

BFAAM Apprenticeship Program

Related Training Instruction (RTI)

Module 4 – Fire Alarm Signaling Systems

Reading material associated with this module:
Chapters 6, 7, 8 of Fire Alarm Signaling Systems,
Third Edition, or
Chapters 7, 8, 9 of the Fourth Edition

Signal Transmission

- The three methods of fire alarm signal transmission are:
 - Hardwiring with copper wire and cable
 - Radio Frequency (RF) also known as “wireless”
 - Fiber optic media

Signal Transmission

- Conventional circuits utilize normally open devices on a circuit that terminates with an end of line resistor, sometimes referred to as a two wire or Class B initiating device circuit
- Circuits that originate and terminate at the control unit are referred to as a four wire or Class A initiating device circuit

Signal Transmission

- Smoke detectors can be two wire, where their operating power is drawn from the initiating device circuit, or four wire, where separate power is supplied to the smoke detector. A two wire smoke detector in an alarm condition may prevent other two wire smoke detectors on the circuit for getting enough power to operate

Signal Transmission

- Four wire smoke detectors should be configured with a power source capable of supporting all detectors in alarm at the same time. This is important when relays in the smoke detector base are relied upon to close fire doors or fire shutters

Signal Transmission

- Addressable devices draw their operating power from the signaling line circuit, and have a unique address that is set at the detector and is communicated to the control unit. When the control unit polls the addressable device, the device transmits its status. When a device fails to respond to a poll from the control unit, a trouble signal is generated

Signal Transmission

- Analog detectors send real time environmental data to the control unit, and the control unit makes the decision to go into an alarm condition. Some control units can also combine data from adjacent detectors to help make the alarm decision

Signal Transmission

- Multiplexing is a technology that allows multiple signals on the same path. An addressable device on a signaling line circuit is one example of multiplexing, wireless transmitters on the same radio frequency are another example of multiplexing. Multiplexing can be either *active* or *passive*

Signal Transmission

- Active multiplexing is the transmission of status signals from an addressable device to a central control or receiving unit upon command, enabling identification of each addressable device responding to the command

Signal Transmission

- Active multiplexing can be utilized at the protected premises between devices and the control unit, and can also be utilized between a supervising station and the protected premises

Signal Transmission

- Passive multiplexing removes the command to transmit, and permits transmitters to report at any time. Coded initiating devices, where the initiating device includes a code wheel that imposes a coded output on the notification appliance output, are an example of passive multiplexing

Signal Transmission

- Wireless transmission is used both for communications between protected premises and the supervising station, and for communications between initiating devices and the control unit. In both cases, transmission is carried on an FCC assigned frequency

Signal Transmission

- Wireless communications between the supervision station and protected premises may be one way RF or two way RF, permitting the supervising station to poll or control the protected premises transmitter

Signal Transmission

- Wireless communications between the initiating devices and the control unit are typically one way, utilizing low power transmitters powered with a dry cell battery

Signal Transmission

- Fiber optic transmission is typically utilized to carry data between fire alarm control panels and remote annunciators. The National Electrical Code Article 770 addresses installation requirements for fiber optic cable and raceways

Signal Transmission

- Device compatibility is an important consideration when utilizing two wire smoke detector. The detectors must be evaluated by a testing laboratory to make sure they function properly with the proposed control unit. Fire alarm control units have lists, known as compatibility lists, of detectors that have been tested to work with the control unit

Alarm Notification

- The intent of fire alarm notification is to notify the occupants of the building of an alarm condition. In most circumstances, the intent is to have the occupants evacuate the building. In some occupancies such as hospitals, occupants may relocate within the building instead of evacuating the building

Alarm Notification

- Notification is accomplished through audible and visible signaling devices. Audible devices may include bells, horns, electronic sounders and fire alarm speakers. Visible devices are typically strobes, used independently or in combination with an audible device

Alarm Notification

- The recommended signal for evacuation is a Code 3 temporal signal. This consists of a signal that is ON for 1/2 second, OFF for 1/2 second, ON for 1/2 second, OFF for 1/2 second, ON for 1/2 second, then OFF for 1.5 seconds, then the cycle is repeated. This pattern can be imposed on bells, horns, tones, and other forms of audible signaling

Alarm Notification

- Fire alarm notification signals are classified as:
 - Coded
 - Non-coded
 - Textual
- Coded signals provide information through the number of strokes on a bell, the number of flashes on a visible appliance, or the number of activations on a horn or buzzer

Alarm Notification

- Non coded signals simply activate, they are either ON or OFF
- Textual signals convey information. A voice message over a fire alarm speaker is an example of a textual message. A text display showing the location of activated devices is another example of a textual signal

Alarm Notification

- Private mode signals are designed to notify only the persons necessary to carry out emergency action, such as notifying a fire brigade in an industrial occupancy
- Public mode signals are designed to notify all occupants of the facility of the need to evacuate or take other appropriate action

Alarm Notification

- Public mode audible notification appliances should have a minimum sound level of 75 decibels (dBA) and a maximum sound level of 120 dBA. Public mode audible notification should be designed to be 15dBA above the average ambient sound level

Alarm Notification

- Private mode audible notification appliances should have a minimum sound level of 45 decibels (dBA) and a maximum sound level of 120 dBA. Private mode audible notification should be designed to be 10dBA above the average ambient sound level

Alarm Notification

- The Americans with Disabilities Act of 1990 (ADA) requires fire alarm systems to provide both audible and visible signaling appliances, so the visually impaired and the hearing impaired are equally aware of the fire alarm signal. ADA is civil rights legislation, failure of the fire alarm system to notify an impaired person is considered a form of discrimination

Alarm Notification

- The ADA Accessibility Guide (ADAAG) specifies a minimum 75 candela (cd) for fire alarm strobe signals
- NFPA 72 permits smaller candela strobes in smaller spaces, such as a 15cd strobe for a 20' x 20' room

Alarm Notification

- The conflict between ADA and NFPA strobe intensity requirements can be resolved. ADA permits “equivalent facilitation”, which means using a means equal to or better than ADA specific requirements to achieve the required performance

Alarm Notification

- The ADA requirement of a 75cd strobe in a room up to 50' square, provides a minimum of .030 lumens per square foot
- NFPA 72 requirements are based on a minimum .0375 lumens per square foot
- Consequently, NFPA 72 compliant strobe intensities and spacing exceed the ADA minimum requirements and are permitted in lieu of the specific ADA requirement

Alarm Notification

- Audible notification appliances may be:
 - Bells, generally in 6", 8" or 10" sizes
 - Horns, either electromechanical or electronic
 - Chimes, typically only used in health care
 - Buzzers, usually trouble signal appliances
 - Sirens
 - Speakers, either connected to a remote tone generator and audio amplifier or the integral type, with the tone generator, amplifier, and speaker contained in a single unit

Fire Safety Functions

- Release of automatic door closers
- Stair pressurization and other mechanical air handling features
- Smoke dampers in smoke barriers
- Automatic shutdown of Air Handling Units
- Stair door unlocking to permit entry from the stair to any floor during an alarm condition

System Installation

- Equipment listed for the purpose
- Adequate power supplies for system operation and notification appliances
- Initiating devices and circuit wiring
- Notification appliances and circuit wiring

System Installation

- Protected from mechanical damage
- Supported independently of attachment to wiring
- Provided with duplicate terminals or leads for wiring supervision
- Wiring must not be looped around terminals, it must be cut and each end attached

System Installation

- Total coverage provides detection in all accessible spaces, including all rooms, basements, attics, and space above suspended ceilings
- Partial coverage provides detection at specified locations, such as corridors, smoke barrier openings, and above control equipment

System Installation

- Detectors should only be installed in an orientation they have been listed to (ceiling mount or wall mount). This is a particular concern when installing detectors under raised floors, the detector should not be mounted upside down attached to the floor

System Installation

- Smoke detectors in HVAC systems are intended to prevent the recirculation of smoke within a building, and typically shut down the HVAC unit when smoke is detected. They are not intended to provide smoke detection for the entire area, just to stop the HVAC if it is transporting smoke from one area to another

System Installation

- Smoke detectors in HVAC systems are subject to dilution from air from other areas, and they only are functional when the HVAC unit is running and moving air through the duct work

System Installation

- The Michigan Mechanical Code requires duct smoke detectors to be installed on the return side of all units in excess of 2,000 cfm. There are two exceptions to the requirement for duct smoke detectors:

System Installation

- Exception: Smoke detectors are not required where the HVAC system cannot move smoke beyond the space in which it was generated. This is typical of many roof top units in large spaces, where there is minimal duct work attached to the RTU. Since the unit cannot move smoke from one space to another, it is exempt from duct smoke detector requirements

System Installation

- Exception: Smoke detectors are not required in the return air system where all portions of the building served by the AHU are protected by area smoke detectors connected to a fire alarm system, and the smoke detection system shuts down the AHU

System Installation

- Detectors for AHU's may be open area detectors located in return air openings, or they may be in duct detector housings which attach to the outside of the ductwork and use a sampling tube to draw air out of the ductwork and across the detector. Detectors shall be listed for the air velocities present

System Installation

- Smoke detectors dedicated for door release service should be installed based on NFPA 72-2007 section 5.16.6.5. Important items are the height of the wall from the top of the door to the ceiling, whether the ceiling height is the same on both sides of the door, and whether the intent is to detect smoke flowing just one way, or either way through the door opening

System Installation

- Fire alarm circuits may be power limited or non power limited. The equipment that powers the circuit (usually the FACP) must identify those circuits that are power limited circuits. If not identified as a power limited circuit, it is a non power limited circuit

System Installation

- Non power limited fire alarm circuits must be provided with overcurrent protection (usually a circuit breaker or fuse)
- NPLFA circuits can only share a raceway, cable or enclosure with AC power circuits when they are both connected to the same equipment

System Installation

- NPLFA circuit conductors can be as small as 18 gauge for single conductors and multi conductor cables
- NPLFA circuit conductors shall be solid or stranded copper

System Installation

- PLFA circuit conductors can be as small as 18 gauge for single conductors and 26 gauge for multi conductor cables
- PLFA circuit conductors shall be solid or stranded copper

System Installation

- Circuit conductors for both NPLFA and PLFA may be installed in raceway systems, or may be installed using cables listed for either NPLFA or PLFA use