Fire Service Guide to Reducing Unwanted Fire Alarms

NFPA®

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About NFPA®: NFPA has been a worldwide leader in providing fire, electrical, building, and life safety to the public since 1896. The mission of this international nonprofit organization is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating consensus codes and standards, research, training, and education.

The Fire Service Guide to Reducing Unwanted Fire Alarms was developed in response to the emphasis that has been placed on the need to properly address the unwanted fire alarm issue and reduce response by fire departments. This Guide addresses the minimum information necessary to remedy the existing stress of unwanted fire alarms. This Guide is available to everyone in a free, downloadable format from the NFPA website, www.nfpa.org/redgd.

Contact Steven Sawyer, Senior Fire Service Specialist, with comments and suggestions at ssawyer@nfpa.org or 617-984-7423.

FOREWORD

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With the emergence of more fire alarm systems in residential and commercial occupancies, fire departments today find that they are receiving more notifications of activated fire/smoke detection devices via fire alarm systems. This increase in notification includes a dramatic increase in the number of responses to activated alarms where no emergency services are needed, and while the number of responses due to malicious or mischievous false alarms has fallen over the past 20 years, the responses to unintentional activations continue at a rate that challenges the fire service. A recent NFPA study found that in 2009, U.S. fire departments responded to an estimated 2.1 million false alarms, which included 979,500 responses due to unintentional activations (45%) and 698,000 due to system malfunctions (32%).

The International Association of Fire Chiefs (IAFC) has flagged the response to unwanted alarms as a major challenge for the fire services of North America. At a time of decreasing financial resources, reduced staffing, and increased call volume due to the provision of emergency medical services and all-hazards responses, fire chiefs across the continent are looking for ways to meet their core mission of protecting life and property. In February 2011, the IAFC and National Fire Protection Association (NFPA), along with the U.S. Fire Administration, hosted a summit on how to address this challenge.

This guide is a product of that summit. It is intended to inform line fire officers and fire fighters how they can assist in reducing unwanted responses by gathering basic information during a response to an activated fire alarm system. The guide provides a quick review of the varied technologies and appliances that comprise today's fire alarm fire protection systems and identifies the most frequent reasons for unwanted activations. Lastly, it illustrates how line personnel can work with their authority having jurisdiction (AHJ) to identify problematic sites and develop a plan to reduce the unwanted activations.

In 1898, NFPA addressed the role of fire alarm systems within structures, with the establishment of the Committee on Thermo Electric Fire Alarms. Since that time, fire alarm systems have become integral parts of the life safety systems in many structures across North America—their installation often required by property insurers, fire departments, and code enforcing officials. The work started in 1898 has evolved into *NFPA 72®, National Fire Alarm and Signaling Code*, the recognized standard for the design, installation, testing, and maintenance of fire alarm systems. Today, as then, NFPA, in partnership with the IAFC, is working to address the challenges faced by responders across the world.

INTRODUCTION

Of the total fire alarms to which fire departments respond each year, approximately 7 percent are unwanted.[1] An *unwanted alarm* is defined by *NFPA 72®, National Fire Alarm and Signaling Code*, as *any alarm that occurs that is not the result of a potentially hazardous condition*. This guide is intended to assist the fire department to determine the cause of unwanted fire alarms and to find solutions to reduce responses to facilities where no fire department response was required.

The intent of this guide is to describe common causes of unwanted fire alarms, assist fire suppression personnel to determine alarm causes, and provide a framework for local officials to develop possible solutions to reduce unwanted alarms. This guide addresses commercial and residential (hotel, dormitory, apartment, and similar occupancies) building fire alarm systems. It also addresses single-family dwellings and single- or multiple-station smoke alarms within dwelling units.

In this guide the term *authority having jurisdiction (AHJ)* means an organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure. This is usually the fire chief, fire marshal, or other personnel assigned the responsibility of enforcement of the jurisdiction's codes, standards, and ordinances.

FIRE ALARM TECHNOLOGY

Types of Signals

Fire Alarm Signal

A fire alarm signal is initiated by a fire alarm–initiating device such as a manual fire alarm box, automatic fire detector, water flow switch, or other device in which activation is indicative of the presence of a fire or fire signature. Receipt of a fire alarm signal at the monitoring facility should require a response from the fire department.

Supervisory Signal

A supervisory signal indicates the need for action in connection with the supervision of guard tours, the fire suppression systems or equipment, or the maintenance features of related systems. Receipt of a supervisory signal at the monitoring facility should be directed to the appropriate individual at the building to ensure that the correct action is taken and the issue is corrected. A response by the fire department is usually not needed.

Trouble Signal

A trouble signal is initiated by a system or device indicative of a fault in a monitored circuit, system, or component. Receipt of a trouble signal at the monitoring facility should be directed to the appropriate individual to ensure that the correct action is taken and the issue is corrected. A response by the fire department is usually not warranted.

[1]Michael J. Karter, Jr., "False Alarm Activity in the U.S. 2010," NFPA, Quincy, MA, issued September 2011.

Smoke Detectors/Alarms

Smoke detectors are common components associated with many unwanted alarms. The activation of the smoke detector may not be the result of a faulty detector, as it only responds to the surrounding conditions. If burnt toast, steam, or dust is in the area of the smoke detector, it may activate because it cannot differentiate smoke from other particulates. Smoke detectors operate on two basic principles: *ionization* (see Figure 1) and *photoelectric* (see Figure 2). Ionization detectors have a very small amount of radioactive material (an alpha emitter) that ionizes the air in the sensing chamber, rendering the air in the sensing chamber conductive and permitting a minute current flow through the air between two charged electrodes. This gives the sensing chamber an effective electrical conductance. When smoke or other airborne particles enter the ionization area, they decrease the conductance of the air by attaching themselves to the ions, causing a reduction in ion mobility. The current flow is monitored, and when conductance is below a predetermined level, the detector is in alarm. Photoelectric detectors operate when smoke particles enter a light path, producing a light-scattering effect. A light source and a photosensitive device are arranged so that the light rays normally do not fall onto the device. When smoke or other particles enter the light path, light strikes the particles and is scattered onto the photosensitive device, causing the detector to respond.

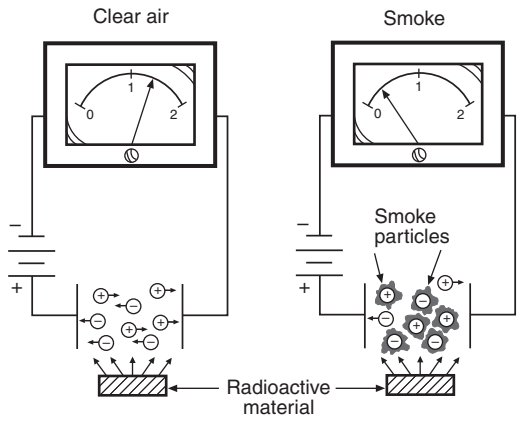


Figure 1
Ionization Detector.

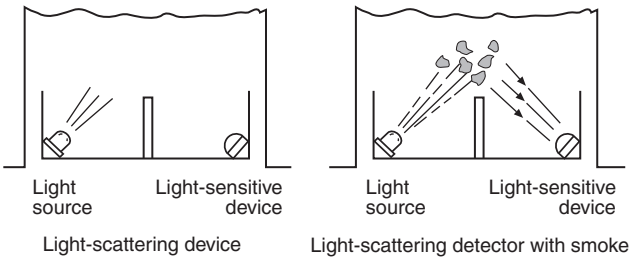
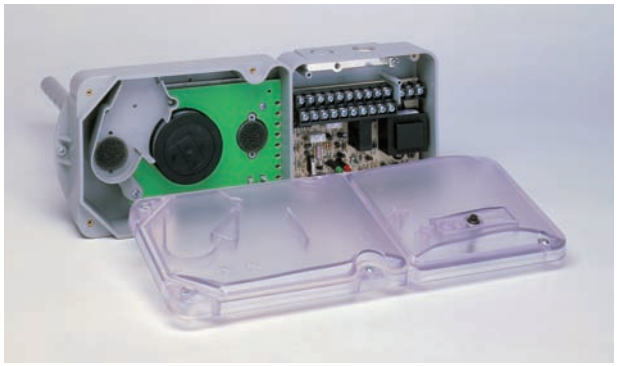


Figure 2
Photoelectric Detector.

Like photoelectric smoke detectors, beam smoke detectors operate on the light obscuration principle. A beam of light is passed a distance of 33 to 330 feet through a space, such as a large room.

Duct detectors operate on smoke detector technology and have a smoke detector installed within the HVAC duct work (see Figure 3). These detectors may be difficult to locate as they are installed behind ceilings or within mechanical rooms.

(a)



(b)

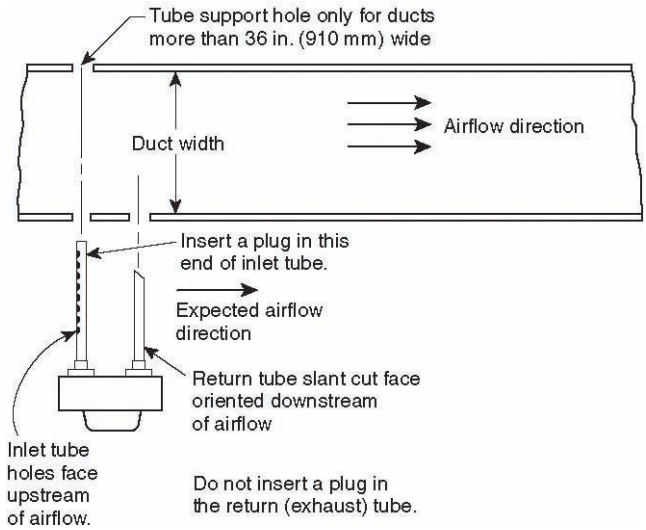


Figure 3

Duct Detector. (a) Example of a Duct Detector (Courtesy of System Sensor Corp., St. Charles, IL); (b) Inlet Tube Orientation.

Heat Detectors

Heat detectors can also be associated with unwanted alarms. Unwanted activations can occur when heat detectors are placed in the wrong locations or too near a heating source. Heat detectors work on two basic principles: *fixed temperature* and *rate of rise*. Some heat detectors have both technologies within one device. Fixed-temperature heat detectors are designed to alarm when the temperature of the operating element reaches a specified point. Rate-of-rise detectors, however, will function when the rate of temperature increase exceeds a predetermined value, typically around 12°F to 15°F (7°C to 8°C) per minute. Rate-of-rise detectors are designed to compensate for the normal changes in ambient temperature (less than 12°F [6.7°C] per minute) that are

expected under nonfire conditions. Figure 4 shows a heat detector with both fixed-temperature and rate-of-rise operating elements.

Rate compensating detectors respond to a predetermined temperature regardless of the rate of temperature rise.

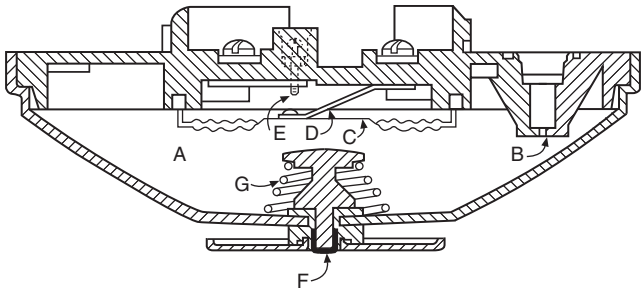


Figure 4

Example of a Spot-Type Combination Rate-of-Rise, Fixed-Temperature Detector. The air in chamber A expands more rapidly than it can escape from vent B. This causes pressure to close electrical contact D between diaphragm C and contact screw E. Fixed-temperature operation occurs when fusible alloy F melts, releasing spring G, which depresses the diaphragm closing contact points.

Manual Fire Alarm Boxes

Manual fire alarm boxes (also called manual pull stations) can also be associated with unwanted alarms when installed in areas where they can be struck accidentally, such as a gymnasium or warehouse, or in areas subject to malicious activation, such as schools. There are two basic types of manual pull stations: single-action and double-action (see Figure 5). A single-action manual fire alarm box requires only one action to operate, making it more prone to activation when struck or leaned on. Double-action manual fire alarm boxes require two actions to operate, generally one to gain access to the activation device and one to activate it.

(a) (b)

Figure 5

Examples of Single- and Double-Action Pull Stations. (a) Single-Action Pull Station. (Courtesy of SimplexGrinnell, Westminster, MA); (b) Double-Action Pull Station. (Courtesy of Fire-Lite Alarms)

Water Flow Devices

Water flow devices (water pressure switches and water flow switches) are installed on automatic fire sprinkler systems as a means of providing an alarm when the system activates. Water flow devices can be the type that operates on pressure, pressure differential, or mechanical sensor. Water pressure switches operate when the switch actuator senses pressure or differential pressure due to water flow within the sprinkler system. Water flow switches operate when the flow of water moves a mechanical operator, such as a paddle. In both cases, the point of sensor activation is intended to occur on the detection of the discharge of a certain number of gallons per minute that is equivalent to the amount of water discharged from a single operating sprinkler. However, water pressure/flow switches have a retard feature that can be programmed to hold the alarm for a set period of time before sending an alarm. The retard feature is intended to prevent slight pressure changes and water surges that occur within the systems from causing an alarm due to activation of the flow switch. The retard time is determined for each system during design. Water flow switches are usually located at the system riser and flow switches are located on the systems (see Figure 6).

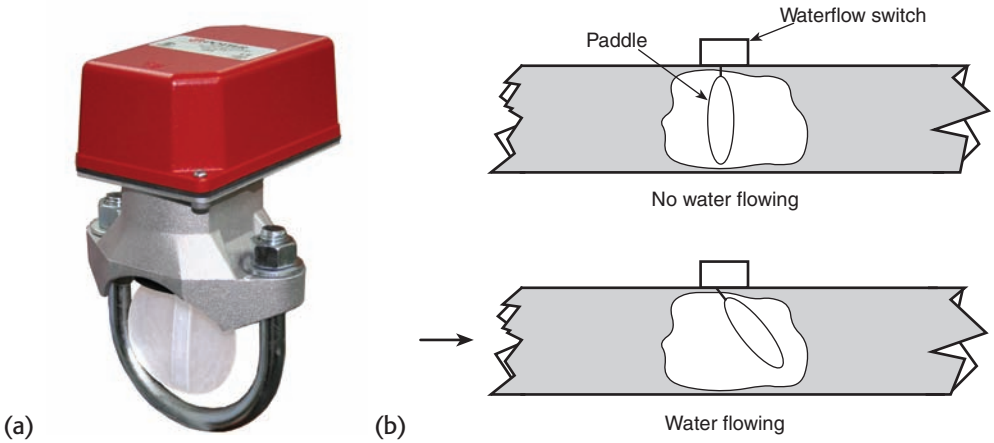


Figure 6

Water Flow and Water Pressure Switches. (a) Example of Water Flow Switch. (Courtesy of Potter Electric Signal Company, LLC, St. Louis, MO); (b) Water Flow Switch Operation. (Source: FIREPRO Incorporated, Andover, MA); (c) Example of Water Pressure Switch. (Courtesy of Potter Electric Signal Company, LLC, St. Louis, MO)

Other Devices

Detectors can also have two or more sensing devices called multi-sensor or multi-criteria detectors, such as a combination smoke/heat detector, combination smoke/carbon monoxide detector, or combination photoelectric and ionization detector.

There are many other types of detection devices not discussed in this guide. They are usually used for special application and are not usually the cause of unwanted alarms. These devices include line detection, video image detection, and aspiration.

Inspection, Testing, and Maintenance

The first line of defense to ensure that systems operate properly is a well designed, installed, tested, and accepted system. Once the system has been installed it must have a proper inspection, testing, and maintenance (ITM) program. Another key reason for unwanted alarms is the lack of an established ITM program. ITM programs are the next line of defense in the reduction of unwanted alarms. By having qualified individuals inspect, test, and maintain fire alarm system components, many issues that can cause an unwanted alarm can be discovered and corrected.

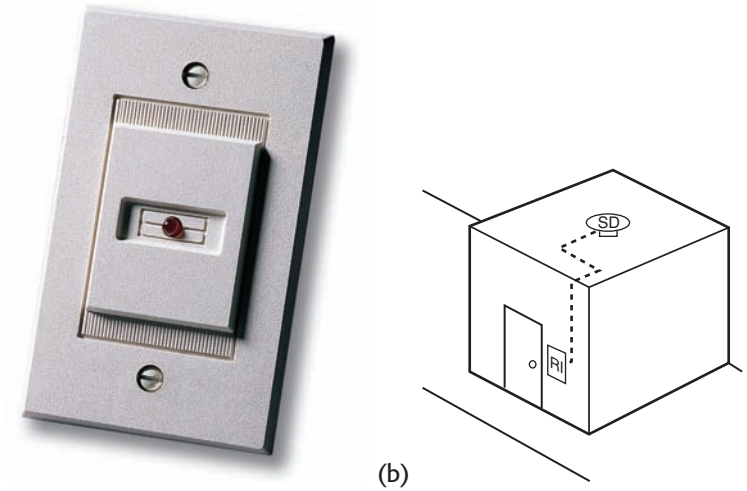
FIRE DEPARTMENT PERSONNEL RESPONSIBILITIES

It is important for fire suppression personnel to assist in the reduction of unwanted alarms by observing and reporting unwanted alarms to the AHJ to take appropriate corrective action. Responding fire suppression personnel need to locate the particular device in alarm and investigate what caused the alarm to activate, document this information on the incident report, and, if necessary, report to the AHJ. You should follow your department's SOPs on how to respond to fire alarm activation.

The means of finding the device in alarm depends on the type of system installed in the building. If the fire alarm control unit (panel) is a zoned panel, the system will only advise you of the area where the device is located, for example, first floor north. If the fire alarm control unit is an addressable type (a point ID type), the panel will advise you of the type of device and location, for example, smoke detector first floor room 110.

Smoke detectors will usually be located on the ceiling and sometimes above the ceiling or under floors. They can be found in almost any area of the building with the exception of some mechanical spaces, cooking areas, and areas subject to dust. The device in alarm will usually have a steady red light.

Duct detectors will be located within ducts or on ducts (with the airflow sensor inside the duct) in mechanical spaces, above ceilings, and other areas typically used for mechanical equipment or spaces. The device in alarm will usually have a steady red light. If a zone type of fire alarm control unit is used, a labeled remote indicator light will be provided on the ceiling or wall nearby to help locate the activated smoke detector (see Figure 7).



(a) (b)

Figure 7

Remote Indicator Light. (a) Example of a Remote Indicator Light. (Courtesy of System Sensor Corp., St. Charles, IL); (b) Concealed Smoke Detector (SD) in Locked Room with Remote Indicator (RI). (Source: FIREPRO Incorporated, Andover, MA)

Heat detectors will usually be located on ceilings, sometimes above the ceiling or under floors, in mechanical spaces, and other spaces subject to dust, debris, and heat. The device in alarm may have a steady red light, the heat-sensing element may be missing, or no indications may be shown at the device.

Manual fire alarm boxes (pull stations) are usually located near exits and along corridors. An activated manual fire alarm box handle will be out of normal position (down), or the handle will be sticking out from the box.

Devices that have cleared or been reset if the panel has been reset will not show an alarm condition. Some panels permit the viewing of signals, or the alarm monitoring company may have the information.

If a water flow/pressure switch has been activated, there will be no indications on the switch. On a fire sprinkler riser, you would need to view the system pressure gauge to determine whether water is flowing. If the switch is located on a fire sprinkler pipe, you would need to listen for water flow or see water flowing from a sprinkler. If a water surge has caused the alarm, you may notice water at the water motor gong or from the drain of the retard chamber.

Determining Cause of Activation

Once you have determined which device has activated, you must then determine why. The reason the alarm activated is crucial to determining whether the activation is unwanted and getting corrective action started. Talking with those that were in the area and observing the activities in the area of the activated device should assist you in determining the cause. See the "Common Causes" section to assist with finding the cause and solutions. The AHJ should be notified if activation is unwanted to initiate corrective action in order to eliminate future alarms.

Common Causes

The solutions in this section require approval from the AHJ and should be in compliance with local building, fire, and mechanical codes. Qualified personnel should perform work required to make changes to fire alarm systems per local requirements. It is best to consult with the AHJ and design professionals on the optimal method to reduce unwanted alarms in a manner that complies with the codes and design intent of the system.

Cooking

Cooking is one of the leading causes of unwanted fire alarms. The activation of the smoke detector has many causes: burnt food, unattended cooking, detectors too close or in the same room as cooking operations, cooking taking place in areas where it is not permitted, fans not in operation during cooking, and steam from cooking.

Solution

- Ensure that cooking equipment is installed properly and that the ancillary cooking equipment is located in proper places. For example, office areas protected with smoke detectors are probably not proper locations for coffee pots and microwaves.
- Smoke detectors should not be placed too close to or in the same room as cooking equipment. This will also help in the reduction of activation for unattended cooking or burnt items with not much smoke production. If permitted, change the smoke detector to a heat detector, or the cooking appliances could be moved to a different location. Smoke alarms should not be placed within 10 feet of a cooking appliance. If within 10 to 20 feet, a photoelectric smoke detector should be used.
- Hood ventilation fans are often not in operation during cooking—this can be fixed by connecting the fan to the light switch, causing the fan to come on anytime the light is turned on.
- Ductless residential hood ventilation systems do not vent the exhaust outside, permitting the exhaust to enter the room. Proper detector placement is the best method to reduce unwanted alarms.

Smoking

Many states prohibit smoking within or in close proximity to a building. In some cases, smoking is allowed in designated smoking areas in buildings.

Solution

- Smoke detectors should not be located within or in close proximity to designated smoking areas. Proper ventilation should be provided in the designated smoking area to prohibit smoke migration to other areas. If smoke detectors are located too close to smoking areas, they should be relocated or changed to heat detectors.

Steam

Steam from showers, cooking equipment, or other appliances can be a cause of unwanted fire alarms.

Solution

- Smoke detectors should not be placed in areas subject to showers or other areas that produce steam. Steam from cooking is covered under the section on cooking.
- Buildings with steam heating systems will sometimes have leaks causing unwanted alarms. Until the leak is shut off, the system will remain in alarm. When the leak will take time to fix, the device could be changed from a smoke detector to a heat detector until the steam leak is fixed. Where the issue of the steam leak is moisture, the detector could be removed and jumped out (i.e., the specific device is taken out of service by qualified personnel), letting the rest of the circuit be in service.

Construction

Construction causes many unwanted alarms. Construction dust, hot work, fumes, and other construction work cause alarm activation, and once construction is complete, if the detectors are not cleaned and calibrated, they can cause more alarms.

Solution

- Smoke detectors should be covered during construction to prevent dust accumulation in the detector chamber. At the end of the day covers should be removed. If permitted, smoke detectors may be changed to heat detectors during construction and restored back to smoke detectors after work is complete. After construction is completed all smoke detectors should be cleaned and sensitivity checked.
- When hot work is performed, smoke detectors may need to be protected or placed out of service in the immediate area of the hot work.
- Sawing, grinding, and drilling operations all cause dust that can set off a smoke detector. In areas where these activities are taking place, the detector needs to be temporarily covered or placed out of service.
- Detectors in areas where painting is taking place should be removed or covered to prevent paint and paint fumes from entering the chamber or getting on chambers or elements of the detector. Detectors with paint exposure or painted detectors will need to be replaced.
- Before construction takes place, the AHJ should be involved in the fire protection requirements for the construction site, such as which detectors will be permitted to be out of service, the type of protection required, the notifications required, and other issues affecting the building, occupants, and fire department response.

Alternate Heating Appliances (Wood Stove/Fireplace/Furnaces)

Smoke and heat detectors placed too close to alternate heating appliances can cause unwanted alarms. Improperly maintained heating appliances can cause improper or incomplete combustion, causing alarms.

Solution

- Where possible, smoke detectors should not be in the same room as alternate heating appliances, especially wood stoves and fireplaces.
- Heat detectors should be placed away from alternate heating appliances and furnaces.

- Heat detectors placed too close to heating appliances should have the correct temperature rating for the area.

Weather Conditions

Detectors and devices can be set off by high humidity, wind, high air movement, and cold and hot temperatures. Heat detectors can be set off by installation exposed to high temperature extremes.

Solution

- Smoke detectors placed near exterior doorways need more frequent maintenance than other detectors. They are susceptible to temperature variations, dust, vehicle exhaust, condensation from temperature changes, and other conditions that cause them to alarm. Smoke detectors should be moved away from exterior doorways or, if permitted, changed to heat detectors.
- Rate-of-rise heat detectors should not be placed in areas subject to fast temperature changes.

Cleaning

Dust from cleaning and certain cleaning solutions can cause smoke detector activation.

Solution

- Care should be taken when sweeping to limit dust from becoming airborne. In areas with large volumes of dust, a smoke detector may not be the best device to protect that area. If a smoke detector is required, use a vacuum to remove the dust or cover the smoke alarm during cleaning, but be sure to remove the cover when completed.

Working on Fire Alarm or Fire Protection Systems

Individuals working on fire alarm or fire protection systems also can cause unwanted alarms. Individuals working on fire alarms and fire protection systems and components should notify the monitoring company, the AHJ, and the fire department to disregard alarms until notified that testing or work has been completed. In some communities, a permit is required from the AHJ and/or the fire department prior to performing system inspection, testing, and maintenance on fire alarm or fire protection systems. The permit and notification information can be on the permit as a condition of the permit and posted at the fire alarm control panel.

General Placement

There are certain areas, other than those discussed above, where the installation of smoke detectors/alarms should be avoided. Avoiding these locations will help reduce unwanted alarms.

Solution

- *Exterior doorways and high traffic areas*—Smoke detectors placed near exterior doorways need more frequent maintenance than other detectors. They are susceptible to temperature variations, dust, vehicle exhaust, and other conditions that cause them to alarm. Detectors should be moved away from exterior doorways or, if permitted, changed to fixed-temperature heat detectors.
- *Linen, lint, and laundry areas*—These areas have a large amount of lint that can activate smoke alarms. Changing to heat detectors will eliminate the unwanted alarm problem.

- *Areas protected by projected beam detectors*—Most unwanted alarms are caused by banners or other items hung in the area that block the beam and cause an alarm. Building owners should be reminded not to hang items within the beam area and, if banners are permitted by the AHJ, the device should be shut down before hanging.
- Some unwanted alarms can be corrected by changing the smoke detector type from ionization to photoelectric, or vice versa, or by changing detector placement.

Water Flow/Pressure Switches

Water flow/pressure switches can cause unwanted alarms when not set up properly or when changes to the water system have taken place.

Solution

- If unwanted alarms are being received, the retard feature of the switch must be checked to ensure it has been set correctly. It needs to be set to prevent fluctuations of water pressure from setting it off. Have the switch checked out to make sure that it is working and set properly.
- Retard chamber drains on the alarm check valve of sprinkler systems can also become clogged, preventing water from draining from the chamber. This eliminates or reduces the retard function of the chamber, causing alarm activation. The drain should be checked to make sure it is not blocked and is draining properly.
- Vane type water flow switches should have the retard function set to eliminate pressure fluctuations.
- Retard functions should not be set to "0." Settings should be per the system design.

Duct Detectors

Duct detectors are subject to dust and humidity. Maintenance of duct detectors is important to reducing unwanted alarms.

- During maintenance, make sure that the proper type of smoke detector/alarm has been installed in the duct.
- Normally, duct detectors are required to transmit a supervisory alarm and should not transmit a fire alarm signal. If duct detectors are required to transmit a fire alarm, the devices should be programmed to transmit a fire alarm.
- High humidity can set off the duct detectors. If the humidity is high, changes to the system may be needed to prevent activation. Many times humidity activations are due to the system being shut off when the building is not occupied and then started before occupancy. The system may need to be programmed to run at a higher setting to prevent humidity from entering the system.

Manual Fire Alarm Boxes (Pull Stations)

The main cause of manual fire alarm box unwanted alarms is the device being struck in places such as gymnasiums or stocking areas. Other times the location is a prime target for malicious activation.

Solution

- Where the likelihood of the manual fire alarm box being hit by an object is high, it should have a listed cover installed. These covers protect the manual fire alarm box from activating when struck.
- If the building is equipped with single-action manual fire alarm boxes and unwanted alarms are taking place, unwanted activation can be reduced by changing them to double-action manual pull stations.
- In stocking areas or areas subject to traffic from forklifts, hand trucks, pallets, etc., consideration of the placement of manual fire alarm boxes should be given to prevent them from being struck.
- In areas subject to malicious activation, listed covers can be installed with a local alarm warning the device has been tampered with.

CONCLUSIONS

How Do We Get the Issue Corrected?

The goal in reducing unwanted alarms is to correct issues that cause them. There are many means of accomplishing this goal. Voluntary correction of the unwanted fire alarms is the first step, followed by abatement/legal corrective action.

Both national fire codes—NFPA® 1, *Fire Code*, and ICC's *International Fire Code*®—contain provisions for corrective action to reduce unwanted alarms. The fire codes, as well as NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, and *NFPA 72®, National Fire Alarm and Signaling Code*, have provisions that require fire alarms and other fire protection systems to be ITM. It also grants the AHJ the authority to cite building owners when ITM is not being performed per code. Systems that have a good ITM program will have fewer unwanted alarm problems. Suggestions provided in the ITM report should be reviewed and acted on to further reduce unwanted alarms. During inspections, fire prevention personnel should be aware of issues that can reduce unwanted alarms and report them.

What Do We Do in the Interim?

If you have identified an unwanted alarm cause and corrective action has been initiated, other actions may be needed in the interim until corrective action has been taken. Some of the corrective actions needed will take time and money, with the possibility of unwanted alarms still occurring. During the time that corrective action is taking place, you may need to consider many different additional safeguards, such as a fire watch, modified response, and alarm verification.

NFPA 25 and *NFPA 72* have specific provisions for handling impairments to fire protection systems. These documents provide guidance on those systems that are impaired and the steps to be taken to eliminate the problem, including the appropriate entities to contact.

Fire departments should look at the type of occupancy protected by the alarm systems, other fire protection equipment installed (e.g., sprinkler systems), fire code violations in the building, and other factors before determining what type of modified response (if any) should be permitted during the time corrective action is taking place. Fire departments have used one or more of the following modified response protocols:

- Fire watch
- Verification of alarm by contacting site
- Response based on type of alarm received, e.g., water flow
- Second alarm device
- Modified response of one engine
- Modified response of battalion or district chief
- No response unless receipt of call from building

Individuals placing fire alarm or fire protection systems out of service for inspection, testing, or maintenance should remember to notify the alarm monitoring company, the AHJ, and the fire department to ensure that they do not respond to unwanted alarms.

The solutions in this guide require approval from the AHJ and other code enforcement personnel and should be in compliance with local building, fire, and mechanical codes. Qualified personnel should perform work required to make changes to fire alarm systems per local requirements. It is best to consult with the AHJ and design professionals on the optimal way to reduce unwanted alarms that comply with the codes and design parameters of the system.

For additional information, see the following:

- NFPA 1®, *Fire Code*
- NFPA 13, *Standard for the Installation of Sprinkler Systems*
- NFPA 13R, *Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies*
- NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*
- *NFPA 72®, National Fire Alarm and Signaling Code*
- NFPA *101®, Life Safety Code*
- *International Building Code®*
- *International Fire Code®*