

## CHAPTER 9

# FIRE PROTECTION SYSTEMS

### SECTION 901 GENERAL

**901.1 Scope.** The provisions of this chapter shall specify where fire protection systems are required and shall apply to the design, installation and operation of fire protection systems.

**901.2 Fire protection systems.** Fire protection systems shall be installed, repaired, operated and maintained in accordance with this code and the *International Fire Code*.

Any fire protection system for which an exception or reduction to the provisions of this code has been granted shall be considered to be a required system.

**Exception:** Any fire protection system or portion thereof not required by this code shall be permitted to be installed for partial or complete protection provided that such system meets the requirements of this code.

**901.2.1 Certificates required.** Individuals who install, inspect, test or maintain life safety systems and equipment shall obtain a certificate from the fire code official.

**901.3 Modifications.** No person shall remove or modify any fire protection system installed or maintained under the provisions of this code or the *International Fire Code* without approval by the building official.

**901.4 Threads.** Threads provided for fire department connections to sprinkler systems, standpipes, yard hydrants or any other fire hose connection shall be compatible with the connections used by the local fire department.

**901.5 Acceptance tests.** Fire protection systems shall be tested in accordance with the requirements of this code and the *International Fire Code*. When required, the tests shall be conducted in the presence of the building official. Tests required by this code, the *International Fire Code* and the standards listed in this code shall be conducted at the expense of the owner or the owner's representative. It shall be unlawful to occupy portions of a structure until the required fire protection systems within that portion of the structure have been tested and approved. Individuals who perform acceptance tests on fire and life safety systems shall obtain the proper certificate from the fire code official.

**901.6 Supervisory service.** Where required, fire protection systems shall be monitored by an approved supervising station in accordance with NFPA 72.

**901.6.1 Automatic sprinkler systems.** Automatic sprinkler systems shall be monitored by an approved supervising station.

#### Exceptions:

1. A supervising station is not required for automatic sprinkler systems protecting one- and two-family dwellings and townhouses.
2. Limited area systems serving fewer than 20 sprinklers.

**901.6.2 Fire alarm systems.** Fire alarm systems required by the provisions of Section 907.2 of this code and Section 907.2 of the *International Fire Code* shall be monitored by an approved supervising station in accordance with Section 907.14.

#### Exceptions:

1. Single- and multiple-station smoke alarms required by Section 907.2.10.
2. Smoke detectors in Group I-3 occupancies.
3. Supervisory service is not required for automatic sprinkler systems in one- and two-family dwellings.

**901.6.3 Group H.** Manual fire alarm, automatic fire-extinguishing and emergency alarm systems in Group H occupancies shall be monitored by an approved supervising station.

**Exception:** When approved by the building official, on-site monitoring at a constantly attended location shall be permitted provided that notifications to the fire department will be equal to those provided by an approved supervising station.

**901.7 Fire areas.** Where buildings, or portions thereof, are divided into fire areas so as not to exceed the limits established for requiring a fire protection system in accordance with this chapter, such fire areas shall be separated by fire barriers having a fire-resistance rating of not less than that determined in accordance with Section 706.3.9.

### SECTION 902 DEFINITIONS

**902.1 Definitions.** The following words and terms shall, for the purposes of this chapter, and as used elsewhere in this code, have the meanings shown herein.

**[F] ALARM NOTIFICATION APPLIANCE.** A fire alarm system component such as a bell, horn, speaker, light or text display that provides audible, tactile or visible outputs, or any combination thereof.

**[F] ALARM SIGNAL.** A signal indicating an emergency requiring immediate action, such as a signal indicative of fire.

**[F] ALARM VERIFICATION FEATURE.** A feature of automatic fire detection and alarm systems to reduce unwanted alarms wherein smoke detectors report alarm conditions for a minimum period of time, or confirm alarm conditions within a given time period, after being automatically reset, in order to be accepted as a valid alarm-initiation signal.

**[F] ANNUNCIATOR.** A unit containing one or more indicator lamps, alphanumeric displays or other equivalent means in which each indication provides status information about a circuit, condition or location.

**[F] AUDIBLE ALARM NOTIFICATION APPLIANCE.** A notification appliance that alerts by the sense of hearing.

**[F] AUTOMATIC.** As applied to fire protection devices, is a device or system providing an emergency function without the necessity for human intervention and activated as a result of a predetermined temperature rise, rate of temperature rise or combustion products.

**[F] AUTOMATIC FIRE-EXTINGUISHING SYSTEM.** An approved system of devices and equipment which automatically detects a fire and discharges an approved fire-extinguishing agent onto or in the area of a fire.

**[F] AUTOMATIC SPRINKLER SYSTEM.** A sprinkler system, for fire protection purposes, is an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The system includes a suitable water supply. The portion of the system above the ground is a network of specially sized or hydraulically designed piping installed in a structure or area, generally overhead, and to which automatic sprinklers are connected in a systematic pattern. The system is usually activated by heat from a fire and discharges water over the fire area.

**[F] AVERAGE AMBIENT SOUND LEVEL.** The root mean square, A-weighted sound pressure level measured over a 24-hour period.

**[F] CARBON DIOXIDE EXTINGUISHING SYSTEMS.** A system supplying carbon dioxide (CO<sub>2</sub>) from a pressurized vessel through fixed pipes and nozzles. The system includes a manual- or automatic-actuating mechanism.

**[F] CEILING LIMIT.** The maximum concentration of an air-borne contaminant to which one may be exposed, as published in DOL 29 CFR Part 1910.1000.

**[F] CLEAN AGENT.** Electrically nonconducting, volatile or gaseous fire extinguishant that does not leave a residue upon evaporation.

**[F] CONSTANTLY ATTENDED LOCATION.** A designated location at a facility staffed by trained personnel on a continuous basis where alarm or supervisory signals are monitored and facilities are provided for notification of the fire department or other emergency services.

**[F] DELUGE SYSTEM.** A sprinkler system employing open sprinklers attached to a piping system connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto.

**[F] DETECTOR, HEAT.** A fire detector that senses heat produced by burning substances. Heat is the energy produced by combustion that causes substances to rise in temperature.

**[F] DRY-CHEMICAL EXTINGUISHING AGENT.** A powder composed of small particles, usually of sodium bicarbonate, potassium bicarbonate, urea-potassium-based bicarbonate, potassium chloride or monoammonium phosphate, with added particulate material supplemented by special treatment to provide resistance to packing, resistance to moisture absorption (caking) and the proper flow capabilities.

**[F] EMERGENCY ALARM SYSTEM.** A system to provide indication and warning of emergency situations involving hazardous materials.

**[F] EMERGENCY VOICE/ALARM COMMUNICATIONS.** Dedicated manual or automatic facilities for originating and distributing voice instructions, as well as alert and evacuation signals pertaining to a fire emergency, to the occupants of a building.

**[F] EXPLOSION.** An effect produced by the sudden violent expansion of gases, that is accompanied by a shock wave or disruption of enclosing materials or structures, or both.

**[F] FIRE ALARM BOX, MANUAL.** See "Manual Fire Alarm Box."

**[F] FIRE ALARM CONTROL UNIT.** A system component that receives inputs from automatic and manual fire alarm devices and is capable of supplying power to detection devices and transponder(s) or off-premises transmitter(s). The control unit is capable of providing a transfer of power to the notification appliances and transfer of condition to relays or devices.

**[F] FIRE ALARM SIGNAL.** A signal initiated by a fire alarm-initiating device such as a manual fire alarm box, automatic fire detector, water flow switch, or other device whose activation is indicative of the presence of a fire or fire signature.

**[F] FIRE ALARM SYSTEM.** A system or portion of a combination system consisting of components and circuits arranged to monitor and annunciate the status of fire alarm or supervisory signal-initiating devices and to initiate the appropriate response to those signals.

**[F] FIRE COMMAND CENTER.** The principal attended or unattended location where the status of detection, alarm communications and control systems is displayed, and from which the system(s) can be manually controlled.

**[F] FIRE DETECTION SYSTEM.** A system of smoke or heat detectors monitored at an approved central station, with no requirement for notification appliances in the building.

**[F] FIRE DETECTOR, AUTOMATIC.** A device designed to detect the presence of a fire signature and to initiate action.

**[F] FIRE PROTECTION SYSTEM.** Approved devices, equipment and systems or combinations of systems used to detect a fire, activate an alarm, extinguish or control a fire, control or manage smoke and products of a fire or any combination thereof.

**[F] FIRE SAFETY FUNCTIONS.** Building and fire control functions that are intended to increase the level of life safety for occupants or to control the spread of harmful effects of fire.

**[F] FOAM-EXTINGUISHING SYSTEM.** A special system discharging a foam made from concentrates, either mechanically or chemically, over the area to be protected.

**[F] HALOGENATED EXTINGUISHING SYSTEM.** A fire-extinguishing system using one or more atoms of an element from the halogen chemical series: fluorine, chlorine, bromine and iodine.

**[F] INITIATING DEVICE.** A system component that originates transmission of a change-of-state condition, such as in a smoke detector, manual fire alarm box or supervisory switch.

**[F] LISTED.** Equipment, materials or services included in a list published by an organization acceptable to the building official and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material or service meets identified standards or has been tested and found suitable for a specified purpose.

**[F] MANUAL FIRE ALARM BOX.** A manually operated device used to initiate an alarm signal.

**[F] MULTIPLE-STATION ALARM DEVICE.** Two or more single-station alarm devices that are capable of interconnection such that actuation of one causes all integral or separate audible alarms to operate. It also can consist of one single-station alarm device having connections to other detectors or to a manual fire alarm box.

**[F] MULTIPLE-STATION SMOKE ALARM.** Two or more single-station alarm devices that are capable of interconnection such that actuation of one causes all integral or separate audible alarms to operate.

**[F] NUISANCE ALARM.** An alarm caused by mechanical failure, malfunction, improper installation or lack of proper maintenance, or an alarm activated by a cause that cannot be determined.

**[W] PORTABLE SCHOOL CLASSROOM.** A structure, transportable in one or more sections, that requires a chassis to be transported, and is designed to be used as an educational space with or without a permanent foundation. The structure shall be trailerable and capable of being demounted and relocated to other locations as needs arise.

**[F] RECORD DRAWINGS.** Drawings (“as built”) that document the location of all devices, appliances, wiring sequences, wiring methods and connections of the components of a fire alarm system as installed.

**[F] SINGLE-STATION SMOKE ALARM.** An assembly incorporating the detector, the control equipment and the alarm-sounding device in one unit, operated from a power supply either in the unit or obtained at the point of installation.

**[F] SMOKE ALARM.** A single- or multiple-station alarm responsive to smoke and not connected to a system.

**[F] SMOKE DETECTOR.** A listed device that senses visible or invisible particles of combustion.

**SMOKEPROOF ENCLOSURE.** An exit stairway designed and constructed so that the movement of the products of combustion produced by a fire occurring in any part of the building into the enclosure is limited.

**[F] STANDPIPE SYSTEM, CLASSES OF.** Standpipe classes are as follows:

**Class I system.** A system providing 2½-inch (64 mm) hose connections to supply water for use by fire departments and those trained in handling heavy fire streams.

**Class II system.** A system providing 1½-inch (38 mm) hose stations to supply water for use primarily by the building occupants or by the fire department during initial response.

**Class III system.** A system providing 1½-inch (38 mm) hose stations to supply water for use by building occupants and 2.5-inch (64 mm) hose connections to supply a larger volume of water for use by fire departments and those trained in handling heavy fire streams.

**[F] STANDPIPE, TYPES OF.** Standpipe types are as follows:

**Automatic dry.** A dry standpipe system, normally filled with pressurized air, that is arranged through the use of a device, such as dry pipe valve, to admit water into the system piping automatically upon the opening of a hose valve. The water supply for an automatic dry standpipe system shall be capable of supplying the system demand.

**Automatic wet.** A wet standpipe system that has a water supply that is capable of supplying the system demand automatically.

**Manual dry.** A dry standpipe system that does not have a permanent water supply attached to the system. Manual dry standpipe systems require water from a fire department pumper to be pumped into the system through the fire department connection in order to meet the system demand.

**Manual wet.** A wet standpipe system connected to a water supply for the purpose of maintaining water within the system but does not have a water supply capable of delivering the system demand attached to the system. Manual-wet standpipe systems require water from a fire department pumper (or the like) to be pumped into the system in order to meet the system demand.

**Semiautomatic dry.** A dry standpipe system that is arranged through the use of a device, such as a deluge valve, to admit water into the system piping upon activation of a remote control device located at a hose connection. A remote control activation device shall be provided at each hose connection. The water supply for a semiautomatic dry standpipe system shall be capable of supplying the system demand.

**[F] SUPERVISING STATION.** A facility that receives signals and at which personnel are in attendance at all times to respond to these signals.

**[F] SUPERVISORY SERVICE.** The service required to monitor performance of guard tours and the operative condition of fixed suppression systems or other systems for the protection of life and property.

**[F] SUPERVISORY SIGNAL.** A signal indicating the need of action in connection with the supervision of guard tours, the fire suppression systems or equipment or the maintenance features of related systems.

**[F] SUPERVISORY SIGNAL-INITIATING DEVICE.** An initiation device, such as a valve supervisory switch, water-level indicator or low-air pressure switch on a dry-pipe sprinkler system, whose change of state signals an off-normal condition and its restoration to normal of a fire protection or life safety system, or a need for action in connection with guard tours, fire suppression systems or equipment or maintenance features of related systems.

**[F] TIRES, BULK STORAGE OF.** Storage of tires where the area available for storage exceeds 20,000 cubic feet (566 m<sup>3</sup>).

**[F] TROUBLE SIGNAL.** A signal initiated by the fire alarm system or device indicative of a fault in a monitored circuit or component.

**[F] VISIBLE ALARM NOTIFICATION APPLIANCE.** A notification appliance that alerts by the sense of sight.

**[F] WET-CHEMICAL EXTINGUISHING SYSTEM.** A solution of water and potassium-carbonate-based chemical, potassium-acetate-based chemical or a combination thereof, forming an extinguishing agent.

**[F] WIRELESS PROTECTION SYSTEM.** A system or a part of a system that can transmit and receive signals without the aid of wire.

**[F] ZONE.** A defined area within the protected premises. A zone can define an area from which a signal can be received, an area to which a signal can be sent or an area in which a form of control can be executed.

### SECTION 903 AUTOMATIC SPRINKLER SYSTEMS

**[F] 903.1 General.** Automatic sprinkler systems shall comply with this section.

**[F] 903.1.1 Alternative protection.** Alternative automatic fire-extinguishing systems complying with Section 904 shall be permitted in lieu of automatic sprinkler protection where recognized by the applicable standard and approved by the fire code official.

**[F] 903.2 Where required.** Approved automatic sprinkler systems in new buildings and structures shall be provided in the locations described in this section.

**Exception:** Spaces or areas in telecommunications buildings used exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided those spaces or areas are equipped throughout with an automatic fire alarm system and are separated from the remainder of the building by fire barriers consisting of not less than 1-hour fire-resistance-rated walls and 2-hour fire-resistance-rated floor/ceiling assemblies.

**[F] 903.2.1 Group A.** An automatic sprinkler system shall be provided throughout buildings and portions thereof used as Group A occupancies as provided in this section. For Group A-1, A-2, A-3 and A-4 occupancies, the automatic sprinkler system shall be provided throughout the floor area where the Group A-1, A-2, A-3 or A-4 occupancy is located, and in all floors between the Group A occupancy and the level of exit discharge, including the level of exit discharge. For Group A-5 occupancies, the automatic sprinkler system shall be provided in the spaces indicated in Section 903.2.1.5.

**[F] 903.2.1.1 Group A-1.** An automatic sprinkler system shall be provided for Group A-1 occupancies where one of the following conditions exists:

1. The fire area exceeds 12,000 square feet (1115 m<sup>2</sup>).
2. The fire area has an occupant load of 300 or more.
3. The fire area is located on a floor other than the level of exit discharge.
4. The fire area contains a multitheater complex.

**[F] 903.2.1.2 Group A-2.** An automatic sprinkler system shall be provided for Group A-2 occupancies where one of the following conditions exists:

1. The fire area exceeds 5,000 square feet (465 m<sup>2</sup>);
2. The fire area has an occupant load of 100 or more; or
3. The fire area is located on a floor other than the level of exit discharge.

**Exception:** Item 3 does not apply to fire areas that include space located one floor above the level of exit discharge where the occupant load of the upper floor is less than 50.

**[F] 903.2.1.3 Group A-3.** An automatic sprinkler system shall be provided for Group A-3 occupancies where one of the following conditions exists:

1. The fire area exceeds 12,000 square feet (1115 m<sup>2</sup>).
2. The fire area has an occupant load of 300 or more.
3. The fire area is located on a floor other than the level of exit discharge.

**Exception:** Areas used exclusively as participant sports areas where the main floor area is located at the same level as the level of exit discharge of the main entrance and exit.

**[F] 903.2.1.4 Group A-4.** An automatic sprinkler system shall be provided for Group A-4 occupancies where one of the following conditions exists:

1. The fire area exceeds 12,000 square feet (1115 m<sup>2</sup>).
2. The fire area has an occupant load of 300 or more.
3. The fire area is located on a floor other than the level of exit discharge.

**Exception:** Areas used exclusively as participant sports areas where the main floor area is located at the same level as the level of exit discharge of the main entrance and exit.

**[F] 903.2.1.5 Group A-5.** An automatic sprinkler system shall be provided for Group A-5 occupancies in the following areas: concession stands, retail areas, press boxes and other accessory use areas in excess of 1,000 square feet (93 m<sup>2</sup>).

**[W] 903.2.1.6 Nightclub.** An automatic sprinkler system shall be provided in accordance with Section 903.3.1.1 throughout all occupancies with a nightclub. Existing nightclubs shall be provided with automatic sprinklers not later than December 1, 2009.

~~[W] [F] 903.2.2 Group E.~~ An automatic sprinkler system shall be provided for Group E occupancies. ~~((as follows:~~

- ~~1. Throughout all Group E fire areas greater than 20,000 square feet (1858 m<sup>2</sup>) in area.~~
- ~~2. Throughout every portion of educational buildings below the level of exit discharge.~~

~~**Exception:** An automatic sprinkler system is not required in any fire area or area below the level of exit discharge where every classroom throughout the building has at least one exterior exit door at ground level.))~~

**Exceptions:**

1. Portable school classrooms, provided the aggregate area of any cluster of portable school classrooms does not exceed 5,000 square feet (464.5 m<sup>2</sup>); and clusters of portable school classrooms shall be separated as required in Chapter 5.
2. Group E occupancies with an occupant load of 50 or less.

**[F] 903.2.3 Group F-1.** An automatic sprinkler system shall be provided throughout all buildings containing a Group F-1 occupancy where one of the following conditions exists:

1. Where a Group F-1 fire area exceeds 12,000 square feet (1115 m<sup>2</sup>);
2. Where a Group F-1 fire area is located more than three stories above grade plane; or
3. Where the combined area of all Group F-1 fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m<sup>2</sup>).

**[F] 903.2.3.1 Woodworking operations.** An automatic sprinkler system shall be provided throughout all Group F-1 occupancy fire areas that contain woodworking operations in excess of 2,500 square feet (232 m<sup>2</sup>) in area which generate finely divided combustible waste or use finely divided combustible materials.

**[F] 903.2.4 Group H.** Automatic sprinkler systems shall be provided in high-hazard occupancies as required in Sections 903.2.4.1 through 903.2.4.3.

**[F] 903.2.4.1 General.** An automatic sprinkler system shall be installed in Group H occupancies.

**[F] 903.2.4.2 Group H-5.** An automatic sprinkler system shall be installed throughout buildings containing Group H-5 occupancies. The design of the sprinkler system shall not be less than that required by this code for the occupancy hazard classifications in accordance with Table 903.2.4.2. Where the design area of the sprinkler system consists of a corridor protected by one row of sprinklers, the maximum number of sprinklers required to be calculated is 13.

**[F] TABLE 903.2.4.2  
GROUP H-5 SPRINKLER DESIGN CRITERIA**

LOCATION	OCCUPANCY HAZARD CLASSIFICATION
Fabrication areas	Ordinary Hazard Group 2
Service corridors	Ordinary Hazard Group 2
Storage rooms without dispensing	Ordinary Hazard Group 2
Storage rooms with dispensing	Extra Hazard Group 2
Corridors	Ordinary Hazard Group 2

**[F] 903.2.4.3 Pyroxylin plastics.** An automatic sprinkler system shall be provided in buildings, or portions thereof, where cellulose nitrate film or pyroxylin plastics are manufactured, stored or handled in quantities exceeding 100 pounds (45 kg).

**[F] 903.2.5 Group I.** An automatic sprinkler system shall be provided throughout buildings with a Group I fire area.

**Exception:** An automatic sprinkler system installed in accordance with Section 903.3.1.2 or 903.3.1.3 shall be allowed in Group I-1 facilities.

**[F] 903.2.6 Group M.** An automatic sprinkler system shall be provided throughout buildings containing a Group M occupancy where one of the following conditions exists:

1. Where a Group M fire area exceeds 12,000 square feet (1115 m<sup>2</sup>);
2. Where a Group M fire area is located more than three stories above grade plane; or
3. Where the combined area of all Group M fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m<sup>2</sup>).

**[F] 903.2.6.1 High-piled storage.** An automatic sprinkler system shall be provided in accordance with the *International Fire Code* in all buildings of Group M where storage of merchandise is in high-piled or rack storage arrays.

**[F] 903.2.7 Group R.** An automatic sprinkler system installed in accordance with Section 903.3 shall be provided throughout all buildings with a Group R fire area.

**Exception:** Automatic sprinkler systems are not required in buildings complying with both the *International Residential Code* and Chapter 5 of the *International Fire Code*.

**[F] 903.2.8 Group S-1.** An automatic sprinkler system shall be provided throughout all buildings containing a Group S-1 occupancy where one of the following conditions exists:

1. A Group S-1 fire area exceeds 12,000 square feet (1115 m<sup>2</sup>);
2. A Group S-1 fire area is located more than three stories above grade plane; or

3. The combined area of all Group S-1 fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m<sup>2</sup>).

**[F] 903.2.8.1 Repair garages.** An automatic sprinkler system shall be provided throughout all buildings used as repair garages in accordance with Section 406, as shown:

1. Buildings two or more stories in height, including basements, with a fire area containing a repair garage exceeding 10,000 square feet (929 m<sup>2</sup>).
2. One-story buildings with a fire area containing a repair garage exceeding 12,000 square feet (1115 m<sup>2</sup>).
3. Buildings with a repair garage servicing vehicles parked in the basement.

**[F] 903.2.8.2 Bulk storage of tires.** Buildings and structures where the area for the storage of tires exceeds 20,000 cubic feet (566 m<sup>3</sup>) shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

**903.2.8.3 Liquor Warehouses.** An automatic sprinkler system shall be installed in liquor warehouses.

**Interpretation I903.2:** Stock rooms of retail liquor sales outlets are not liquor warehouses.

**[F] 903.2.9 Group S-2.** An automatic sprinkler system shall be provided throughout buildings classified as enclosed parking garages in accordance with Section 406.4 or where located beneath other groups.

**Exception:** Enclosed parking garages located beneath Group R-3 occupancies.

**[F] 903.2.9.1 Commercial parking garages.** An automatic sprinkler system shall be provided throughout buildings used for storage of commercial trucks or buses where the fire area exceeds 5,000 square feet (464 m<sup>2</sup>).

**[F] 903.2.10 Windowless stories in all occupancies.** An automatic sprinkler system shall be installed in the locations set forth in Sections 903.2.10.1 through 903.2.10.1.3.

**Exception:** Group R-3 and Group U.

**[F] 903.2.10.1 Stories and basements without openings.** An automatic sprinkler system shall be installed throughout every story or basement of all buildings where the floor area exceeds 1,500 square feet (139.4 m<sup>2</sup>) and where there is not provided at least one of the following types of exterior wall openings:

1. Openings below grade that lead directly to ground level by an exterior stairway complying with Section 1009 or an outside ramp complying with Section 1010. Openings shall be located in each 50 linear feet (15 240 mm), or fraction thereof, of exterior wall in the story on at least one side.
2. Openings entirely above the adjoining ground level totaling at least 20 square feet (1.86 m<sup>2</sup>) in each 50 linear feet (15 240 mm), or fraction

thereof, of exterior wall in the story on at least one side.

**[F] 903.2.10.1.1 Opening dimensions and access.** Openings shall have a minimum dimension of not less than 30 inches (762 mm). Such openings shall be accessible to the fire department from the exterior and shall not be obstructed in a manner that fire fighting or rescue cannot be accomplished from the exterior.

**[F] 903.2.10.1.2 Openings on one side only.** Where openings in a story are provided on only one side and the opposite wall of such story is more than 75 feet (22 860 mm) from such openings, the story shall be equipped throughout with an approved automatic sprinkler system, or openings as specified above shall be provided on at least two sides of the story.

**[F] 903.2.10.1.3 Basements.** Where any portion of a basement is located more than 75 feet (22 860 mm) from openings required by Section 903.2.10.1, the basement shall be equipped throughout with an approved automatic sprinkler system.

**[F] 903.2.10.2 Rubbish and linen chutes.** An automatic sprinkler system shall be installed at the top of rubbish and linen chutes and in their terminal rooms. Chutes extending through three or more floors shall have additional sprinkler heads installed within such chutes at alternate floors. Chute sprinklers shall be accessible for servicing.

**[F] 903.2.10.3 Buildings 55 feet or more in height.** An automatic sprinkler system shall be installed throughout buildings with a floor level having an occupant load of 30 or more that is located 55 feet (16 764 mm) or more above the lowest level of fire department vehicle access.

**Exceptions:**

1. Airport control towers.
2. Open parking structures.
3. Occupancies in Group F-2.

**903.2.10.4 Basement storage and sale of combustible materials.** An automatic sprinkler system shall be installed throughout basements that are not stories above grade plane that are used for storage or sale of combustible materials.

**Exceptions:**

1. Sprinklers are not required in portions of the basement not containing combustible materials and protected by a fire barrier with at least a 1-hour fire-resistance rating.
2. Sprinklers are not required in storage rooms meeting the following criteria:
  - 2.1. The area of the room does not exceed 500 square feet (46.5 m<sup>2</sup>);
  - 2.2. The room is protected by a fire barrier with at least a 1-hour fire-resistance rating;
  - 2.3. The room contains no material classified as a flammable liquid, hazardous

material or highly combustible material;

2.4. The room is served by exterior fire access or interior access by a 1-hour fire-resistance rated corridor.

2.5. No more than three such rooms are permitted in any one basement.

**[F] 903.2.11 During construction.** Automatic sprinkler systems required during construction, alteration and demolition operations shall be provided in accordance with the *International Fire Code*.

**[F] 903.2.12 Other hazards.** Automatic sprinkler protection shall be provided for the hazards indicated in Sections 903.2.12.1 and 903.2.12.2.

**[F] 903.2.12.1 Ducts conveying hazardous exhausts.** Where required by the *International Mechanical Code*, automatic sprinklers shall be provided in ducts conveying hazardous exhaust, or flammable or combustible materials.

**Exception:** Ducts in which the largest cross-sectional diameter of the duct is less than 10 inches (254 mm).

**[F] 903.2.12.2 Commercial cooking operations.** An automatic sprinkler system shall be installed in commercial kitchen exhaust hood and duct system where an automatic sprinkler system is used to comply with Section 904.

**[F] 903.2.13 Other required suppression systems.** In addition to the requirements of Section 903.2, the provisions indicated in Table 903.2.13 also require the installation of a suppression system for certain buildings and areas.

**[F] TABLE 903.2.13  
ADDITIONAL REQUIRED SUPPRESSION SYSTEMS**

SECTION	SUBJECT
402.8	Covered malls
403.2, 403.3	High-rise buildings
404.3	Atriums
405.3	Underground structures
407.5	Group I-2
410.6	Stages
411.4	Special amusement buildings
412.2.5, 412.2.6	Aircraft hangars
415.6.2.4	Group H-2
416.4	Flammable finishes
417.4	Drying rooms
507	Unlimited area buildings
508.2	Incidental use areas
1025.6.2.3	Smoke-protected assembly seating
IFC	Sprinkler system requirements as set forth in Section 903.2.13 of the <i>International Fire Code</i>

**[F] 903.3 Installation requirements.** Automatic sprinkler systems shall be designed and installed in accordance with Sections 903.3.1 through 903.3.7.

**[F] 903.3.1 Standards.** Sprinkler systems shall be designed and installed in accordance with Section 903.3.1.1, 903.3.1.2 or 903.3.1.3.

**[F] 903.3.1.1 NFPA 13 sprinkler systems.** Where the provisions of this code require that a building or portion thereof be equipped throughout with an automatic sprinkler system in accordance with this section, sprinklers shall be installed throughout in accordance with NFPA 13 and in accordance with rules promulgated by the building or fire code official, except as provided in Section 903.3.1.1.1.

**[F] 903.3.1.1.1 Exempt locations.** Automatic sprinklers shall not be required in the following rooms or areas where such rooms or areas are protected with an approved automatic fire detection system, in accordance with Section 907.2, that will respond to visible or invisible particles of combustion. Sprinklers shall not be omitted from any room merely because it is damp, of fire-resistance-rated construction or contains electrical equipment.

1. Any room where the application of water, or flame and water, constitutes a serious life or fire hazard, when approved by the fire code official.
2. Any room or space where sprinklers are considered undesirable because of the nature of the contents, when approved by the fire code official.
3. Generator and transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than 2 hours.
4. In rooms or areas that are of noncombustible construction with wholly noncombustible contents.

**903.3.1.1.2 High-rise building sprinkler system design.** In high-rise buildings as defined in Section 403, combination standpipe/sprinkler risers using pipe at least 6 inches (152 mm) in diameter shall be used with the sprinkler system connected between standpipe risers. Shut-off valves, water-flow devices and check valves or pressure reducing valves shall be provided on each floor at the sprinkler system connection to each standpipe. Two four-way fire department connections serving the combination system shall be provided on separate streets well separated from each other. At least one of the fire department connections shall be connected to the riser above a riser isolation valve.

Where a mid-level fire pump is required by NFPA 14, two pumps with the same rating shall be installed.

Dry pipe sprinkler systems serving parking garages are permitted to use one separate two-way

fire department connection. The dry pipe sprinkler system shall be supplied by the on-site water tank.

[F] **903.3.1.2 NFPA 13R sprinkler systems.** Where allowed in buildings of Group R, up to and including four stories in height, automatic sprinkler systems shall be installed throughout in accordance with NFPA 13R.

[F] **903.3.1.2.1 Balconies and decks.** Sprinkler protection shall be provided for exterior balconies, decks and ground floor patios of dwelling units where the building is of Type V construction. Sidewall sprinklers that are used to protect such areas shall be permitted to be located such that their deflectors are within 1 inch (25 mm) to 6 inches (152 mm) below the structural members and a maximum distance of 14 inches (356 mm) below the deck of the exterior balconies and decks that are constructed of open wood joist construction.

[F] **903.3.1.3 NFPA 13D sprinkler systems.** Where allowed, automatic sprinkler systems in one- and two-family dwellings shall be installed throughout in accordance with NFPA 13D. A NFPA 13D sprinkler system is permitted to be installed in townhouses when approved by the fire code official where each townhouse unit has its own water service, each unit exits to a public way, no unit is located over another unit or common space, and each unit and contiguous attic and crawl spaces are separated from other units by at least a 1-hour fire partition.

[F] **903.3.2 Quick-response and residential sprinklers.** Where automatic sprinkler systems are required by this code, quick-response or residential automatic sprinklers shall be installed in the following areas in accordance with Section 903.3.1 and their listings:

1. Throughout all spaces within a smoke compartment containing patient sleeping units in Group I-2 in accordance with this code.
2. Dwelling units, and sleeping units in Group R and I-1 occupancies.
3. Light-hazard occupancies as defined in NFPA 13.

[F] **903.3.3 Obstructed locations.** Automatic sprinklers shall be installed ~~((with due regard to obstructions that will delay activation or obstruct the water distribution pattern.))~~ in accordance with NFPA 13 obstruction criteria and the listing requirements of the sprinkler. Automatic sprinklers shall be installed in or under covered kiosks, displays, booths, concession stands, or equipment that exceeds 4 feet (1219 mm) in width and depth, and for all multi-level exhibit booths. Not less than a 3-foot (914 mm) clearance shall be maintained between automatic sprinklers and the top of piles of combustible fibers.

**Exceptions:**

1. Kitchen equipment under exhaust hoods protected with a fire-extinguishing system in accordance with Section 904.
2. Temporary single-level covered booths, kiosks or concession stands less than 300 square feet (28 m<sup>2</sup>)

in area that are in spaces operating under a temporary place of assembly permit.

[F] **903.3.4 Actuation.** Automatic sprinkler systems shall be automatically actuated unless specifically provided for in this code.

[F] **903.3.5 Water supplies.** Water supplies for automatic sprinkler systems shall comply with this section and the standards referenced in Section 903.3.1. The potable water supply shall be protected against backflow in accordance with the requirements of this section and the ~~((International))~~ Uniform Plumbing Code.

[F] **903.3.5.1 Domestic services.** Where the domestic service provides the water supply for the automatic sprinkler system, the supply shall be in accordance with this section.

[F] **903.3.5.1.1 Limited area sprinkler systems.** Limited area sprinkler systems serving fewer than 20 sprinklers on any single connection are permitted to be connected to the domestic service where a wet automatic standpipe is not available. Limited area sprinkler systems connected to domestic water supplies shall comply with each of the following requirements:

1. Valves shall not be installed between the domestic water riser control valve and the sprinklers.

**Exception:** An approved indicating control valve supervised in the open position in accordance with Section 903.4.

2. The domestic service shall be capable of supplying the simultaneous domestic demand and the sprinkler demand required to be hydraulically calculated by NFPA 13, NFPA 13R or NFPA 13D.

[F] **903.3.5.1.2 ((Residential-e)) Combination services.** A single combination water supply shall be allowed for buildings that are not high-rise buildings provided that the domestic demand is added to the sprinkler demand as required by NFPA 13R.

[F] **903.3.5.2 Secondary water supply.** A secondary on-site water supply providing a minimum net volume of 33,000 gallons (124 918 L) shall be provided for high-rise buildings. A lesser amount equal to the hydraulically calculated sprinkler demand, including the hose stream requirement((;)) in NFPA, shall be allowed. ((provided for high-rise buildings in Seismic Design Category C, D, E or F as determined by this code.)) The secondary water supply shall have a duration of not less than 30 minutes for buildings with light hazard occupancies only and 60-minute duration for buildings with ordinary hazard occupancies as defined by NFPA. ((as determined by the occupancy hazard classification in accordance with NFPA 13.))

**Exception:** Existing buildings including those undergoing substantial alteration.

**[F] 903.3.6 Hose threads.** Fire hose threads and fittings used in connection with automatic sprinkler systems shall be as prescribed by the fire code official.

**[F] 903.4 Sprinkler system monitoring and alarms.** All valves controlling the water supply for automatic sprinkler systems, pumps, tanks, water levels and temperatures, critical air pressures and water-flow switches on all sprinkler systems shall be electrically supervised.

**Exceptions:**

1. Automatic sprinkler systems protecting one- and two-family dwellings and townhouses.
2. Limited area systems serving fewer than 20 sprinklers.
3. Automatic sprinkler systems installed in accordance with NFPA 13R where a common supply main is used to supply both domestic water and the automatic sprinkler systems and a separate shutoff valve for the automatic sprinkler system is not provided.
4. Jockey pump control valves that are sealed or locked in the open position.
5. Control valves to commercial kitchen hoods, paint spray booths or dip tanks that are sealed or locked in the open position.
6. Valves controlling the fuel supply to fire pump engines that are sealed or locked in the open position.
7. Trim valves to pressure switches in dry, preaction and deluge sprinkler systems that are sealed or locked in the open position.

**[F] 903.4.1 Signals.** Alarm, supervisory and trouble signals shall be distinctly different and automatically transmitted to ~~((an approved central station, remote supervising station or proprietary supervising station as defined in NFPA 72 or, when approved by the fire code official, shall sound an audible signal at a constantly attended location))~~ a location as specified in the *International Fire Code*.

**Exceptions:**

1. Underground key or hub valves in roadway boxes or underground vaults provided by the municipality or public utility are not required to be monitored.
2. Backflow prevention device test valves located in limited area sprinkler system supply piping shall be locked in the open position. In occupancies required to be equipped with a fire alarm system, the backflow preventer valves shall be electrically supervised by a tamper switch installed in accordance with NFPA 72 and separately annunciated.

**[F] 903.4.2 Alarms.** Approved audible devices shall be connected to every automatic sprinkler system. Such sprinkler water-flow alarm devices shall be activated by water flow equivalent to the flow of a single sprinkler of the smallest orifice size installed in the system. Alarm devices shall be provided on the exterior of the building in an approved location. Where a fire alarm system is installed, actuation of

the automatic sprinkler system shall actuate the building fire alarm system.

**[F] 903.4.3 Floor control valves.** Approved supervised indicating control valves shall be provided at the point of connection to the riser on each floor in high-rise buildings.

**[F] 903.5 Testing and maintenance.** Sprinkler systems shall be tested and maintained in accordance with the *International Fire Code*.

## SECTION 904 ALTERNATIVE AUTOMATIC FIRE-EXTINGUISHING SYSTEMS

**[F] 904.1 General.** Automatic fire-extinguishing systems, other than automatic sprinkler systems, shall be designed, installed, inspected, tested and maintained in accordance with the provisions of this section and the applicable referenced standards.

**[F] 904.2 Where required.** Automatic fire-extinguishing systems installed as an alternative to the required automatic sprinkler systems of Section 903 shall be approved by the fire code official. Automatic fire-extinguishing systems shall not be considered alternatives for the purposes of exceptions or reductions allowed by other requirements of this code.

**[F] 904.2.1 Commercial hood and duct systems.** Each required commercial kitchen exhaust hood and duct system required by Section 609 of the *International Fire Code* or Chapter 5 of the *International Mechanical Code* to have a Type I hood shall be protected with an approved automatic fire-extinguishing system installed in accordance with this code.

**[F] 904.3 Installation.** Automatic fire-extinguishing systems shall be installed in accordance with this section by individuals who possess the proper certificate from the fire code official.

**[F] 904.3.1 Electrical wiring.** Electrical wiring shall be in accordance with the ~~((*International Code Council Electrical Code Administrative Provisions*))~~ *Seattle Electrical Code*.

**[F] 904.3.2 Actuation.** Automatic fire-extinguishing systems shall be automatically actuated and provided with a manual means of actuation in accordance with Section 904.11.1.

**[F] 904.3.3 System interlocking.** Automatic equipment interlocks with fuel shutoffs, ventilation controls, door closers, window shutters, conveyor openings, smoke and heat vents and other features necessary for proper operation of the fire-extinguishing system shall be provided as required by the design and installation standard utilized for the hazard.

**[F] 904.3.4 Alarms and warning signs.** Where alarms are required to indicate the operation of automatic fire-extinguishing systems, distinctive audible and visible alarms and warning signs shall be provided to warn of pending agent discharge. Where exposure to automatic-extinguishing agents poses a hazard to persons and a delay is required to ensure the evacuation of occupants before agent discharge, a separate warning signal shall be provided to alert occu-

pants once agent discharge has begun. Audible signals shall be in accordance with Section 907.9.2.

**[F] 904.3.5 Monitoring.** Where a building fire alarm system is installed, automatic fire-extinguishing systems shall be monitored by the building fire alarm system in accordance with NFPA 72.

**[F] 904.4 Inspection and testing.** Automatic fire-extinguishing systems shall be inspected and tested in accordance with the provisions of this section prior to acceptance.

**[F] 904.4.1 Inspection.** Prior to conducting final acceptance tests, the following items shall be inspected:

1. Hazard specification for consistency with design hazard.
2. Type, location and spacing of automatic- and manual-initiating devices.
3. Size, placement and position of nozzles or discharge orifices.
4. Location and identification of audible and visible alarm devices.
5. Identification of devices with proper designations.
6. Operating instructions.

**[F] 904.4.2 Alarm testing.** Notification appliances, connections to fire alarm systems and connections to approved supervising stations shall be tested in accordance with this section and Section 907 to verify proper operation.

**[F] 904.4.2.1 Audible and visible signals.** The audibility and visibility of notification appliances signaling agent discharge or system operation, where required, shall be verified.

**[F] 904.4.3 Monitor testing.** Connections to protected premises and supervising station fire alarm systems shall be tested to verify proper identification and retransmission of alarms from automatic fire-extinguishing systems.

**[F] 904.5 Wet-chemical systems.** Wet-chemical extinguishing systems shall be installed, maintained, periodically inspected and tested by individuals who possess the proper certificate from the fire code official in accordance with NFPA 17A and their listing.

**[F] 904.6 Dry-chemical systems.** Dry-chemical extinguishing systems shall be installed, maintained, periodically inspected and tested by individuals who possess the proper certificate from the fire code official in accordance with NFPA 17 and their listing.

**[F] 904.7 Foam systems.** Foam-extinguishing systems shall be installed, maintained, periodically inspected and tested by individuals who possess the proper certificate from the fire code official in accordance with NFPA 11 and NFPA 16 and their listing.

**[F] 904.8 Carbon dioxide systems.** Carbon dioxide extinguishing systems shall be installed, maintained, periodically inspected and tested by individuals who possess the proper certificate from the fire code official in accordance with NFPA 12 and their listing.

**[F] 904.9 Halon systems.** Halogenated extinguishing systems shall be installed, maintained, periodically inspected and tested by individuals who possess the proper certificate from the fire code official in accordance with NFPA 12A and their listing.

**[F] 904.10 Clean-agent systems.** Clean-agent fire-extinguishing systems shall be installed, maintained, periodically inspected and tested by individuals who possess the proper certificate from the fire code official in accordance with NFPA 2001 and their listing.

**[F] 904.11 Commercial cooking systems.** The automatic fire-extinguishing system for commercial cooking systems shall be of a type recognized for protection of commercial cooking equipment and exhaust systems of the type and arrangement protected. Preengineered automatic dry- and wet-chemical extinguishing systems shall be tested in accordance with UL 300 and listed and labeled for the intended application. Other types of automatic fire-extinguishing systems shall be listed and labeled for specific use as protection for commercial cooking operations. The system shall be installed by individuals who possess the proper certificate from the fire code official in accordance with this code, its listing and the manufacturer's installation instructions. Automatic fire-extinguishing systems of the following types shall be installed in accordance with the referenced standard indicated, as follows:

1. Carbon dioxide extinguishing systems, NFPA 12.
2. Automatic sprinkler systems, NFPA 13.
3. Foam-water sprinkler system or foam-water spray systems, NFPA 16.
4. Dry-chemical extinguishing systems, NFPA 17.
5. Wet-chemical extinguishing systems, NFPA 17A.

**Exception:** Factory-built commercial cooking recirculating systems that are tested in accordance with UL 710B and listed, labeled and installed in accordance with Section 304.1 of the *International Mechanical Code*.

**[F] 904.11.1 Manual system operation.** A manual actuation device shall be located at or near a means of egress from the cooking area a minimum of 10 feet (3048 mm) and a maximum of 20 feet (6096 mm) from the kitchen exhaust system. The manual actuation device shall be installed not more than 48 inches (1200 mm) or less than 42 inches (1067 mm) above the floor and shall clearly identify the hazard protected. The manual actuation shall require a maximum force of 40 pounds (178 N) and a maximum movement of 14 inches (356 mm) to actuate the fire suppression system.

**Exception:** Automatic sprinkler systems shall not be required to be equipped with manual actuation means.

**[F] 904.11.2 System interconnection.** The actuation of the fire suppression system shall automatically shut down the fuel or electrical power supply to the cooking equipment. The fuel and electrical supply reset shall be manual.

**[F] 904.11.3 Carbon dioxide systems.** When carbon dioxide systems are used, there shall be a nozzle at the top of the ventilating duct. Additional nozzles that are symmetrically arranged to give uniform distribution shall be installed within vertical ducts exceeding 20 feet (6096 mm) and horizontal ducts exceeding 50 feet (15 240 mm). Dampers shall

be installed at either the top or the bottom of the duct and shall be arranged to operate automatically upon activation of the fire-extinguishing system. Where the damper is installed at the top of the duct, the top nozzle shall be immediately below the damper. Automatic carbon dioxide fire-extinguishing systems shall be sufficiently sized to protect against all hazards venting through a common duct simultaneously.

**[F] 904.11.3.1 Ventilation system.** Commercial-type cooking equipment protected by an automatic carbon dioxide-extinguishing system shall be arranged to shut off the ventilation system upon activation.

**[F] 904.11.4 Special provisions for automatic sprinkler systems.** Automatic sprinkler systems protecting commercial-type cooking equipment shall be supplied from a separate, readily accessible, indicating-type control valve that is identified.

**[F] 904.11.4.1 Listed sprinklers.** Sprinklers used for the protection of fryers shall be tested in accordance with UL 199E, listed for that application and installed in accordance with their listing.

## SECTION 905 STANDPIPE SYSTEMS

**[F] 905.1 General.** Standpipe systems shall be provided in new buildings and structures in accordance with this section. Fire hose threads used in connection with standpipe systems shall be approved and shall be compatible with fire department hose threads. The location of fire department hose connections shall be approved. In buildings used for high-piled combustible storage, fire protection shall be in accordance with the *International Fire Code*.

**[F] 905.2 Installation standard.** Standpipe systems shall be installed in accordance with this section, ~~(and)~~ NFA 14 and rules promulgated by the building or fire code official.

**[F] 905.3 Required installations.** Standpipe systems shall be installed where required by Sections 905.3.1 through 905.3.7 and in the locations indicated in Sections 905.4, 905.5 and 905.6. Standpipe systems are allowed to be combined with automatic sprinkler systems.

**Exception:** Standpipe systems are not required in Group R-3 occupancies.

**[F] 905.3.1 Building height.** Class III standpipe systems shall be installed throughout buildings where the floor level of the highest story is located more than 30 feet (9144 mm) above the lowest level of fire department vehicle access, or where the floor level of the lowest story is located more than 30 feet (9144 mm) below the highest level of fire department vehicle access.

### Exceptions:

1. Class I standpipes are allowed in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.

2. Class I manual standpipes are allowed in open parking garages where the highest floor is located not more than 150 feet (45 720 mm) above the lowest level of fire department vehicle access.
3. Class I manual dry standpipes are allowed in open parking garages that are subject to freezing temperatures, provided that the hose connections are located as required for Class II standpipes in accordance with Section 905.5.
4. Class I standpipes are allowed in basements equipped throughout with an automatic sprinkler system.
5. In determining the lowest level of fire department vehicle access, it shall not be required to consider:
  - 5.1. Recessed loading docks for four vehicles or less; and
  - 5.2. Conditions where topography makes access from the fire department vehicle to the building impractical or impossible.
6. Standpipe systems are not required in townhouses.

**[F] 905.3.2 Group A.** Class I automatic or manual standpipes shall be provided in nonsprinklered Group A buildings having an occupant load exceeding 1,000 persons.

### Exceptions:

1. Open-air-seating spaces without enclosed spaces.
2. Class I automatic dry and semiautomatic dry standpipes or manual wet standpipes are allowed in buildings where the highest floor surface used for human occupancy is 75 feet (22 860 mm) or less above the lowest level of fire department vehicle access.

**[F] 905.3.3 Covered mall buildings.** A covered mall building shall be equipped throughout with a Class I automatic or manual standpipe system ~~((where required by Section 905.3.1. Covered mall buildings not required to be equipped with a standpipe system by Section 905.3.1 shall be equipped with Class I hose connections connected to a system sized to deliver water at 250 gallons per minute (946.4 L/min) at the most hydraulically remote outlet. Hose))~~ with hose connections ~~((shall be))~~ provided at each of the following locations:

1. Within the mall at the entrance to each exit passageway or corridor.
2. At each floor-level landing within enclosed stairways opening directly on the mall.
3. At exterior public entrances to the mall.

**[F] 905.3.4 Stages.** Stages greater than 1,000 square feet in area (93 m<sup>2</sup>) shall be equipped with a Class III wet standpipe system with 1½-inch and 2½-inch (38 mm and 64 mm) hose connections on each side of the stage.

**Exception:** Where the building or area is equipped throughout with an automatic sprinkler system, a 1½-inch (38 mm) hose connection shall be installed in

accordance with NFPA 13 or in accordance with NFPA 14 for Class II or III standpipes.

**[F] 905.3.4.1 Hose and cabinet.** The 1½-inch (38 mm) hose connections shall be equipped with sufficient lengths of 1½-inch (38 mm) hose to provide fire protection for the stage area. Hose connections shall be equipped with an approved adjustable fog nozzle and be mounted in a cabinet or on a rack.

**[F] 905.3.5 Underground buildings.** Underground buildings shall be equipped throughout with a Class I automatic wet or manual wet standpipe system.

**[F] 905.3.6 Helistops and heliports.** Buildings with a helistop or heliport that are equipped with a standpipe shall extend the standpipe to the roof level on which the helistop or heliport is located in accordance with Section 1107.5 of the *International Fire Code*.

**[F] 905.3.7 Marinas and boatyards.** Marinas and boatyards shall be equipped throughout with standpipe systems in accordance with ((NFPA 303)) *Seattle Fire Code Chapter 46*.

**905.3.8 High-rise building standpipes.** Standpipe risers in high-rise buildings as defined in Section 403 shall be combination standpipe/sprinkler risers using a minimum pipe size of 6 inches (152 mm). Two 2½-inch (64 mm) hose connections shall be provided on every floor level landing in every required stairway. Where pressure reduction valves (prv) are required, each hose connection shall be provided with its own prv. The system shall be designed to provide a minimum flow of 300 gpm (19 L/s) at a minimum pressure of 150 psi (1034 kPa) [maximum 205 psi (1413 kPa)] at each standpipe connection, in addition to the flow and pressure requirements contained in NFPA 14.

**[F] 905.4 Location of Class I standpipe hose connections.** Class I standpipe hose connections shall be provided in all of the following locations:

1. In every required stairway, a hose connection shall be provided for each floor level above or below grade. Hose connections shall be located at an intermediate floor level landing between floors or the floor landing, but shall be consistent throughout the building, unless otherwise approved by the fire code official.
2. On each side of the wall adjacent to the exit opening of a horizontal exit.

**Exception:** Where floor areas adjacent to a horizontal exit are reachable from exit stairway hose connections by a 30-foot (9144 mm) hose stream from a nozzle attached to 100 feet (30480 mm) of hose, a hose connection shall not be required at the horizontal exit.

3. In every exit passageway at the entrance from the exit passageway to other areas of a building.
4. In covered mall buildings, adjacent to each exterior public entrance to the mall and adjacent to each entrance from an exit passageway or exit corridor to the mall and at each floor level landing within enclosed stairways opening directly onto the mall.

5. Where the roof has a slope less than 4 units vertical in 12 units horizontal (33.3-percent slope), ((each)) at least one standpipe shall be provided with ((a)) two 2½-inch (64 mm) hose connections located ((either)) on the roof at least 10 feet (3048 mm) from the roof edge, skylight, light well or other opening, unless protected by a 42-inch-high (1067 mm) guardrail or equivalent. Additional roof connections shall be provided so that all portions of the roof are within 200 feet (60 960 mm) of hose travel distance from a standpipe hose connection. Where stairs are required to provide roof access, the standpipe roof connections shall be located adjacent to the stair opening.

The roof hose connections shall be arranged to be operable without entering the building.

Roof connections in high-rise buildings are permitted to be located ((or)) at the highest landing of stairways with stair access to the roof. An additional hose connection shall be provided at the top of the most hydraulically remote standpipe for testing purposes.

6. Where the most remote portion of a nonsprinklered floor or story is more than 150 feet (45 720 mm) of hose travel distance from a hose connection or the most remote portion of a sprinklered floor or story is more than 200 feet (60 960 mm) of hose travel distance from a hose connection, additional hose connections shall be provided in protected locations that are accessed through protected enclosures. The protected enclosure shall be a corridor constructed as a smoke barrier from the exit enclosure to the standpipe connection. Additional hose connections in parking garages are not required to be accessed through or located in protected enclosures. ((the fire code official is authorized to require that additional hose connections be provided in approved locations.))

**[F] 905.4.1 Protection.** Risers and laterals of Class I standpipe systems not located within an enclosed stairway or pressurized enclosure shall be protected by a degree of fire resistance equal to that required for vertical enclosures in the building in which they are located.

**Exception:** In buildings equipped throughout with an approved automatic sprinkler system, laterals that are not located within an enclosed stairway or pressurized enclosure are not required to be enclosed within fire-resistance-rated construction.

**[F] 905.4.2 Interconnection.** In buildings where more than one standpipe is provided, the standpipes shall be interconnected in accordance with NFPA 14.

**[F] 905.5 Location of Class II standpipe hose connections.** Class II standpipe hose connections shall be accessible and located so that all portions of the building are within 30 feet (9144 mm) of a nozzle attached to 100 feet (30 480 mm) of hose.

**[F] 905.5.1 Groups A-1 and A-2.** In Group A-1 and A-2 occupancies with occupant loads of more than 1,000, hose connections shall be located on each side of any stage, on each side of the rear of the auditorium, on each side of the balcony and on each tier of dressing rooms.

**[F] 905.5.2 Protection.** Fire-resistance-rated protection of risers and laterals of Class II standpipe systems is not required.

**[F] 905.5.3 Class II system 1-inch hose.** A minimum 1-inch (25 mm) hose shall be permitted to be used for hose stations in light-hazard occupancies where investigated and listed for this service and where approved by the fire code official.

**[F] 905.6 Location of Class III standpipe hose connections.** Class III standpipe systems shall have hose connections located as required for Class I standpipes in Section 905.4 and shall have Class II hose connections as required in Section 905.5.

**[F] 905.6.1 Protection.** Risers and laterals of Class III standpipe systems shall be protected as required for Class I systems in accordance with Section 905.4.1.

**[F] 905.6.2 Interconnection.** In buildings where more than one Class III standpipe is provided, the standpipes shall be interconnected at the bottom.

**[F] 905.7 Cabinets.** Cabinets containing fire-fighting equipment such as standpipes, fire hoses, fire extinguishers or fire department valves shall not be blocked from use or obscured from view.

**[F] 905.7.1 Cabinet equipment identification.** Cabinets shall be identified in an approved manner by a permanently attached sign with letters not less than 2 inches (51 mm) high in a color that contrasts with the background color, indicating the equipment contained therein.

**Exceptions:**

1. Doors not large enough to accommodate a written sign shall be marked with a permanently attached pictogram of the equipment contained therein.
2. Doors that have either an approved visual identification clear glass panel or a complete glass door panel are not required to be marked.

**[F] 905.7.2 Locking cabinet doors.** Cabinets shall be unlocked.

**Exceptions:**

1. Visual identification panels of glass or other approved transparent frangible material that is easily broken and allows access.
2. Approved locking arrangements.
3. Group I-3.

**[F] 905.8 Dry standpipes.** Dry standpipes shall not be installed.

**Exception:** Where subject to freezing and in accordance with NFPA 14.

**[F] 905.9 Valve supervision.** Valves controlling water supplies shall be supervised in the open position so that a change in the normal position of the valve will generate a supervisory signal at the supervising station required by Section 903.4. Where a fire alarm system is provided, a signal shall also be transmitted to the control unit.

**Exceptions:**

1. Valves ((to ~~underground key or hub valves in roadway boxes~~)) provided by the municipality or public utility do not require supervision.
2. Valves locked in the normal position and inspected as provided in this code in buildings not equipped with a fire alarm system nor provided with monitoring by a central station service.

**[F] 905.10 During construction.** Standpipe systems required during construction and demolition operations shall be provided in accordance with Section 3311.

## SECTION 906 PORTABLE FIRE EXTINGUISHERS

**[F] 906.1 General.** Portable fire extinguishers shall be provided in occupancies and locations as required by the *International Fire Code*.

## SECTION 907 FIRE ALARM AND DETECTION SYSTEMS

**[F] 907.1 General.** This section covers the application, installation, performance and maintenance of fire alarm systems and their components. All fire alarm and fire detection systems shall be designed, installed and maintained in accordance with NFPA 72.

**Exception:** The location of initiating devices shall comply with Section 907 of the *International Fire Code*.

For the purposes of this Section 907, fire walls not located on a property line shall not constitute a separate building.

**[F] 907.1.1 Construction documents.** Construction documents for fire alarm systems shall be submitted for review and approval prior to system installation. Construction documents shall include, but not be limited to, all of the following:

1. A floor plan which indicates the use of all rooms.
2. Locations of alarm-initiating and notification appliances.
3. Alarm control and trouble signaling equipment.
4. Annunciation.
5. Power connection.
6. Battery calculations.
7. Conductor type and sizes.
8. Voltage drop calculations.
9. Manufacturers, model numbers and listing information for equipment, devices and materials.
10. Details of ceiling height and construction.
11. The interface of fire safety control functions.

**[F] 907.1.2 Equipment.** Systems and their components shall be listed and approved for the purpose for which they are installed.

**[F]907.2 Where required.** An approved manual, automatic or manual and automatic fire alarm system installed in accordance with the provisions of this code and NFPA 72 shall be provided in new buildings and structures in accordance with Sections 907.2.1 through 907.2.23 and provide occupant notification in accordance with Section 907.9, unless other requirements are provided by another section of this code. Where automatic sprinkler protection installed in accordance with Section 903.3.1.1 or 903.3.1.2 is provided and connected to the building fire alarm system, automatic heat detection required by this section shall not be required.

The automatic fire detectors shall be smoke detectors. Where ambient conditions prohibit installation of automatic smoke detection, other automatic fire detection shall be allowed.

**[F]907.2.1 Group A.** A manual fire alarm system shall be installed in Group A occupancies having an occupant load of 300 or more. Portions of Group E occupancies occupied for assembly purposes shall be provided with a fire alarm system as required for the Group E occupancy.

**Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system and the alarm notification appliances will activate upon sprinkler water flow.

**[F] 907.2.1.1 System initiation in Group A occupancies with an occupant load of 1,000 or more.** Activation of the fire alarm in Group A occupancies with an occupant load of 1,000 or more shall initiate a signal using an emergency voice/alarm communications system in accordance with NFPA 72.

**Exception:** Where approved, the prerecorded announcement is allowed to be manually deactivated for a period of time, not to exceed 3 minutes, for the sole purpose of allowing a live voice announcement from an approved, constantly attended location.

**[F] 907.2.1.2 Emergency power.** Emergency voice/alarm communications systems shall be provided with an approved emergency power source.

**[F] 907.2.2 Group B.** A manual fire alarm system shall be installed in Group B occupancies having an occupant load of 500 or more persons or more than 100 persons above or below the lowest level of exit discharge.

**Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system and the alarm notification appliances will activate upon sprinkler water flow.

**[F] 907.2.3 Group E.** A manual fire alarm system shall be installed in Group E occupancies. When automatic sprinkler systems or smoke detectors are installed, such systems or detectors shall be connected to the building fire alarm system.

**Exceptions:**

1. Group E occupancies with an occupant load of less than 50.
2. Manual fire alarm boxes are not required in Group E occupancies where all the following apply:

- 2.1. Interior corridors are protected by smoke detectors with alarm verification.
- 2.2. Auditoriums, cafeterias, gymnasiums and the like are protected by heat detectors or other approved detection devices.
- 2.3. Shops and laboratories involving dusts or vapors are protected by heat detectors or other approved detection devices.
- 2.4. Off-premises monitoring is provided.
- 2.5. The capability to activate the evacuation signal from a central point is provided.
- 2.6. In buildings where normally occupied spaces are provided with a two-way communication system between such spaces and a constantly attended receiving station from where a general evacuation alarm can be sounded, except in locations specifically designated by the fire code official.

3. Manual fire alarm boxes shall not be required in Group E occupancies where the building is equipped throughout with an approved automatic sprinkler system, the notification appliances will activate on sprinkler water flow and manual activation is provided from a normally occupied location.

**[F] 907.2.4 Group F.** A manual fire alarm system shall be installed in Group F occupancies that are two or more stories in height and have an occupant load of 500 or more above or below the lowest level of exit discharge.

**Exception:** Manual fire alarm boxes are not required when the building is equipped throughout with an automatic sprinkler system and the notification appliances will activate upon sprinkler water flow.

**[F] 907.2.5 Group H.** A manual fire alarm system shall be installed in Group H-5 occupancies and in occupancies used for the manufacture of organic coatings. An automatic smoke detection system shall be installed for highly toxic gases, organic peroxides and oxidizers in accordance with Chapters 37, 39 and 40, respectively, of the *International Fire Code*.

**[F] 907.2.6 Group I.** A manual fire alarm system shall be installed in Group I occupancies. An electrically supervised, automatic smoke detection system shall be provided in accordance with Sections 907.2.6.1 and 907.2.6.2.

**Exception:** Manual fire alarm boxes in resident or patient sleeping areas of Group I-1 and I-2 occupancies shall not be required at exits if located at all nurses' control stations or other constantly attended staff locations, provided such stations are visible and continuously accessible and that travel distances required in Section 907.3.1 are not exceeded.

**[F] 907.2.6.1 Group I-1.** Corridors, habitable spaces other than sleeping units and kitchens and waiting areas that are open to corridors shall be equipped with an automatic smoke detection system.

**Exceptions:**

1. Smoke detection in habitable spaces is not required where the facility is equipped throughout with an automatic sprinkler system.
2. Smoke detection is not required for exterior balconies.

**[F] 907.2.6.2 Group I-2.** Corridors in nursing homes (both intermediate care and skilled nursing facilities), detoxification facilities and spaces permitted to be open to the corridors by Section 407.2 shall be equipped with an automatic fire detection system. Hospitals shall be equipped with smoke detection as required in Section 407.2.

**Exceptions:**

1. Corridor smoke detection is not required in smoke compartments that contain patient sleeping units where patient sleeping units are provided with smoke detectors that comply with UL 268. Such detectors shall provide a visual display on the corridor side of each patient sleeping unit and an audible and visual alarm at the nursing station attending each unit.
2. Corridor smoke detection is not required in smoke compartments that contain patient sleeping units where patient sleeping unit doors are equipped with automatic door-closing devices with integral smoke detectors on the unit sides installed in accordance with their listing, provided that the integral detectors perform the required alerting function.

**[F] 907.2.6.3 Group I-3.** Group I-3 occupancies shall be equipped with a manual and automatic fire alarm system installed for alerting staff.

**[F] 907.2.6.3.1 System initiation.** Actuation of an automatic fire-extinguishing system, a manual fire alarm box or a fire detector shall initiate an approved fire alarm signal which automatically notifies staff. Presignal systems shall not be used.

**[F] 907.2.6.3.2 Manual fire alarm boxes.** Manual fire alarm boxes are not required to be located in accordance with Section 907.3 where the fire alarm boxes are provided at staff-attended locations having direct supervision over areas where manual fire alarm boxes have been omitted.

Manual fire alarm boxes shall be permitted to be locked in areas occupied by detainees, provided that staff members are present within the subject area and have keys readily available to operate the manual fire alarm boxes.

**[F] 907.2.6.3.3 Smoke detectors.** An approved automatic smoke detection system shall be installed throughout resident housing areas, including sleeping units and contiguous day rooms, group activity spaces and other common spaces normally accessible to residents.

**Exceptions:**

1. Other approved smoke detection arrangements providing equivalent protection including, but not limited to, placing detectors in exhaust ducts from cells or behind protective guards listed for the purpose are allowed when necessary to prevent damage or tampering.
2. Sleeping units in Use Conditions 2 and 3.
3. Smoke detectors are not required in sleeping units with four or fewer occupants in smoke compartments that are equipped throughout with an approved automatic sprinkler system.

**[F] 907.2.7 Group M.** A manual fire alarm system shall be installed in Group M occupancies having an occupant load of 500 or more persons or more than 100 persons above or below the lowest level of exit discharge. The initiation of a signal from a manual fire alarm box shall initiate alarm notification appliances as required by Section 907.9.

**Exceptions:**

1. Covered mall buildings complying with Section 402.
2. Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system and the alarm notification appliances will automatically activate upon sprinkler water flow.

~~**[F] 907.2.7.1 Occupant notification.** During times that the building is occupied, the initiation of a signal from a manual fire alarm box or from a water flow switch shall not be required to activate the alarm notification appliances when an alarm signal is activated at a constantly attended location from which evacuation instructions shall be initiated over an emergency voice/alarm communication system installed in accordance with Section 907.2.12.2.~~

~~The emergency voice/alarm communication system shall be allowed to be used for other announcements provided the manual fire alarm use takes precedence over any other use.)~~

**[F] 907.2.8 Group R-1.** Fire alarm systems shall be installed in Group R-1 occupancies as required in Sections 907.2.8.1 through 907.2.8.3.

**[F] 907.2.8.1 Manual and automatic fire alarm system.** A manual and automatic fire alarm system shall be installed in Group R-1 occupancies.

**Exceptions:**

1. A manual and automatic fire alarm system is not required in buildings not more than two stories in height where all individual sleeping units and contiguous attic and crawl spaces are separated from each other and public or common areas by at least 1-hour fire partitions and each individual sleeping unit has an exit directly to a public way, exit court or yard.

~~((2. Manual fire alarm boxes are not required throughout the building when the following conditions are met:~~

- ~~2.1. The building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2;~~
- ~~2.2. The notification appliances will activate upon sprinkler water flow; and~~
- ~~2.3. At least one manual fire alarm box is installed at an approved location.))~~

**[F] 907.2.8.2 Automatic ((fire alarm system)) detection.** ~~((An automatic fire alarm system))~~ Automatic smoke detectors shall be installed throughout all interior corridors serving sleeping units. Automatic heat detectors shall be provided in any unsprinklered interior areas outside guestrooms other than attics and crawl spaces.

**Exception:** ~~((An automatic fire detection system))~~ Automatic smoke detection is not required in buildings that do not have interior corridors serving sleeping units and where each sleeping unit has a means of egress door opening directly to an exterior exit access that leads directly to an exit.

**[F] 907.2.8.3 Smoke alarms.** Smoke alarms shall be installed as required by Section 907.2.10. In buildings that are not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2, the smoke alarms in sleeping units shall be connected to an emergency electrical system and shall be annunciated by sleeping unit at a constantly attended location from which the fire alarm system is capable of being manually activated.

**[F] 907.2.9 Group R-2.** ~~((A))~~ Except in townhouses meeting the requirements of Section 907.2.9.2, a manual and automatic fire alarm system shall be installed in Group R-2 occupancies where:

1. Any dwelling unit or sleeping unit is located three or more stories above the lowest level of exit discharge;
2. Any dwelling unit or sleeping unit is located more than one story below the highest level of exit discharge of exits serving the dwelling unit or sleeping unit; or
3. The building contains more than 16 dwelling units or sleeping units.

**Exceptions:**

1. A fire alarm system is not required in buildings not more than two stories in height where all dwelling units or sleeping units and contiguous attic and crawl spaces are separated from each other and public or common areas by at least 1-hour fire partitions and each dwelling unit or sleeping unit has an exit directly to a public way, exit court or yard.
- ~~((2. Manual fire alarm boxes are not required throughout the building when the following conditions are met:~~

~~2.1. The building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or Section 903.3.1.2; and~~

~~2.2. The notification appliances will activate upon sprinkler flow.~~

3))2. A fire alarm system is not required in buildings that do not have interior corridors serving dwelling units and are protected by an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2, provided that dwelling units either have a means of egress door opening directly to an exterior exit access that leads directly to the exits or are served by open-ended corridors designed in accordance with Section 1023.6, Exception 4.

**907.2.9.1 Automatic detection.** Automatic heat detectors shall be provided in any unsprinklered interior areas outside dwelling units other than attics and crawl spaces.

**907.2.9.2 Townhouses.** Where a fire alarm system is required by Section 907.2.9, a fire alarm system is not required for townhouse structures meeting all of the following criteria:

1. Each unit has its own exit to a public way.
2. No unit is located above any other unit or common space.
3. Each unit and contiguous attic and crawl spaces are separated from other units by at least a one-hour fire partition.
4. Each unit is provided with an interconnected smoke alarm system that includes heat detectors in the garage.
5. The sprinkler waterflow switch activates the interconnected smoke alarm and heat detection system within the affected unit.

**[F] 907.2.10 Single- and multiple-station smoke alarms.** Listed single- and multiple-station smoke alarms complying with UL 217 shall be installed in accordance with the provisions of this code and the household fire-warning equipment provisions of NFPA 72.

**[F] 907.2.10.1 Where required.** Single- or multiple-station smoke alarms shall be installed in the locations described in Sections 907.2.10.1.1 through 907.2.10.1.3.

**[F] 907.2.10.1.1 Group R-1.** Single- or multiple-station smoke alarms shall be installed in all of the following locations in Group R-1:

1. In sleeping areas.
2. In every room in the path of the means of egress from the sleeping area to the door leading from the sleeping unit.
3. In each story within the sleeping unit, including basements. For sleeping units with split levels and without an intervening door between the adjacent levels, a smoke alarm installed on the upper level shall suffice for the adjacent lower

level provided that the lower level is less than one full story below the upper level.

**[F] 907.2.10.1.2 Groups R-2, R-3(~~R-4~~) and I-1.** Single- or multiple-station smoke alarms shall be installed and maintained in Groups R-2, R-3(~~R-4~~) and I-1, regardless of occupant load at all of the following locations:

1. On the ceiling or wall outside of each separate sleeping area in the immediate vicinity of bedrooms.
2. In each room used for sleeping purposes.
3. In each story within a dwelling unit, including basements but not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels and without an intervening door between the adjacent levels, a smoke alarm installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

**[F] 907.2.10.1.3 Group I-1.** Single- or multiple-station smoke alarms shall be installed and maintained in sleeping areas in Group I-1 occupancies.

**Exception:** Single- or multiple-station smoke alarms shall not be required where the building is equipped throughout with an automatic fire detection system in accordance with Section 907.2.6.

**[F] 907.2.10.2 Power source.** In new construction, required smoke alarms shall receive their primary power from the building wiring where such wiring is served from a commercial source and shall be equipped with a battery backup. Smoke alarms shall emit a signal when the batteries are low. Wiring shall be permanent and without a disconnecting switch other than as required for overcurrent protection.

**Exception:** Smoke alarms are not required to be equipped with battery backup in Group R-1 where they are connected to an emergency electrical system.

**[F] 907.2.10.3 Interconnection.** Where more than one smoke alarm is required to be installed within an individual dwelling unit in Group R-2, or R-3 (~~R-4~~), or within an individual dwelling unit or sleeping unit in Group R-1, the smoke alarms shall be interconnected in such a manner that the activation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

**[F] 907.2.10.4 Acceptance testing.** When the installation of the alarm devices is complete, each detector and interconnecting wiring for multiple-station alarm devices shall be tested in accordance with the household fire warning equipment provisions of NFPA 72.

**[F] 907.2.11 Special amusement buildings.** An approved automatic smoke detection system shall be provided in special amusement buildings in accordance with this section.

**Exception:** In areas where ambient conditions will cause a smoke detection system to alarm, an approved alternative type of automatic detector shall be installed.

**[F] 907.2.11.1 Alarm.** Activation of any single smoke detector, the automatic sprinkler system or any other automatic fire detection device shall immediately sound an alarm at the building at a constantly attended location from which emergency action can be initiated, including the capability of manual initiation of requirements in Section 907.2.11.2.

**[F] 907.2.11.2 System response.** The activation of two or more smoke detectors, a single smoke detector with alarm verification, the automatic sprinkler system or other approved fire detection device shall automatically:

1. Cause illumination of the means of egress with light of not less than 1 foot-candle (11 lux) at the walking surface level;
2. Stop any conflicting or confusing sounds and visual distractions; and
3. Activate an approved directional exit marking that will become apparent in an emergency.

Such system response shall also include activation of a prerecorded message, clearly audible throughout the special amusement building, instructing patrons to proceed to the nearest exit. Alarm signals used in conjunction with the prerecorded message shall produce a sound which is distinctive from other sounds used during normal operation.

The wiring to the auxiliary devices and equipment used to accomplish the above fire safety functions shall be monitored for integrity in accordance with NFPA 72.

**[F] 907.2.11.3 Emergency voice/alarm communication system.** An emergency voice/alarm communication system, which is also allowed to serve as a public address system, shall be installed in accordance with NFPA 72, and shall be audible throughout the entire special amusement building.

**[F] 907.2.12 High-rise buildings.** Buildings with a floor used for human occupancy located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access shall be provided with an automatic fire alarm system and an emergency voice/alarm communication system in accordance with Section 907.2.12.2.

**Exceptions:**

1. Airport traffic control towers in accordance with Sections 412 and 907.2.22.
2. Open parking garages in accordance with Section 406.3.
3. Buildings with an occupancy in Group A-5.
4. Low-hazard special occupancies in accordance with Section 503.1.1.

~~(5. Buildings with an occupancy in Group H-1, H-2 or H-3 in accordance with Section 415.)~~

**[F] 907.2.12.1 Automatic fire detection.** Smoke detectors shall be provided in accordance with this section. Smoke detectors shall be connected to an automatic fire alarm system. The activation of any detector required by this section, other than duct smoke detectors, shall operate the emergency voice/alarm communication system. Smoke detectors shall be located as follows:

1. In each ((~~mechanical equipment~~)) electrical, transformer, telephone equipment or similar room which is not provided with sprinkler protection, elevator machine rooms and in elevator lobbies.
2. In the main return air and exhaust air plenum of each air-conditioning system having a capacity greater than 2,000 cubic feet per minute (cfm) (0.94 m<sup>3</sup>/s). Such detectors shall be located in a serviceable area downstream of the last duct inlet.
3. At each connection to a vertical duct or riser serving two or more stories from a return air duct or plenum of an air-conditioning system. In Group R-1 and R-2 occupancies a listed smoke detector is allowed to be used in each return air riser carrying not more than 5,000 cfm (2.4 m<sup>3</sup>/s) and serving not more than 10 air inlet openings.
4. Within 5 feet (1524 mm) of doors exiting into stairways that are smokeproof enclosures, or are pressurized stairways.

**[F] 907.2.12.2 Emergency voice/alarm communication system.** The operation of any automatic fire detector, sprinkler water-flow device or manual fire alarm box shall automatically sound an alert tone followed by voice instructions giving approved information and directions for a general or staged evacuation on a minimum of the alarming floor, the floor above and ((~~the~~)) two floors below in accordance with the building's fire safety and evacuation plans required by Section 404 of the *International Fire Code*. For purposes of this section, a floor will be considered all floors interconnected without automatic opening protectives. Speakers shall be provided throughout the building by paging zones. As a minimum, paging zones shall be provided as follows:

1. Elevator groups.
2. ((~~Exit~~)) Each exit stairway((~~s~~)).
3. Each floor.
4. Areas of refuge as defined in Section 1002.1.

**Exception:** In Group I-1 and I-2 occupancies, the alarm shall sound in a constantly attended area and a general occupant notification shall be broadcast over the overhead page.

**[F] 907.2.12.2.1 Manual override.** A manual override for emergency voice communication shall be provided on a selective and all-call basis for all paging zones.

**[F] 907.2.12.2.2 Live voice messages.** The emergency voice/alarm communication system shall also have the capability to broadcast live voice messages through paging zones on a selective and all-call basis.

**[F] 907.2.12.2.3 Standard.** The emergency voice/alarm communication system shall be designed and installed in accordance with NFPA 72.

**[F] 907.2.12.3 Fire department communication system.** An approved two-way, fire department communication system designed and installed in accordance with NFPA 72 shall be provided for fire department use. It shall operate between a fire command center complying with Section 911 and elevators, elevator lobbies, emergency and standby power rooms, fire pump rooms, areas of refuge and inside enclosed exit stairways. The fire department communication device shall be provided at each floor level within the enclosed stairway. Eight portable handsets for the communication system shall be provided in the fire command center.

**Exception:** Fire department radio systems where approved by the fire department.

**[F] 907.2.13 Atriums connecting more than two stories.** A fire alarm system shall be installed in occupancies with an atrium that connects more than two stories. The system shall be activated in accordance with Section 907.6. Such occupancies in Group A, E or M shall be provided with an emergency voice/alarm communication system complying with the requirements of Section 907.2.12.2.

**[F] 907.2.14 High-piled combustible storage areas.** An automatic fire detection system shall be installed throughout high-piled combustible storage areas where required by the *International Fire Code*.

**[F] 907.2.15 Delayed egress locks.** Where delayed egress locks are installed on means of egress doors in accordance with Section 1008.1.8.6, an automatic smoke or heat detection system shall be installed as required by that section.

**[F] 907.2.16 Aerosol storage uses.** Aerosol storage rooms and general-purpose warehouses containing aerosols shall be provided with an approved manual fire alarm system where required by the *International Fire Code*.

**[F] 907.2.17 Lumber, wood structural panel and veneer mills.** Lumber, wood structural panel and veneer mills shall be provided with a manual fire alarm system.

**[F] 907.2.18 Underground buildings with smoke exhaust system.** Where a smoke exhaust system is installed in an underground building in accordance with this code, automatic fire detectors shall be provided in accordance with this section.

**[F] 907.2.18.1 Smoke detectors.** A minimum of one smoke detector listed for the intended purpose shall be installed in the following areas:

1. ((~~Mechanical equipment~~, e)) Electrical, transformer, telephone equipment, elevator machine or similar rooms.
2. Elevator lobbies.
3. The main return and exhaust air plenum of each air-conditioning system serving more than one story and located in a serviceable area downstream of the last duct inlet.

4. Each connection to a vertical duct or riser serving two or more floors from return air ducts or plenums of heating, ventilating and air-conditioning systems, except that in Group R occupancies, a listed smoke detector is allowed to be used in each return air riser carrying not more than 5,000 cfm (2.4 m<sup>3</sup>/s) and serving not more than 10 air inlet openings.

5. Within 5 feet (1524 mm) of doors exiting into stairways that are smokeproof enclosures, or are pressurized stairways.

**[F] 907.2.18.2 Alarm required.** Activation of the smoke exhaust system shall activate an audible alarm at a constantly attended location.

**[F] 907.2.19 Underground buildings.** Where the lowest level of a structure is more than 60 feet (18 288 mm) below the lowest level of exit discharge, the structure shall be equipped throughout with a manual fire alarm system, including an emergency voice/alarm communication system installed in accordance with Section 907.2.12.2.

**[F] 907.2.19.1 Public address system.** Where a fire alarm system is not required by Section 907.2, a public address system shall be provided that shall be capable of transmitting voice communications to the highest level of exit discharge serving the underground portions of the structure and all levels below.

**[F] 907.2.20 Covered mall buildings.** Covered mall buildings exceeding 50,000 square feet (4645 m<sup>2</sup>) in total floor area shall be provided with an emergency voice/alarm communication system. An emergency voice/alarm communication system serving a mall, required or otherwise, shall be accessible to the fire department. The system shall be provided in accordance with Section 907.2.12.2.

**[F] 907.2.21 Residential aircraft hangars.** A minimum of one listed smoke alarm shall be installed within a residential aircraft hangar as defined in Section 412.3.1 and shall be interconnected into the residential smoke alarm or other sounding device to provide an alarm that will be audible in all sleeping areas of the dwelling.

**[F] 907.2.22 Airport traffic control towers.** An automatic fire detection system shall be provided in airport traffic control towers.

**[F] 907.2.23 Battery rooms.** An approved automatic smoke detection system shall be installed in areas containing stationary storage battery systems having a liquid capacity of more than 50 gallons (189.3 L). The detection system shall be supervised by an approved central, proprietary or remote station service or a local alarm that will sound an audible signal at a constantly attended location.

**[F] 907.3 Manual fire alarm boxes.** Manual fire alarm boxes shall be installed in accordance with Sections 907.3.1 through 907.3.5.

**[F] 907.3.1 Location.** Manual fire alarm boxes shall be located not more than 5 feet (1524 mm) from the entrance to each exit at every floor level. Additional manual fire alarm boxes shall be located so that travel distance to the nearest box does not exceed 200 feet (60 960 mm).

**[F] 907.3.2 Height.** The height of the manual fire alarm boxes shall be a minimum of 42 inches (1067 mm) and a maximum of 48 inches (1219 mm), measured vertically, from the floor level to the activating handle or lever of the box.

**[F] 907.3.3 Color.** Manual fire alarm boxes shall be red in color.

**[F] 907.3.4 Signs.** Where fire alarm systems are not monitored by a supervising station, an approved permanent sign shall be installed adjacent to each manual fire alarm box that reads: **WHEN ALARM SOUNDS—CALL FIRE DEPARTMENT.**

**Exception:** Where the manufacturer has permanently provided this information on the manual fire alarm box.

**[F] 907.3.5 Protective covers.** The fire code official is authorized to require the installation of listed manual fire alarm box protective covers to prevent malicious false alarms or to provide the manual fire alarm box with protection from physical damage. The protective cover shall be transparent or red in color with a transparent face to permit visibility of the manual fire alarm box. Each cover shall include proper operating instructions. A protective cover that emits a local alarm signal shall not be installed unless approved.

**[F] 907.4 Power supply.** The primary and secondary power supplies for the fire alarm system shall be provided in accordance with NFPA 72.

**[F] 907.5 Wiring.** Wiring shall comply with the requirements of the (~~International Code Council Electrical Code Administrative Provisions~~) Seattle Electrical Code and NFPA 72. Wireless protection systems utilizing radio-frequency transmitting devices shall comply with the special requirements for supervision of low-power wireless systems in NFPA 72.

**[F] 907.6 Activation.** Where an alarm notification system is required by another section of this code, it shall be activated by:

1. (~~A required automatic fire alarm system~~) Automatic heat and smoke detectors, other than duct smoke detectors, and smoke alarms located inside dwelling units and sleeping units.
2. Sprinkler water-flow devices.
3. Required manual fire alarm boxes.
4. Any other fire suppression system installed within the building.

**[F] 907.7 Presignal system.** Presignal systems shall not be installed unless approved by the fire code official and the fire department. Where a presignal system is installed, 24-hour personnel supervision shall be provided at a location approved by the fire department, in order that the alarm signal can be actuated in the event of fire or other emergency.

**[F] 907.8 Zones.** Each floor shall be zoned separately and a zone shall not exceed 22,500 square feet (2090 m<sup>2</sup>). The length of any zone shall not exceed 300 feet (91 440 mm) in any direction.

**Exception:** Automatic sprinkler system zones shall not exceed the area permitted by NFPA 13.

**[F] 907.8.1** (~~Zoning indicator panel.~~ A zoning indicator panel and the associated controls shall be provided in an approved location.) **Annunciator Panel.** All fire alarm systems shall include either an annunciator or the main control panel located inside the building at the main building entrance. The fire code official is permitted to approve exterior annunciator panels designed specifically for the purpose. Graphic annunciators, when provided, shall be mounted to maintain the viewer’s directional orientation. The visual zone indication shall lock in until the system is reset and shall not be canceled by the operation of an audible alarm-silencing switch.

Alarm panels and annunciators shall not be installed where they will obstruct exiting. The required exit width plus 12 inches (305 mm) shall be provided where the panel is located in a means of egress. Alarm panels shall not be installed in an exit enclosure providing the sole exit from any space.

**[F] 907.8.2 High-rise buildings.** In buildings with a floor used for human occupancy that is located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access, a separate zone by floor shall be provided for all of the following types of alarm-initiating devices where provided:

1. Smoke detectors.
2. Sprinkler water-flow devices.
3. Manual fire alarm boxes.
4. Other approved types of automatic fire detection devices or suppression systems.

**[F] 907.9 Alarm notification appliances.** Alarm notification appliances shall be provided and shall be listed for their purpose.

**[F] 907.9.1 Visible alarms.** Visible alarm notification appliances shall be provided in accordance with Sections 907.9.1.1 through 907.9.1.4.

**Exceptions:**

1. Visible alarm notification appliances are not required in alterations, except where an existing fire alarm system is upgraded or replaced, or a new fire alarm system is installed in accordance with rules promulgated by the building or fire code official.
2. Visible alarm notification appliances shall not be required in exits as defined in Section 1002.1.

**[F] 907.9.1.1 Public and common areas.** Visible alarm notification appliances shall be provided in public areas and common areas.

**[F] 907.9.1.2 Employee work areas.** Where employee work areas have audible alarm coverage, the notification appliance circuits serving the employee work areas shall be initially designed with a minimum of 20 percent spare capacity to account for the potential of adding visible notification appliances in the future to accommodate hearing impaired employees.

**[F] 907.9.1.3 Groups I-1 and R-1.** Group I-1 and R-1 sleeping units in accordance with Table 907.9.1.3 shall

be provided with a visible alarm notification appliance, activated by both the in-room smoke alarm and the building fire alarm system.

**[F] TABLE 907.9.1.3  
VISIBLE AND AUDIBLE ALARMS**

NUMBER OF SLEEPING UNITS	SLEEPING UNITS WITH VISIBLE AND AUDIBLE ALARMS
6 to 25	2
26 to 50	4
51 to 75	7
76 to 100	9
101 to 150	12
151 to 200	14
201 to 300	17
301 to 400	20
401 to 500	22
501 to 1,000	5% of total
1,001 and over	50 plus 3 for each 100 over 1,000

**[F] 907.9.1.4 Group R-2.** In Group R-2 occupancies required by Section 907 to have a fire alarm system, all dwelling units and sleeping units shall be provided with the capability to support visible alarm notification appliances in accordance with ICC A117.1.

**[F] 907.9.2 Audible alarms.** Audible alarm notification appliances shall be provided and shall sound a distinctive sound that is not to be used for any purpose other than that of a fire alarm. The audible alarm notification appliances shall provide a sound pressure level of 15 decibels (dBA) above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater, in every occupied space within the building, or in the case of nonrequired partial fire alarm systems, throughout the space that is being provided with the fire alarm system. The minimum sound pressure levels shall be: 70 dBA in occupancies in Groups R and I-1; 90 dBA in mechanical equipment rooms and 60 dBA in other occupancies. The maximum sound pressure level for audible alarm notification appliances shall be 120 dBA at the minimum hearing distance from the audible appliance. Where the average ambient noise is greater than 105 dBA, visible alarm notification appliances shall be provided in accordance with NFPA 72 and audible alarm notification appliances shall not be required. In assembly occupancies with high sound levels such as nightclubs and bars, an interface shall be provided between the fire alarm system and noise source to eliminate the noise source.

**Exceptions:**

1. Visible alarm notification appliances shall be allowed in lieu of audible alarm notification appliances in critical-care areas of Group I-2 occupancies. Private mode signaling in accordance with NFPA 72 is allowed in areas of Group I-2 occupancies where patients are not expected to self-evacuate.

2. Audibility is not required for fire detection systems monitored by an approved central station in buildings in which a fire alarm is not required by this section.

**907.9.2.1 Audible alarms in existing buildings.** Required fire alarms systems in existing residential buildings shall provide a sound level of 60 dBA minimum or 15 dBA above ambient noise levels in sleeping rooms.

**[F] 907.10 Fire safety functions.** Automatic fire detectors utilized for the purpose of performing fire safety functions shall be connected to the building's fire alarm control panel where a fire alarm system is required by Section 907.2. Detectors shall, upon actuation, perform the intended function and activate the alarm notification appliances or a visible and audible supervisory signal at a constantly attended location. In buildings not required to be equipped with a fire alarm system, the automatic fire detector shall be powered by normal electrical service and, upon actuation, perform the intended function. The detectors shall be located in accordance with Chapter 5 of NFPA 72.

**[F] 907.11 Duct smoke detectors.** Duct smoke detectors shall be connected to the building's fire alarm control panel as a supervisory signal when a fire alarm system is provided. Duct detectors shall not activate a fire alarm signal. Activation of a duct smoke detector shall initiate a visible and audible supervisory signal at a constantly attended location. Duct smoke detectors shall not be used as a substitute for required open-area detection.

**Exception(s):**

- ~~((1. The supervisory signal at a constantly attended location is not required where duct smoke detectors activate the building's alarm notification appliances.~~
- 2.)) In occupancies not required to be equipped with a fire alarm system, actuation of a smoke detector shall activate a visible and audible signal in an approved location. Smoke detector trouble conditions shall activate a visible or audible signal in an approved location and shall be identified as air duct detector trouble.

**[F] 907.12 Access.** Access shall be provided to each detector for periodic inspection, maintenance and testing.

**[F] 907.13 Fire-extinguishing systems.** Automatic fire-extinguishing systems shall be connected to the building fire alarm system where a fire alarm system is required by another section of this code or is otherwise installed.

**[F] 907.14 Monitoring.** Fire alarm systems required by this chapter or the *International Fire Code* shall be monitored by an approved supervising station in accordance with NFPA 72.

**Exception:** Supervisory service is not required for:

1. Single- and multiple-station smoke alarms required by Section 907.2.10.
2. Smoke detectors in Group I-3 occupancies.
3. Automatic sprinkler systems in one- and two-family dwellings and townhouses.

**[F] 907.15 Automatic telephone-dialing devices.** Automatic telephone-dialing devices used to transmit an emergency alarm

shall not be connected to any fire department telephone number unless approved by the fire chief.

**[F] 907.16 Acceptance tests.** Upon completion of the installation of the fire alarm system, and after the electrical inspector has approved the installation, alarm notification appliances and circuits, alarm-initiating devices and circuits, supervisory-signal initiating devices and circuits, signaling line circuits, and primary and secondary power supplies shall be tested in accordance with NFPA 72 in the presence of the fire code official, by individuals who possess the proper certificate from the fire code official.

**[F] 907.17 Record of completion.** A record of completion in accordance with NFPA 72 verifying that the system has been installed in accordance with the approved plans and specifications shall be provided.

**[F] 907.18 Instructions.** Operating, testing and maintenance instructions, and record drawings ("as built") and equipment specifications shall be provided at an approved location.

**[F] 907.19 Inspection, testing and maintenance.** The maintenance and testing schedules and procedures for fire alarm and fire detection systems shall be in accordance with the *International Fire Code*.

## SECTION 908 EMERGENCY ALARM SYSTEMS

**[F] 908.1 Group H occupancies.** Emergency alarms for the detection and notification of an emergency condition in Group H occupancies shall be provided in accordance with Section 414.7.

**[F] 908.2 Group H-5 occupancy.** Emergency alarms for notification of an emergency condition in an HPM facility shall be provided as required in Section 415.8.4.6. A continuous gas-detection system shall be provided for HPM gases in accordance with Section 415.8.7.

**[F] 908.3 Highly toxic and toxic materials.** A gas detection system shall be provided to detect the presence of gas at or below the permissible exposure limit (PEL) or ceiling limit of the gas for which detection is provided. The system shall be capable of monitoring the discharge from the treatment system at or below one-half the immediately dangerous to life and health (IDLH) limit.

**Exception:** A gas-detection system is not required for toxic gases when the physiological warning threshold level for the gas is at a level below the accepted PEL for the gas.

**[F] 908.3.1 Alarms.** The gas detection system shall initiate a local alarm and transmit a signal to a constantly attended control station when a short-term hazard condition is detected. The alarm shall be both visible and audible and shall provide warning both inside and outside the area where gas is detected. The audible alarm shall be distinct from all other alarms.

**Exception:** Signal transmission to a constantly attended control station is not required when not more than one cylinder of highly toxic or toxic gas is stored.

**[F] 908.3.2 Shutoff of gas supply.** The gas detection system shall automatically close the shutoff valve at the source on gas supply piping and tubing related to the system being monitored for whichever gas is detected.

**Exception:** Automatic shutdown is not required for reactors utilized for the production of highly toxic or toxic compressed gases where such reactors are:

1. Operated at pressures less than 15 pounds per square inch gauge (psig) (103.4 kPa).
2. Constantly attended.
3. Provided with readily accessible emergency shutoff valves.

**[F] 908.3.3 Valve closure.** The automatic closure of shutoff valves shall be in accordance with the following:

1. When the gas-detection sampling point initiating the gas detection system alarm is within a gas cabinet or exhausted enclosure, the shutoff valve in the gas cabinet or exhausted enclosure for the specific gas detected shall automatically close.
2. Where the gas-detection sampling point initiating the gas detection system alarm is within a gas room and compressed gas containers are not in gas cabinets or exhausted enclosures, the shutoff valves on all gas lines for the specific gas detected shall automatically close.
3. Where the gas-detection sampling point initiating the gas detection system alarm is within a piping distribution manifold enclosure, the shutoff valve for the compressed container of specific gas detected supplying the manifold shall automatically close.

**Exception:** When the gas-detection sampling point initiating the gas-detection system alarm is at a use location or within a gas valve enclosure of a branch line downstream of a piping distribution manifold, the shutoff valve in the gas valve enclosure for the branch line located in the piping distribution manifold enclosure shall automatically close.

**[F] 908.4 Ozone gas-generator rooms.** Ozone gas-generator rooms shall be equipped with a continuous gas-detection system that will shut off the generator and sound a local alarm when concentrations above the PEL occur.

**[F] 908.5 Repair garages.** A flammable-gas detection system shall be provided in repair garages for vehicles fueled by nonodorized gases in accordance with Section 406.6.6.

**[F] 908.6 Refrigerant detector.** Machinery rooms shall contain a refrigerant detector with an audible and visual alarm. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak will concentrate. The alarm shall be actuated at a value not greater than the corresponding TLV-TWA values for the refrigerant classification indicated in the *International Mechanical Code*. Detectors and alarms shall be placed in approved locations.

## SECTION 909 SMOKE CONTROL SYSTEMS

**[F] 909.1 Scope and purpose.** This section applies to mechanical or passive smoke control systems when they are required by other provisions of this code. The purpose of this section is to establish minimum requirements for the design, installation and acceptance testing of smoke control systems that are intended to provide a tenable environment for the evacuation or relocation of occupants. These provisions are not intended for the preservation of contents, the timely restoration of operations or for assistance in fire suppression or overhaul activities. Smoke control systems regulated by this section serve a different purpose than the smoke- and heat-venting provisions found in Section 910. Mechanical smoke control systems shall not be considered exhaust systems under Chapter 5 of the *International Mechanical Code*.

**[F] 909.2 General design requirements.** Buildings, structures or parts thereof required by this code to have a smoke control system or systems shall have such systems designed in accordance with the applicable requirements of Section 909 and the generally accepted and well-established principles of engineering relevant to the design. The construction documents shall include sufficient information and detail to adequately describe the elements of the design necessary for the proper implementation of the smoke control systems. These documents shall be accompanied by sufficient information and analysis to demonstrate compliance with these provisions.

**[F] 909.3 Special inspection and test requirements.** In addition to the ordinary inspection and test requirements which buildings, structures and parts thereof are required to undergo, smoke control systems subject to the provisions of Section 909 shall undergo special inspections and tests sufficient to verify the proper commissioning of the smoke control design in its final installed condition. The design submission accompanying the construction documents shall clearly detail procedures and methods to be used and the items subject to such inspections and tests. Such commissioning shall be in accordance with generally accepted engineering practice and, where possible, based on published standards for the particular testing involved. The special inspections and tests required by this section shall be conducted under the same terms in Section 1704.

**[F] 909.4 Analysis.** A rational analysis supporting the types of smoke control systems to be employed, their methods of operation, the systems supporting them and the methods of construction to be utilized shall accompany the submitted construction documents and shall include, but not be limited to, the items indicated in Sections 909.4.1 through 909.4.6.

**[F] 909.4.1 Stack effect.** The system shall be designed such that the maximum probable normal or reverse stack effect will not adversely interfere with the system's capabilities. In determining the maximum probable stack effect, altitude, elevation, weather history and interior temperatures shall be used.

**[F] 909.4.2 Temperature effect of fire.** Buoyancy and expansion caused by the design fire in accordance with Section 909.9 shall be analyzed. The system shall be designed such that these effects do not adversely interfere with the system's capabilities.

**[F] 909.4.3 Wind effect.** The design shall consider the adverse effects of wind. Such consideration shall be consistent with the wind-loading provisions of Chapter 16.

**[F] 909.4.4 HVAC systems.** The design shall consider the effects of the heating, ventilating and air-conditioning (HVAC) systems on both smoke and fire transport. The analysis shall include all permutations of systems status. The design shall consider the effects of the fire on the HVAC systems.

**[F] 909.4.5 Climate.** The design shall consider the effects of low temperatures on systems, property and occupants. Air inlets and exhausts shall be located so as to prevent snow or ice blockage.

**[F] 909.4.6 Duration of operation.** All portions of active or passive smoke control systems shall be capable of continued operation after detection of the fire event for a period of not less than either 20 minutes or 1.5 times the calculated egress time, whichever is less.

**[F] 909.5 Smoke barrier construction.** Smoke barriers shall comply with Section 709, and shall be constructed and sealed to limit leakage areas exclusive of protected openings. The maximum allowable leakage area shall be the aggregate area calculated using the following leakage area ratios:

- 1. Walls:  $A/A_w = 0.00100$
- 2. Exit enclosures:  $A/A_w = 0.00035$
- 3. All other shafts:  $A/A_w = 0.00150$
- 4. Floors and roofs:  $A/A_F = 0.00050$

where:

$A$  = Total leakage area, square feet (m<sup>2</sup>).

$A_F$  = Unit floor or roof area of barrier, square feet (m<sup>2</sup>).

$A_w$  = Unit wall area of barrier, square feet (m<sup>2</sup>).

The leakage area ratios shown do not include openings due to doors, operable windows or similar gaps. These shall be included in calculating the total leakage area.

**[F] 909.5.1 Leakage area.** The total leakage area of the barrier is the product of the smoke barrier gross area multiplied by the allowable leakage area ratio, plus the area of other openings such as gaps and operable windows. Compliance shall be determined by achieving the minimum air pressure difference across the barrier with the system in the smoke control mode for mechanical smoke control systems. Passive smoke control systems tested using other approved means such as door fan testing shall be as approved by the fire code official.

**[F] 909.5.2 Opening protection.** Openings in smoke barriers shall be protected by automatic-closing devices actuated by the required controls for the mechanical smoke control system. Door openings shall be protected by fire door assemblies complying with Section 715.4.3.

**Exceptions:**

1. Passive smoke control systems with automatic-closing devices actuated by spot-type smoke detectors listed for releasing service installed in accordance with Section 907.10.
2. Fixed openings between smoke zones that are protected utilizing the airflow method.
3. In Group I-2, where such doors are installed across corridors, a pair of opposite-swinging doors without a center mullion shall be installed having vision panels with fire protection-rated glazing materials in fire protection-rated frames, the area of which shall not exceed that tested. The doors shall be close-fitting within operational tolerances and shall not have undercuts, louvers or grilles. The doors shall have head and jamb stops, astragals or rabbets at meeting edges and shall be automatic-closing by smoke detection in accordance with Section 715.4.7.3. Positive-latching devices are not required.
4. Group I-3.
5. Openings between smoke zones with clear ceiling heights of 14 feet (4267 mm) or greater and bank-down capacity of greater than 20 minutes as determined by the design fire size.

**[F] 909.5.2.1 Ducts and air transfer openings.** Ducts and air transfer openings are required to be protected with a minimum Class II, 250°F (121°C) smoke damper complying with Section 716.

**[F] 909.6 Pressurization method.** The primary mechanical means of controlling smoke shall be by pressure differences across smoke barriers. Maintenance of a tenable environment is not required in the smoke control zone of fire origin.

**[F] 909.6.1 Minimum pressure difference.** The minimum pressure difference across a smoke barrier shall be 0.05-inch water gauge (0.0124 kPa) in fully sprinklered buildings.

In buildings permitted to be other than fully sprinklered, the smoke control system shall be designed to achieve pressure differences at least two times the maximum calculated pressure difference produced by the design fire.

**[F] 909.6.2 Maximum pressure difference.** The maximum air pressure difference across a smoke barrier shall be determined by required door-opening or closing forces. The actual force required to open exit doors when the system is in the smoke control mode shall be in accordance with Section 1008.1.2. Opening and closing forces for other doors shall be determined by standard engineering methods for the resolution of forces and reactions. The calculated force to set a side-hinged, swinging door in motion shall be determined by:

$$F = F_{dc} + K(WA\Delta P)/2(W - d) \tag{Equation 9-1}$$

where:

- A = Door area, square feet (m<sup>2</sup>).
- d = Distance from door handle to latch edge of door, feet (m).
- F = Total door opening force, pounds (N).
- F<sub>dc</sub> = Force required to overcome closing device, pounds (N).
- K = Coefficient 5.2 (1.0).
- W = Door width, feet (m).
- ΔP = Design pressure difference, inches of water (Pa).

**[F] 909.7 Airflow design method.** When approved by the fire code official, smoke migration through openings fixed in a permanently open position, which are located between smoke control zones by the use of the airflow method, shall be permitted. The design airflow shall be in accordance with this section. Airflow shall be directed to limit smoke migration from the fire zone. The geometry of openings shall be considered to prevent flow reversal from turbulent effects.

**[F] 909.7.1 Velocity.** The minimum average velocity through a fixed opening shall not be less than:

$$v = 217.2 [h (T_f - T_o) / (T_f + 460)]^{1/2} \quad \text{(Equation 9-2)}$$

For SI:  $v = 119.9 [h (T_f - T_o) / T_f]^{1/2}$

where:

- h = Height of opening, feet (m).
- T<sub>f</sub> = Temperature of smoke, °F (K).
- T<sub>o</sub> = Temperature of ambient air, °F (K).
- v = Air velocity, feet per minute (m/minute).

**[F] 909.7.2 Prohibited conditions.** This method shall not be employed where either the quantity of air or the velocity of the airflow will adversely affect other portions of the smoke control system, unduly intensify the fire, disrupt plume dynamics or interfere with exiting. In no case shall airflow toward the fire exceed 200 feet per minute (1.02 m/s). Where the formula in Section 909.7.1 requires airflow to exceed this limit, the airflow method shall not be used.

**[F] 909.8 Exhaust method.** When approved by the fire code official, mechanical smoke control for large enclosed volumes, such as in atriums or malls, shall be permitted to utilize the exhaust method. Smoke control systems using the exhaust method shall be designed in accordance with NFPA 92B.

**[F] 909.8.1 Smoke layer.** The height of the lowest horizontal surface of the accumulating smoke layer shall be maintained at least 6 feet (1829 mm) above any walking surface that forms a portion of a required egress system within the smoke zone.

**[F] 909.9 Design fire.** The design fire shall be based on a rational analysis performed by the registered design professional and approved by the fire code official. The design fire shall be based on the analysis in accordance with Section 909.4 and this section.

**[F] 909.9.1 Factors considered.** The engineering analysis shall include the characteristics of the fuel, fuel load, effects

included by the fire and whether the fire is likely to be steady or unsteady.

**[F] 909.9.2 Separation distance.** Determination of the design fire shall include consideration of the type of fuel, fuel spacing and configuration.

**[F] 909.9.3 Heat-release assumptions.** The analysis shall make use of best available data from approved sources and shall not be based on excessively stringent limitations of combustible material.

**[F] 909.9.4 Sprinkler effectiveness assumptions.** A documented engineering analysis shall be provided for conditions that assume fire growth is halted at the time of sprinkler activation.

**[F] 909.10 Equipment.** Equipment including, but not limited to, fans, ducts, automatic dampers and balance dampers, shall be suitable for its intended use, suitable for the probable exposure temperatures that the rational analysis indicates and as approved by the fire code official.

**[F] 909.10.1 Exhaust fans.** Components of exhaust fans shall be rated and certified by the manufacturer for the probable temperature rise to which the components will be exposed. This temperature rise shall be computed by:

$$T_s = (Q_c / mc) + (T_a) \quad \text{(Equation 9-3)}$$

where:

- c = Specific heat of smoke at smoke layer temperature, Btu/lb°F (kJ/kg · K).
- m = Exhaust rate, pounds per second (kg/s).
- Q<sub>c</sub> = Convective heat output of fire, Btu/s (kW).
- T<sub>a</sub> = Ambient temperature, °F (K).
- T<sub>s</sub> = Smoke temperature, °F (K).

**Exception:** Reduced T<sub>s</sub> as calculated based on the assurance of adequate dilution air.

**[F] 909.10.2 Ducts.** Duct materials and joints shall be capable of withstanding the probable temperatures and pressures to which they are exposed as determined in accordance with Section 909.10.1. Ducts shall be constructed and supported in accordance with the *International Mechanical Code*. Ducts shall be leak tested to 1.5 times the maximum design pressure in accordance with nationally accepted practices. Measured leakage shall not exceed 5 percent of design flow. Results of such testing shall be a part of the documentation procedure. Ducts shall be supported directly from fire-resistance-rated structural elements of the building by substantial, noncombustible supports.

**Exception:** Flexible connections (for the purpose of vibration isolation) complying with the *International Mechanical Code*, that are constructed of approved fire-resistance-rated materials.

**[F] 909.10.3 Equipment, inlets and outlets.** Equipment shall be located so as to not expose uninvolved portions of the building to an additional fire hazard. Outside air inlets shall be located so as to minimize the potential for introducing smoke or flame into the building. Exhaust outlets shall be so located as to minimize reintroduction of smoke into

the building and to limit exposure of the building or adjacent buildings to an additional fire hazard.

**[F] 909.10.4 Automatic dampers.** Automatic dampers, regardless of the purpose for which they are installed within the smoke control system, shall be listed and conform to the requirements of approved, recognized standards.

**[F] 909.10.5 Fans.** In addition to other requirements, belt-driven fans shall have 1.5 times the number of belts required for the design duty, with the minimum number of belts being two. Fans shall be selected for stable performance based on normal temperature and, where applicable, elevated temperature. Calculations and manufacturer's fan curves shall be part of the documentation procedures. Fans shall be supported and restrained by noncombustible devices in accordance with the requirements of Chapter 16. Motors driving fans shall not be operated beyond their nameplate horsepower (kilowatts), as determined from measurement of actual current draw, and shall have a minimum service factor of 1.15.

**[F] 909.11 Power systems.** The smoke control system shall be supplied with two sources of power. Primary power shall be from the normal building power system. Secondary power shall be from an approved ~~((standby))~~ emergency source complying with the ~~((International Code Council Electrical Code Administrative Provisions))~~ *Seattle Electrical Code*. The ~~((standby))~~ emergency power source and its transfer switches shall be in a separate room from the normal power transformers and switch gear and shall be enclosed in a room constructed of not less than 1-hour fire barriers ventilated directly to and from the exterior. Power distribution from the two sources shall be by independent routes. Transfer to full ~~((standby))~~ emergency power shall be automatic and within 60 seconds of failure of the primary power. The systems shall comply with this code ~~((or))~~ and the ~~((International Code Council Electrical Code Administrative Provisions))~~ *Seattle Electrical Code*.

**[F] 909.11.1 Power sources and power surges.** Elements of the smoke management system relying on volatile memories or the like shall be supplied with uninterruptable power sources of sufficient duration to span a 15-minute primary power interruption. Elements of the smoke management system susceptible to power surges shall be suitably protected by conditioners, suppressors or other approved means.

**[F] 909.11.2 Wiring.** In addition to meeting requirements of the *Seattle Electrical Code*, all wiring regardless of voltage, shall have fire-resistance-rated protection of at least 2 hours or as required in rules promulgated by the building official.

**Exception:** Subject to the approval of the building official, fire-resistance-rating is not required for wiring located in a parking garage.

**[F] 909.12 Detection and control systems.** Fire detection systems providing control input or output signals to mechanical smoke control systems or elements thereof shall comply with the requirements of Section 907. Such systems shall be equipped with a control unit complying with UL 864 and listed as smoke control equipment.

Control systems for mechanical smoke control systems shall include provisions for verification. Verification shall include positive confirmation of actuation, testing, manual override, the presence of power downstream of all disconnects and, through a preprogrammed weekly test sequence, report abnormal conditions audibly, visually and by printed report.

**[F] 909.12.1 Wiring.** ~~((In addition to meeting requirements of the *International Code Council Electrical Code Administrative Provisions*, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways.))~~ See Section 909.11.2.

**[F] 909.12.2 Activation.** Smoke control systems shall be activated in accordance with this section.

**[F] 909.12.2.1 Pressurization, airflow or exhaust method.** Mechanical smoke control systems using the pressurization, airflow or exhaust method shall have completely automatic control.

**[F] 909.12.2.2 Passive method.** Passive smoke control systems actuated by approved spot-type detectors listed for releasing service shall be permitted.

**[F] 909.12.3 Automatic control.** Where completely automatic control is required or used, the automatic-control sequences shall be initiated from an appropriately zoned automatic sprinkler system complying with Section 903.3.1.1, manual controls that are readily accessible to the fire department and any smoke detectors ~~((required by engineering analysis)).~~

**[F] 909.13 Control air tubing.** Control air tubing shall be of sufficient size to meet the required response times. Tubing shall be flushed clean and dry prior to final connections and shall be adequately supported and protected from damage. Tubing passing through concrete or masonry shall be sleeved and protected from abrasion and electrolytic action.

**[F] 909.13.1 Materials.** Control air tubing shall be hard drawn copper, Type L, ACR in accordance with ASTM B 42, ASTM B 43, ASTM B 68, ASTM B 88, ASTM B 251 and ASTM B 280. Fittings shall be wrought copper or brass, solder type, in accordance with ASME B 16.18 or ASME B 16.22. Changes in direction shall be made with appropriate tool bends. Brass compression-type fittings shall be used at final connection to devices; other joints shall be brazed using a BCuP5 brazing alloy with solidus above 1,100°F (593°C) and liquids below 1,500°F (816°C). Brazing flux shall be used on copper-to-brass joints only.

**Exception:** Nonmetallic tubing used within control panels and at the final connection to devices, provided that all of the following conditions are met:

1. Tubing shall be listed by an approved agency for flame and smoke characteristics.
2. Tubing and connected devices shall be completely enclosed within galvanized or paint-grade steel enclosure of not less than 0.030 inch (0.76 mm) (No. 22 galvanized sheet gauge) thickness. Entry to the enclosure shall be by copper tubing with a protective grommet of neoprene or teflon or by suitable brass compression to male-barbed adapter.

3. Tubing shall be identified by appropriately documented coding.
4. Tubing shall be neatly tied and supported within enclosure. Tubing bridging cabinet and door or moveable device shall be of sufficient length to avoid tension and excessive stress. Tubing shall be protected against abrasion. Tubing serving devices on doors shall be fastened along hinges.

**[F] 909.13.2 Isolation from other functions.** Control tubing serving other than smoke control functions shall be isolated by automatic isolation valves or shall be an independent system.

**[F] 909.13.3 Testing.** Control air tubing shall be tested at three times the operating pressure for not less than 30 minutes without any noticeable loss in gauge pressure prior to final connection to devices.

**[F] 909.14 Marking and identification.** The detection and control systems shall be clearly marked at all junctions, accesses and terminations.

**[F] 909.15 Control diagrams.** Identical control diagrams showing all devices in the system and identifying their location and function shall be maintained current and kept on file with the fire code official, the fire department and in the fire command center in a format and manner approved by the fire chief.

**[F] 909.16 Fire-fighter's smoke control panel.** A fire-fighter's smoke control panel for fire department emergency response purposes only shall be provided and shall include manual control or override of automatic control for mechanical smoke control systems. The panel shall be located in a fire command center complying with Section 911 in high-rise buildings or buildings with smoke-protected assembly seating. In all other buildings, the fire-fighter's smoke control panel shall be installed in an approved location adjacent to the fire alarm control panel. The fire-fighter's smoke control panel shall comply with Sections 909.16.1 through 909.16.3.

**[F] 909.16.1 Smoke control systems.** Fans within the building shall be shown on the fire-fighter's control panel. A clear indication of the direction of airflow and the relationship of components shall be displayed. Status indicators shall be provided for all smoke control fans ~~((equipment, annunciated by fan and zone, and by pilot-lamp-type indicators))~~ as follows:

1. Fans ~~((, dampers and other operating equipment))~~ in their normal status—WHITE.
2. Fans ~~((, dampers and other operating equipment))~~ in their off ~~((or closed))~~ status—RED.
3. Fans ~~((, dampers and other operating equipment))~~ in their on ~~((or open))~~ status—GREEN.
4. Fans ~~((, dampers and other operating equipment))~~ in a fault status—YELLOW/AMBER.

**[F] 909.16.2 Smoke control panel.** The fire-fighter's control panel shall provide control capability over the complete smoke-control system equipment within the building as follows:

1. ON-AUTO-OFF control over each shaft pressurization fan. ~~((individual piece of operating smoke control equipment that can also be controlled from other sources within the building. This includes stairway pressurization fans; smoke exhaust fans; supply, return and exhaust fans; elevator shaft fans and other operating equipment used or intended for smoke control purposes.))~~
2. ~~((OPEN-AUTO-CLOSE control over individual dampers relating to smoke control and that are also controlled from other sources within the building.))~~ AUTO-OFF-POSITIVE PRESSURE-NEGATIVE PRESSURE control over each smoke control zone designed with such features. Individual control of each damper and fan used to achieve the positive or negative pressure condition is not required.
3. ~~((ON-OFF or OPEN-CLOSE control over smoke control and other critical equipment associated with a fire or smoke emergency and that can only be controlled from the fire-fighter's control panel.))~~ AUTO-EXHAUST-OFF control over each smoke control zone using the exhaust method of smoke control. Individual control of each damper and fan used to exhaust is not required.

**Exception(s):**

1. ~~((+))~~ Complex exhaust systems using multiple exhaust fans and/or zones may require individual fan control when required by the fire code official. ~~((Complex systems, where approved, where the controls and indicators are combined to control and indicate all elements of a single smoke zone as a unit.~~
2. ~~Complex systems, where approved, where the control is accomplished by computer interface using approved, plain English commands.))~~

**[F] 909.16.3 Control action and priorities.** The fire-fighter's control panel actions shall be as follows:

1. ON-OFF and OPEN-CLOSE control actions shall have the highest priority of any control point within the building. Once issued from the fire-fighter's control panel, no automatic or manual control from any other control point within the building shall contradict the control action. Where automatic means are provided to interrupt normal, nonemergency equipment operation or produce a specific result to safeguard the building or equipment (i.e., duct freezestats, duct smoke detectors, high-temperature cutouts, temperature-actuated linkage and similar devices), such means shall be capable of being overridden by the fire-fighter's control panel. The last control action as indicated by each fire-fighter's control panel switch position shall prevail. In no case shall control actions require the smoke control system to assume more than one configuration at any one time.

**Exception:** Power disconnects required by the ~~((International Code Council Electrical Code Administrative Provisions))~~ Seattle Electrical Code.

2. Only the AUTO position of each three-position fire-fighter's control panel switch shall allow automatic or manual control action from other control points within the building. The AUTO position shall be the NORMAL, nonemergency, building control position. Where a fire-fighter's control panel is in the AUTO position, the actual status of the device (on, off, open, closed) shall continue to be indicated by the status indicator described above. When directed by an automatic signal to assume an emergency condition, the NORMAL position shall become the emergency condition for that device or group of devices within the zone. In no case shall control actions require the smoke control system to assume more than one configuration at any one time.

**[F] 909.17 System response time.** Smoke-control system activation shall be initiated immediately after receipt of an appropriate automatic or manual activation command. Smoke control systems shall activate individual components (such as dampers and fans) in the sequence necessary to prevent physical damage to the fans, dampers, ducts and other equipment. For purposes of smoke control, the fire-fighter's control panel response time shall be the same for automatic or manual smoke control action initiated from any other building control point. The total response time, including that necessary for detection, shutdown of operating equipment and smoke control system startup, shall allow for full operational mode to be achieved before the conditions in the space exceed the design smoke condition. The system response time for each component and their sequential relationships shall be detailed in the required rational analysis and verification of their installed condition reported in the required final report.

**[F] 909.18 Acceptance testing.** Devices, equipment, components and sequences shall be individually tested. These tests, in addition to those required by other provisions of this code, shall consist of determination of function, sequence and, where applicable, capacity of their installed condition.

**[F] 909.18.1 Detection devices.** Smoke or fire detectors that are a part of a smoke control system shall be tested in accordance with Chapter 9 in their installed condition. When applicable, this testing shall include verification of airflow in both minimum and maximum conditions.

**[F] 909.18.2 Ducts.** Ducts that are part of a smoke control system shall be traversed using generally accepted practices to determine actual air quantities.

**[F] 909.18.3 Dampers.** Dampers shall be tested for function in their installed condition.

**[F] 909.18.4 Inlets and outlets.** Inlets and outlets shall be read using generally accepted practices to determine air quantities.

**[F] 909.18.5 Fans.** Fans shall be examined for correct rotation. Measurements of voltage, amperage, revolutions per minute (rpm) and belt tension shall be made.

**[F] 909.18.6 Smoke barriers.** Measurements using inclined manometers or other approved calibrated measuring devices shall be made of the pressure differences across

smoke barriers. Such measurements shall be conducted for each possible smoke control condition.

**[F] 909.18.7 Controls.** Each smoke zone, equipped with an automatic-initiation device, shall be put into operation by the actuation of one such device. Each additional device within the zone shall be verified to cause the same sequence without requiring the operation of fan motors in order to prevent damage. Control sequences shall be verified throughout the system, including verification of override from the fire-fighter's control panel and simulation of standby power conditions.

**[F] 909.18.8 Special inspections for smoke control.** Smoke control systems shall be tested by a special inspector for compliance with the approved plans.

**[F] 909.18.8.1 Scope of testing.** Special inspections shall be conducted in accordance with the following:

- ~~(1. During erection of ductwork and prior to concealment for the purposes of leakage testing and recording of device location.~~
- 2.) Prior to occupancy and after sufficient completion for the purposes of pressure-difference testing, flow measurements, and detection and control verification.

**[F] 909.18.8.2 Qualifications.** Special inspection agencies for smoke control shall have expertise in fire protection engineering, mechanical engineering and certification as air balancers.

**[F] 909.18.8.3 Reports.** A complete report of testing shall be prepared by the special inspector or special inspection agency. The report shall include identification of all devices by manufacturer, nameplate data, design values, measured values and identification tag or mark. The report shall be reviewed by the responsible registered design professional and, when satisfied that the design intent has been achieved, the responsible registered design professional shall seal, sign and date the report.

**[F] 909.18.8.3.1 Report filing.** A copy of the final report shall be filed with the fire code official and an identical copy shall be maintained in an approved location at the building.

**[F] 909.18.9 Identification and documentation.** Charts, drawings and other documents identifying and locating each component of the smoke control system, and describing its proper function and maintenance requirements, shall be maintained on file at the building as an attachment to the report required by Section 909.18.8.3. Devices shall have an approved identifying tag or mark on them consistent with the other required documentation and shall be dated indicating the last time they were successfully tested and by whom.

**[F] 909.19 System acceptance.** Buildings, or portions thereof, required by this code to comply with this section shall not be issued a certificate of occupancy until such time that the fire code official determines that the provisions of this section have been fully complied with and that the fire department has received satisfactory instruction on the operation, both automatic and manual, of the system.

**Exception:** In buildings of phased construction, a temporary certificate of occupancy, as approved by the fire code official, shall be allowed provided that those portions of the building to be occupied meet the requirements of this section and that the remainder does not pose a significant hazard to the safety of the proposed occupants or adjacent buildings.

**909.20 Smokeproof enclosures.** Where required by Section 1020.1.7, a smokeproof enclosure shall be constructed in accordance with ~~((this section.))~~ Sections 909.10 through 909.20. A smokeproof enclosure shall consist of an enclosed interior exit stairway that conforms to Section 1020.1 ~~((and an open exterior balcony or ventilated vestibule meeting))~~ and is pressurized according to the requirements of this section. Where access to the roof is required by the *International Fire Code*, such access shall be from the smokeproof enclosure where a smokeproof enclosure is required.

~~((909.20.1 Access. Access to the stair shall be by way of a vestibule or an open exterior balcony. The minimum dimension of the vestibule shall not be less than the required width of the corridor leading to the vestibule but shall not have a width of less than 44 inches (1118 mm) and shall not have a length of less than 72 inches (1829 mm) in the direction of egress travel.~~

**909.20.2 Construction.** The smokeproof enclosure shall be separated from the remainder of the building by not less than a 2-hour fire barrier without openings other than the required means of egress doors. The vestibule shall be separated from the stairway by not less than a 2-hour fire barrier. The open exterior balcony shall be constructed in accordance with the fire-resistance-rating requirements for floor construction.

**909.20.2.1 Door closers.** Doors in a smokeproof enclosure shall be self- or automatic closing by actuation of a smoke detector in accordance with Section 715.4 and shall be installed at the floor-side entrance to the smokeproof enclosure. The actuation of the smoke detector on any door shall activate the closing devices on all doors in the smokeproof enclosure at all levels. Smoke detectors shall be installed in accordance with Section 907.10.

**909.20.3 Natural ventilation alternative.** The provisions of Sections 909.20.3.1 through 909.20.3.3 shall apply to ventilation of smokeproof enclosures by natural means.

**909.20.3.1 Balcony doors.** Where access to the stairway is by way of an open exterior balcony, the door assembly into the enclosure shall be a fire door assembly in accordance with Section 715.4.

**909.20.3.2 Vestibule doors.** Where access to the stairway is by way of a vestibule, the door assembly into the vestibule shall be a fire door assembly complying with Section 715.4. The door assembly from the vestibule to the stairway shall have not less than a 20-minute fire protection rating complying with Section 715.4.

**909.20.3.3 Vestibule ventilation.** Each vestibule shall have a minimum net area of 16 square feet (1.5 m<sup>2</sup>) of

opening in a wall facing an outer court, yard or public way that is at least 20 feet (6096 mm) in width.

**909.20.4 Mechanical ventilation alternative.** The provisions of Sections 909.20.4.1 through 909.20.4.4 shall apply to ventilation of smokeproof enclosures by mechanical means.

**909.20.4.1 Vestibule doors.** The door assembly from the building into the vestibule shall be a fire door assembly complying with Section 715.4.3. The door assembly from the vestibule to the stairway shall not have less than a 20-minute fire protection rating and meet the requirements for a smoke door assembly in accordance with Section 715.4.3. The door shall be installed in accordance with NFPA 105.

**909.20.4.2 Vestibule ventilation.** The vestibule shall be supplied with not less than one air change per minute and the exhaust shall not be less than 150 percent of supply. Supply air shall enter and exhaust air shall discharge from the vestibule through separate, tightly constructed ducts used only for that purpose. Supply air shall enter the vestibule within 6 inches (152 mm) of the floor level. The top of the exhaust register shall be located at the top of the smoke trap but not more than 6 inches (152 mm) down from the top of the trap, and shall be entirely within the smoke trap area. Doors in the open position shall not obstruct duct openings. Duct openings with controlling dampers are permitted where necessary to meet the design requirements, but dampers are not otherwise required.

**909.20.4.2.1 Engineered ventilation system.** Where a specially engineered system is used, the system shall exhaust a quantity of air equal to not less than 90 air changes per hour from any vestibule in the emergency operation mode and shall be sized to handle three vestibules simultaneously. Smoke detectors shall be located at the floor-side entrance to each vestibule and shall activate the system for the affected vestibule. Smoke detectors shall be installed in accordance with Section 907.10.

**909.20.4.3 Smoke trap.** The vestibule ceiling shall be at least 20 inches (508 mm) higher than the door opening into the vestibule to serve as a smoke and heat trap and to provide an upward-moving air column. The height shall not be decreased unless approved and justified by design and test.

**909.20.4.4 Stair shaft air movement system.** The stair shaft shall be provided with a dampered relief opening and supplied with sufficient air to maintain a minimum positive pressure of 0.10 inch of water (25 Pa) in the shaft relative to the vestibule with all doors closed.)

**909.20.5 Stair pressurization ((alternative.** Where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the vestibule is not required, provided that interior exit)) Exit stairways ~~((are))~~ shall be pressurized to a minimum of 0.15 inch of water (37 Pa) and a maximum of 0.35 inch of water (87 Pa) in the shaft relative to the building measured with all stairway doors closed under maximum anticipated stack pres-

tures. The pressure differential shall be measured between the smokeproof enclosure and the adjacent area. In residential buildings, the pressure differential is permitted to be measured between the smokeproof enclosure and the dwelling units.

**Exception:** The pressure differential is permitted to be measured relative to outdoor atmosphere on floors other than the following:

1. the fire floor,
2. the two floors immediately below the fire floor, and
3. the floor immediately above the fire floor.

**909.20.5.1 Supply Air.** Air for stairway pressurization shall be supplied at intervals sufficient to maintain the required pressure throughout the shaft.

**Note:** The performance goal for Section 909.20.5.1 is compliance with minimum and maximum pressures at all levels of the shaft, and to ensure upward flow of air and smoke.

**909.20.5.2 Air intake.** Supply air shall be taken directly from an outside, uncontaminated source at least 20 feet (6096 mm) from any air exhaust system or outlet. Air intakes shall be located at the exterior of the building. The intake shall be continuous to the exterior of the building. Two smoke detectors shall be located in the duct in accordance with NFPA 72 arranged to automatically shut down the fan system only when both smoke detectors activate. The detectors shall be located upstream of the fan and shall be connected to the fire alarm as a supervisory signal.

**909.20.5.3 Dampened relief opening.** The exit enclosure shall be equipped with a barometric dampened relief opening at the top, and a motorized damper as required by the *Washington State Energy Code with Seattle Amendments*. The motorized damper shall be of the normally open type (open with the power off). Activation of the damper shall be initiated by the building fire alarm system and by actuation of the automatic sprinkler system.

The pressurization system shall be capable of maintaining the pressure required by Section 909.20.5 while 2,500 cubic feet per minute (1180 L/s) of air is being discharged through the relief opening.

Supply ducts between the exterior of the building and the exit enclosure shall be enclosed in construction at least equivalent to that of the exit enclosure.

**909.20.6 ((Ventilating)) Pressurization equipment.** The ((activation of ventilating)) pressurization equipment required by ((the alternatives in)) Section((s 909.20.4 and)) 909.20.5 shall be activated by a fire alarm signal originating anywhere in the building. ((smoke detectors installed at each floor level at an approved location at the entrance to the smokeproof enclosure. When the closing device for the stair shaft and vestibule doors is activated by smoke detection or power failure, the mechanical equipment shall activate and

operate at the required performance levels.)) Smoke detectors shall be installed in accordance with Section 907.10.

**909.20.6.1 ((Ventilation)) Pressurization systems.** Smokeproof enclosure ((ventilation)) pressurization systems shall be independent of other building ventilation systems.

**Exception:** Ventilation systems other than smokeproof enclosure supply air systems are permitted to be used to exhaust air from adjacent space when necessary to maintain pressure relationships. Ventilation systems used to achieve smokeproof enclosure pressurization are not required to comply with Section 909.

The equipment and ductwork shall comply with one of the following:

1. Equipment and ductwork shall be located exterior to the building and directly connected to the smokeproof enclosure or connected to the smokeproof enclosure by ductwork enclosed by 2-hour fire barriers.
2. Equipment and ductwork shall be located within the smokeproof enclosure with intake or exhaust directly from and to the outside or through ductwork enclosed by 2-hour fire barriers.
3. Equipment and ductwork shall be located within the building if separated from the remainder of the building, including other mechanical equipment, by 2-hour fire barriers.

**Interpretation I909.20:** Dampers other than motorized dampers required by the *Washington State Energy Code with Seattle Amendments* are not permitted in smokeproof enclosure system air supply unless approved by the building official.

**909.20.6.2 ((Standby)) Emergency power.** Mechanical ((vestibule and)) stair shaft ((ventilation)) pressurization systems and automatic fire detection systems shall be powered by an approved ((standby)) emergency power system conforming to Section ((403.10.1)) 403.11 and Chapter 27.

**909.20.6.3 Acceptance and testing.** Before the mechanical equipment is approved, the system shall be tested ((in the presence of the building official)) to confirm that the system is operating in compliance with these requirements. Mechanical stair shaft pressurization systems shall comply with Sections 909.18 through 909.19.

**909.21 Pressurization for low-rise buildings.** Where stairway shaft pressurization is provided in accordance with exception 4 of Section 1019.2 or with item 9 of Section 509.2, the pressurization system shall comply with the following:

1. Shafts shall be pressurized to a minimum positive pressure of 0.15 inch of water column (37 Pa) relative to the main occupied area on each floor, and a maximum pressure that complies with Section 1008.1.2.

2. The shaft pressurization shall be activated by a fire alarm originating anywhere in the building. Smoke detectors shall be installed within 5 feet (1524 mm) of doors exiting into stairways that are smokeproof enclosures, or are pressurized stairways.
3. Pressurization equipment and its duct work located within the building shall be separated from other portions of the building by construction equal to that required for the shaft.
4. Supply air shall be taken directly from an outside, uncontaminated source at least 20 feet (6096 mm) from any air exhaust system or outlet. Air ducts shall be continuous to the exterior of the building. Two smoke detectors shall be located in the duct in accordance with NFPA 72 arranged to automatically shut down the fan system only when both smoke detectors activate. The detectors shall be located upstream of the fan and shall be connected to the fire alarm as a supervisory signal.
5. A legally required standby source of power shall be provided for the pressurization system according to *Seattle Electrical Code* Section 701.11. A connection ahead of the service disconnecting means shall be permitted as the sole source of power to the pressurization system.
6. Other measures to prevent loss of pressurization shall be provided in the design and construction of shafts, such as doors and door closers, quality of workmanship and caulking of penetrations and joints.

## SECTION 910 SMOKE AND HEAT VENTS

**[F] 910.1 General.** Where required by this code or otherwise installed, smoke and heat vents, or mechanical smoke exhaust systems, and draft curtains shall conform to the requirements of this section.

**Exceptions:**

1. Frozen food warehouses used solely for storage of Class I and II commodities where protected by an approved automatic sprinkler system.
2. Where areas of buildings are equipped with early suppression fast-response (ESFR) sprinklers, automatic smoke and heat vents shall not be required within these areas.

**[F] 910.2 Where required.** Smoke and heat vents shall be installed in the roofs of one-story buildings or portions thereof occupied for the uses set forth in Sections 910.2.1 through 910.2.3.

**[F] 910.2.1 Group F-1 or S-1.** Buildings and portions thereof used as a Group F-1 or S-1 occupancy having more than 50,000 square feet (4645 m<sup>2</sup>) in undivided area.

**Exception:** Group S-1 aircraft repair hangars.

**[F] 910.2.2 High-piled combustible storage.** Buildings and portions thereof containing high-piled combustible stock or rack storage in any occupancy group in accordance with Section 413 and the *International Fire Code*.

**[F] 910.2.3 Exit access travel distance increase.** Buildings and portions thereof used as a Group F-1 or S-1 occupancy where the maximum exit access travel distance is increased in accordance with Section 1016.2.

**[F] 910.3 Design and installation.** The design and installation of smoke and heat vents and draft curtains shall be as specified in Sections 910.3.1 through 910.3.5.2 and Table 910.3.

**[F] 910.3.1 Design.** Smoke and heat vents shall be listed and labeled to indicate compliance with UL 793.

**[F] 910.3.2 Vent operation.** Smoke and heat vents shall be capable of being operated by approved automatic and manual means. Automatic operation of smoke and heat vents shall conform to the provisions of Sections 910.3.2.1 through 910.3.2.3.

**[F] 910.3.2.1 Gravity-operated drop-out vents.** Automatic smoke and heat vents containing heat-sensitive glazing designed to shrink and drop out of the vent opening when exposed to fire shall fully open within 5 minutes after the vent cavity is exposed to a simulated fire, represented by a time-temperature gradient that reaches an air temperature of 500°F (260°C) within 5 minutes.

**[F] 910.3.2.2 Sprinklered buildings.** Where installed in buildings provided with an approved automatic sprinkler system, smoke and heat vents shall be designed to operate automatically.

**[F] 910.3.2.3 Nonsprinklered buildings.** Where installed in buildings not provided with an approved automatic sprinkler system, smoke and heat vents shall operate automatically by actuation of a heat-responsive device rated at between 100°F (38°C) and 220°F (104°C) above ambient.

**Exception:** Gravity-operated drop-out vents complying with Section 910.3.2.1

**[F] 910.3.3 Vent dimensions.** The effective venting area shall not be less than 16 square feet (1.5 m<sup>2</sup>) with no dimension less than 4 feet (1219 mm), excluding ribs or gutters having a total width not exceeding 6 inches (152 mm).

**[F] 910.3.4 Vent locations.** Smoke and heat vents shall be located 20 feet (6096 mm) or more from adjacent lot lines and fire walls and 10 feet (3048 mm) or more from fire barrier walls. Vents shall be uniformly located within the roof area above high-piled storage areas, with consideration given to roof pitch, draft curtain location, sprinkler location and structural members.

**[F] 910.3.5 Draft curtains.** Where required by Table 910.3, draft curtains shall be provided in accordance with this section.

**Exception:** Where areas of buildings are equipped with ESFR sprinklers, draft curtains shall not be provided within these areas. Draft curtains shall only be provided at the separation between the ESFR sprinklers and the conventional sprinklers.

**[F] 910.3.5.1 Construction.** Draft curtains shall be constructed of sheet metal, lath and plaster, gypsum board or other approved materials which provide equivalent performance to resist the passage of smoke. Joints and connections shall be smoke tight.

[F] TABLE 910.3  
REQUIREMENTS FOR DRAFT CURTAINS AND SMOKE AND HEAT VENTS<sup>a</sup>

OCCUPANCY GROUP AND COMMODITY CLASSIFICATION	DESIGNATED STORAGE HEIGHT (feet)	MINIMUM DRAFT CURTAIN DEPTH (feet)	MAXIMUM AREA FORMED BY DRAFT CURTAINS (square feet)	VENT-AREA-TO-FLOOR-AREA RATIO <sup>c</sup>	MAXIMUM SPACING OF VENT CENTERS (feet)	MAXIMUM DISTANCE TO VENTS FROM WALL OR DRAFT CURTAINS <sup>b</sup> (feet)
Group F-1 and S-1	—	$0.2 \times H^d$ but $\geq 4$	50,000	1:100	120	60
High-piled Storage (see Section 910.2.2) I-IV (Option 1)	$\leq 20$	6	10,000	1:100	100	60
	$> 20 \leq 40$	6	8,000	1:75	100	55
High-piled Storage (see Section 910.2.2) I-IV (Option 2)	$\leq 20$	4	3,000	1:75	100	55
	$> 20 \leq 40$	4	3,000	1:50	100	50
High-piled Storage (see Section 910.2.2) High hazard (Option 1)	$\leq 20$	6	6,000	1:50	100	50
	$> 20 \leq 30$	6	6,000	1:40	90	45
High-piled Storage (see Section 910.2.2) High hazard (Option 2)	$\leq 20$	4	4,000	1:50	100	50
	$> 20 \leq 30$	4	2,000	1:30	75	40

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m<sup>2</sup>.

- a. Requirements for rack storage heights in excess of those indicated shall be in accordance with Chapter 23 of the *International Fire Code*. For solid-piled storage heights in excess of those indicated, an approved engineered design shall be used.
- b. The distance specified is the maximum distance from any vent in a particular draft curtained area to walls or draft curtains which form the perimeter of the draft curtained area.
- c. Where draft curtains are not required, the vent-area-to-floor-area ratio shall be calculated based on a minimum draft curtain depth of 6 feet (Option 1).
- d. "H" is the height of the vent, in feet, above the floor.

[F] 910.3.5.2 **Location and depth.** The location and minimum depth of draft curtains shall be in accordance with Table 910.3.

[F] 910.4 **Mechanical smoke exhaust.** Where approved by the fire code official, engineered mechanical smoke exhaust shall be an acceptable alternate to smoke and heat vents.

[F] 910.4.1 **Location.** Exhaust fans shall be uniformly spaced within each draft-curtained area and the maximum distance between fans shall not be greater than 100 feet (30 480 mm).

[F] 910.4.2 **Size.** Fans shall have a maximum individual capacity of 30,000 cfm (14.2 m<sup>3</sup>/s). The aggregate capacity of smoke exhaust fans shall be determined by the equation:

$$C = A \times 300 \quad \text{(Equation 9-4)}$$

where:

C = Capacity of mechanical ventilation required, in cubic feet per minute (m<sup>3</sup>/s).

A = Area of roof vents provided in square feet (m<sup>2</sup>) in accordance with Table 910.3.

[F] 910.4.3 **Operation.** Mechanical smoke exhaust fans shall be automatically activated by the automatic sprinkler system or by heat detectors having operating characteristics equivalent to those described in Section 910.3.2. Individual manual controls of each fan unit shall also be provided.

[F] 910.4.4 **Wiring and control.** Wiring for operation and control of smoke exhaust fans shall be connected ahead of the main disconnect and protected against exposure to temperatures in excess of 1,000°F (538°C) for a period of not less than 15 minutes. Controls shall be located so as to be immediately accessible to the fire service from the exterior of the building and protected against interior fire exposure by fire barriers having a fire-resistance rating not less than 1 hour.

[F] 910.4.5 **Supply air.** Supply air for exhaust fans shall be provided at or near the floor level and shall be sized to provide a minimum of 50 percent of required exhaust. Openings for supply air shall be uniformly distributed around the periphery of the area served.

[F] 910.4.6 **Interlocks.** In combination comfort air-handling/smoke removal systems or independent comfort air-handling systems, fans shall be controlled to shut down in accordance with the approved smoke control sequence.

## SECTION 911 FIRE COMMAND CENTER

[F] 911.1 **Features.** Where required by other sections of this code, a fire command center for fire department operations shall be provided. The location and accessibility of the fire command center shall be approved by the fire department. The

fire command center shall be separated from the remainder of the building by not less than a 1-hour fire barrier constructed in accordance with Section 706 or horizontal assembly constructed in accordance with Section 711, or both. The room shall be a minimum of 96 square feet (9 m<sup>2</sup>) with a minimum dimension of 8 feet (2438 mm). A layout of the fire command center and all features required by the section to be contained therein shall be submitted for approval prior to installation. The fire command center shall comply with NFPA 72 and shall contain the following features:

1. The emergency voice/alarm communication system unit.
2. The fire department communications unit.
3. Fire detection and alarm system annunciator unit.
4. Annunciator unit visually indicating the location of the elevators and whether they are operational.
5. Status indicators and controls for air-handling systems.
6. The fire-fighter's control panel required by Section 909.16 for smoke control systems installed in the building.
7. Controls for unlocking stairway doors simultaneously.
8. Sprinkler valve and water-flow detector display panels.
9. Emergency and standby power status indicators.
10. A telephone for fire department use with controlled access to the public telephone system.
11. Fire pump status indicators.
12. Schematic building plans indicating the typical floor plan and detailing the building core, means of egress, fire protection systems, fire-fighting equipment and fire department access.
13. Worktable.
14. Generator supervision devices, manual start and load transfer capabilities and procedures ((~~features~~)).
15. Public address system, where specifically required by other sections of this code.
16. On-site water tank fill-valve control switch.

## SECTION 912 FIRE DEPARTMENT CONNECTIONS

**[F] 912.1 Installation.** Fire department connections shall be installed in accordance with the NFPA standard applicable to the system design and shall comply with Sections 912.2 through 912.5.

**[F] 912.2 Location.** With respect to hydrants, driveways, buildings and landscaping, fire department connections shall be so located that fire apparatus and hose connected to supply the system will not obstruct access to the buildings for other fire apparatus. The location of fire department connections shall be approved.

**[F] 912.2.1 Visible location.** Fire department connections shall be located on the street side of buildings, fully visible and recognizable from the street or nearest point of fire

department vehicle access or as otherwise approved by the fire code official.

**[F] 912.2.2 Existing buildings.** On existing buildings, wherever the fire department connection is not visible to approaching fire apparatus, the fire department connection shall be indicated by an approved sign mounted on the street front or on the side of the building. Such sign shall have the letters "FDC" at least 6 inches (152 mm) high and words in letters at least 2 inches (51 mm) high or an arrow to indicate the location. All such signs shall be subject to the approval of the fire code official.

**[F] 912.3 Access.** Immediate access to fire department connections shall be maintained at all times and without obstruction by fences, bushes, trees, walls or any other object for a minimum of 3 feet (914 mm).

**[F] 912.3.1 Locking fire department connection caps.** The fire code official is authorized to require locking caps on fire department connections for water-based fire protection systems where the responding fire department carries appropriate key wrenches for removal.

**[F] 912.4 Signs.** A metal sign with raised letters at least 1 inch (25 mm) in size shall be mounted on all fire department connections serving automatic sprinklers, standpipes or fire pump connections. Such signs shall read: AUTOMATIC SPRINKLERS, STANDPIPES or TEST CONNECTION, or a combination thereof as applicable.

**[P] 912.5 Backflow protection.** The potable water supply to automatic sprinkler and standpipe systems shall be protected against backflow as required by the ((~~International~~)) *Uniform Plumbing Code*.