

## SECTION 287220 - FIRE ALARM SYSTEMS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. This Section includes fire alarm system.

#### 1.02 SYSTEM DESCRIPTION

- A. Non-coded, addressable system; multiplexed signal transmission dedicated to fire alarm service only.

#### 1.03 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72.
- B. Fire alarm signal initiation shall be by one or more of the following devices:
  - 1. Manual stations.
  - 2. Heat detectors.
  - 3. Smoke detectors.
  - 4. Automatic sprinkler system water flow.
- C. Fire alarm signal shall initiate the following actions:
  - 1. Alarm notification appliances shall operate continuously.
  - 2. Identify alarm at the FACP and remote annunciators.
  - 3. Transmit an alarm signal to the remote alarm receiving station.
- D. Supervisory signal initiation shall be by one or more of the following devices or actions:
  - 1. Operation of a fire-protection system valve tamper.
- E. System trouble signal initiation shall be by one or more of the following devices or actions:
  - 1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
  - 2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
  - 3. Loss of primary power at the FACP.
  - 4. Ground or a single break in FACP internal circuits.
  - 5. Abnormal ac voltage at the FACP.
  - 6. A break in standby battery circuitry.
  - 7. Failure of battery charging.

8. Abnormal position of any switch at the FACP or annunciator.
- F. System Trouble and Supervisory Signal Actions: Annunciate at the FACP and remote annunciators.

#### 1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  1. Shop Drawings shall be prepared by persons with the following qualifications:
    - a. Trained and certified by manufacturer in fire alarm system design.
  2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
  3. Device Address List: Coordinate with final system programming.
  4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
  5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
  6. Batteries: Size calculations.
  7. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.
- F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section, Submittal Procedures, make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.
- G. Documentation:
  1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.

2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.

## 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Work of this Section be performed by a UL-listed company (if required by local A.H.J.).
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. FACP and Equipment:
    - a. Edwards (EST)
    - b. NOTIFIER
    - c. SimplexGrinnell LP
    - d. Silent Knight

### 2.02 FACP

- C. General Description:
  1. Modular, power-limited design with electronic modules, UL 864 listed.
  2. Addressable initiation devices that communicate device identity and status.
    - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.
    - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
  3. Addressable control circuits for operation of mechanical equipment.

- D. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
  - 1. Annunciator and Display: Liquid-crystal type, three line(s) of [80] characters, minimum.
- E. Circuits:
  - 1. Signaling Line Circuits: NFPA 72, Class B, Style 4.5.
    - a. System Layout: Install no more than 70 addressable devices on each signaling line circuit.
  - 2. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
- F. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.
- G. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.
- H. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.
  - 1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
  - 2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
  - 3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- I. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.
- J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.

- K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator transmitter shall be powered by the 24-V dc source.
  - 1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
  - 2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."
- L. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
  - 1. Batteries: Sealed lead calcium.
  - 2. Battery and Charger Capacity: Comply with NFPA 72.
- M. Surge Protection:
  - 1. Install surge protection on normal ac power for the FACP and its accessories. Comply with Division 16 Section "Transient Voltage Suppression" for auxiliary panel suppressors.
  - 2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.
- N. 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.

## 2.02 MANUAL FIRE ALARM BOXES

- A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.
  - 1. Single-action mechanism with integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
  - 2. Station Reset: Key- or wrench-operated switch.
  - 3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
  - 4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

## 2.03 SYSTEM SMOKE DETECTORS

### A. General Description:

1. UL 268 listed, operating at 24-Vdc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Multipurpose type, containing the following:
  - a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
  - b. Piezoelectric sounder rated at 88 dBA at 10 feet (3 m) according to UL 464.
  - c. Heat sensor, combination rate-of-rise and fixed temperature.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
  - a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg F (8 or 11 deg C) per minute.
  - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 155 deg F (57 or 68 deg C).
  - c. Provide multiple levels of detection sensitivity for each sensor.

### B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

### C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:
  - a. Sensor: LED or infrared light source with matching silicon-cell receiver.
  - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
  - a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where indicated.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
8. Each sensor shall have multiple levels of detection sensitivity.
9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
10. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

## 2.04 NONSYSTEM SMOKE DETECTORS

### A. Single-Station Smoke Detectors:

1. UL 217 listed, suitable for NFPA 101, Section 9.6.2.10 occupancies, operating at 120-V ac, with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.
2. Auxiliary Relays: One Form C, rated at 0.5A.
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet (3 m) according to UL 464.
4. Combination smoke/carbon monoxide detectors as noted on drawing. Test Switch: Push-to-test, simulates smoke at rated obscuration.
5. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
6. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
7. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
8. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

## 2.05 HEAT DETECTORS

### A. General: UL 521 listed.

- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or rate-of-rise of temperature that exceeds 15 deg F (8 deg C) per minute, unless otherwise indicated.
  - 1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
  - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
  - 1. Mounting Plug-in base, interchangeable with smoke-detector bases.
  - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

## 2.06 NOTIFICATION APPLIANCES

- A. Description: Equipped for mounting as indicated and with screw terminals for system connections.
  - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn.
- C. Low Frequency Sounder: The low frequency sounder shall be listed to UL 464 and shall be approved for fire protective service. The low frequency sounder shall have an option to switch between a temporal three-pattern, non-temporal (continuous) or coded pattern. These options are set by a multiple position switch. The low frequency sounder shall be compatible with standard reverse polarity supervision of circuit wiring by a Fire Alarm Control Panel (FACP) with the ability to operate from 16 to 33 VDC. The audible shall have 520 Hz output shall produce a sound-pressure level of 80 dBA, measured 10 feet (3 m) from the sounder.
- D. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
  - 1. Rated Light Output: 75 candela minimum (or as required by NFPA 72).
  - 2. Strobe Leads: Factory connected to screw terminals.

## 2.07 REMOTE ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.



1. Mounting: Flush cabinet, NEMA 250, Class 1.

B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

## 2.08 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

## 2.09 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled according to UL 632.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## 2.010 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, No. 18 AWG.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.

2. Line-Voltage Circuits: No. 12 AWG, minimum.

### PART 3 - EXECUTION

#### 3.01 EQUIPMENT INSTALLATION

- A. Smoke or Heat Detector Spacing:
  - 1. Smooth ceiling spacing shall not exceed 30 feet (9 m).
  - 2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
  - 3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.
- B. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
- C. 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.
- D. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- E. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
- F. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- G. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- H. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

#### 3.02 WIRING INSTALLATION

- A. Install wiring according to the following:
  - 1. TIA/EIA 568-A
- B. Wiring Method:
  - 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
  - 2. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.

- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.03 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Section 16050.
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM".

### 3.04 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

### 3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
    - a. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters.

2. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
3. Testing: Follow procedure and record results complying with requirements in NFPA 72.
  - a. Detectors that are outside their marked sensitivity range shall be replaced.
4. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

### 3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 287220