Technical Principles and Practices of Fire Prevention

Module
Residential

MODULE OBJECTIVES	*The students will be able to:*
	• *Identify residential occupancies and subclasses.*
	• *Identify the major fire and life safety hazards in residential occupancies.*
	• *Given examples of potential hazards in residences, identify concerns and propose solutions.*
	• *Identify access requirements for structures.*
	• *Identify types of alarm systems and describe the appropriate procedure to verify operational readiness.*

DEFINE RESIDENTIAL

Buildings or parts of buildings used for sleeping accommodations on either a transient or permanent basis that may or may not have cooking facilities for meals. Another type of residential use is for the purpose of providing personal care. Some codes will classify this type of use, as an institutional use and others as a residential board and care, depending on the number of residents being cared for.

SUBCLASSES OF RESIDENTIAL OCCUPANCIES

	BOCA and International	Southern	Uniform
R-1	This use group shall include **all hotels, motels, boarding houses,** and similar buildings arranged for shelter and sleeping accommodations and in which the occupants are primarily transient in nature, occupying the facilities for a period of less than 30 days.	Where the occupants are primarily transient in nature including: Boarding housing (transient) Hotels Motels	Division 1. Hotels and apartment houses. Congregate residences (each accommodating more than ten persons).
R-2	This use group shall include all multiple-family dwellings having more than two dwelling units, except for multiple single-family dwelling units, and shall also include all boarding houses and similar buildings arranged for shelter and sleeping accommodations in which the occupants are primarily not transient in nature. A dormitory facility which accommodates more than five persons more than 2-1/2 years of age shall be classified as Use Group R-2.	Multiple dwellings where the occupants are primarily permanent in nature, including: apartment houses, monasteries, convents, rectories, fraternities and sororities, rooming houses (not transient), dormitory facilities which accommodate six or more persons of more than 2-1/2 years of age who stay more than 24 hours.	Division 2. Not used.
R-3	This use group shall include all buildings arranged for occupancy as one- or two-family dwelling units, including not more than five lodgers or boarders per family and multiple single-family dwellings where each unit has an independent means of egress and is separated by a two-hour fire separation assembly. A child care facility which accommodates five or less children of any age shall be classified as Use Group R-3.	Child care facilities which accommodate five of less children of any age for any time period. One- and two-family dwellings where the occupants are primarily permanent in nature and not classified as R-1, R-2, or 1. Rooming houses (transient).	Division 3. Dwellings and lodging houses. Congregate residences (each accommodating ten persons or less).
R-4	Residential occupancies arranged for residential care/assisted living including more than five but not more than 16 occupants.		

HAZARDS AND INSPECTION ISSUES IN RESIDENCES

While all residential occupancies are characterized by sleeping facilities, there are a wide variety of conditions and possible scenarios within this occupancy class. The hazards found in residences are typical of the common hazards found in most occupancies. The special hazards found in the more industrialized occupancies normally are not present, but these types of hazards can be introduced during maintenance, renovation or expansion activities. Cutting, welding, flammable liquids, flammable gases, and spray finishing are examples of special hazards that might be introduced.

Flammable liquids can be found in residential occupancies, but most codes severely restrict the amount of these liquids. Generally the quantity permitted is from three to five gallons. This does not necessarily prevent people from bringing gasoline-powered equipment inside residences.

Motorcycles can be found in apartments or homes; lawnmowers are stored in basements or other inappropriate locations. This is a very difficult problem to find and correct. Flammable liquids also may be found in storage rooms or maintenance areas.

One of the most important special considerations in residential occupancies is the constitutional protection against unreasonable search versus the right of entry to inspect. Except in an emergency, for example, a fire, apartments, single-family dwellings, townhouses, and other similar dwellings require permission of occupants or a search warrant to enter and make any type of inspection. Dormitories, fraternities, and sorority houses, and other such occupancies generally are less restrictive. Common areas like laundry rooms and areas open to the public are unrestricted.

Storage Rooms

Many residential occupancies have storage rooms. In hotels they are used for tables and chairs, linens, and other materials needed for operations. In apartments they provide a place for tenants to store household goods and other infrequently used materials. Certain general rules are found in most codes for storage rooms. First, they must be separated physically from the remainder of the occupancy. Depending on the code, the separation must be constructed to the required fire-resistance rating, or the space must be protected by an automatic fire sprinkler system. Some codes may require both fire-resistive construction and automatic fire suppression.

Hazardous materials and flammable liquids are not permitted in residential storage rooms.

Many residential buildings or complexes also have a maintenance area or areas. These spaces are used by building staff for work areas and storage. Normally they must meet the same fire separation or automatic protection rules as the storage room. They need to be inspected for good housekeeping and flammable liquid storage. In some larger complexes the maintenance area is in a detached nonresidential building. Frequently these separate maintenance buildings are small and have very minimal fire safety requirements.

Exitway Maintenance

Exits must be maintained clear of any obstruction. The most common obstructions vary with the type of residential building. In an apartment house it may be bicycles, motorcycles, or other tenant property. In a hotel it is frequently tables, chairs, serving carts, or other hotel supplies and equipment. The exits also must have proper exit signs, and directions to exits in larger buildings. Fire escapes are a special type of exterior exitway. They require good maintenance and must not be obstructed. They should be tested periodically for proper function. The area under the fire escape mechanism must be clear to allow the fire escape to work.

Most codes assign the responsibility for testing and maintaining systems to the owner of the systems. The owner may delegate the responsibility to the tenants or some other party through a written lease or contract; delegation is more common in commercial buildings than in residential buildings. The inspector should check to make sure that any system that is present is in good operating condition and that the necessary test and maintenance records are available and up-to-date. Systems include standpipes, automatic fire sprinklers, alarm systems, voice alarms, and PA systems.

Fire Extinguishers

Fire extinguishers need to be filled and in good working condition. They should be tagged indicating service has been performed within the code-specified timeframe. In some apartment buildings extinguishers have been installed in each apartment to avoid the problems of theft and vandalism of extinguishers in common areas.

Fire Doors

Fire doors are used to delay the spread of fire through separation walls. These walls could be corridor walls, stairway walls, or walls enclosing the furnace or storage room. It is important that fire doors not be propped open. If it is necessary for a door to be open, it must be equipped with an approved automatic closing device. The self-closing mechanism must be installed correctly and working, and the door latch must secure the door when it is closed.

Automatic Smoke Detectors

All types of residential uses have automatic smoke detectors installed and operational. The detectors must be tested and maintained on a continual basis.

Other Hazards

Many residential occupancies have laundry facilities. Clothes dryers must be vented properly, and lint removed regularly to prevent a dangerous buildup.

Combustibles may not be placed or stored next to water heaters or furnaces. Driveways, fire lanes, or other fire department access facilities must not be obstructed.

Openings or penetrations in fire separations, walls or floor/ceiling assemblies must be sealed or protected.

Highrise Buildings

Highrise buildings have some unique features and code requirements. Older highrise buildings may not have the same fire safety features as recently constructed buildings. However, some communities have required retroactive installation of fire safety systems.

Some buildings have a built-in fire department communication system. If such a system is present, it should be checked to ensure it is operational.

Smoke removal, pressurization, and venting features, if present, also should be checked for operational condition.

Elevator door and fire department emergency elevator service keys must be available.

In buildings with an atrium, furnishings and decorative material must be controlled in accordance with code.

Fire safety plans are required by most codes. The plan should be printed and widely distributed.

Laundry or Trash Chutes

Many apartment buildings are equipped with laundry or trash chutes. Because the chute communicates from floor to floor it must be enclosed with fire-resistive construction to prevent fire spread. The door used to load the chute must be of appropriate fire-resistive construction and be maintained to be self-closing and self-latching. Automatic fire sprinkler protection, if required, must be checked by feel, as they are inaccessible

for visual inspection. The terminal area or storage area should have automatic separation from chute.

Hotels

Most codes require exit plans to be posted in guest rooms. They also require staff training and emergency drills to be conducted and recorded.

FIRE DETECTION AND SIGNALING SYSTEMS

A fire alarm or fire detection system is a key element of any building's overall fire protection features. Properly designed, installed, tested, and maintained, these systems can aid in reducing the loss of life from fire and help to limit fire losses in buildings. The primary motivation for fire alarm/detection system requirements in buildings is to provide early notification to building occupants so they can exit the building and take emergency actions, and to notify the fire service automatically so it can respond to the fire.

Fire alarm or fire detection systems are installed and shall be maintained in accordance with the National Fire Protection Association's (NFPA) 72, *National Fire Alarm Code* [R]. After the proper installation and acceptance testing of these systems, the proper routine testing and maintenance must be provided by qualified service personnel. A fire alarm or fire detection system is composed of a series of electronically monitored circuits that are controlled by a fire alarm control panel (FACP). When activated, depending on the type of signal, the appropriate response could be evacuation of the building, operation of fire protection systems or building control features, indication of an abnormal condition in the building, or trouble within the system itself. The alarm signal may be transmitted throughout the building for notification of occupants to evacuate. The alarm signal also could be transmitted off site, to an alarm-receiving monitoring station, for the notification of forces responsible for responding to the alarm signal.

Components of a Fire Detection System

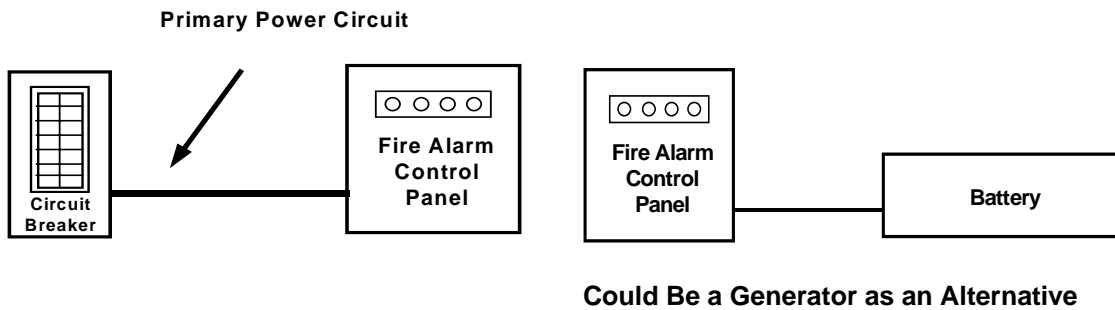- The FACP contains the electronics that either control or monitor the system. It is the brain of the system.

FACP = Fire Alarm Control Panel

○ ○ ○ ○
Fire Alarm Control Panel
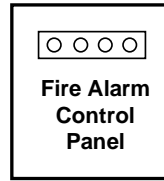
- The power supply consists of the primary electrical supply from the incoming power service that is provided from a dedicated circuit to the control panel. In addition, a secondary, backup power supply is required to allow the system to operate if the primary supply fails. The secondary power supply activates automatically when the primary power fails, to maintain the system's normal operating power. The time period requirements for secondary power operations vary depending on the type of system, as noted in NFPA 72.

Primary Power   **Secondary Power**

Primary Power Circuit

Circuit Breaker		**Fire Alarm Control Panel**		**Fire Alarm Control Panel**	**Battery**

Could Be a Generator as an Alternative

- Trouble signal--upon detection of an abnormal condition within the system, a trouble signal is activated at the control panel or other locations to attract attention to the system so that repairs can be made. Typically, the trouble signal will activate when an open fault or ground condition occurs in the system's wiring circuits or in the connected equipment, devices, or appliances, with loss of the primary or secondary power supplies.
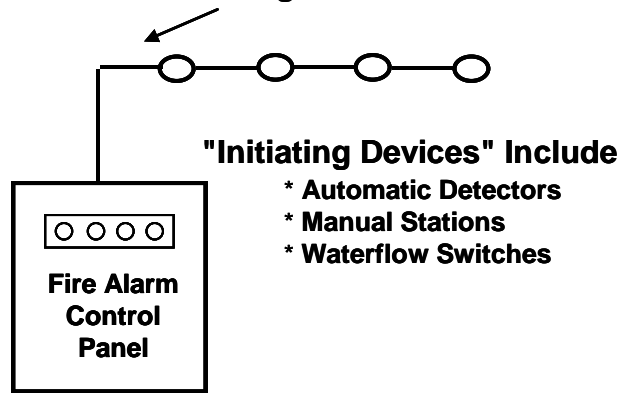
Trouble Signal
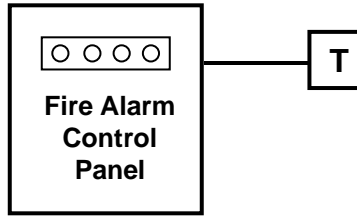
• Types of circuits.

Initiating circuits are connected to either manual fire alarm pull stations, smoke or heat detectors, etc., or water flow alarms from sprinkler systems.

Initiating Device Circuit

"Initiating Devices" Include
* Automatic Detectors
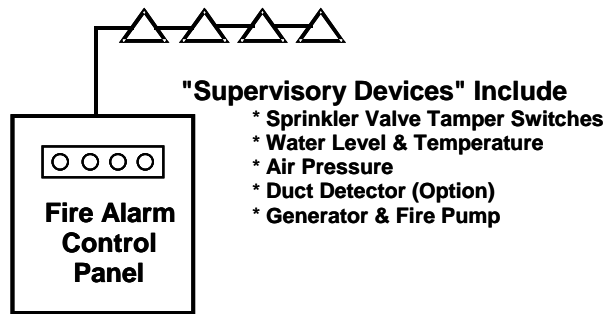* Manual Stations
* Waterflow Switches

Indicating circuits are connected to both audible and visible alarm signaling appliances that provide warning to the building occupants.

Indicating Appliance Circuit

"Indicating Appliances" Include

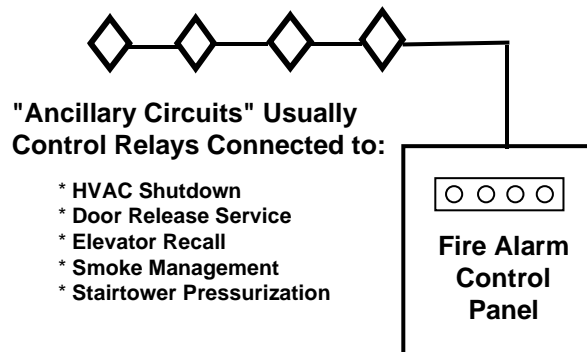|		
* Horns	* Bells	* Chimes
* Speakers	* Strobes	* Sirens
* Buzzers	* Etc.	
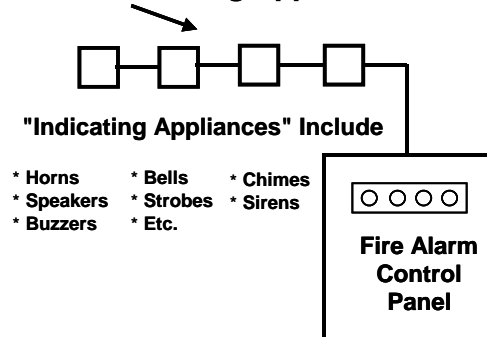
Supervisory circuits are connected to devices that are important to the overall fire safety of the building. They indicate an "abnormal" condition, not a fire or "alarm" condition, such as a sprinkler system control valve tamper switch.

Supervisory Circuit

"Supervisory Devices" Include
* Sprinkler Valve Tamper Switches
* Water Level & Temperature
* Air Pressure
* Duct Detector (Option)
* Generator & Fire Pump

Fire Alarm Control Panel

Ancillary (control circuits) are connected to devices or control functions in a building that are part of a building's fire protection features, such as the operating of a smoke control system or automatic fire door release.

Ancillary (Control) Circuit

"Ancillary Circuits" Usually Control Relays Connected to:

* HVAC Shutdown
* Door Release Service
* Elevator Recall
* Smoke Management
* Stairtower Pressurization

Fire Alarm Control Panel

Signaling circuits are connected from the building's fire alarm control panel within the protected premises to an offsite or remote monitoring station.
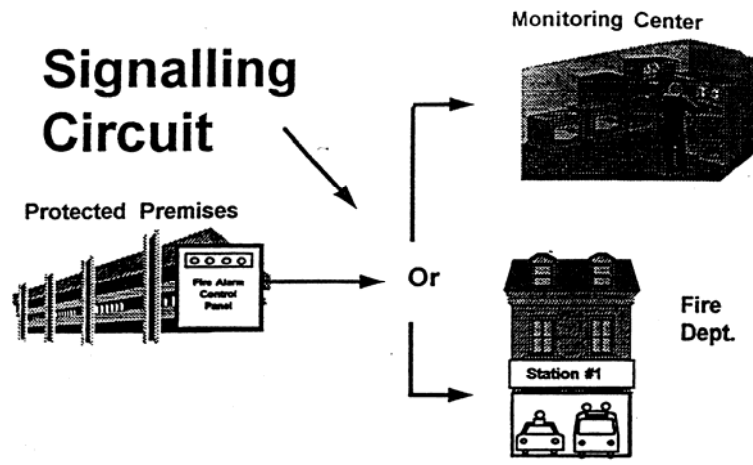
Most systems will have initiating and indicating circuits. Other types of circuits may be provided, depending on the required functions of the system related to the building's installed fire protection systems and features.

Example of an Alarm System
Represents all Types of Circuits.
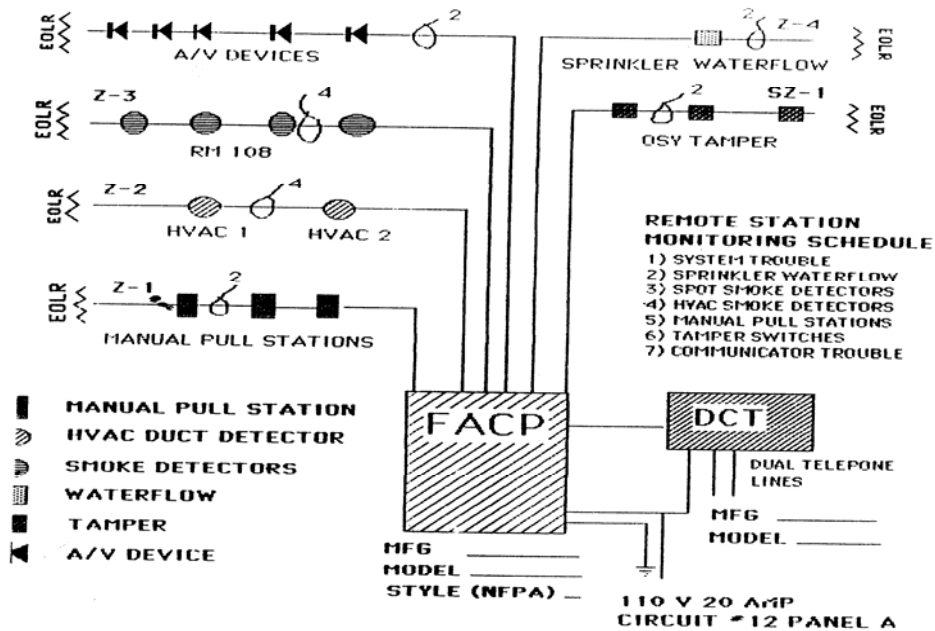
Types of Alarm Systems

Local protective signaling systems provide a notification and evacuation alarm for the building's occupants. The alarm is not transmitted from the

building; therefore, fire service notification must be done by someone within the building who would hear the alarm.

**Local Protective
Signaling System**

**Provides Occupant
Notification at the
Protected Premises.**

An auxiliary protective signaling system is connected to a municipal fire alarm street box system. Activation of the building alarm system sends a signal through a street box to the local fire department. This type of system is not common because the old systems were removed after the adoption of the emergency 911 reporting system.

**Auxiliary Protective
Signaling System**

**Ties into Municipal Fire
Boxes. "May" also Provide
Notification on Protected Premises.**

A proprietary protection signaling system is connected to a monitoring center that is owned by the same concern as the building or buildings being monitored. The building may or may not be on the same property as the monitoring center.
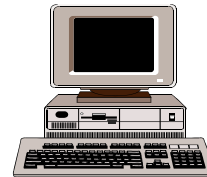
**Proprietary Protective
Signaling System**

**Ties into Station Owned by
Protected Premises Owner.
"May" Include Notification at
the Protected Premises.**

A remote station protective signaling system is connected to a remote monitoring station such as a local fire or police department or other government function. The monitoring station also may be a privately owned station that is not listed by Underwriters Laboratories (UL) as a central station system.

**Remote Station
Protective Signaling
System**

**Ties Into Police or Fire Station
Or Other Location Acceptable
to AHJ.**

**"May" Also Provide
Notification at the Protected
Premises.**

A central station protective signaling system--this type of system is connected to a UL-listed central station. In addition, the building alarm system must be certified and the building owner must maintain a maintenance, inspection, and testing contract in accordance with NFPA 72.

Central Station
Protective Signaling
System

❖ **Ties into "Listed" Monitoring Station.**
❖ **System is issued a "Certificate."**
❖ **Maintenance, Inspection and Testing "Contract."**
❖ **"Runner" Service must be Provided.**

Other Considerations

Remote Annunciators

Remote annunciators frequently are included in the alarm system. The annunciator displays the condition of the alarm system, usually through lights (LED's) on a graphic or tabular display panel. Annunciators can be equipped with switches that control the FACP. These remote panels are provided at locations such as the main lobby of a building, or at a security desk so that the condition of the alarm system is readily available.

Audible and Visible Indicating Appliances

Occupants of a building must be notified in some manner in order to be aware of a possible fire emergency in a building. The alarm typically uses both audible and visible indicators. Older alarm systems may not have visible indication. However, if the alarm system is required to be upgraded to meet Americans with Disabilities Act (ADA) requirements, visible appliances must be added. NFPA 72 notes specific requirements for the performances of both the audible and visible signaling appliances. Some buildings may have an emergency voice/alarm communication system. This type of audible system provides for transmission of information to occupants of the building and also can be used by the fire department when operating in the building.

After the alarm systems have been installed and accepted, the inspector must be alert to any modifications to the building or floor area arrangement that could affect the occupants' ability either to hear the alarms or to see the visible signaling appliances.

Inspection, Testing, and Maintenance

As with any system, the alarm system must be tested and maintained routinely to assure proper operation. These systems are extremely important and must meet specific acceptance testing requirements, in accordance with NFPA 72, when they are first installed. In addition NFPA 72 requires that the building owner maintain and test the alarm system on at least an annual basis, by a qualified alarm company or individual. Records of required inspections and testing must be maintained by the building owner.

All electronic components are susceptible to failure. The greater the frequency of periodic testing and inspection, the greater the probability that the system will be in working condition when a fire occurs.

Verifying Alarm System Operational Readiness

During the course of conducting inspections in buildings that contain an alarm system, the following recommended procedures should be followed.

- The FACP shall be inspected to assure it is in normal operating condition. Check the condition of any LED trouble indicators or trouble signals at the panel. The panel should indicate that it is being powered by the primary power supply in the building.

Example of Simplex Model 4020 Control Panel Indicator

ALPHNUMERIC DISPLAY

YELLOW LED (FLASHING)

ACKNOWLEDGE KEYS
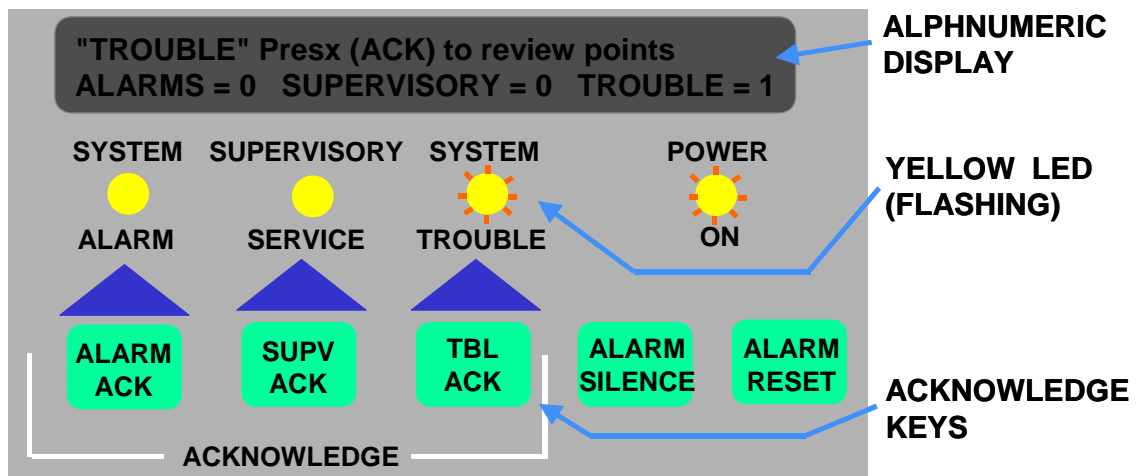
- The secondary (backup) power supply shall indicate that it can meet the requirements of the alarm system. Both the control panel and power supplies should have records that they are being tested annually.

- If the alarm system transmits to an offsite location, verify that the system and its connection are being tested quarterly.

- Remote annunciator, if provided, should be inspected to determine that it is operational, and the panel should be tested annually to determine the correct annunciation at the panel, along with the testing of any control switches.

- Smoke detectors are required to be functionally tested with smoke or simulated smoke at least annually, must appear to be operating, and not be damaged.

- All occupant notification signals, both audible and visible, shall be tested annually, and must appear to be operational, not damaged, and mounted securely.

- All ancilliary building fire control features that are controlled by the alarm system shall be tested at least annually. Examples are elevator recall, smoke control, and HVAC control shutdown and automatic door release.

- Heat detectors of the fixed temperature nonrestorable type shall be sample tested every 15 years. Restorable-type heat detectors shall be tested annually, must appear to be operational and not be damaged.

- Manual pull stations shall be tested annually, must appear to be operational, and not be damaged.

- Supervisory devices such as valve tamper switches and sprinkler system air pressure shall be tested annually.

- Sprinkler system water flow devices shall be tested quarterly.

- Records of testing and maintenance shall be available for examination.

- No unannounced fire alarm testing should be conducted.

FIRE DEPARTMENT ACCESS

When you approach a building to make an inspection, note conditions affecting fire department response and fireground operations, including the location of fire hydrants. Accessibility is an important factor. Fire lanes should be well marked and unobstructed. Vehicular activity should be limited to the pickup and discharge of passengers, and parking should be prohibited. Fire lanes must be wide enough to allow fire apparatus to pass. Hydrants and other sources of water must be accessible. Sprinkler valves must be open, and sprinkler and standpipe connections must be capped, free of debris, and accessible.

Specific requirements are found in most codes. They are designed to get motorized apparatus into functional positions in the event of emergency. Some codes have weak or ambiguous requirements; other codes are much stronger. The most extensive regulations are in the Uniform Code. The width, distance to the building or to an entrance, and turnaround requirements usually are specified. In many codes, a fire lane provision is included, and marking and parking controls are defined. Most codes specifically prohibit obstructions in fire lanes.   Separate access requirements for buildings under construction also may be listed in the code.

Activity R.1

Identify Types of Residences

Purpose

To identify and differentiate among the various types of residential occupancies.

Directions

1. Individually generate a list of residences in your area.

2. Differentiate subclasses by answering these questions:

    a.   What are some of the things that are unique about this type of residence?

    b.   What residential classification is the building?

Activity R.2

Hazards in Residences

Purpose

To identify fire and life safety hazards in residences.

Directions

1.   Your group will be assigned two occupancies from the list of residences generated in Activity R.1.

2.   Develop a list of hazards you would expect to find in these types of residences.

3.   Select a spokesperson to report the group's list.

Activity R.3

Hazard Correction

Purpose

Given a list of potential hazards in residential occupancies from Activity R.2, describe the hazard and suggest proper method for solving the problem.

Directions

1.   Review the list below, and note any deficiencies you discover.

2.   Look up the suspected deficiency in your code book and develop a solution. List the problem, the solution, and the code reference.

3.   Be prepared to discuss your solutions.

Hazards

Five-gallon gas can in storage room.

Bike in stairway.

Fire alarm turned off.

_____

_____

_____

Fire extinguisher missing.

_____

_____

_____

Trash dump container in fire lane.

_____

_____

_____

Activity R.4

Fire Apparatus Access

Purpose

To identify access requirements for structures.

Directions

Using a diagram of a building complex and your fire code book, answer the following questions:

1.   How close does the access have to be?

2.   How wide does it have to be?

3.   What alternative methods, if any, could be used to provide access?

4.   Is there a throughway or turnaround provided?

Parking

Parking

Parking

Parking

Parking

Parking

Building 1

Building 2

Building 3

Building 4

Public Street