SECTION 28 46 00
FIRE ALARM SYSTEMS, ADDRESSABLE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Fire-alarm control unit.
   2. Manual pull stations.
   3. System smoke detectors.
   4. Notification appliances.
   5. Remote annunciator.
   6. Addressable interface device.
   7. Digital alarm communicator transmitter.

B. Related Documents: The following Sections contain requirements that relate to this Section:
   1. Division 26 Section “General Electrical Requirements.”
   2. Division 26 Section “Low-Voltage Power Conductors and Cables.”
   3. Division 26 Section “Raceways and Boxes.”

1.3 DEFINITIONS

A. General: Definitions in NFPA 72 apply to fire alarm terms used in this Section.
B. FACP: Fire alarm control panel.
C. FAAP: Fire alarm annunciator panel.
D. LED: Light-emitting diode.
E. NICET: National Institute for Certification in Engineering Technologies.
F. Manual Station: Manual fire alarm box.

1.4 SYSTEM DESCRIPTION

A. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.
B. Automatic and selective fire alarm notification using vibrating electric horn (with strobe where required) to all occupiable spaces. Horns shall sound at temporal march-time.
C. Activation of any standpipe or sprinkler tamper switch shall activate a distinctive system audible supervisory signal and illuminate a valve tamper LED at the system controls (so that there shall be no confusion between valve tamper activation and opens and/or ground on fire alarm initiation wiring) and visually indicate the type of device at both the control panel and the remote annunciator on an addressable system.
D. All manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system supervisory signal.
E. Each independently supervised circuit shall include discrete amber "Trouble" LED to indicate disarrangement conditions per circuit.

F. Supervise the incoming power to the system so that any power failure shall be audibly and visually indicated at both the control panel and the remote annunciator.
G. Provide low/high air supervisory signal for dry automatic sprinkler system.
H. Provide running and power fault trouble signals for the generator.
    1. Provide signal circuit and auxiliary function disconnect capability by disconnect switch or keypad to facilitate testing without disruption.
        a. Provide the following at the FACP:
            1) Disconnect switches to disable notification, audible appliances, visual strobes, and auxiliary function points for testing purposes.
            2) Alarm sensitivity testing at the FACP.
I. Provide all zones or alphanumeric point of address designations in property operation's terminology.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
    1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specifies and the unit will be fully operational after the seismic event."
B. Compatibility with Existing Equipment: Fire alarm system and components shall operate as an extension of an existing system.

1.6 SUBMITTALS

A. General Submittal Requirements
    1. Submit all product data and/or shop drawings bound in a single, soft-cover binder. Incomplete submittals, i.e., missing peripherals, cable, single-line risers, Contractor’s stamp, etc. will be returned to the sender without any action being taken. The fire alarm submittal shall comply with following:
        a. Complete schedule of ALL equipment and materials that are to be furnished for the work.
        b. Typewritten cover page that includes the Contractor's and Supplier’s name, addresses, and telephone numbers, and the name of the Project.
        c. Organized and physically divided into sections for each group of items, i.e., separate sections for the peripherals, panels, single-line riser, etc.
        d. Clearly identify each item by high-light marker or arrow to define that specific component, all associated characteristics, and all hardware.
    2. Approvals: Shop Drawings including product data for the fire protection system(s) shall be submitted to indicate conformance with Code and the Construction Documents and shall be approved prior to the start of system installation. Were required by the statutes of the jurisdiction in which the Project is to be constructed, the Construction Documents and/or Shop Drawings shall be prepared by a registered/licensed Design Professional.
        a. Shop Drawings: The items listed below may be in addition to the submittal requirements specified elsewhere in this section.
            1) A floor plan which indicates the use of all rooms.
            2) Locations of alarm-initiating and notification appliances (shown on floor plan).
            3) Alarm control and trouble signaling equipment.
            4) Annunciation.

5) Power connection (show on floor plan).
6) Battery calculations.
7) Conductor type and sizes (may be shown on floor plan or one-line riser).
8) Voltage drop calculations.
9) Manufacturers, model numbers and listing information for equipment, devices and materials. Equipment shall be listed and approved for the purpose for which they are intended to be installed.
10) Details of ceiling height and construction (architectural building sections may be used).
11) The interface of fire safety control functions.

b. Deferred Submittal: Product Data and Shop Drawings in accordance with the paragraphs above shall be submitted to the Professional in responsible charge who will review them and when acceptable, forward them to the Authorities Having Jurisdiction (AHJ) with a notation indicating that the deferred submittal documents have been reviewed and been found to be in general conformance to the design of the building. The deferred submittal items shall not be installed by the Contractor until the complete Fire Alarm System submittal has been approved by the AHJ.
1) Resubmittal: On receipt of comments from the AHJ, the Engineer will forward to the Contractor for review. If required to make clarifications or revisions, the Contractor shall resubmit to the Professional until the AHJ approves the submittal.

c. Authorities Having Jurisdiction (AHJ): To facilitate review, include copies of annotated Contract Drawings and/or Shop Drawings as needed to depict component locations. On receipt of comments from AHJ, submit them to the Engineer for review. If required to make clarifications or revisions, resubmit to the AHJ until the AHJ approves the submittal.

3. Shop Drawings shall be prepared by persons with the following minimum qualifications:
a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified fire-alarm technician, Level III minimum. A copy of the preparer's certificate shall be included with the submittals.
c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Device Address List: Coordinate with final system programming.
3. System Riser Diagram: Include with device addresses, conduit sizes, and cable and wire types and sizes.
4. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
5. Calculations
a. Notification appliance circuits.
b. Battery-size.
6. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

7. Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to scale and coordinating the installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
8. Voice/Alarm Signaling Service: Equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
9. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

E. Qualification Data: For qualified Installer.

F. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Field quality-control reports.

H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 00710, "General Conditions," include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record/burn copy of site-specific software to compact disk (CD) for programming the fire alarm system. Include all passwords needed to gain access. A write-protected flash drive may be provided in lieu of a CD.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.

7. Copy of NFPA 25.

I. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals in both hard copy and electronic format.
   2. Program Software Backup: On compact disk or write-protected flash drive complete with data files and passwords.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
   1. Components shall be compatible with, and operate as, an extension of existing system.

B. Manufacturer Qualifications: Material and equipment shall be new and UL or ETL listed.
   1. Equipment shall be manufactured by a firm who has been actively manufacturing fire alarm systems of the type required and shall have supplied similar equipment to comparable installations and rendered satisfactory service for a minimum of 10 years. The vendor supplying the equipment and standard products of a single manufacturer shall manufacture all components of the fire alarm system.
   2. Equipment manufacturer shall maintain factory trained personnel within 50 miles of the Project site and shall be available 24 hours per day.

C. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
   1. NICET Certification: Installation shall be by personnel certified by NICET as fire-alarm Level II technician. A copy of the installer's certificate shall be included with the shop drawing submittals.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authorities having jurisdiction.

F. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

G. Transient Protection: All control equipment shall have transient protection devices to comply with UL864 requirements.

1.8 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two (2) years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two (2) years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
   1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
3. Smoke Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamper proofed components.
6. Audible and Visual Notification Appliances: One (1) of each type installed.
7. Fuses: Two (2) of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. To match existing system in the facility.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
   1. Manual stations.
   2. Smoke detectors.
   3. Verified automatic alarm operation of smoke detectors.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances.
   2. Identify alarm at fire-alarm control unit and remote annunciators.
   3. Transmit an alarm signal to the remote alarm receiving station.
   4. Activate voice/alarm communication system.
   5. Activate emergency lighting control.
   6. Activate emergency shutoffs for gas and fuel supplies.
   7. Record events in the system memory.

C. System trouble signal initiation shall be by one or more of the following devices and actions:
   1. Open circuits, shorts, and grounds in designated circuits.
   2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   3. Loss of primary power at fire-alarm control unit.
   4. Ground or a single break in fire-alarm control unit internal circuits.
   5. Abnormal ac voltage at fire-alarm control unit.
   6. Break in standby battery circuitry.
   7. Failure of battery charging.
   8. Abnormal position of any switch at fire-alarm control unit or annunciator.

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

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit
   1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.
a. Smoke detectors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
b. Temperature detectors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
a. Install no more than 50 addressable devices on each signaling line circuit.
2. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
a. Initiating Device Circuits: Style B.
b. Notification Appliance Circuits: Style Y.
c. Install no more than 50 addressable devices on each signaling line circuit.

D. Interface to Building Security System: Provide four (4) relay contacts to interface with the security system for door control.

E. Notification Appliance Circuit: Operation shall sound in accordance with the Owner’s existing evacuation scheme sound pattern.

F. Smoke-Alarm Verification
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator

transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

2.4 MANUAL PULL STATIONS

A. General Requirements for Manual Pull Stations: Comply with UL 38. Pull stations shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
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.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to 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.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.

b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.)

C. Beam Smoke Detector
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.)

2.6 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, 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, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
1. Rated Light Output
a. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

2.7 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
1. Mounting: Surface cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.8 ADDRESSABLE INTERFACE DEVICE

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

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)

A. Digital alarm communicator transmitter (DACT) shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:
   1. Verification that both telephone lines are available.
   2. Programming device.
   3. LED display.
   4. Manual test report function and manual transmission clear indication.
   5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
   1. Address of the alarm-initiating device.
   2. Address of the supervisory signal.
   3. Address of the trouble-initiating device.
   4. Loss of ac supply or loss of power.
   5. Low battery.
   6. Abnormal test signal.
   7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

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

2.10 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the smoke detector, gong, or other automatic device requiring protection.
   1. Factory fabricated and furnished by manufacturer of device.
   2. Finish: Paint of color to match the protected device.

2.11 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760. All wire and cable are to be installed in conduit. Plenum or exposed conductors are not permitted.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 14 AWG or larger as recommended by system manufacturer.

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

1. Low-Voltage Circuits: No. 14 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

D. Copper Cable and Termination:
1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
2. Cable Type - Voice Cable: TIA-568.2 Category 3 UTP (unshielded twisted pair); 22 AWG..
3. Cable Capacity: 2-pair.
4. Cable Applications:
a. General Purpose Applications: Use listed NFPA 70 Type CM/CMG general purpose cable.
5. Cable Jacket Color -VoiceCable: Gray.
6. Jacks and Connectors: Modular RJ-11

PART 3 - EXECUTION

3.1 ALARM SEQUENCE

A. Manual Station or Automatic Detection Device: The system alarm operation subsequent to the alarm activation of any manual station or automatic detection device is to be as follows:
1. All audible alarm notification appliances shall sound a temporal code pattern (.5 sec. on, .5 sec. off, .5 sec. on, .5 sec. off, .5 sec. on, 2.5 sec. off, then repeat) until silenced by the alarm silence switch at the control panel or at the remote annunciator panel.
2. All visual alarm notification appliances (Xenon Strobes) shall display a continuous pattern until the system is reset.
3. All doors normally held open by door control devices shall release.
4. The Digital Alarm Communicating Transmitter, programmed to notify an owner selected central station is to be activated.
5. The alarm is to be recorded with the time and date in the system's alarm log.

B. Smoke Shutdown and Evacuation: The alarm activation of any sensor and/or detector shall, in addition to the operations listed above, cause the smoke evacuation/control system to operate according to the following sequence:
1. The control unit shall provide dry contact output for use by the DDC system for air handling unit and rooftop unit shutdown.
2. System shall provide additional contacts to initiate smoke evacuation by the DDC system.
a. The appropriate system control relays shall activate to initiate the required signals to the building’s DDC System in order to operate the smoke evacuation/control sequence. Detectors shall activate their associated smoke evacuation fan(s).
3. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.

3.2 INSTALLATION - GENERAL

A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.
1. Connect new equipment to the existing control panel in the existing part of the building.
2. Connect new equipment to the existing monitoring equipment at the Supervising Station.
3. Expand, modify, and supplement the existing equipment as necessary to extend the existing functions to the new points. New components shall be capable of merging with the existing configuration without degrading the performance of either system.

B. Install system in accordance with all national, state and local codes, UL standards, and the manufacturer's published instructions.
C. Provide necessary materials and appurtenances, including coordination with the Owner concerning a complete and timely central system tie-in between the fire alarm system and the local fire department or jurisdictional authority when required by Public Authorities. A functional test of the tie-in shall be demonstrated during the final fire alarm system testing.
D. The Contractor shall provide a complete fire alarm system that meets all codes and complies.
E. Coordinate devices that pertain to other Work in the Contract with the appropriate trades.
F. Cover smoke detectors to prevent contamination by dust, and keep covered until Substantial Completion.
G. Provide duct detectors under the fire alarm system as required by code. Provide remote test switch with indicator light for each duct detector.

3.3 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.
B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches above the finished floor. Comply with requirements for concrete base specified in Division 03 and Division 26 Section "Hangers and Supports" for concrete base construction.
    1. Install seismic bracing. Comply with requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
    2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
    3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    5. Install anchor bolts to elevations required for proper attachment to supported equipment.
C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
    1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls."
D. Equipment Mounting: Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
    1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls."
E. Manual Pull Stations
    1. Mount semiflush in recessed back boxes with operating handles 42 inches above the finished floor or lower as indicated.
    2. Where stations are shown adjacent to exit doors, mount pull stations within 60 inches of the exit door.
F. Smoke- or Heat-Detector Spacing
    1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.

2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Corridors: Install ceiling-mounted detectors in center of corridors or as indicated on the drawings but not less than 4 inches from a sidewall to the near edge.
5. Walls: Install detectors located on the wall at least 4 inches but not more than 12 inches below the ceiling.
6. Solid Joist Construction: For exposed solid joist construction, mount detectors on the bottoms of the joists.
7. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
8. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
9. Fire-Alarm Control Unit: Locate smoke detector within 15 feet of the main control unit, all remote control units, including notification appliance power panels in accordance with 2007 NFPA 72 paragraph 4.4.5. These detectors shall be installed even though they may not be indicated on the drawings.

G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
1. Combine audible and visual alarms at the same location into a single unit.

I. Visible Alarm-Indicating Devices: Install at least 6 inches below the ceiling but not more than 80 inches above the finished floor. Install strobes on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
1. Combine audible and visual alarms at the same location into a single unit.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

K. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

L. Annunciator: Surface mounted with top of panel not more than 72 inches above the finished floor.

M. Protective Devices: In addition to the locations shown on the Drawings, install protective devices as indicated below.
1. Protective Shield: Install on all manual stations installed in public spaces (e.g., corridors/halls, vestibules, assembly rooms, dining areas, etc.) that are subject to physical abuse/damage and tampering. Install weatherproof type on the manual stations subject to harsh conditions or located outdoors.
2. Device Guard: Install on all detectors and audible / visible devices installed in areas subject to physical abuse/damage (e.g., gymnasiums, multipurpose rooms, garages / work bays, shops, etc.)

N. Remote Alarm Indicators/Test Switches: Locate in public space near the device they monitor.

O. Addressable Modules: Furnish and install modules as required to provide location specific addressability to non-addressable devices such as waterflow, sprinkler tamper switches, and kitchen suppression systems, furnished by others, by monitoring normally open dry contacts.

3.4 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.
2. TIA/EIA 568-A.

B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes."
1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

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.

3.5 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
2. Alarm-initiating connection to activate emergency lighting control.
3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification."

B. Instructions: Install in a location visible from fire-alarm control unit.

C. Power-Supply Disconnect Means (remote from control unit): Paint red and label "FIRE ALARM."

D. Junction Boxes: Paint red including and covers.

3.7 GROUNDING

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

3.8 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Owner, Engineer and authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

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

testing.

D. Tests and Inspections
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
      b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
   2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
   3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
   4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
   5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
   6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

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

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

G. Prepare test and inspection reports.

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

I. Annual Test and Inspection: One (1) year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.9 DEMONSTRATION

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

END OF SECTION 28 46 00