

DIVISION 28 – FIRE ALARM

Fire Alarm work shall be defined by drawings numbered with the prefix “F-“, the general provision of the Contract including General Conditions and Supplementary Conditions, Division 1 Specification sections, and Division-28 Communication Specifications.

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02/04/19

SECTION 281300 - VIDEO INTERCOM AND ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics for equipment installation.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Hard copies of manufacturer's specification sheets, operating specifications, user's guides, and PDF files on CD-ROM of the hard-copy submittal.
 - 2. System installation and setup guides.
 - 3. Wiring Diagrams

1.4 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70, "National Electrical Code."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Central Station, Workstations, and Controllers:
 - 1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, noncondensing.

2. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
3. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.6 WARRANTY

- A. Warranty Period: Two years from substantial completion

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. iPhone (Basis of Design and Preferred Alternate)

2.2 ACCESSORIES

- A. Electric Door Strike: Design Basis: Model EL-12S or door strike suitable for door being released.
 1. 12 V AC, 125 mA.
 2. 12 V DC, 200 mA.
- B. Form C Door Release Relay: Design Basis: Model RY-18L.
- C. DC Power Supply: Design Basis: Model PS-1820UL.
- D. Door Strike PowerSupply: Design Basis: Model PT-1210N.
- E. Desk Mount Stand: Design Basis: Model MCW-S/A.

2.3 CABLES

- A. PVC-Jacketed, Aiphone Cables (basis of design):
 1. Two (2) conductor (model #871802), non-shielded No. 18 AWG, copper conductors, polyethylene insulation; PVC jacket.
 2. Four (4) conductor (model #871804), non-shielded No. 18 AWG, copper conductors, polyethylene insulation; PVC jacket.
 3. NFPA 70, Type CM.

2.4 TRANSFORMERS

- A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLING

- A. Comply with NECA 1, "Good Workmanship in Electrical Construction."
- B. Wiring Method: Install wiring in raceway except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used.
- C. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to supervise and assist with startup service.
- B. Installer shall coordinate with owner to adjust system to meet site requirements.

3.4 PROTECTION

- A. Protect video intercom system during construction.

3.5 DEMONSTRATION

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

END OF SECTION 281300

SECTION 281600 – INTRUSION DETECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Intrusion detection with communication links to perform monitoring, alarm, and control functions.
 - 2. Integration of other electronic and electrical systems and equipment.

1.3 DEFINITIONS

- A. PIR: Passive infrared.
- B. RFI: Radio-frequency interference.
- C. UPS: Uninterruptible power supply.
- D. Control Unit: System component that monitors inputs and controls outputs through various circuits.
- E. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.
- F. Standard Intruder: A person who weighs **100 lb (45 kg)** or less and whose height is **60 inches (1525 mm)** or less; dressed in a long-sleeved shirt, slacks, and shoes.
- G. Zone. A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

1.4 ACTION SUBMITTALS

- A. Product Data: Components for sensing, detecting, systems integration, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify control interface devices and media to be used. Describe characteristics of network and other data communication lines.
 - a. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.
 2. Device Address List: Coordinate with final system programming.
 3. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
 4. Details of surge-protection devices and their installation.
 5. Sensor detection patterns and adjustment ranges.
- C. Design Data: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
 1. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
- C. Product Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Data for each type of product, including features and operating sequences, both automatic and manual.
 2. Master control-unit hardware and software data.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Intrusion Detection Devices: Furnish quantity equal to five percent of the number of units of each type installed, but no fewer than one of each type.

2. Fuses: Three of each kind and size.
3. Tool Kit: Provide three sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. 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.

C. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.

D. Comply with NFPA 70.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. A preferred alternate will be obtained for the Design Basis equipment and components as identified in this specification. Design Basis Honeywell Ademco Vista series

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Description: Hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.

B. Supervision: System components shall be continuously monitored for normal, alarm, supervisor, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
 2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
- C. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.
- D. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- E. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.
- F. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
- G. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.3 SYSTEM COMPONENT REQUIREMENTS

- A. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:
1. Door hardware specified in Section 087100 “Door Hardware.”
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
1. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.
- C. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.
- D. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.

2.4 ENCLOSURES

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.
- C. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

2.5 SECURE AND ACCESS DEVICES

- A. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.
- B. Design Basis: Honeywell #6148

2.6 DOOR SWITCHES

- A. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.
- B. Flush-Mounted Switches: Unobtrusive and flush with surface of door and frame.

2.7 PIR SENSORS

- A. Listed and labeled by a qualified testing agency for compliance with SIA PIR-01. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.
 - 1. Ceiling-Mounted Unit Spot-Detection Pattern, full 360-degree conical. Design Basis: Bosch Systems #DS938Z.
 - 2. Ceiling-Mounted Unit Directional Pattern, wide range use. Design Basis: Bosch #DS939.
 - 3. Ceiling-Mounted Unit Directional Pattern, long range corridor use. Design Basis: Bosch #DS778.
- B. Device Performance:
 - 1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of **2 deg F (1 deg C)** or less, and standard-intruder movement within sensor's detection patterns at any speed between **0.3 to 7.5 fps (0.09 to 2.3 m/s)** across two adjacent segments of detector's field of view.
 - 2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.

2.8 INTRUSION DETECTION CONTROL UNITS

- A. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.
 - 1. 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.
 - 2. Include a real-time clock for time annotation of events on the event recorder.
- B. Comply with UL 609; listed by ETL or UL.
- C. Console Controls and Displays: Arranged for interface between human operator at control unit. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: LCD.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
 - 3. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer.
 - 4. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.
 - 5. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:
 - a. Acknowledge alarm.
 - b. Silence alarm.
 - c. System reset.
 - d. LED test.
 - 6. Alarm Indication: Audible signal sounds and an LED lights at control unit identifying the protected zone originating the alarm. Annunciator panel displays a common alarm light and sounds an audible tone.
 - 7. Alarm activation sounds a bell or siren and strobe.
- D. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.
- E. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.
- F. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line.
- G. Design Basis: Honeywell #VISTA-20P.

2.9 AUDIBLE AND VISUAL ALARM DEVICES

- A. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 117 dB at 30 feet.
 - 1. Self-contained outdoor horn with choice of two tones – steady and yelp.
 - 2. Enclosure: Weather-resistant with mounting swivel.
 - 3. Design Basis: Honeywell #ZR830EC.

2.10 DURESS / PANIC ALARM SYSTEM

- A. Automatic Voice / Pager Dialer:
 - 1. Design Basis for Preferred Alternate Bid: United Security Products #AD-2001.
- B. Power Supply:
 - 1. Design Basis for Preferred Alternate Bid: United Security Products #PB12P.
- C. Duress / Panic Alarm Switches:
 - 1. Description: A switch with a shroud over the activating lever that allows an individual to covertly send a duress signal to master control unit, with no visible or audible indication when activated. Switch shall lock in activated position until reset with a key.
 - a. Push Button: Finger activated, suitable for mounting on horizontal or vertical surface.
 - 2. Design Basis for Preferred Alternate Bid:
 - a. Switch: United Security Products #HUB2B.
 - b. Reset Tool: United Security Products #HUB-RT.
- D. Switch Covers:
 - 1. Design Basis for Preferred Alternate Bid: STI Mini Stopper #STI-65XX Series.

2.11 SECURITY FASTENERS

- A. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
- B. Drive System Types: Pinned Torx-Plus, pinned Torx, or pinned hex (Allen).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.

- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
- D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.
 - 1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
 - 2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.
- E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEM INSTALLATION

- A. Comply with UL 681 and NFPA 731.
- B. Install wall-mounted equipment, with tops of cabinets not more than **72 inches (1830 mm)** above the finished floor.

3.3 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceways according to Section 260533 “Raceways and Boxes for Electrical Systems.” Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be **1/2 inch (13 mm)**. Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring Method: Install wiring in metal raceways according to Section 260533 “Raceways and Boxes for Electrical Systems,” except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be **1/2 inch (13 mm)**. Control and data transmission wiring shall not share conduit with other building wiring systems.
- C. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system’s wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Wires and Cables:
 - 1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.

- 2. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable.
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- G. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.
- H. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Section 260553 "Identification for Electrical Systems."
- B. Install instructions frame in a location visible from master control unit.

3.5 GROUNDING

- A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.
- B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

3.6 FIELD QUALITY CONTROL

- A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
 - 1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
- B. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."
 - 1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
 - 2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."

- C. Documentation: Comply with provisions in NFPA 731, Ch. 4, “Documentation.”
- D. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

3.8 DEMONSTRATION

- A. Train Owner’s maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, “Documentation and User Training.”

END OF SECTION 281600

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Device guards.
 - 7. Magnetic door holders.
 - 8. Remote annunciator.
 - 9. Addressable interface device.
 - 10. Digital alarm communicator transmitter.
 - 11. System Printer

1.3 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.
- F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring required for HVAC unit shutdown on alarm.
 - c. Locate detectors according to manufacturer's written recommendations.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; **Level III** minimum.
 - c. Licensed or certified by authorities having jurisdiction.

D. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

E. Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification.

- F. Product Data: Provide electrical characteristics and connection requirements, and provide mA draw for each device submitted and the listed minimum voltage required to operate. Panel submittal shall list voltage drop allowed for panel and for individual NAC circuits.
- G. The fire alarm contractor shall submit complete Shop Drawings to the Architect/Engineer for review, prior to performing any work. They shall clearly demonstrate compliance with the Architect/Engineer's Drawings and specifications, which have a System Response Matrix showing the fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal. Any non-compliant features shall be fully described.
- H. The submitted shop drawings shall show equipment, device identification numbers and locations, and connecting wiring of entire fire alarm system. Include wiring and riser diagrams. Wiring diagrams shall be based on the project floor plans, with devices and proposed conduit routing. The conductor composition for each conduit section shall be provided. The distance and route for each NAC (Notification Appliance Circuit) shall be shown. Riser diagrams shall show consecutive connections for all devices with addresses and candela and candela ratings. Provide detailed battery and communications amplifier(s) capacity calculations.
- I. Architect/Engineer's approval (with or without comments) of contractor's Shop Drawings, samples, cut sheets, etc., is for general conformance with the contract documents and design concept. It shall not relieve the contractor of responsibility for full compliance with the project plans and specifications, EXCEPT for any specific non-compliant features for which the Architect/Engineer gives written authorization.
- J. Installation Instructions: The contractor shall submit to the Architect/Engineer the manufacturer's detailed installation instruction for the Fire Alarm Control Panel and all duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.
- K. Battery Calculations:
 - 1. Include a copy of system battery sizing calculations with the shop drawing submittal to the Architect/Engineer. Use manufacturer's battery discharge curve to determine expected battery voltage after 60 hours of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected voltage drop at End of the Line Resistor (EOL), based on conductor resistance per manufacturer's data sheet or NEC.
 - 2. Fire Alarm Vendor's calculations shall be submitted with the shop drawings, and prior to installation of equipment. In the submittal package identify Notification Appliance Circuits (NAC) current draws and voltage drops for each circuit. In no case shall the calculated voltage at any notification appliance fall below the minimum listed operating voltage for the devices used.
 - 3. The voltage drop at EOL shall not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. (Typically, for a 24 volt system, this limits the voltage drop from the battery to the EOL to 3 volts). Determine "worst case" voltage at far end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. The result shall be no less than the minimum listed operating voltage for the alarm notification appliances used.
 - 4. All of these calculations shall be placed on a dedicated sheet of as-built drawings, for future reference by fire alarm service technicians. NAC voltage drop is to be verified during system tests.

- L. Maintenance Data: The contractor shall submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. This data, product data, and shop drawings shall be included in the maintenance manual.
- M. Certifications: Submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses, and telephone numbers in the certification. The installing contractor's technicians shall hold current (within previous 24 months) certifications issued by the manufacturer. These certifications shall be submitted to the Architect/Engineer prior to installation showing name, photo identification, date of training and date of certification.
- N. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and commissioning of products.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
 - g. Record copy of site-specific software.
 - h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - i. Manufacturer's required maintenance related to system warranty requirements.
 - j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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 one unit.
2. Lamps for Strobe Units: Quantity equal to **10** percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Heat Detectors: Quantity equal to **10** percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to **two** percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: **One** of each type installed.
7. Fuses: **Two** of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.7 QUALITY ASSURANCE

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

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm **Level II** technician.

1.8 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify **Owner** no fewer than **seven** days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without **Owner's** written permission.

- C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.9 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 - 2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Notifier (Preferred Alternate)

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. Heat detectors.
 - 3. Smoke detectors.
 - 4. Duct smoke detectors.
 - 5. Carbon monoxide detectors.
 - 6. Automatic sprinkler system water flow.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances, **including voice evacuation notices**.
 - 2. Identify alarm and specific initiating device at fire-alarm control unit **and remote annunciators**.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.

6. Activate voice/alarm communication system.
 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 8. Record events in the system memory.
 9. Record events by the system printer.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 4. Loss of primary power at fire-alarm control unit.
 5. Ground or a single break in internal circuits of fire-alarm control unit.
 6. Abnormal ac voltage at fire-alarm control unit.
 7. Break in standby battery circuitry.
 8. Failure of battery charging.
 9. Abnormal position of any switch at fire-alarm control unit or annunciator.
 10. Voice signal amplifier failure.
- E. System Supervisory Signal Actions:
1. Initiate notification appliances.
 2. Identify specific device initiating the event at fire-alarm control unit **and remote annunciators**.
 3. Record the event on system printer.
 4. After a time delay of **200 seconds** transmit a trouble or supervisory signal to the remote alarm receiving station.
 5. Transmit system status to building management system.

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.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, 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.
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.

- e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
 3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- 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, **80** characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, **Class A**.
 2. Pathway Survivability: **Level 1**.
 3. Install no more than **100** addressable devices on each signaling-line circuit.
 4. Serial Interfaces:
 - a. One dedicated RS 485 port for **central-station** operation using point ID DACT.
 - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - c. One **RS 232** port for PC configuration.
 - d. One RS 232 port for voice evacuation interface.
- D. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an 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.
- E. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
 2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.

3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall **be** connected to fire-alarm system.
 - 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. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided **as a special module that is part of fire-alarm control unit**.
 1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
 - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.
 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
 - J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
 - K. 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.

- L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed Gel-cell type with expected life of 10 years.
- M. 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.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Double-action mechanism requiring two actions to initiate an alarm, **pull-lever** type; with **integral** addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Station Reset: Key- or wrench-operated switch.

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 **and power-on status**.
 - 7. Remote Control: Unless otherwise indicated, detectors shall be digital-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 of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for **15 or 20 deg F (8 or 11 deg C)** per minute.
 - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units 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 (57 or 68 deg C)**.
 - c. Multiple levels of detection sensitivity for each sensor.
 - d. Sensitivity levels based on time of day.

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. Ionization 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 PROJECTED BEAM SMOKE DETECTORS

- A. Projected Beam Light Source and Receiver: Designed to accommodate small angular movements and continue to operate and not cause nuisance alarms.
- B. Detector Address: Accessible from fire-alarm control unit and able to identify the detector's location within the system and its sensitivity setting.
- C. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 1. Primary status.
 2. Device type.
 3. Present average value.
 4. Present sensitivity selected.
 5. Sensor range (normal, dirty, etc.).

2.7 CARBON MONOXIDE DETECTORS

- A. General: Carbon monoxide detector listed for connection to fire-alarm system.
 1. Mounting: Adapter plate for outlet box mounting.
 2. Testable by introducing test carbon monoxide into the sensing cell.

3. Detector shall provide alarm contacts and trouble contacts.
4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Comply with UL 2075.
6. Locate, mount, and wire according to manufacturer's written instructions.
7. Provide means for addressable connection to fire-alarm system.
8. Test button simulates an alarm condition.

2.8 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of **135 deg F (57 deg C)** or a rate of rise that exceeds **15 deg F (8 deg C)** per minute unless otherwise indicated.
 1. Mounting: **Twist-lock base interchangeable with smoke-detector bases.**
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of **190 deg F (88 deg C)**.
 1. Mounting: **Twist-lock base interchangeable with smoke-detector bases.**
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.9 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, 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 (3 m)** from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Xenon strobe lights complying with 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:
 - 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**.

D. Voice/Tone Notification Appliances:

1. Comply with UL 1480.
2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
3. High-Range Units: Rated 2 to 15 W.
4. Low-Range Units: Rated 1 to 2 W.
5. Mounting: **surface mounted and bidirectional**.
6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.10 MAGNETIC DOOR HOLDERS

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

1. Electromagnets: Require no more than 3 W to develop **25-lbf (111-N)** holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.11 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.

2.12 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to **circuit-breaker shunt trip for power shutdown**.
 1. Allow the control panel to switch the relay contacts on command.
 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
 1. Operate notification devices.
 2. Operate solenoids for use in sprinkler service.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- 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.
 5. Loss of power.
 6. Low battery.
 7. Abnormal test signal.
 8. 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.

2.14 SYSTEM PRINTER

- A. Printer shall be listed and labeled as an integral part of fire-alarm system.

2.15 DEVICE GUARDS

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

2.16 SURGE PROTECTION

- A. The following protection against voltage transients and surges shall be provided by the fire alarm equipment supplier, and installed by the electrical contractor:
 - 1. On AC Input: A feed-through (not shunt-type) branch circuit transient suppressor such as Leviton 51020-WM-DN, or Di-Tech DTK-120S20A, or equivalent UL 1449 - 2nd Edition Listed device.
 - 2. On DC Circuits Extending Outside Building: Adjacent to the FACP, and also near point of entry to outlying building, provide "pi"-type filter on each leg, consisting of a primary arrester, series impedance, and a fast acting secondary arrester that clamps at 30v-40v. Some acceptable models: Simplex 2081-9027, Simplex 2081-9028, Transtector TSP8601, Ditek DTK 2MHLP24B series, Citel America B280-24V, and Northern Technologies DLP-42. Submit data on others to the Architect/Engineer for approval. UL 497B listing is normally a prerequisite for their consideration. Devices using only MOV active elements are not acceptable.

2.17 WIRING

- A. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. Belden 5320FJ acceptable if only FPL rating needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.
- B. Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable.
- C. In underground conduit, Type TC or PLTC cable (PE insulated) shall be used to avoid problems from moisture.

2.18 TERMINAL CABINETS

- A. Terminal cabinets shall be sheet steel, hinged cover type not less than 10" x 16" x 10" deep. Cabinets shall conform to Specs Section 260534 and shall be labeled in accordance with Specs Section 260553.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than **78 inches (1980 mm)** above the finished floor.
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within **60 inches (1520 mm)** of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between **42 inches (1060 mm)** and **48 inches (1220 mm)** above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 3. HVAC: Locate detectors not closer than **36 inches (910 mm)** from air-supply diffuser or return-air opening.
 4. Lighting Fixtures: Locate detectors not closer than **12 inches (300 mm)** from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than **36 inches (9100 mm)** long shall be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- G. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.
- H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- I. 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.
- J. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- K. 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. Install all devices at the same height unless otherwise indicated.
- L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least **6 inches (150 mm)** below the ceiling. Install all devices at the same height unless otherwise indicated.
- M. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 SURGE PROTECTION

- A. For each AC power circuit that interfaces with fire alarm equipment install an AC suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance shall improve the effectiveness of the suppressor in clipping fast rise time voltage transients.

- B. On DC Circuits Extending Outside Building: Install the surge arrestor in a labeled enclosure near the point of entry to or exit from each building.

3.4 AC POWER

- A. Switching to emergency power during alarm shall not cause signal drop-out. Batteries shall meet the appropriate NFPA capacity requirements, with a 25% safety factor. This requirement is in effect even if generator power is supplied to the Fire Alarm Control Panel.
- B. The branch circuit breaker(s) supplying the system shall be physically protected by panelboard lock or handle lock and each shall be identified with a 1/4" permanent red dot applied to handle or exposed body area.
- C. Provide an engraved label at each fire alarm system control unit, system sub-panel or data gathering panel, supplementary notification appliance (SNAC) panel, digital alarm communicator, etc.
- D. The fire alarm system shall monitor 120vac power to shunt trip breakers used in conjunction with fire suppression systems. Examples include a shunt trip used for cooking appliance power shut-off when the kitchen hood fire suppression system is activated, or primary elevator power shut-down upon sprinkler flow in any elevator equipment space or shaft. Use an addressable monitor module to accomplish this supervisory function.

3.5 CONDUIT AND WIRING

- A. The exterior of all junction boxes containing fire alarm conductors shall be painted red; box interiors shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted red on both sides.
- B. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
- C. All fire alarm system wiring shall be in metal conduit or surface metal raceway. All fire alarm system raceway, couplers, and connectors shall meet the performance and installation requirements of Electrical Specification Section "RACEWAYS".
- D. If cable size and the requirement to maintain a Class "A" loop on all Signaling Line Circuits cause conduit fill to exceed specified maximums for the 1/2" size; 3/4" raceway shall be used.
- E. All conduits that penetrate outside walls from air conditioned space shall have internal sealing (duct-seal), to prevent condensation from infiltrating humid air.
- F. All wiring shall be color coded. All the circuits in the system shall be wired with AWG 14, minimum, stranded copper, THHN/THWN conductor, installed in metallic conduits. Color Coded wires shall be in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run;
 - 1. Initiating Circuits, general Red (+)/White (-)
 - 2. Initiating Circuits, smoke only Violet (+)/Gray (-)

3.	Signal Line Circuit cable	Red jacket with Red(+)/Black(-)
4.	Alarm Indicating Appliance Circuits	Blue (+)/Black (-)
5.	AHU Shutdown Circuits	Yellow (+)/Brown (-)
6.	Door Control Circuits	Orange
7.	Elevator Capture Circuits	Brown

- G. To minimize wiring fault impact, isolation modules shall be provided in all of the locations listed below. If ceiling height ≤ 10 feet, isolator base type initiating devices are permitted to be used to satisfy any or all of the following:
1. In or immediately adjacent to the FACP, at each end of the addressable loop. These two isolators shall be in the same room and within 15 feet of the FACP.
 2. After each 20 initiating devices and control points on the addressable loop, or a lesser number where recommended by the manufacturer. (Check instructions.)
 3. For loops with 20 devices and control points, install an isolator at the approximate middle of the loop (in addition to those at the FACP).
 4. Near the point any addressable circuit extends outside the building, except for those attached to the building exterior walls and well sheltered by walkways.
 5. For loops covering more than one floor, install isolator at terminal cabinet on each floor (with additional isolator[s] on any floor with over 20 addresses).
 6. Each isolation module shall be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling), and shown on as-built drawings.
- H. Detection or alarm circuits shall not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power shall be properly separated from other circuits and the enclosure shall have an appropriate warning label to alert service personnel to the potential hazard.
- I. Style 6 Circuits Required: Systems with one or more addressable sub-panels that (1) have an integral addressable loop controller, or (2) monitor multiple non-addressable initiation zones, shall comply with the NFPA 72 requirements for Style 6 circuits.
- J. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices shall not be permitted. Permanent wire markers shall be used to identify all connections at the FACP and other control equipment, at power supplies, and in terminal cabinets. All terminal block screws shall have pressure wire connectors of the self lifting or box-lug type.
- K. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten (10) megohms, as verified with a megger. Provide advance notice to the Architect/Engineer of these tests.
- L. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.

3.6 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than **36 inches (910 mm)** from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Magnetically held-open doors.
 - 2. Supervisory connections at valve supervisory switches.

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.8 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.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **12 months'** full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.10 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.

- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for **two** years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least **10** days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.11 PRINTER

- A. An event printer is required for all systems exceeding 100 addressable points, or if the building exceeds 3 occupied floors or 60,000 SF. Provide a 120vac tractor feed printer that uses ordinary (non-thermal) paper. Install in location selected by the owner. For high rise buildings only, the printer is required to be FACP -monitored and powered from a 120vac circuit supported by the generator.

3.12 AIR HANDLER UNIT (AHU) SHUTDOWN

- A. A supervised "AHU Shutdown Defeat" switch shall be provided in/adjacent to the FACP or as a key-operated function in the Remote Annunciator (if provided). If the FAA option is utilized, provide an informative engraved label at the FACP about this function. The switch shall cause a system "trouble" indication when it's placed in the off-normal ("Shutdown Defeated") position. This is to provide the Owner with a convenient means to temporarily resume HVAC operation in the event an unwanted alarm shall not clear, prior to arrival of the fire alarm service technician.
- B. If the system includes AHU shutdown or smoke removal startup, silencing the alarm (without resetting) shall not reverse the shutdown. A supervised "AHU Shutdown Defeat" switch shall be provided in the FACP. The switch shall be labeled and its "Normal" position indicated. Provide supervised Hand-Off-Auto switch(es) at the FACP for any building smoke control equipment (pressurization or exhaust fans).

3.13 ANNUNCIATOR

- A. Each addressable fire alarm system shall include an LED-type "zone" annunciator at (or in) the FACP, or in another location if acceptable to the AHJ. As a minimum, this annunciator shall indicate the specific type of alarm or supervisory signal (smoke detector, water-flow, sprinkler valve closed, etc.), for groups of addressable devices. The area ("zone") that is represented by each LED shall not exceed 1 floor or 22,500 square feet, and shall not cross building fire walls or smoke compartments.
 - 1. Systems in 1 or 2-story buildings, which have 30 or fewer initiating devices, are permitted to omit the LED-type "zone" annunciator.
 - 2. Systems with a Graphic Annunciator (GA) are permitted to omit the LED-type "zone" annunciator.

3. The LED annunciator is permitted to be omitted if the FACP has a multi-line display that automatically defaults to displaying the first alarm, plus the first 3 (minimum) water-flow alarms and the last alarm. This is permitted to be done using 2 automatically alternating screens. If there is no sprinkler system, program the FACP to show the first 4 alarms plus the last alarm received.

3.14 ALARM VERIFICATION FOR SMOKE DETECTORS

- A. The fire alarm system shall be equipped with Alarm Verification.
- B. System shall provide as a feature an alternate signal processing algorithm to verify the presence of smoke. The algorithm shall be selectable during system programming. The total effective delay created by the verification algorithm shall not exceed 60 seconds.

3.15 REMOTE ALARM TRANSMISSION REQUIREMENTS

- A. Each system with automatic fire detection, or which monitors a sprinkler system, shall be equipped with a 4-channel (minimum) Digital Alarm Communicator Transmitter (DACT) for transmission of fire alarm, supervisory, and trouble signals to a Central Station, Remote Supervising Station, or Proprietary Supervising Station. DACT shall be dual line type in accordance with NFPA 72.
- B. As applicable the following signals shall be reported:
 1. Fire Alarm
 2. Fire Alarm System AC Power Trouble (only if 120vac interrupted for 1 to 8 hours)
- C. In lieu of a DACT, the use of an addressable network is acceptable. Other appropriate means of transmitting fire alarm system signals off-premises may be permitted to be used, at the discretion of the AHJ who approves the plans.
- D. The Contractor shall provide a type of DACT that is compatible with the owner's alarm receiving equipment, or the Supervising Station selected by the owner, as applicable. He shall also program the PROM, connect each DACT to the telephone line(s) provided to him, and verify proper signal receipt by the Supervising Station. The transmission means shall comply with NFPA 72 (which does not permit VOIP).
 1. See NFPA 72 for means of transmission requirements. It permits the phone line(s) to be shared, since the DACT can capture a line that's busy if needed. However, PBX station circuits are not permitted to be used. Contact the AHJ if VOIP, cellular, derived local channel, or RF technology is intended for the reporting means
 2. Where leased or dedicated lines are available back to the Owner's security station provide a polarity reversal type alarm module. Polarity reversal type alarm modules report only Alarm, Line Trouble, and OK conditions.

3.16 AUTOMATIC SMOKE DOOR AND AUTOMATIC LOCK REQUIREMENTS

- A. Wall-mounted magnetic door holders and separate heavy-duty closers shall be used, instead of combination door control units. The electromagnets shall be controlled by the building's smoke

detection system FACP. Individual smoke detector auxiliary contacts shall not be used to release door holders.

- B. Automatic door locks controlled by the system shall be either fail safe magnetic locks or fail-safe electro-mechanical with reverse bevel dead bolts.
- C. All locked protected doors shall immediately unlock upon fire alarm, loss of AC power, disablement of the fire alarm system (defined as loss of 24 VDC power) or upon manual operation of an unlock switch at a constantly attended location.

3.17 SPRINKLER SYSTEM MONITORING

- A. The following sprinkler system alarm and supervisory functions shall be provided as a part of the fire alarm system:
 - 1. Water-flow alarm, by sprinkler zone (not to exceed one floor).
 - 2. Supervision of each control valve.
- B. Sprinkler supervisory monitoring of flow switches, tamper switches, and similar functions shall be accomplished with a separate system address for each activity monitored.

3.18 KITCHEN EXHAUST HOOD EXTINGUISHING SYSTEMS

- A. Installation shall comply with the current edition of NFPA 72 Standard for the type of system installed.
- B. System(s) shall be interconnected with the fire alarm system as a separate system address.
- C. The exhaust fan shall continue running after the system has been discharged, (except on carbon dioxide systems) to remove smoke; the supply fan should stop. All sources of heat for appliances served by the extinguishing system (both electric and/or gas) shall be turned off.

3.19 FIRE ALARM SYSTEM INSTALLATION AND CONFIGURATION

- A. Supervision required: The connection between individual addressable modules and their contact type initiating device(s) shall be supervised. Where indicated on the Drawings, a Graphic Annunciator (GA) with separate Light Emitting Diodes (LED) indication for each alarm and supervisory signal initiating device shall be included. Multiple initiating devices of the same type within a single room may be permitted to share a common LED. The GA shall show all major building features such as corridors, elevators, stairs, exits, and "YOU ARE HERE". GA layout shall be submitted for approval.
- B. Graphic Chart shall be mounted behind Plexiglass and secured to surface. Mounting shall be such that charts cannot be removed without a flat head screw driver.
- C. Floor Plans with Device Numbers: A copy of the floor plans shall be provided in the control panel. A separate sheet shall be provided for each floor. Plans shall be reduced in size from engineering plans in order to fit on 11 x 14 sheets. All device addresses shall be clearly labeled on plans. Indicate locations of all cabinets, modules and end of line device. Plans shall be bound in book form. Sheets shall be laminated. Provide legend for symbols. Provide holder

for plan book in panel or in a locked box adjacent to panel keyed to match panel. Provide label for box and book.

- D. Loop 1 shall be assigned to the first floor devices and loop number shall increase with floor number. Device numbering starts in the same location on each floor and increase accordingly as circuit location increases.

3.20 FIRE AND LIFE SAFETY CRITERIA FOR DOORS CONTROLLED BY FIRE ALARM SYSTEM

- A. Exit or exit access doors that are locked to delay egress, in accordance with the NC Building Code:
 - 1. These doors shall immediately unlock upon any fire alarm signal, loss of building AC power, disablement of the fire alarm system (defined as loss of its 24vdc power), or upon manual operation of an unlock switch at a constantly attended location.
 - 2. Where installed on smoke or fire doors, power failure shall cause these mechanisms to default to the egress mode with normal mechanical latching; this is to assure the smoke or fire doors continue to perform their vital function in a power failure situation, instead of swinging open and allowing the passage of smoke and fire between compartments.
 - 3. Smoke doors are permitted to be held open by 24vdc wall/floor-mounted magnets powered by the FACP, and released upon alarm. The resulting current drain shall be included in the standby battery calculations or the system shall be programmed to drop the door hold-open magnet load 60 seconds after the loss of 120vac power
- B. Contact the AHJ for guidance on programming the fire alarm system to determine which fire alarm initiation devices should cause release of these doors. The customary setup is to have this done for selected smoke detector and/or water-flow alarm in adjacent spaces, rather than upon general alarm, to minimize the potential disruption of possible nuisance alarms in remote parts of the building. The FACP should have an appropriate information placard regarding this function, to avoid nuisance drops during routine system maintenance operations.

3.21 SYSTEM DOCUMENTATION, TRAINING AND MAINTENANCE

- A. Maintenance: The manufacturer, or authorized distributor, shall maintain software version records on the system installed. The system software shall be upgraded free of any charge if a new VER is released during the warranty period. For new VER to correct operating problems, free upgrade shall apply during the entire life of the system.
- B. System Report in addition to the Shop Drawing submittal described elsewhere, the fire alarm system contractor shall provide the Architect/Engineer two bound copies of the following technical information, for transmittal to the owner:
 - 1. As-Built wiring diagram showing all loop numbers and device addresses, plus terminal numbers where they connect to control equipment.
 - 2. As-built wiring and conduit layout diagrams, including wire color code and/or label numbers, and showing all interconnections in the system.
 - 3. Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
 - 4. Manufacturer's detailed maintenance requirement.

5. Technical literature on all control equipment, isolation modules, power supplies, batteries, detectors, manual stations, alarm/supervisory signal initiating devices, alarm notification appliances, relays, remote alarm transmission means, etc.
 6. The as-built "calculations" sheet.
- C. Electronic archive: Complete configuration data (site-specific programming) for the system shall be stored on electronic media and archived by the fire alarm system manufacturer or authorized distributor. A diskette or CD copy of this data shall be submitted to the Architect/Engineer for transmission to the owner on the day the system is commissioned. The contractor shall provide the owner with one copy of the following:
1. All software required, both for the installed fire alarm system and personal computer (PC) necessary to access the fire alarm system for trouble shooting, programming, modifications, monitoring, de-bugging, or similar functions, (if Owner does not have the needed PC to check the system).
 2. Complete documentation for all software for both the installed fire alarm system and for any interface PC software necessary for system functions as described above.
 3. Framed floor plans, mounted at the FACP. Plans shall show all system devices with the unique device identification numbers indicated adjacent to each device. The identification numbers shall match those represented in the as-built drawings and those reported at the FACP and the LCD annunciator.
 4. Interconnection cable where such is required to connect the fire alarm system to a PC; (if Owner does not have the needed PC to check the system).
- D. Training; the manufacturer's authorized representative shall instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. Two copies of a written, bound summary shall be provided, for future reference.
1. Some facilities maintain their own systems and require more in-depth training. Check to verify needs and requirements.
 2. Scheduling of training shall be arranged to meet the Owner's schedule. Additional training shall be available at a cost to be mutually agreed upon by the Owner and the Contractor.
 3. Training shall be in the Owner's provided classroom.
 4. The training may not be waived, deleted or reduced in the number of hours required.
 5. Training shall cover as minimum the following topics:
 - a. Preventive maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
 - b. Overall system concepts, capabilities, and functions. Training shall be in depth, so that the owner shall be able to take any device out of service and return any device to service without need of Manufacture's approval or assistance.
 - c. Explanation of all control functions, including training to program and operate the system software.
 - d. Methods and means of troubleshooting and replacement of all field wiring devices.
 - e. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
 - f. Manuals, drawings, and technical documentation. Actual system software used for training shall be provided in digital form and shall be left with the Owner at the completion of training for the Owner's use in the future.
 - g. The owner shall be trained to perform all NFPA 72 required maintenance. The training shall include both demonstration and supervision of a "hands-on" replacement of heads. Panel modifications required to take detector heads out of

service and return them to service shall be “hands-on” training session. The training shall be in a minimum of two 4-hour sessions provided on separate days. The schedule shall be coordinated with the owner. A written competency test shall be submitted to the Architect/Engineer and to the owner as a sample prior to using the written competency test at the site. A written description of a hands-on test shall be provided to the Architect/Engineer and owner for review prior to using the test at the site. As a minimum the following tests shall occur during certification of the owner’s employee:

- 1) Three smoke heads shall be taken offline at the panel and removed physically.
- 2) Three smoke heads shall be reinstalled and returned to service at the fire alarm panel.
- 3) The vendor shall provide three dirty smoke detector heads to be installed at various positions in the building. The owner shall print a sensitivity report and the employees shall find the “dirty” smoke detector heads by reviewing the sensitivity report.
- 4) A ground fault and an isolation problem shall be introduced by the vendor into the system. The employees shall then find the ground fault and the isolation problem.
- 5) An NFPA 72 “Record of Completion” form shall be provided and the employees shall fill out the forms which shall be checked by the vendor for proper use of the form.
- 6) The written testing for how to perform services on a panel shall be given during the last 4 hour session with the employees.
- 7) The vendors shall witness the owner’s “trained” employees, train other employees and correct any mistakes made during the training session. This is expected to occur during the 2nd four hour session.

3.22 SPARE PARTS

A. The following spare parts shall be provided with the system. For multi-building projects, calculate quantities separately for each building that contains a dedicated fire alarm control panel. If FACP also serves auxiliary buildings (e.g., storage, boiler/chiller), calculate as if one building. Increase decimal quantities to the next higher whole number:

1. Fuses (If Used)..... 2 of each size in system
2. Manual Fire Alarm Boxes..... 2% of installed quantity
3. Addressable Control Relays..... 4% of installed quantity
4. Indoor Horns/Speakers with Strobes Lights..... 4% of installed quantity
5. Indoor Strobe-only Notification Appliances..... 4% of installed quantity
6. Monitor Modules (Addressable Interface)..... 4% of installed quantity
7. Isolation Modules / Isolation Bases.....4% of installed quantity
8. Addressable, Electronic Heat Detectors..... 4% of installed quantity
9. Spot-Type Smoke Detectors / Sounder Bases..... 6% of installed quantity
10. No spares are required for projected beam, air sampling, or duct smoke detectors.

3.23 SYSTEM TESTING AND CERTIFICATION

A. Upon completion of the installation the Contractor and the Manufacturer's authorized installer together shall conduct a 100% performance test of each and every alarm initiating device for

proper response. The system shall operate for 48 hours prior to start of test. The Contractor shall be present for the full 100% test.

- B. The A/E and owner shall be given 7 days advance notice of the tests. All Audio Visual Device Testing shall be scheduled with the owner.
- C. 100% Test: The manufacturer or authorized distributor (by definition, "installer") shall 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation shall be part of the "System Status and Programming Report".
1. Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc. The Architect/Engineer shall be notified in advance of these 100% tests, to permit witnessing them if desired.
 2. If AHU shutdown occurs for any alarm, then the matrix would indicate the specific control relay(s) for that function being commanded to operate for alarm from any initiating device. If a rolling steel fire door is to drop only upon water-flow alarm from its sprinkler zone, or upon any two spot smoke detectors in adjacent spaces being simultaneously in alarm, the matrix would show the door's control relay activating upon alarm from the applicable water-flow switch(es), or from any two smoke detectors in the selected spaces (AND gate)
 3. The Digital communicator shall be on-line tested for proper communication to the receiving station.
 4. All supervised circuits shall also be tested to verify proper supervision. (Control circuits and remote annunciation lines are among those required to be supervised.)
 5. All testing described above shall be repeated in the event that subsequent software or wiring modifications are determined necessary to meet the requirements of the contract documents. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.
 6. Test Documentation: The installer shall fill out and submit the following documentation to the owner, through the Architect/Engineer, prior to the AHJ's system acceptance inspection:
 - a. Written verification that this 100% system test was done with copy of print out generated during test.
 - b. The NFPA 72, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and also to certify that: (a.) It was done per Code, and (b.) The Code-required 100% test was performed. The fire alarm installer (manufacturer or authorized distributor's technician) shall sign this form. If a representative of the AHJ, owner, or Architect/Engineer witnesses the tests, in whole or in part, they shall also sign the form to signify that fact only (annotating the form as needed to clarify their limited role).
 - c. For buildings with a smoke control or smoke purge system, an HVAC balance report, in the smoke control / smoke purge mode.
 - d. The System Status and Programming Report described in NFPA 72. This shall be generated on the day of the system acceptance inspection and shall include the measured sensitivity of each smoke detector.
 - e. The purpose of doing Item (d) on the day of the inspection is to assure detector sensitivity has not been affected by construction dust. Prudent contractors shall

have taken measures to prevent detector contamination during construction, and shall also have had the system do a detector sensitivity test and printout prior to the day of the inspection, to make certain all devices are properly programmed and operating within their limits.

7. After completion of the 100% system test and submission of documentation as described above the installer is to request the Architect/Engineer to set up an inspection. The system shall operate for at least two days prior to this inspection. The responding Fire Department shall be notified of this, for pre-fire planning purposes. On local government projects, local fire authorities may also want to participate in system acceptance inspections. However, for State-owned property they have no inspection jurisdiction and, if present, are only to observe.

3.24 PRE-FINAL AND FINAL INSPECTION

- A. Pre-Final Inspection: At the Owner's request and after passing the Designer's pre-final inspection, the Contractor and Manufacturer's authorized installer shall conduct system test in the presence of the Owner and the Designer.
- B. Final Inspection: The fire alarm system shall be inspected, with portions of it functionally tested. This shall normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off-premises supervising station. Operation of any smoke removal system shall be checked as instructed by the AHJ. This statistical (sampling) inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. The electrical contractor shall provide two-way radios, ladders, and any other materials needed for testing the system, including a suitable smoke source.
- C. The test shall be conducted entirely by the Contractor. A copy of the final database software shall be presented to the Owner before this test. The software shall be loaded from these disks into the system in the presence of the Owner. The review shall then be conducted using this software. Any deficiencies shall be recorded and corrected. After the items have been corrected, the system shall be tested again.
 1. In the event of malfunctions or excessive nuisance alarms, the Contractor shall take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections.
 2. Test Report: Upon successful completion of the Inspection and after the correction of all efficiencies, the manufacturer's authorized representative shall issue a test report to the Architect/Engineer and Owner, detailing and certifying the test.
 3. System Acceptance: After successful completion of the Final Inspection and recommendation of the Architect/Engineer, the system shall be accepted by the Owner. At this time the warranty period begins.

END OF SECTION 284621.11