

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, inspection, operation, testing and maintenance of all fire protection systems.

901.2 Construction documents. The Fire Code Official shall have the authority to require construction documents and calculations for all fire protection systems and to require permits be issued for the installation, rehabilitation or modification of any fire protection system. Construction documents for fire protection systems shall be submitted for review and approval prior to system installation.

901.2.1 Statement of compliance. Before requesting final approval of the installation, where required by the fire code official, the installing contractor shall furnish a written statement to the fire code official that the subject fire protection system has been installed in accordance with approved plans and has been tested in accordance with the manufacturer's specifications and the appropriate installation standard. Any deviations from the design standards shall be noted and copies of the approvals for such deviations shall be attached to the written statement.

901.3 Permits. Permits shall be required as set forth in Section 105.6 and 105.7.

901.3.1 Modifications. No person shall remove or modify any fire protection system installed or maintained under the provisions of this code without approval by the Building Official and the Fire Code Official.

901.4 Installation. Fire protection systems shall be installed and maintained in accordance with the original installation standards for that system. Required systems shall be extended, altered, or augmented as necessary to maintain and continue protection whenever the building is altered, remodeled or added to. Alterations to fire protection systems shall be done in accordance with applicable standards.

901.4.1 Required fire protection systems. Fire protection systems required by this code or the *International Building Code* shall be installed, repaired, operated, tested and maintained in accordance with this code.

901.4.2 Nonrequired fire protection systems. Any fire protection system or portion thereof not required by this code or the *International Building Code* shall be allowed to be furnished for partial or complete protection provided such installed system meets the requirements of this code and the *International Building Code*.

901.4.3 Additional fire protection systems. In occupancies or sites of a hazardous nature, where special hazards exist in addition to the normal hazards of the occupancy or site, or where the fire code official determines that access for fire

apparatus is unduly difficult, the Fire Code Official shall have the authority to require additional safeguards. Such safeguards include, but shall not be limited to, the following: automatic fire detection systems, fire alarm systems, automatic fire-extinguishing systems, standpipe systems, or portable or fixed extinguishers. Fire protection equipment required under this section shall be installed in accordance with this code and the applicable referenced standards.

901.4.4 Appearance of equipment. Any device that has the physical appearance of life safety or fire protection equipment but that does not perform that life safety or fire protection function, shall be prohibited.

901.5 Installation acceptance testing. Fire detection and alarm systems, fire-extinguishing systems, fire hydrant systems, fire standpipe systems, fire pump systems, private fire service mains and all other fire protection systems and appurtenances thereto shall be subject to acceptance tests as contained in the installation standards and as approved by the fire code official. The fire code official shall be notified before any required acceptance testing.

901.5.1 Occupancy. It shall be unlawful to occupy any portion of a building or structure until the required fire protection systems have been tested and approved.

901.6 Inspection, testing and maintenance. Fire detection, alarm and extinguishing systems shall be maintained in an operative condition at all times, and shall be replaced or repaired where defective. It shall be the responsibility of the owner to ensure that these requirements are met. Nonrequired fire protection systems and equipment shall be inspected, tested and maintained or removed. Prior to the removal of any fire protection system, a permit shall be obtained from the fire code official.

901.6.1 Standards. Fire protection systems shall be installed, inspected, tested and maintained in accordance with the referenced standards listed in Table 901.6.1 and Chapter 45.

**TABLE 901.6.1
FIRE PROTECTION SYSTEM MAINTENANCE STANDARDS**

SYSTEM	STANDARD
Portable fire extinguishers	NFPA 10
Carbon dioxide fire-extinguishing system	NFPA 12
Halon 1301 fire-extinguishing systems	NFPA 12A
Dry-chemical extinguishing systems	NFPA 17
Wet-chemical extinguishing systems	NFPA 17A
Water-based fire protection systems	NFPA 25
Fire alarm systems	NFPA 72
Water-mist systems	NFPA 750
Clean-agent extinguishing systems	NFPA 2001

901.6.2 Records. Records of all system inspections, tests and maintenance required by the referenced standards shall be maintained on the premises for a minimum of three years and shall be copied to the fire code official upon request.

901.6.2.1 Records information. Initial records shall include the name of the installation contractor, type of components installed, manufacturer of the components, location and number of components installed per floor. Records shall also include the manufacturers' operation and maintenance instruction manuals. Such records shall be maintained on the premises.

901.6.3 Inspections and tests. At a minimum, all fire protection systems shall be inspected and tested annually by a contractor licensed by the State of Arizona and has a current Business Certificate issued by the Phoenix Fire Department to work on the particular fire protection system being inspected or tested (see Section 105.6).

Kitchen hood extinguishing systems shall be inspected and tested every six months by a contractor who has a current Business Certificate issued by the Phoenix Fire Department.

Exception: In Group R-3 occupancies, the owner shall be responsible for inspecting and testing all fire protection and detection systems.

901.6.4 Inspection forms. Inspection and test records shall be documented on forms that comply with the appropriate inspection standard. The forms shall clearly identify type and quantities of all components inspected or tested and identify all deficiencies found. Deficiencies shall be identified by the appropriate code or standard referenced.

Inspection and test reports and records shall include the name of the company performing the inspection or test, the Phoenix Fire Department business certificate number, and the printed name and signature of the company representative performing the inspection and tests.

901.6.5 Inspection and testing tags. Upon completion of the inspection and testing of fire protection systems, a tag shall be attached to the system in a conspicuous location. The tag shall document: the date of inspection or test, the name and business certificate number of the fire protection company, the name of the individual performing the inspection and tests, and a statement of compliance or noncompliance with code requirements. When a deficiency report is issued a copy shall be sent to the Division of Fire Prevention. Copy shall be signed by the building representative.

901.7 Systems out of service. Where a required fire protection system is out of service, the Phoenix Fire Department Alarm Room, 602-495-5555, and the Fire Code Official shall be notified immediately. Where required by the fire code official, the building shall either be evacuated or an approved fire watch shall be provided for all occupants left unprotected by the shut down until the fire protection system has been returned to service.

Where utilized, fire watches shall be provided with at least one approved means for notification of the fire department, and their only duty shall be to perform constant patrols of the pro-

TECTED PREMISES AND KEEP WATCH FOR FIRES. Fire watch shall be in accordance with Section 113.

Exception: Group R-3 occupancies.

901.7.1 Impairment coordinator. The building owner shall assign an impairment coordinator to comply with the requirements of this section. In the absence of a specific designee, the owner shall be the impairment coordinator.

901.7.2 Impairment tag required. A tag shall be used to indicate that a system, or portion thereof, has been removed from service.

901.7.3 Placement of tag. The tag shall be posted at each fire department connection, system control valve, fire alarm control unit, fire alarm annunciator and fire command center, indicating which system, or part thereof, has been removed from service.

901.7.4 Preplanned impairment programs. Preplanned impairments shall be authorized by the impairment coordinator. Before authorization is given, the impairment coordinator shall be responsible for verifying that all of the following procedures have been implemented:

1. The extent and expected duration of the impairment have been determined.
2. The areas or buildings involved have been inspected and the increased risks determined.
3. Recommendations have been submitted to management or building owner/manager.
4. The Phoenix Fire Department Alarm room has been notified at 602-495-5555.
5. The insurance carrier, the alarm company, building owner/manager, and other authorities having jurisdiction have been notified.
6. The occupants in the areas to be affected have been notified.
7. A tag impairment system has been implemented.
8. Additional procedures as determined by the impairment coordinator.

901.7.5 Emergency impairments. When unplanned impairments occur, appropriate emergency action shall be taken to minimize potential injury and damage. The impairment coordinator shall implement the steps outlined in Section 901.7.4.

901.7.6 Restoring systems to service. When impaired equipment is restored to normal working order, the impairment coordinator shall verify that all of the following procedures have been implemented:

1. Necessary inspections and tests have been conducted to verify that affected systems are operational.
2. Occupants in the affected area have been advised that protection is restored.
3. The Phoenix Fire Department Alarm Room has been advised that protection has been restored. Call 602-495-5555.

4. The building owner/manager, insurance carrier, alarm company and other involved parties have been advised that protection is restored.
5. The impairment tag has been removed.

901.8 Removal of or tampering with equipment. It shall be unlawful for any person to remove, tamper with or otherwise disturb any fire hydrant, fire detection and alarm system, fire suppression system, or other fire appliance required by this code except for the purpose of extinguishing fire, training purposes, recharging or making necessary repairs, or when approved by the Fire Code Official.

901.8.1 Removal of or tampering with appurtenances.

Locks, gates, key boxes, key switches, preemption devices doors, barricades, chains, enclosures, signs, tags or seals which have been installed by or at the direction of the fire code official shall not be removed, unlocked, destroyed, tampered with or otherwise vandalized in any manner.

901.9 Recall of fire protection components. Any fire protection system component regulated by this code that is the subject of a voluntary or mandatory recall under federal law shall be replaced with approved, listed components in compliance with the referenced standards of this code. The Fire Code Official shall be notified in writing by the building owner when the recalled component parts have been replaced.

901.10 Clearance around fire-protection systems and equipment. A minimum 3-foot (914 mm) clear space shall be maintained for access to fire protection equipment, including control valves and control panels.

901.11 Systems in high-rise buildings. The owner of a high-rise building shall be responsible for ensuring that the fire and life-safety systems required by the *Phoenix Building Code* are maintained in an operable condition at all times. Unless otherwise required by the Fire Code Official, quarterly tests of such systems shall be conducted by approved persons. A written record shall be maintained and shall be made available to the inspection authority.

901.12 Smoke-control systems. Mechanical smoke-control systems, such as those in high-rise buildings, buildings containing atria, covered mall buildings and mechanical ventilation systems utilized in smoke proof enclosures and for smoke-removal systems utilized in high-piled combustible storage occupancies, shall be maintained in an operable condition at all times. Unless otherwise required by the Fire Code Official, quarterly tests of such systems shall be conducted by approved persons. A written record shall be maintained and shall be made available to the inspection authority.

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.

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.

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

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.

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.

AUDIBLE ALARM NOTIFICATION APPLIANCE. A notification appliance that alerts by the sense of hearing.

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.

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.

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.

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

CARBON DIOXIDE EXTINGUISHING SYSTEM. A system supplying carbon dioxide (CO₂) from a pressurized vessel through fixed pipes and nozzles. The system includes a manual- or automatic-actuating mechanism.

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

COMMON AREA. For the purposes of the Americans with Disabilities Act (ADA) compliance for visual notification, a common area shall be a room, space, or element made available for the use of a restricted group of people (for example, occupants of a homeless shelter; the occupants of an office building, or the guests of such occupants). Common areas shall include restrooms, hallways, lobbies, meeting and conference rooms, classrooms, cafeterias, filing and photocopy rooms, employee break rooms, open office areas exceeding 300 square feet (28 m²), examination and treatment rooms, and similar areas that are not used solely as employee work areas in accordance with the U.S. Access Board Technical Bulletin on Visual Alarms. Mechanical, electrical and telephone closets, janitor's closets,

and similar nonoccupiable spaces that are not common areas or assigned work areas are not required to have visual alarms.

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.

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 area as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto.

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.

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.

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

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.

FIRE ALARM BOX, MANUAL. See “Manual fire alarm box.”

FIRE ALARM CONTROL PANEL. See “Fire alarm control unit.”

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) of 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 of devices.

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.

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.

[B] FIRE AREA. The aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls, or fire-resistance-rated horizontal assemblies of a building.

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

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.

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 the harmful effects of fire.

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

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.

IMPAIRMENT COORDINATOR. The person responsible for the maintenance of a particular fire protection system.

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.

MANUAL FIRE ALARM BOX. A manually operated device used to initiate an alarm signal.

MULTIPLE-STATION ALARM DEVICE. Two or more single-station alarm devices that can be interconnected 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.

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.

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.

PRIMARY STRUCTURAL SYSTEM. A system that consists of beams, trusses, joists, columns, slabs (floors), roofs and load bearing walls incorporated by design to support gravity loads and resist lateral forces.

FPN: The intent is to require all buildings that have fire damage to the structure to install sprinkler systems.

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.

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.

[B] SLEEPING UNIT. A room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such rooms and spaces that are also part of a dwelling unit are not sleeping units.

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

SMOKE DETECTOR. A listed device that senses visible or invisible particles of combustion.

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 2½-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.

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 a 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 supply the system demand.

Manual wet. A wet standpipe system connected to a water supply for the purpose of maintaining water within the system but which 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 supply 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.

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

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.

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.

SUPERVISORY SIGNAL-INITIATING DEVICE. An initiating 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.

TIRES, BULK STORAGE OF. Storage of tires where the area available for storage exceeds 20,000 cubic feet (566 m³).

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

VISIBLE ALARM NOTIFICATION APPLIANCE. A notification appliance that alerts by the sense of sight.

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

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

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

903.1 General. Automatic sprinkler system shall comply with the requirements of this Sections 903.2 and 903.2.2, whichever is more restrictive.

903.1.1 Design documents. For fire sprinkler systems, the following are considered to be professional registrant activities in accordance with the requirements of the Arizona Board of Technical Registration:

1. Consider the range of hazards of the project;
2. Prepare hazard analysis; identify the hazard classification of the intended occupancy, including any special hazards;
3. Determine the applicable codes and standards and appropriate engineering practices;
4. Ascertain the availability and adequacy of the water supply for the project; and
5. Determine the appropriate design density and area of operation for each hazard area.

These activities need to be completed prior to development of construction documents to be submitted for permit.

Exception: Automatic sprinkler systems installed in accordance with NFPA 13D.

Design document shall be sealed and signed in accordance with Arizona Revised Statutes Title 32, Chapter 1.

Exception: Where the occupancy hazard or commodity does not change to a higher hazard in accordance with NFPA 13, modifications of fire protection systems do not require sealed plans.

903.1.1.1 Owner responsibilities. The owner of a building or structure, where the fire sprinkler system is going to be installed, or the owner's authorized agent shall provide the design professional with the following information prior to preparation of design documents.

1. Intended use of the building.
2. A description of the materials to be used or stored within the building.
3. A description of how the materials are to be used in the building.
4. A description of the commodity stored and proposed storage configuration including the maximum height.
5. A preliminary plan of the building or structure along with the design concepts necessary to prepare the design documents listed in Section 903.1.1.
6. Speculative buildings shall be in accordance with Chapter 23.

These activities need to be completed prior to development of construction documents to be submitted for permit.

Exception: Automatic sprinkler systems installed in accordance with NFPA 13D.

903.1.2 Construction documents. Construction documents shall be in accordance with NFPA 13.

903.1.3 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 building and fire code official.

903.1.4 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.

903.2 Bret Tarver Sprinkler Ordinance. An approved automatic sprinkler system shall be installed throughout all levels of all new Group A, B, E, F, H, I, M, R-1, R-2, R-4, and S occupancies of more than zero square feet and throughout all Group R-3 occupancies built under the *International Residential*

Code and Group U occupancies of more than 5,000 square feet (464 m²).

The calculated area of Group R-3 occupancies shall include all livable space and the area of any attached garage and carports, aircraft hangar or areas located under living spaces.

Automatic sprinkler systems shall be installed in accordance with NFPA 13 for Group A, B, E, F, H, I, M, R-1, R-2, R-4 and S occupancies. NFPA 13R for residential occupancies up to and including four stories in height, in Group R-1, R-2, R-4 occupancies and NFPA 13D for one- and two-family dwellings and mobile homes in Group R-3 and R-4 occupancies with 6-10 licensed beds. Exceptions to or reductions in code requirements are not allowed for the installation of residential sprinkler systems installed in accordance with NFPA 13R and NFPA 13D unless specifically allowed by the *International Building Code*.

Exceptions:

1. Detached gazebos, temporary tents and ramadas for residential and public use.
2. Independent buildings such as restrooms or snack shops 600 square feet (56 m²) or less that are of noncombustible construction associated with golf courses, parks, and similar uses.
3. Guardhouses that are less than 300 square feet (28 m²) in size used to control access to or within residential and/or commercial developments of combustible construction or 600 square feet (56 m²) or less that are of noncombustible construction.
4. Detached equipment or storage buildings for commercial use not exceeding 300 square feet (28 m²).
5. Detached noncombustible canopies used exclusively for automotive, motor fuel-dispensing stations not exceeding 5,000 square feet (464 m²) or detached noncombustible carports or parking canopies regardless of size.
6. Manufactured (Mobile) homes built on a permanent chassis designed, built and occupied as a dwelling unit and recreational vehicles that were not site built and are portable in nature.
7. Factory built buildings utilized as temporary office buildings similar to real estate leasing offices and construction offices.

903.2.1 Retrofit. Existing buildings are required to comply with the provisions of Section 903.2.1 when any of the following apply:

903.2.1.1 Retrofit in Group R-3 occupancies. Existing Group R-3 occupancies shall be protected by an automatic fire sprinkler system when:

1. One or more additions are made within any 3-year period; and
2. The aggregate of the additions exceeds 50 percent of the square footage of the house as of June 17, 2002; and
3. The new total area of the building is greater than 5,000 square feet (464 m²).

The calculated area of Group R-3 occupancies shall include all livable space and the area of any attached garage, carports, aircraft hangar or basement.

903.2.1.2 Retrofit in all other occupancies.

1. Building additions other than Group R-3 that equal 50 percent or more of the existing building floor area, or exceed 10,000 square feet (929 m²); whichever is less.
2. Two or more building permits related to increased square footage are issued over any three consecutive years where:
 - 2.1. The aggregate of the additions exceeds 50 percent of the square footage of the building as of June 17, 2002.
 - 2.2. The new total area of the building is greater than 10,000 square feet (929 m²).

903.2.1.2.1 Building remodels. An automatic fire sprinkler system shall be installed when 50 percent or more of the roof assembly is replaced or repaired due to fire damage or structural failure or, when the removal of existing fire-rated assemblies' results in an increase of the original basic allowable area.

903.2.1.2.2 Change of occupancy within hazard Level 1. An automatic fire sprinkler system shall be installed when a building, regardless of the building area, undergoes a change of occupancy within hazard Level 1 as defined by Table 903.2.1.3.

903.2.1.2.3 Change of occupancy over 2,500 square feet. An automatic fire sprinkler system shall be installed in any building 2,500 square feet (232 m²) or greater that undergoes a change of occupancy.

903.2.1.2.4 Change of occupancy under 2,500 square feet. An automatic fire sprinkler system shall be installed in any building under 2,500 square feet (232 m²) that undergoes a change of occupancy to a higher hazard level as defined by Table 903.2.1.3.

TABLE 903.2.1

HAZARD LEVEL	1997 UFC BUILDING OCCUPANCY TYPE	2006 IFC OCCUPANCY TYPE
1 (Highest)	H, I, A, R-1	H, I, A, R-1, R-2, R-4, S-3
2	S-1, S-5, F-1	S-1, F-1
3	E, F-2, S-2, S-3, S-4	E, F-2, S-2
4 (Lowest)	B, M, U, R-3	B, M, U, R-3

903.2.1.2.5 Sprinkler systems—partially sprinklered buildings. When existing nonsprinklered buildings of mixed occupancy are required to install sprinklers based on a change of occupancy classification, sprinklers shall be installed throughout the fire area that includes the new occupancy. The fire-resistance rating of fire barriers or horizontal assemblies separating sprinklered and nonsprinklered fire areas shall be a minimum of 2

hours. Fire department connection signage shall be in accordance with Section 912.

903.2.2 Occupancy specific requirements of the International Fire Code.

903.2.2.1 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. For Group A-5 occupancies, the automatic sprinkler system shall be provided in the spaces indicated in Section 903.2.1.5.

903.2.2.1.1 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 m²);
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; or The fire area contains a multi-theater complex.

903.2.2.1.2 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 m²);
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.

903.2.2.1.3 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 m²);
2. The fire area has an occupant load of 300 or more; or
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.

903.2.2.1.4 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 m²);

FIRE PROTECTION SYSTEMS

2. The fire area has an occupant load of 300 or more; or
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.

903.2.2.1.5 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 m²).

903.2.2.2 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 m²) 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.

903.2.2.3 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 m²);
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 m²).

903.2.2.3.1 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 in area (232 m²) which generate finely divided combustible waste or which use finely divided combustible materials.

903.2.2.4 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.

903.2.2.4.1 General. An automatic sprinkler system shall be installed in Group H occupancies.

903.2.2.4.2 Group H-5 occupancies. 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 under the *International Building Code* for the occupancy hazard classifications in accordance with Table 903.2.2.4.2.

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.

**TABLE 903.2.2.4.2
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

903.2.2.4.3 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).

903.2.2.5 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.

903.2.2.6 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 m²);
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 m²).

903.2.2.6.1 High-piled storage. An automatic sprinkler system shall be provided as required in Chapter 23 in all buildings of Group M where storage of merchandise is in high-piled or rack storage arrays.

903.2.2.7 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.

903.2.2.8 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 m²);
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 m²).

903.2.2.8.1 Repair garages. An automatic sprinkler system shall be provided throughout all buildings used as repair garages in accordance with the *International Building Code*, as follows:

1. Buildings two or more stories in height, including basements, with a fire area containing a repair garage exceeding 10,000 square feet (929 m²).
2. One-story buildings with a fire area containing a repair garage exceeding 12,000 square feet (1115 m²).
3. Buildings with a repair garage servicing vehicles parked in the basement.

903.2.2.8.2 Bulk storage of tires. Buildings and structures where the area for the storage of tires exceeds 20,000 cubic feet (566 m³) shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

903.2.2.9 Group S-2. An automatic sprinkler system shall be provided throughout buildings classified as enclosed parking garages in accordance with Section 406.4 of the *International Building Code* or where located beneath other groups.

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

903.2.2.9.1 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 m²).

903.2.2.10 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: Groups R-3 and U.

903.2.2.10.1 Stories and basements without openings. An automatic sprinkler system shall be installed in every story or basement of all buildings where the floor area exceeds 1,500 square feet (139.4 m²) 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 m²) in each 50 linear feet (15 240 mm), or fraction thereof, of exterior wall in the story on at least one side.

903.2.2.10.1.1 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.

903.2.2.10.1.2 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.

903.2.2.10.1.3 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.

903.2.2.10.2 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.

903.2.2.10.2.1 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.

903.2.2.11 During construction. Automatic sprinkler systems required during construction, alteration and demolition operations shall be provided in accordance with Chapter 14.

903.2.2.12 Other hazards. Automatic sprinkler protection shall be provided for the hazards indicated in Sections 903.2.2.12.1 and 903.2.2.12.2.

903.2.2.12.1 Ducts conveying hazardous exhausts.

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

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

903.2.2.12.2 Commercial cooking operations. An automatic sprinkler system shall be installed in a com-

mercial kitchen exhaust hood and duct system where an automatic sprinkler system is used to comply with Section 904.

903.2.2.13 Other required suppression systems. In addition to the requirements of Section 903.2, the provisions indicated in Table 903.2.2.13 also require the installation of a suppression system for certain buildings and areas.

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

903.3.1 Standards. Sprinkler systems shall be designed and installed in accordance with Sections 903.3.1.2 or 903.3.1.3.

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.

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.

903.3.1.2.2 Exterior storage closets. Sprinkler protection shall be extended into attached exterior storage closets in Group R-1 and R-2 occupancies protected by sprinkler systems installed according to NFPA 13R.

903.3.1.2.3 Attached garages, carports and balconies. Attached garages, carports with living space directly above or adjacent to shall be provided with sprinkler protection. Open patios or balconies with living spaces directly above or adjacent to shall be provided with sprinkler protection.

903.3.1.2.4 Residential combination services. With Water Services Department approval, a single combination water supply shall be permitted provided that the domestic demand is added to the sprinkler demand as required by NFPA 13R.

903.3.1.3 NFPA 13D sprinkler systems. Where allowed, automatic sprinkler systems installed in one- and two-family dwellings shall be installed throughout in accordance with NFPA 13D.

903.3.1.3.1 Attached garages, carports and balconies. Attached garages and carports shall be provided with sprinkler protection. Open patios or balconies with living spaces directly above or adjacent to shall be provided with sprinkler protection.

903.3.1.3.2 Domestic services. Where the domestic service provides the water supply for the automatic sprinkler system, the supply shall be in accordance with this section.

903.3.1.3.3 Residential combination services. A single combination water supply shall be permitted provided that the domestic demand is added to the sprinkler demand as required by NFPA 13D.

903.3.1.3.4 Sizing of residential water meters for combined fire sprinkler and domestic sprinkler systems. When a water meter is installed in a NFPA 13D sprinkler system, the meter shall be sized to meet the greater domestic or fire flow demand.

FPN: One- and two-family homes equipped with a sprinkler system installed in accordance with NFPA 13D utilizing a combined fire/domestic supply line are required by the City Water Services Department to be provided with a water meter. The flow allowed by the meter shall be adequate to supply the system demand (see NFPA 13D, 2007 ed., Section 8.4.4). The meter shall be sized to provide for the required sprinkler flow according to the manufacturer's listing for the "Maximum Continuous Operation" given in gallons per minute and shall be a minimum of 3/4-inch (19 mm). The meter is also required to be sized in a different manner for the domestic water flow demand (see DSD Technical Guideline—Water Meter Sizing, February 19, 2002). The meter shall be sized to meet the greatest flow demand (domestic or fire).

The City of Phoenix currently uses the Record All Cold Water Bronze Disk Meter manufactured by Badger Meter, Inc. Each of these meters is acceptable for sprinkler waterflow demand as follows:

- a) A 5/8 by 3/4-inch (16 by 19 mm) meter is acceptable for flows up to 24 gpm (914 L/m);*
- b) A 3/4-inch (19 mm) meter is acceptable for flows up to 35 gpm (132 L/m);*
- c) A 1-inch (25 mm) meter is acceptable for flows up to 50 gpm (189 L/m); and*
- d) A 1 1/2-inch (38 mm) meter is acceptable for flows of 51 - 70 gpm (193 to 265 L/m).*

Note that these flow capacities are subject to change if the type and/or manufacturer of the meters is changed.

903.3.1.3.5 Sprinkler design requirements. Sprinkler design shall be based on the hazard classification of the building or area in accordance with NFPA 13. Automatic sprinkler designs for high-piled storage shall be in accordance with Chapter 23.

903.3.1.4 Changes in commodity hazard. Changes of commodity to a higher hazard classification or storage

**TABLE 903.2.2.13
ADDITIONAL REQUIRED FIRE-EXTINGUISHING SYSTEMS**

SECTION	SUBJECT
914.2.1	Covered malls
914.3.1	High rise buildings
914.4.1	Atriums
914.5.1	Underground structures
914.6.1	Stages
914.7.1	Special amusement buildings
914.8.2, 914.8.5	Aircraft hangars
914.9	Flammable finishes
914.10	Drying rooms
1025.6.2.3	Smoke-protected seating
1208.2	Dry cleaning plants
1208.3	Dry cleaning machines
1504.2	Spray finishing in Group A, E, I or R
1504.4	Spray booths and spray rooms
1505.2	Dip-tank rooms in Group A, I or R
1505.4.1	Dip tanks
1505.9.4	Hardening and tempering tanks
1803.10	HPM facilities
1803.10.1.1	HPM work station exhaust
1803.10.2	HPM gas cabinets and exhausted enclosures
1803.10.3	HPM exit access corridor
1803.10.4	HPM exhaust ducts
1803.10.4.1	HPM noncombustible ducts
1803.10.4.2	HPM combustible ducts
1907.3	Lumber production conveyor enclosures
1908.7	Recycling facility conveyor enclosures
2106.1	Class A and B ovens
2106.2	Class C and D ovens
2209.3.2.6.2	Hydrogen motor fuel-dispensing area canopies
Table 2306.2	Storage fire protection
2306.4	Storage
2703.8.4.1	Gas rooms
2703.8.5.3	Exhausted enclosures
2704.5	Indoor storage of hazardous materials
2705.1.8	Indoor dispensing of hazardous materials
2804.4.1	Aerosol warehouses
2806.3.2	Aerosol display and merchandising areas
2904.5	Storage of more than 1,000 cubic feet of loose combustible fibers
3306.5.2.1	Storage of smokeless propellant
3306.5.2.3	Storage of small arms primers

(continued)

**TABLE 903.2.2.13—continued
ADDITIONAL REQUIRED FIRE-EXTINGUISHING SYSTEMS**

SECTION	SUBJECT
3404.3.7.5.1	Flammable and combustible liquid storage rooms
3404.3.8.4	Flammable and combustible liquid storage warehouses
3405.3.7.3	Flammable and combustible liquid Group H-2 or H-3 areas
3704.1.2	Gas cabinets for highly toxic and toxic gas
3704.1.3	Exhausted enclosures for highly toxic and toxic gas
3704.2.2.6	Gas rooms for highly toxic and toxic gas
3704.3.3	Outdoor storage for highly toxic and toxic gas
4106.2.2	Exhausted enclosures or gas cabinets for silane gas
4204.1.1	Pyroxylin plastic storage cabinets
4204.1.3	Pyroxylin plastic storage vaults
4204.2	Pyroxylin plastic storage and manufacturing

For SI: 1 cubic foot = 0.023 m³.

configuration that exceeds the capabilities of the existing sprinkler system design shall require the sprinkler system to be modified. The sprinkler system shall be modified to provide an approved design in accordance with NFPA 13, or other applicable design standard, for the commodity present in the building or area.

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 the *International Building Code*.
2. Dwelling units and sleeping units in Group R and I-1 occupancies.
3. Light-hazard occupancies as defined in NFPA 13.

903.3.2.1 Installation of quick response sprinklers in existing light hazard occupancy sprinkler systems being modified. When existing occupancies and sprinkler systems are being remodeled or renovated, existing standard response sprinklers shall be replaced with quick response sprinklers as follows:

1. Existing standard response sprinklers shall be replaced with quick response sprinklers when all sprinklers are being replaced in an area segregated by construction and openings have a minimum 8-inch (208 mm) lintel, and
2. When an existing system with standard response sprinklers is being modified, the standard response sprinklers shall be replaced with quick-response sprinklers throughout the tenant space, floor or suite when more than 50 percent of the sprinklers

in the space, floor, or suite are being added or relocated.

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. Automatic sprinklers shall be installed in or under covered kiosks, displays, booths, concession stands, or equipment that exceeds 4 feet (1219 mm) in width. Not less than a 3-foot (914 mm) clearance shall be maintained between automatic sprinklers and the top of piles of combustible fibers.

Exception: Kitchen equipment under exhaust hoods protected with a fire-extinguishing system in accordance with Section 904.

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

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 *Arizona State Plumbing Code*.

903.3.5.1 Water supply tests. Hydrant flow tests used to design sprinkler systems, standpipe systems, and fire supply mains shall be performed on public hydrants by the City of Phoenix Water Services Department within 180 days of fire plans submittal. A copy of the City's hydrant flow test report shall be submitted with the construction documents and calculations. When conducting a hydrant flow test for the design of automatic fire sprinkler systems, the minimum flow volume of the test shall meet or exceed the system demand.

903.3.5.2 Water supply tests on private hydrants. Hydrant flow tests performed on private hydrants by the property owner or his representative to be used in the design of fire protection systems shall be witnessed by the Phoenix Fire Department or a registered design professional. When conducting a hydrant flow test for the design of automatic fire sprinkler systems, the minimum flow volume of the test shall meet or exceed the system demand.

903.3.5.3 Sprinkler design safety factor. Sprinkler systems for NFPA 13, 13R and 13D systems shall be designed with a minimum safety factor as follows:

1. When the static pressure exceeds 90 psi (621 kPa), the maximum design static pressure shall be 80 psi (552 kPa) regardless of actual test pressure. The slope of the original water supply curve shall be used even though the design pressure is reduced to 80 psi (552 kPa).

The actual flow test pressures shall be used to determine the need for sizing fire pumps, pressure reducing valves, and hanger requirements in accordance with NFPA 13, 13D and 13R.

2. When the static pressure is less than 90 psi (621 kPa), a minimum 10 psi (69 kPa) safety factor shall be provided between the available water supply and the system flow and pressure demand and shall include hose stream allowances required by NFPA 13, 13D and 13R.

903.3.5.4 Protection of exterior exposed sprinkler system components. Protection for exterior exposed sprinkler system components shall be as follows:

1. Sprinkler pipe and components located on the exterior of a building shall be either galvanized or painted to protect from corrosion.
2. Sprinkler pipe other than steel, smaller than 2-inches (51 mm) in diameter and installed in unheated areas shall be insulated to protect from freezing. Providing insulation on any exterior piping part of the sprinkler system or its supply smaller than 2 inches (51 mm) in diameter is an allowable alternative.
3. Hydraulic design information signs shall be metal with the information maintained clearly and permanently stamped onto the sign.

903.3.5.5 Domestic services. Where the domestic service provides the water supply for the automatic sprinkler system, the supply shall be in accordance with this section.

903.3.5.5.1 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.

903.3.5.5.2 Residential combination services. A single combination water supply shall be allowed provided that the domestic demand is added to the sprinkler demand as required by NFPA 13R.

903.3.5.6 Secondary water supply. A secondary on-site water supply equal to the hydraulically calculated sprinkler demand, including the hose stream requirement, shall be provided for high-rise buildings in Seismic Design Category C, D, E or F as determined by the *International Building Code*. The secondary water supply shall have a duration of not less than 30 minutes as deter-

mined by the occupancy hazard classification in accordance with NFPA 13.

Exception: Existing buildings.

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.

903.3.7 Fire department connections. The location of fire department connections shall be installed according to NFPA 13 and Section 912 of this code.

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.

Automatic sprinkler systems in residential occupancies classified as Group R-4 (per IBC 310.1) shall be electrically supervised for water flow.

Exceptions: Backflow-preventer or post indicator valves shall be supervised by one of the following methods:

- A) A local signaling service that will initiate an audible signal at a constantly attended location.
- B) Valves locked in the open position and inspected monthly in accordance with an approved procedure.
 - 1. Automatic sprinkler systems protecting Group R-3 occupancies.
 - 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 system, 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.

903.4.1 Signals. Alarm, supervisory and trouble signals shall be distinctly different and shall be 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.

Exceptions:

- 1. Underground key or hub valves in roadway boxes.

- 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.

903.4.1.1 Monitoring at a constantly attended location. When monitoring of sprinkler system is required per Section 903.4.1, the facilities owner may request to monitor the system(s) at the facility site using facility personnel. Where the alarm monitoring station does not strictly comply with the NFPA 72 requirements for a proprietary supervising station, the following minimum provisions shall be met and approved by the Fire Code Official.

- 1. The policies and procedures for monitoring the sprinkler system shall be written and submitted to the Fire Code Official for approval prior to occupancy or terminating central station service or remote service. A copy of the approved fire alarm policies and procedures shall be maintained at the constantly attended location.
- 2. The alarm monitoring station shall be constantly attended by competent trained personnel. At least one person shall monitor the fire alarm panel at all times. Provisions shall be made to relieve the alarm monitor prior to shift changes, during breaks, or performance of other assigned duties outside of the alarm monitoring room.
- 3. A list of trained personnel qualified to monitor the sprinkler system shall be maintained at the alarm monitoring station. Documentation of the alarm monitoring training shall be approved by the Fire Code Official and maintained at the alarm monitoring station and made available to the Fire Code Official on request.
- 4. The policies and procedures shall address the dispensation of the various fire alarm signals. The fire department shall be immediately notified upon the activation of a fire alarm signal (smoke or heat detector, sprinkler water flow, manual pull station, special extinguishing system, etc.). Any investigation by the facility staff shall occur after or concurrent to notification of the fire department. If the investigation by facility staff determines that there is no emergency condition at the facility, the fire department shall be immediately notified to allow them to modify their response.
- 5. The fire department shall not be summoned for emergency response upon receipt of a supervisory or trouble signal, but procedures shall address dispensation of those signals by facility personnel.
- 6. A log shall be maintained at the monitoring station that note all of the signals received and the dispensation of those signals. The log sheet shall be made available to the Phoenix Fire Department on request.

903.4.1.2 Multitenant buildings with different addresses. The alarm monitoring station shall identify all addresses of buildings or suites protected by the same sprinkler system and provide this information to the Phoenix Fire Department alarm room center.

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.

903.4.2.1 Fire alarm systems. Fire alarm systems required by the provisions of Section 903 of this code shall be monitored by an approved supervising station in accordance with Section 903.4.1.1.

Exceptions:

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

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.

903.5 Testing and maintenance. Sprinkler systems shall be tested and maintained in accordance with Section 901.

903.6 Existing buildings. The provisions of this section are intended to provide a reasonable degree of safety in existing structures not complying with the minimum requirements of the *International Building Code* by requiring installation of an automatic fire-extinguishing system.

903.6.1 Pyroxylin plastics. All structures occupied for the manufacture or storage of articles of cellulose nitrate (pyroxylin) plastic shall be equipped with an approved automatic fire-extinguishing system. Vaults located within buildings for the storage of raw pyroxylin shall be protected with an approved automatic sprinkler system capable of discharging 1.66 gallons per minute per square foot (68 L/min/m²) over the area of the vault.

**SECTION 904
ALTERNATIVE AUTOMATIC FIRE-EXTINGUISHING
SYSTEMS**

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.

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 building and

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.

904.2.1 Commercial hood and duct systems. Each required commercial kitchen exhaust hood and duct system required by Section 609 to have a Type I hood shall be protected with an approved automatic fire-extinguishing system installed in accordance with this code.

904.3 Installation. Automatic fire-extinguishing systems shall be installed in accordance with this section.

904.3.1 Electrical wiring. Electrical wiring shall be in accordance with the *National Electrical Code*.

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.

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.

904.3.4 Alarms and warning signs. Where alarms are required to indicate the operation of automatic fire-extinguishing systems, distinctive audible, 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 occupants once agent discharge has begun. Audible signals shall be in accordance with Section 907.10.2.

904.3.4.1 Kitchen hood systems. When kitchen hood systems are installed in buildings equipped with a fire alarm system designed to notify the building occupants, actuation of the hood system shall initiate the fire alarm system.

904.3.5 Supervision. Where a building fire alarm system is installed, automatic fire-extinguishing systems shall be supervised by the building fire alarm system in accordance with NFPA 72.

Exceptions:

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

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.

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.

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.

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.

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.

904.5 Wet-chemical systems. Wet-chemical extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 17A and their listing.

904.5.1 System test. Systems shall be inspected and tested for proper operation at 6-month intervals in accordance with manufacturer's inspection, testing and maintenance manuals and NFPA 17A. Tests shall include a check of the detection system, alarms and releasing devices, including manual stations and other associated equipment. Extinguishing system units shall be weighed and the required amount of agent verified. Stored pressure-type units shall be checked for the required pressure. The cartridge of cartridge-operated units shall be weighed and replaced at intervals indicated by the manufacturer.

904.5.2 Fusible link maintenance. Fixed temperature-sensing elements shall be maintained to ensure proper operation of the system.

904.6 Dry-chemical systems. Dry-chemical extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 17 and their listing.

904.6.1 System test. Systems shall be inspected and tested for proper operation at 6-month intervals. Tests shall include a check of the detection system, alarms and releasing devices, including manual stations and other associated equipment. Extinguishing system units shall be weighed, and the required amount of agent verified. Stored pressure-type units shall be checked for the required pressure. The cartridge of cartridge-operated units shall be weighed and replaced at intervals indicated by the manufacturer.

904.6.2 Fusible link maintenance. Fixed temperature-sensing elements shall be maintained to ensure proper operation of the system.

904.7 Foam systems. Foam-extinguishing systems shall be installed, maintained, periodically inspected and tested in

accordance with NFPA 11, NFPA 11A and NFPA 16 and their listing.

904.7.1 System test. Foam-extinguishing systems shall be inspected and tested at intervals in accordance with NFPA 25.

904.8 Carbon dioxide systems. Carbon dioxide extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 12 and their listing.

904.8.1 System test. Systems shall be inspected and tested for proper operation at 12-month intervals.

904.8.2 High-pressure cylinders. High-pressure cylinders shall be weighed and the date of the last hydrostatic test shall be verified at 6-month intervals. Where a container shows a loss in original content of more than 10 percent, the cylinder shall be refilled or replaced.

904.8.3 Low-pressure containers. The liquid-level gauges of low-pressure containers shall be observed at one-week intervals. Where a container shows a content loss of more than 10 percent, the container shall be refilled to maintain the minimum gas requirements.

904.8.4 System hoses. System hoses shall be examined at 12-month intervals for damage. Damaged hoses shall be replaced or tested. At 5-year intervals, all hoses shall be tested.

904.8.4.1 Test procedure. Hoses shall be tested at not less than 2,500 pounds per square inch (psi) (17 238 kPa) for high-pressure systems and at not less than 900 psi (6206 kPa) for low-pressure systems.

904.8.5 Auxiliary equipment. Auxiliary and supplementary components, such as switches, door and window releases, interconnected valves, damper releases and supplementary alarms, shall be manually operated at 12-month intervals to ensure that such components are in proper operating condition.

904.9 Halon systems. Halogenated extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 12A and their listing.

904.9.1 System test. Systems shall be inspected and tested for proper operation at 12-month intervals.

904.9.2 Containers. The extinguishing agent quantity and pressure of containers shall be checked at 6-month intervals. Where a container shows a loss in original weight of more than 5 percent or a loss in original pressure (adjusted for temperature) of more than 10 percent, the container shall be refilled or replaced. The weight and pressure of the container shall be recorded on a tag attached to the container.

904.9.3 System hoses. System hoses shall be examined at 12-month intervals for damage. Damaged hoses shall be replaced or tested. At 5-year intervals, all hoses shall be tested.

904.9.3.1 Test procedure. For Halon 1301 systems, hoses shall be tested at not less than 1,500 psi (10 343 kPa) for 600 psi (4137 kPa) charging pressure systems and not less than 900 psi (6206 kPa) for 360 psi (2482

kPa) charging pressure systems. For Halon 1211 hand-hose line systems, hoses shall be tested at 2,500 psi (17 238 kPa) for high-pressure systems and 900 psi (6206 kPa) for low-pressure systems.

904.9.4 Auxiliary equipment. Auxiliary and supplementary components, such as switches, door and window releases, interconnected valves, damper releases and supplementary alarms, shall be manually operated at 12-month intervals to ensure such components are in proper operating condition.

904.10 Clean-agent systems. Clean-agent fire-extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 2001 and their listing.

904.10.1 System test. Systems shall be inspected and tested for proper operation at 12-month intervals.

904.10.2 Containers. The extinguishing agent quantity and pressure of the containers shall be checked at 6-month intervals. Where a container shows a loss in original weight of more than 5 percent or a loss in original pressure, adjusted for temperature, of more than 10 percent, the container shall be refilled or replaced. The weight and pressure of the container shall be recorded on a tag attached to the container.

904.10.3 System hoses. System hoses shall be examined at 12-month intervals for damage. Damaged hoses shall be replaced or tested. All hoses shall be tested at 5-year intervals.

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 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*.

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 maxi-

imum of 20 feet (6096 mm) from the kitchen exhaust system. The manual actuation device shall be installed not more than 48 inches (1200 mm) nor 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.

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

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. When 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 all hazards venting through a common duct simultaneously.

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.

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.

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.

904.11.5 Portable fire extinguishers for commercial cooking equipment. Portable fire extinguishers shall be provided within a 30-foot (9144 mm) travel distance of commercial-type cooking equipment. Cooking equipment involving vegetable or animal oils and fats shall be protected by a Class K rated portable extinguisher.

904.11.5.1 Portable fire extinguishers for solid fuel cooking appliances. All solid fuel cooking appliances, whether or not under a hood, with fireboxes 5 cubic feet (0.14 m³) or less in volume shall have a minimum 2.5-gallon (9 L) or two 1.5-gallon (6 L) Class K wet-chemical portable fire extinguishers located in accordance with Section 904.11.5.

904.11.5.2 Class K portable fire extinguishers for deep fat fryers. When hazard areas include deep fat fryers,

listed Class K portable fire extinguishers shall be provided as follows:

1. For up to four fryers having a maximum cooking medium capacity of 80 pounds (36.3 kg) each: One Class K portable fire extinguisher of a minimum 1.5 gallon (6 L) capacity.
2. For every additional group of four fryers having a maximum cooking medium capacity of 80 pounds (36.3 kg) each: One additional Class K portable fire extinguisher of a minimum 1.5 gallon (6 L) capacity shall be provided.
3. For individual fryers exceeding 6 square feet (0.55 m²) in surface area: Class K portable fire extinguishers shall be installed in accordance with the extinguisher manufacturer's recommendations.

904.11.6 Operations and maintenance. Commercial cooking systems shall be operated and maintained in accordance with this section.

904.11.6.1 Ventilation system. The ventilation system in connection with hoods shall be operated at the required rate of air movement, and classified grease filters shall be in place when equipment under a kitchen grease hood is used.

904.11.6.2 Grease extractors. Where grease extractors are installed, they shall be operated when the commercial-type cooking equipment is used.

904.11.6.3 Cleaning. Hoods, grease-removal devices, fans, ducts and other appurtenances shall be cleaned at intervals necessary to prevent the accumulation of grease. Cleanings shall be recorded, and records shall state the extent, time and date of cleaning. Such records shall be maintained on the premises.

904.11.6.4 Extinguishing system service. Automatic fire-extinguishing systems shall be serviced at least every 6 months and after activation of the system. Inspection shall be by qualified individuals, and a certificate of inspection shall be forwarded to the fire code official upon completion.

904.11.6.5 Fusible link and sprinkler head replacement. Fusible links and automatic sprinkler heads shall be replaced at least annually, and other protection devices shall be serviced or replaced in accordance with the manufacturer's instructions.

Exception: Frangible bulbs are not required to be replaced annually.

SECTION 905 STANDPIPE SYSTEMS

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 Phoenix threads. The location of fire department hose connections shall be in accordance with Section 912. In buildings used for high-piled combustible storage,

fire protection shall be in accordance with Chapter 23. Temporary standpipes installed during construction shall be in accordance with Chapter 14.

905.2 Installation standard. Standpipe systems shall be installed in accordance with this section and NFPA 14.

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.

905.3.1 Building height. Class I 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 the fire department apparatus 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 apparatus access.

Exceptions:

1. Group R-3 occupancies four stories or less shall not require a standpipe system.
2. The residual pressure(s) as noted in NFPA 14 are not required to be maintained in buildings less than 75 feet (22 860 mm) in height which are equipped throughout with an approved automatic fire suppression system installed in accordance with NFPA 13. However, the system shall be designed to accommodate the outlet pressures and water flows in accordance with NFPA 14 and inlet pressures consistent with Phoenix Fire Department equipment.

905.3.2 Reserved.

905.3.3 Covered mall buildings. A covered mall building shall be equipped throughout with a Class I standpipe installed according to NFPA 14. 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.

905.3.4 Stages. Stages greater than 1,000 square feet (93 m²) in area shall be equipped with a Class I wet standpipe system with 2¹/₂-inch (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 1¹/₂ inch (38 mm) hose connection shall be installed in accordance with NFPA 13 or in accordance with NFPA 14 for Class I standpipes.

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

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.

905.3.7 Marinas and boatyards. Marinas and boatyards shall be equipped throughout with standpipe systems in accordance with NFPA 303.

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, unless otherwise approved by the fire code official.

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.

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.
5. Where the roof has a slope less than four units vertical in 12 units horizontal (33.3-percent slope), each standpipe shall be provided with a hose connection located either on the roof or at the highest landing of a stairway 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) from a hose connection or the most remote portion of a sprinklered floor or story is more than 200 feet (60 960 mm) from a hose connection, the fire code official is authorized to require that additional hose connections be provided in approved locations.

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.

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

905.5 Groups A-1 and A-2. In Group A-1 and A-2 occupancies with occupant loads of more than 1,000, Class I 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. Class I hose connections shall be installed in accordance with NFPA 14.

905.6 Cabinets. Cabinets containing fire-fighting equipment, such as standpipes, fire hose, fire extinguishers or fire department valves, shall not be blocked from use or obscured from view.

905.6.1 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.

905.6.2 Locking cabinet doors. Cabinets shall be unlocked.

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.
3. Group I-3 occupancies.

905.7 Dry standpipes. Dry standpipes shall not be installed.

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

905.8 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 fire alarm control panel.

Exceptions:

1. Valves to underground key or hub valves in roadway boxes.
2. Valves locked in the normal position and inspected as provided in this code in buildings not equipped with a fire alarm system.

905.9 During construction. Standpipe systems required during construction and demolition operations shall be provided in accordance with Section 1413.

905.10 Existing buildings. Existing structures with occupied floors located more than 50 feet (15 240 mm) above or below the lowest level of fire department access shall be equipped

with standpipes installed in accordance with Section 905. The standpipes shall have an approved fire department connection with hose connections at each floor level above or below the lowest level of fire department access. The fire code official is authorized to approve the installation of manual standpipe systems to achieve compliance with this section where the responding fire department is capable of providing the required hose flow at the highest standpipe outlet.

**SECTION 906
PORTABLE FIRE EXTINGUISHERS**

906.1 Where required. Portable fire extinguishers shall be installed in the following locations.

1. In new and existing Group A, B, E, F, H, I, M, R-1, R-2, R-4 and S occupancies.

Exception: In new and existing Group A, B and E occupancies equipped throughout with quick-response sprinklers, portable fire extinguishers shall be required only in locations specified in Items 2 through 6.

2. Within 30 feet (9144 mm) of commercial cooking equipment.
3. In areas where flammable or combustible liquids are stored, used or dispensed.
4. On each floor of structures under construction, except Group R-3 occupancies, in accordance with Section 1415.1.
5. Where required by the sections indicated in Table 906.1.
6. Special-hazard areas, including but not limited to laboratories, computer rooms and generator rooms, where required by the fire code official.

906.2 General requirements. Portable fire extinguishers shall be selected, installed and maintained in accordance with this section and NFPA 10.

Exceptions:

1. The travel distance to reach an extinguisher shall not apply to the spectator seating portions of Group A-5 occupancies.
2. Thirty-day inspections shall not be required and maintenance shall be allowed to be once every three years for dry-chemical or halogenated agent portable fire extinguishers that are supervised by a listed and approved electronic monitoring device, provided that all of the following conditions are met:
 - 2.1. Electronic monitoring shall confirm that extinguishers are properly positioned, properly charged and unobstructed.
 - 2.2. Loss of power or circuit continuity to the electronic monitoring device shall initiate a trouble signal.
 - 2.3. The extinguishers shall be installed inside of a building or cabinet in a noncorrosive environment.

**TABLE 906.1
ADDITIONAL REQUIRED PORTABLE FIRE EXTINGUISHERS**

SECTION	SUBJECT
303.5	Asphalt kettles
307.5	Open burning
308.4	Open flames-torches
309.4	Powered industrial trucks
1105.2	Aircraft towing vehicles
1105.3	Aircraft welding apparatus
1105.4	Aircraft fuel-servicing tank vehicles
1105.5	Aircraft hydrant fuel-servicing vehicles
1105.6	Aircraft fuel-dispensing stations
1107.7	Heliports and helistops
1208.4	Dry cleaning plants
1415.1	Buildings under construction or demolition
1417.3	Roofing operations
1504.4.1	Spray-finishing operations
1505.4.2	Dip-tank operations
1506.4.2	Powder-coating areas
1904.2	Lumberyards/woodworking facilities
1908.8	Recycling facilities
1909.5	Exterior lumber storage
2003.5	Organic-coating areas
2106.3	Industrial ovens
2205.5	Motor fuel-dispensing facilities
2210.6.4	Marine motor fuel-dispensing facilities
2211.6	Repair garages
2306.10	Rack storage
2404.12	Tents, canopies and membrane structures
2508.2	Tire rebuilding/storage
2604.2.6	Welding and other hot work
2903.6	Combustible fibers
3308.11	Fireworks
3403.2.1	Flammable and combustible liquids, general
3404.3.3.1	Indoor storage of flammable and combustible liquids
3404.3.7.5.2	Liquid storage rooms for flammable and combustible liquids
3405.4.9	Solvent distillation units
3406.2.7	Farms and construction sites-flammable and combustible liquids storage
3406.4.10.1	Bulk plants and terminals for flammable and combustible liquids
3406.5.4.5	Commercial, industrial, governmental or manufacturing establishments-fuel dispensing
3406.6.4	Tank vehicles for flammable and combustible liquids
3606.5.7	Flammable solids
3808.2	LP-gas

FIRE PROTECTION SYSTEMS

- 2.4. Electronic monitoring devices and supervisory circuits shall be tested every 3 years when extinguisher maintenance is performed.
- 2.5. A written log of required hydrostatic test dates for extinguishers shall be maintained by the owner to ensure that hydrostatic tests are conducted at the frequency required by NFPA 10.

906.3 Size and distribution. For occupancies that involve primarily Class A fire hazards, the minimum sizes and distribution shall comply with Table 906.3(1). Fire extinguishers for occupancies involving flammable or combustible liquids with depths of less than or equal to 0.25-inch (6.35 mm) shall be selected and placed in accordance with Table 906.3(2). Fire extinguishers for occupancies involving flammable or combustible liquids with a depth of greater than 0.25-inch (6.35 mm) or involving combustible metals shall be selected and

**TABLE 906.3(1)
FIRE EXTINGUISHERS FOR CLASS A FIRE HAZARDS**

	LIGHT (Low) HAZARD OCCUPANCY	ORDINARY (Moderate) HAZARD OCCUPANCY	EXTRA (High) HAZARD OCCUPANCY
Minimum Rated Single Extinguisher	2-A ^c	2-A	4-A ^a
Maximum Floor Area Per Unit of A	3,000 square feet	1,500 square feet	1,000 square feet
Maximum Floor Area For Extinguisher ^b	11,250 square feet	11,250 square feet	11,250 square feet
Maximum Travel Distance to Extinguisher	75 feet	75 feet	75 feet

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m², 1 gallon = 3.785 L.
 a. Two 2.5-gallon water-type extinguishers shall be deemed the equivalent of one 4-A rated extinguisher.
 b. Annex E.3.3 of NFPA 10 provides more details concerning application of the maximum floor area criteria.
 c. Two water-type extinguishers each with a 1-A rating shall be deemed the equivalent of one 2-A rated extinguisher for Light (Low) Hazard Occupancies.

**TABLE 906.3(2)
FLAMMABLE OR COMBUSTIBLE LIQUIDS WITH DEPTHS OF
LESS THAN OR EQUAL TO 0.25-INCH**

TYPE OF HAZARD	BASIC MINIMUM EXTINGUISHER RATING	MAXIMUM TRAVEL DISTANCE TO EXTINGUISHERS (feet)
Light (Low)	5-B	30
	10-B	50
Ordinary (Moderate)	10-B	30
	20-B	50
Extra (High)	40-B	30
	80-B	50

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.
 NOTE. For requirements on water-soluble flammable liquids and alternative sizing criteria, see Section 4.3 of NFPA 10.

placed in accordance with NFPA 10. Extinguishers for Class C fire hazards shall be selected and placed on the basis of the anticipated Class A or Class B hazard.

906.4 Cooking grease fires. Fire extinguishers provided for the protection of cooking grease fires shall be of an approved type compatible with the automatic fire-extinguishing system agent and in accordance with Section 904.11.5.

906.5 Conspicuous location. Portable fire extinguishers shall be located in conspicuous locations where they will be readily accessible and immediately available for use. These locations shall be along normal paths of travel, unless the fire code official determines that the hazard posed indicates the need for placement away from normal paths of travel.

906.6 Unobstructed and unobscured. Portable fire extinguishers shall not be obstructed or obscured from view. In rooms or areas in which visual obstruction cannot be completely avoided, means shall be provided to indicate the locations of extinguishers.

906.7 Hangers and brackets. Hand-held portable fire extinguishers, not housed in cabinets, shall be installed on the hangers or brackets supplied. Hangers or brackets shall be securely anchored to the mounting surface in accordance with the manufacturer's installation instructions.

906.8 Cabinets. Cabinets used to house portable fire extinguishers shall not be locked.

Exceptions:

1. Where portable fire extinguishers subject to malicious use or damage are provided with a means of ready access.
2. In Group I-3 occupancies and in mental health areas in Group I-2 occupancies, access to portable fire extinguishers shall be permitted to be locked or to be located in staff locations provided the staff has keys.

906.9 Height above floor. Portable fire extinguishers having a gross weight not exceeding 40 pounds (18 kg) shall be installed so that its top is not more than 4 feet (1219 mm) above the floor. Hand-held portable fire extinguishers having a gross weight exceeding 40 pounds (18 kg) shall be installed so that its top is not more than 3.5 feet (1067 mm) above the floor. The clearance between the floor and the bottom of installed hand-held extinguishers shall not be less than 4 inches (102 mm).

906.10 Wheeled units. Wheeled fire extinguishers shall be conspicuously located in a designated location.

**SECTION 907
FIRE ALARM AND DETECTION SYSTEMS**

907.1 General. This section covers the application, installation, performance and maintenance of fire alarm systems and their components in new and existing buildings and structures. The requirements of Section 907.2 are applicable to new buildings and structures. The requirements of Section 907.3 are applicable to existing buildings and structures.

907.1.1 Design documents. For fire alarm and other code regulated alarm systems, the following are considered to be professional registrant activities in accordance with the

requirements of the Arizona Board of Technical Registration:

1. Determine the system type;
2. Determine the applicable codes and standards and appropriate engineering practices;
3. Determine device types and locations;
4. Prepare generalized riser diagram;
5. Coordinate and interface with other systems; and
6. Develop system specifications.

Exception: Where the modification of fire protection systems does not require mathematical calculations or hazard analysis.

These activities need to be completed prior to development of construction documents to be submitted for permit.

907.1.2 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.

907.1.3 Equipment. Systems and their components shall be listed and approved for the purpose for which they are installed.

907.2 Where required-new buildings and structures. 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 907.10, 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.

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.

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.

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

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.

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 of 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 com-

munication 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 may be deleted in Group E occupancies where all of the following apply:
 - 3.1. Auditoriums, cafeterias, gymnasiums and the like are protected by heat detectors or other approved detection devices.
 - 3.2. Unoccupied spaces, shops and laboratories involving dusts or vapors are protected by heat detectors or other approved detection devices.
 - 3.3. Off-premises monitoring is provided.
 - 3.4. The capability to activate the evacuation signal from a central point is provided.
 - 3.5. All other normally occupied spaces are protected by smoke detectors with alarm verification.
4. 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.

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 where the building is equipped throughout with an automatic sprinkler system and the alarm notification appliances will activate upon sprinkler water flow.

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.

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 907.4.1 are not exceeded.

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.

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 of the *International Building Code* shall be equipped with an automatic fire detection system. Hospitals shall be equipped with smoke detection as required in Section 407.2 of the *International Building Code*.

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 shall provide 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.

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

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.

907.2.6.3.2 Manual fire alarm boxes. Manual fire alarm boxes are not required to be located in accordance with Section 907.4 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 are allowed 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.

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.

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 907.10.

Exceptions:

1. A manual fire alarm system is required in covered mall buildings complying with Section 402 of the *International Building Code*.
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.

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.

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.

907.2.8.1 Manual fire alarm system. A manual fire alarm system shall be installed in Group R-1 occupancies.

Exceptions:

1. A manual 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.

907.2.8.2 Automatic fire alarm system. An automatic fire alarm system shall be installed throughout all interior corridors serving sleeping units.

Exception: An automatic fire detection system 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.

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.

907.2.9 Group R-2. A manual 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 accor-

FIRE PROTECTION SYSTEMS

dance with Section 903.3.1.1 or 903.3.1.2;
and

2.2. The notification appliances will activate upon sprinkler flow.

3. 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.

907.2.10 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.

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.

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.

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.

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.

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.

907.2.10.3 Interconnection. Where more than one smoke alarm is required to be installed within an individual dwelling unit or sleeping unit in Group R-2, R-3 or R-4, or within an individual 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.

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.

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.

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.

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.

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 be audible throughout the entire special amusement building.

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 Section 907.2.22 and Section 412 of the *International Building Code*.
2. Open parking garages in accordance with Section 406.3 of the *International Building Code*.
3. Buildings with an occupancy in Group A-5 in accordance with Section 303.1 of the *International Building Code*.
4. Low-hazard special occupancies in accordance with Section 503.1.1 of the *International Building Code*.
5. Buildings with an occupancy in Group H-1, H-2 or H-3 in accordance with Section 415 of the *International Building Code*.

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 shall operate the emergency voice/alarm communication system. Duct smoke detectors shall be allowed to provide a supervisory signal. 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 m³/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 m³/s) and serving not more than 10 air-inlet openings.

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 floor below in accordance with the building's fire safety and evacuation plans required by Section 404. 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 stairways.
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.

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.

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.

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

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 509 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 exit stairway.

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

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 907.7. Such occupancies in Group A, E or M shall be provided with an emer-

gency voice/alarm communication system complying with the requirements of Section 907.2.12.2.

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 Section 2306.5.

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.

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 this code.

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.

907.2.18 Underground buildings with smoke exhaust systems. Where a smoke exhaust system is installed in an underground building in accordance with the *International Building Code*, automatic fire detectors shall be provided in accordance with this section.

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, 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 m³/s) and serving not more than 10 air inlet openings.

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

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.

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 which shall be capable of trans-

mitting voice communications to the highest level of exit discharge serving the underground portions of the structure and all levels below.

907.2.20 Covered mall buildings. Covered mall buildings exceeding 50,000 square feet (4645 m²) 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.

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

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

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 L). The detection system shall be supervised by an approved central, proprietary, or remote station service or a local alarm which will sound an audible signal at a constantly attended location.

907.3 Where required-retroactive in existing buildings and structures. An approved manual, automatic or manual and automatic fire alarm system shall be installed in existing buildings and structures in accordance with Sections 907.3.1 through 907.3.1.8. Where automatic sprinkler protection is provided in accordance with Section 903.3.1.1 or 903.3.1.2 and connected to the building fire alarm system, automatic heat detection required by this section shall not be required. When an existing building is required to install a fire alarm system based on a change of occupancy classification, use or retroactive requirements per the building or fire code, fire alarm devices shall be installed throughout the area. A minimum of 2 hour fire resistance rated fire barriers or horizontal assemblies shall separate the protected and nonprotected areas.

An approved automatic fire detection system shall be installed in accordance with the provisions of this code and NFPA 72. Devices, combinations of devices, appliances and equipment shall be approved. The automatic fire detectors shall be smoke detectors, except an approved alternative type of detector shall be installed in spaces such as boiler rooms where, during normal operation, products of combustion are present in sufficient quantity to actuate a smoke detector.

907.3.1 Occupancy requirements. A fire alarm system shall be installed in accordance with Sections 907.3.1.1 through 907.3.1.8.

Exception: Occupancies with an existing, previously approved fire alarm system.

907.3.1.1 Group E. A fire alarm system shall be installed in existing Group E occupancies in accordance with Section 907.2.3.

Exceptions:

1. A building with a maximum area of 1,000 square feet (93 m²) that contains a single classroom and is located no closer than 50 feet (15 240 mm) from another building.
2. Group E with an occupant load less than 50.

907.3.1.2 Group I-1. A fire alarm system shall be installed in existing Group I-1 residential care/assisted living facilities.

Exception: Where each sleeping room has a means of egress door opening directly to an exterior egress balcony that leads directly to the exits in accordance with Section 1014.5, and the building is not more than three stories in height.

907.3.1.3 Group I-2. A fire alarm system shall be installed in existing Group I-2 occupancies in accordance with Section 907.2.6.2.

907.3.1.4 Group I-3. A fire alarm system shall be installed in existing Group I-3 occupancies in accordance with Section 907.2.6.3.

907.3.1.5 Group R-1 hotels and motels. A fire alarm system shall be installed in existing Group R-1 hotels and motels more than three stories or with more than 20 sleeping units.

Exception: Buildings less than two stories in height where all sleeping units, attics and crawl spaces are separated by 1-hour fire-resistance-rated construction and each sleeping unit has direct access to a public way, exit court or yard.

907.3.1.6 Group R-1 boarding and rooming houses. A fire alarm system shall be installed in existing Group R-1 boarding and rooming houses.

Exception: Buildings that have single-station smoke alarms meeting or exceeding the requirements of Section 907.2.10.1 and where the fire alarm system includes at least one manual fire alarm box per floor arranged to initiate the alarm.

907.3.1.7 Group R-2. A fire alarm system shall be installed in existing Group R-2 occupancies more than three stories in height or with more than 16 dwelling units or sleeping units.

Exceptions:

1. Where each living unit is separated from other contiguous living units by fire barriers having a fire-resistance rating of not less than 0.75 hour, and where each living unit has either its own independent exit or its own independent stairway or ramp discharging at grade.
2. A separate fire alarm system is not required in buildings that are equipped throughout with an approved supervised automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 and having a local alarm to notify all occupants.

tem installed in accordance with Section 903.3.1.1 or 903.3.1.2 and having a local alarm to notify all occupants.

3. 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.

907.3.1.8 Group R-4. A fire alarm system shall be installed in existing Group R-4 residential care/assisted living facilities.

Exceptions:

1. Where there are interconnected smoke alarms meeting the requirements of Section 907.2.10 and there is at least one manual fire alarm box per floor arranged to sound continuously the smoke alarms.
2. Other manually activated, continuously sounding alarms approved by the fire code official.

907.3.2 Single- and multiple-station smoke alarms. Single- and multiple-station smoke alarms shall be installed in existing Group R occupancies in accordance with Sections 907.3.2.1 through 907.3.2.3.

907.3.2.1 General. Existing Group R occupancies not already provided with single-station smoke alarms shall be provided with approved single-station smoke alarms. Installation shall be in accordance with Section 907.2.10, except as provided in Sections 907.3.2.2 and 907.3.2.3.

907.3.2.2 Interconnection. Where more than one smoke alarm is required to be installed within an individual dwelling unit in Group R-2, R-3 or R-4, or within an individual 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.

Exceptions:

1. Interconnection is not required in buildings that are not undergoing alterations, repairs or construction of any kind.
2. Smoke alarms in existing areas are not required to be interconnected where alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available which could provide access for interconnection without the removal of interior finishes.

907.3.2.3 Power source. In Group R occupancies, single-station smoke alarms shall receive their primary power from the building wiring provided that 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 permitted to be solely battery operated: in existing buildings where no construction is taking place; in buildings that are not served from a commercial power source; and in existing areas of buildings undergoing alterations or repairs that do not result in the removal of interior walls or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available which could provide access for building wiring without the removal of interior finishes.

907.4 Manual fire alarm boxes. Manual fire alarm boxes shall be installed in accordance with Sections 907.4.1 through 907.4.5.

907.4.1 Location. Manual fire alarm boxes shall be located not more than 5 feet (1524 mm) from the entrance to each exit. Additional manual fire alarm boxes shall be located so that travel distance to the nearest box does not exceed 200 feet (60 960 mm).

907.4.2 Height. The height of the manual fire alarm boxes shall be a minimum of 42 inches (1067 mm) and a maximum of 48 inches (1372 mm) measured vertically, from the floor level to the activating handle or lever of the box.

907.4.3 Color. Manual fire alarm boxes shall be red in color.

907.4.4 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.

907.4.5 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.

907.5 Power supply. The primary and secondary power supply for the fire alarm system shall be provided in accordance with NFPA 72.

907.6 Wiring. Wiring shall comply with the requirements of the *National 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.

907.7 Activation. Where an alarm notification system is required by another section of this code, it shall be activated by:

1. Required automatic fire alarm system.
2. Sprinkler water-flow devices.
3. Required manual fire alarm boxes.
4. Other fire protection systems.

907.8 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.

907.9 Zones. Each floor shall be zoned separately and a zone shall not exceed 22,500 square feet (2090 m²). 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 (see Section 903.4 for sprinkler alarm monitoring requirements).

907.9.1 Zoning indicator panel (fire alarm annunciator panel). A zoning indicator panel and the associated controls shall be provided in an approved location. 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.

907.9.1.1 Location. In buildings greater than one story or 22,500 square feet (2090 ft²), the fire alarm panel or a fire alarm annunciator panel shall be installed in a location that is visible from the lobby or area adjacent to the primary fire department response entrance. It shall be permissible to locate the fire alarm panel in a room immediately adjacent to this lobby provided the door to this room is accessible to the fire department, visible from the lobby and is provided with a permanent, visible placard noting the location of the fire alarm control panel.

Exception: A zone indicator panel is not required for single story buildings protected by a fire alarm system where the initiating devices consist of automatic sprinklers supplied by a single sprinkler system.

907.9.2 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 apparatus 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 protection systems.

907.10 Alarm notification appliances—new construction. Alarm notification appliances shall be provided and shall be listed for their purpose.

907.10.1 Visible alarms. Visible alarm notification appliances shall be provided in accordance with Sections 907.10.1.1 through 907.10.1.4.

Exceptions:

1. Visible alarm notification appliances are not required in building alterations, that do not involve changing the floor plan by the addition, removal, or relocation of walls or result in a change in occupancy classification except where an existing fire alarm system is upgraded or replaced, or a new fire alarm system is installed.
2. Visible alarm notification appliances shall not be required in exits as defined in Section 1002.1.
3. Visual alarms are not required in operating rooms or treatment rooms of Group-I occupancies where patients are constantly attended by trained facility personnel.

907.10.1.1 Public and common areas. Visible alarm notification appliances shall be provided in public areas and common areas.

907.10.1.2 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 employee(s).

**TABLE 907.10.1.3
VISIBLE AND AUDIBLE ALARMS**

NUMBER OF SLEEPING UNITS	SLEEPING ACCOMMODATIONS 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

907.10.1.3 Groups I-1 and R-1. Group I-1 and R-1 sleeping units in accordance with Table 907.10.1.3 shall be provided with a visible alarm notification appliance, activated by both the in-room smoke alarm and the building fire alarm system.

907.10.1.4 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.

907.10.1.5 Visible alarms in existing facilities. Visual fire alarm devices shall be installed in public and common areas of existing facilities in accordance with Sections 907.10.1.5 through 907.10.1.5.3.

907.10.1.5.1 Changes in occupancy. When a building undergoes a change in occupancy classification, the fire alarm system shall comply with the requirements of Section 907.2 for that occupancy.

907.10.1.5.2 Building renovations. Buildings undergoing renovations, alterations, or modifications consisting of structural renovations, including the addition, removal, or relocation of walls and partitions, shall have visual alarm devices installed in any new public or common area created by the renovations.

907.10.1.5.3 Fire alarm panel replacement. Visual alarm devices shall be installed in public and common areas, including elevator lobbies, restrooms and corridors of building core areas when an existing fire alarm control panel is replaced.

907.10.2 Audible alarms. Audible alarm notification appliances shall be provided and 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. 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.

Exception: Visible alarm notification appliances shall be allowed in lieu of audible alarm notification appliances in critical care areas of Group I-2 occupancies.

Group A, B, E, F, H, I, M, R, S and U occupancies shall meet public mode audible requirements of NFPA 72.

Exception: Group I occupancies shall be allowed to use private mode audible requirements of NFPA 72, when approved.

Registered design professionals shall specify on plans and in construction documents the specific mode for each area of the occupancy. When the private mode is specified, the designer shall provide written documentation for the use of this mode.

907.11 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 activate a visible and audible

FIRE PROTECTION SYSTEMS

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.

907.12 Duct smoke detectors. Duct smoke detectors shall be connected to the building's fire alarm control panel when a fire alarm system is provided. 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.

Exceptions:

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 an 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.

907.13 Access. Access shall be provided to each detector for periodic inspection, maintenance and testing.

907.14 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.

907.15 Monitoring. Fire alarm systems required by this chapter or by the *International Building Code* shall be monitored by 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 complying with Section 903.4.1.1.

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.

907.16 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.

907.17 Acceptance tests. Upon completion of the installation of the fire alarm system, 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.

907.18 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.

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

907.20 Inspection, testing and maintenance. The maintenance and testing schedules and procedures for fire alarm and fire detection systems shall be in accordance with this section and Chapter 10 of NFPA 72.

907.20.1 Maintenance required. Whenever or wherever any device, equipment, system, condition, arrangement, level of protection or any other feature is required for compliance with the provisions of this code, such device, equipment, system, condition, arrangement, level of protection or other feature shall thereafter be continuously maintained in accordance with applicable NFPA requirements or as directed by the Fire Code Official.

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.

907.20.2 Testing. Testing shall be performed in accordance with the schedules in Chapter 10 of NFPA 72 or more frequently where required by the fire code official. Where automatic testing is performed at least weekly by a remotely monitored fire alarm control unit specifically listed for the application, the manual testing frequency shall be permitted to be extended to annual.

Exception: Devices or equipment that are inaccessible for safety considerations shall be tested during scheduled shutdowns where approved by the fire code official, but not less than every 18 months.

907.20.3 Detector sensitivity. Detector sensitivity shall be checked within one year after installation and every alternate year thereafter. After the second calibration test, where sensitivity tests indicate that the detector has remained within its listed and marked sensitivity range (or 4-percent obscuration light grey smoke, if not marked), the length of time between calibration tests shall be permitted to be extended to a maximum of five years. Where the frequency is extended, records of detector-caused nuisance alarms and subsequent trends of these alarms shall be maintained. In zones or areas where nuisance alarms show any increase over the previous year, calibration tests shall be performed.

907.20.4 Method. To ensure that each smoke detector is within its listed and marked sensitivity range, it shall be tested using either a calibrated test method, the manufacturer's calibrated sensitivity test instrument, listed control equipment arranged for the purpose, a smoke detector/control unit arrangement whereby the detector causes a signal at the control unit where its sensitivity is outside its acceptable sensitivity range or other calibrated sensitivity test method acceptable to the fire code official. Detectors found to have a sensitivity outside the listed and marked sensitivity range shall be cleaned and recalibrated or replaced.

Exceptions:

1. Detectors listed as field adjustable shall be permitted to be either adjusted within the listed and marked sensitivity range and cleaned and recalibrated or they shall be replaced.
2. This requirement shall not apply to single-station smoke alarms.

907.20.4.1 Testing device. Detector sensitivity shall not be tested or measured using a device that administers an unmeasured concentration of smoke or other aerosol into the detector.

907.20.5 Maintenance, inspection and testing. The building owner shall be responsible for ensuring that the fire and life safety systems are maintained in an operable condition at all times. Service personnel shall meet the qualification requirements of NFPA 72 for maintaining, inspecting and testing such systems and shall have a Business Certificate issued by the Phoenix Fire Department to install, maintain, inspect and test fire alarm systems. A written record shall be maintained and shall be made available to the fire code official.

SECTION 908 EMERGENCY ALARM SYSTEMS

908.1 Group H occupancies. Emergency alarms for the detection and notification of an emergency condition in Group H occupancies shall be provided as required in Chapter 27.

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 1803.12. A continuous gas detection system shall be provided for HPM gases in accordance with Section 1803.13.

908.3 Highly toxic and toxic materials. Where required by Section 3704.2.2.10, 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.

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 2211.7.2.

[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

909.1 Scope and purpose. This section applies to mechanical or passive smoke control systems when they are required for new buildings or portions thereof by provisions of the *International Building Code* or 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*.

909.2 General design requirements. Buildings, structures, or parts thereof required by the *International Building Code* or 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 describe adequately the elements of the design necessary for the proper implementation of the smoke control systems. These documents shall be accompanied with sufficient information and analysis to demonstrate compliance with these provisions.

909.3 Special inspection and test requirements. In addition to the ordinary inspection and test requirements to 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 as in Section 1704 of the *International Building Code*.

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

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.

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.

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 the *International Building Code*.

909.4.4 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 heating, ventilating and air-conditioning systems.

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.

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.

909.5 Smoke barrier construction. Smoke barriers shall comply with the *International Building Code*. Smoke barriers 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 (m²).

A_F = Unit floor or roof area of barrier, square feet (m²).

A_w = Unit wall area of barrier, square feet (m²).

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.

909.5.1 Leakage area. 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.

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 of the *International Building Code*.

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 of the *International Building Code*. 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.

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 of the *International Building Code*.

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.

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

In buildings allowed 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.

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:

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

where:

A = Door area, square feet (m²).

d = Distance from door handle to latch edge of door, feet (m).

F = Total door opening force, pounds (N).

F_{dc} = 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).

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.

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

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

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

where:

h = Height of opening, feet (m).

T_f = Temperature of smoke, °F (K).

T_o = Temperature of ambient air, °F (K).

v = Air velocity, feet per minute (m/minute).

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 airflows to exceed this limit, the airflow method shall not be used.

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.

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.

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.

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.

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

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.

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.

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

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 smokelayer temperature, Btu/lb°F · (kJ/kg · K).

m = Exhaust rate, pounds per second (kg/s).

Q_c = Convective heat output of fire, Btu/s (kW).

T_a = Ambient temperature, °F (K).

T_s = Smoke temperature, °F (K).

Exception: Reduced T_s as calculated based on the assurance of adequate dilution air.

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* and which are constructed of approved fire-resistance-rated materials.

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.

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.

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 structural design requirements of Chapter 16 of the *International Building Code*. 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.

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 source complying with the *National Electrical Code*. The standby 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 power shall be automatic and within 60 seconds of failure of the primary power. The systems shall comply with this code or the *National Electrical Code*.

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 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.

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.

909.12.1 Wiring. In addition to meeting requirements of the *National Electrical Code*, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways.

909.12.2 Activation. Smoke control systems shall be actuated in accordance with this section.

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.

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

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 the engineering analysis.

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.

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 liquidus 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 all of the following conditions are met:

1. Tubing shall be listed by an approved agency for flame and smoke characteristics.
2. Tubing and the connected device shall be completely enclosed within a galvanized or paint-grade steel enclosure of not less than 0.030 inch (0.76 mm) (No. 22 galvanized sheet gage) 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.

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.

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.

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

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.

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 509 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.

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 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.

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 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.
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.

Exceptions:

1. 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.

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 *National 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.

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, shut-

down 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.

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.

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.

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.

909.18.3 Dampers. Dampers shall be tested for function in their installed condition.

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

909.18.5 Fans. Fans shall be examined for correct rotation. Measurements of voltage, amperage, revolutions per minute and belt tension shall be made.

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.

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.

909.18.8 Special inspections for smoke control. Smoke control systems shall be tested by a special inspector prior to the final acceptance test. The City of Phoenix Development Services Department and Phoenix Fire Department shall witness and approve the final acceptance test of the system.

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.

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.

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.

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.

909.18.9 Identification and documentation. Charts, drawings and other documents identifying and locating each component of the smoke control system, and describing their 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.

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 Maintenance. Smoke control systems shall be maintained to ensure to a reasonable degree that the system is capable of controlling smoke for the duration required. The system shall be maintained in accordance with the manufacturer's instructions and Sections 909.20.1 through 909.20.5.

909.20.1 Schedule. A routine maintenance and operational testing program shall be initiated immediately after the smoke control system has passed the acceptance tests. A written schedule for routine maintenance and operational testing shall be established.

909.20.2 Written record. A written record of smoke control system testing and maintenance shall be maintained on the premises. The written record shall include the date of the maintenance, identification of the servicing personnel and notification of any unsatisfactory condition and the corrective action taken, including parts replaced.

909.20.3 Testing. Operational testing of the smoke control system shall include all equipment such as initiating devices, fans, dampers, controls, doors and windows.

909.20.4 Dedicated smoke control systems. Dedicated smoke control systems shall be operated for each control sequence semiannually. The system shall also be tested under standby power conditions.

909.20.5 Nondedicated smoke control systems. Nondedicated smoke control systems shall be operated for each control sequence annually. The system shall also be tested under standby power conditions.

SECTION 910 SMOKE AND HEAT VENTS

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.

910.1.1 Permit. A permit is required to install smoke and heat vents or a mechanical smoke removal system required in accordance with this Section 105.7.

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.

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 m²) of undivided area.

Exception: Group S-1 aircraft repair hangars.

910.2.2 High-piled combustible storage. Buildings and portions thereof containing high-piled combustible stock or rack storage in any occupancy group when required by Section 2306.7.

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.

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.

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

910.3.2 Vent operation. Smoke and heat vents shall be approved and labeled and shall be capable of being operated by approved automatic and manual means from inside the building and from the roof. Automatic operation of smoke

FIRE PROTECTION SYSTEMS

and heat vents shall conform to the provisions of Sections 910.3.2.1 through 910.3.2.3.

Smoke and heat vents shall operate automatically by actuation of a heat-responsive device. The device shall be rated a minimum of 50°F (10°C) above the rating of the automatic sprinklers but not more than 386°F (197°C).

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.

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

910.3.2.3 Nonsprinklered buildings. Where installed in buildings not equipped 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 (56°C) and 220°F (122°C) above ambient.

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

910.3.3 Vent dimensions. The effective venting area shall not be less than 16 square feet (1.5 m²) with no dimension less than 4 feet (1219 mm), excluding ribs or gutters having a total width not exceeding 6 inches (152 mm).

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.

910.3.5 Draft curtains. Where required, 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.

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

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

910.4 Mechanical smoke exhaust. Where approved by the fire code official, engineered mechanical smoke exhaust shall be an acceptable alternative to smoke and heat vents.

910.4.1 Fans. Exhaust fans shall be uniformly spaced within area and the maximum distance between fans shall not be greater than 100 feet (30 480 mm). Exhaust fans shall be listed for the environmental conditions to which they will be subjected.

**TABLE 910.3
REQUIREMENTS FOR DRAFT CURTAINS AND SMOKE AND HEAT VENTS^a**

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 ^c	MAXIMUM SPACING OF VENT CENTERS (feet)	MAXIMUM DISTANCE TO VENTS FROM WALL OR DRAFT CURTAIN ^b (feet)
Group F-1 and S-1	—	0.2 × H ^d but ≥ 4	50,000	0.1111111	120	60
High-piled storage (see Section 910.2.2) I-IV (Option 1)	≤ 20	6	10,000	0.1111111	100	60
	> 20 ≤ 40	6	8,000	0.09375	100	55
High-piled storage (see Section 910.2.2) I-IV (Option 2)	≤ 20	4	3,000	0.09375	100	55
	> 20 ≤ 40	4	3,000	1:50	100	50
High-piled storage (see Section 910.2.2) High hazard (Option 1)	≤ 20	6	6,000	1:50	100	50
	> 20 ≤ 30	6	6,000	1:40	90	45
High-piled storage (see Section 910.2.2) High hazard (Option 2)	#20	4	4,000	1:50	100	50
	> 20 ≤ 30	4	2,000	1:30	75	40

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

- a. Requirements for rack storage heights in excess of those indicated shall be in accordance with Chapter 23. 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.

910.4.2 Size. Fans shall have a maximum individual capacity of 30,000 cfm (14.2 m³/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 (m³/s).

A = Area of roof vents provided in square feet (m²) in accordance with Table 910.3.

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 for each fan unit shall also be provided.

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.

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.

910.4.6 Interlocks. On 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 EXPLOSION CONTROL

911.1 General. Explosion control shall be provided in the following locations:

1. Where a structure, room or space is occupied for purposes involving explosion hazards as identified in Table 911.1.
2. Where quantities of hazardous materials specified in Table 911.1 exceed the maximum allowable quantities in Table 2703.1.1(1).

Such areas shall be provided with explosion (deflagration) venting, explosion (deflagration) prevention systems, or barricades in accordance with this section and NFPA 69, or NFPA 495 as applicable. Deflagration venting shall not be utilized as a means to protect buildings from detonation hazards.

911.2 Required deflagration venting. Areas that are required to be provided with deflagration venting shall comply with the following:

1. Walls, ceilings and roofs exposing surrounding areas shall be designed to resist a minimum internal pressure of 100 pounds per square foot (psf) (4788 Pa). The minimum internal design pressure shall not be less than five

times the maximum internal relief pressure specified in Section 911.2, Item 5.

2. Deflagration venting shall be provided only in exterior walls and roofs.

Exception: Where sufficient exterior wall and roof venting cannot be provided because of inadequate exterior wall or roof area, deflagration venting shall be allowed by specially designed shafts vented to the exterior of the building.

3. Deflagration venting shall be designed to prevent unacceptable structural damage. Where relieving a deflagration, vent closures shall not produce projectiles of sufficient velocity and mass to cause life threatening injuries to the occupants or other persons on the property or adjacent public ways.
4. The aggregate clear area of vents and venting devices shall be governed by the pressure resistance of the construction assemblies specified in Item 1 of this section and the maximum internal pressure allowed by Item 5 of this section.
5. Vents shall be designed to withstand loads in accordance with the *International Building Code*. Vents shall consist of any one or any combination of the following to relieve at a maximum internal pressure of 20 pounds per square foot (958 Pa), but not less than the loads required by the *International Building Code*:
 - 5.1. Exterior walls designed to release outward.
 - 5.2. Hatch covers.
 - 5.3. Outward swinging doors.
 - 5.4. Roofs designed to uplift.
 - 5.5. Venting devices listed for the purpose.
6. Vents designed to release from the exterior walls or roofs of the building when venting a deflagration shall discharge directly to the exterior of the building where an unoccupied space not less than 50 feet (15 240 mm) in width is provided between the exterior walls of the building and the property line.

Exception: Vents complying with Item 7 of this section.
7. Vents designed to remain attached to the building when venting a deflagration shall be so located that the discharge opening shall not be less than 10 feet (3048 mm) vertically from window openings and exits in the building and 20 feet (6096 mm) horizontally from exits in the building, from window openings and exits in adjacent buildings on the same property, and from the property line.
8. Discharge from vents shall not be into the interior of the building.

911.3 Explosion prevention systems. Explosion prevention systems shall be of an approved type and installed in accordance with the provisions of this code and NFPA 69.

911.4 Barricades. Barricades shall be designed and installed in accordance with NFPA 495.

**SECTION 912
FIRE DEPARTMENT CONNECTIONS**

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 912.2.11 through 912.6.

912.1.1 Threads. Fire department connection hose threads shall be Phoenix threads. See Figure 912.1.1A and 912.1.1B. Where fire department connection hose threads greater than 2½-inch (64 mm) are used.

912.1.2 Inlet Connection. The minimum size of a fire department inlet connection shall be 2½ inch (64 mm) with Phoenix threads.

912.1.3 Number of inlets. The number of inlets for fire department connection shall be based on the sprinkler system base of riser demand with 500 gpm (1893 L/m) allowed for each fire department inlet connection.

912.1.4 Underground pipe. All fire department connection underground piping shall be installed as a minimum Class 200.

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. A site plan detail shall be submitted to the Fire Code

**TABLE 911.1
EXPLOSION CONTROL REQUIREMENTS**

MATERIAL	CLASS	EXPLOSION CONTROL METHODS	
		Barricade construction	Explosion (deflagration) venting or explosion (deflagration) prevention systems
Hazard Category			
Combustible dusts ^a	—	Not required	Required
Cryogenic fluids	Flammable	Not required	Required
Explosives	Division 1.1	Required	Not required
	Division 1.2	Required	Not required
	Division 1.3	Not required	Required
	Division 1.4 ^f	Not required	Required
	Division 1.5	Required	Not required
Flammable gas	Gaseous	Not required	Required
	Liquefied	Not required	Required
Flammable liquids	IA ^b	Not required	Required
	IB ^c	Not required	Required
Organic peroxides	Unclassified detonable I	Required Required	Not permitted Not permitted
Oxidizer liquids and solids	4	Required	Not permitted
Pyrophoric	Gases	Not required	Required
Unstable (reactive)	4	Required	Not permitted
	3 detonable	Required	Not permitted
	3 nondetonable	Not required	Required
Water-reactive liquids and solids	3	Not required	Required
	2 ^e	Not required	Required
Special Uses			
Acetylene generator rooms	—	Not required	Required
Grain processing	—	Not required	Required
Liquefied petroleum gas distribution facilities	—	Not required	Required
Where explosion hazards exist ^d	Detonation	Required	Not permitted
	Deflagration	Not required	Required

a. Combustible dusts that are generated during manufacturing or processing. See definition of Combustible Dust in Chapter 2.
 b. Storage or use.
 c. In open use or dispensing.
 d. Rooms containing dispensing and use of hazardous materials when an explosive environment can occur because of the characteristics or nature of the hazardous materials or as a result of the dispensing or use process.
 e. A method of explosion control shall be provided when Class 2 water-reactive materials can form potentially explosive mixtures.
 f. Explosion control is not required for Division 1.4S materials.

Official for approval as part of the construction documents. See Section 105.

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.

The location of fire department connections shall be approved and installed as follows:

1. Within 50 feet (15 240 mm) of an approved roadway or driveway, and arranged so that hose lines can be readily attached to the inlets without interference from any nearby objects including buildings, fences, posts, plantings, or other fire department connections.
2. Within 200 feet (60960 mm) of an approved hydrant.
3. So that the inlet height shall not be less than 18 inches nor more than 48 inches (1219 mm) above grade.
4. Guard posts or other approved means may be required to protect fire department inlet connections from vehicular damage. When guard posts are installed, the posts shall be in accordance with Chapter 5.

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. All such signs shall be subject to the approval of the fire code official. Signs shall be in accordance with Section 912.4.

912.3 Access. Immediate access to fire department connections shall be maintained at all times and without obstruction by fences, bushes, trees, walls, mechanical equipment, retention ponds or any other object. A minimum of 3 feet (914 mm) clearance shall be maintained around fire department connections.

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

912.3.2 Height. The fire department connection height shall not be less than 18 inches (57 mm) or greater than 48 inches (1219 mm).

912.3.3 Location to hydrant. The fire department connection shall be located within 200 feet (60 960 mm) of an approved fire hydrant.

912.4 Signs. Each fire department connection shall be identified by a permanent weather resistant sign. The sign face shall be a minimum 12 inches x 12 inches (305 by 305 mm) and fabricated from .080 aluminum sheet or equivalent. The sign face shall have a white 3M diamond grade sheeting or equivalent applied as background. When the system supplied by the FDC does not supply the entire building or supplies multiple buildings the sign shall identify the buildings or areas of the building supplied by the FDC. The fire department connection sign shall

identify the building address or area, where necessary, and type of systems the FDC supplies (see Figures 912.4A and 912.B).

912.5 Backflow protection. The potable water supply to automatic sprinkler and standpipe systems shall be protected against backflow as required by the *Arizona State Plumbing Code*.

912.6 Inspection, testing and maintenance. All fire department connections shall be periodically inspected, tested and maintained in accordance with NFPA 25.

SECTION 913 FIRE PUMPS

913.1 General. Where provided, fire pumps shall be installed in accordance with this section and NFPA 20.

913.2 Protection against interruption of service. The fire pump, driver, and controller shall be protected in accordance with NFPA 20 against possible interruption of service through damage caused by explosion, fire, flood, earthquake, rodents, insects, windstorm, freezing, vandalism and other adverse conditions. Where a legally required or optional electrical standby power system is installed and an electric fire pump is installed, the fire pump shall be connected to this power supply. An automatic transfer switch is required for the operation of this pump.

913.3 Temperature of pump room. Suitable means shall be provided for maintaining the temperature of a pump room or pump house, where required, above 40°F (5°C).

913.3.1 Engine manufacturer's recommendation. Temperature of the pump room, pump house or area where engines are installed shall never be less than the minimum recommended by the engine manufacturer. The engine manufacturer's recommendations for oil heaters shall be followed.

913.4 Valve supervision. Where provided, the fire pump suction, discharge and bypass valves, and the isolation valves on the backflow prevention device or assembly shall be supervised open by one of the following methods.

1. Central-station, proprietary or remote-station signaling service.
2. Local signaling service that will cause the sounding of an audible signal at a constantly attended location.
3. Locking valves open.
4. Sealing of valves and approved weekly recorded inspection where valves are located within fenced enclosures under the control of the owner.

913.4.1 Test outlet valve supervision. Fire pump test outlet valves shall be supervised in the closed position.

913.5 Testing and maintenance. Fire pumps shall be inspected, tested and maintained in accordance with the requirements of this section and NFPA 25.

913.5.1 Acceptance test. Acceptance testing shall be done in accordance with the requirements of NFPA 20.

913.5.2 Generator sets. Engine generator sets supplying emergency or standby power to fire pump assemblies shall be periodically tested in accordance with NFPA 110.

913.5.3 Transfer switches. Automatic transfer switches shall be periodically tested in accordance with NFPA 110.

913.5.4 Pump room environmental conditions. Tests of pump room environmental conditions, including heating, ventilation and illumination shall be made to ensure proper manual or automatic operation of the associated equipment.

SECTION 914

FIRE PROTECTION BASED ON SPECIAL DETAILED REQUIREMENTS OF USE AND OCCUPANCY

914.1 General. This section shall specify where fire protection systems are required based on the detailed requirements of use and occupancy of the *International Building Code*.

914.2 Covered mall buildings. Covered mall buildings shall comply with Sections 914.2.1 through 914.2.4.

914.2.1 Automatic sprinkler system. The covered mall building and buildings connected shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.1.1, which shall comply with the following:

1. The automatic sprinkler system shall be complete and operative throughout occupied space in the covered mall building prior to occupancy of any of the tenant spaces. Unoccupied tenant spaces shall be similarly protected unless provided with approved alternate protection.
2. Sprinkler protection for the mall shall be independent from that provided for tenant spaces or anchors. Where tenant spaces are supplied by the same system, they shall be independently controlled.

Exception: An automatic sprinkler system shall not be required in spaces or areas of open parking garages constructed in accordance with Section 406.2 of the *International Building Code*.

914.2.2 Standpipe system. The covered mall building shall be equipped throughout with a standpipe system in accordance with Section 905.

914.2.3 Emergency voice/alarm communication system. Covered mall buildings exceeding 50,000 square feet (4645 m²) in total floor area shall be provided with an emergency voice/alarm communication system. Emergency voice/alarm communication systems 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.

914.2.4 Fire department access to equipment. Rooms or areas containing controls for air-conditioning systems, automatic fire-extinguishing systems or other detection, suppression or control elements shall be identified for use by the fire department.

914.3 High-rise buildings. High-rise buildings shall comply with Sections 914.3.1 through 914.3.5.

914.3.1 Automatic sprinkler system. Buildings and structures shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 and a

secondary water supply where required by Section 903.3.5.2.

Exception: An automatic sprinkler system shall not be required in spaces or areas of:

1. Open parking garages in accordance with Section 406.3 of the *International Building Code*.
2. Telecommunication equipment buildings used exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an automatic fire detection system in accordance with Section 907.2 and are separated from the remainder of the building with fire barriers consisting of not less than 1-hour fire-resistance-rated walls and 2-hour fire-resistance-rated floor/ceiling assemblies.

914.3.2 Automatic fire detection. Smoke detection shall be provided in accordance with Section 907.2.12.1.

914.3.3 Emergency voice/alarm communication system. An emergency voice/alarm communication system shall be provided in accordance with Section 907.2.12.2.

914.3.4 Fire department communication system. A two-way fire department communication system shall be provided for fire department use in accordance with Section 907.2.12.3.

914.3.5 Fire command. A fire command center complying with Section 509 shall be provided in a location approved by the fire department.

914.4 Atriums. Atriums shall comply with Sections 914.4.1 and 914.4.2.

914.4.1 Automatic sprinkler system. An approved automatic sprinkler system shall be installed throughout the entire building.

Exceptions:

1. That area of a building adjacent to or above the atrium need not be sprinklered, provided that portion of the building is separated from the atrium portion by not less than a 2-hour fire-resistant-rated barrier or horizontal assembly, or both.
2. Where the ceilings of the atrium are more than 55 feet (16 764 mm) above the floor, sprinkler protection at the ceiling of the atrium is not required.

914.4.2 Fire alarm system. A fire alarm system shall be provided where required by Section 907.2.13.

914.5 Underground buildings. Underground buildings shall comply with Sections 914.5.1 through 914.5.6.

914.5.1 Automatic sprinkler system. The highest level of exit discharge serving the underground portions of the building and all levels below shall be equipped with an automatic sprinkler system installed in accordance with Section 903.3.1.1. Water-flow switches and control valves shall be supervised in accordance with Section 903.4.

914.5.2 Smoke control system. A smoke control system is required to control the migration of products of combustion in accordance with Section 909 and provisions of this section. Smoke control shall restrict movement of smoke to the general area of fire origin and maintain means of egress in a usable condition.

914.5.3 Compartment smoke control system. Where compartmentation is required by Section 405.4 of the *International Building Code*, each compartment shall have an independent smoke-control system. The system shall be automatically activated and capable of manual operation in accordance with Section 907.2.18.

914.5.4 Fire alarm system. A fire alarm system shall be provided where required by Section 907.2.19.

914.5.5 Public address. A public address system shall be provided where required by Section 907.2.19.1.

914.5.6 Standpipe system. The underground building shall be provided throughout with a standpipe system in accordance with Section 905.

914.6 Stages. Stages shall comply with Sections 914.6.1 and 914.6.2.

914.6.1 Automatic sprinkler system. Stages shall be equipped with an automatic fire-extinguishing system in accordance with Chapter 9. Sprinklers shall be installed under the roof and gridiron and under all catwalks and galleries over the stage. Sprinklers shall be installed in dressing rooms, performer lounges, shops and storerooms accessory to such stages.

Exceptions:

1. Sprinklers are not required under stage areas less than 4 feet (1219 mm) in clear height utilized exclusively for storage of tables and chairs, provided the concealed space is separated from the adjacent spaces by not less than $\frac{3}{8}$ -inch (15.9 mm) Type X gypsum board.
2. Sprinklers are not required for stages 1,000 square feet (93 m²) or less in area and 50 feet (15 240 mm) or less in height where curtains, scenery or other combustible hangings are not retractable vertically. Combustible hangings shall be limited to a single main curtain, borders, legs and a single backdrop.
3. Sprinklers are not required within portable orchestra enclosures on stages.

914.6.2 Standpipe system. Standpipe systems shall be provided in accordance with Section 905.

914.7 Special amusement buildings. Special amusement buildings shall comply with Sections 914.7.1 and 914.7.2.

914.7.1 Automatic sprinkler system. Special amusement buildings shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1. Where the special amusement building is temporary, the sprinkler water supply shall be of an approved temporary means.

Exception: Automatic sprinklers are not required where the total floor area of a temporary special amusement building is less than 1,000 square feet (93 m²) and the travel distance from any point to an exit is less than 50 feet (15 240 mm).

914.7.2 Automatic fire detection. Special amusement buildings shall be equipped with an automatic fire detection system in accordance with Section 907.2.11.

914.8 Aircraft-related occupancies. Aircraft-related occupancies shall comply with Sections 914.8.1 through 914.8.5.

914.8.1 Automatic fire detection systems. Airport traffic control towers shall be provided with an automatic fire detection system installed in accordance with Section 907.2.

914.8.2 Fire suppression. Aircraft hangars shall be provided with fire suppression as required by NFPA 409.

Exception: Group II hangars, as defined in NFPA 409, storing private aircraft without major maintenance or overhaul are exempt from foam suppression requirements.

914.8.3 Finishing. The process of “doping,” involving the use of a volatile flammable solvent, or of painting shall be carried on in a separate detached building equipped with automatic fire-extinguishing equipment in accordance with Section 903.

914.8.4 Residential aircraft hangar smoke alarms. Smoke alarms shall be provided within residential aircraft hangars in accordance with Section 907.2.21.

914.8.5 Aircraft paint hangar fire suppression. Aircraft paint hangars shall be provided with fire suppression as required by NFPA 409.

914.9 Application of flammable finishes. An automatic fire-extinguishing system shall be provided in all spray, dip and immersing spaces and storage rooms, and shall be installed in accordance with Chapter 9.

914.10 Drying rooms. Drying rooms designed for high-hazard materials and processes, including special occupancies as provided for in Chapter 4 of the *International Building Code*, shall be protected by an approved automatic fire-extinguishing system complying with the provisions of Chapter 9.

SECTION 915 FIRE-FIGHTER AIR SYSTEMS

915.1 Scope. The design, installation, and maintenance of firefighter air systems shall be in accordance with this section.

915.2 Required installations. Effective May 2, 2004, a firefighter air system shall be installed in the following buildings:

1. Buildings classified as high-rise in accordance with the building code.
2. Underground structures that are two or more floors below grade with an area greater than 10,000 square feet (929 m²).

915.3 Permits, plans and fees.

915.3.1 Permits. A permit is required to install or modify a firefighter air system.

915.3.2 Plans. Prior to the installation of a fire-fighter air system, a minimum of two sets of plans and specifications shall be submitted to the Phoenix Fire Department for review and approval. Plans shall demonstrate compliance with the requirements of this section and shall include calculations prepared by a registered professional engineer demonstrating that the design criteria for all pressure containing components is satisfied plus a minimum safety factor of 25 percent.

The plans submittal shall also include specifications for the tubing, fittings, and manufacturer data sheets for valves, pressure regulators, pressure relief devices, gauges, RIC universal air connections and cylinder filling hoses.

915.3.3 Contractor qualification. The fire-fighter air system shall be installed by Arizona state licensed contractors. Proof of licensure shall be provided with the plan submittal.

915.4 Design criteria.

915.4.1 The system shall be designed to fill, at each interior cylinder filling panel one 66 standard cubic foot compressed breathing air cylinder to a maximum pressure of 3,000 and 4,500 psig (20 685 kPa and 31 028 kPa).

915.4.2 The filling operation shall be completed in not more than two minutes upon connection of the cylinder to the fill hose.

915.4.3 The minimum design flow of the breathing air piping system shall be calculated using two interior cylinder filling panels operating simultaneously and located at the highest level above the fire department access.

915.5 Operating pressure. All components used in the system shall be rated to operate at a minimum pressure of 5,000 psig (34 475 kPa) at 70°F (21°C).

915.6 Marking. System piping, gauges, valves and air outlets shall be clearly marked by means of steel or plastic labels or tags indicating their function. Markings used for piping systems shall consist of the content's name and include a direction of flow arrow. Markings shall be provided at each valve; at wall, floor or ceiling penetrations; at each change of direction; and at a minimum of every 20 feet (6096 mm) or fraction thereof throughout the piping system.

915.7 Base station exterior fire department connection panel and enclosure.

915.7.1 Location. A fire department connection panel shall be attached to the building or on a remote monument at the exterior of the building. The panel shall be secured inside of a weather resistant enclosure. The panel shall be within 50 feet (15240 mm) of an approved roadway or driveway, or other location approved by the Phoenix Fire Department. The enclosure shall be visible and accessible on approach to the building.

915.7.2 Construction. The fire department connection panel shall be installed in a cabinet constructed of minimum 18-gauge carbon steel. When constructed of steel, the cabinet shall be provided with coating to protect the cabinet

from corrosion. When the enclosure is constructed of nonmetallic materials, the enclosure shall be resistant to ultraviolet and infrared solar radiation.

915.7.3 Vehicle protection. When the panel is located in an area subject to vehicle traffic, impact protection shall be provided in accordance with this code.

915.7.4 Base station enclosure marking. The front of the enclosure shall be marked "FIRE-FIGHTER AIR SYSTEM" on securely attached steel, plastic engraved or painted plate. The lettering shall be in a color that contrasts with the enclosure front and in letters that are a minimum of 2 inches (51 mm) high with $\frac{3}{8}$ -inch (9053 mm) brush stroke. The marking of the enclosure shall be visible.

915.7.5 Base station enclosure components. The components in the base station panel shall consist of the necessary components to provide air to the air substations located on upper and/or lower building levels. The fire department air supply source shall be designed to connect to the base station panel. The following components shall be installed in the Base Station Enclosure.

1. One—Male RIC UAC fitting. When connected to a female fitting, the assembled UAC shall meet the construction, performance and dimensional requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services 2002 Edition*.
2. One—downstream shutoff valve.
3. One—pressure gauge to check pressure of the piping distribution to air substations located on upper and lower building levels.
4. One—pressure relief valve designed for 1.25 times the design discharge of the fire department air supply or air supply trucks. All fittings, hoses and hard piping in the base station supply panel and distribution piping to air substations supply panels, shall be designed for an air pressure of 1.5 times the pressure of the fire department air delivery system.
5. Base station can be designed for a dual air pressure supply piping system for supply of air to air substations. The dual air supply lines will require an intermediate regulator to provide air pressure for a 4500 psig (31 028 kPa) system and a 3000 psig (20 685 kPa) system. Each of these air supply lines will be fitted with separate pressure relief valves set at 1.25 times the working pressure of the air supply line and the operating pressure of each of the separate pressurized lines.
6. The relief valve, piping, pressure regulator, pressure gauges, fittings and connection hoses shall meet the requirement of the ASME *Boiler and Pressure Code*, Section VIII, *Unified Pressure Vessel Code*. The installation of the piping system, as a minimum, will be based on ASME B31.3-2004 Code.
7. Mechanical supports for piping, hoses, gauges and pressure components, will be designed and built to provide a solid rigid structure.

915.7.6 Security. To prevent unauthorized access to or tampering with the system, the fire department connection panel enclosure shall be maintained locked by an approved means.

915.7.7 Fire department key box. A fire department key box shall be provided adjacent to the fire department connection panel and enclosure. A key for the enclosure shall be provided in the key box.

915.8 Interior cylinder fill panels and enclosure—air substation.

915.8.1 Location. Cylinder fill panels shall be installed in the interior of buildings as follows:

1. An interior air substation cylinder fill panel and enclosure shall be installed adjacent to standpipe outlets in all stairwells of buildings commencing on the second floor above grade, below grade and every other floor thereafter.
2. Underground Structures. An interior air substation cylinder fill panel and enclosure shall be installed in all stairwells on the second level below grade and every other below grade level thereafter.

The panel shall be located a minimum of 36 inches (914 mm) but not more than 60 inches (1524 mm) above the finished floor or a stairway landing.

915.8.2 Cabinet requirements. Each air substation cylinder fill panel shall be installed in a cabinet constructed of minimum 18-gauge carbon steel. The depth of the cabinet shall not create an exit obstruction when installed in building stairways. With the exception of the shutoff valve, pressure gauges, fill hoses and ancillary components, no system components shall be visible and shall be contained behind a minimum 18-gauge interior panel.

915.8.3 Door. Hinges for the cabinet door shall be located inside of the cabinet. The door shall be arranged such that when the door is open, it does not reduce the required exit width or create an obstruction in the path of egress. A minimum of 80 percent of the door surface area shall be constructed of tempered glass. The thickness of the glass shall not be greater than $\frac{1}{8}$ -inch (3.17 mm).

915.8.4 Cabinet marking. The front of each cylinder fill panel shall be marked "FIRE-FIGHTER AIR SYSTEM." The lettering shall be in a color that contrasts with the cabinet front and in letters that are a minimum of 2 inches (50 mm) high with $\frac{3}{8}$ -inch (5 mm) brush stroke. The marking of the cabinet shall be visible to emergency response personnel.

915.8.5 Air substation cabinet components. The cabinet shall be of sufficient size to allow for the installation of the following components:

1. One— isolation valve located between the air discharge line to the next air substation and the downstream line to the air base station supply or the air substation immediately below to the next substation above the air base station.

2. The fill hoses and isolation valves shall be installed between the air bottle connection line and the fresh air supply.
3. Excess bleed valves shall be located between the air bottle fill hose and the next air substation.
4. When multiple bottle fill hoses are required at a single air substation, the air supply lines shall be identified as 4,500 psig (31 028 kPa) pressure and 3,000 psig (20 685 kPa) pressure and shall be controlled by a single valve between the air supply and air bottle. The SCBA fill hoses shall be designed with RIC UAC fittings. A protective cap to be provided for each hose.
5. Mechanical supports for piping, hoses, gauges and pressure components shall be designed and built to provide a solid rigid structure.

915.8.6 Cylinder filling hose. The design of the cabinet shall provide a means for storing the hose to prevent kinking. When the hose is coiled, the brackets shall be installed so that the hose bend radius is maintained at 4 inches (102 mm) or greater.

The discharge outlet of each cylinder filling hose shall have a female RIC UAC. The female fitting shall be designed to connect to a male RIC UAC. The assembled RIC UAC shall meet the construction, performance and dimensional requirements of NFPA 1981, *Standard on Open Circuit Self-Contained Apparatus for Fire and Emergency Services*, 2002 edition, Section 6.4.

915.8.7 Security. To prevent unauthorized access to or tampering with the system, each panel cover shall be maintained locked by an approved means.

915.9 Installation of components.

915.9.1 Pressure monitoring switch. An electric low pressure monitoring switch shall be installed in the piping system to monitor the air pressure. The pressure switch shall be connected to the building's fire alarm system. The pressure switch shall transmit a supervisory signal when the pressure of the breathing air system is less than 3,000 psig (20 685 kPa) at 70° F (21°C), + 100 psig (690 kPa). If the building is not equipped with a fire alarm system, activation of the pressure switch shall activate an audible alarm located at the building's main entrance. A weather resistant sign shall be provided adjacent to the audible alarm stating "FIRE-FIGHTER AIR SYSTEM - LOW AIR PRESSURE ALARM." The lettering shall be in a contrasting color and the letters shall be a minimum of 2 inches (51 mm) high with $\frac{3}{8}$ -inch (9.53 mm) brush stroke.

915.9.2 Tubing. Piping shall be constructed of stainless steel or other approved materials that are compatible with breathing air. The use of nonmetallic materials shall be compatible with breathing air. When stainless steel tubing is used, it shall meet ASTM A-269, Grade 316 or an equal standard. Stainless steel fitting shall be a minimum 0.375 inches (9.5 mm) outside diameter by .065 inches (1.6 mm) wall Grade 316 fully annealed seamless. Stainless steel fittings shall be at least Grade 316 and meet the requirements of ASTM A 479 or equal. Routing of tubing and bends shall be such as to protect the tubing from mechanical damage.

915.9.3 Support. Piping shall be supported at maximum intervals of 5 feet (1524 mm). Individual tubing clamps and mounting components shall be mechanically secured to the building support-members in accordance with manufacturers specifications.

915.9.4 Fittings. Fittings shall be constructed of stainless steel or other approved materials that are compatible with breathing air. The use of nonmetallic materials shall be compatible with breathing air. Stainless steel fittings shall be at least Grade 316 and meet the requirements of ASTM A 479 or an equal standard.

915.9.5 Prohibition. The use of carbon steel, iron pipe, malleable iron, high strength gray iron, or alloy steel is prohibited.

915.10 System assembly requirements. The system shall be all welded system except where the tubing joints are readily accessible and at the individual air fill panels. When mechanical high-pressure tube fittings are used, they shall be approved for the type of materials to be joined and rated for the maximum pressure of the system.

Welding procedures shall meet ASME B31.1-1989, Part 4 and Chapter V (Exhibit VI). Prior to and during the welding of sections of tubing, a continuous, regulated dry nitrogen or argon purge at 3 psig (20.68 kPa) shall be maintained to eliminate contamination with products of the oxidation or welding flux. The purge shall commence a minimum of 2 minutes prior to welding operations and continue until the welded joint is at ambient temperature 60° to 80°F (15.5° to 26.6°C).

915.11 Prevention of contamination. The installing contractor shall ensure that, at all times, the system components are not exposed to contaminants, including, but not limited to, oils, solvents, dirt and construction materials. When contamination of system components has occurred, the affected component shall not be installed in the system.

915.12 Testing and inspection.

915.12.1 Testing. Following fabrication, assembly, and installation of the piping distribution system, exterior connection panel and interior cylinder fill panels, the Phoenix Fire Department shall witness the pneumatic testing of the complete system at a minimum test pressure of 5,500 psi (37 923 kPa) using oil free dry air, nitrogen or argon. A minimum 24-hour pneumatic or hydrostatic test shall be performed. During this test all fittings, joints and system components shall be inspected for leaks. A solution compatible with the system component materials shall be used on each joint and fitting. Any defects in the system or leaks detected shall be documented on an inspection report, repaired or replaced. As an alternate, a pressure decay test in accordance with ASME B31.3 is allowed.

A test of the low pressure monitoring switch shall be performed.

Each air fill panel shall be tested for compatibility with the fire department's SCBA RIC UAC.

The pipe or tubing manufacturer mill report shall be provided to the Phoenix Fire Department.

915.12.2 Air samples. A minimum of two samples shall be taken from separate air fill panels and submitted to an independent certified gas analysis laboratory to verify the system's cleanliness and that the air is certified as breathing air. The laboratory shall submit a written report of the analysis to the Phoenix Fire Department documenting that the breathing air complies with this section.

915.12.3 Quality analysis. During the period of air quality analysis, the air fill panel inlet shall be secured so that no air can be introduced into the system and each air fill panel shall be provided with a sign stating "AIR QUALITY ANALYSIS IN PROGRESS, DO NOT FILL OR USE ANY AIR FROM THIS SYSTEM." This sign shall be a minimum of 8 1/2 × 11 inches (215 mm × 279 mm) with minimum of 1-inch (25 mm) lettering.

915.12.4 Inspection. Annually, the breathing air within the system shall be inspected in accordance with this section.

Annually one air sample shall be taken and certified as breathing air in accordance with the section. The laboratory test results shall be maintained available for review by the Phoenix Fire Department.

915.13 System acceptance and certification. Prior to the final acceptance of the air system, the building owner shall provide for the testing and certification of the system. As a minimum, this shall include verifying the system's compatibility with the fire department's SCBA apparatus; the system's ability to maintain 5,000 psi (34 475 kPa) working pressure; the operability of the low-pressure monitoring switch and that the system's air quality complies with the requirements of Section 915.12. Prior to final acceptance, the building owner shall provide the Phoenix Fire Department with written verification of a testing and certification contract.

Upon satisfactory completion of all tests and verification of air quality, the system shall be considered complete.