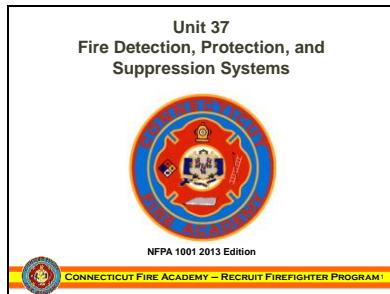




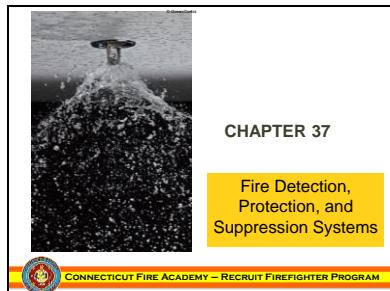
The Connecticut Fire Academy  
Recruit Firefighter Program  
**Presentation Instructor Notes**

**Session 37.1**  
**Chapter 37 - Fire Detection, Protection  
and Suppression Systems**

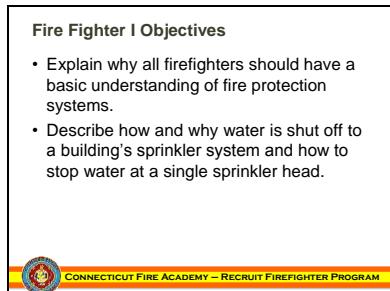
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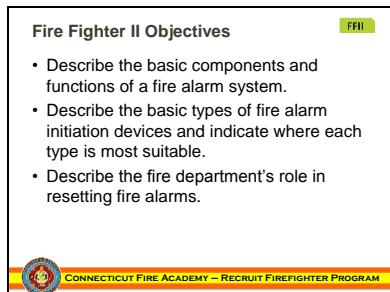
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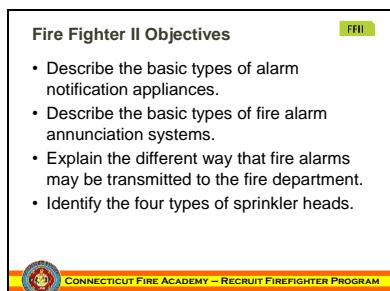
Slide 3



Slide 4



Slide 5





Slide 6

**Fire Fighter II Objectives** FFII

- Identify the different styles of indicating valves.
- Describe the operation and application of the following types of automatic sprinkler systems: wet-pipe system, dry-pipe system, preaction system, and deluge system.

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Slide 7

**Fire Fighter II Objectives** FFII

- Describe the differences between commercial and residential sprinkler systems.
- Identify the three types of standpipes and point out the differences among them.
- Describe two problems that fire fighters could encounter when using a standpipe in a high-rise building.

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Slide 8

**Fire Fighter II Objectives** FFII

- Identify the hazards that specialized extinguishing systems can pose to responding fire fighters.

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Slide 9

**Introduction** FFII

- Fire prevention and building codes require that most new structures have some sort of fire protection system installed.
- Understanding how these systems operate is important for fire fighter safety and effective customer service.

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Slide 10

**Introduction** FFI

- From a safety standpoint:
  - The operations and limitations of fire detection and suppression systems
- From a customer service standpoint:
  - Help dispel misconceptions about fire protection systems.
  - Advise building owners and occupants after an alarm is sounded.

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## Introduction

From a safety standpoint, fire fighters need to understand the operations and limitations of fire detection and suppression systems. From a customer service standpoint, fire fighters can help dispel misconceptions about fire protection systems and advise building owners and occupants after an alarm is sounded.

Most people have no idea of how the fire prevention or detection systems in their building work, and there are often more false alarms in buildings with fire protection systems than actual fires.

Help owners and occupants determine what activated the system, how they can prevent future false alarms, and what needs to be done to restore a system to service.

Slide 11

**Introduction** FFI

- “False alarms”
  - Sensors record an error somewhere in the system
  - Detectors too close to the kitchen
  - People become used to nuisance alarms and fail to respond accordingly

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## Introduction

The term “false alarm” is not always completely accurate. The sensors within the fire alarm system have usually recorded an error somewhere within the system.

Smoke detectors are usually placed too close to the kitchen, resulting in numerous “false alarms.”

The major problem with these nuisance alarms is that people become used to hearing them and do not respond accordingly.

Fire alarms should be treated as true emergencies until someone from the fire department arrives on the scene and dictates otherwise.

Slide 12

**Fire Alarm and Detection Systems** FFI

- A fire detection system recognizes when a fire is occurring and activates the fire alarm system.
  - Alerts occupants
  - May alert the fire department
  - May automatically activate fire suppression systems

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## Fire Alarm and Detection Systems

Introduction to fire alarm and detection systems A fire detection system recognizes when a fire is occurring and activates the fire alarm system.

- Alerts occupants
- In some cases, alerts the fire department
- Some systems automatically activate fire suppression systems.



Slide 13

**Fire Alarm and Detection Systems** FFI

- Fire alarm and detection systems can be very simple or very complex.
  - These systems generally have the same basic components.

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### **Fire Alarm and Detection Systems**

Fire alarm and detection systems range from simple, single-station smoke alarms for private homes to complex fire detection and control systems for high-rise buildings. These systems generally have the same basic components.

Slide 14

**Fire Alarm System Components** FFI

- Three basic components in a fire alarm system:
  - Alarm initiation device
  - Alarm notification device
  - Control panel

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### **Fire Alarm System Components**

- Alarm initiation device is either an automatic or manually operated device that, when activated, causes the system to indicate an alarm.
- Alarm notification device is generally an audible device, often accompanied by a visual device, that alerts occupants when the system is activated.
- Control panel links the initiation device to the notification device,

Slide 15

**Fire Alarm System Control Panels** FFI

- Serves as the “brain” of the system
- Manages and monitors the proper operation of the system
- Can indicate the source of an alarm
- Also manages primary power supply and provides backup power supply for the system

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### **Fire Alarm System Control Panels**

- Control panel serves as the “brain” of the system.
- Manages and monitors the proper operation of the system
- It can indicate the source of an alarm so that responding fire personnel will know what activated the alarm and where the initial activation occurred.
- Also manages the primary power supply and provides a backup power supply for the system.

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**Fire Alarm System Control Panels** FFI

- May perform additional functions
- May interface with other systems
- Vary greatly

  
Courtesy of Honeywell

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### **Fire Alarm System Control Panels**

It may perform additional functions, such as notifying the fire department when the alarm system is activated, and may interface with other systems and facilities. Control panels vary greatly, depending on the age of the system and the manufacturer.



Slide 17

**Fire Alarm System Control Panels** FFP

- Used to silence alarm and reset system
- Many buildings have a remote annunciator
- In some systems, a battery will automatically activate when the external power is interrupted.

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### **Fire Alarm System Control Panels**

Fire alarm control panels are used to silence the alarm and reset the system.

Many buildings have an additional display panel, called a remote annunciator, in a separate location.

The fire alarm control panel should also monitor the condition of the entire alarm system to detect any faults. A fire alarm system is usually powered by a 110-volt line, even though the system's appliances may use a lower voltage.

In some systems, a battery in the fire alarm control panel will automatically activate when the external power is interrupted.

The control panel in a large building may be programmed to perform several additional functions.

Slide 18

**Residential Fire Alarm Systems** FFP

- Single-station smoke alarm most common type of residential fire alarm system
- Includes both a smoke detection device and an audible alarm within a single unit

  
Courtesy of Kidde Residential and Commercial Divisions

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### **Residential Fire Alarm Systems**

Single-station smoke alarm is the most common type of residential fire alarm system.

Includes both a smoke detection device and an audible alarm within a single unit, quickly alerting occupants when a fire occurs

Millions have been installed in private dwellings and apartments.

Slide 19

**Residential Fire Alarm Systems** FFP

- Smoke alarms can be battery powered or hard-wired to a 110-volt electrical system.
- Up-to-date codes require a smoke alarm in every bedroom and on every floor level.
- Many home fire alarm systems are part of security systems.

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### **Residential Fire Alarm Systems**

Smoke alarms can be battery powered or hard-wired to a 110-volt electrical system. Most building codes require hard-wired, AC-powered smoke alarms in all newly constructed dwellings.

Battery-powered units are popular for existing occupancies.

Major concern with a battery-powered smoke alarm: Ensuring that the battery is replaced on a regular basis. The most up-to-date codes require new homes to have a smoke alarm in every bedroom and on every floor level. Many home fire alarm systems are part of security systems.



Slide 20

**Ionization Versus Photoelectric Smoke Detectors**

FFI

- Ionization detectors are triggered by the invisible products of combustion.
- Photoelectric detectors are triggered by the visible products of combustion.

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### **Ionization Versus Photoelectric Smoke Detectors**

Ionization versus photoelectric smoke detectors

Ionization detectors are triggered by the invisible products of combustion.

Photoelectric detectors are triggered by the visible products of combustion.

Ionization smoke detectors work on the principle that burning materials release many different products of combustion.

An ionization detector senses the presence of these invisible charged particles (ions).

Has a very small amount of radioactive material inside a chamber

Radioactive material releases charged particles into the chamber, and a small electric current flows between two plates.

When smoke particles enter the chamber, they neutralize the charged particles and interrupt the current flow.

Detector senses the interruption and activates the alarm.

Photoelectric smoke detectors use a light beam and a photocell to detect larger visible particles of smoke.

Operate by reflecting the light beam either away from or onto the photocell, depending on the design of the device

When visible particles of smoke pass through the light beam, they reflect the beam onto or prevent it from striking the photocell, activating the alarm.

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**Ionization Versus Photoelectric Smoke Detectors**

FFI



Courtesy of Symington Standard

Courtesy of Kevin Reed

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### **Ionization Versus Photoelectric Smoke Detectors**

Ionization smoke detectors are more common and less expensive than photoelectric smoke detectors.

Photoelectric smoke detectors are more responsive to a slow-burning or smoldering fire.

Both ionization and photoelectric smoke detectors are acceptable life-safety devices.

Combination ionization/photoelectric smoke alarms are also available.

Most ionization and photoelectric smoke alarms look very similar to each other.

The only sure way to identify the type of alarm is to read the label, which is often on the back of the case.



Slide 22

**Alarm-Initiating Devices**

- Components that activate a fire alarm system
  - Manual initiation devices require human activation.
  - Automatic devices function without human intervention.

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### **Alarm – Initiating Devices**

Alarm initiation devices are the components that activate a fire alarm system.

Manual initiation devices require human activation.

Automatic devices function without human intervention.

Slide 23

**Manual Initiation Devices**

- Designed so that building occupants can activate the fire alarm system
- Primary manual initiation device is the manual fire alarm box or manual pull-station.



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### **Manual Initiation Devices**

Manual initiation devices Designed so that building occupants can activate the fire alarm system if they discover a fire in the building.

Primary manual initiation device is the manual fire alarm box or manual pull-station.

Has a switch that either opens or closes an electrical circuit to activate the alarm

Single-action pull-stations require a person to pull down a lever, toggle, or handle to activate the alarm.

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**Double-Action Pull Stations**

- Designed to prevent malicious false alarms, is covered with a piece of clear plastic
- Often used in areas where malicious false alarms frequently occur



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### **Double-Action Pull Stations**

Double-action pull-stations are designed to reduce false alarms and require a person to perform two steps before the alarm will activate. Person must move a flap, lift a cover, or break a piece of glass to reach the alarm activation device.

Once activated, a manual pull-station should stay in the “activated” position until it is reset.

Enables responding fire fighters to determine which pull-station initiated the alarm.

Resetting the pull-station requires a special key, screwdriver, or Allen wrench.

A variation on the double-action pull-station, designed to prevent malicious false alarms, is covered with a piece of clear plastic

Often used in areas where malicious false alarms frequently occur, such as high schools and college dormitories

Plastic cover must be opened before the pull-station can be activated.

Lifting the cover triggers a loud tamper alarm at that specific location but does not activate the fire alarm system.

Snapping the cover back into place resets the tamper alarm.



Slide 25

**Automatic Initiating Devices** FFI

- Designed to function without human intervention
- Can use several different types of detectors
  - Some detectors activated by smoke or by invisible products of combustion
  - Others react to heat, light produced by an open flame, or specific gases.

  
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### **Automatic Initiating Devices**

Automatic initiating devices Designed to function without human intervention and will activate the alarm system when they detect evidence of a fire

Automatic initiating devices can use several different types of detectors.

Some detectors are activated by smoke or by the invisible products of combustion.

Others react to heat, the light produced by an open flame, or specific gases.

Slide 26

**Smoke Detectors** FFI

- Designed to sense the presence of smoke
- Most common are ionization and photoelectric detectors.

  
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### **Smoke Detectors**

Smoke detectors Designed to sense the presence of smoke

Commonly found in school, hospital, business, and commercial occupancies with fire alarm systems

Come in different designs and styles for different applications

Most common smoke detectors are ionization and photoelectric detectors, which operate in the same way that residential smoke alarms do.

Each detection device is rated to protect a certain floor area, so in large areas the detectors are often placed in a grid pattern.

A beam detector is a type of photoelectric smoke detector used to protect large, open areas, such as churches, auditoriums, airport terminals, and indoor sports areas.

Two components: A sending unit that projects a narrow beam of light across the open area and a receiving unit that measures the intensity of the light when the beam strikes the receiver

Most photoelectric beam detectors are set to respond to a certain obscuration rate, meaning percentage of the light that is blocked.

Smoke detectors are usually powered by a low-voltage circuit and send a signal to the fire alarm control panel when they are activated.



Slide 27

**Heat Detectors**

- Can provide property protection
- Used where smoke alarms cannot be used
- Often installed in unheated areas
- Generally very reliable and less prone to false alarms than smoke alarms

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### **Heat Detectors**

Heat detectors Common automatic alarm initiation devices

Can provide property protection but cannot provide reliable life-safety protection because they do not react quickly enough to incipient fires

Generally used in situations where smoke alarms cannot be used, such as dusty environments and areas that experience extreme cold or heat

Often installed in unheated areas, such as attics and storage rooms, and in boiler rooms and manufacturing areas

Generally very reliable and less prone to false alarms than smoke alarms

There are several types of heat detectors, each designed for specific situations and applications.

Single-station heat alarms are sometimes installed in unoccupied areas of buildings that do not have fire alarm systems, such as attics or storage rooms.

Spot detectors are individual units that can be spaced throughout an occupancy; each detector covers a specific floor area.

Line detectors use wire or tubing strung along the ceiling of large, open areas to detect an increase in heat.

Heat detectors can be designed to operate at a fixed temperature or to react to a rapid increase in temperature.

Slide 28

**Fixed Temperature Heat Detectors**

- Designed to operate at a preset temperature
- Usually use a metal alloy that will melt at the preset temperature

  
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### **Fixed Temperature Heat Detectors**

Fixed temperature heat detectors Designed to operate at a preset temperature

They usually use a metal alloy that will melt at the preset temperature. The melting alloy releases a lever-and-spring mechanism to open or close a switch.



Slide 29

**Rate-of-Rise Heat Detectors** FFII

- Will activate if air temperature rises more than a set amount in a given period. Most are self-restoring
- Generally respond faster to most fires than fixed-temperature heat detectors

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### **Rate-of-Rise Heat Detectors**

Rate-of-rise heat detectors Will activate if the temperature of the surrounding air rises more than a set amount in a given period

Some have a bimetallic strip made of two metals that respond differently to heat. A rapid increase in temperature causes the strip to bend unevenly, which opens or closes a switch.

Most rate-of-rise heat detectors are self-restoring and do not need to be replaced after an activation unless they were directly exposed to a fire.

They generally respond faster to most fires than fixed-temperature heat detectors. However, a slow-burning fire may not activate a rate-of-rise heat detector until the fire is well established.

Slide 30

**Line Heat Detectors** FFII

- Use wires or a sealed tube to sense heat
- Wire-type
  - Two wires separated by insulating material, or
  - Measures changes in electrical resistance of a wire as it heats up
- Tube-type
  - Has a sealed metal tube filled with air

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### **Line Heat Detectors**

Line heat detectors Use wires or a sealed tube to sense heat

One wire-type line detector has two wires inside, separated by an insulating material. When heat melts the insulation, the wires short out and activate the alarm.

Another wire-type detector measures changes in the electrical resistance of a single wire as it heats up.

The tube-type line heat detector has a sealed metal tube filled with air or a nonflammable gas. When the tube is heated, the internal pressure increases and activates the alarm.

Slide 31

**Flame Detectors** FFII

- Specialized devices that detect the electromagnetic light waves produced by a flame
- Complicated and expensive



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### **Flame Detectors**

- Flame detectors Specialized devices that detect the electromagnetic light waves produced by a flame
- Typically found in places such as aircraft hangars or specialized industrial settings in which early detection and rapid reaction to a fire are critical
- Also used in explosion suppression systems to detect and suppress an explosion as it is occurring
- Flame detectors are complicated and expensive.
- Other infrared or UV sources, such as the sun or a welding operation, can set off an unwanted alarm.
- Flame detectors that combine infrared and UV sensors are sometimes used to lessen the chances of a false alarm.



Slide 32

**Gas Detectors** FFI

- Calibrated to detect the presence of a specific gas
- Need regular calibration
- Usually found only in specific commercial or industrial applications
- Most common is carbon monoxide detector

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### Gas Detectors

- Gas detectors Calibrated to detect the presence of a specific gas that is created by combustion or that is used in the facility. May be programmed to activate either the building's fire alarm system or a separate alarm
- Need regular calibration
- Usually found only in specific commercial or industrial applications
- Most common type is carbon monoxide detector

Slide 33

**Air Sampling Detectors** FFI

- Continuously capture air samples and measure the concentrations of specific gases or products of combustion

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### Air Sampling Detectors

- Air sampling detectors Continuously capture air samples and measure the concentrations of specific gases or products of combustion
- Draw in the air samples through a sampling unit and analyze it using an ionization or photoelectric smoke detector
- Often installed in the return air ducts of large buildings
- Will sound an alarm and shut down the air-conditioning system if they detect smoke
- More complex systems are sometimes installed in special hazard areas to draw air samples from rooms, enclosed spaces, or equipment cabinets.

Slide 34

**Residential Carbon Monoxide Detectors** FFI

- Sound a visible alarm when concentration is high enough to pose health risk
- Must be investigated by personnel who can detect gas
- All occupants must be checked for carbon monoxide poisoning.

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### Residential Carbon Monoxide Detectors

- Residential carbon monoxide detectors Sound a visible alarm when concentration of carbon monoxide is high enough to pose a health risk.
- Activation must be investigated by personnel who can detect gas.
- All occupants must be checked for carbon monoxide poisoning.

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**Alarm Initiation by Fire Suppression Systems** FFI

- System alerts building occupants and the fire department to a possible fire.
- Ensures that someone is aware water is flowing in case of an unintentional discharge

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### Alarm Initiation by Fire Suppression Systems

- Alarm initiation by fire suppression systems Automatic sprinkler systems are usually connected to the fire alarm system and will activate the alarm if there is a water flow.
- This system not only alerts building occupants and the fire department to a possible fire, it also ensures that someone is aware water is flowing in case of an unintentional discharge.



Slide 36

**False, Unwanted, and Nuisance Alarms**

FFI

- Malicious false alarms
  - Individuals deliberately activate a fire alarm
- Unwanted alarms
  - Alarm is activated by a condition that is not really an emergency
- Nuisance alarms
  - Improper functioning of an alarm system

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### **False, Unwanted, and Nuisance Alarms**

False, unwanted, and nuisance alarms The term “false alarm” is generally used by the public to describe all fire alarm activations that are not associated with a true emergency.

In reality, there are three distinct types of false alarms: unwanted alarms, nuisance alarms, and malicious false alarms.

Regardless of the cause, all three types of false alarms have the same results.

They waste fire department resources and may delay legitimate responses.

Frequent false alarms at the same site can desensitize building occupants to the alarm system so that they may not respond appropriately to a real emergency.

#### **Malicious false alarms**

Caused by individuals who deliberately activate a fire alarm when there is no fire, causing a disturbance

A malicious false alarm is an illegal act.

#### **Unwanted alarms**

Occur when an alarm system is activated by a condition that is not really an emergency

For example, a smoke alarm placed too close to a kitchen may be triggered by normal cooking activities.

#### **Nuisance alarms**

Caused by improper functioning of an alarm system or one of its components.

#### **Preventing unwanted and nuisance alarms**

Systems that experience unwanted and nuisance alarms should be examined to determine the cause and correct the problem.

Proper design, installation, and system maintenance are essential to prevent nuisance alarms.

Several different methods can be used to reduce unwanted and nuisance alarms caused by smoke detection systems.

In a cross-zoned system, the activation of a single smoke detector will not sound the fire alarm, although it will usually set off a trouble alarm. A second smoke detector must be activated before the actual fire alarm will sound.

In a verification system, there is a delay of 30 to 60 seconds between activation and notification.



Slide 37

**Alarm Notification Appliances**

FFI

- Produce an audible signal when fire alarm is activated
- Some signals play a recorded announcement in conjunction with the temporal-3 pattern.



Courtesy of Honeywell Fire Alarms

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### Alarm Notification Appliances

Alarm notification appliances Audible and visual alarm notification devices, such as bells, horns, and electronic speakers, produce an audible signal when the fire alarm is activated. Some systems also incorporate visual alerting devices.

Older systems used various sounds as notification devices.

More recent fire prevention codes have adopted a standardized audio pattern, called the temporal-3 pattern, that must be produced by any audio device used as a fire alarm.

This enables people to recognize a fire alarm immediately.

Some public buildings also play a recorded evacuation announcement in conjunction with the temporal-3 pattern.

Slide 38

**Alarm Notification Appliances**

FFI

- Many new systems incorporate visual notification devices.



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### Alarm Notification Appliances

Many new fire alarm systems incorporate visual notification devices, such as high-intensity strobe lights or other types of flashing lights, as well as audio devices. Visual devices alert hearing-impaired occupants to a fire alarm and are very useful in noisy environments where an audible alarm might not be heard.

Slide 39

**Other Fire Alarm Functions**

FFI

- May also control other building functions, such as air-handling systems, fire doors, and elevators
- Responding fire personnel must understand which building functions are being controlled by the fire alarm.

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### Other Fire Alarm Functions

Other fire alarm functions Fire alarm systems may also control other building functions, such as air handling systems, fire doors, and elevators.

To control smoke movement through the building, the system may shut down or start up air handling systems. Fire doors that are normally held open by magnets may be released to compartmentalize the building and confine the fire to a specific area.

Doors allowing reentry from exit stairways into occupied areas may be unlocked.

Elevators will be summoned to a predetermined floor, usually the main lobby, so they can be used by fire crews.

Responding fire personnel must understand which building functions are being controlled by the fire alarm for both safety and fire suppression reasons.



Slide 40

**Fire Alarm Annunciation Systems** FFI

- Zoned system
  - Alarm control panel will indicate where in the building the alarm was activated.
- Coded system
  - Zone is identified at alarm control panel and through audio notification device.

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### **Fire Alarm Annunciation Systems**

Fire alarm annunciation systems In a zoned system, the alarm control panel will indicate where in the building the alarm was activated.

Almost all alarm systems are now zoned to some extent. In a coded system, the zone is identified not only at the alarm control panel but also through the audio notification device.

Systems can be broken down into four categories:

- noncoded alarm
- zoned noncoded alarm
- zoned coded alarm
- and master-coded alarm

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**Noncoded Alarm System** FFI

- No information indicating where in the building the fire alarm was activated
- Typically sounds a bell or horn
- Fire department personnel must search the entire building to find which initiation device was activated.

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### **Noncoded Alarm System**

- Noncoded alarm system Control panel has no information indicating where in the building the fire alarm was activated.
- Typically sounds a bell or horn
- Fire department personnel must search the entire building to find which initiation device was activated.
- Generally found only in older, smaller buildings.

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**Zoned Noncoded Alarm System** FFI

- Most common type of system, particularly in newer buildings
- Building divided into multiple zones, often by floor or by wing
- Alarm control panel indicates in which zone the activated device is located.

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### **Zoned Noncoded Alarm System**

- Zoned noncoded alarm system Most common type of system, particularly in newer buildings
- The building is divided into multiple zones, often by floor or by wing.
- The alarm control panel indicates in which zone the activated device is located.
- It may also indicate the type of device that was activated.
- Responding personnel can go directly to that part of the building to search for the problem and check the activated device.



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**Zoned Coded Alarm**

- In addition to having all the features of a zoned alarm system, also indicates which zone has been activated over the announcement system
- Hospitals often use this type of system.

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**Master-Coded Alarm**

- Audible notification devices for fire alarms also are used for other purposes.
- Most of these systems have been replaced by modern speaker systems that use the temporal-3 pattern fire alarm signal and have public address capabilities.

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Slide 45

**Fire Department Notification**

- Fire alarm systems can be broken down into five categories based on how the fire department is notified of an alarm:
  - Local alarm system
  - Remote station system
  - Auxiliary system
  - Proprietary system
  - Central station

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**Fire Department Notification**

- Local alarm system
  - Does not notify the fire department
  - The alarm sounds only in the building to notify the occupants.



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### **Zoned Coded Alarm**

- Zoned coded alarm In addition to having all the features of a zoned alarm system, a zoned coded alarm system will also indicate which zone has been activated over the announcement system.
- Hospitals often use this type of system because it is not possible to evacuate all staff and patients for every fire alarm.
- The audible notification devices give a numbered code that indicates which zone was activated.
- A code list tells building personnel which zone is in an alarm condition and which areas must be evacuated.

### **Master-Coded Alarm**

Master-coded alarm Audible notification devices for fire alarms also are used for other purposes. For example, a school may use the same bell to announce a change in classes, to signal a fire alarm, to summon the janitor, or to make other notifications. Most of these systems have been replaced by modern speaker systems that use the temporal-3 pattern fire alarm signal and have public address capabilities.

### **Fire Department Notification**

Fire department notification The fire department should always be notified when a fire alarm system is activated. Fire alarm systems can be classified in five categories based on how the fire department is notified of an alarm.

- Local alarm system
- Remote station system
- Auxiliary system
- Proprietary system
- Central station

### **Fire Department Notification**

- Local alarm system Does not notify the fire department
- The alarm sounds only in the building to notify the occupants.
- Buildings with this type of system should have notices posted requesting occupants to call the fire department and report the alarm after they exit.



Slide 47

**Fire Department Notification** FFI

- Remote station system
  - Sends signal directly to fire department or to another monitoring location via a telephone line or a radio signal
- Auxiliary system
  - Building's fire alarm system is tied into a master alarm box located outside.

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### **Fire Department Notification**

#### Remote station system

- Sends a signal directly to the fire department or to another monitoring location via a telephone line or a radio signal
- This type of direct notification can only be installed in jurisdictions where the fire department is equipped to handle direct alarms.

#### Auxiliary system

- Can be used in jurisdictions with a public fire alarm box system
- A building's fire alarm system is tied into a master alarm box located outside the building.
- When the alarm activates, it trips the master box, which transmits the alarm directly to the fire department communications center.

Slide 48

**Fire Department Notification** FFI

- Proprietary system
  - Building's alarms are connected directly to monitoring site owned and operated by building owner.

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### **Fire Department Notification**

#### Proprietary system

- The building's fire alarms are connected directly to a monitoring site that is owned and operated by the building owner.
- Often installed at facilities with multiple buildings belonging to the same owner, such as universities or industrial complexes
- Each building is connected to a monitoring site on the premises, usually the security center, which is staffed at all times.
- When an alarm sounds, the staff at the monitoring site report the alarm to the fire department, usually by telephone or a direct line.

Slide 49

**Fire Department Notification** FFI

- Central stations
  - Third-party, off-site monitoring facility
  - An activated alarm transmits a signal to the central station by telephone or radio.
  - Personnel notify the appropriate fire department.

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### **Fire Department Notification**

#### Central station

- A third-party, off-site monitoring facility that monitors multiple alarm systems
- Individual building owners contract and pay the central station to monitor their facilities.
- An activated alarm transmits a signal to the central station by telephone or radio.
- Personnel at the central station then notify the appropriate fire department of the fire alarm.
- Usually, building alarms are connected to the central station through leased or standard telephone lines.
- However, the use of either cellular telephone frequencies or radio frequencies is becoming more common.



Slide 50

**Fire Suppression Systems**

- Include automatic sprinkler systems, standpipe systems, and specialized extinguishing systems, such as dry chemical systems
- Understanding how these systems work is important because they can affect fire behavior.

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### Fire Suppression Systems

- Introduction to fire suppression systems Fire suppression systems include automatic sprinkler systems, standpipe systems, and specialized extinguishing systems, such as dry chemical systems.
- Understanding how these systems work is important because they can affect fire behavior.
- Fire fighters should know how to interface with the system and how to shut down a system to prevent unnecessary damage.

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**Automatic Sprinkler Systems**

- In most automatic sprinkler systems, the sprinkler heads open one at a time as they are heated to their operating temperature.
- One of the major advantages of a sprinkler system is that it can function as both a fire detection system and a fire suppression system.

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### Automatic Sprinkler Systems

Automatic sprinkler systems When properly installed and maintained, automatic sprinkler systems can help control fires and protect lives and property.

Unfortunately, the general public doesn't have an accurate understanding of how automatic sprinklers work.

In most automatic sprinkler systems, the sprinkler heads open one at a time as they are heated to their operating temperature.

Usually, only one or two sprinkler heads open before the fire is controlled

The basic operating principles of an automatic sprinkler system are simple.

A system of water pipes is installed throughout a building to deliver water to every area where a fire might occur.

Automatic sprinkler heads are located along the system of pipes.

Each sprinkler head covers a particular floor area.

One of the major advantages of a sprinkler system is that it can function as both a fire detection system and a fire suppression system.

An activated sprinkler head triggers a water-motor gong, a flow alarm that signifies there is water in the system.

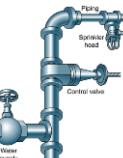
The system prompts electric flow switches to activate the building's fire alarm system, notifying the fire department.



Slide 52

**Automatic Sprinkler System Components**

- Four major components:
  - Automatic sprinkler heads
  - Piping
  - Control valves
  - A water supply, which may or may not include a fire pump



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### Automatic Sprinkler System Components

Automatic sprinkler system components Overall design of automatic sprinkler systems can be complex, but even the largest systems have just four major components: the automatic sprinkler heads, piping, control valves, and a water supply, which may or may not include a fire pump.

Slide 53

**Automatic Sprinkler Heads**

- Working ends of a sprinkler system
- Composed of:
  - A body including the orifice (opening)
  - A release mechanism
  - A deflector that directs the water in a spray pattern



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### Automatic Sprinkler Heads

- The working ends of a sprinkler system In most systems, the heads serve two functions: they activate the sprinkler system and they apply water to the fire.
- Composed of a body, which includes the orifice (opening), a release mechanism that holds a cap in place over the orifice, and a deflector that directs the water in a spray pattern
- Standard sprinkler heads have a  $\frac{1}{2}$ " (1.27-cm) orifice, but several other sizes are available for special applications.
- Sprinkler heads are categorized according to the type of release mechanism and the intended mounting position: upright, pendant, or horizontal.
- They are also rated according to their release temperature.

Slide 54

**Fusible Link Sprinkler Heads**

- Use a metal alloy that melts at a specific temperature
  - Alloy links two other pieces of metal that keep the cap in place.
  - When designated operating temperature is reached, the cap is released.



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### Fusible Link Sprinkler Heads

Fusible link sprinkler heads use a metal alloy, such as solder that melts at a specific temperature. The alloy links two other pieces of metal that keep the cap in place.

When the designated operating temperature is reached, the solder melts and the link breaks, releasing the cap.

Slide 55

**Frangible Bulb Sprinkler Heads**

- Use a glass bulb filled with glycerin or alcohol to hold the cap in place
  - As bulb is heated, liquid absorbs the air bubble and expands until it breaks the glass, releasing the cap.



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### Frangible Bulb Sprinkler Heads

Frangible bulb sprinkler heads use a glass bulb filled with glycerin or alcohol to hold the cap in place. The bulb also contains a small air bubble. As the bulb is heated, the liquid absorbs the air bubble and expands until it breaks the glass, releasing the cap.



Slide 56

**Chemical-Pellet Sprinkler Heads** FFI

- Use a plunger mechanism and a small chemical pellet to hold the cap in place
  - Pellet will liquefy at a preset temperature.
  - When pellet melts, liquid compresses the plunger, releasing the cap and allowing water to flow.

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### **Chemical-Pellet Sprinkler Heads**

- Chemical-pellet sprinkler heads use a plunger mechanism and a small chemical pellet to hold the cap in place.
- The chemical pellet will liquefy at a preset temperature.
- When the pellet melts, the liquid compresses the plunger, releasing the cap and allowing water to flow.

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**Special Sprinkler Heads** FFI

- Designed for special applications
- Early-suppression, fast-response sprinkler heads have improved heat collectors to speed up response and ensure rapid release.

 CONNECTICUT FIRE ACADEMY – RECRUIT FIREFIGHTER PROGRAM

### **Special Sprinkler Heads**

- Special sprinkler heads Sprinkler heads can also be designed for special applications, such as covering large areas or discharging the water in extra-large droplets or as a fine mist.
- Some sprinkler heads have protective coatings to help prevent corrosion.
- Sprinkler heads that are intended for residential occupancies are manufactured with a release mechanism that provides a fast response.
- Early-suppression, fast-response sprinkler heads have improved heat collectors to speed up the response and ensure rapid release.
- Used in large warehouses and distribution facilities where early fire suppression is important

Slide 58

**Deluge Heads** FFI

- Easily identifiable because they have no cap or release mechanism
- Orifice is always open.
- Only used in deluge sprinkler systems

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### **Deluge Heads**

- Deluge heads Easily identifiable, because they have no cap or release mechanism
- The orifice is always open.
- Only used in deluge sprinkler systems, which are covered later in this chapter



Slide 59

**Temperature Ratings**

FFI

- Typical rating in a light hazard occupancy would be 165°F (74°C).
- Temperature rating must match the anticipated ambient air temperatures.
- Spare heads that match those used in the system should always be available on site.

CONNECTICUT FIRE ACADEMY – RECRUIT FIREFIGHTER PROGRAM

### Temperature Ratings

- Temperature ratings Sprinkler heads are rated according to their release temperature.
- A typical rating for sprinkler heads in a light hazard occupancy, such as an office building, would be 165°F (74°C).
- The rating should be stamped on the body of the sprinkler head.
- Frangible bulb sprinkler heads use a color-coding system to identify the temperature rating.
- Some fusible link and chemical-pellet sprinklers also use this system.
- The temperature rating on a sprinkler head must match the anticipated ambient air temperatures.
- Spare heads that match those used in the system should always be available on site.
- Usually the spare heads are kept in a clearly marked box near the main control valve.



Slide 60



### Mounting Position

**Figure 37-31:** Sprinkler head mounting positions. **A.** Upright. **B.** Pendant. **C.** Sidewall.

Mounting position Sprinkler heads with different mounting positions are not interchangeable.

Each mounting position has deflectors specifically designed to produce an effective water stream down or out toward the fire.

Each automatic sprinkler head is designed to be mounted in one of three positions:

- Pendant sprinkler heads are designed to be mounted on the underside of the sprinkler piping, hanging down toward the room. Pendant heads are commonly marked SSP, which stands for standard spray pendant.
- Upright sprinkler heads are designed to be mounted on top of the supply piping as the name suggests. Upright heads are usually marked SSU, for standard spray upright.
- Sidewall sprinkler heads are designed for horizontal mounting, projecting out from a wall.

Old-style versus new-style sprinkler heads

- Up until the early 1950s, deflectors in both pendant and upright sprinkler heads directed part of the water stream up toward the ceiling.
- Sprinkler heads with this design are called old-style sprinklers.
- Automatic sprinklers manufactured after the mid 1950s deflect the entire water stream down to the fire.
- These types of heads are referred to as new-style heads or standard spray heads.
- New-style heads can replace old-style heads, but the reverse is not true.



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**Sprinkler Piping**

FFI

- Network of pipes that delivers water to sprinkler heads
- Usually made of steel
- Plastic pipe sometimes used in residential systems



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### Sprinkler Piping

- Sprinkler piping The network of pipes that delivers water to the sprinkler heads
- Includes the main water supply lines, risers, feeder lines, and branch lines
- Usually made of steel, but other metals can be used
- Plastic pipe is sometimes used in residential sprinkler systems.
- Sprinkler system designers use piping schedules or hydraulic calculations to determine the size of pipe and the layout of the “grid.”
- Most new systems are designed using computer software.
- Near the main control valve, pipes have a large diameter; as the pipes approach the sprinkler heads, the diameter generally decreases.

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**Valves**

FFI

- Sprinkler system includes several valves:
  - Main water supply control valve
  - Alarm valve
  - Other, smaller valves used for testing and service
- Play a critical role in the design and function of the system

CONNECTICUT FIRE ACADEMY – RECRUIT FIREFIGHTER PROGRAM

### Valves

Valves A sprinkler system includes several different valves, such as:

- Main water supply control valve
- Alarm valve
- Other, smaller valves used for testing and service
- All of the valves play a critical role in the design and function of the system.

#### Water supply control valves

Water supply control valves must be of the “indicating” type, meaning that the position of the valve itself indicates whether it is open or closed.

The outside screw and yoke (OS&Y) valve has a stem that moves in and out as the valve is opened or closed. If the stem is out, the valve is open.

OS&Y valves are often found in a mechanical room in the building, where water to supply the sprinkler system enters the building.

- In warmer climates, OS&Y valves may be found outside.
- The post indicator valve (PIV) has an indicator that reads either open or shut, depending on its position.
- A PIV is usually located in an open area outside the building and controls an underground valve.
- A wall PIV is similar to a traditional PIV but is designed to be mounted on the outside wall of a building.
- The main control valve, whether it is an OS&Y valve or a PIV, should be locked in the open position.
- An alternative to locking the valves open is equipping them with tamper switches.



- These devices monitor the position of the valve.
- If someone opens or closes the valve, the tamper switch sends a signal to the fire alarm control panel, indicating a change in valve position.

**Main sprinkler system valves:**

The type used depends on the type of sprinkler system installed.

Options include an alarm valve, a dry-pipe valve, or a deluge valve.

**Alarm valve**

- Signals an alarm when a sprinkler head is activated and prevents nuisance alarms caused by pressure variations and surges in the water supply to the system
- Has a clapper mechanism that remains in the closed position until a sprinkler head opens
- The closed clapper prevents water from flowing out of the system and back into the public water mains when water pressure drops.
- When a sprinkler head is activated, the clapper opens fully and allows water to flow freely through the system.
- The open clapper also allows water to flow to the water-motor gong, sounding an alarm.
- Electrical flow switches activate connections to external alarm systems.
- Without a properly functioning alarm valve, sprinkler system flow alarms would occur frequently.
- Dry-pipe valve and deluge valve
- Main valve functions both as an alarm valve and as a dam, holding back the water until the sprinkler system is activated.
- When the system is activated, the valve opens fully so water can enter the sprinkler piping.

**Additional valves**

- Several smaller valves are usually located near the main control valve, with others located elsewhere in the building.
- Smaller valves include drain valves, test valves, and connections to alarm devices.
- In larger facilities, the sprinkler system may be divided into zones.
- Each zone has a valve that controls the flow of water to that particular zone.
- This design makes maintenance easy and also is valuable when a fire occurs.



Slide 63

**Water Supplies** FFI

- Water may come from municipal water system, on-site storage tanks, or static water sources.
  - Preferred source for a sprinkler system is a municipal water supply.

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### Water Supplies

- Water supplies Water may come from a municipal water system, on-site storage tanks, or static water sources, such as storage ponds or rivers.
- The water supply must be able to handle the demand of the sprinkler system, as well as the needs of the fire department in the event of a fire.
- The preferred water source for a sprinkler system is a municipal water supply, if one is available.
- If the municipal supply cannot meet the water pressure and volume requirements of the sprinkler system, alternative supplies must be provided.

Slide 64

**Fire Pumps** FFI

- Used when the water comes from a static source
- May also be used to boost the pressure in some sprinkler systems, particularly for tall buildings



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### Fire Pumps

Fire pumps are used when the water comes from a static source. May also be used to boost the pressure in some sprinkler systems, particularly for tall buildings

A large industrial complex could have more than one water source, such as a municipal system and a backup storage tank.

Multiple fire pumps would provide water to the sprinkler and standpipe systems in different areas through underground pipes.

Private hydrants may also be connected to the same underground system.

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**Fire Department Connection (FDC)** FFI

- Allows the department's engine to pump water into the sprinkler system
- Used as either a supplement or the main source of water



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### Fire Department Connection (FDC)

Fire department connection (FDC) Each sprinkler system should also have a FDC.

Allows the department's engine to pump water into the sprinkler system

Used as either a supplement or the main source of water

Usually has two or more 2½" (6.35-cm) female couplings mounted on an outside wall or placed near the building

Ties directly into the sprinkler system after the main control valve or alarm valve

Each fire department should have a procedure that specifies how to connect to the FDC and when to charge the system.

In large facilities, a single FDC may be used to deliver water to all fire protection systems in the complex.



Slide 66

**Water Flow Alarms**

FFI

- Water-motor gong.
- When system is activated and main alarm valve opens, water is fed through a pipe to a water-powered gong located outside the building.



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### Water Flow Alarms

Water flow alarms All sprinkler systems should be equipped with a method for sounding an alarm whenever there is water flowing in the pipes. Without these alarms, the occupants or the fire department might not be aware of the sprinkler activation.

Most systems incorporate a mechanical flow alarm called a water-motor gong.

When the sprinkler system is activated and the main alarm valve opens, some water is fed through a pipe to a water-powered gong located on the outside of the building.

This type of alarm will function even if there is no electricity.

Unintentional soundings of water-motor gongs are rare. If a water-motor gong is sounding, water is probably flowing from the sprinkler system somewhere in the building.

Sprinkler systems also are connected to the building's fire alarm system by either an electric flow switch or a pressure switch.

This connection will trigger the alarm to alert the building's occupants.

A monitored system also will notify the fire department.

Slide 67

**Types of Automatic Sprinkler Systems**

FFI

- Divided into four categories:
  - Wet sprinkler systems
  - Dry sprinkler systems
  - Preaction sprinkler systems
  - Deluge sprinkler systems

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**Wet Sprinkler Systems** FFI

- Most common and the least expensive type of automatic sprinkler system
- Piping always filled with water.
- As sprinkler head activates, water is immediately discharged onto the fire.
- Major drawback: Cannot be used in areas where temperatures drop below freezing

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### **Wet Sprinkler Systems**

Wet sprinkler systems Most common and the least expensive type of automatic sprinkler system

Piping in a wet system is always filled with water. As a sprinkler head activates, water is immediately discharged onto the fire.

The major drawback to a wet sprinkler system is that it cannot be used in areas where temperatures drop below freezing.

They will also flow water if a sprinkler head is unintentionally opened or a leak occurs in the piping. A dry-pendant sprinkler head can be used to protect a freezer box.

Larger unheated areas, such as a loading dock, can be protected with an antifreeze loop.

An antifreeze loop is a small section of the wet sprinkler system that is filled with glycol or glycerin instead of water.

Slide 69

**Dry Sprinkler Systems** FFI

- Operate much like wet sprinkler systems, except that the pipes are filled with pressurized air instead of water
- A dry-pipe valve keeps water from entering the pipes until the air pressure is released.

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### **Dry Sprinkler Systems**

Dry sprinkler systems Operate much like wet sprinkler systems, except that the pipes are filled with pressurized air instead of water

A dry-pipe valve keeps water from entering the pipes until the air pressure is released.

Dry systems are used in large facilities that may experience below-freezing temperatures.

The air pressure is set high enough to hold a clapper inside the dry-pipe valve in the closed position

When a sprinkler head opens, the air escapes.

As the air pressure drops, the water pressure on the other side of the clapper forces it open and water flows into the pipes.

When the water reaches the open sprinkler head, it is discharged onto the fire.

If a sprinkler head breaks, the air pressure will drop and water will flow, just as in a wet sprinkler system.

The clapper assembly inside most dry-pipe valves works on a pressure differential.

The system or air side of the clapper has a larger surface area than the supply or wet side.

In this way, a lower air pressure can hold back a higher water pressure.

A small compressor is used to maintain the air pressure in the system.

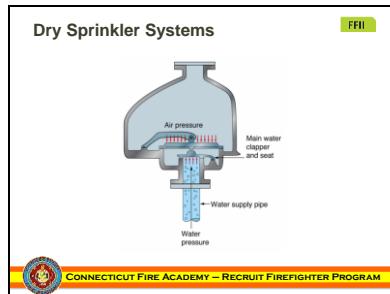
Dry sprinkler systems should have an air pressure alarm to alert building personnel if the air pressure drops.

Dry sprinkler systems must be drained after every activation so the dry-pipe valve can be reset.

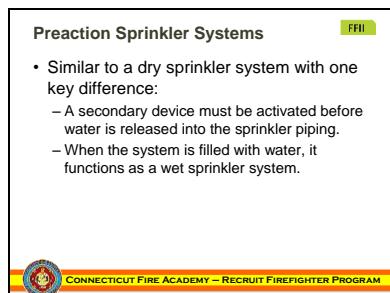
The clapper also must be reset, and the air pressure must be restored before the water is turned back on.



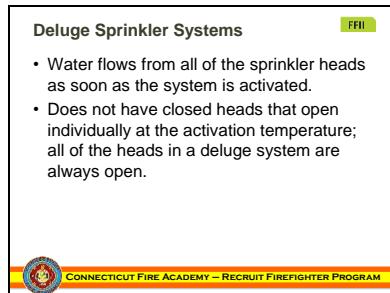
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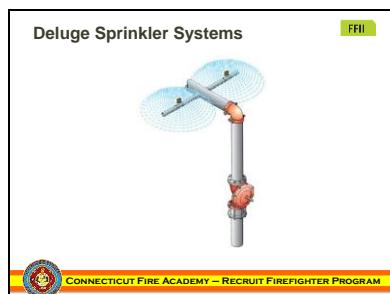
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Slide 72



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## Dry Sprinkler Systems

Accelerators and exhausters

One problem encountered in dry sprinkler systems is the delay between the activation of a sprinkler head and the actual flow of water out of the head.

The pressurized air that fills the system must escape through the open head before the water will flow.

To compensate for this problem, two additional devices are used: accelerators and exhausters.

An accelerator is installed at the dry-pipe valve.

## Preaction Sprinkler Systems

Preaction sprinkler systems Similar to a dry sprinkler system with one key difference:

- Similar to a dry sprinkler system with one key difference:
  - A secondary device must be activated before water is released into the sprinkler piping.
  - When the system is filled with water, it functions as a wet sprinkler system.

In a preaction sprinkler system, a secondary device must be activated before water is released into the sprinkler piping.

When the system is filled with water, it functions as a wet sprinkler system.

Uses a deluge valve instead of a dry-pipe valve

Deluge valve will not open until it receives a signal that the secondary device has been activated.

The primary advantage of a preaction sprinkler system is in preventing unintentional water discharges.

## Deluge Sprinkler Systems

Water flows from all of the sprinkler heads as soon as the system is activated.

Does not have closed heads that open individually at the activation temperature; all of the heads in a deluge system are always open.

Deluge sprinkler systems A type of dry sprinkler system in which water flows from all of the sprinkler heads as soon as the system is activated

Does not have closed heads that open individually at the activation temperature; all of the heads in a deluge system are always open.

## Deluge Sprinkler Systems

**Figure 37-43:** Water flows from all of the heads in a deluge system as soon as the system is activated.

A detection system can release the deluge valve when a detector is activated. The deluge system can also be connected to a separate pilot system of air-filled pipes with closed sprinkler heads.

Most deluge valves can be released manually as well. Only used in special applications where rapid fire suppression is critical.



Slide 74

**Shutting Down Sprinkler Systems**

- Order to shut down sprinkler system should come only from the incident commander.
- In most cases, system can be shut down by closing main control valve.



**Shutting down sprinkler systems (Fire Fighter Level I)**

If the system is unintentionally activated, it should be shut down as soon as possible to avoid excessive water damage.

In an actual fire, the order to shut down the sprinkler system should come only from the incident commander.

Generally, the sprinkler system should not be shut down until the fire is completely extinguished.

When the system is shut down, a fire fighter with a portable radio should stand by at the control valve in case it has to be reopened quickly.

In most cases, the entire sprinkler system can be shut down by closing the main control valve (OS&Y or PIV).

In a zoned system, the affected zone can be shut down by closing the appropriate valve.

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**Shutting Down Sprinkler Systems**

- Placing a wooden wedge or a commercial sprinkler stop into the sprinkler head can quickly stop the flow of water.
  - This will not work with all types of heads.



**Shutting Down Sprinkler Systems**

Placing a wooden wedge or a commercial sprinkler stop into the sprinkler head can quickly stop the flow of water, although this will not work with all types of heads. Shuts off the flow of water until the control valve can be located and shut down



Slide 76

**Residential Sprinkler Systems**

- Relatively new
- Typically use smaller piping and sprinkler heads with smaller orifices and less water discharge
- Reduce fire death by 82%



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### **Residential Sprinkler Systems**

Residential sprinkler systems Relatively new, but many homes now being built include them

Design and theory of residential sprinkler systems are similar to commercial systems, but there are significant variations.

The primary objective of a residential sprinkler system is life safety, so the sprinkler heads are designed to respond quickly.

A fast response helps protect the occupants and control incipient-stage fires.

Typically use smaller piping and sprinkler heads with smaller orifices and less water discharge

To control costs, plastic pipe may be used instead of metal.

Usually wet sprinkler systems, although some dry-pipe systems exist

Usually connected to the domestic water supply instead of a public water main

Fire fighters should know how these systems work and how to shut down a system that has been activated.

Usually there is a main shut-off valve for the sprinklers, near the location where water enters the house.

If the house has a basement, the shut-off valve may be located with other utility controls.

If a separate shut-off for the sprinkler system cannot be found, the main shut-off for the house can be used to shut down the system.

Working smoke alarms and a residential sprinkler system reduce the chance of death from a home fire by 82%.

Slide 77

**Standpipe Systems**

- Network of pipes and outlets for fire hoses to provide water for firefighting purposes
- Usually used in high-rise buildings, although they are found in many other structures as well.



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### **Standpipe Systems**

Network of pipes and outlets for fire hoses to provide water for firefighting purposes

Usually used in high-rise buildings, although they are found in many other structures as well.

Standpipe systems Network of pipes and outlets for fire hoses built into a structure to provide water for firefighting purposes

Usually used in high-rise buildings, although they are found in many other structures as well

At set intervals throughout the building, there is a valve where fire fighters can connect a hose to the standpipe.

Found in buildings with and without sprinkler systems  
The three categories of standpipes—Class I, Class II, and Class III—are defined by their intended use.



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**Class I Standpipes**

- Designed for use by fire department personnel only
- Each outlet has a 2½" (6.35-cm) male coupling and a valve to open the water supply after the hose is connected.



FFI

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### **Class I Standpipes**

Class I standpipe Designed for use by fire department personnel only

Each outlet has a 2½" (6.35-cm) male coupling and a valve to open the water supply after the hose is connected.

Often, the connection is located inside a cabinet, which may or may not be locked.

Responding fire personnel carry the hose into the building with them, usually in some sort of roll, bag, or backpack.

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**Class II Standpipes**

- Outlets generally equipped with a length of 1½" (3.81-cm) single-jacket hose preconnected to the system.
- Intended to enable occupants to attack a fire



FFI

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### **Class II Standpipes**

Class II standpipes Designed for use by the building occupants

Outlets are generally equipped with a length of 1½" (3.81-cm) single-jacket hose preconnected to the system.

They are intended to enable occupants to attack a fire before the fire department arrives, but their safety and effectiveness are questionable. Most building occupants are not trained to attack fires safely. If a fire cannot be controlled with a regular fire extinguisher, it is usually safer for the occupants to evacuate the building and call the fire department.

May be useful at facilities where workers are trained as an in-house fire brigade

Responding fire personnel should not use Class II standpipes for fighting a fire. The hose and nozzles may be of inferior quality and the water flow may not be adequate to control a fire.

### **Class III Standpipes**

Class III standpipes Have the features of both Class I and Class II standpipes in a single system

Have 2½" (6.35-cm) outlets for fire department use and smaller outlets with attached hoses for occupant use

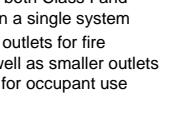
Unfortunately, the occupant hoses have been removed, either intentionally or by vandalism, in many facilities, so the system basically becomes a Class I system.

Fire fighters should use only the 2½" (6.35-cm) outlets, even if they are using an adapter to connect a smaller hose. The 1½" (3.81-cm) outlets may have pressure-reducing devices to limit the flow and pressure for use by untrained civilians.

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**Class III Standpipes**

- Have the features of both Class I and Class II standpipes in a single system
- Have 2½" (6.35-cm) outlets for fire department use as well as smaller outlets with attached hoses for occupant use



FFI

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**Water Flow in Standpipe Systems** FF10

- Flow-restriction devices or pressure-reducing valves often installed at outlets to limit pressure and flow
  - If not properly installed and maintained, these devices can cause problems for fire fighters.

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### Water Flow in Standpipe Systems

Water flow in standpipe systems Standpipes are designed to deliver a minimum amount of water at a particular pressure to each floor.

The design requirements depend on the code requirements in effect when the building was constructed.

Flow-restriction devices or pressure-reducing valves are often installed at the outlets to limit the pressure and flow.

If they are not properly installed and maintained, these devices can cause problems for fire fighters.

An improperly adjusted pressure-reducing valve could severely restrict the flow to a hose line.

A flow restriction device could also limit the flow of water to fight a fire.

The flow and pressure capabilities of a standpipe system should be determined during preincident planning.

Many standpipe systems deliver water at a pressure of only 65 psi at the top of the building.

The combination fog-and-straight-stream nozzles used by many fire departments are designed to operate at 100 psi.

As a result, many fire departments use low-pressure combination nozzles for fighting fires in high-rise buildings or require the use of only smooth-bore nozzles when operating from a standpipe system. Preincident plans for high-rise buildings should include an evaluation of the building's standpipe system and a determination of the anticipated flows and pressures.

Engine companies that respond to buildings equipped with standpipes should carry a kit that includes the appropriate hose and nozzle, a spanner wrench, and any required adapters.

This kit should also include tools to adjust the settings of pressure-reducing valves or to remove restrictors that are obstructing flows.



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**Water Supplies** FFI

- Wet standpipe systems are connected to a public water supply with an electric or diesel fire pump to provide pressure.
- Most dry standpipe systems must use the FDC to pump water into the system.

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## Water Supplies

Water supplies Wet standpipe systems in modern buildings are connected to a public water supply with an electric or diesel fire pump to provide additional pressure.

Many of these systems also have a water storage tank as a backup supply.

In these systems the FDC on the outside of the building can be used to increase the flow, boost the pressure, or obtain water from an alternative source. Dry standpipe systems are found in many older buildings.

If freezing weather is a problem these systems are still acceptable.

Most dry standpipe systems do not have a permanent connection to a water supply, so the FDC must be used to pump water into the system.

If there is a fire in a building with dry standpipes, connecting the hose lines to the FDC and charging the system with water are high priorities.

Some dry standpipe systems are connected to a water supply through a dry-pipe or deluge valve, similar to a sprinkler system.

High-rise buildings and skyscrapers often have complex systems of risers, storage tanks, and fire pumps to deliver the needed flows to upper floors.

The details of these systems should be obtained during preincident planning surveys.

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**Specialized Extinguishing Systems** FFI

- Specialized extinguishing systems are often used in areas where water would not be an acceptable extinguishing agent.

  
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## Specialized Extinguishing Systems

Specialized extinguishing systems Specialized extinguishing systems are often used in areas where water would not be an acceptable extinguishing agent. For example, water is not the agent of choice for areas containing sensitive electronic equipment or contents, such as computers, valuable books, or documents. Water is also incompatible with materials, such as flammable liquids or water-reactive chemicals.



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**Dry Chemical Extinguishing Systems** 

- Finely powdered agents
- Agent kept in self-pressurized tanks or in tanks with an external cartridge of carbon dioxide.



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### **Dry Chemical Extinguishing Systems**

Dry chemical and wet chemical extinguishing systems

The most common specialized agent systems

Used in commercial kitchens to protect the cooking areas and exhaust systems

Many self-service gas stations have dry chemical systems that protect the dispensing areas.

Often installed inside buildings to protect areas where flammable liquids are stored or used

Dry chemical extinguishing systems

Use the same types of finely powdered agents as dry chemical fire extinguishers

The agent is kept in self-pressurized tanks or in tanks with an external cartridge of carbon dioxide or nitrogen that provides pressure when the system is activated.

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**Wet Chemical Extinguishing Systems** 

- Used in most new commercial kitchens
- Use a proprietary liquid extinguishing agent
  - Much more effective on vegetable oils than the dry chemicals used in older kitchen systems



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### **Wet Chemical Extinguishing Systems**

Wet chemical extinguishing systems Used in most new commercial kitchens

Use a proprietary liquid extinguishing agent, which is much more effective on vegetable oils than the dry chemicals used in older kitchen systems

Easier to clean up after a discharge, so the kitchen can resume operations more quickly after the system has discharged

Not compatible with normal all-purpose dry chemical extinguishing agents

Only wet agents or B:C-rated dry chemical extinguishers should be used where these systems are installed.

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**Initiation Devices** 

- Fusible links are placed above the target hazard.
- Manual discharge button also provided so that workers can activate the system if they discover a fire.



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### **Initiation Devices**

Fusible links or other automatic initiation devices are placed above the target hazard to activate both dry chemical and wet extinguishing agent systems. A manual discharge button is also provided so that workers can activate the system if they discover a fire.

Open nozzles are located over the target areas to discharge the agent directly onto a fire.

When the system is activated, the extinguishing agent flows out of all the nozzles.

Many kitchen systems discharge agent into the ductwork above the exhaust hood ad onto the cooking surface.

This helps prevent a fire from igniting any grease build-up inside the ductwork and spreading throughout the system.

Most dry and wet chemical extinguishing systems are tied into the building's fire alarm system.



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**Clean Agent Extinguishing Systems** FFI

- Installed in areas where computers or sensitive electronic equipment are used or where valuable documents are stored
- Nonconductive and leave no residue
- Halogenated agents or carbon dioxide are generally used.

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### **Clean Agent Extinguishing Systems**

Often installed in areas where computers or sensitive electronic equipment are used or where valuable documents are stored

Agents are nonconductive and leave no residue

Halogenated agents or carbon dioxide are generally used because they will extinguish a fire without causing significant damage to the contents.

Operate by discharging a gaseous agent into the atmosphere at a concentration that will extinguish a fire

Smoke detectors or heat detectors installed in these areas activate the system.

A manual discharge button is also provided with most installations.

Discharge is usually delayed 30 to 60 seconds after the detector is activated to allow workers in the area to evacuate.

During this delay (the prealarm period), an abort switch can be used to stop the discharge.

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**Clean Agent Extinguishing Systems** FFI

- Should be completely discharged before fire fighters arrive
- Should be tied to building's fire alarm system and indicated as a zone on the control panel

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### **Clean Agent Extinguishing Systems**

If there is a fire, the clean agent system should be completely discharged before fire fighters arrive. Fire fighters entering the area should use self-contained breathing apparatus (SCBA) until the area has been properly ventilated.

Although these agents are not considered immediately dangerous to life and health, it is better to avoid any unnecessary exposure to them.

Clean agent systems should be tied to the building's fire alarm system and indicated as a zone on the control panel.

Alerts fire fighters that they are responding to a situation where a clean agent has discharged

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**Carbon Dioxide Extinguishing System** FFI

- Designed to protect a single room or series of rooms
- Should be connected to fire alarm system
- Creates oxygen-deficient atmosphere

Courtesy of Chemtron Fire Systems



### **Carbon Dioxide Extinguishing Systems**

Carbon dioxide systems protect a single room or a series of rooms. Same series of prealarms and abort buttons in Halon 1301 systems

Creates an oxygen-deficient atmosphere and is dangerous to life

Occupants will be rendered unconscious and asphyxiated.



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**Summary** FFI

- Fire protection systems include fire alarms, automatic fire detection, and fire suppression systems.
- Fire alarm and detection systems range from simple to complex.
- A fire alarm system has three basic components.

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**Summary** FFI

- The most common residential alarm system is a single-station smoke alarm.
- There are two types of fire detection devices used in a smoke alarm to detect combustion.
- Alarm initiation devices begin the fire alarm process manually or automatically.

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**Summary** FFI

- There are nine types of automatic initiation devices.
- Residential carbon monoxide detectors create an audible or visual alarm.
- It is important to know how to handle false, unwanted, and nuisance alarms.
- There are three types of false alarms.

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**Summary** FFI

- There are two methods that can be used to reduce unwanted and nuisance alarms.
- Alarm communication systems are classified into four categories.
- There are five categories of fire department notification systems.

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**Summary** FFI

- Fire suppression systems include sprinkler systems, standpipe systems, and specialized extinguishing systems.
- The most common fire suppression system is the automatic sprinkler system.
- Basic operating principles of an automatic sprinkler system are simple.

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**Summary** FFI

- Automatic sprinkler systems include four major components.
- Automatic sprinkler systems are divided into four categories.

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**Summary** FFI

- There are three types of standpipe systems.
- Specialized extinguishing are installed in areas where water may not be used.

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