

Student Notes:

Active Fire Protection Systems

Presented by:

Michael Gilbertie

Office of Education and Data
Management



"Active Fire Protection Systems"



"Passive" Fire Protection Systems"

What are "passive" fire protection systems?



- Passive systems do not rely on automatic or manual operation to work.
 - Examples
 - » Fire doors
 - » Fire walls
- Active systems rely on moving parts
 - Examples
 - » Fire Sprinkler Systems
 - » Fire Detection/Alarm Systems.

Student Notes:

The Total Safety Package



Comprehensive fire protection relies on both passive and active systems to provide life safety and building safety.

VIDEO



SPRINKLERS NFPA 13, 2002 EDITION



- Usually only 1 or 2 sprinklers are required to control the fire.
- When wet pipe sprinklers operated, 88% of reported fires involved only 1 or 2 sprinklers.
- For dry pipe sprinklers, 73% involved only 1 or 2 sprinklers.

Student Notes:

Automatic Sprinkler Systems

Requirements for installation of automatic sprinklers in specific occupancies can be found in:

- CGS 29-315
- Connecticut Fire Safety Code
- Connecticut State Building Code

What is An Effective System?

- ✓Matches hazard levels.
- ✓It's reliable.
- ✓Conforms to code requirements.
- ✓It's tested and maintained

THE MOST IMPORTANT COMPONENT NEEDED FOR A SPRINKLER SYSTEM

Proper water supply from:

- Municipal Water Supply
- Tanks (gravity or ground)
- Static Water Source

Student Notes:

System Types

1. Wet Pipe System
2. Dry Pipe System
3. Preaction System
4. Deluge System
5. Combined Dry Pipe – Preaction System
6. Anti Freeze System

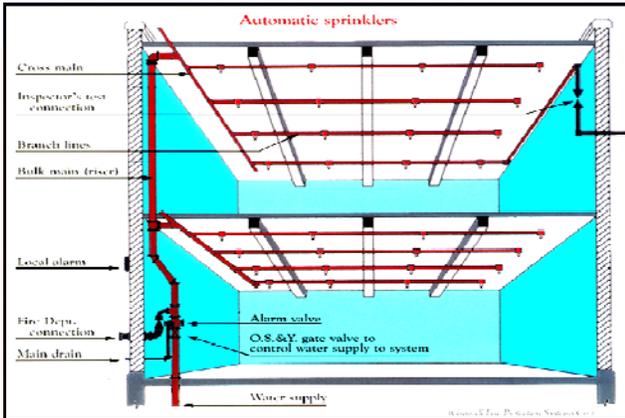
Wet Type Sprinkler Systems

- Automatic suppression
- Most common
- Pipes filled with water at all times
- Water held in pipes by sprinkler heads
- Heat activates sprinkler head causing water to flow onto fire.

The System includes:

- One or more automatic water supplies
- Piping above and underground
- Hangers and Fittings
- Sprinklers installed in a systematic pattern
- Valves
- Alarms
- Fire Department Connection

Student Notes:



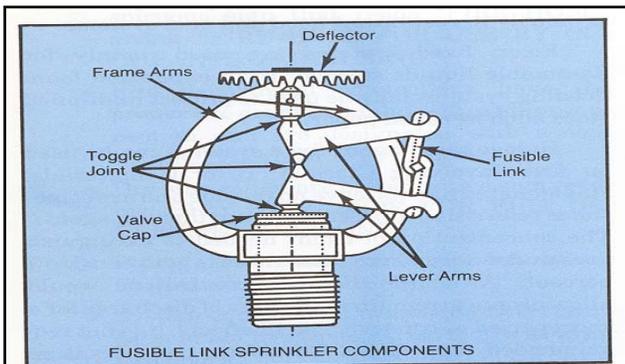
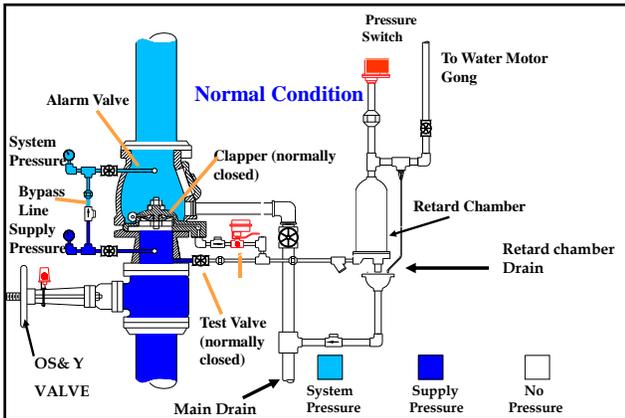


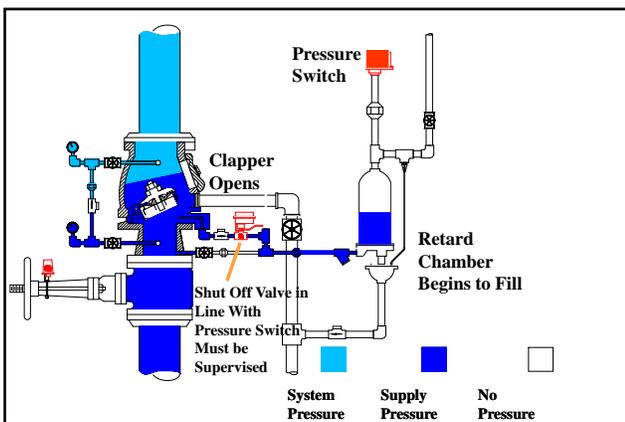
Figure 7.18 Sprinklers remain intact at normal temperatures, but fall away when the temperature exceeds the rated temperature of the sprinkler.

Sequence of Operation

1. Sprinkler System is filled with water
2. Fire starts
3. Sprinklers in the vicinity of the fire operate
4. Water is discharged from the operated sprinklers
5. Alarm Check Valve Opens
6. Water is directed to sound an alarm

Student Notes:





System Size Limitations

Light Hazard	52,000 Square Feet
Ordinary Hazard	52,000 Square Feet
Extra Hazard	40,000 Square Feet
Extra Hazard (Pipe Schedule)	25,000 Square Feet
High Piled Storage	40,000 Square Feet

Student Notes:

Dry Pipe Systems

- Dry Systems not as quick as Wet Systems
- Dry Systems protect unheated areas
- More costly to maintain
- More costly to operate and install

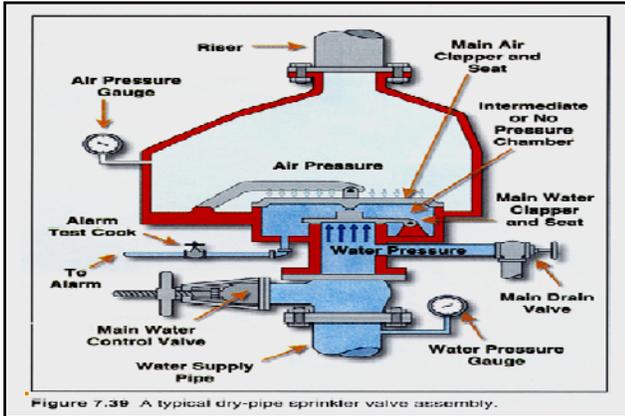
Dry Pipe Systems

- Larger systems operate slower
- Hydraulic Design Areas increased by 30 %
- 750 gallon capacity (Unless water flow is obtained within 60 seconds)
- Gridded Dry Pipe Systems are not allowed
- Quick Opening Devices required over 500 gallon capacity

Dry Type Sprinkler Systems

- Automatic Suppression
- Pipes pressurized with air
- Equipped with an automatic water supply
- Water is retained by a dry pipe valve
 - Air pressure holding valve closed
- Sprinkler head opens, releases air pressure causing dry pipe valve to open and water flows

Student Notes:



Example of Air Pressure and Water Pressure Ratios

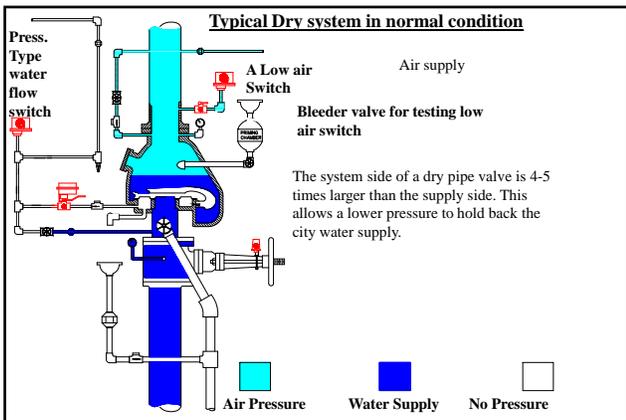
- To determine air pressure for a Dry Pipe System having a water pressure of 108 psi:
- $108 \text{ psi} \div 6 + 20 = 38 \text{ psi}$
- Air pressure 20 psi above the tripping pressure, based on highest normal water pressure of the system supply.

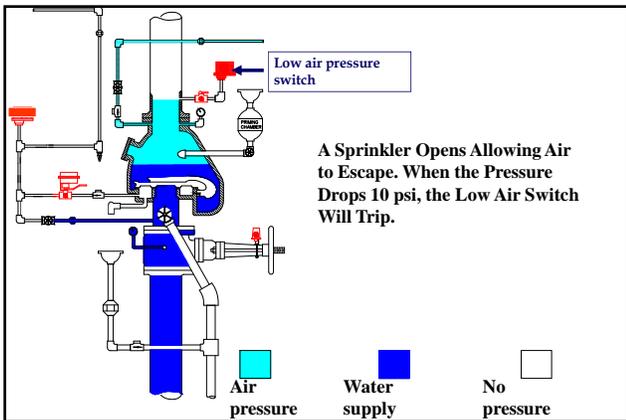
Quick Opening Devices Exhausters and Accelerators

- Required for Systems Over 500 Gallon Capacity
- Unless Water Flow to the Inspector's Test Connection can be achieved Within One Minute

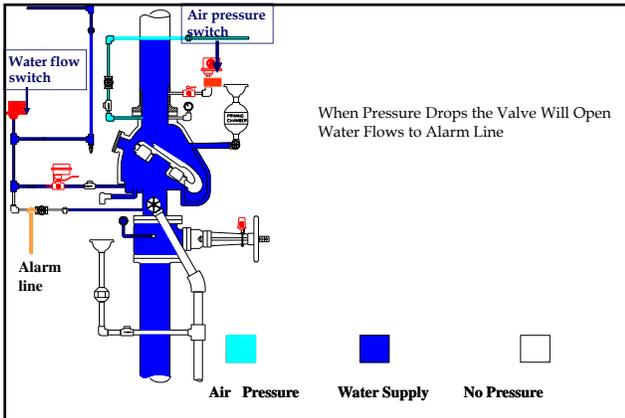
Student Notes:





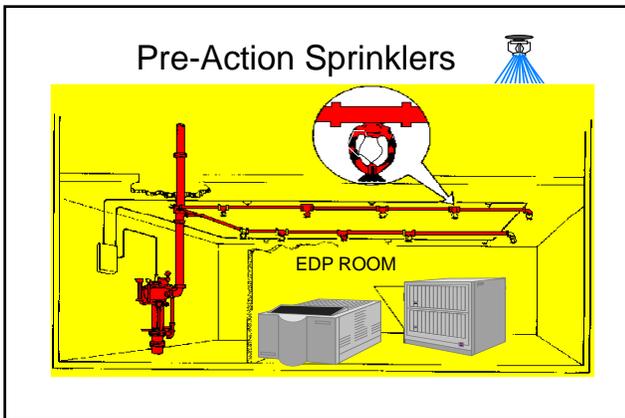


Student Notes:



Preaction Systems

- System Contains Air Contains a Detection System
- Over 20 Sprinklers require Automatic Supervision for system piping and detection devices
- Water supply is held back by an Automatic Water Control Valve



Student Notes:

Pre-action/Deluge Valves



Deluge Systems

Normally actuated by heat detection system

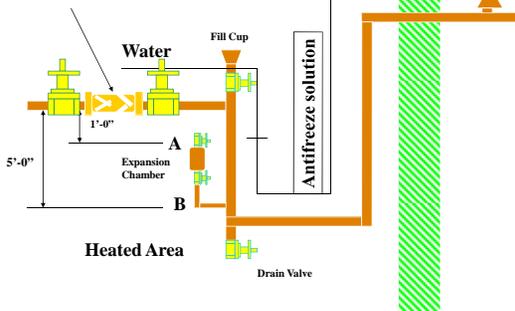
Pre-action Systems

Normally actuated by Smoke Detectors



- Need to test detection system per NFPA 72 requirements
- Various requirements based on type of detectors

Antifreeze Systems With Backflow Devices



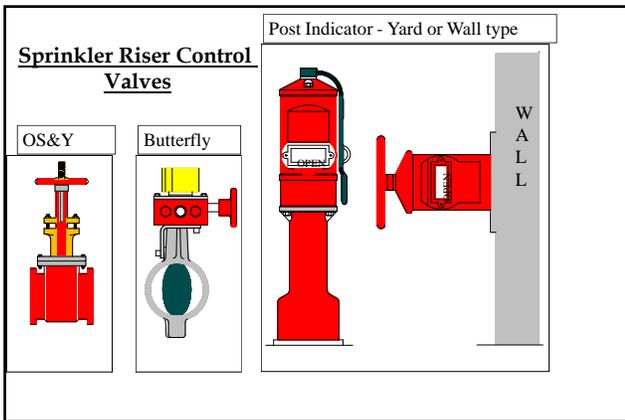
Student Notes:

Types of Valves needed for Sprinkler Systems

- Control Valves
- Directional Valves
- Check Valves
- Double Check Valve Assemblies
- Backflow Prevention Assembly

Valves Controlling Connections to Water Supplies

- Must be Listed Type
- Must be Indicating Type
- Shall Not Close in Less Than 5 Seconds
- Number of Valves Required
 - 1 per system
 - 1 per floor if system is attached to hose valves for FD use
- Control valves installed overhead must have indicator, visible from floor level



Student Notes:

Sprinkler Riser Control Valves

OS&Y



Sprinkler Riser Control Valves

continued:

Wall Mounted
Control Valve



Sprinkler Riser Control Valves

continued:

Butterfly Control
Valve

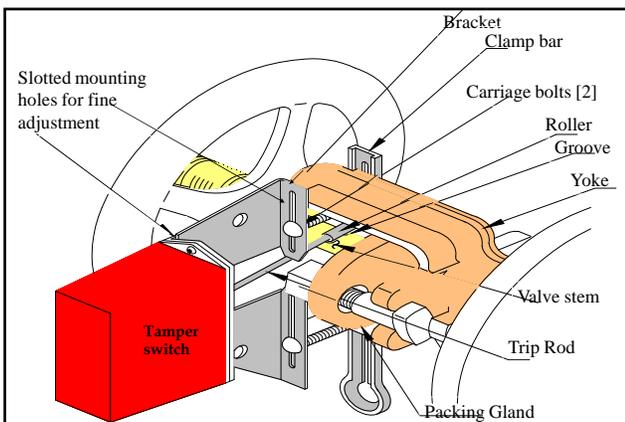


Student Notes:

Control Valve Supervision IS VITAL

Supervision Methods:

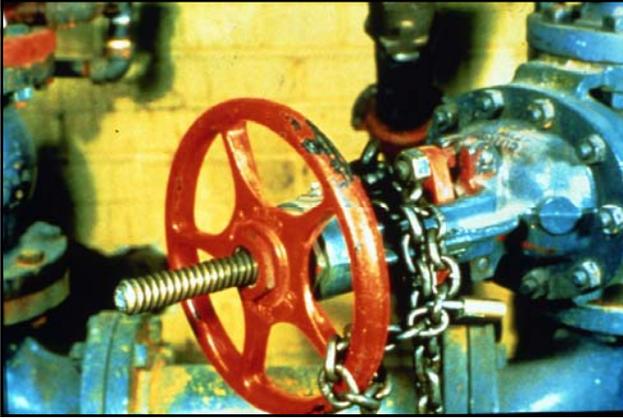
- Local Signaling Service to a constantly attended station
- Central Station, Proprietary or Remote Signaling Service
- Chain & Lock valves in Open position
- Seal valves in Open position (if fenced, under control of the owner and inspected weekly)



Control Valve Supervisory Switches

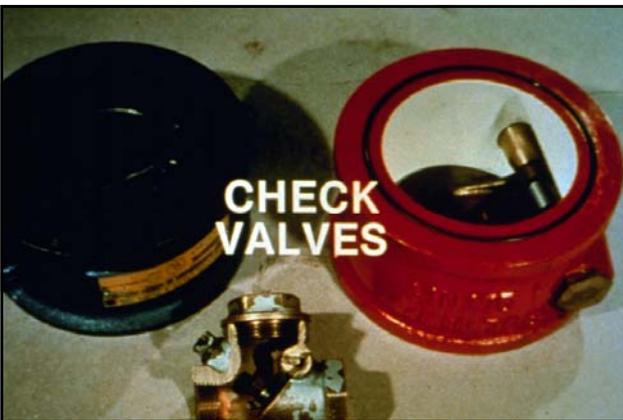


Student Notes:





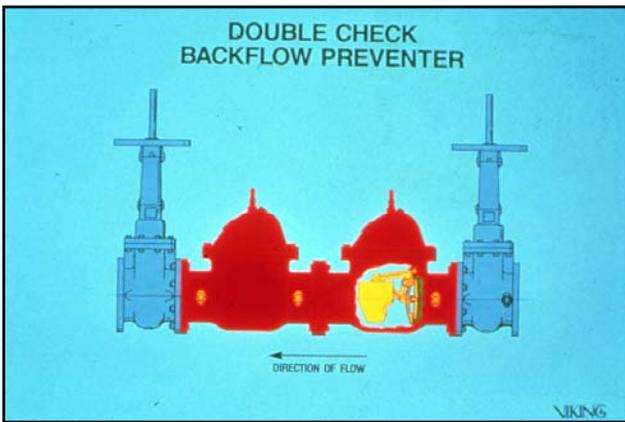
Lead or Plastic wire seals



CHECK VALVES

Student Notes:





Fire Department Connection Required

Fire Department Connections are required for all systems except:

1. The building is in a remote location not accessible to the fire department or;
2. The system is a large capacity deluge system designed with flows beyond the fire departments ability or;
3. The system serves a single story building not exceeding 2,000 square feet.

Student Notes:

Fire Department Connection

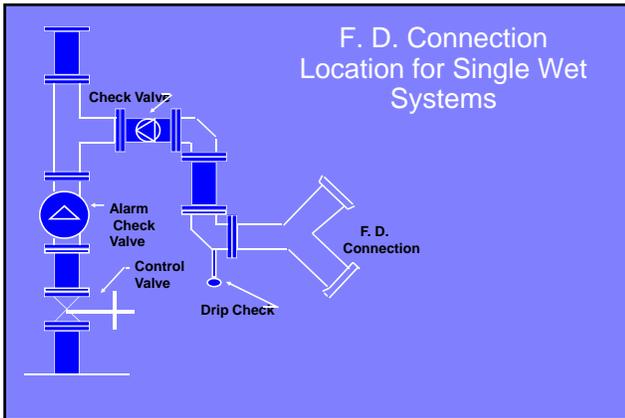
A sign must be provided for the FDC indicating inlet required pressure unless the system demand is less than 150 psi



Fire Department Connections (Continued)

- Must have a Check Valve
- Must be installed on the System Side of Check Valve
- Plugs or caps Must be listed
- No Shut Off Valves
- Cannot be installed on the suction side of Fire Pump

Student Notes:



Water Flow Alarms

- Device must be listed
- Alarm must sound upon water flow
- Alarm must sound within 5 minutes on the premises
- Types of alarms:
 - Alarm Check Valve*
 - Water Flow Detecting Device*
- On Preaction and Deluge Systems, alarms must be actuated independently by the detection system

Water Flow Alarms (Continued)

- Alarms with More Than 20 Sprinklers
- High Rise Building Requirements :
 - *Waterflow devices on each floor must be connected to an alarm system.*
 - *Flow device shall be indicated on the Annunciator*
 - *Supervision required*

Student Notes:

Alarm Check Valves

- Function as:
An Alarm Device
A Check Valve
- Retarding Chambers must be provided if variable water pressure conditions are encountered (Surge in pressure)



Alarm Check Valve

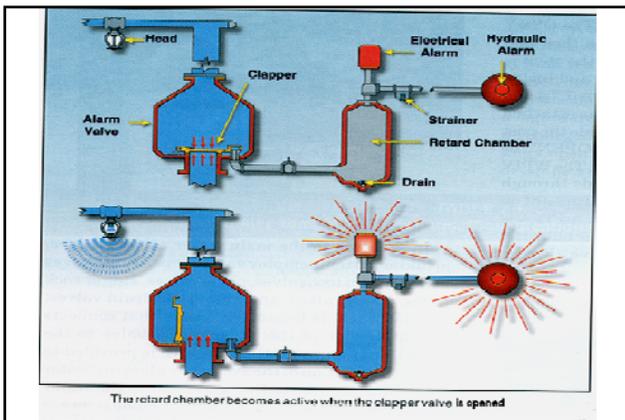


Student Notes:

Alarm Check Valves (Continued)

Sequence of Operation:

1. Fire activates Sprinkler
2. Water flows opens the Alarm Check Valve
3. Water to an Alarm Device
4. Water fills the Retarding Chamber (If provided)
5. Water flow activates a Pressure Switch or
6. Water flow is directed to a Water Motor Gong



Inspectors Test Outlet



Student Notes:

Section 9.2 Installation of Pipe Hangers

General requirements:

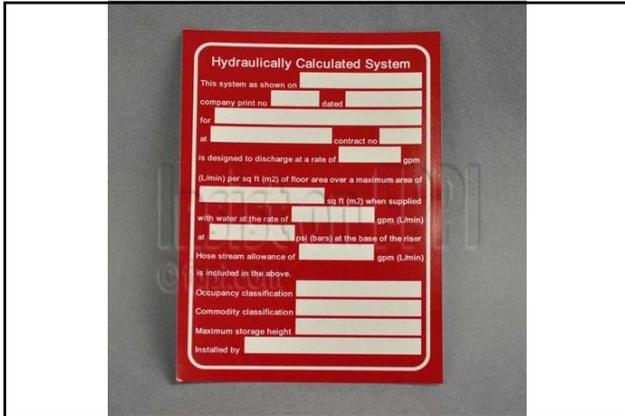
- Maximum Distance between Hangers
- Location of Hangers on Branch Lines
- Location of Hangers on Mains
- Support of Risers

Hydraulic Design Information Sign

- Location of the design area
- Density over the design area
- Required flow and residual pressure
- Occupancy or Commodity classification, storage height and configuration
- Hose stream demand plus sprinkler demand



Student Notes:



PIPE SCHEDULE METHOD

- Pipe sizing is selected from a schedule
- Schedule is determined by:
 - Occupancy classification
 - Type of pipe
 - Sprinklers above & below ceiling
- A given number of sprinklers are supplied from specific sizes of pipe. As the number of sprinklers increase, the pipe sizes increase

Table 8-5.2.2 Light Hazard Pipe Schedules

Steel		Copper	
1 in.	2 sprinklers	1 in.	2 sprinklers
1 ¹ / ₄ in.	3 sprinklers	1 ¹ / ₄ in.	3 sprinklers
1 ¹ / ₂ in.	5 sprinklers	1 ¹ / ₂ in.	5 sprinklers
2 in.	10 sprinklers	2 in.	12 sprinklers
2 ¹ / ₂ in.	30 sprinklers	2 ¹ / ₂ in.	40 sprinklers
3 in.	60 sprinklers	3 in.	65 sprinklers
3 ¹ / ₂ in.	100 sprinklers	3 ¹ / ₂ in.	115 sprinklers
4 in.	See Section 5-2	4 in.	See Section 5-2

Student Notes:

FIRE SPRINKLERS

- Upright 
- Pendent 
- Sidewall 

SPRINKLER SELECTION

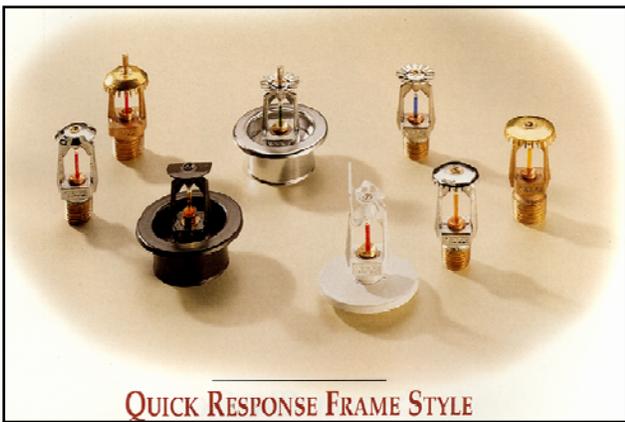
- Residential Sprinklers
- Large Drop Sprinklers
- Open Sprinklers
- Corrosion Resistant Sprinklers
- Intermediate Level/Rack Storage Sprinklers
- Old Style/Conventional Sprinklers
- Quick Response Sprinklers
- Early Suppression Fast Response Sprinklers

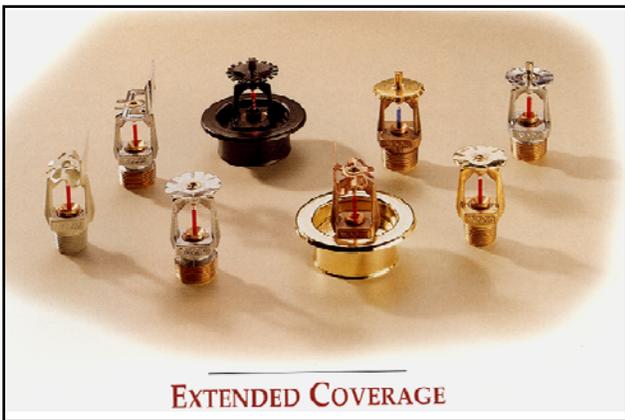
**SPRINKLER SELECTION
(CONT.)**

- Concealed Sprinklers
- Flush Sprinklers
- Recessed Sprinklers
- Dry Sprinklers
- On/Off Sprinklers

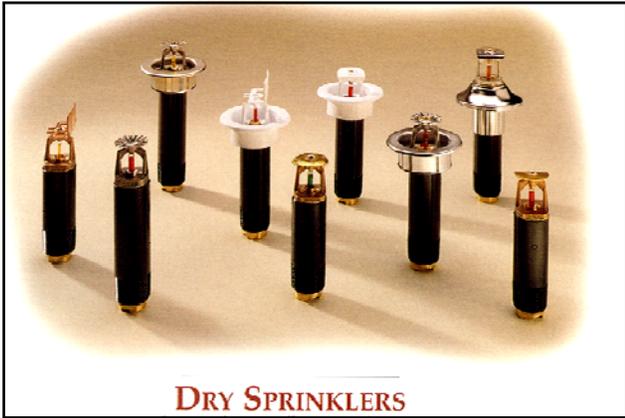
Student Notes:



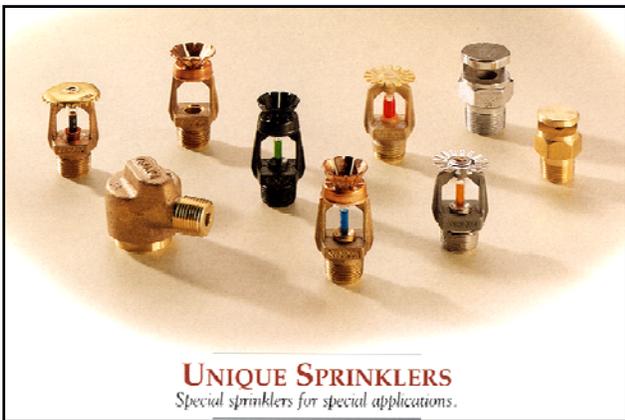




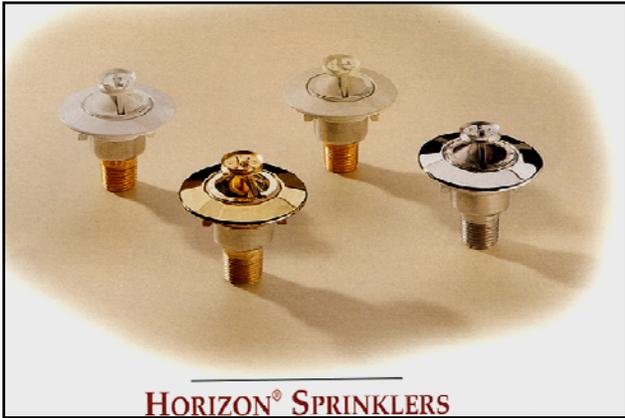
Student Notes:

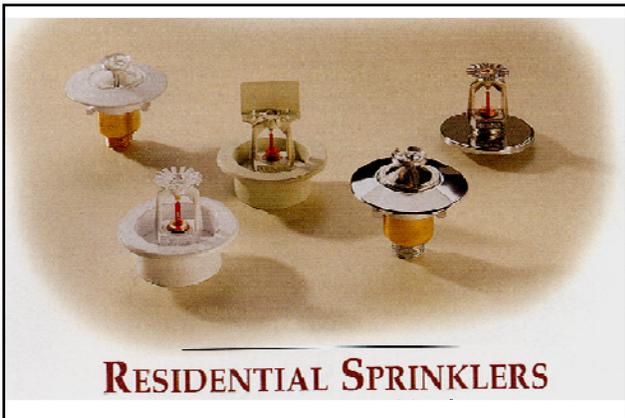


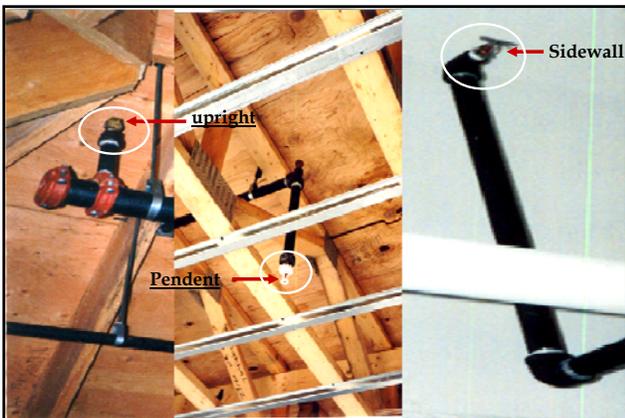




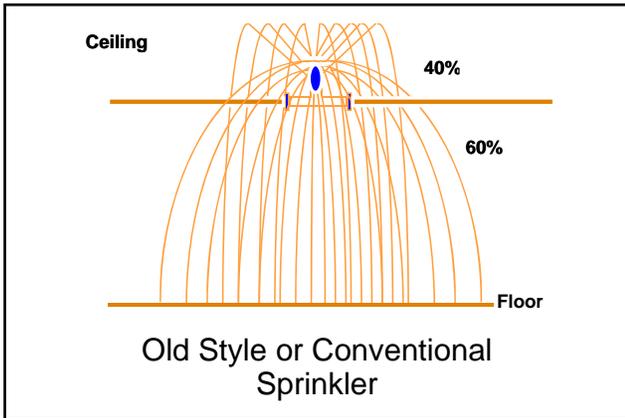
Student Notes:

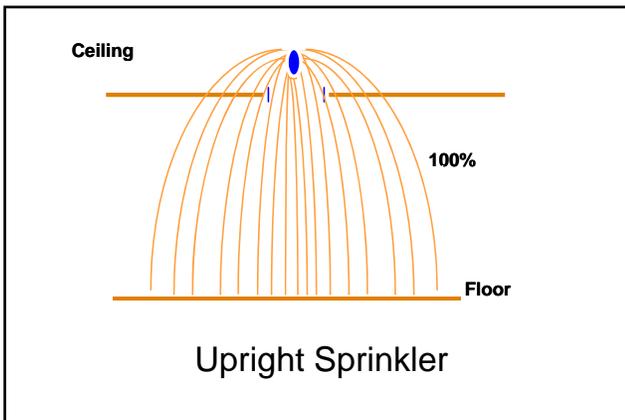


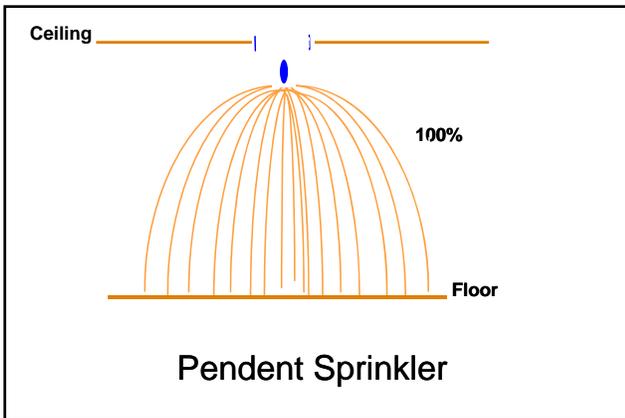




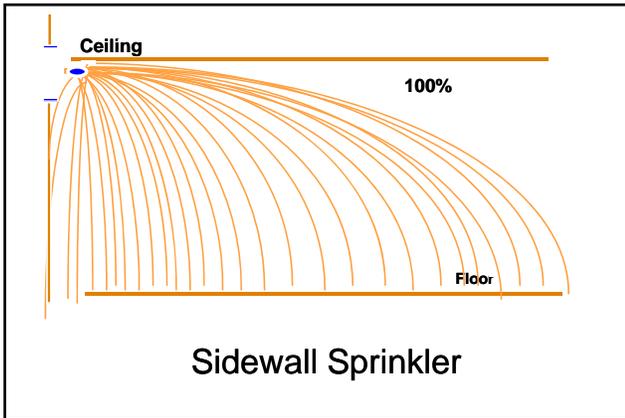
Student Notes:







Student Notes:



Sprinkler Temperature Ratings

Maximum Ceiling Temperature		Temperature Rating		Temperature Classification	Frame Arms Color Code	Glass Bulb Colors
F	C	F	C			
100	38	135-170	57-77	Ordinary	uncolored or Black	Orange or Red
150	66	175-225	79-107	Intermediate	White	Yellow or Green
225	107	250-300	121-149	High	Blue	Blue
300	149	325-375	163-191	Extra High	Red	Purple
375	191	400-475	204-246	Very Extra High	Green	Black
475	246	500-575	260-302	Ultra High	Orange	Black
625	329	650	343	Ultra High	Orange	Black

Obstructions that Prevent Sprinkler Discharge from Reaching the Fire

- Obstructions over 4 feet

- Obstructions not fixed in place
 - i.e. as conference tables, do not require sprinklers under the obstruction.

Student Notes:

VIDEO



FIRE ALARMS



FIRE ALARMS

- Fire Detection
- Alarm
- Communication Systems

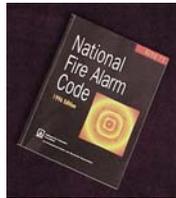


87

Student Notes:

Required Fire Alarm System:

Shall be installed, tested, and maintained in accordance with NFPA 70 and NFPA 72



88

Summary of Manual Fire Alarm and Automatic Fire Detection Thresholds

Manual Fire Alarms	
Occupancy	Threshold
Assembly (A-1, A-2, A-3, A-4, A-5)	All with occupant load \geq 300
Business (B)	Total occupant load \geq 500 or occupant load $>$ 100 above/below level of exit discharge
Educational (E)	50 or more occupants (see exceptions)
Factory (F-1, F-2)	\geq Two stories with occupant load \geq 500
High Hazard (H-2, H-3, H-5)	H-5 occupancies and occupancies used for manufacture of organic coatings
Institutional (I-1, I-2, I-3, I-4)	(Exceptions for I-1 + I-2 occ.)
Mercantile (M)	Total occupant load \geq 500 or occupant load $>$ 100 above/below level of exit discharge
Hotels (R-1)	All unsprinklered buildings except \leq Two stories with guestrooms having exit directly to exterior
Apartments (R-2)	Unsprinklered four stories or one story below level of exit discharge or $>$ 16 units without exits directly to exterior Note: occupancies (1 and 2) require sprinklers
Automatic Fire Detection	
Occupancy	Threshold
High Hazard (H-1), H-2, H-3, H-4, H-5)	Highly toxic gases, organic peroxides and oxidizers in accordance with IFC
Institutional (I-1, I-2, I-3, I-4)	All
Hotels (R-1)	All except building without interior corridors and guestrooms having exit directly to exterior

NFPA 72, 2002 Edition

(National Fire Alarm Code) does not tell you where a fire system shall be installed; however, it is the how to or installation standard when a fire alarm system is required to be installed.



90

Student Notes:

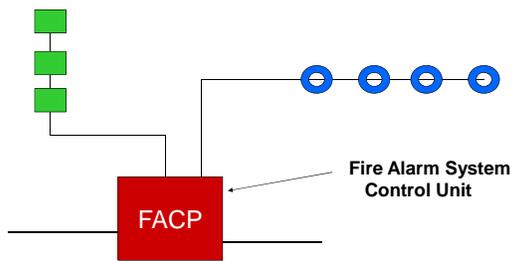
FIRE ALARM SYSTEM OPERATION

- The primary function of a fire alarm system is for the protection of life and property.
- It must perform the following functions:

- ✓ Detect.....
- ✓ Notify..
- ✓ Operate
- ✓ Notify

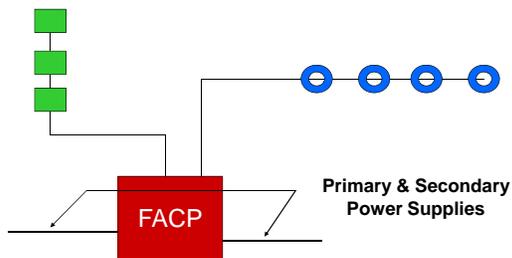
91

Basic Fire Alarm System



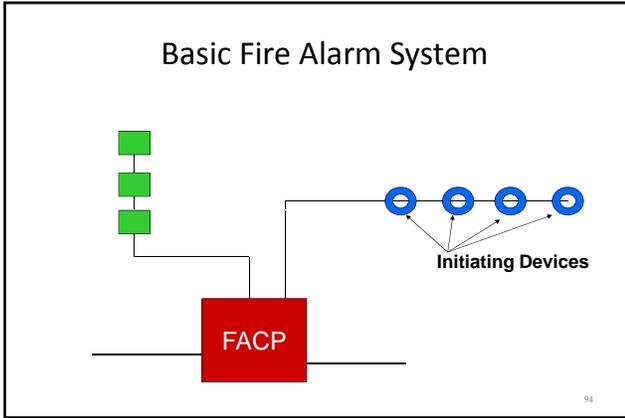
92

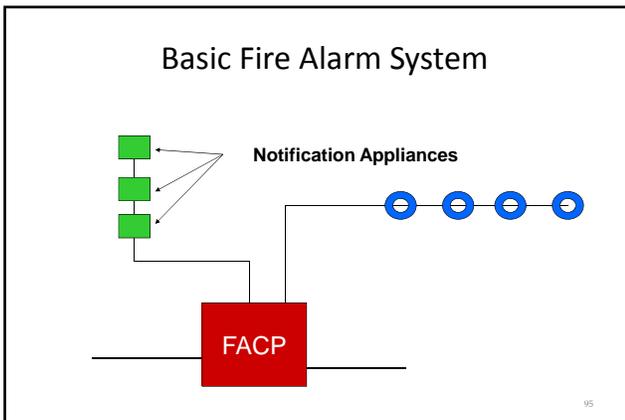
Basic Fire Alarm System

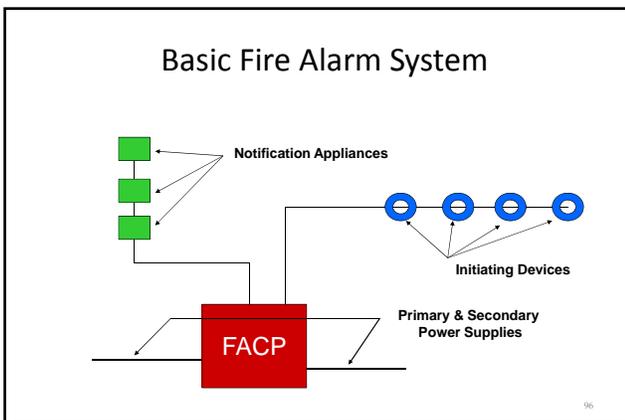


93

Student Notes:







Student Notes:

A Complete Fire Alarm System

Shall provide functions for:

- Initiation
- Notification
- Control

97

Initiating Devices

- Automatic fire detection devices
- Sprinkler water flow detectors
- Manually activated fire alarm stations
- Supervisory signal-initiating devices

98

SYSTEM OPERATION

Smoke and heat detectors are the most common Fire alarm (initiating) devices and are classified as “automatic” detection devices.



Pull stations are classified as “manual” fire alarm devices and are usually placed at all building exits.



99

Student Notes:

Initiating Devices

- Manual Pull Stations
- Automatic Smoke Detectors
- Heat Detectors
- Fixed Temperature Heat Detectors
- Combination Detectors
- Rate-of-Rise Compensated Fixed Temperature Detectors
- Smoke Detectors
- Ionization Smoke Detectors



100

Initiating Devices continued...

- Photoelectric Smoke Detectors
- Photoelectric Beam Smoke Detectors
- 2-Wire Smoke Detectors
- 4-Wire Smoke Detectors
- Air-Duct Type Smoke Detectors
- Automatic Sprinkler Systems
- Waterflow Switches
- Sprinkler System Control Valves
- Supervisory Switches



101

MANUAL PULL STATIONS

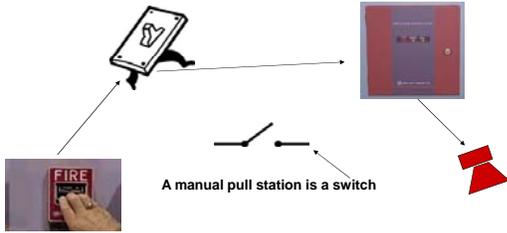
When a general alarm pull station is activated it will immediately sound the notification appliances throughout the building.



102

Student Notes:

MANUAL PULL STATION



103

AUTOMATIC FIRE DEVICES -

Fire produces well-defined Signatures such as thermal energy (heat), smoke, and radiant energy.



104

HEAT DETECTORS -

Heat detectors respond to the thermal energy (heat) signature from a fire and are generally located on or near the ceiling.



105

Student Notes:

FIXED-TEMPERATURE HEAT DETECTORS

These detectors initiate an alarm when the detecting element reaches a predetermined fixed temperature.



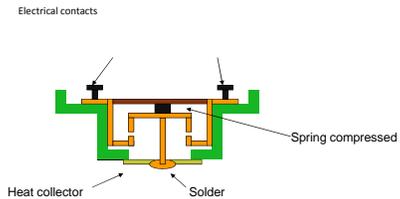
106

FIXED-TEMPERATURE HEAT DETECTORS

One form of a spot-type fixed-temperature detector uses a fusible element made from a eutectic metal alloy that melts rapidly at a predetermined temperature (commonly 135 degrees F).

107

FIXED-TEMPERATURE HEAT DETECTOR (non restorable)



Normal mode

108

Student Notes:

FIXED-TEMPERATURE HEAT DETECTOR (non restorable)

Electrical contacts

Spring released

Heat collector

Solder

Operation mode

When solder melts, plunger drops and contacts are shorted

109

FIXED-TEMPERATURE HEAT DETECTOR (bimetallic)

Electrical contacts

Two metals having different coefficients of thermal expansion

Normal mode

110

FIXED-TEMPERATURE HEAT DETECTOR (bimetallic)

Electrical contacts

Operation mode

111

Student Notes:

RATE-OF-RISE HEAT DETECTORS

A rate-of-rise detector will operate when the rate of temperature increase from a fire exceeds a predetermined level, typically at 15 degrees F° per minute.

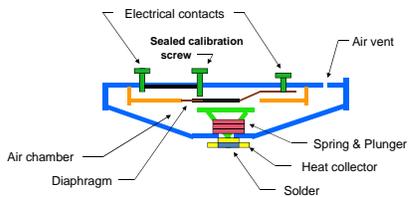
112

COMBINATION DETECTORS

- Detectors can contain more than one element to respond to a fire.
- Examples include a combination rate-of-rise and fixed-temperature heat detector, or a combination of a smoke detector and a heat detector.

113

RATE-OF-RISE / FIXED TEMPERATURE DETECTOR



114

Student Notes:

SMOKE DETECTORS

Fires that occur in buildings typically produce detectable quantities of smoke before they produce detectable levels of heat..



115

SMOKE DETECTORS

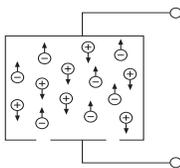
Due to their inherent characteristics, ionization and photoelectric smoke detectors will respond differently to visible and invisible smoke particles.



116

IONIZATION DETECTORS

Ionization smoke detectors are more responsive to sensing invisible smoke particles produced by flaming fires, like those produced from flammable liquids.



117

Student Notes:

AIR-DUCT TYPE SMOKE DETECTORS

This type of smoke detector detects smoke for the primary purpose of controlling the spread of smoke through the heating, ventilating and air conditioning system (HVAC).



118

ELEVATOR RECALL



SYSTEM OPERATION

Once a fire alarm system has been activated, occupant notification is accomplished by using audible and visual notification appliances.



120

Student Notes:

NOTIFICATION APPLIANCES

Notification Appliances Overview:

- Bells
- Horns
- Temporal Signal
- Strobes
- Synchronization
- Speakers
- Chimes
- Combination audible/visible



121

OCCUPANT NOTIFICATION

Occupant notification shall be provided to alert occupants of a fire or other emergency



122

HORNS

- Horns are used for applications that require louder or more distinctive signals, or both.
- Horns may require more operating power than bells, and care should be exercised to see that circuits are electrically compatible when powering both types of signals.



123

Student Notes:

SPEAKERS

Speakers are generally operated from audio amplifiers housed in the control panel that delivers a standard output line levels of 70.7 or 25 volts.



124

STROBES

Stroboscopic lights (commonly called "strobes") operate on the energy discharge principle to produce a high intensity flash of short duration.



125

SYSTEM OPERATION

It is also essential during a fire to control other building systems, such as air conditioning, smoke doors and elevators.



126

Student Notes:

Power Supplies

At least two independent power supplies shall be provided:

- One Primary
- One Secondary



127

Secondary Power Supply

The secondary power supply shall automatically provide power to the protected premises fire alarm system within 10 seconds, whenever the primary power supply fails to provide the minimum voltage required for proper operation.



128

Fire Alarm Boxes

Manual fire alarm boxes shall be located throughout the protected area so that they are conspicuous, unobstructed, and accessible.



129

Student Notes:

Smoke Detector/Smoke Alarm

What is the difference?

130

Smoke Alarm

A detector comprising an assembly that incorporates a sensor, control components, and an alarm notification appliance.



131

Smoke Detector

A device that detects visible or invisible particles of combustion and transmits a signal to the FACP



132

Student Notes:

Smoke Alarms

Single-station, multiple-station and system smoke alarms and detectors shall be in accordance with NFPA 72



133

Smoke Alarms

Smoke alarms, other than battery-operated devices as permitted by other sections of this Code shall receive their operating power from the building electrical system.

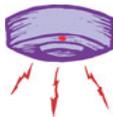
CFSCGB section 9.6.2.10.2



134

Smoke Alarms shall sound

....only within an individual dwelling unit and shall not actuate the building fire alarm system.



135

Student Notes:

Signals definition:

A status indication communicated by electrical or other means:

- Alarm Signal
- Supervisory Signal
- Trouble Signal

136

Alarm Signal

A signal indicating an emergency that requires immediate action.



137

Supervisory Signal

A signal indicating the need for action in connection with the supervision of fire suppression systems or equipment.

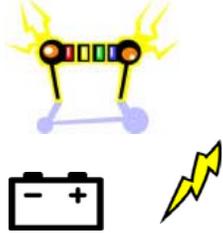


138

Student Notes:

Trouble Signal

A signal initiated by the fire alarm system or device indicative of a fault in a monitored circuit or component i.e. a short in a wire, smoke detector removed, or a low battery.



139

VIDEO



QUESTIONS / COMMENTS?



141
