factory authorized service representative shall conduct two 2 hour training seminar for Owner's Representatives upon completion and acceptance of system. Training seminars shall be scheduled as selected by the owner. Include all costs based on the training seminars being schedule on separate days. It is likely that the second seminar will be scheduled after the owner moves into the facility. Instructions shall include safe operation, maintenance and testing of equipment with both classroom training and hands-on instruction.
- B. Contractor shall schedule training with a minimum of 7 days advance notice.

**END OF SECTION**