

## CHAPTER 4

# SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

### SECTION 401 SCOPE

**401.1 Detailed use and occupancy requirements.** In addition to the occupancy and construction requirements in this code, the provisions of this chapter apply to the special uses and occupancies described herein.

### SECTION 402 COVERED MALL AND OPEN MALL BUILDINGS

*Section 402 has been completely reorganized from the 2009 code; therefore, the \* and \*\* margin indicators have not been included for clarity.*

**402.1 Applicability.** The provisions of this section shall apply to buildings or structures defined herein as *covered or open mall buildings* not exceeding three floor levels at any point nor more than three *stories above grade plane*. Except as specifically required by this section, *covered and open mall buildings* shall meet applicable provisions of this code.

#### Exceptions:

1. Foyers and lobbies of Groups B, R-1 and R-2 are not required to comply with this section.
2. Buildings need not comply with the provisions of this section where they totally comply with other applicable provisions of this code.

**402.1.1 Open space.** A *covered mall building* and attached *anchor buildings* and parking garages shall be surrounded on all sides by a permanent open space or not less than 60 feet (18 288 mm). An *open mall building* and *anchor buildings* and parking garages adjoining the perimeter line shall be surrounded on all sides by a permanent open space of not less than 60 feet (18 288 mm).

**Exception:** The permanent open space of 60 feet (18 288 mm) shall be permitted to be reduced to not less than 40 feet (12 192 mm), provided the following requirements are met:

1. The reduced open space shall not be allowed for more than 75 percent of the perimeter of the *covered or open mall building* and *anchor buildings*;
2. The *exterior wall* facing the reduced open space shall have a *fire-resistance rating* of not less than 3 hours;
3. Openings in the *exterior wall* facing the reduced open space shall have opening protectives with a *fire protection rating* of not less than 3 hours; and
4. Group E, H, I or R occupancies are not located within the *covered or open mall building* or *anchor buildings*.

**402.1.2 Open mall building perimeter line.** For the purpose of this code, a perimeter line shall be established. The perimeter line shall encircle all buildings and structures which comprise the *open mall building* and shall encompass any open-air interior walkways, open-air courtyards or similar open-air spaces. The perimeter line shall define the extent of the *open mall building*. *Anchor buildings* and parking structures shall be outside of the perimeter line and are not considered as part of the *open mall building*.

**402.2 Definitions.** The following terms are defined in Chapter 2:

**ANCHOR BUILDING.**

**COVERED MALL BUILDING.**

**Mall.**

**Open mall.**

**Open mall building.**

**FOOD COURT.**

**GROSS LEASABLE AREA.**

~~((402.3 Lease plan. Each owner of a covered mall building or of an open mall building shall provide both the building and fire departments with a lease plan showing the location of each occupancy and its exits after the certificate of occupancy has been issued. No modifications or changes in occupancy or use shall be made from that shown on the lease plan without prior approval of the building official.))~~

**402.4 Construction.** The construction of *covered and open mall buildings*, *anchor buildings* and parking garages associated with a *mall* building shall comply with Sections 402.4.1 through 402.4.3.

**402.4.1 Area and types of construction.** The *building area* of any *covered mall or open mall building*, including *anchor buildings*, of Type I, II, III and IV construction shall not be limited provided the *anchor buildings* do not exceed three *stories above grade plane*.

The construction type of *open parking garages* and enclosed parking garages shall comply with Sections 406.5 and 406.6, respectively.

**Exception:** The type of construction allowable *building height* and *building area* of *anchor buildings* greater than three *stories above grade plane* shall comply with Section 503, as modified by Sections 504 and 506.

**402.4.2 Fire-resistance-rated separation.** Fire-resistance-rated separation is not required between tenant spaces and the *mall*. Fire-resistance-rated separation is not required between a *food court* and adjacent tenant spaces or the *mall*.

**402.4.2.1 Tenant separations.** Each tenant space shall be separated from other tenant spaces by a *fire partition* complying with Section 708. A tenant separation wall is not required between any tenant space and the *mall*.

**402.4.2.2 Anchor building separation.** An *anchor building* shall be separated from the *covered or open mall building* by *fire walls* complying with Section 706.

**Exceptions:**

1. *Anchor buildings* of not more than three *stories above grade plane* that have an occupancy classification the same as that permitted for tenants of the *mall building* shall be separated by 2-hour fire-resistance-rated *fire barriers* complying with Section 707.
2. The exterior walls of *anchor buildings* separated from an *open mall building* by an *open mall* shall comply with Table 602.

**402.4.2.2.1 Openings between anchor building and mall.** Except for the separation between Group R-1 *sleeping units* and the *mall*, openings between *anchor buildings* of Type IA, IB, IIA or IIB construction and the *mall* need not be protected.

**402.4.2.3 Parking garages.** An attached garage for the storage of passenger vehicles having a capacity of not more than nine persons and *open parking garages* shall be considered as a separate building where it is separated from the *covered or open mall building or anchor building* by not less than 2-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

Parking garages, open or enclosed, which are separated from covered mall buildings, open mall buildings or anchor buildings shall comply with the provisions of Table 602.

Pedestrian walkways and tunnels which connect garages to mall buildings or anchor buildings shall be constructed in accordance with Section 3104.

**402.4.3 Open mall construction.** Floor assemblies in, and *roof assemblies* over, the *open mall* of an *open mall building* shall be open to the atmosphere for not less than 20 feet (9096 mm), measured perpendicular from the face of the tenant spaces on the lowest level, from edge of balcony to edge of balcony on upper floors and from edge of roof line to edge of roof line. The openings within, or the unroofed area of, an *open mall* shall extend from the lowest/grade level of the open mall through the entire *roof assembly*. Balconies on upper levels of the *mall* shall not project into the required width of the opening.

**402.4.3.1 Pedestrian walkways.** *Pedestrian walkways* connecting balconies in an *open mall* shall be located not less than 20 feet (9096 mm) from any other *pedestrian walkway*.

[F] **402.5 Automatic sprinkler system.** *Covered and open mall buildings* and buildings connected shall be equipped

throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1, which shall comply with the all of the following:

1. The *automatic sprinkler system* shall be complete and operative throughout occupied space in the *mall building* prior to occupancy of any of the tenant spaces. Unoccupied tenant spaces shall be similarly protected unless provided with *approved* alternative protection.
2. Sprinkler protection for the *mall* of a *covered mall building* shall be independent from that provided for tenant spaces or *anchor buildings*.
3. Sprinkler protection for the tenant spaces of an *open mall building* shall be independent from that provided for *anchor buildings*.
4. Sprinkler protection shall be provided beneath exterior circulation balconies located adjacent to an *open mall*.
5. 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* separated from the *covered or open mall building* in accordance with Section 402.4.2.3 and constructed in accordance with Section 406.5.

**402.6 Interior finishes and features.** Interior finishes within the *mall* and installations within the *mall* shall comply with Sections 402.6.1 through 402.6.4.

**402.6.1 Interior finish.** *Interior wall and ceiling finishes* within the *mall* of a *covered mall building* and within the *exits* of *covered or open mall buildings* shall have a minimum *flame spread index* and *smoke-developed index* of Class B in accordance with Chapter 8. *Interior floor finishes* shall meet the requirements of Section 804.

**402.6.2 Kiosks.** Kiosks and similar structures (temporary or permanent) located within the *mall* of a *covered mall building* or within the perimeter line of an *open mall building* shall meet the following requirements:

1. Combustible kiosks or other structures shall not be located within a *covered or open mall* unless constructed of any of the following materials:
  - 1.1. *Fire-retardant-treated wood* complying with Section 2303.2.
  - 1.2. Foam plastics having a maximum heat release rate not greater than 100 kW (105 Btu/h) when tested in accordance with the exhibit booth protocol in UL 1975 or when tested in accordance with NFPA 289 using the 20 kW ignition source.
  - 1.3. Aluminum composite material (ACM) meeting the requirements of Class A *interior finish* in accordance with Chapter 8 when tested as an assembly in the maximum thickness intended.
2. Kiosks or similar structures located within the *mall* shall be provided with *approved automatic sprinkler system* and detection devices.

3. The horizontal separation between kiosks or groupings thereof and other structures within the *mall* shall be not less than 20 feet (6096 mm).
4. Each kiosk or similar structure or groupings thereof shall have an area not greater than 300 square feet (28 m<sup>2</sup>).

**402.6.3 Children's play structures.** Children's play structures located within the *mall* of a *covered mall building* or within the perimeter line of an *open mall building* shall comply with Section 424. The horizontal separation between children's play structures, kiosks and similar structures within the *mall* shall be not less than 20 feet (6096 mm).

**402.6.4 Plastic signs.** Plastic signs affixed to the storefront of any tenant space facing a *mall* or *open mall* shall be limited as specified in Sections 402.6.4.1 through 402.6.4.5.

**402.6.4.1 Area.** Plastic signs shall be not more than 20 percent of the wall area facing the *mall*.

**402.6.4.2 Height and width.** Plastic signs shall be not greater than 36 inches (914 mm) in height, except that if the sign is vertical, the height shall be not greater than 96 inches (2438 mm) and the width shall be not greater than 36 inches (914 mm).

**402.6.4.3 Location.** Plastic signs shall be located not less than 18 inches (457 mm) from adjacent tenants.

**402.6.4.4 Plastics other than foam plastics.** Plastics other than foam plastics used in signs shall be light-transmitting plastics complying with Section 2606.4 or shall have a self-ignition temperature of 650°F (343°C) or greater when tested in accordance with ASTM D 1929, and a *flame spread index* not greater than 75 and smoke-developed index not greater than 450 when tested in the manner intended for use in accordance with ASTM E 84 or UL 723 or meet the acceptance criteria of Section 803.1.2.1 when tested in accordance with NFPA 286.

**402.6.4.4.1 Encasement.** Edges and backs of plastic signs in the *mall* shall be fully encased in metal.

**402.6.4.5 Foam plastics.** Foam plastics used in signs shall have flame-retardant characteristics such that the sign has a maximum heat-release rate of 150 kilowatts when tested in accordance with UL 1975 or when tested in accordance with NFPA 289 using the 20 kW ignition source, and the foam plastics shall have the physical characteristics specified in this section. Foam plastics used in signs installed in accordance with Section 402.6.4 shall not be required to comply with the *flame spread* and smoke-developed indices specified in Section 2603.3.

**402.6.4.5.1 Density.** The density of foam plastics used in signs shall be not less than 20 pounds per cubic foot (pcf) (320 kg/ m<sup>3</sup>).

**402.6.4.5.2 Thickness.** The thickness of foam plastic signs shall not be greater than 1/2 inch (12.7 mm).

**[F] 402.7 Emergency systems.** *Covered and open mall buildings, anchor buildings* and associated parking garages shall be provided with emergency systems complying with Sections 402.7.1 through 402.7.5.

**[F] 402.7.1 Standpipe system.** *Covered and open mall buildings* shall be equipped throughout with a standpipe system as required by Section 905.3.3.

**[F] 402.7.2 Smoke control.** Where a *covered mall building* contains an *atrium*, a smoke control system shall be provided in accordance with Section 404.5.

**Exception:** A smoke control system is not required in *covered mall buildings* where an *atrium* connects only two stories.

**[F] 402.7.3 ((Standby power)) Emergency power system.** *Covered mall buildings* greater than 50,000 square feet (4645 m<sup>2</sup>) in area and *open mall buildings* greater than 50,000 square feet (4645 m<sup>2</sup>) within the established perimeter line shall be provided with ((standby)) emergency power systems that are capable of operating the *emergency voice/alarm communication system*.

**[F] 402.7.4 Emergency voice/alarm communication system.** Where the total floor area is greater than 50,000 square feet (4645 m<sup>2</sup>) within either a *covered mall building* or within the perimeter line of an *open mall building*, an *emergency voice/alarm communication system* shall be provided.

*Emergency voice/alarm communication systems* serving a *mall*, required or otherwise, shall be accessible to the fire department. The systems shall be provided in accordance with Section 907.5.2.2.

**[F] 402.7.5 Fire department access to equipment.** Rooms or areas containing controls for air-conditioning systems, *automatic fire-extinguishing systems, automatic sprinkler systems* or other detection, suppression or control elements shall be identified for use by the fire department.

**402.8 Means of egress.** *Covered mall buildings, open mall buildings* and each tenant space within a *mall building* shall be provided with *means of egress* as required by this section and this code. Where there is a conflict between the requirements of this code and the requirements of Sections 402.8.1 through 402.8.8, the requirements of Sections 402.8.1 through 402.8.8 shall apply.

**402.8.1 Mall width.** For the purpose of providing required egress, *malls* are permitted to be considered as *corridors* but need not comply with the requirements of Section 1005.1 of this code where the width of the *mall* is as specified in this section.

**402.8.1.1 Minimum width.** The aggregate clear egress width of the *mall* in either a *covered or open mall building* shall be not less than 20 feet (6096 mm). The *mall* width shall be sufficient to accommodate the *occupant load* served. No portion of the minimum required aggregate egress width shall be less than 10 feet (3048 mm) measured to a height of 8 feet (2438 mm) between any projection of a tenant space bordering the *mall* and the nearest kiosk, vending machine,

bench, display opening, *food court* or other obstruction to *means of egress* travel.

**402.8.2 Determination of occupant load.** The *occupant load* permitted in any individual tenant space in a *covered or open mall building* shall be determined as required by this code. *Means of egress* requirements for individual tenant spaces shall be based on the *occupant load* thus determined.

**402.8.2.1 Occupant formula.** In determining required *means of egress* of the *mall*, the number of occupants for whom *means of egress* are to be provided shall be based on *gross leasable area* of the *covered or open mall building* (excluding *anchor buildings*) and the *occupant load* factor as determined by Equation 4-1.

$$OLF = (0.00007) (GLA) + 25 \quad \text{(Equation 4-1)}$$

where:

*OLF* = The *occupant load* factor (square feet per person).

*GLA* = The *gross leasable area* (square feet).

**Exception:** Tenant spaces attached to a *covered or open mall building* but with a *means of egress* system that is totally independent of the *open mall* of an *open mall building* or of a *covered mall building* shall not be considered as *gross leasable area* for determining the required *means of egress* for the *mall building*.

**402.8.2.2 OLF range.** The *occupant load* factor (*OLF*) is not required to be less than 30 and shall not exceed 50.

**402.8.2.3 Anchor buildings.** The *occupant load* of *anchor buildings* opening into the *mall* shall not be included in computing the total number of occupants for the *mall*.

**402.8.2.4 Food courts.** The *occupant load* of a *food court* shall be determined in accordance with Section 1004. For the purposes of determining the *means of egress* requirements for the *mall*, the *food court occupant load* shall be added to the *occupant load* of the *covered or open mall building* as calculated above.

**402.8.3 Number of means of egress.** Wherever the distance of travel to the *mall* from any location within a tenant space used by persons other than employees is greater than 75 feet (22 860 mm) or the tenant space has an *occupant load* of 50 or more, no fewer than two *means of egress* shall be provided.

**402.8.4 Arrangements of means of egress.** Assembly occupancies with an *occupant load* of 500 or more located within a *covered mall building* shall be so located such that their entrance will be immediately adjacent to a principal entrance to the *mall* and shall have not less than one-half of their required *means of egress* opening directly to the exterior of the *covered mall building*. Assembly occupancies located within the perimeter line of an *open mall building* shall be permitted to have their main *exit* open to the *open mall*.

**402.8.4.1 Anchor building means of egress.** Required *means of egress* for *anchor buildings* shall be provided independently from the *mall means of egress* system. The *occupant load* of *anchor buildings* opening into the *mall* shall not be included in determining *means of egress* requirements for the *mall*. The path of *egress* travel of *malls* shall not exit through *anchor buildings*. *Malls* terminating at an *anchor building* where no other *means of egress* has been provided shall be considered as a dead-end *mall*.

**402.8.5 Distance to exits.** Within each individual tenant space in a *covered or open mall building*, the distance of travel from any point to an *exit* or entrance to the *mall* shall be not greater than 200 feet (60 960 mm).

The distance of travel from any point within a *mall* of a *covered mall building* to an *exit* shall be not greater than 200 feet (60 960 mm). The maximum distance of travel from any point within an *open mall* to the perimeter line of the *open mall building* shall be not greater than 200 feet (60 960 mm).

**402.8.6 Access to exits.** Where more than one *exit* is required, they shall be so arranged that it is possible to travel in either direction from any point in a *mall* of a *covered mall building* to separate *exits* or from any point in an *open mall* of an *open mall building* to two separate locations on the perimeter line, provided neither location is an exterior wall of an *anchor building* or parking garage. The width of an *exit passageway* or *corridor* from a *mall* shall be not less than 66 inches (1676 mm).

**Exception:** Access to exits are permitted by way of a dead-end *mall* which does not exceed a length equal to twice the width of the *mall* measured at the narrowest location within the dead-end portion of the *mall*.

**402.8.6.1 Exit passageways.** Where *exit passageways* provide a secondary *means of egress* from a tenant space, doorways to the *exit passageway* shall be protected by 1-hour *fire door assemblies* that are self- or automatic-closing by smoke detection in accordance with Section 716.5.9.3.

**402.8.7 Service areas fronting on exit passageways.** Mechanical rooms, electrical rooms, building service areas and service elevators are permitted to open directly into *exit passageways*, provided the *exit passageway* is separated from such rooms with not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both. The *fire protection rating* of openings in the *fire barriers* shall be not less than 1 hour.

**402.8.8 Security grilles and doors.** Horizontal sliding or vertical security grilles or doors that are a part of a required *means of egress* shall conform to the following:

1. They shall remain in the full open position during the period of occupancy by the general public.
2. Doors or grilles shall not be brought to the closed position when there are 10 or more persons occupying spaces served by a single *exit* or 50 or more persons occupying spaces served by more than one *exit*.

3. The doors or grilles shall be openable from within without the use of any special knowledge or effort where the space is occupied.
4. Where two or more *exits* are required, not more than one-half of the *exits* shall be permitted to include either a horizontal sliding or vertical rolling grille or door.

### SECTION 403 HIGH-RISE BUILDINGS

**403.1 Applicability.** *High-rise buildings* shall comply with Sections 403.2 through 403.6.

**Exception:** The provisions of Sections 403.2 through 403.6 shall not apply to the following buildings and structures:

1. Airport traffic control towers in accordance with Section 412.3.
2. *Open parking garages* in accordance with Section 406.5.
3. Buildings with a Group A-5 occupancy in accordance with Section 303.6.
4. Special industrial occupancies in accordance with Section 503.1.1.
5. Buildings with a Group H-1, H-2 or H-3 occupancy in accordance with Section 415.

**Interpretation I403.1a:** Item 2 only includes buildings in which parking is the principal use.

**Interpretation I403.1b:** For the purpose of this section, occupied roof decks are considered floors used for human occupancy if the *occupant load* of the deck is ten or more on the roof of a building not equipped with an *automatic sprinkler system* or where the *occupant load* is 50 or more on the roof of a building that is equipped with an *automatic sprinkler system*.

**403.1.1 Predesign conference.** At least 60 days prior to application, the applicant shall arrange a predesign conference with the design team, the *building official* and the fire code official, to review the proposed emergency life safety systems for the building and the protection of the life safety systems. The purpose of the meeting is to obtain conceptual approval from the *building official* and the fire code official of the proposed systems and to allow for design based upon the latest state-of-the-art.

The *building official* and fire code official are permitted to require sufficient documentation, based upon appropriate analyses, that the proposal meets the intent of nationally recognized good practices. The building permit shall not be issued until the *building official* and fire code official have *approved, in writing, the emergency life safety systems for the building and the protection of the life safety systems*. The documentation of

the predesign meeting shall be reflected on the plans for the building and become a permanent part of the Department of Planning and Development's records.

The sequence and timing of operation of smoke and heat detection systems shall be determined at the predesign conference.

**403.1.2 Testing.** All mechanical and electrical equipment installed according to *approved plans and specifications pursuant to this section shall be tested and proven to be in proper working condition to the satisfaction of the fire code official before issuance of the Certificate of Occupancy. Such systems shall be maintained in accordance with the Fire Code.*

**403.2 Construction.** The construction of *high-rise buildings* shall comply with the provisions of Sections 403.2.1 through 403.2.4.

**403.2.1 Reduction in fire-resistance rating.** The *fire-resistance-rating* reductions listed in Sections 403.2.1.1 and 403.2.1.2 shall be allowed in buildings that have sprinkler control valves equipped with supervisory initiating devices and water-flow initiating devices for each floor.

**403.2.1.1 Type of construction.** The following reductions in the minimum *fire-resistance rating* of the building elements in Table 601 shall be permitted as follows:

1. For buildings not greater than 420 feet (128 000 mm) in *building height*, the *fire-resistance rating* of the building elements in Type IA construction shall be permitted to be reduced to the minimum *fire-resistance ratings* for the building elements in Type IB.

**Exception:** The required *fire-resistance rating* of (~~columns supporting floors~~) structural frame and bearing walls shall not be permitted to be reduced.

2. In other than Group F-1, M and S-1 occupancies, the *fire-resistance rating* of the building elements in Type IB construction other than structural frame and bearing walls shall be permitted to be reduced to the *fire-resistance ratings* in Type IIA.
3. The *building height* and *building area* limitations of a building containing building elements with reduced *fire-resistance ratings* shall be permitted to be the same as the building without such reductions.

**403.2.1.2 Shaft enclosures.** For buildings not greater than 420 feet (128 000 mm) in *building height*, the required *fire-resistance rating* of the *fire barriers* enclosing vertical *shafts*, other than *exit enclosures* and elevator hoistway enclosures, is permitted to be reduced to 1 hour where automatic sprinklers are installed within the *shafts* at the top and at alternate floor levels.

**403.2.2 Seismic considerations.** For seismic considerations, see Chapter 16.

**403.2.3 Structural integrity of interior exit stairways and elevator hoistway enclosures.** For *high-rise buildings of Risk Category III or IV* in accordance with Section 1604.5, for fire service access elevators, and for all buildings that are more than 420 feet (128 000 mm) in *building height*, enclosures for *interior exit stairways* and elevator hoistway enclosures shall comply with Sections 403.2.3.1 through 403.2.3.4.

**403.2.3.1 Wall assembly.** The wall assemblies making up the enclosures for *interior exit stairways* and elevator hoistway enclosures shall meet or exceed Soft Body Impact Classification Level 2 as measured by the test method described in ASTM C 1629/C 1629M.

**403.2.3.2 Wall assembly materials.** The face of the wall assemblies making up the enclosures for *interior exit stairways* and elevator hoistway enclosures that are not exposed to the interior of the enclosures for *interior exit stairways* or elevator hoistway enclosure shall be constructed in accordance with one of the following methods:

1. The wall assembly shall incorporate no fewer than two layers of impact-resistant construction board each of which meets or exceeds Hard Body Impact Classification Level 2 as measured by the test method described in ASTM C 1629/C 1629M.
2. The wall assembly shall incorporate no fewer than one layer of impact-resistant construction material that meets or exceeds Hard Body Impact Classification Level 3 as measured by the test method described in ASTM C 1629/C 1629M.
3. The wall assembly incorporates multiple layers of any material, tested in tandem, that meets or exceeds Hard Body Impact Classification Level 3 as measured by the test method described in ASTM C 1629/C 1629M.

**403.2.3.3 Concrete and masonry walls.** Concrete or masonry walls shall be deemed to satisfy the requirements of Sections 403.2.3.1 and 403.2.3.2.

**403.2.3.4 Other wall assemblies.** Any other wall assembly that provides impact resistance equivalent to that required by Sections 403.2.3.1 and 403.2.3.2 for Hard Body Impact Classification Level 3, as measured by the test method described in ASTM C 1629/C 1629M, shall be permitted.

**403.2.4 Sprayed fire-resistant materials (SFRM).** The bond strength of the SFRM installed throughout the building shall be in accordance with Table 403.2.4.

**TABLE 403.2.4  
MINIMUM BOND STRENGTH**

HEIGHT OF BUILDING <sup>a</sup>	SFRM MINIMUM BOND STRENGTH
Up to 420 feet	430 psf
Greater than 420 feet	1,000 psf

For SI: 1 foot = 304.8 mm, 1 pound per square foot (psf) = 0.0479 kW/m<sup>2</sup>.  
a. Above the lowest level of fire department vehicle access.

**[F] 403.3 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. See Section 903.3.1.1.2 for additional requirements for sprinkler systems in high-rise buildings.

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

- ~~1. Open parking garages in accordance with Section 406.5.~~
2. ~~Ⓣ)telecommunications 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 by not less than 1-hour fire barriers constructed in accordance with Section 707 or not less than 2-hour horizontal assemblies constructed in accordance with Section 711, or both.~~

**[F] 403.3.1 Number of sprinkler risers and system design.** Each sprinkler system zone in buildings that are more than 420 feet (128 000 mm) in *building height* shall be supplied by no fewer than two risers. Each riser shall supply sprinklers on alternate floors. If more than two risers are provided for a zone, sprinklers on adjacent floors shall not be supplied from the same riser.

**[F] 403.3.1.1 Riser location.** Sprinkler risers shall be placed in *interior exit stairways* and ramps that are remotely located in accordance with Section 1015.2.

~~((**[F] 403.3.2 Water supply to required fire pumps.** Required fire pumps shall be supplied by connections to no fewer than two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.~~

~~**Exception:** Two connections to the same main shall be permitted provided the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through no fewer than one of the connections.))~~

**[F] 403.3.3 Fire pump room.** Fire pumps shall be located in rooms protected in accordance with Section 913.2.1.

**[F] 403.4 Emergency systems.** The detection, alarm and emergency systems of *high-rise buildings* shall comply with Sections 403.4.1 through 403.4.9.

**[F] 403.4.1 Smoke detection.** Smoke detection shall be provided in accordance with Section 907.2.13.1.

**[F] 403.4.2 Fire alarm system.** A *fire alarm* system shall be provided in accordance with Section 907.2.13.

**[F] 403.4.3 Standpipe system.** A *high-rise building* shall be equipped with a standpipe system as required by Section 905.3.

[F] **403.4.4 Emergency voice/alarm communication system.** An *emergency voice/alarm communication system* shall be provided in accordance with Section 907.5.2.2.

[F] **403.4.5 Emergency responder radio coverage.** Emergency responder radio coverage shall be provided in accordance with Section 510 of the *International Fire Code*.

[F] **403.4.6 Fire command.** A *fire command center* complying with Section 911 shall be provided in a location *approved* by the fire department.

**403.4.7 No requirements.** ~~((Smoke removal. To facilitate smoke removal in post fire salvage and overhaul operations, buildings and structures shall be equipped with natural or mechanical ventilation for removal of products of combustion in accordance with one of the following:~~

1. Easily identifiable, manually operable windows or panels shall be distributed around the perimeter of each floor at not more than 50 foot (15 240 mm) intervals. The area of operable windows or panels shall be not less than 40 square feet (3.7 m<sup>2</sup>) per 50 linear feet (15 240 mm) of perimeter.

**Exceptions:**

1. In Group R-1 occupancies, each *sleeping unit* or suite having an *exterior wall* shall be permitted to be provided with 2 square feet (0.19 m<sup>2</sup>) of venting area in lieu of the area specified in Item 1.
2. Windows shall be permitted to be fixed provided that glazing can be cleared by fire fighters.
2. Mechanical air handling equipment providing one exhaust air change every 15 minutes for the area involved. Return and exhaust air shall be moved directly to the outside without recirculation to other portions of the building.
3. Any other *approved* design that will produce equivalent results.))

[F] **403.4.8 No requirements.** ~~((Standby power. A standby power system complying with Chapter 27 and Section 3003 shall be provided for standby power loads specified in 403.4.8.2. Where elevators are provided in a high rise building for accessible means of egress, fire service access or occupant self-evacuation, the standby power system shall also comply with Sections 1007.4, 3007 or 3008, as applicable.~~

~~[F] **403.4.8.1 Special requirements for standby power systems.** If the standby system is a generator set inside a building, the system shall be located in a separate room enclosed with 2 hour fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both. System supervision with manual start and transfer features shall be provided at the fire command center.~~

~~[F] **403.4.8.2 Standby power loads.** The following are classified as standby power loads:~~

1. ~~Power and lighting for the fire command center required by Section 403.4.6;~~
2. ~~Ventilation and automatic fire detection equipment for smokeproof enclosures; and~~
3. ~~Elevators.))~~

[F] **403.4.9 Emergency power systems.** An emergency power system complying with Chapter 27 and Section 403.4.9.2 shall be provided for emergency power loads specified in Section 403.4.9.1.

[F] **403.4.9.1 Emergency power loads.** The following are classified as emergency power loads:

1. Exit signs and *means of egress* illumination required by Chapter 10;
2. Elevator car lighting;
3. *Emergency voice/alarm communications systems*;
4. Automatic fire detection systems;
5. *Fire alarm* systems; ~~((and))~~
6. Electrically powered fire pumps;
7. Power and lighting for mechanical equipment rooms and the fire command center required by Section 403.4.6;
8. Lighting for elevator machine rooms, machine spaces and control rooms;
9. Ventilation and automatic fire detection equipment for pressurized stairways;
10. Smoke control system; and
11. A selected elevator in each bank, in accordance with Section 3016.6.

**Note:** A bank of elevators is a group of elevators or a single elevator controlled by a common operating system. All elevators that respond to a single call button constitute a bank of elevators. All elevators shall be transferable to an emergency power system. There is no limit on the number of cars that are permitted to be in a bank, but no more than four cars are permitted within a common hoistway. See Section 3016.7.

12. For fire service and occupant evacuation elevators:
  - 12.1. Operation of all elevator cars.
  - 12.2. Elevator controller cooling equipment.
  - 12.3. Elevator machine room ventilation and cooling equipment.
  - 12.4. For fire service access elevators only, elevator hoistway lighting.

**403.4.9.2 Special requirements for emergency power systems.** Emergency power systems shall be located in

a separate room enclosed with two-hour fire-resistance-rated fire barriers and horizontal assemblies. System supervision with manual start and transfer features shall be provided at the fire command center.

**Exceptions:**

1. Where located within a sprinklered parking garage of Type I or II construction, emergency power and legally required standby power systems with fixed fuel quantities meeting the limits of Section 603.3 of the *International Fire Code*, and their transfer switches, are not required to be in a separate room. Other occupancies located in the *story* where the system is located shall be separated from the system by fire barriers with a minimum 1 hour fire-resistance rating.
2. Combustion and radiator intake air are permitted to be transferred from the adjacent garage. Radiator discharge air is permitted to be transferred to the adjacent garage. Radiator ventilation intake and discharge air locations shall be separated to maintain the radiator ventilation intake air temperature below the maximum temperature allowed to meet the emergency and legally required standby power system loads.

**403.5 Means of egress and evacuation.** The means of egress in high-rise buildings shall comply with Sections 403.5.1 through 403.5.6.

**403.5.1 Remoteness of interior exit stairways.** Required interior exit stairways shall be separated by a distance not less than 30 feet (9144 mm) or not less than one-fourth of the length of the maximum overall diagonal dimension of the building or area to be served, whichever is less. The distance shall be measured in a straight line between the nearest points of the interior exit stairways. In buildings with three or more interior exit stairways, no fewer than two of the interior exit stairways shall comply with this section. Interlocking or scissor stairs shall be counted as one interior exit stairway.

**Exception:** In buildings containing primarily Group R occupancies, required interior exit stairways are permitted to be separated by a distance not less than 15 feet (4572 mm).

**403.5.2 Additional exit stairway.** For buildings other than Group R-2 that are more than 420 feet (128 000 mm) in building height, one additional exit stairway meeting the requirements of Sections 1009 and 1022 shall be provided in addition to the minimum number of exits required by Section 1021.1. The total width of any combination of remaining exit stairways with one exit stairway removed shall be not less than the total width required by Section 1005.1. Scissor stairs shall not be considered the additional exit stairway required by this section.

**Exception:** ((An)) Subject to the approval of the building official, an additional exit stairway shall not be

required to be installed in buildings having elevators used for occupant self-evacuation in accordance with Section ((3008)) 403.6.2.

**403.5.3 Stairway door operation.** Stairway doors other than the exit discharge doors shall be permitted to be locked from the stairway side. Stairway doors that are locked from the stairway side shall be capable of being unlocked simultaneously without unlatching upon a signal from the fire command center and shall be capable of being unlocked simultaneously and automatically upon a signal from a fire alarm originating anywhere in the building. When stairway doors are installed that are not locked from the stairway side, wiring shall be installed to facilitate future installations of locking hardware.

**403.5.3.1 Stairway communication system.** A telephone or other two-way communications system connected to an approved constantly attended station shall be provided at not less than every fifth floor in each stairway ((where the doors to the stairway are locked)).

**403.5.3.2 Stairway penthouses.** All required interior exit stairways shall terminate at the roof in a penthouse with a door complying with Sections 1008.1.1 and 1008.1.2. The building official is permitted to approve an alternate design at the pre-design conference.

**403.5.4 ((Smokeproof enclosures)) Smoke control in exit stairways and elevator hoistways.** Every required exit stairway serving floors more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access shall ((be a smokeproof enclosure in accordance)) comply with Sections 909.20 and 1022.10.

**Exception:** Unless required by other sections of this code, portions of such stairways which serve floors below the level of exit discharge are not required to comply with Sections 909.20 and 1022.10 if the portion of the stairway below the level of exit discharge is separated from the pressurized stairway with not less than 1 hour fire barriers or horizontal assemblies or both.

**403.5.5 Luminous egress path markings.** Luminous egress path markings shall be provided in accordance with Section 1024.

**403.5.6 Emergency escape and rescue.** Emergency escape and rescue openings required by Section 1029 are not required.

**403.6 Elevators.** Elevator installation and operation in high-rise buildings shall comply with Chapter 30 and this section. ((Sections 403.6.1 and 403.6.2.))

In buildings with an elevator landing located more than 160 feet (48 768 mm) above the lowest level of fire department access, access to each floor shall be provided by not less than two elevators served by separate machine rooms.

**403.6.1 Fire service access elevator.** In buildings with an occupied floor more than 120 feet (36 576 mm) above the lowest level of fire department vehicle access, no fewer



than two fire service access elevators, or all elevators, whichever is less, shall be provided in accordance with this section ((Section 3007)). Each fire service access elevator shall have a capacity of not less than 3500 pounds (1588 kg).

**403.6.1.1 General.** Where required by Section 403.6.1, every floor of the building shall be served by fire service access elevators complying with Sections 403.6.1.1 through 403.6.1.9.1. Except as modified in this section, fire service access elevators shall be installed in accordance with this chapter and ASME A17.1/CSA B44.

**403.6.1.2 Phase I emergency recall operation.** Actuation of any building fire alarm-initiating device shall initiate Phase I emergency recall operation on all fire service access elevators in accordance with the requirements in ASME A17.1/CSA B44. All other elevators shall remain in normal service unless Phase I emergency recall operation is manually initiated by a separate, required three-position, key-operated "Fire Recall" switch or automatically initiated by the associated elevator lobby, hoistway or elevator machine room *smoke detectors*. In addition, if the building also contains occupant evacuation elevators in accordance with Section 403.6.2, an independent, three-position, key-operated "Fire Recall" switch conforming to the applicable requirements in ASME A17.1/CSA B44 shall be provided at the designated level for each fire service access elevator.

**403.6.1.3 Water protection.** An approved method to prevent water from infiltrating into the hoistway enclosure from the operation of the *automatic sprinkler system* outside the fire service access elevator lobby shall be provided.

**403.6.1.4 Hoistway enclosures.** The fire service access elevator hoistway shall be located in a *shaft enclosure* complying with Section 713.

**403.6.1.5 Hoistway lighting.** When fire-fighters' emergency operation is active, the entire height of the hoistway shall be illuminated at not less than 1 footcandle (11 lux) as measured from the top of the car of each fire service access elevator.

**403.6.1.6 Fire service access elevator lobby.** The fire service access elevator shall open into a fire service access elevator lobby in accordance with Sections 403.6.1.6.1 through 403.6.1.6.5.

**Exception:** Where a fire service access elevator has two entrances onto a floor, the second entrance shall be permitted to open into an elevator lobby in accordance with Section 713.14.1.

**403.6.1.6.1 Access.** The fire service access elevator lobby shall have direct access to an enclosure for an *interior exit stairway*.

**403.6.1.6.2 Lobby enclosure.** The fire service access elevator lobby shall be enclosed with a *smoke barrier* having a *fire-resistance rating* of not less

than 1 hour, except that lobby doorways shall comply with Section 403.6.1.6.3.

**Exceptions:**

1. Enclosed fire service access elevator lobbies are not required at the *levels of exit discharge*.
2. Enclosed fire service access elevator lobbies are not required for elevators with pressurized hoistways.

**403.6.1.6.3 Lobby doorways.** Other than the door to the hoistway, each doorway to a fire service access elevator lobby shall be provided with a  $\frac{3}{4}$ -hour *fire door assembly* complying with Section 716.5. The *fire door assembly* shall also comply with the smoke and draft control door assembly requirements of Section 716.5.3.1 with the UL 1784 test conducted without the artificial bottom seal.

**403.6.1.6.4 Lobby size.** Each enclosed fire service access elevator lobby shall be not less than 150 square feet (14 m<sup>2</sup>) in an area with a minimum dimension of 8 feet (2440 mm).

**403.6.1.6.5 Fire service access elevator symbol.** A pictorial symbol of a standardized design designating which elevators are fire service access elevators shall be installed on each side of the hoistway door frame on the portion of the frame at right angles to the fire service access elevator lobby. The fire service access elevator symbol shall be designed as shown in Figure 403.6.1.6.5 and shall comply with the following:

1. The fire service access elevator symbol shall be not less than 3 inches (76 mm) in height.
2. The vertical center line of the fire service access elevator symbol shall be centered on the hoistway door frame. Each symbol shall not be less than 78 inches (1981 mm), and not more than 84 (2134 mm) inches above the finished floor at the threshold.



**FIGURE 403.6.1.6.5  
FIRE SERVICE ACCESS ELEVATOR SYMBOL**

**403.6.1.7 Elevator system monitoring.** The fire service access elevator shall be continuously monitored at the *fire command center* by a standard emergency service interface system meeting the requirements of NFPA 72.

**403.6.1.8 Protection of wiring or cables.** Wires or cables that are located outside of the elevator hoistway and machine room and that provide normal or emer-

gency power, control signals, communication with the car, lighting, heating, air conditioning, *ventilation* and fire-detecting systems to fire service access elevators shall be protected by construction having a *fire-resistance rating* of not less than 2 hours, or shall be circuit integrity cable having a *fire-resistance rating* of not less than 2 hours.

**Exception:** Wiring and cables to control signals are not required to be protected provided that wiring and cables do not serve Phase II emergency in-car operations.

**403.6.1.9 Standpipe hose connection.** A Class I standpipe hose connection in accordance with Section 905 shall be provided in the *interior exit stairway* and *ramp* having direct access from the fire service access elevator lobby.

**403.6.1.9.1 Access.** The *exit* enclosure containing the standpipe shall have access to the floor without passing through the fire service access elevator lobby.

**403.6.2 Occupant evacuation elevators.** Where installed in accordance with ((Section 3008)) this section, all passenger elevators for general public use shall be permitted to be used for occupant self-evacuation.

**403.6.2.1 General.** Where elevators are to be used for occupant self-evacuation during fires, all passenger elevators for general public use shall comply with Sections 403.6.2.1.1 through 403.6.2.9.1. Where other elevators are used for occupant self-evacuation, they shall also comply with these sections.

**403.6.2.1.1 Additional exit stairway.** Where an additional *means of egress* is required in accordance with Section 403.5.2, an additional *exit stairway* shall not be required to be installed in buildings provided with occupant evacuation elevators complying with Section 403.6.2.

**403.6.2.1.2 Fire safety and evacuation plan.** The building shall have an *approved* fire safety and evacuation plan in accordance with the applicable requirements of Section 404 of the *International Fire Code*. The fire safety and evacuation plan shall incorporate specific procedures for the occupants using evacuation elevators.

**403.6.2.2 Phase I emergency recall operation.** An independent, three-position, key-operated "Fire Recall" switch complying with ASME A17.1/CSA B44 shall be provided at the designated level for each occupant evacuation elevator.

**403.6.2.2.1 Operation.** The occupant evacuation elevators shall be used for occupant self-evacuation only in the normal elevator operating mode prior to Phase I Emergency Recall Operation in accordance with the requirements in ASME A17.1/CSA B44 and the building's fire safety and evacuation plan.

**403.6.2.2.2 Activation.** Occupant evacuation elevator systems shall be activated by any of the following:

1. The operation of an *automatic sprinkler system* complying with Section 903.3.1.1;
2. Fire alarm initiating devices required by another provision of the code that do not initiate Phase I Emergency Recall Operation;
3. *Approved* manual controls.

**403.6.2.3 Water protection.** An *approved* method to prevent water from infiltrating into the hoistway enclosure from the operation of the *automatic sprinkler system* outside the occupant evacuation elevator lobby shall be provided.

**403.6.2.4 Hoistway enclosure protection.** Occupant evacuation elevator hoistways shall be located in *shaft enclosures* complying with Section 713.

**403.6.2.5 Occupant evacuation elevator lobby.** The occupant evacuation elevators shall open into an elevator lobby in accordance with Sections 403.6.2.5.1 through 403.6.2.5.7.2.

**403.6.2.5.1 Access.** The occupant evacuation elevator lobby shall have direct access to an *interior exit stairway* or *ramp*.

**403.6.2.5.2 Lobby enclosure.** The occupant evacuation elevator lobby shall be enclosed with a *smoke barrier* having a *fire-resistance rating* of not less than 1 hour, except that lobby doorways shall comply with Section 403.6.2.5.3.

**Exceptions:**

1. Enclosed occupant evacuation elevator lobbies are not required at the *levels of exit discharge*.
2. Elevators with pressurized hoistways are not required to comply with Section 403.6.2.5.2.

**403.6.2.5.3 Lobby doorways.** Other than the door to the hoistway, each doorway to an occupant evacuation elevator lobby shall be provided with a  $\frac{3}{4}$ -hour *fire door assembly* complying with Section 716.5. The *fire door assembly* shall also comply with the smoke and draft control assembly requirements of Section 716.5.3.1 with the UL 1784 test conducted without the artificial bottom seal.

**403.6.2.5.3.1 Vision panel.** A vision panel shall be installed in each *fire door assembly* protecting the lobby doorway. The vision panel shall consist of fire-protection-rated glazing and shall be located to furnish clear vision of the occupant evacuation elevator lobby.

**403.6.2.5.3.2 Door closing.** Each *fire door assembly* protecting the lobby doorway shall be

automatic-closing upon receipt of any fire alarm signal from the emergency voice/alarm communication system serving the building.

**403.6.2.5.4 Lobby size.** Each occupant evacuation elevator lobby shall have minimum floor area as follows:

1. The occupant evacuation elevator lobby floor area shall accommodate, at 3 square feet (0.28 m<sup>2</sup>) per person, not less than 25 percent of the occupant load of the floor area served by the lobby.
2. The occupant evacuation elevator lobby floor area also shall accommodate one wheelchair space of 30 inches by 48 inches (760 mm by 1220 mm) for each 50 persons, or portion thereof, of the occupant load of the floor area served by the lobby.

**Exception:** The size of lobbies serving multiple banks of elevators shall have the minimum floor area approved on an individual basis and shall be consistent with the building's fire safety and evacuation plan.

**403.6.2.5.5 Signage.** An approved sign indicating elevators are suitable for occupant self-evacuation shall be posted on all floors adjacent to each elevator call station serving occupant evacuation elevators.

**403.6.2.5.6 Lobby status indicator.** Each occupant evacuation elevator lobby shall be equipped with a status indicator arranged to display all of the following information:

1. An illuminated green light and the message, "Elevators available for occupant evacuation," when the elevators are operating in normal service and the fire alarm system is indicating an alarm in the building.
2. An illuminated red light and the message, "Elevators out of service, use exit stairs," when the elevators are in Phase I emergency recall operation in accordance with the requirements in ASME A17.1/CSA B44.
3. No illuminated light or message when the elevators are operating in normal service.

**403.6.2.5.7 Two-way communication system.** A two-way communication system shall be provided in each occupant evacuation elevator lobby for the purpose of initiating communication with the fire command center or an alternate location approved by the fire department.

**403.6.2.5.7.1 Design and installation.** The two-way communication system shall include audible and visible signals and shall be designed and installed in accordance with the requirements in ICC A117.1.

**403.6.2.5.7.2 Instructions.** Instructions for the use of the two-way communication system along with the location of the station shall be perma-

nently located adjacent to each station. Signage shall comply with the ICC A117.1 requirements for visual characters.

**403.6.2.6 Elevator system monitoring.** The occupant evacuation elevators shall be continuously monitored at the fire command center or a central control point approved by the fire department and arranged to display all of the following information:

1. Floor location of each elevator car.
2. Direction of travel of each elevator car.
3. Status of each elevator car with respect to whether it is occupied.
4. Status of normal power to the elevator equipment, elevator controller cooling equipment, and elevator machine room ventilation and cooling equipment.
5. Status of standby or emergency power system that provides backup power to the elevator equipment, elevator controller cooling equipment, and elevator machine room ventilation and cooling equipment.
6. Activation of any fire alarm initiating device in any elevator lobby, elevator machine room or machine space, or elevator hoistway.

**403.6.2.7 Elevator recall.** The fire command center or an alternate location approved by the fire department shall be provided with the means to manually initiate a Phase I Emergency Recall of the occupant evacuation elevators in accordance with ASME A17.1/CSA B44.

**403.6.2.8 Protection of wiring or cables.** Wires or cables that are located outside of the elevator hoistway and machine room and that provide normal or standby power, control signals, communication with the car, lighting, heating, air conditioning, ventilation and fire-detecting systems to fire service access elevators shall be protected by construction having a fire-resistance rating of not less than 2 hours, or shall be circuit integrity cable having a fire-resistance rating of not less than 2 hours.

**Exception:** Wiring and cables to control signals are not required to be protected provided that wiring and cables do not serve Phase II emergency in-car operations.

**403.6.2.9 Emergency voice/alarm communication system.** The building shall be provided with an emergency voice/alarm communication system. The emergency voice/alarm communication system shall be accessible to the fire department. The system shall be provided in accordance with Section 907.5.2.2.

**403.6.2.9.1 Notification appliances.** No fewer than one audible and one visible notification appliance shall be installed within each occupant evacuation elevator lobby.

**403.7 Emergency operational plan.** Prior to the issuance of a Certificate of Occupancy, the owner-occupant of the building shall assign a responsible person as the building's Fire

Safety Director to work with the fire code official in establishing an operational plan for the building. The operational plan shall contain the guidelines and procedures to be followed and responsibilities of the fire department, building employees, and tenants under emergency conditions, including special provisions for persons with disabilities. The plan shall also include procedures for operation, maintenance and testing of the life safety systems and the allowable use and occupancy of each portion of the building. One copy of the operational plan shall be filed with the fire code official, and one shall be posted in the central control station prior to issuance of the Certificate of Occupancy.

**403.8 Signs.** Signs complying with Sections 403.8.1 through 403.8.4 shall be provided in *high-rise buildings*.

**403.8.1 Elevator lobbies.** A sign shall be posted in every elevator lobby above each hall call fixture noting that the elevators will be recalled to the building lobby on fire alarm.

**Exception:** If approved by the *building official*, signs need not be posted in lobbies at the main egress level if the means of egress are obviously identifiable.

**403.8.2 Recall floor lobbies.** A sign indicating the number of each elevator shall be posted and maintained in the elevator lobby at each designated recall floor and at alternate floors of recall, if provided.

**403.8.3 Stair re-entry signs.** A sign shall be posted on each floor landing within a stairway indicating where re-entry is provided into the building or indicating the location of telephones or other means of two-way communication.

**403.8.4 Other signs.** Other signs required by this code, including but not limited to stairway identification signs required by Section 1022.9 and exit signs required by Section 1011, shall be provided.

## SECTION 404 ATRIUMS

**404.1 General.** In other than Group H occupancies, and where permitted by Section 712.1.6, the provisions of Sections 404.1 through 404.9 shall apply to buildings or structures containing vertical openings defined as “Atriums.”

**404.1.1 Definition.** The following term is defined in Chapter 2:

**ATRIUM.**

**404.1.2 Predesign conference.** A predesign conference is required for atriums connecting more than two stories. At least 60 days prior to application, the applicant shall arrange a predesign conference with the design team, the *building official* and the fire code official, to review the proposed smoke control and life safety systems for the building. The purpose of the meeting is to obtain conceptual approval from the *building official* and the fire code official of the proposed systems and to allow for a design based upon the latest state-of-the-art.

The *building official* and fire code official are permitted to require sufficient documentation, based upon appropri-

ate analyses, that the concept meets the intent of nationally recognized good practices. The building permit shall not be issued until the *building official* and fire code official have approved in writing the smoke control and life safety systems for the building. A summary of the substance of predesign meeting shall be documented on the building plans and become a permanent part of the Department of Planning and Development's records.

**404.2 Use.** The floor of the *atrium* shall not be used for other than low fire hazard uses and only approved materials and decorations in accordance with the *International Fire Code* shall be used in the *atrium* space.

**Exception:** The *atrium* floor area is permitted to be used for any approved use where the individual space is provided with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

[F] **404.3 Automatic sprinkler protection.** 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 2-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.
2. Where the ceiling of the *atrium* is more than 55 feet (16 764 mm) above ~~(the floor)~~ any floor area open to the *atrium*, sprinkler protection at the ceiling of the *atrium* is not required.

[F] **404.4 Fire alarm system.** A *fire alarm system* shall be provided in accordance with Section 907.2.14.

**404.5 Smoke control.** A smoke control system shall be installed in accordance with Section 909.

**Exception:** Smoke control is not required for *atriums* that connect only two *stories*.

**404.6 Enclosure of atriums.** *Atrium* spaces shall be separated from adjacent spaces by a 1-hour *fire barrier* constructed in accordance with Section 707 or a *horizontal assembly* constructed in accordance with Section 711, or both.

**Exceptions:**

1. A *fire barrier* is not required where a glass wall forming a smoke partition is provided. The glass wall shall comply with all of the following:
  - 1.1. Automatic sprinklers are provided along both sides of the separation wall and doors, or on the room side only if there is not a walkway on the *atrium* side. The sprinklers shall be located between 4 inches and 12 inches (102 mm and 305 mm) away from the glass and at intervals along the glass not greater than 6 feet (1829 mm). The sprinkler system shall be designed so that the entire

surface of the glass is wet upon activation of the sprinkler system without obstruction;

- 1.2. The glass wall shall be installed in a gasketed frame in a manner that the framing system deflects without breaking (loading) the glass before the sprinkler system operates; and
- 1.3. Where glass doors are provided in the glass wall, they shall be either *self-closing* or automatic-closing.
2. A *fire barrier* is not required where a glass-block wall assembly complying with Section 2110 and having a  $\frac{3}{4}$ -hour *fire protection rating* is provided.
3. A *fire barrier* is not required between the *atrium* and the adjoining spaces of any three floors of the *atrium* provided such spaces are accounted for in the design of the smoke control system.
4. A *fire barrier* is not required between the *atrium* and the adjoining spaces for *atriums* that connect only two stories.

**Code Alternate CA404.6:** The separation between the atrium and tenant spaces that are not guest rooms or *dwelling units* is permitted to be omitted on four floors when:

1. The building is of Type IA or IB construction;
2. The perimeter of the opening is protected by draft curtains and a row of automatic sprinkler heads not more than 6 feet (1829 mm) on center as required for escalator protection;
3. All spaces of the building separated from the atrium by less than 1-hour fire-resistive construction are equipped with an automatic smoke detection system;
4. Tenant spaces open to the atrium have access to two interior exit stairways separated by one-half of the building diagonal with one exit located so that occupants can exit in a direction away from the atrium. For the purpose of this requirement “away from the atrium” means not being forced to exit parallel and adjacent to the atrium opening. “Areas open to the atrium” are those areas that are not separated from the atrium with at least a 1-hour fire barrier.

[F] **404.7 ((Standby)) Emergency power.** Equipment required to provide smoke control shall be connected to ((a standby)) an emergency power system in accordance with Section 909.11.

**Code Alternate CA404.7:** An emergency power system is not required for smoke control systems in buildings that have at least two exits and atriums with a total volume of less than 40,000 cubic feet (1133 m<sup>3</sup>).

**404.8 Interior finish.** The *interior finish* of walls and ceilings of the *atrium* shall be not less than Class B with no reduction in class for sprinkler protection.

**404.9 Travel distance.** In other than the lowest level of the *atrium*, where the required *means of egress* is through the *atrium* space, the portion of *exit access* travel distance within the *atrium* space shall be not greater than 200 feet (60 960 mm). The travel distance requirements for areas of buildings open to the *atrium* and where access to the *exits* is not through the *atrium*, shall comply with the requirements of Section 1016.

## SECTION 405 UNDERGROUND BUILDINGS

**405.1 General.** The provisions of Sections 405.2 through 405.10 apply to building spaces having a floor level used for human occupancy more than 30 feet (9144 mm) below the finished floor of the lowest *level of exit discharge*.

**Exception:** The provisions of Section 405 are not applicable to the following buildings or portions of buildings:

1. One- and two-family *dwelling*s, sprinklered in accordance with Section 903.3.1.3.
2. Parking garages provided with *automatic sprinkler systems* in compliance with Section 405.3.
3. Fixed guideway transit systems that comply with NFPA 130 as amended.
4. *Grandstands, bleachers*, stadiums, arenas and similar facilities.
5. Where the lowest *story* is the only *story* that would qualify the building as an underground building and has an area not greater than 1,500 square feet (139 m<sup>2</sup>) and has an *occupant load* less than 10.
6. Pumping stations and other similar mechanical spaces intended only for limited periodic use by service or maintenance personnel.

**405.2 Construction requirements.** The underground portion of the building shall be of Type I construction.

[F] **405.3 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.

**405.4 Compartmentation.** Compartmentation shall be in accordance with Sections 405.4.1 through 405.4.3.

**405.4.1 Number of compartments.** A building having a floor level more than 60 feet (18 288 mm) below the finished floor of the lowest *level of exit discharge* shall be divided into no fewer than two compartments of approximately equal size. Such compartmentation shall extend through the highest *level of exit discharge* serving the underground portions of the building and all levels below.

**Exception:** The lowest *story* need not be compartmented where the area is not greater than 1,500 square feet (139 m<sup>2</sup>) and has an *occupant load* of less than 10.

**405.4.2 Smoke barrier penetration.** The compartments shall be separated from each other by a *smoke barrier* in

## SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

accordance with Section 709. Penetrations between the two compartments shall be limited to plumbing and electrical piping and conduit that are firestopped in accordance with Section 714. Doorways shall be protected by *fire door assemblies* that are automatic-closing by smoke detection in accordance with Section 716.5.9.3 and are installed in accordance with NFPA 105 and Section 716.5.3. Where provided, each compartment shall have an air supply and an exhaust system independent of the other compartments.

**405.4.3 Elevators.** Where elevators are provided, each compartment shall have direct access to an elevator. Where an elevator serves more than one compartment, an elevator lobby shall be provided and shall be separated from each compartment by a *smoke barrier* in accordance with Section 709. Doors shall be gasketed, have a drop sill and be automatic-closing by smoke detection in accordance with Section 716.5.9.3.

**405.5 Smoke control system.** A smoke control system shall be provided in accordance with Sections 405.5.1 and 405.5.2.

**405.5.1 Control system.** A smoke control system is required to control the migration of products of combustion in accordance with Section 909 and the 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.

**405.5.2 Compartment smoke control system.** Where compartmentation is required, each compartment shall have an independent smoke control system. The system shall be automatically activated and capable of manual operation in accordance with Sections 907.2.18 and 907.2.19.

**[F] 405.6 Fire alarm systems.** A *fire alarm* system shall be provided where required by Sections 907.2.18 and 907.2.19.

**405.7 Means of egress.** *Means of egress* shall be in accordance with Sections 405.7.1 and 405.7.2.

**405.7.1 Number of exits.** Each floor level shall be provided with no fewer than two *exits*. Where compartmentation is required by Section 405.4, each compartment shall have no fewer than one *exit* and shall also have no fewer than one *exit access* doorway into the adjoining compartment.

**405.7.2 ((Smokeproof enclosure)) Smoke control in exit stairways.** Every required *stairway* serving floor levels more than 30 feet (9144 mm) below the finished floor of its *level of exit discharge* shall comply with ((the requirements for a *smokeproof enclosure* as provided in)) Section 1022.10.

**[F] 405.8 No requirements.** ((Standby power. A standby power system complying with Chapter 27 shall be provided standby power loads specified in Section 405.8.1.))

**[F] 405.8.1 Standby power loads.** The following loads are classified as standby power loads:

1. ~~Smoke control system.~~
2. ~~Ventilation and automatic fire detection equipment for smokeproof enclosures.~~

### ~~3. Fire pumps.~~

~~Standby power shall be provided for elevators in accordance with Section 3003.~~

**[F] 405.8.2 Pick-up time.** The standby power system shall pick up its connected loads within 60 seconds of failure of the normal power supply.--))

**[F] 405.9 Emergency power.** An emergency power system complying with Chapter 27 shall be provided for emergency power loads specified in Section 405.9.1.

**[F] 405.9.1 Emergency power loads.** The following loads are classified as emergency power loads:

1. *Emergency voice/alarm communications systems.*
2. *Fire alarm systems.*
3. *Automatic fire detection systems.*
4. *Elevator car lighting.*
5. *Means of egress and exit sign illumination as required by Chapter 10.*
6. Smoke control systems.
7. Ventilation and automatic fire detection equipment for smokeproof enclosures.
8. Fire pumps.
9. A selected elevator in each bank in accordance with Section 3016.6. A bank of elevators is a group of elevators or a single elevator controlled by a common operating system. All elevators that respond to a single call button constitute a bank of elevators. All elevators shall be transferable to an emergency power system.

**Note:** There is no limit on the number of cars that are permitted to be in a bank, but no more than four cars are permitted within a common hoistway. See Section 3016.7.

**[F] 405.10 Standpipe system.** The underground building shall be equipped throughout with a standpipe system in accordance with Section 905.

## SECTION 406

### MOTOR-VEHICLE-RELATED OCCUPANCIES

*Section 406 has been completely reorganized from the 2009 code; therefore, the \* and \*\* margin indicators have not been included for clarity.*

**406.1 General.** Motor-vehicle-related occupancies shall comply with Sections 406.1 through 406.8.

**406.2 Definitions.** The following terms are defined in Chapter 2:

**MECHANICAL-ACCESS OPEN PARKING GARAGES.  
OPEN PARKING GARAGE.**

**RAMP-ACCESS OPEN PARKING GARAGES.**

**406.3 Private garages and carports.** Private garages and carports shall comply with Sections 406.3.1 through 406.3.5.

**406.3.1 Classification.** Buildings or parts of buildings classified as Group U occupancies because of the use or character of the occupancy shall be not greater than 1,000 square feet (93 m<sup>2</sup>) in area or one *story* in height except as provided in Section 406.3.2. Any building or portion thereof that exceeds the limitations specified in this section shall be classified in the occupancy group other than Group U that it most nearly resembles.

**406.3.2 Area increase.** Group U occupancies used for the storage of private or pleasure-type motor vehicles where no repair work is completed or fuel is dispensed are permitted to be 3,000 square feet (279 m<sup>2</sup>) where the following provisions are met:

1. For a mixed occupancy building, the *exterior wall* and opening protection for the Group U portion of the building shall be as required for the major occupancy of the building. For such a mixed occupancy building, the allowable floor area of the building shall be as permitted for the major occupancy contained therein.
2. For a building containing only a Group U occupancy, the *exterior wall* shall not be required to have a *fire-resistance rating* and the area of openings shall not be limited where the *fire separation distance* is 5 feet (1524 mm) or more.

More than one 3,000-square-foot (279 m<sup>2</sup>) Group U occupancy shall be permitted to be in the same structure, provided each 3,000-square-foot (279 m<sup>2</sup>) area is separated by *fire walls* complying with Section 706.

**406.3.3 Garages and carports.** Carports shall be open on no fewer than two sides. Carport floor surfaces shall be of *approved* noncombustible material. Carports not open on at least two sides shall be considered a garage and shall comply with the provisions of this section for garages.

**Exception:** Asphalt surfaces shall be permitted at ground level in carports.

The area of floor used for parking of automobiles or other vehicles shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway.

**406.3.4 Separation.** Separations shall comply with the following:

1. The private garage shall be separated from the *dwelling unit* and its *attic* area by means of gypsum board, not less than 1/2 inch (12.7 mm) in thickness, applied to the garage side. Garages beneath habitable rooms shall be separated from all habitable rooms above by not less than a 5/8-inch (15.9 mm) Type X gypsum board or equivalent and 1/2-inch (12.7 mm) gypsum board applied to structures supporting the separation from habitable rooms above the garage. Door openings between a private garage and the *dwelling unit* shall be equipped with either

solid wood doors or solid or honeycomb core steel doors not less than 1<sup>3</sup>/<sub>8</sub> inches (34.9 mm) in thickness, or doors in compliance with Section 716.5.3 with a fire protection rating of not less than 20 minutes. Openings from a private garage directly into a room used for sleeping purposes shall not be permitted. Doors shall be *self-closing* and self-latching.

2. Ducts in a private garage and ducts penetrating the walls or ceilings separating the *dwelling unit*, including its *attic* area, from the garage shall be constructed of sheet steel of not less than 0.019 inches (0.48 mm), in thickness, and shall have no openings into the garage.
3. A separation is not required between a Group R-3 and U carport, provided the carport is entirely open on two or more sides and there are not enclosed areas above.

**406.3.5 Automatic garage door openers.** Automatic garage door openers, if provided, shall be *listed* in accordance with UL 325.

**406.4 Public parking garages.** Parking garages, other than private parking garages, shall be classified as public parking garages and shall comply with the provisions of Sections 406.4.2 through 406.4.8 and shall be classified as either an *open parking garage* or an enclosed parking garage. *Open parking garages* shall also comply with Section 406.5. Enclosed parking garages shall also comply with Section 406.6. See Section 510 for special provisions for parking garages.

**406.4.1 Clear height.** The clear height of each floor level in vehicle and pedestrian traffic areas shall be not less than (~~7 feet (2134 mm)~~) 6 feet 6 inches (1981 mm). Vehicle and pedestrian areas accommodating van-accessible parking shall comply with Section 1106.5.

**406.4.2 Guards.** Guards shall be provided in accordance with Section 1013. Guards serving as *vehicle barriers* shall comply with Sections 406.4.3 and 1013.

**406.4.3 Vehicle barriers.** *Vehicle barriers* not less than 2 feet 9 inches (835 mm) in height shall be placed at the ends of drive lanes, and at the end of parking spaces where the vertical distance to the ground or surface directly below is greater than 1 foot (305 mm). *Vehicle barriers* shall comply with the loading requirements of Section 1607.8.3.

**Exception:** *Vehicle barriers* are not required in vehicle storage compartments in a mechanical access parking garage.

**406.4.4 Ramps.** Vehicle ramps shall not be considered as required *exits* unless pedestrian facilities are provided. Vehicle ramps that are utilized for vertical circulation as well as for parking shall not exceed a slope of 1:15 (6.67 percent).

**406.4.5 Floor surface.** Parking surfaces shall be of concrete or similar noncombustible and nonabsorbent materials.

~~((The area of floor used for parking of automobiles or other vehicles shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway.))~~

**Exception(s):**

~~((1.) Asphalt parking surfaces shall be permitted at ground level.~~

~~((2. Floors of Group S-2 parking garages shall not be required to have a sloped surface.))~~

**406.4.6 Mixed occupancy separation.** Parking garages shall be separated from other occupancies in accordance with Section 508.1.

**406.4.7 Special hazards.** Connection of a parking garage with any room in which there is a fuel-fired appliance shall be by means of a vestibule providing a two-doorway separation.

**Exception:** A single door shall be allowed provided the sources of ignition in the appliance are not less than 18 inches (457 mm) above the floor.

**406.4.8 Attached to rooms.** Openings from a parking garage directly into a room used for sleeping purposes shall not be permitted.

**406.5 Open parking garages.** *Open parking garages* shall comply with Sections 406.5.1 through 406.5.11.

**406.5.1 Construction.** *Open parking garages* shall be of Type I, II or IV construction. *Open parking garages* shall meet the design requirements of Chapter 16. For *vehicle barriers*, see Section 406.4.3.

**406.5.2 Openings.** For natural *ventilation* purposes, the exterior side of the structure shall have uniformly distributed openings on two or more sides. The area of such openings in *exterior walls* on a tier shall be not less than 20 percent of the total perimeter wall area of each tier. The aggregate length of the openings considered to be providing natural *ventilation* shall be not less than 40 percent of the perimeter of the tier. Interior walls shall be not less than 20 percent open with uniformly distributed openings.

**Exception:** Openings are not required to be distributed over 40 percent of the building perimeter where the required openings are uniformly distributed over two opposing sides of the building.

**406.5.2.1 Openings below grade.** Where openings below grade provide required natural *ventilation*, the outside horizontal clear space shall be one and one-half times the depth of the opening. The width of the horizontal clear space shall be maintained from grade down to the bottom of the lowest required opening.

**406.5.3 Uses.** Mixed uses shall be allowed in the same building as an *open parking garage* subject to the provisions of Sections 402.4.2.3, 406.5.11, 508.1, 510.3, 510.4 and 510.7.

**406.5.4 Area and height.** Area and height of *open parking garages* shall be limited as set forth in Chapter 5 for Group S-2 occupancies and as further provided for in Section 508.1.

**406.5.4.1 Single use.** Where the *open parking garage* is used exclusively for the parking or storage of private motor vehicles, with no other uses in the building, the area and height shall be permitted to comply with Table 406.5.4, along with increases allowed by Section 406.5.5.

**Exception:** The grade-level tier is permitted to contain an office, waiting and toilet rooms having a total combined area of not more than 1,000 square feet (93 m<sup>2</sup>). Such area need not be separated from the *open parking garage*.

In *open parking garages* having a spiral or sloping floor, the horizontal projection of the structure at any cross section shall not exceed the allowable area per parking tier. In the case of an *open parking garage* having a continuous spiral floor, each 9 feet 6 inches (2896 mm) of height, or portion thereof, shall be considered a tier.

The clear height of a parking tier in vehicle and pedestrian areas shall be not less than ~~((7 feet (2134 mm)))~~ 6 feet 6 inches (1981 mm), except that a lower clear height is permitted in mechanical-access *open parking garages* where approved by the building official.

**406.5.5 Area and height increases.** The allowable area and height of *open parking garages* shall be increased in accordance with the provisions of this section. Garages with sides open on three-fourths of the building's perimeter are permitted to be increased by 25 percent in area and one tier in height. Garages with sides open around the entire building's perimeter are permitted to be increased by 50 percent in area and one tier in height. For a side to be considered open under the above provisions, the total area of openings along the side shall not be less than 50 percent of the interior area of the side at each tier and such openings shall be equally distributed along the length of the tier. For purposes of calculating the interior area of the side, the height shall not exceed 7 feet (2134 mm).

Allowable tier areas in Table 406.5.4 shall be increased for *open parking garages* constructed to heights less than the table maximum. The gross tier area of the garage shall not exceed that permitted for the higher structure. No fewer than three sides of each such larger tier shall have continuous horizontal openings not less than 30 inches (762 mm) in clear height extending for not less than 80 percent of the length of the sides and no part of such larger tier shall be more than 200 feet (60 960 mm) horizontally from such an opening. In addition, each such opening shall face a street or yard accessible to a street with a width of not less than 30 feet (9144 mm) for the full length of the opening, and standpipes shall be provided in each such tier.



TABLE 406.5.4  
OPEN PARKING GARAGES AREA AND HEIGHT

TYPE OF CONSTRUCTION	AREA PER TIER (square feet)	HEIGHT (in tiers)		
		Ramp access	Mechanical access	
			Automatic sprinkler system	
			No	Yes
IA	Unlimited	Unlimited	Unlimited	Unlimited
IB	Unlimited	12 tiers	12 tiers	18 tiers
IIA	50,000	10 tiers	10 tiers	15 tiers
IIB	50,000	8 tiers	8 tiers	12 tiers
IV	50,000	4 tiers	4 tiers	4 tiers

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

Open parking garages of Type II construction, with all sides open, shall be unlimited in allowable area where the building height does not exceed 75 feet (22 860 mm). For a side to be considered open, the total area of openings along the side shall not be less than 50 percent of the interior area of the side at each tier and such openings shall be equally distributed along the length of the tier. For purposes of calculating the interior area of the side, the height shall not exceed 7 feet (2134 mm). All portions of tiers shall be within 200 feet (60 960 mm) horizontally from such openings or other natural ventilation openings as defined in Section 406.5.2. These openings shall be permitted to be provided in courts with a minimum dimension of 20 feet (6096 mm) for the full width of the openings.

**406.5.6 Fire separation distance.** Exterior walls and openings in exterior walls shall comply with Tables 601 and 602. The distance to an adjacent lot line shall be determined in accordance with Table 602 and Section 705.

**406.5.7 Means of egress.** Where persons other than parking attendants are permitted, open parking garages shall meet the means of egress requirements of Chapter 10. Where no persons other than parking attendants are permitted, there shall be no fewer than two exit stairways. Each exit stairway shall be not less than 36 inches (914 mm) in width. Lifts shall be permitted to be installed for use of employees only, provided they are completely enclosed by noncombustible materials.

**[F] 406.5.8 Standpipe system.** An open parking garage shall be equipped with a standpipe system as required by Section 905.3.

**406.5.9 Enclosure of vertical openings.** Enclosure shall not be required for vertical openings except as specified in Section 406.5.7.

**406.5.10 Ventilation.** Ventilation, other than the percentage of openings specified in Section 406.5.2, shall not be required.

**406.5.11 Prohibitions.** The following uses and alterations are not permitted:

1. Vehicle repair work.
2. Parking of buses, trucks and similar vehicles.
3. Partial or complete closing of required openings in exterior walls by tarpaulins or any other means.
4. Dispensing of fuel.

**406.6 Enclosed parking garages.** Enclosed parking garages shall comply with Sections 406.6.1 through 406.6.3.

**406.6.1 Heights and areas.** Enclosed vehicle parking garages and portions thereof that do not meet the definition of open parking garages shall be limited to the allowable heights and areas specified in Table 503 as modified by Sections 504, 506 and 507. Roof parking is permitted.

**406.6.2 Ventilation.** A mechanical ventilation system shall be provided in accordance with the International Mechanical Code.

**[F] 406.6.3 Automatic sprinkler system.** An enclosed parking garage shall be equipped with an automatic sprinkler system in accordance with Section 903.2.10.

**406.7 Motor fuel-dispensing facilities.** Motor fuel-dispensing facilities shall comply with the International Fire Code and Sections 406.7.1 and 406.7.2.

**406.7.1 Vehicle fueling pad.** The vehicle shall be fueled on noncoated concrete or other approved paving material having a resistance not exceeding 1 megohm as determined by the methodology in EN 1081.

**406.7.2 Canopies.** Canopies under which fuels are dispensed shall have a clear, unobstructed height of not less than 13 feet 6 inches (4115 mm) to the lowest projecting element in the vehicle drive-through area. Canopies and their supports over pumps shall be of noncombustible materials, fire-retardant-treated wood complying with Chapter 23, wood of Type IV sizes or of construction providing 1-hour fire resistance. Combustible materials used in or on a canopy shall comply with one of the following:

1. Shielded from the pumps by a noncombustible element of the canopy, or wood of Type IV sizes;
2. Plastics covered by aluminum facing having a thickness of not less than 0.010 inch (0.30 mm) or corrosion-resistant steel having a base metal thickness of not less than 0.016 inch (0.41 mm). The plastic shall have a flame spread index of 25 or less and a smoke-developed index of 450 or less when tested in the form intended for use in accordance with ASTM E 84 or UL 723 and a self-ignition temperature of 650°F (343°C) or greater when tested in accordance with ASTM D 1929; or
3. Panels constructed of light-transmitting plastic materials shall be permitted to be installed in canopies erected over motor vehicle fuel-dispensing sta-

tion fuel dispensers, provided the panels are located not less than 10 feet (3048 mm) from any building on the same *lot* and face *yards* or streets not less than 40 feet (12 192 mm) in width on the other sides. The aggregate areas of plastics shall be not greater than 1,000 square feet (93 m<sup>2</sup>). The maximum area of any individual panel shall be not greater than 100 square feet (9.3 m<sup>2</sup>).

**406.7.2.1 Canopies used to support gaseous hydrogen systems.** *Canopies* that are used to shelter dispensing operations where flammable compressed gases are located on the roof of the *canopy* shall be in accordance with the following:

1. The *canopy* shall meet or exceed Type I construction requirements.
2. Operations located under *canopies* shall be limited to refueling only.
3. The *canopy* shall be constructed in a manner that prevents the accumulation of hydrogen gas.

**406.8 Repair garages.** Repair garages shall be constructed in accordance with the *International Fire Code* and Sections 406.8.1 through 406.8.6. This occupancy shall not include motor fuel-dispensing facilities, as regulated in Section 406.7.

**406.8.1 Mixed uses.** Mixed uses shall be allowed in the same building as a repair garage subject to the provisions of Section 508.1.

**406.8.2 Ventilation.** Repair garages shall be mechanically ventilated in accordance with the *International Mechanical Code*. The *ventilation* system shall be controlled at the entrance to the garage.

**406.8.3 Floor surface.** Repair garage floors shall be of concrete or similar noncombustible and nonabsorbent materials.

**Exception:** Slip-resistant, nonabsorbent, *interior floor finishes* having a critical radiant flux not more than 0.45 W/cm<sup>2</sup>, as determined by NFPA 253, shall be permitted.

**406.8.4 Heating equipment.** Heating equipment shall be installed in accordance with the *International Mechanical Code*.

[F] **406.8.5 Gas detection system.** Repair garages used for the repair of vehicles fueled by nonodorized gases such as hydrogen and nonodorized LNG, shall be provided with a flammable gas detection system.

[F] **406.8.5.1 System design.** The flammable gas detection system shall be *listed* or *approved* and shall be calibrated to the types of fuels or gases used by vehicles to be repaired. The gas detection system shall be designed to activate when the level of flammable gas exceeds 25 percent of the lower flammable limit (LFL). Gas detection shall be provided in lubrication or chassis service pits of repair garages used for repairing nonodorized LNG-fueled vehicles.

[F] **406.8.5.1.1 Gas detection system components.** Gas detection system control units shall be *listed*

and *labeled* in accordance with UL 864 or UL 2017. Gas detectors shall be *listed* and *labeled* in accordance with UL 2075 for use with the gases and vapors being detected.

[F] **406.8.5.2 Operation.** Activation of the gas detection system shall result in all of the following:

1. Initiation of distinct audible and visual alarm signals in the repair garage.
2. Deactivation of all heating systems located in the repair garage.
3. Activation of the mechanical *ventilation* system, where the system is interlocked with gas detection.

[F] **406.8.5.3 Failure of the gas detection system.** Failure of the gas detection system shall result in the deactivation of the heating system, activation of the mechanical *ventilation* system where the system is interlocked with the gas detection system and cause a trouble signal to sound in an *approved* location.

[F] **406.8.6 Automatic sprinkler system.** A repair garage shall be equipped with an *automatic sprinkler system* in accordance with Section 903.2.9.1.

## SECTION 407 GROUP I-2

**407.1 General.** Occupancies in Group I-2 shall comply with the provisions of Sections 407.1 through 407.10 and other applicable provisions of this code.

**407.2 Corridors continuity and separation.** *Corridors* in occupancies in Group I-2 shall be continuous to the *exits* and shall be separated from other areas in accordance with Section 407.3 except spaces conforming to Sections 407.2.1 through 407.2.4.

**407.2.1 Waiting and similar areas.** Waiting areas and similar spaces constructed as required for *corridors* shall be permitted to be open to a *corridor*, only where all of the following criteria are met:

1. The spaces are not occupied as care recipient's sleeping rooms, treatment rooms, incidental uses in accordance with Section 509, or hazardous uses.
2. The open space is protected by an automatic fire detection system installed in accordance with Section 907.
3. The *corridors* onto which the spaces open, in the same *smoke compartment*, are protected by an automatic fire detection system installed in accordance with Section 907, or the *smoke compartment* in which the spaces are located is equipped throughout with quick-response sprinklers in accordance with Section 903.3.2.
4. The space is arranged so as not to obstruct access to the required *exits*.

**407.2.2 Care providers' stations.** Spaces for care providers', supervisory staff, doctors' and nurses' charting,

communications and related clerical areas shall be permitted to be open to the *corridor*, where such spaces are constructed as required for *corridors*.

**407.2.3 Psychiatric treatment areas.** Areas wherein psychiatric care recipients who are not capable of self-preservation are housed, or group meeting or multipurpose therapeutic spaces other than incidental uses in accordance with Section 509, under continuous supervision by facility staff, shall be permitted to be open to the *corridor*, where the following criteria are met:

1. Each area does not exceed 1,500 square feet (140 m<sup>2</sup>).
2. The area is located to permit supervision by the facility staff.
3. The area is arranged so as not to obstruct any access to the required *exits*.
4. The area is equipped with an automatic fire detection system installed in accordance with Section 907.2.
5. Not more than one such space is permitted in any one *smoke compartment*.
6. The walls and ceilings of the space are constructed as required for *corridors*.

**407.2.4 Gift shops.** Gift shops and associated storage that are less than 500 square feet (455 m<sup>2</sup>) in area shall be permitted to be open to the *corridor* where such spaces are constructed as required for *corridors*.

**407.3 Corridor wall construction.** *Corridor* walls shall be constructed as smoke partitions in accordance with Section 710.

**407.3.1 Corridor doors.** *Corridor* doors, other than those in a wall required to be rated by Section 509.4 or for the enclosure of a vertical opening or an *exit*, shall not have a required *fire protection rating* and shall not be required to be equipped with *self-closing* or automatic-closing devices, but shall provide an effective barrier to limit the transfer of smoke and shall be equipped with positive latching. Roller latches are not permitted. Other doors shall conform to Section 716.5.

\*\* **407.4 Means of egress.** Group I-2 occupancies shall be provided with means of egress complying with Chapter 10 and Sections 407.4.1 through 407.4.3.

**407.4.1 Direct access to a corridor.** Habitable rooms in Group I-2 occupancies shall have an *exit access* door leading directly to a *corridor*.

**Exceptions:**

1. Rooms with *exit* doors opening directly to the outside at ground level.
2. Rooms arranged as *care suites* complying with Section 407.4.3

**407.4.1.1 Locking devices.** Locking devices that restrict access to a care recipient's room from the *corridor* and that are operable only by staff from the *corri-*

*dor* side shall not restrict the *means of egress* from the care recipient's room.

**Exceptions:**

1. This section shall not apply to rooms in psychiatric treatment and similar care areas.
2. Locking arrangements in accordance with Section 1008.1.9.6.

**407.4.2 Travel distance.** The travel distance between any point in a Group I-2 occupancy sleeping room and an *exit access* door in that room shall be not greater than 50 feet (15 240 mm).

**407.4.3 Group I-2 care suites.** *Care suites* in Group I-2 shall comply with Section 407.4.3.1 through 407.4.3.4 and either Section 407.4.3.5 or 407.4.3.6.

**407.4.3.1 Exit access through care suites.** *Exit access* from all other portions of a building not classified as a *care suite* shall not pass through a *care suite*. In a *care suite* required to have more than one *exit*, one *exit access* is permitted to pass through an adjacent *care suite* provided all of the other requirements of Sections 407.4 and 1014.2 are satisfied.

**[W] 407.4.3.2 Separation.** *Care suites* shall be separated from other portions of the building by a smoke partition complying with Section 710. Partitions within suites are not required to be smoke resistant or fire resistance rated unless required by another section of this code.

**407.4.3.3 One intervening room.** For rooms other than sleeping rooms located within a *care suite*, *exit access* travel from the *care suite* shall be permitted through one intervening room where the travel distance to the *exit access* door from the *care suite* is not greater than 100 feet (30 480 mm).

**407.4.3.4 Two intervening rooms.** For rooms other than sleeping rooms located within a *care suite*, *exit access* travel within the *care suite* shall be permitted through two intervening rooms where the travel distance to the *exit access* door from the *care suite* is not greater than 50 feet (15 240 mm).

**407.4.3.5 Care suites containing sleeping room areas.** Sleeping rooms shall be permitted to be grouped into *care suites* with one intervening room if one of the following conditions is met:

1. The intervening room within the *care suite* is not used as an *exit access* for more than eight care recipient beds.
2. The arrangement of the *care suite* allows for direct and constant visual supervision by care providers.

**407.4.3.5.1 Area.** *Care suites* containing sleeping rooms shall be not greater than 5,000 square feet (465 m<sup>2</sup>) in area.

**407.4.3.5.2 Exit access.** Any sleeping room, or any *care suite* that contains sleeping rooms, of more than 1,000 square feet (93 m<sup>2</sup>) shall have no fewer than

two *exit access* doors from the *care suite* located in accordance with Section 1015.2.

**407.4.3.5.3 Travel distance.** The travel distance between any point in a *care suite* containing sleeping rooms and an *exit access* door from that *care suite* shall be not greater than 100 feet (30 480 mm).

**407.4.3.6 Care suites not containing sleeping rooms.** Areas not containing sleeping rooms, but only treatment areas and the associated rooms, spaces or circulation space shall be permitted to be grouped into *care suites* and shall conform to the limitations in Section 407.4.3.6.1 and 407.4.3.6.2.

**407.4.3.6.1 Area.** *Care suites* of rooms, other than sleeping rooms, shall have an area not greater than 10,000 square feet (929 m<sup>2</sup>).

**407.4.3.6.2 Exit access.** *Care suites*, other than sleeping rooms, with an area of more than 2,500 square feet (232 m<sup>2</sup>) shall have no fewer than two *exit access* doors from the *care suite* located in accordance with Section 1015.2.

**407.5 Smoke barriers.** *Smoke barriers* shall be provided to subdivide every *story* used by persons receiving care, treatment or sleeping and to divide other *stories* with an *occupant load* of 50 or more persons, into no fewer than two *smoke compartments*. Such *stories* shall be divided into *smoke compartments* with an area of not more than 22,500 square feet (2092 m<sup>2</sup>) and the travel distance from any point in a *smoke compartment* to a *smoke barrier* door shall be not greater than 200 feet (60 960 mm). The *smoke barrier* shall be in accordance with Section 709.

**407.5.1 Refuge area.** Refuge areas shall be provided within each *smoke compartment*. The size of the refuge area shall accommodate the occupants and care recipients from the adjoining *smoke compartment*. Where a *smoke compartment* is adjoined by two or more *smoke compartments*, the minimum area of the refuge area shall accommodate the largest *occupant load* of the adjoining compartments. The size of the refuge area shall provide the following:

1. Not less than 30 net square feet (2.8 m<sup>2</sup>) for each care recipient confined to bed or litter.
2. Not less than 6 square feet (0.56 m<sup>2</sup>) for each ambulatory care recipient not confined to bed or litter and for other occupants.

Areas or spaces permitted to be included in the calculation of refuge area are *corridors*, sleeping areas, treatment rooms, lounge or dining areas and other low-hazard areas.

**407.5.2 Independent egress.** A *means of egress* shall be provided from each *smoke compartment* created by *smoke barriers* without having to return through the *smoke compartment* from which *means of egress* originated.

**407.5.3 Horizontal assemblies.** *Horizontal assemblies* supporting *smoke barriers* required by this section shall be designed to resist the movement of smoke and shall comply with Section 711.9.

[F] **407.6 Automatic sprinkler system.** *Smoke compartments* containing sleeping rooms shall be equipped throughout with an *automatic sprinkler* system in accordance with Sections 903.3.1.1 and 903.3.2.

[F] **407.7 Fire alarm system.** A *fire alarm* system shall be provided in accordance with Section 907.2.6.

[F] **407.8 Automatic fire detection.** *Corridors* in *nursing homes*, long-term care facilities, *detoxification facilities* and spaces permitted to be open to the *corridors* by Section 407.2 shall be equipped with an automatic fire detection system. Hospitals shall be equipped with smoke detection as required in Section 407.2.

#### Exceptions:

1. *Corridor* smoke detection is not required where sleeping rooms are provided with *smoke detectors* that comply with UL 268. Such detectors shall provide a visual display on the *corridor* side of each sleeping room and an audible and visual alarm at the care provider's station attending each unit.
2. *Corridor* smoke detection is not required where sleeping room 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.

**407.9 Secured yards.** Grounds are permitted to be fenced and gates therein are permitted to be equipped with locks, provided that safe dispersal areas having 30 net square feet (2.8 m<sup>2</sup>) for bed and litter care recipients and 6 net square feet (0.56 m<sup>2</sup>) for ambulatory care recipients and other occupants are located between the building and the fence. Such provided safe dispersal area shall be located not less than 50 feet (15 240 mm) from the building they serve.

**407.10 Hyperbaric facilities.** Hyperbaric facilities in Group I-2 occupancies shall meet the requirements contained in Chapter 20 of NFPA 99.

## SECTION 408 GROUP I-3

**408.1 General.** Occupancies in Group I-3 shall comply with the provisions of Sections 408.1 through 408.11 and other applicable provisions of this code (see Section 308.5).

**408.1.1 Definitions.** The following terms are defined in Chapter 2:

**CELL.**

**CELL TIER.**

**HOUSING UNIT.**

**SALLYPORT.**

**408.2 Other occupancies.** Buildings or portions of buildings in Group I-3 occupancies where security operations necessitate the locking of required *means of egress* shall be permitted to be classified as a different occupancy. Occupancies classified as other than Group I-3 shall meet the applicable

requirements of this code for that occupancy provided provisions are made for the release of occupants at all times.

*Means of egress* from detention and correctional occupancies that traverse other use areas shall, as a minimum, conform to requirements for detention and correctional occupancies.

**Exception:** It is permissible to exit through a *horizontal exit* into other contiguous occupancies that do not conform to detention and correctional occupancy egress provisions but that do comply with requirements set forth in the appropriate occupancy, as long as the occupancy is not a Group H use.

**408.3 Means of egress.** Except as modified or as provided for in this section, the *means of egress* provisions of Chapter 10 shall apply.

**408.3.1 Door width.** Doors to resident *sleeping units* shall have a clear width of not less than 28 inches (711 mm).

**408.3.2 Sliding doors.** Where doors in a *means of egress* are of the horizontal-sliding type, the force to slide the door to its fully open position shall be not greater than 50 pounds (220 N) with a perpendicular force against the door of 50 pounds (220 N).

**408.3.3 Guard tower doors.** A hatch or trap door not less than 16 square feet (610 m<sup>2</sup>) in area through the floor and having dimensions of not less than 2 feet (610 mm) in any direction shall be permitted to be used as a portion of the *means of egress* from guard towers.

**408.3.4 Spiral stairways.** *Spiral stairways* that conform to the requirements of Section 1009.12 are permitted for access to and between staff locations.

**408.3.5 Ship ladders.** Ship ladders shall be permitted for egress from control rooms or elevated facility observation rooms in accordance with Section 1009.14.

**408.3.6 Exit discharge.** *Exits* are permitted to discharge into a fenced or walled courtyard. Enclosed *yards* or *courts* shall be of a size to accommodate all occupants, be located not less than 50 feet (15 240 mm) from the building and have an area of not less than 15 square feet (1.4 m<sup>2</sup>) per person.

**408.3.7 Sallyports.** A *sallyport* shall be permitted in a *means of egress* where there are provisions for continuous and unobstructed passage through the *sallyport* during an emergency egress condition.

**408.3.8 Interior exit stairway and ramp construction.** One *interior exit stairway* or *ramp* in each building shall be permitted to have glazing installed in doors and interior walls at each landing level providing access to the *interior exit stairway* or *ramp*, provided that the following conditions are met:

1. The *interior exit stairway* or *ramp* shall not serve more than four floor levels.
2. *Exit* doors shall be not less than  $\frac{3}{4}$ -hour *fire door assemblies* complying with Section 716.5

3. The total area of glazing at each floor level shall not exceed 5,000 square inches (3.2 m<sup>2</sup>) and individual panels of glazing shall not exceed 1,296 square inches (0.84 m<sup>2</sup>).
4. The glazing shall be protected on both sides by an *automatic sprinkler system*. The sprinkler system shall be designed to wet completely the entire surface of any glazing affected by fire when actuated.
5. The glazing shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (loading) the glass before the sprinkler system operates.
6. Obstructions, such as curtain rods, drapery traverse rods, curtains, drapes or similar materials shall not be installed between the automatic sprinklers and the glazing.

**408.4 Locks.** Egress doors are permitted to be locked in accordance with the applicable use condition. Doors from a refuge area to the outside are permitted to be locked with a key in lieu of locking methods described in Section 408.4.1. The keys to unlock the exterior doors shall be available at all times and the locks shall be operable from both sides of the door.

**408.4.1 Remote release.** Remote release of locks on doors in a *means of egress* shall be provided with reliable means of operation, remote from the resident living areas, to release locks on all required doors. In Occupancy Conditions 3 or 4, the arrangement, accessibility and security of the release mechanisms required for egress shall be such that with the minimum available staff at any time, the lock mechanisms are capable of being released within 2 minutes.

**Exception:** Provisions for remote locking and unlocking of occupied rooms in Occupancy Condition 4 are not required provided that not more than 10 locks are necessary to be unlocked in order to move occupants from one smoke compartment to a refuge area within 3 minutes. The opening of necessary locks shall be accomplished with not more than two separate keys.

**408.4.2 Power-operated doors and locks.** Power-operated sliding doors or power-operated locks for swinging doors shall be operable by a manual release mechanism at the door, and either emergency power or a remote mechanical operating release shall be provided.

**Exception:** Emergency power is not required in facilities with 10 or fewer locks complying with the exception to Section 408.4.1.

**408.4.3 Redundant operation.** Remote release, mechanically operated sliding doors or remote release, mechanically operated locks shall be provided with a mechanically operated release mechanism at each door, or shall be provided with a redundant remote release control.

**408.4.4 Relock capability.** Doors remotely unlocked under emergency conditions shall not automatically relock when closed unless specific action is taken at the remote location to enable doors to relock.

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**408.5 Protection of vertical openings.** Any vertical opening shall be protected by a *shaft enclosure* in accordance with Section 713, or shall be in accordance with Section 408.5.1.

**408.5.1 Floor openings.** Openings in floors within a *housing unit* are permitted without a *shaft enclosure*, provided all of the following conditions are met:

1. The entire normally occupied areas so interconnected are open and unobstructed so as to enable observation of the areas by supervisory personnel;
2. *Means of egress* capacity is sufficient for all occupants from all interconnected *cell tiers* and areas;
3. The height difference between the floor levels of the highest and lowest *cell tiers* shall not exceed 23 feet (7010 mm); and
4. Egress from any portion of the *cell tier* to an *exit* or *exit access* door shall not require travel on more than one additional floor level within the *housing unit*.

**408.5.2 Shaft openings in communicating floor levels.**

Where a floor opening is permitted between communicating floor levels of a *housing unit* in accordance with Section 408.5.1, plumbing chases serving vertically stacked individual *cells* contained within the *housing unit* shall be permitted without a *shaft enclosure*.

**408.6 Smoke barrier.** Occupancies in Group I-3 shall have *smoke barriers* complying with Sections 408.7 and 709 to divide every *story* occupied by residents for sleeping, or any other *story* having an *occupant load* of 50 or more persons, into no fewer than two *smoke compartments*.

**Exception:** Spaces having a direct *exit* to one of the following, provided that the locking arrangement of the doors involved complies with the requirements for doors at the *smoke barrier* for the use condition involved:

1. A *public way*.
2. A building separated from the resident housing area by a 2-hour fire-resistance-rated assembly or 50 feet (15 240 mm) of open space.
3. A secured *yard* or *court* having a holding space 50 feet (15 240 mm) from the housing area that provides 6 square feet (0.56 m<sup>2</sup>) or more of refuge area per occupant, including residents, staff and visitors.

**408.6.1 Smoke compartments.** The number of residents in any *smoke compartment* shall be not more than 200. The travel distance to a door in a *smoke barrier* from any room door required as *exit access* shall be not greater than 150 feet (45 720 mm). The travel distance to a door in a *smoke barrier* from any point in a room shall be not greater than 200 feet (60 960 mm).

**408.6.2 Refuge area.** Not less than 6 net square feet (0.56 m<sup>2</sup>) per occupant shall be provided on each side of each *smoke barrier* for the total number of occupants in adjoining *smoke compartments*. This space shall be readily available wherever the occupants are moved across the *smoke barrier* in a fire emergency.

**408.6.3 Independent egress.** A *means of egress* shall be provided from each *smoke compartment* created by *smoke*

*barriers* without having to return through the *smoke compartment* from which *means of egress* originates.

**408.7 Security glazing.** In occupancies in Group I-3, windows and doors in 1-hour *fire barriers* constructed in accordance with Section 707, *fire partitions* constructed in accordance with Section 708 and *smoke barriers* constructed in accordance with Section 709 shall be permitted to have security glazing installed provided that the following conditions are met.

1. Individual panels of glazing shall not exceed 1,296 square inches (0.84 m<sup>2</sup>).
2. The glazing shall be protected on both sides by an *automatic sprinkler system*. The sprinkler system shall be designed to, when actuated, wet completely the entire surface of any glazing affected by fire.
3. The glazing shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (loading) the glass before the sprinkler system operates.
4. Obstructions, such as curtain rods, drapery traverse rods, curtains, drapes or similar materials shall not be installed between the automatic sprinklers and the glazing.

**408.8 Subdivision of resident housing areas.** Sleeping areas and any contiguous day room, group activity space or other common spaces where residents are housed shall be separated from other spaces in accordance with Sections 408.8.1 through 408.8.4.

**408.8.1 Occupancy Conditions 3 and 4.** Each sleeping area in Occupancy Conditions 3 and 4 shall be separated from the adjacent common spaces by a smoke-tight partition where the travel distance from the sleeping area through the common space to the *corridor* exceeds 50 feet (15 240 mm).

**408.8.2 Occupancy Condition 5.** Each sleeping area in Occupancy Condition 5 shall be separated from adjacent sleeping areas, *corridors* and common spaces by a smoke-tight partition. Additionally, common spaces shall be separated from the *corridor* by a smoke-tight partition.

**408.8.3 Openings in room face.** The aggregate area of openings in a solid sleeping room face in Occupancy Conditions 2, 3, 4 and 5 shall not exceed 120 square inches (0.77 m<sup>2</sup>). The aggregate area shall include all openings including door undercuts, food passes and grilles. Openings shall be not more than 36 inches (914 mm) above the floor. In Occupancy Condition 5, the openings shall be closeable from the room side.

**408.8.4 Smoke-tight doors.** Doors in openings in partitions required to be smoke tight by Section 408.8 shall be substantial doors, of construction that will resist the passage of smoke. Latches and door closures are not required on *cell* doors.

**408.9 Windowless buildings.** For the purposes of this section, a windowless building or portion of a building is one with nonopenable windows, windows not readily breakable or without windows. Windowless buildings shall be provided

with an engineered smoke control system to provide a tenable environment for exiting from the *smoke compartment* in the area of fire origin in accordance with Section 909 for each windowless *smoke compartment*.

[F] **408.10 Fire alarm system.** A *fire alarm* system shall be provided in accordance with Section 907.2.6.3.

[F] **408.11 Automatic sprinkler system.** Group I-3 occupancies shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.2.6.

## SECTION 409 MOTION PICTURE PROJECTION ROOMS

**409.1 General.** The provisions of Sections 409.1 through 409.5 shall apply to rooms in which ribbon-type cellulose acetate or other safety film is utilized in conjunction with electric arc, xenon or other light-source projection equipment that develops hazardous gases, dust or radiation. Where cellulose nitrate film is utilized or stored, such rooms shall comply with NFPA 40.

**409.1.1 Projection room required.** Every motion picture machine projecting film as mentioned within the scope of this section shall be enclosed in a projection room. Appurtenant electrical equipment, such as rheostats, transformers and generators, shall be within the projection room or in an adjacent room of equivalent construction.

**409.2 Construction of projection rooms.** Every projection room shall be of permanent construction consistent with the construction requirements for the type of building in which the projection room is located. Openings are not required to be protected.

The room shall have a floor area of not less than 80 square feet (7.44 m<sup>2</sup>) for a single machine and not less than 40 square feet (3.7 m<sup>2</sup>) for each additional machine. Each motion picture projector, floodlight, spotlight or similar piece of equipment shall have a clear working space of not less than 30 inches by 30 inches (762 mm by 762 mm) on each side and at the rear thereof, but only one such space shall be required between two adjacent projectors. The projection room and the rooms appurtenant thereto shall have a ceiling height of not less than 7 feet 6 inches (2286 mm). The aggregate of openings for projection equipment shall not exceed 25 percent of the area of the wall between the projection room and the auditorium. Openings shall be provided with glass or other *approved* material, so as to close completely the opening.

**409.3 Projection room and equipment ventilation.** *Ventilation* shall be provided in accordance with the *International Mechanical Code*.

**409.3.1 Supply air.** Each projection room shall be provided with adequate air supply inlets so arranged as to provide well-distributed air throughout the room. Air inlet ducts shall provide an amount of air equivalent to the amount of air being exhausted by projection equipment. Air is permitted to be taken from the outside; from adjacent spaces within the building, provided the volume and infiltration rate is sufficient; or from the building air-con-

ditioning system, provided it is so arranged as to provide sufficient air when other systems are not in operation.

**409.3.2 Exhaust air.** Projection rooms are permitted to be exhausted through the lamp exhaust system. The lamp exhaust system shall be positively interconnected with the lamp so that the lamp will not operate unless there is the required airflow. Exhaust air ducts shall terminate at the exterior of the building in such a location that the exhaust air cannot be readily recirculated into any air supply system. The projection room *ventilation* system is permitted to also serve appurtenant rooms, such as the generator and rewind rooms.

**409.3.3 Projection machines.** Each projection machine shall be provided with an exhaust duct that will draw air from each lamp and exhaust it directly to the outside of the building. The lamp exhaust is permitted to serve to exhaust air from the projection room to provide room air circulation. Such ducts shall be of rigid materials, except for a flexible connector *approved* for the purpose. The projection lamp or projection room exhaust system, or both, is permitted to be combined but shall not be interconnected with any other exhaust or return system, or both, within the building.

**409.4 Lighting control.** Provisions shall be made for control of the auditorium lighting and the *means of egress* lighting systems of theaters from inside the projection room and from not less than one other convenient point in the building.

**409.5 Miscellaneous equipment.** Each projection room shall be provided with rewind and film storage facilities.

## SECTION 410 STAGES, PLATFORMS AND TECHNICAL PRODUCTION AREAS

**410.1 Applicability.** The provisions of Sections 410.1 through 410.8 shall apply to all parts of buildings and structures that contain *stages* or *platforms* and similar appurtenances as herein defined.

**410.2 Definitions.** The following terms are defined in Chapter 2:

**PLATFORM.**

**PROCENIUM WALL.**

**STAGE.**

**TECHNICAL PRODUCTION AREA.**

**410.3 Stages.** *Stage* construction shall comply with Sections 410.3.1 through 410.3.8.

**410.3.1 Stage construction.** *Stages* shall be constructed of materials as required for floors for the type of construction of the building in which such *stages* are located.

**Exception:** *Stages* need not be constructed of the same materials as required for the type of construction provided the construction complies with one of the following:

1. *Stages* of Type IIB or IV construction with a nominal 2-inch (51 mm) wood deck, provided

that the *stage* is separated from other areas in accordance with Section 410.3.4.

2. In buildings of Type IIA, IIIA and VA construction, a fire-resistance-rated floor is not required, provided the space below the *stage* is equipped with an *automatic sprinkler system or fire-extinguishing system* in accordance with Section 903 or 904.
3. In all types of construction, the finished floor shall be constructed of wood or *approved* non-combustible materials. Openings through *stage* floors shall be equipped with tight-fitting, solid wood trap doors with *approved* safety locks.

**410.3.1.1 Stage height and area.** *Stage* areas shall be measured to include the entire performance area and adjacent backstage and support areas not separated from the performance area by fire-resistance-rated construction. *Stage* height shall be measured from the lowest point on the *stage* floor to the highest point of the roof or floor deck above the *stage*.

**410.3.2 Technical production areas: galleries, gridirons and catwalks.** Beams designed only for the attachment of portable or fixed theater equipment, gridirons, galleries and catwalks shall be constructed of *approved* materials consistent with the requirements for the type of construction of the building; and a *fire-resistance rating* shall not be required. These areas shall not be considered to be floors, *stories*, *mezzanines* or levels in applying this code.

**Exception:** Floors of fly galleries and catwalks shall be constructed of any *approved* material.

**410.3.3 Exterior stage doors.** Where protection of openings is required, exterior *exit* doors shall be protected with *fire door assemblies* that comply with Section 716. Exterior openings that are located on the *stage* for *means of egress* or loading and unloading purposes, and that are likely to be open during occupancy of the theater, shall be constructed with vestibules to prevent air drafts into the auditorium.

**410.3.4 Proscenium wall.** Where the *stage* height is greater than 50 feet (15 240 mm), all portions of the *stage* shall be completely separated from the seating area by a proscenium wall with not less than a 2-hour *fire-resistance rating* extending continuously from the foundation to the roof.

**410.3.5 Proscenium curtain.** Where a proscenium wall is required to have a *fire-resistance rating*, the *stage* opening shall be provided with a fire curtain complying with NFPA 80 or an *approved* water curtain complying with Section 903.3.1.1 or, in facilities not utilizing the provisions of smoke-protected assembly seating in accordance with Section 1028.6.2, a smoke control system complying with Section 909 or natural *ventilation* designed to maintain the smoke level not less than 6 feet (1829 mm) above the floor of the *means of egress*.

**410.3.6 Scenery.** Combustible materials used in sets and scenery shall meet the fire propagation performance criteria of NFPA 701, in accordance with Section 806 and the

*International Fire Code*. Foam plastics and materials containing foam plastics shall comply with Section 2603 and the *International Fire Code*.

**410.3.7 Stage ventilation.** Emergency *ventilation* shall be provided for *stages* larger than 1,000 square feet (93 m<sup>2</sup>) in floor area, or with a *stage* height greater than 50 feet (15 240 mm). Such *ventilation* shall comply with Section 410.3.7.1 or 410.3.7.2.

**410.3.7.1 Roof vents.** Two or more vents constructed to open automatically by *approved* heat-activated devices and with an aggregate clear opening area of not less than 5 percent of the area of the *stage* shall be located near the center and above the highest part of the *stage* area. Supplemental means shall be provided for manual operation of the ventilator. Curbs shall be provided as required for skylights in Section 2610.2. Vents shall be labeled.

[F] **410.3.7.2 Smoke control.** Smoke control in accordance with Section 909 shall be provided to maintain the smoke layer interface not less than 6 feet (1829 mm) above the highest level of the assembly seating or above the top of the proscenium opening where a proscenium wall is provided in compliance with Section 410.3.4.

**410.4 Platform construction.** Permanent *platforms* shall be constructed of materials as required for the type of construction of the building in which the permanent *platform* is located. Permanent *platforms* are permitted to be constructed of *fire-retardant-treated wood* for Types I, II and IV construction where the *platforms* are not more than 30 inches (762 mm) above the main floor, and not more than one-third of the room floor area and not more than 3,000 square feet (279 m<sup>2</sup>) in area. Where the space beneath the permanent *platform* is used for storage or any purpose other than equipment, wiring or plumbing, the floor assembly shall be not less than 1-hour fire-resistance-rated construction. Where the space beneath the permanent *platform* is used only for equipment, wiring or plumbing, the underside of the permanent *platform* need not be protected.

**410.4.1 Temporary platforms.** *Platforms* installed for a period of not more than 30 days are permitted to be constructed of any materials permitted by the code. The space between the floor and the *platform* above shall only be used for plumbing and electrical wiring to *platform* equipment.

**410.5 Dressing and appurtenant rooms.** Dressing and appurtenant rooms shall comply with Sections 410.5.1 and 410.5.2.

**410.5.1 Separation from stage.** The *stage* shall be separated from dressing rooms, scene docks, property rooms, workshops, storerooms and compartments appurtenant to the *stage* and other parts of the building by *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both. The *fire-resistance rating* shall be not less than 2 hours for *stage* heights greater than 50 feet (15 240 mm) and not less than 1 hour for *stage* heights of 50 feet (15 240 mm) or less.



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**410.5.2 Separation from each other.** Dressing rooms, scene docks, property rooms, workshops, storerooms and compartments appurtenant to the *stage* shall be separated from each other by not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

**410.6 Means of egress.** Except as modified or as provided for in this section, the provisions of Chapter 10 shall apply.

**410.6.1 Arrangement.** Where two or more *exits* or *exit access doorways* from the *stage* are required in accordance with Section 1015.1, no fewer than one *exit* or *exit access doorway* shall be provided on each side of a *stage*.

**410.6.2 Stairway and ramp enclosure.** *Exit access stairways* and *ramps* serving a *stage* or *platform* are not required to be enclosed. *Exit access stairways* serving *technical production areas* are not required to be enclosed.

**410.6.3 Technical production areas.** *Technical production areas* shall be provided with means of egress and means of escape in accordance with Sections 410.6.3.1 through 410.6.3.5.

**410.6.3.1 Means of egress.** No fewer than one *means of egress* shall be provided from *technical production areas*.

**410.6.3.2 Travel distance.** The length of *exit access* travel shall be not greater than 300 feet (91 440 mm) for buildings without a sprinkler system and 400 feet (121 900 mm) for buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

**410.6.3.3 Two means of egress.** Where two *means of egress* are required, the *common path of travel* shall be not greater than 100 feet (30 480 mm).

**Exception:** A means of escape to a roof in place of a second *means of egress* is permitted.

**410.6.3.4 Path of egress travel.** The following *exit access* components are permitted where serving *technical production areas*:

1. *Stairways*.
2. *Ramps*.
3. *Spiral stairways*.
4. *Catwalks*.
5. *Alternating tread devices*.
6. *Permanent ladders*.

**410.6.3.5 Width.** The path of egress travel within and from technical support areas shall be not less than 22 inches (559 mm).

[F] **410.7 Automatic sprinkler system.** *Stages* shall be equipped with an *automatic sprinkler system* in accordance with Section 903.3.1.1. 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 that are utilized exclusively for storage of tables and chairs, provided the concealed space is separated from the adjacent spaces by Type X gypsum board not less than  $\frac{5}{8}$  inch (15.9 mm) in thickness.
2. Sprinklers are not required for *stages* 1,000 square feet (93 m<sup>2</sup>) 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*.

[F] **410.8 Standpipes.** Standpipe systems shall be provided in accordance with Section 905.

**SECTION 411  
SPECIAL AMUSEMENT BUILDINGS**

**411.1 General.** Special *amusement buildings* having an *occupant load* of 50 or more shall comply with the requirements for the appropriate Group A occupancy and Sections 411.1 through 411.8. Amusement buildings having an *occupant load* of less than 50 shall comply with the requirements for a Group B occupancy and Sections 411.1 through 411.8.

**Exception:** Amusement buildings or portions thereof that are without walls or a roof and constructed to prevent the accumulation of smoke need not comply with this section.

For flammable *decorative materials*, see the *International Fire Code*.

**411.2 Definition.** The following term is defined in Chapter 2:

**SPECIAL AMUSEMENT BUILDING.**

[F] **411.3 Automatic fire detection.** *Special amusement buildings* shall be equipped with an automatic fire detection system in accordance with Section 907.

[F] **411.4 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 m<sup>2</sup>) and the travel distance from any point to an *exit* is less than 50 feet (15 240 mm).

[F] **411.5 Alarm.** Actuation of a single *smoke detector*, the *automatic sprinkler system* or other automatic fire detection device shall immediately sound an alarm at the building at a *constantly attended location* from which emergency action

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can be initiated including the capability of manual initiation of requirements in Section 907.2.12.2.

**[F] 411.6 Emergency voice/alarm communications system.** An *emergency voice/alarm communications system* shall be provided in accordance with Sections 907.2.12 and 907.5.2.2, which is also permitted to serve as a public address system and shall be audible throughout the entire *special amusement building*.

**411.7 Exit marking.** Exit signs shall be installed at the required *exit* or *exit access doorways* of amusement buildings in accordance with this section and Section 1011. *Approved* directional exit markings shall also be provided. Where mirrors, mazes or other designs are utilized that disguise the path of egress travel such that they are not apparent, *approved* and *listed* low-level exit signs that comply with Section 1011.5, and directional path markings *listed* in accordance with UL 1994, shall be provided and located not more than 8 inches (203 mm) above the walking surface and on or near the path of egress travel. Such markings shall become visible in an emergency. The directional exit marking shall be activated by the automatic fire detection system and the *automatic sprinkler system* in accordance with Section 907.2.12.2.

**411.7.1 Photo luminescent exit signs.** Where photo luminescent exit signs are installed, activating light source and viewing distance shall be in accordance with the listing and markings of the signs.

**411.8 Interior finish.** The *interior finish* shall be Class A in accordance with Section 803.1.

**SECTION 412  
AIRCRAFT-RELATED OCCUPANCIES**

**412.1 General.** Aircraft-related occupancies shall comply with Sections 412.1 through 412.7 and the *International Fire Code*.

**412.2 Definitions.** The following terms are defined in Chapter 2:

**FIXED BASE OPERATOR (FBO).**

**HELIPORT.**

**HELISTOP.**

**RESIDENTIAL AIRCRAFT HANGAR.**

**TRANSIENT AIRCRAFT.**

**412.3 Airport traffic control towers.** The provisions of Sections 412.3.1 through 412.3.5 shall apply to airport traffic control towers not exceeding 1,500 square feet (140 m<sup>2</sup>) per floor occupied only for the following uses:

1. Airport traffic control cab.
2. Electrical and mechanical equipment rooms.
3. Airport terminal radar and electronics rooms.
4. Office spaces incidental to the tower operation.
5. Lounges for employees, including sanitary facilities.

**412.3.1 Type of construction.** Airport traffic control towers shall be constructed to comply with the height and area limitations of Table 412.3.2.

**TABLE 412.3.1  
HEIGHT AND AREA LIMITATIONS  
FOR AIRPORT TRAFFIC CONTROL TOWERS**

TYPE OF CONSTRUCTION	HEIGHT <sup>a</sup> (feet)	MAXIMUM AREA (square feet)
IA	Unlimited	1,500
IB	240	1,500
IIA	100	1,500
IIB	85	1,500
IIIA	65	1,500

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

a. Height to be measured from grade plane to cab floor.

**412.3.2 Egress.** Not less than one *exit stairway* shall be permitted for airport traffic control towers of any height provided that the *occupant load* per floor is not greater than 15. The *stairway* shall conform to the requirements of Section 1009. The *stairway* shall be separated from elevators by a distance of not less than one-half of the diagonal of the area served measured in a straight line. The *exit stairway* and elevator hoistway are permitted to be located in the same *shaft enclosure*, provided they are separated from each other by a 4-hour *fire barrier* having no openings. Such *stairway* shall be pressurized to not less than 0.15 inch of water column (43 Pa) and not greater than 0.35 inch of water column (101 Pa) in the *shaft* relative to the building with *stairway* doors closed. *Stairways* need not extend to the roof as specified in Section 1009.16. The provisions of Section 403 do not apply.

~~(Exception: Smokeproof enclosures as set forth in Section 1022.10 are not required where required stairways are pressurized.)~~

**[F] 412.3.3 Automatic fire detection systems.** Airport traffic control towers shall be provided with an automatic fire detection system installed in accordance with Section 907.2.

**[F] 412.3.4 Legally required standby ((Standby)) power system.** A legally required standby power system that conforms to Chapter 27 shall be provided in airport traffic control towers more than 65 feet (19 812 mm) in height. Power shall be provided to the following equipment:

1. Pressurization equipment, mechanical equipment and lighting.
2. Elevator operating equipment.
3. *Fire alarm* and smoke detection systems.

**412.3.5 Accessibility.** Airport traffic control towers need not be *accessible* as specified in the provisions of Chapter 11.

**412.4 Aircraft hangars.** Aircraft hangars shall be in accordance with Sections 412.4.1 through 412.4.6.

**412.4.1 Exterior walls.** *Exterior walls* located less than 30 feet (9144 mm) from *lot lines* or a *public way* shall have a *fire-resistance rating* not less than 2 hours.

**412.4.2 Basements.** Where hangars have *basements*, floors over *basements* shall be of Type IA construction and shall be made tight against seepage of water, oil or vapors. There shall be no opening or communication

between *basements* and the hangar. Access to *basements* shall be from outside only.

**412.4.3 Floor surface.** Floors shall be graded and drained to prevent water or fuel from remaining on the floor. Floor drains shall discharge through an oil separator to the sewer or to an outside vented sump.

**Exception:** Aircraft hangars with individual lease spaces not exceeding 2,000 square feet (186 m<sup>2</sup>) each in which servicing, repairing or washing is not conducted and fuel is not dispensed shall have floors that are graded toward the door, but shall not require a separator.

**412.4.4 Heating equipment.** Heating equipment shall be placed in another room separated by 2-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both. Entrance shall be from the outside or by means of a vestibule providing a two-doorway separation.

**Exceptions:**

1. Unit heaters and vented infrared radiant heating equipment suspended not less than 10 feet (3048 mm) above the upper surface of wings or engine enclosures of the highest aircraft that are permitted to be housed in the hangar need not be located in a separate room provided they are mounted not less than 8 feet (2438 mm) above the floor in shops, offices and other sections of the hangar communicating with storage or service areas.
2. Entrance to the separated room shall be permitted by a single interior door provided the sources of ignition in the appliances are not less than 18 inches (457 mm) above the floor.

**412.4.5 Finishing.** The process of “doping,” involving 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.

[F] **412.4.6 Fire suppression.** Aircraft hangars shall be provided with a fire suppression system designed in accordance with NFPA 409, based upon the classification for the hangar given in Table 412.4.6.

**Exception:** Where a *fixed base operator* has separate repair facilities on site, Group II hangars operated by a *fixed base operator* used for storage of *transient aircraft* only shall have a fire suppression system, but the system is exempt from foam requirements.

[F] **412.4.6.1 Hazardous operations.** Any Group III aircraft hangar according to Table 412.4.6 that contains hazardous operations including, but not limited to, the following shall be provided with a Group I or II fire suppression system in accordance with NFPA 409 as applicable:

1. Doping.
2. Hot work including, but not limited to, welding, torch cutting and torch soldering.
3. Fuel transfer.

4. Fuel tank repair or maintenance not including defueled tanks in accordance with NFPA 409, inerted tanks or tanks that have never been fueled.
5. Spray finishing operations.
6. Total fuel capacity of all aircraft within the unsprinklered single *fire area* in excess of 1,600 gallons (6057 L).
7. Total fuel capacity of all aircraft within the maximum single *fire area* in excess of 7,500 gallons (28 390 L) for a hangar with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

[F] **412.4.6.2 Separation of maximum single fire areas.** Maximum single *fire areas* established in accordance with hangar classification and construction type in Table 412.4.6 shall be separated by 2-hour *fire walls* constructed in accordance with Section 706. In determining the maximum single *fire area* as set forth in Table 412.4.6, ancillary uses which are separated from aircraft servicing areas by a *fire barrier* of not less than one hour, constructed in accordance with Section 707 shall not be included in the area.

**412.4.6.3 Restrictions in the Fire District.** Aircraft hangars shall not be located in the Fire District unless work is limited to exchange of parts and maintenance requiring no open flame or welding.

**412.5 Residential aircraft hangars.** *Residential aircraft hangars* shall comply with Sections 412.5.1 through 412.5.5.

**412.5.1 Fire separation.** A hangar shall not be attached to a *dwelling* unless separated by a *fire barrier* having a *fire-resistance rating* of not less than 1 hour. Such separation shall be continuous from the foundation to the underside of the roof and unpierced except for doors leading to the *dwelling unit*. Doors into the *dwelling unit* shall be equipped with *self-closing* devices and conform to the requirements of Section 716 with a noncombustible raised sill not less than 4 inches (102 mm) in height. Openings from a hanger directly into a room used for sleeping purposes shall not be permitted.

**412.5.2 Egress.** A hangar shall provide two *means of egress*. One of the doors into the *dwelling* shall be considered as meeting only one of the two *means of egress*.

[F] **412.5.3 Smoke alarms.** *Smoke alarms* shall be provided within the hangar in accordance with Section 907.2.21.

**412.5.4 Independent systems.** Electrical, mechanical and plumbing drain, waste and vent (DWV) systems installed within the hangar shall be independent of the systems installed within the *dwelling*. Building sewer lines shall be permitted to be connected outside the structures.

**Exception:** *Smoke detector* wiring and feed for electrical subpanels in the hangar.

**412.5.5 Height and area limits.** *Residential aircraft hangars* shall be not greater than 2,000 square feet (186 m<sup>2</sup>) in area and 20 feet (6096 mm) in *building height*.

**SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY**

**[F] TABLE 412.4.6  
HANGAR FIRE SUPPRESSION REQUIREMENTS<sup>a,b,c</sup>**

MAXIMUM SINGLE FIRE AREA (square feet)	TYPE OF CONSTRUCTION								
	IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
≥ 40,001	Group I	Group I	Group I	Group I	Group I	Group I	Group I	Group I	Group I
40,000	Group II	Group II	Group II	Group II	Group II	Group II	Group II	Group II	Group II
30,000	Group III	Group II	Group II	Group II	Group II	Group II	Group II	Group II	Group II
20,000	Group III	Group III	Group II	Group II	Group II	Group II	Group II	Group II	Group II
15,000	Group III	Group III	Group III	Group II	Group III	Group II	Group III	Group II	Group II
12,000	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group II	Group II
8,000	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group II
5,000	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group III

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

- a. Aircraft hangars with a door height greater than 28 feet shall be provided with fire suppression for a Group I hangar regardless of maximum fire area.
- b. Groups shall be as classified in accordance with NFPA 409.
- c. Membrane structures complying with Section 3102 shall be classified as a Group IV hangar.

**[F] 412.6 Aircraft paint hangars.** Aircraft painting operations where flammable liquids are used in excess of the maximum allowable quantities per *control area* listed in Table 307.1(1) shall be conducted in an aircraft paint hangar that complies with the provisions of Sections 412.6.1 through 412.6.6.

**[F] 412.6.1 Occupancy group.** Aircraft paint hangars shall be classified as Group H-2. Aircraft paint hangars shall comply with the applicable requirements of this code and the *International Fire Code* for such occupancy.

**412.6.2 Construction.** The aircraft paint hangar shall be of Type I or II construction.

**[F] 412.6.3 Operations.** Only those flammable liquids necessary for painting operations shall be permitted in quantities less than the maximum allowable quantities per *control area* in Table 307.1(1). Spray equipment cleaning operations shall be conducted in a liquid use, dispensing and mixing room.

**[F] 412.6.4 Storage.** Storage of flammable liquids shall be in a liquid storage room.

**[F] 412.6.5 Fire suppression.** Aircraft paint hangars shall be provided with fire suppression as required by NFPA 409.

**[F] 412.6.6 Ventilation.** Aircraft paint hangars shall be provided with *ventilation* as required in the *International Mechanical Code*.

**[F] 412.7 Heliports and helistops.** *Heliports* and *helistops* shall be permitted to be erected on buildings or other locations where they are constructed in accordance with Sections 412.7.1 through 412.7.5.

**[F] 412.7.1 Size.** The landing area for helicopters less than 3,500 pounds (1588 kg) shall be not less than 20 feet (6096 mm) in length and width. The landing area shall be surrounded on all sides by a clear area having a minimum

average width at roof level of 15 feet (4572 mm) but with no width less than 5 feet (1524 mm).

**[F] 412.7.2 Design.** Helicopter landing areas and the supports thereof on the roof of a building shall be noncombustible construction. Landing areas shall be designed to confine any flammable liquid spillage to the landing area itself and provisions shall be made to drain such spillage away from any *exit* or *stairway* serving the helicopter landing area or from a structure housing such *exit* or *stairway*. For structural design requirements, see Section 1605.4.

**[F] 412.7.3 Means of egress.** The *means of egress* from *heliports* and *helistops* shall comply with the provisions of Chapter 10. Landing areas located on buildings or structures shall have two or more *means of egress*. For landing areas less than 60 feet (18 288 mm) in length or less than 2,000 square feet (186 m<sup>2</sup>) in area, the second *means of egress* is permitted to be a fire escape, *alternating tread device* or ladder leading to the floor below.

**[F] 412.7.4 Rooftop heliports and helistops.** Rooftop *heliports* and *helistops* shall comply with NFPA 418.

**[F] 412.7.5 Standpipe system.** In buildings equipped with a standpipe system, the standpipe shall extend to the roof level in accordance with Section 905.3.6.

**412.7.6 Restrictions in the Fire District.** Heliports shall not be located in the *Fire District*.

**SECTION 413  
COMBUSTIBLE STORAGE**

**413.1 General.** High-piled stock or rack storage in any occupancy group shall comply with the *International Fire Code*.

**413.2 Attic, under-floor and concealed spaces.** *Attic*, under-floor and concealed spaces used for storage of combus-

tible materials shall be protected on the storage side as required for 1-hour fire-resistance-rated construction. Openings shall be protected by assemblies that are *self-closing* and are of noncombustible construction or solid wood core not less than 1<sup>3</sup>/<sub>4</sub> inch (45 mm) in thickness.

**Exception:** Neither fire-resistance-rated construction nor opening protectives are required in any of the following locations:

1. Areas protected by *approved automatic sprinkler systems*.
2. Group R-3 and U occupancies.

**413.3 Mini-storage warehouses.** In mini-storage warehouse buildings, individual storage lockers shall be separated from each other with fire partitions.

**Exception:** The separation between individual storage lockers is permitted to be non-rated in rooms 500 square feet (46 m<sup>2</sup>) or less in area and in sprinklered rooms of any size.

**413.4 Basement storage and sale of combustibles materials.** Storage and sale of combustible material in basements shall be in accordance with Sections 413.4.1 through 413.4.5.

**Exception:** Areas protected with an *approved automatic sprinkler system* that are separated from other areas in the basement by fire barriers with at least a one-hour fire resistance rating are not required to comply with this section.

**413.4.1 Storage room size.** Combustible material being stored or available for sales shall be placed in rooms no larger than 500 square feet (46.5 m<sup>2</sup>).

**413.4.2 Storage room construction.** Each storage room shall be separated from other areas by fire barriers with at least a one hour fire-resistance rating.

**413.4.3 Number of storage rooms.** There shall be a maximum of three storage rooms within any one basement.

**413.4.4 Storage room access.** Each storage room shall be provided with access directly from the building exterior, or through a one-hour fire resistance rated corridor between each room and an exterior door or *exit* enclosure.

**413.4.5 Storage room restrictions.** Storage rooms shall not contain any material classified as a flammable liquid, hazardous material, or highly combustible material.

## SECTION 414 HAZARDOUS MATERIALS

[F] **414.1 General.** The provisions of Sections 414.1 through 414.7 shall apply to buildings and structures occupied for the manufacturing, processing, dispensing, use or storage of hazardous materials.

[F] **414.1.1 Other provisions.** Buildings and structures with an occupancy in Group H shall comply with this section and the applicable provisions of Section 415 and the *International Fire Code*.

[F] **414.1.2 Materials.** The safe design of hazardous material occupancies is material dependent. Individual material requirements are also found in Sections 307 and 415, and in the *International Mechanical Code* and the *International Fire Code*.

[F] **414.1.2.1 Aerosols.** Level 2 and 3 aerosol products shall be stored and displayed in accordance with the *International Fire Code*. See Section 311.2 and the *International Fire Code* for occupancy group requirements.

[F] **414.1.3 Information required.** A report shall be submitted to the *building official* identifying the maximum expected quantities of hazardous materials to be stored, used in a *closed system* and used in an *open system*, and subdivided to separately address hazardous material classification categories based on Tables 307.1(1) and 307.1(2). The methods of protection from such hazards, including but not limited to *control areas*, fire protection systems and Group H occupancies shall be indicated in the report and on the *construction documents*. The opinion and report shall be prepared by a qualified person, firm or corporation *approved* by the *building official* and provided without charge to the enforcing agency.

For buildings and structures with an occupancy in Group H, separate floor plans shall be submitted identifying the locations of anticipated contents and processes so as to reflect the nature of each occupied portion of every building and structure.

**414.1.4 Pre-design conference.** Prior to application for a permit for a Group H-5 Occupancy, the applicant shall arrange a pre-design conference with the design team, the *building official* and fire code official to review proposed emergency life safety systems for the building and the appropriate protection of the life safety systems. For Group H-4 occupancies, a pre-design conference is recommended. The purpose of the meeting is to obtain conceptual approval from the *building official* and the fire code official of the proposed systems and to allow for design based upon the latest state-of-the-art.

Applicants shall bring to the conference preliminary building plans and a draft of the Hazardous Materials Management Plan. The *building official* and fire code official are authorized to require sufficient documentation, based upon appropriate analyses, that the proposal meets the intent of nationally-recognized good practices. The building permit shall not be issued until the *building official* and fire code official have *approved*, in writing, the emergency life safety systems for the building and the appropriate protection of the life safety systems. The documentation of the pre-design meeting shall be reflected on the plans for the building and become a permanent part of the Department of Planning and Development's records.

**414.1.5 Hazardous material areas in buildings over 420 feet in building height.** In buildings in which an occupant evacuation elevator is used to comply with Section 403.5.2, no building areas shall contain hazardous materials exceeding the maximum allowable quantities per *control area* as addressed in Section 414.2.

**SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY**

**[F] 414.2 Control areas.** *Control areas* shall comply with Sections 414.2.1 through 414.2.5 and the *International Fire Code*.

**[F] 414.2.1 Construction requirements.** *Control areas* shall be separated from each other by *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

**[F] 414.2.2 Percentage of maximum allowable quantities.** The percentage of maximum allowable quantities of hazardous materials per *control area* permitted at each floor level within a building shall be in accordance with Table 414.2.2.

**Exception:** *Non-production laboratory facilities* are permitted to be in accordance with Section 414.8

**[F] 414.2.3 Number.** The maximum number of *control areas* within a building shall be in accordance with Table 414.2.2.

**Exception:** *Non-production laboratory facilities* are permitted to be in accordance with Section 414.8.

**[F] 414.2.4 Fire-resistance-rating requirements.** The required *fire-resistance rating* for *fire barriers* shall be in accordance with Table 414.2.2 or Table 414.8 for *non-production laboratory facilities*. The floor assembly of the *control area* and the construction supporting the floor of the *control area* shall have a *fire-resistance rating* of not less than 2 hours.

**Exception:** The floor assembly of the *control area* and the construction supporting the floor of the *control area* are allowed to be 1-hour fire-resistance rated in build-

ings of Types IIA, IIIA and VA construction, provided that both of the following conditions exist:

1. The building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1; and
2. The building is three or fewer *stories above grade plane*.

**[F] 414.2.5 Hazardous material in Group M display and storage areas and in Group S storage areas.** The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials permitted within a single *control area* of a Group M display and storage area, a Group S storage area or an outdoor *control area* is permitted to exceed the maximum allowable quantities per *control area* specified in Tables 307.1(1) and 307.1(2) without classifying the building or use as a Group H occupancy, provided that the materials are displayed and stored in accordance with the *International Fire Code* and quantities do not exceed the maximum allowable specified in Table 414.2.5(1).

In Group M occupancy wholesale and retail sales uses, indoor storage of flammable and combustible liquids shall not exceed the maximum allowable quantities per *control area* as indicated in Table 414.2.5(2), provided that the materials are displayed and stored in accordance with the *International Fire Code*.

The maximum quantity of aerosol products in Group M occupancy retail display areas, storage areas adjacent to retail display areas and retail storage areas shall be in accordance with the *International Fire Code*.

**[F] TABLE 414.2.2  
DESIGN AND NUMBER OF CONTROL AREAS**

FLOOR LEVEL		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA <sup>a</sup>	NUMBER OF CONTROL AREAS PER FLOOR	FIRE-RESISTANCE RATING FOR FIRE BARRIERS IN HOURS <sup>b</sup>
Above grade plane	Higher than 9	5	1	2
	7-9	5	2	2
	6	12.5	2	2
	5	12.5	2	2
	4	12.5	2	2
	3	50	2	1
	2	75	3	1
	1	100	4	1
Below grade plane	1	75	3	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

- a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 307.1(1) and 307.1(2), with all increases allowed in the notes to those tables.
- b. Separation shall include fire barriers and horizontal assemblies as necessary to provide separation from other portions of the building.

**SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY**

**[F] TABLE 414.2.5(1)  
MAXIMUM ALLOWABLE QUANTITY PER INDOOR AND OUTDOOR CONTROL AREA IN  
GROUP M AND S OCCUPANCIES NONFLAMMABLE SOLIDS AND NONFLAMMABLE AND NONCOMBUSTIBLE LIQUIDS<sup>d,e,f</sup>**

CONDITION		MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA	
Material <sup>a</sup>	Class	Solids pounds	Liquids gallons
<b>A. Health-hazard materials—nonflammable and noncombustible solids and liquids</b>			
1. Corrosives <sup>b,c</sup>	Not Applicable	9,750	975
2. Highly toxics	Not Applicable	20 <sup>b,c</sup>	2 <sup>b,c</sup>
3. Toxics <sup>b,c</sup>	Not Applicable	1,000	100
<b>B. Physical-hazard materials—nonflammable and noncombustible solids and liquids</b>			
1. Oxidizers <sup>b,c</sup>	4	Not Allowed	Not Allowed
	3	1,150 <sup>g</sup>	115
	2	2,250 <sup>h</sup>	225
	1	18,000 <sup>i,j</sup>	1,800 <sup>i,j</sup>
2. Unstable (reactives) <sup>b,c</sup>	4	Not Allowed	Not Allowed
	3	550	55
	2	1,150	115
	1	Not Limited	Not Limited
3. Water reactives	3 <sup>b,c</sup>	550	55
	2 <sup>b,c</sup>	1,150	115
	1	Not Limited	Not Limited

For SI: 1 pound = 0.454 kg, 1 gallon = 3.785 L.

- Hazard categories are as specified in the *International Fire Code*.
- Maximum allowable quantities shall be increased 100 percent in buildings that are sprinklered in accordance with Section 903.3.1.1. When Note c also applies, the increase for both notes shall be applied cumulatively.
- Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, in accordance with the *International Fire Code*. When Note b also applies, the increase for both notes shall be applied cumulatively.
- See Table 414.2.2 for design and number of control areas.
- Allowable quantities for other hazardous material categories shall be in accordance with Section 307.
- Maximum quantities shall be increased 100 percent in outdoor control areas.
- Maximum amounts are permitted to be increased to 2,250 pounds when individual packages are in the original sealed containers from the manufacturer or packager and do not exceed 10 pounds each.
- Maximum amounts are permitted to be increased to 4,500 pounds when individual packages are in the original sealed containers from the manufacturer or packager and do not exceed 10 pounds each.
- The permitted quantities shall not be limited in a building equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
- Quantities are unlimited in an outdoor control area.

**[F] TABLE 414.2.5(2)  
MAXIMUM ALLOWABLE QUANTITY OF FLAMMABLE AND COMBUSTIBLE LIQUIDS  
IN WHOLESALE AND RETAIL SALES OCCUPANCIES PER CONTROL AREA<sup>a</sup>**

TYPE OF LIQUID	MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA (gallons)		
	Sprinklered in accordance with note b densities and arrangements	Sprinklered in accordance with Tables 3404.3.6.3(4) through 3404.3.6.3(8) and Table 3404.3.7.5.1 of the <i>International Fire Code</i>	Nonsprinklered
Class IA	60	60	30
Class IB, IC, II and IIIA	7,500 <sup>c</sup>	15,000 <sup>c</sup>	1,600
Class IIIB	Unlimited	Unlimited	13,200

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m<sup>2</sup>, 1 gallon = 3.785 L, 1 gallon per minute per square foot = 40.75 L/min/m<sup>2</sup>.

- Control areas shall be separated from each other by not less than a 1-hour fire barrier wall.
- To be considered as sprinklered, a building shall be equipped throughout with an approved automatic sprinkler system with a design providing minimum densities as follows:
  - For uncartoned commodities on shelves 6 feet or less in height where the ceiling height does not exceed 18 feet, quantities are those permitted with a minimum sprinkler design density of Ordinary Hazard Group 2.
  - For cartoned, palletized or racked commodities where storage is 4 feet 6 inches or less in height and where the ceiling height does not exceed 18 feet, quantities are those permitted with a minimum sprinkler design density of 0.21 gallon per minute per square foot over the most remote 1,500-square-foot area.
- Where wholesale and retail sales or storage areas exceed 50,000 square feet in area, the maximum allowable quantities are allowed to be increased by 2 percent for each 1,000 square feet of area in excess of 50,000 square feet, up to a maximum of 100 percent of the table amounts. A control area separation is not required. The cumulative amounts, including amounts attained by having an additional control area, shall not exceed 30,000 gallons.

**[F] 414.3 Ventilation.** Rooms, areas or spaces of Group H in which explosive, corrosive, combustible, flammable or highly toxic dusts, mists, fumes, vapors or gases are or may be emitted due to the processing, use, handling or storage of materials shall be mechanically ventilated as required by the *International Fire Code* and the *International Mechanical Code*.

Ducts conveying explosives or flammable vapors, fumes or dusts shall extend directly to the exterior of the building without entering other spaces. Exhaust ducts shall not extend into or through ducts and plenums.

**Exception:** Ducts conveying vapor or fumes having flammable constituents less than 25 percent of their lower flammable limit (LFL) are permitted to pass through other spaces.

Emissions generated at workstations shall be confined to the area in which they are generated as specified in the *International Fire Code* and the *International Mechanical Code*.

The location of supply and exhaust openings shall be in accordance with the *International Mechanical Code*. Exhaust air contaminated by *highly toxic* material shall be treated in accordance with the *International Fire Code*.

A manual shutoff control for *ventilation* equipment required by this section shall be provided outside the room adjacent to the principal access door to the room. The switch shall be of the break-glass type and shall be labeled: VENTILATION SYSTEM EMERGENCY SHUTOFF.

**[F] 414.4 Hazardous material systems.** Systems involving hazardous materials shall be suitable for the intended application. Controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls, where provided, shall be designed to be fail safe.

**[F] 414.5 Inside storage, dispensing and use.** The inside storage, dispensing and use of hazardous materials shall be in accordance with Sections 414.5.1 through 414.5.4 of this code and the *International Fire Code*.

**[F] 414.5.1 Explosion control.** Explosion control shall be provided in accordance with the *International Fire Code* as required by Table 414.5.1 where quantities of hazardous materials specified in that table exceed the maximum allowable quantities in Table 307.1(1) or where a structure, room or space is occupied for purposes involving explosion hazards as required by Section 415 or the *International Fire Code*.

**[F] 414.5.2 Monitor control equipment.** Monitor control equipment shall be provided where required by the *International Fire Code*.

**[F] 414.5.3 Emergency or standby power.** Where mechanical *ventilation*, treatment systems, temperature control, alarm, detection or other electrically operated systems are required by the *International Fire Code* or this code, such systems shall be provided with an emergency

or legally required standby power system in accordance with Chapter 27 and the *International Fire Code*.

**Exceptions:**

1. Emergency or standby power are not required for the following storage areas:
  - 1.1. Mechanical *ventilation* for storage of Class IB and Class IC flammable and combustible liquids in closed containers not exceeding 6.5 gallons (25 L) capacity.
  - 1.2. Storage areas for Class 1 and 2 oxidizers.
  - 1.3. Storage areas for Class II, III, IV and V organic peroxides.
  - 1.4. Storage, use and handling areas for asphyxiant, irritant and radioactive gases.
  - 1.5. For storage, use and handling areas for highly toxic or toxic materials, see Sections 6004.2.2.8 and 6004.3.4.2 of the *International Fire Code*.
2. ((Standby)) Legally required standby power for mechanical *ventilation*, treatment systems and temperature control systems shall not be required where an *approved* fail-safe engineered system is installed.

**[F] 414.5.4 Spill control, drainage and containment.** Rooms, buildings or areas occupied for the storage of solid and liquid hazardous materials shall be provided with a means to control spillage and to contain or drain off spillage and fire protection water discharged in the storage area where required in the *International Fire Code*. The methods of spill control shall be in accordance with the *International Fire Code*.

**[F] 414.6 Outdoor storage, dispensing and use.** The outdoor storage, dispensing and use of hazardous materials shall be in accordance with the *International Fire Code*.

**[F] 414.6.1 Weather protection.** Where weather protection is provided for sheltering outdoor hazardous material storage or use areas, such areas shall be considered outdoor storage or use when the weather protection structure complies with Sections 414.6.1.1 through 414.6.1.3.

**[F] 414.6.1.1 Walls.** Walls shall not obstruct more than one side of the structure.

**Exception:** Walls shall be permitted to obstruct portions of multiple sides of the structure, provided that the obstructed area is not greater than 25 percent of the structure's perimeter.

**[F] 414.6.1.2 Separation distance.** The distance from the structure to buildings, *lot lines*, *public ways* or *means of egress* to a *public way* shall be not less than the distance required for an outside hazardous material storage or use area without weather protection.



[F] **414.6.1.3 Noncombustible construction.** The overhead structure shall be of *approved* noncombustible construction with a maximum area of 1,500 square feet (140 m<sup>2</sup>).

**Exception:** The maximum area is permitted to be increased as provided by Section 506.

[F] **414.7 Emergency alarms.** Emergency alarms for the detection and notification of an emergency condition in Group H occupancies shall be provided as set forth herein.

[F] **414.7.1 Storage.** An *approved* manual *emergency alarm system* shall be provided in buildings, rooms or areas used for storage of hazardous materials. Emergency alarm-initiating devices shall be installed outside of each interior *exit* or *exit access* door of storage buildings, rooms

or areas. Activation of an emergency alarm-initiating device shall sound a local alarm to alert occupants of an emergency situation involving hazardous materials.

[F] **414.7.2 Dispensing, use and handling.** Where hazardous materials having a hazard ranking of 3 or 4 in accordance with NFPA 704 are transported through *corridors*, *interior exit stairways* or *ramps*, or *exit passageways* there shall be an emergency telephone system, a local manual alarm station or an *approved* alarm-initiating device at not more than 150-foot (45 720 mm) intervals and at each *exit* and *exit access doorway* throughout the transport route. The signal shall be relayed to an *approved* central, proprietary or remote station service or constantly attended on-site location and shall initiate a local audible alarm.

[F] TABLE 414.5.1  
EXPLOSION CONTROL REQUIREMENTS<sup>a</sup>

MATERIAL	CLASS	EXPLOSION CONTROL METHODS	
		Barricade construction	Explosion (deflagration) venting or explosion (deflagration) prevention systems <sup>b</sup>
<b>HAZARD CATEGORY</b>			
Combustible dusts <sup>c</sup>	—	Not Required	Required
Cryogenic flammables	—	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	Not Required	Required
	Division 1.5	Required	Not Required
	Division 1.6	Required	Not Required
Flammable gas	Gaseous	Not Required	Required
	Liquefied	Not Required	Required
Flammable liquid	IA <sup>d</sup>	Not Required	Required
	IB <sup>e</sup>	Not Required	Required
Organic peroxides	U	Required	Not Permitted
	I	Required	Not Permitted
Oxidizer liquids and solids	4	Required	Not Permitted
Pyrophoric gas	—	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 <sup>g</sup>	Not Required	Required
<b>SPECIAL USES</b>			
Acetylene generator rooms	—	Not Required	Required
Grain processing	—	Not Required	Required
Liquefied petroleum gas-distribution facilities	—	Not Required	Required
Where explosion hazards exist <sup>f</sup>	Detonation	Required	Not Permitted
	Deflagration	Not Required	Required

a. See Section 414.1.3.

b. See the *International Fire Code*.

c. As generated during manufacturing or processing.

d. Storage or use.

e. In open use or dispensing.

f. 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.

g. A method of explosion control shall be provided when Class 2 water-reactive materials can form potentially explosive mixtures.

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[F] **414.7.3 Supervision and monitoring.** *Emergency alarm, detection and automatic fire-extinguishing systems required by Sections 414.7.1 and 414.7.2 shall be electrically supervised and monitored by an approved supervising station or, when approved, shall initiate an audible and visual signal at a constantly attended on-site location.*

**414.8 Non-production laboratory facilities.** *Non-production laboratory facilities are permitted to comply with Sections 414.8.1 through 414.8.4.*

**414.8.1 Maximum allowable quantity per control area.** *The aggregate amount of hazardous materials in a control area shall not exceed the percentage specified in Table 414.8.*

**414.8.2 Fire-resistance-rating requirements.** *The required fire-resistance rating for fire barriers shall be in accordance with Table 414.8 for non-production laboratory facilities.*

**414.8.3 Storage.** *Storage in control areas shall be in accordance with this code and Sections 414.8.3.1 through 414.8.3.2.*

**414.8.3.1 Density.** *Storage of Class I flammable liquids shall not exceed 4 gallons per 100 square feet (0.13 L/m<sup>2</sup>) of floor area above floor level 6.*

**414.8.3.2 Container size.** *Individual containers in storage shall not exceed 1 gallon (3.8 L) for Class I flammable liquids.*

**414.8.4 Automatic sprinkler system.** *An approved automatic sprinkler system shall be installed throughout a building containing a non-production laboratory facility. The sprinkler system shall be designed to protect an ordinary hazard group 2 occupancy.*

**SECTION 415  
GROUPS H-1, H-2, H-3, H-4 AND H-5**

*Section 415 has been completely reorganized from the 2009 code; therefore, the \* and \*\* margin indicators have not been included for clarity.*

[F] **415.1 Scope.** *The provisions of Sections 415.1 through 415.10 shall apply to the storage and use of hazardous materials in excess of the maximum allowable quantities per control area listed in Section 307.1. Buildings and structures with an occupancy in Group H shall also comply with the applicable provisions of Section 414 and the International Fire Code.*

[F] **415.2 Definitions.** *The following terms are defined in Chapter 2:*

- CONTINUOUS GAS DETECTION SYSTEM.
- DETACHED BUILDING.
- EMERGENCY CONTROL STATION.
- EXHAUSTED ENCLOSURE.
- FABRICATION AREA.
- FLAMMABLE VAPORS OR FUMES.
- GAS CABINET.
- GASROOM.
- HAZARDOUS PRODUCTION MATERIAL (HPM).
- HPM FLAMMABLE LIQUID.
- HPM ROOM.
- IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH).
- LIQUID.
- LIQUID STORAGE ROOM.
- LIQUID USE, DISPENSING AND MIXING ROOM.

**TABLE 414.8  
DESIGN AND NUMBER OF CONTROL AREAS IN NON-PRODUCTION LABORATORY FACILITIES<sup>a</sup>**

FLOOR LEVEL		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA <sup>b</sup>	NUMBER OF CONTROL AREAS PER FLOOR	FIRE-RESISTANCE RATING FOR FIRE BARRIERS IN HOURS <sup>c,d</sup>
Above Grade Plane	Higher than 20	Not Allowed	Not Allowed	Not Allowed
	6-20	15	2	2
	5	25	2	2
	4	25	2	2
	3	50	2	2
	2	75	2	1
	1	100	2	1
Below Grade Plane	1	75	2	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

a. Table 414.8 applies to non-production laboratory facilities meeting the criteria of Section 414.8.  
 b. Percentages shall be of the maximum allowable quantity per control area shown in Tables 307.1(1) and 307.1(2) with all increases allowed in the footnotes to those tables.  
 c. Fire barriers shall include walls and floors as necessary to provide separation from other portions of the building.  
 d. Vertical fire barriers separating control areas from other spaces on the same floor may be one-hour rated.

LOWER FLAMMABLE LIMIT (LFL).  
 NORMAL TEMPERATURE AND PRESSURE (NTP).  
 PHYSIOLOGICAL WARNING THRESHOLD LEVEL.  
 SERVICE CORRIDOR.  
 SOLID.  
 STORAGE, HAZARDOUS MATERIALS.  
 USE (MATERIAL).  
 WORKSTATION.

[F] **415.3 Automatic fire detection systems.** Group H occupancies shall be provided with an automatic fire detection system in accordance with Section 907.2.

[F] **415.4 Automatic sprinkler system.** Group H occupancies shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.2.5.

[F] **415.5 Fire separation distance.** Group H occupancies shall be located on property in accordance with the other provisions of this chapter. In Groups H-2 and H-3, not less than 25 percent of the perimeter wall of the occupancy shall be an *exterior wall*.

**Exceptions:**

1. *Liquid use, dispensing and mixing rooms* having a floor area of not more than 500 square feet (46.5 m<sup>2</sup>) need not be located on the outer perimeter of the building where they are in accordance with the *International Fire Code* and NFPA 30.
2. *Liquid storage rooms* having a floor area of not more than 1,000 square feet (93 m<sup>2</sup>) need not be located on the outer perimeter where they are in accordance with the *International Fire Code* and NFPA 30.
3. Spray paint booths that comply with the *International Fire Code* need not be located on the outer perimeter.

[F] **415.5.1 Group H occupancy minimum fire separation distance.** Regardless of any other provisions, buildings containing Group H occupancies shall be set back to the minimum *fire separation distance* as set forth in Sections 415.5.1.1 through 415.5.1.4. Distances shall be measured from the walls enclosing the occupancy to *lot lines*, including those on a public way. Distances to assumed *lot lines* established for the purpose of determining exterior wall and opening protection are not to be used to establish the minimum *fire separation distance* for buildings on sites where explosives are manufactured or used when separation is provided in accordance with the quantity distance tables specified for explosive materials in the *International Fire Code*.

[F] **415.5.1.1 Group H-1.** Group H-1 occupancies shall be set back not less than 75 feet (22 860 mm) and not less than required by the *International Fire Code*.

~~((Exception: Fireworks manufacturing buildings separated in accordance with NFPA 1124.))~~

**415.5.1.1.1 Restrictions in the Fire District.** Group H-1 occupancies shall not be located in the *Fire District*.

[F] **415.5.1.2 Group H-2.** Group H-2 occupancies shall be set back not less than 30 feet (9144 mm) where the area of the occupancy is greater than 1,000 square feet (93 m<sup>2</sup>) and it is not required to be located in a *detached building*.

**415.5.1.2.1 Restrictions in the Fire District.** Group H-2 occupancies having a floor area in excess of 500 square feet (46 m<sup>2</sup>) are not permitted in the *Fire District*. Group H-3 Occupancies having a floor area in excess of 1,500 square feet (139 m<sup>2</sup>) are not permitted in the *Fire District*.

[F] **415.5.1.3 Groups H-2 and H-3.** Group H-2 and H-3 occupancies shall be set back not less than 50 feet (15 240 mm) where a *detached building* is required (see Table 415.5.2).

[F] **415.5.1.4 Explosive materials.** Group H-2 and H-3 occupancies containing materials with explosive characteristics shall be separated as required by the *International Fire Code*. Where separations are not specified, the distances required shall be determined by a technical report issued in accordance with Section 414.1.3.

[F] **415.5.2 Detached buildings for Group H-1, H-2 or H-3 occupancy.** The storage or use of hazardous materials in excess of those amounts listed in Table 415.5.2 shall be in accordance with the applicable provisions of Sections 415.6 and 415.7.

[F] **415.5.2.1 Wall and opening protection.** Where a *detached building* is required by Table 415.5.2, there are no requirements for wall and opening protection based on *fire separation distance*.

[F] **415.6 Special provisions for Group H-1 occupancies.** Group H-1 occupancies shall be in buildings used for no other purpose, shall not exceed one *story* in height and be without *basements*, crawl spaces or other under-floor spaces. Roofs shall be of lightweight construction with suitable thermal insulation to prevent sensitive material from reaching its decomposition temperature. Group H-1 occupancies containing materials that are in themselves both physical and health hazards in quantities exceeding the maximum allowable quantities per *control area* in Table 307.1(2) shall comply with requirements for both Group H-1 and H-4 occupancies.

[F] **415.6.1 Floors in storage rooms.** Floors in storage areas for organic peroxides, pyrophoric materials and unstable (reactive) materials shall be of liquid-tight, non-combustible construction.

[F] **415.7 Special provisions for Group H-2 and H-3 occupancies.** Group H-2 and H-3 occupancies containing quantities of hazardous materials in excess of those set forth in Table 415.5.2 shall be in *detached buildings* used for manufacturing, processing, dispensing, use or storage of hazardous materials. Materials listed for Group H-1 occupancies in Section 307.3 are permitted to be located within Group H-2 or H-3 *detached buildings* provided the amount of materials per *control area* do not exceed the maximum allowed quantity specified in Table 307.1(1).

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[F] TABLE 415.5.2  
DETACHED BUILDING REQUIRED

A DETACHED BUILDING IS REQUIRED WHEN THE QUANTITY OF MATERIAL EXCEEDS THAT LISTED HEREIN			
Material	Class	Solids and Liquids (tons) <sup>a, b</sup>	Gases (cubic feet) <sup>a, b</sup>
Explosives	Division 1.1	Maximum Allowable Quantity	Not Applicable
	Division 1.2	Maximum Allowable Quantity	
	Division 1.3	Maximum Allowable Quantity	
	Division 1.4	Maximum Allowable Quantity	
	Division 1.4 <sup>c</sup>	1	
	Division 1.5	Maximum Allowable Quantity	
	Division 1.6	Maximum Allowable Quantity	
Oxidizers	Class 4	Maximum Allowable Quantity	Maximum Allowable Quantity
Unstable (reactives) detonable	Class 3 or 4	Maximum Allowable Quantity	Maximum Allowable Quantity
Oxidizer, liquids and solids	Class 3	1,200	Not Applicable
	Class 2	2,000	Not Applicable
Organic peroxides	Detonable	Maximum Allowable Quantity	Not Applicable
	Class I	Maximum Allowable Quantity	Not Applicable
	Class II	25	Not Applicable
	Class III	50	Not Applicable
Unstable (reactives) nondetonable	Class 3	1	2,000
	Class 2	25	10,000
Water reactives	Class 3	1	Not Applicable
	Class 2	25	Not Applicable
Pyrophoric gases	Not Applicable	Not Applicable	2,000

For SI: 1 ton = 906 kg, 1 cubic foot = 0.02832 m<sup>3</sup>, 1 pound = 0.454 kg.

- a. For materials that are detonable, the distance to other buildings or lot lines shall be in accordance with Chapter 56 of the *International Fire Code* based on trinitrotoluene (TNT) equivalence of the material. For materials classified as explosives, see Chapter 56 of the *International Fire Code*.
- b. "Maximum Allowable Quantity" means the maximum allowable quantity per control area set forth in Table 307.1(1).
- c. Limited to Division 1.4 materials and articles, including articles packaged for shipment, that are not regulated as an explosive under Bureau of Alcohol, Tobacco, Firearms and Explosives (BATF) regulations or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles, provided the net explosive weight of individual articles does not exceed 1 pound.

[F] **415.7.1 Detached buildings.** *Detached buildings* shall not exceed one *story* in height and shall be without *basements*, crawl spaces or other under-floor spaces.

[F] **415.7.2 Multiple hazards.** Group H-2 or H-3 occupancies containing materials which are in themselves both physical and health hazards in quantities exceeding the maximum allowable quantities per *control area* in Table 307.1(2) shall comply with requirements for Group H-2, H-3 or H-4 occupancies as applicable.

[F] **415.7.3 Separation of incompatible materials.** Hazardous materials other than those listed in Table 415.5.2 shall be allowed in manufacturing, processing, dispensing, use or storage areas when separated from incompatible materials in accordance with the provisions of the *International Fire Code*.

[F] **415.7.4 Water reactives.** Group H-2 and H-3 occupancies containing water-reactive materials shall be resistant to water penetration. Piping for conveying liquids shall not be over or through areas containing water reactives, unless isolated by *approved* liquid-tight construction.

**Exception:** Fire protection piping shall be permitted over or through areas containing water reactives without isolating it with liquid-tight construction.

[F] **415.7.5 Floors in storage rooms.** Floors in storage areas for organic peroxides, oxidizers, pyrophoric materials, unstable (reactive) materials and water-reactive solids and liquids shall be of liquid-tight, noncombustible construction.

[F] **415.7.6 Waterproof room.** Rooms or areas used for the storage of water-reactive solids and liquids shall be constructed in a manner that resists the penetration of water through the use of waterproof materials. Piping carrying water for other than *approved automatic sprinkler systems* shall not be within such rooms or areas.

[F] **415.8 Group H-2.** Occupancies in Group H-2 shall be constructed in accordance with Sections 415.8.1 through 415.8.4 and the *International Fire Code*.

[F] **415.8.1 Combustible dusts, grain processing and storage.** The provisions of Sections 415.8.1.1 through 415.8.1.6 shall apply to buildings in which materials that produce combustible dusts are stored or handled. Buildings that store or handle combustible dusts shall comply with the applicable provisions of NFPA 61, NFPA 85, NFPA 120, NFPA 484, NFPA 654, NFPA 655 and NFPA 664, and the *International Fire Code*.

[F] **415.8.1.1 Type of construction and height exceptions.** Buildings shall be constructed in compliance

with the height and area limitations of Table 503 for Group H-2; except that where erected of Type I or II construction, the heights and areas of grain elevators and similar structures shall be unlimited, and where of Type IV construction, the maximum *building height* shall be 65 feet (19 812 mm) and except further that, in isolated areas, the maximum *building height* of Type IV structures shall be increased to 85 feet (25 908 mm).

[F] **415.8.1.2 Grinding rooms.** Every room or space occupied for grinding or other operations that produce combustible dusts shall be enclosed with *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both. The *fire-resistance rating* of the enclosure shall be not less than 2 hours where the area is not more than 3,000 square feet (279 m<sup>2</sup>), and not less than 4 hours where the area is greater than 3,000 square feet (279 m<sup>2</sup>).

[F] **415.8.1.3 Conveyors.** Conveyors, chutes, piping and similar equipment passing through the enclosures of rooms or spaces shall be constructed dirt tight and vapor tight, and be of *approved* noncombustible materials complying with Chapter 30.

[F] **415.8.1.4 Explosion control.** Explosion control shall be provided as specified in the *International Fire Code*, or spaces shall be equipped with the equivalent mechanical *ventilation* complying with the *International Mechanical Code*.

[F] **415.8.1.5 Grain elevators.** Grain elevators, malt houses and buildings for similar occupancies shall not be located within 30 feet (9144 mm) of interior *lot lines* or structures on the same *lot*, except where erected along a railroad right-of-way.

[F] **415.8.1.6 Coal pockets.** Coal pockets located less than 30 feet (9144 mm) from interior *lot lines* or from structures on the same *lot* shall be constructed of not less than Type IB construction. Where more than 30 feet (9144mm) from interior *lot lines*, or where erected along a railroad right-of-way, the minimum type of construction of such structures not more than 65 feet (19 812 mm) in *building height* shall be Type IV.

[F] **415.8.2 Flammable and combustible liquids.** The storage, handling, processing and transporting of flammable and combustible liquids in Groups H-2 and H-3 occupancies shall be in accordance with Sections 415.8.2.1 through 415.8.2.9, the *International Mechanical Code* and the *International Fire Code*.

[F] **415.8.2.1 Mixed occupancies.** Where the storage tank area is located in a building of two or more occupancies and the quantity of liquid exceeds the maximum allowable quantity for one *control area*, the use shall be completely separated from adjacent occupancies in accordance with the requirements of Section 508.4.

[F] **415.8.2.1.1 Height exception.** Where storage tanks are located within a building no more than one *story above grade plane*, the height limitation of Section 503 shall not apply for Group H.

[F] **415.8.2.2 Tank protection.** Storage tanks shall be noncombustible and protected from physical damage. *Fire barriers* or *horizontal assemblies* or both around the storage tanks shall be permitted as the method of protection from physical damage.

[F] **415.8.2.3 Tanks.** Storage tanks shall be *approved* tanks conforming to the requirements of the *International Fire Code*.

[F] **415.8.2.4 Leakage containment.** A liquid-tight containment area compatible with the stored liquid shall be provided. The method of spill control, drainage control and secondary containment shall be in accordance with the *International Fire Code*.

**Exception:** Rooms where only double-wall storage tanks conforming to Section 415.8.2.3 are used to store Class I, II and IIIA flammable and combustible liquids shall not be required to have a leakage containment area.

[F] **415.8.2.5 Leakage alarm.** An *approved* automatic alarm shall be provided to indicate a leak in a storage tank and room. The alarm shall sound an audible signal, 15 dBA above the ambient sound level, at every point of entry into the room in which the leaking storage tank is located. An *approved* sign shall be posted on every entry door to the tank storage room indicating the potential hazard of the interior room environment, or the sign shall state: WARNING, WHEN ALARM SOUNDS, THE ENVIRONMENT WITHIN THE ROOM MAY BE HAZARDOUS. The leakage alarm shall also be supervised in accordance with Chapter 9 to transmit a trouble signal.

[F] **415.8.2.6 Tank vent.** Storage tank vents for Class I, II or IIIA liquids shall terminate to the outdoor air in accordance with the *International Fire Code*.

[F] **415.8.2.7 Room ventilation.** Storage tank areas storing Class I, II or IIIA liquids shall be provided with mechanical *ventilation*. The mechanical *ventilation* system shall be in accordance with the *International Mechanical Code* and the *International Fire Code*.

[F] **415.8.2.8 Explosion venting.** Where Class I liquids are being stored, explosion venting shall be provided in accordance with the *International Fire Code*.

[F] **415.8.2.9 Tank openings other than vents.** Tank openings other than vents from tanks inside buildings shall be designed to ensure that liquids or vapor concentrations are not released inside the building.

[F] **415.8.3 Liquefied petroleum gas facilities.** The construction and installation of liquefied petroleum gas facilities shall be in accordance with the requirements of this code, the *International Fire Code*, the *International*

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*Mechanical Code*, the *International Fuel Gas Code* and NFPA 58.

[F] **415.8.4 Dry cleaning plants.** The construction and installation of dry cleaning plants shall be in accordance with the requirements of this code, the *International Mechanical Code*, the (~~*International*~~) *Uniform Plumbing Code* and NFPA 32. Dry cleaning solvents and systems shall be classified in accordance with the *International Fire Code*.

[F] **415.9 Groups H-3 and H-4.** Groups H-3 and H-4 shall be constructed in accordance with the applicable provisions of this code and the *International Fire Code*.

[F] **415.9.1 Flammable and combustible liquids.** The storage, handling, processing and transporting of flammable and combustible liquids in Group H-3 occupancies shall be in accordance with Section 415.8.2.

[F] **415.9.2 Gas rooms.** Where gas rooms are provided, such rooms shall be separated from other areas by not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

[F] **415.9.3 Floors in storage rooms.** Floors in storage areas for corrosive liquids and highly toxic or toxic materials shall be of liquid-tight, noncombustible construction.

[F] **415.9.4 Separation-highly toxic solids and liquids.** Highly toxic solids and liquids not stored in *approved* hazardous materials storage cabinets shall be isolated from other hazardous materials storage by not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

[F] **415.10 Group H-5.** In addition to the requirements set forth elsewhere in this code, Group H-5 shall comply with the provisions of Sections 415.10.1 through 415.10.11 and the *International Fire Code*.

[F] **415.10.1 Fabrication areas.** *Fabrication areas* shall comply with Sections 415.10.1.1 through 415.10.1.8.

[F] **415.10.1.1 Hazardous materials.** Hazardous materials and hazardous production materials (HPM) shall comply with Sections 415.10.1.1.1 and 415.10.1.1.2.

[F] **415.10.1.1.1 Aggregate quantities.** The aggregate quantities of hazardous materials stored and used in a single *fabrication area* shall not exceed the quantities set forth in Table 415.10.1.1.1.

**Exception:** The quantity limitations for any hazard category in Table 415.10.1.1.1 shall not apply where the *fabrication area* contains quantities of hazardous materials not exceeding the maximum

allowable quantities per *control area* established by Tables 307.1(1) and 307.1(2).

[F] **415.10.1.1.2 Hazardous production materials.** The maximum quantities of hazardous production materials (HPM) stored in a single *fabrication area* shall not exceed the maximum allowable quantities per *control area* established by Tables 307.1(1) and 307.1(2).

[F] **415.10.1.2 Separation.** *Fabrication areas*, whose sizes are limited by the quantity of hazardous materials allowed by Table 415.10.1.1.1, shall be separated from each other, from *corridors* and from other parts of the building by not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

### Exceptions:

1. Doors within such *fire barrier* walls, including doors to *corridors*, shall be only *self-closing fire door assemblies* having a *fire protection rating* of not less than  $\frac{3}{4}$  hour.
2. Windows between *fabrication areas* and *corridors* are permitted to be fixed glazing *listed* and labeled for a *fire protection rating* of not less than  $\frac{3}{4}$  hour in accordance with Section 716.

[F] **415.10.1.3 Location of occupied levels.** Occupied levels of *fabrication areas* shall be located at or above the first *story above grade plane*.

[F] **415.10.1.4 Floors.** Except for surfacing, floors within *fabrication areas* shall be of noncombustible construction.

Openings through floors of *fabrication areas* are permitted to be unprotected where the interconnected levels are used solely for mechanical equipment directly related to such *fabrication areas* (see also Section 415.10.1.5).

Floors forming a part of an occupancy separation shall be liquid tight.

[F] **415.10.1.5 Shafts and openings through floors.** Elevator hoistways, vent *shafts* and other openings through floors shall be enclosed where required by Sections 712 and 713. Mechanical, duct and piping penetrations within a *fabrication area* shall not extend through more than two floors. The *annular space* around penetrations for cables, cable trays, tubing, piping, conduit or ducts shall be sealed at the floor level to restrict the movement of air. The *fabrication area*, including the areas through which the ductwork and piping extend, shall be considered a single conditioned environment.

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**[F] TABLE 415.10.1.1.1  
QUANTITY LIMITS FOR HAZARDOUS MATERIALS IN A SINGLE FABRICATION AREA IN GROUP H-5<sup>a</sup>**

HAZARD CATEGORY		SOLIDS (pounds per square foot)	LIQUIDS (gallons per square foot)	GAS (cubic feet @ NTP/square foot)
<b>PHYSICAL-HAZARD MATERIALS</b>				
Combustible dust		Note b	Not Applicable	Not Applicable
Combustible fiber	Loose	Note b	Not Applicable	Not Applicable
	Baled	Notes b, c		
Combustible liquid	II	Not Applicable	0.01	Not Applicable
	III A		0.02	
III B	Not Limited			
Combination Class	I, II and III A		0.04	
Cryogenic gas	Flammable Oxidizing	Not Applicable	Not Applicable	Note d 1.25
Explosives		Note b	Note b	Note b
Flammable gas	Gaseous	Not Applicable	Not Applicable	Note d
	Liquefied			Note d
Flammable liquid	IA	Not Applicable	0.0025	Not Applicable
	IB		0.025	
IC	0.025			
Combination Class	IA, IB and IC		0.025	
Combination Class	I, II and III A		0.04	
Flammable solid		0.001	Not Applicable	Not Applicable
Organic peroxide	Unclassified detonable	Note b	Not Applicable	Not Applicable
	Class I	Note b		
	Class II	0.025		
	Class III	0.1		
	Class IV	Not Limited		
Oxidizing gas	Gaseous	Not Applicable	Not Applicable	1.25
	Liquefied			1.25
Combination of gaseous and liquefied				
Oxidizer	Class 4	Note b	Note b	Not Applicable
	Class 3	0.003	0.03	
	Class 2	0.003	0.03	
	Class 1	0.003	0.03	
Combination Class	1, 2, 3	0.003	0.03	
Pyrophoric materials		0.01	0.00125	Notes d and e
Unstable (reactive)	Class 4	Note b	Note b	Note b
	Class 3	0.025	0.0025	Note b
	Class 2	0.1	0.01	Note b
	Class 1	Not Limited	Not Limited	Not Limited
Water reactive	Class 3	Note b	0.00125	Not Applicable
	Class 2	0.25	0.025	
	Class 1	Not Limited	Not Limited	
<b>HEALTH-HAZARD MATERIALS</b>				
Corrosives		Not Limited	Not Limited	Not Limited
Highly toxic		Not Limited	Not Limited	Note d
Toxics		Not Limited	Not Limited	Note d

For SI: 1 pound per square foot = 4.882 kg/m<sup>2</sup>, 1 gallon per square foot = 40.7 L/m<sup>2</sup>, 1 cubic foot @ NTP/square foot = 0.305 m<sup>3</sup> @ NTP/m<sup>2</sup>,  
1 cubic foot = 0.02832 m<sup>3</sup>.

- Hazardous materials within piping shall not be included in the calculated quantities.
- Quantity of hazardous materials in a single fabrication shall not exceed the maximum allowable quantities per control area in Tables 307.1(1) and 307.1(2).
- Densely packed baled cotton that complies with the packing requirements of ISO 8115 shall not be included in this material class.
- The aggregate quantity of flammable, pyrophoric, toxic and highly toxic gases shall not exceed 9,000 cubic feet at NTP.
- The aggregate quantity of pyrophoric gases in the building shall not exceed the amounts set forth in Table 415.5.2.

**[F] 415.10.1.6 Ventilation.** Mechanical exhaust *ventilation* at the rate of not less than 1 cubic foot per minute per square foot [ $0.0051 \text{ m}^3/(\text{s} \cdot \text{m}^2)$ ] of floor area shall be provided throughout the portions of the *fabrication area* where HPM are used or stored. The exhaust air duct system of one *fabrication area* shall not connect to another duct system outside that *fabrication area* within the building.

A *ventilation* system shall be provided to capture and exhaust gases, fumes and vapors at workstations.

Two or more operations at a workstation shall not be connected to the same exhaust system where either one or the combination of the substances removed could constitute a fire, explosion or hazardous chemical reaction within the exhaust duct system.

Exhaust ducts penetrating *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711 shall be contained in a *shaft* of equivalent fire-resistance-rated construction. Exhaust ducts shall not penetrate *fire walls*.

*Fire dampers* shall not be installed in exhaust ducts.

**[F] 415.10.1.7 Transporting hazardous production materials to fabrication areas.** HPM shall be transported to *fabrication areas* through enclosed piping or tubing systems that comply with Section 415.10.6, through *service corridors* complying with Section 415.10.3, or in *corridors* as permitted in the exception to Section 415.10.2. The handling or transporting of HPM within *service corridors* shall comply with the *International Fire Code*.

**[F] 415.10.1.8 Electrical.** Electrical equipment and devices within the *fabrication area* shall comply with ((NFPA 70)) the *Seattle Electrical Code*. The requirements for hazardous locations need not be applied where the average air change is at least four times that set forth in Section 415.10.1.6 and where the number of air changes at any location is not less than three times that required by Section 415.10.1.6. The use of recirculated air shall be permitted.

**[F] 415.10.1.8.1 Workstations.** Workstations shall not be energized without adequate exhaust *ventilation*. See Section 415.10.1.6 for workstation exhaust *ventilation* requirements.

**[F] 415.10.2 Corridors.** *Corridors* shall comply with Chapter 10 and shall be separated from *fabrication areas* as specified in section 415.10.1.2. *Corridors* shall not contain HPM and shall not be used for transporting such materials except through closed piping systems as provided in Section 415.10.6.4

**Exception:** Where existing *fabrication areas* are altered or modified, HPM is allowed to be transported in existing *corridors*, subject to the following conditions:

1. Nonproduction HPM is allowed to be transported in *corridors* if utilized for maintenance, lab work and testing.

2. Where existing *fabrication areas* are altered or modified, HPM is allowed to be transported in existing *corridors*, subject to the following conditions:

- 2.1. *Corridors.* *Corridors* adjacent to the *fabrication area* where the alteration work is to be done shall comply with Section 1018 for a length determined as follows:

- 2.1.1. The length of the common wall of the *corridor* and the *fabrication area*; and

- 2.1.2. For the distance along the *corridor* to the point of entry of HPM into the *corridor* serving that *fabrication area*.

- 2.2. *Emergency alarm system.* There shall be an emergency telephone system, a local manual alarm station or other *approved* alarm-initiating device within *corridors* at not more than 150-foot (45 720 mm) intervals and at each *exit* and doorway. The signal shall be relayed to an *approved* central, proprietary or remote station service or the emergency control station and shall also initiate a local audible alarm.

- 2.3. *Pass-throughs.* *Self-closing* doors having a *fire protection rating* of not less than 1 hour shall separate *pass-throughs* from existing *corridors*. *Pass-throughs* shall be constructed as required for the *corridors* and protected by an *approved automatic sprinkler system*.

**[F] 415.10.3 Service corridors.** *Service corridors* within a Group H-5 occupancy shall comply with Sections 415.10.3.1 through 415.10.3.4.

**[F] 415.10.3.1 Use conditions.** *Service corridors* shall be separated from *corridors* as required by Section 415.10.1.2. *Service corridors* shall not be used as a required *corridor*.

**[F] 415.10.3.2 Mechanical ventilation.** *Service corridors* shall be mechanically ventilated as required by Section 415.10.1.6 or at not less than six air changes per hour, whichever is greater.

**[F] 415.10.3.3 Means of egress.** The distance of travel from any point in a *service corridor* to an *exit*, *exit access corridor* or door into a *fabrication area* shall be not greater than 75 feet (22 860 mm). Dead ends shall be not greater than 4 feet (1219 mm) in length. There shall be not less than two *exits*, and not more than one-half of the required *means of egress* shall require travel into a *fabrication area*. Doors from *service corridors* shall swing in the direction of egress travel and shall be *self-closing*.



[F] **415.10.3.4 Minimum width.** The clear width of a *service corridor* shall be not less than 5 feet (1524 mm), or 33 inches (838 mm) wider than the widest cart or truck used in the *service corridor*, whichever is greater.

[F] **415.10.3.5 Emergency alarm system.** *Emergency alarm systems* shall be provided in accordance with this section and Sections 414.7.1 and 414.7.2. The maximum allowable quantity per *control area* provisions shall not apply to *emergency alarm systems* required for HPM.

[F] **415.10.3.5.1 Service corridors.** An *emergency alarm system* shall be provided in *service corridors*, with no fewer than one alarm device in each *service corridor*.

[F] **415.10.3.5.2 Corridors and interior exit stairways and ramps.** Emergency alarms for *corridors*, *interior exit stairways* and *ramps* and *exit passageways* shall comply with Section 414.7.2.

[F] **415.10.3.5.3 Liquid storage rooms, HPM rooms and gas rooms.** Emergency alarms for liquid storage rooms, HPM rooms and gas rooms shall comply with Section 414.7.1.

[F] **415.10.3.5.4 Alarm-initiating devices.** An *approved* emergency telephone system, local alarm manual pull stations, or other *approved* alarm-initiating devices are allowed to be used as emergency alarm-initiating devices.

[F] **415.10.3.5.5 Alarm signals.** Activation of the *emergency alarm system* shall sound a local alarm and transmit a signal to the emergency control station.

[F] **415.10.4 Storage of hazardous production materials.** Storage of hazardous production materials (HPM) in *fabrication areas* shall be within *approved* or *listed* storage cabinets or gas cabinets or within a workstation. The storage of HPM in quantities greater than those listed in Section 5004.2 of the *International Fire Code* shall be in liquid storage rooms, HPM rooms or gas rooms as appropriate for the materials stored. The storage of other hazardous materials shall be in accordance with other applicable provisions of this code and the *International Fire Code*.

[F] **415.10.5 HPM rooms, gas rooms, liquid storage room construction.** HPM rooms, gas rooms and liquid shall be constructed in accordance with Sections 415.10.5.1 through 415.10.5.9.

[F] **415.10.5.1 HPM rooms and gas rooms.** HPM rooms and gas rooms shall be separated from other areas by *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both. The *fire-resistance rating* shall be not less than 2 hours where the area is 300 square feet (27.9 m<sup>2</sup>) or more and not less than 1 hour where the area is less than 300 square feet (27.9 m<sup>2</sup>).

[F] **415.10.5.2 Liquid storage rooms.** Liquid storage rooms shall be constructed in accordance with the following requirements:

1. Rooms greater than 500 square feet (46.5 m<sup>2</sup>) in area, shall have no fewer than one exterior door *approved* for fire department access.
2. Rooms shall be separated from other areas by *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both. The *fire-resistance rating* shall be not less than 1 hour for rooms up to 150 square feet (13.9 m<sup>2</sup>) in area and not less than 2 hours where the room is more than 150 square feet (13.9 m<sup>2</sup>) in area.
3. Shelving, racks and wainscoting in such areas shall be of noncombustible construction or wood of not less than 1-inch (25 mm) nominal thickness or fire-retardant-treated wood complying with Section 2303.2.
4. Rooms used for the storage of Class I flammable liquids shall not be located in a *basement*.

[F] **415.10.5.3 Floors.** Except for surfacing, floors of HPM rooms and liquid storage rooms shall be of noncombustible liquid-tight construction. Raised grating over floors shall be of noncombustible materials.

[F] **415.10.5.4 Location.** Where HPM rooms, liquid storage rooms and gas rooms are provided, they shall have no fewer than one *exterior wall* and such wall shall be not less than 30 feet (9144 mm) from *lot lines*, including *lot lines* adjacent to *public ways*.

[F] **415.10.5.5 Explosion control.** Explosion control shall be provided where required by Section 414.5.1.

[F] **415.10.5.6 Exits.** Where two *exits* are required from HPM rooms, liquid storage rooms and gas rooms, one shall be directly to the outside of the building.

[F] **415.10.5.7 Doors.** Doors in a *fire barrier wall*, including doors to *corridors*, shall be *self-closing fire door assemblies* having a *fire protection rating* of not less than  $\frac{3}{4}$  hour.

[F] **415.10.5.8 Ventilation.** Mechanical exhaust *ventilation* shall be provided in liquid storage rooms, HPM rooms and gas rooms at the rate of not less than 1 cubic foot per minute per square foot (0.044 L/s/m<sup>2</sup>) of floor area or six air changes per hour, whichever is greater, for categories of material.

Exhaust *ventilation* for gas rooms shall be designed to operate at a negative pressure in relation to the surrounding areas and direct the exhaust *ventilation* to an exhaust system.

[F] **415.10.5.9 Emergency alarm system.** An *approved emergency alarm system* shall be provided for HPM rooms, liquid storage rooms and gas rooms.

Emergency alarm-initiating devices shall be installed outside of each interior *exit* door of such rooms.

## SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

Activation of an emergency alarm-initiating device shall sound a local alarm and transmit a signal to the emergency control station.

An *approved* emergency telephone system, local alarm manual pull stations or other *approved* alarm-initiating devices are allowed to be used as emergency alarm-initiating devices.

**[F] 415.10.6 Piping and tubing.** Hazardous production materials piping and tubing shall comply with this section and ASME B31.3.

**[F] 415.10.6.1 HPM having a health-hazard ranking of 3 or 4.** Systems supplying HPM liquids or gases having a health-hazard ranking of 3 or 4 shall be welded throughout, except for connections, to the systems that are within a ventilated enclosure if the material is a gas, or an *approved* method of drainage or containment is provided for the connections if the material is a liquid.

**[F] 415.10.6.2 Location in service corridors.** Hazardous production materials supply piping or tubing in *service corridors* shall be exposed to view.

**[F] 415.10.6.3 Excess flow control.** Where HPM gases or liquids are carried in pressurized piping above 15 pounds per square inch gauge (psig) (103.4 kPa), excess flow control shall be provided. Where the piping originates from within a liquid storage room, HPM room or gas room, the excess flow control shall be located within the liquid storage room, HPM room or gas room. Where the piping originates from a bulk source, the excess flow control shall be located as close to the bulk source as practical.

**[F] 415.10.6.4 Installations in corridors and above other occupancies.** The installation of HPM piping and tubing within the space defined by the walls of *corridors* and the floor or roof above, or in concealed spaces above other occupancies, shall be in accordance with Sections 415.10.6.1 through 415.10.6.3 and the following conditions:

1. Automatic sprinklers shall be installed within the space unless the space is less than 6 inches (152 mm) in the least dimension.
2. *Ventilation* not less than six air changes per hour shall be provided. The space shall not be used to convey air from any other area.
3. Where the piping or tubing is used to transport HPM liquids, a receptor shall be installed below such piping or tubing. The receptor shall be designed to collect any discharge or leakage and drain it to an *approved* location. The 1-hour enclosure shall not be used as part of the receptor.
4. HPM supply piping and tubing and nonmetallic waste lines shall be separated from the *corridor* and from occupancies other than Group H-5 by *fire barriers* that have a *fire-resistance rating* of not less than 1 hour. Where gypsum wallboard is

used, joints on the piping side of the enclosure are not required to be taped, provided the joints occur over framing members. Access openings into the enclosure shall be protected by *approved* fire protection-rated assemblies.

5. Readily accessible manual or automatic remotely activated fail-safe emergency shutoff valves shall be installed on piping and tubing other than waste lines at the following locations:

5.1. At branch connections into the *fabrication area*.

5.2. At entries into *corridors*.

**Exception:** Transverse crossings of the *corridors* by supply piping that is enclosed within a ferrous pipe or tube for the width of the *corridor* need not comply with Items 1 through 5.

**[F] 415.10.6.5 Identification.** Piping, tubing and HPM waste lines shall be identified in accordance with ANSI A13.1 to indicate the material being transported.

**[F] 415.10.7 Continuous gas detection systems.** A *continuous gas detection system* shall be provided for HPM gases where the physiological warning threshold level of the gas is at a higher level than the accepted permissible exposure limit (PEL) for the gas and for flammable gases in accordance with Sections 415.10.7.1 and 415.10.7.2.

**[F] 415.10.7.1 Where required.** A *continuous gas detection system* shall be provided in the areas identified in Sections 415.10.7.1.1 through 415.10.7.1.4.

**[F] 415.10.7.1.1 Fabrication areas.** A *continuous gas detection system* shall be provided in *fabrication areas* where gas is used in the *fabrication area*.

**[F] 415.10.7.1.2 HPM rooms.** A *continuous gas detection system* shall be provided in HPM rooms where gas is used in the room.

**[F] 415.10.7.1.3 Gas cabinets, exhausted enclosures and gas rooms.** A *continuous gas detection system* shall be provided in gas cabinets and exhausted enclosures. A *continuous gas detection system* shall be provided in gas rooms where gases are not located in gas cabinets or exhausted enclosures.

**[F] 415.10.7.1.4 Corridors.** Where gases are transported in piping placed within the space defined by the walls of a *corridor* and the floor or roof above the *corridor*, a *continuous gas detection system* shall be provided where piping is located and in the *corridor*.

**Exception:** A *continuous gas detection system* is not required for occasional transverse crossings of the *corridors* by supply piping that is enclosed in a ferrous pipe or tube for the width of the *corridor*.

**[F] 415.10.7.2 Gas detection system operation.** The *continuous gas detection system* shall be capable of

monitoring the room, area or equipment in which the gas is located at or below all the following gas concentrations:

1. Immediately dangerous to life and health (IDLH) values where the monitoring point is within an exhausted enclosure, ventilated enclosure or gas cabinet.
2. Permissible exposure limit (PEL) levels where the monitoring point is in an area outside an exhausted enclosure, ventilated enclosure or gas cabinet.
3. For flammable gases, the monitoring detection threshold level shall be vapor concentrations in excess of 25 percent of the lower flammable limit (LFL) where the monitoring is within or outside an exhausted enclosure, ventilated enclosure or gas cabinet.
4. Except as noted in this section, monitoring for highly toxic and toxic gases shall also comply with Chapter 60 of the *International Fire Code*.

**[F] 415.10.7.2.1 Alarms.** The gas detection system shall initiate a local alarm and transmit a signal to the emergency control station when a short-term hazard condition is detected. The alarm shall be both visual and audible and shall provide warning both inside and outside the area where the gas is detected. The audible alarm shall be distinct from all other alarms.

**[F] 415.10.7.2.2 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 which gas is detected when a short-term hazard condition is detected. Automatic closure of shutoff valves shall comply with the following:

1. Where 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 room and compressed gas containers are not in gas cabinets or an exhausted enclosure, 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 supplying the manifold for the compressed gas container of the specific gas detected shall automatically close.

**Exception:** Where the gas detection sampling point initiating the gas detection system alarm is at the use location or within a gas valve enclosure of a branch line downstream of a piping distribu-

tion manifold, the shutoff valve for the branch line located in the piping distribution manifold enclosure shall automatically close.

**[F] 415.10.8 Manual fire alarm system.** An *approved* manual fire alarm system shall be provided throughout buildings containing Group H-5. Activation of the alarm system shall initiate a local alarm and transmit a signal to the emergency control station. The fire alarm system shall be designed and installed in accordance with Section 907.

**[F] 415.10.9 Emergency control station.** An emergency control station shall be provided in accordance with Sections 415.10.9.1 through 415.10.9.3.

**[F] 415.10.9.1 Location.** The emergency control station shall be located on the premises at an *approved* location outside the *fabrication area*.

**[F] 415.10.9.2 Staffing.** Trained personnel shall continuously staff the emergency control station.

**[F] 415.10.9.3 Signals.** The emergency control station shall receive signals from emergency equipment and alarm and detection systems. Such emergency equipment and alarm and detection systems shall include, but not be limited to, the following where such equipment or systems are required to be provided either in this chapter or elsewhere in this code:

1. Automatic sprinkler system alarm and monitoring systems.
2. Manual fire alarm systems.
3. Emergency alarm systems.
4. Continuous gas detection systems.
5. Smoke detection systems.
6. Emergency power system.
7. Automatic detection and alarm systems for pyrophoric liquids and Class 3 water-reactive liquids required in Section 2705.2.3.4 of the *International Fire Code*.
8. Exhaust ventilation flow alarm devices for pyrophoric liquids and Class 3 water-reactive liquids cabinet exhaust ventilation systems required in Section 2705.2.3.4 of the *International Fire Code*.

**[F] 415.10.10 Emergency power system.** An emergency power system shall be provided in Group H-5 occupancies where required in Section 415.10.10.1. The emergency power system shall be designed to supply power automatically to required electrical systems when the normal electrical supply system is interrupted.

**[F] 415.10.10.1 Required electrical systems.** ((Emergency)) An emergency power system shall be provided for electrically operated equipment and connected control circuits for the following systems:

1. HPM exhaust ventilation systems.
2. HPM gas cabinet ventilation systems.
3. HPM exhausted enclosure ventilation systems.
4. HPM gas room ventilation systems.

5. HPM gas detection systems.
6. *Emergency alarm systems.*
7. *Manual fire alarm systems.*
8. *Automatic sprinkler system* monitoring and alarm systems.
9. Automatic alarm and detection systems for pyrophoric liquids and Class 3 water-reactive liquids required in Section 2705.2.3.4 of the *International Fire Code.*
10. Flow alarm switches for pyrophoric liquids and Class 3 water-reactive liquids cabinet exhaust *ventilation* systems required in Section 2705.2.3.4 of the *International Fire Code.*
11. Electrically operated systems required elsewhere in this code or in the *International Fire Code* applicable to the use, storage or handling of HPM.

**[F] 415.10.10.2 Exhaust ventilation systems.** Exhaust *ventilation* systems are allowed to be designed to operate at not less than one-half the normal fan speed on the emergency power system where it is demonstrated that the level of exhaust will maintain a safe atmosphere.

**[F] 415.10.11 Automatic sprinkler system protection in exhaust ducts for HPM.** An *approved automatic sprinkler system* shall be provided in exhaust ducts conveying gases, vapors, fumes, mists or dusts generated from HPM in accordance with Sections 415.10.11.1 through 415.10.11.3 and the *International Mechanical Code.*

**[F] 415.10.11.1 Metallic and noncombustible non-metallic exhaust ducts.** An *approved automatic sprinkler system* shall be provided in metallic and noncombustible nonmetallic exhaust ducts where all of the following conditions apply:

1. Where the largest cross-sectional diameter is equal to or greater than 10 inches (254 mm).
2. The ducts are within the building.
3. The ducts are conveying flammable gases, vapors or fumes.

**[F] 415.10.11.2 Combustible nonmetallic exhaust ducts.** *Automatic sprinkler system* protection shall be provided in combustible nonmetallic exhaust ducts where the largest cross-sectional diameter of the duct is equal to or greater than 10 inches (254 mm).

**Exception:** Duct need not be provided with automatic sprinkler protection as follows:

1. Ducts *listed* or *approved* for applications without *automatic sprinkler system* protection.
2. Ducts not more than 12 feet (3658 mm) in length installed below ceiling level.

**[F] 415.10.11.3 Automatic sprinkler locations.** Sprinkler systems shall be installed at 12-foot (3658 mm) intervals in horizontal ducts and at changes in direction. In vertical ducts, sprinklers shall be installed at the top and at alternate floor levels.

## SECTION 416 APPLICATION OF FLAMMABLE FINISHES

**[F] 416.1 General.** The provisions of this section shall apply to the construction, installation and use of buildings and structures, or parts thereof, for the application of flammable finishes. Such construction and equipment shall comply with the *International Fire Code.*

**[F] 416.2 Spray rooms.** Spray rooms shall be enclosed with not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both. Floors shall be water-proofed and drained in an *approved* manner.

**[F] 416.2.1 Surfaces.** The interior surfaces of spray rooms shall be smooth and shall be so constructed to permit the free passage of exhaust air from all parts of the interior and to facilitate washing and cleaning, and shall be so designed to confine residues within the room. Aluminum shall not be used.

**[F] 416.2.2 Ventilation.** Mechanical *ventilation* and interlocks with the spraying operation shall be in accordance with the *International Mechanical Code.*

**[F] 416.3 Spraying spaces.** Spraying spaces shall be ventilated with an exhaust system to prevent the accumulation of flammable mist or vapors in accordance with the *International Mechanical Code.* Where such spaces are not separately enclosed, noncombustible spray curtains shall be provided to restrict the spread of flammable vapors.

**[F] 416.3.1 Surfaces.** The interior surfaces of spraying spaces shall be smooth and continuous without edges; shall be so constructed to permit the free passage of exhaust air from all parts of the interior and to facilitate washing and cleaning; and shall be so designed to confine residues within the spraying space. Aluminum shall not be used.

**[F] 416.4 Spray booths.** Spray booths shall be designed, constructed and operated in accordance with the *International Fire Code*

**[F] 416.5 Fire protection.** An *automatic sprinkler system* or *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.

## SECTION 417 DRYING ROOMS

**[F] 417.1 General.** A drying room or dry kiln installed within a building shall be constructed entirely of *approved* noncombustible materials or assemblies of such materials regulated by the *approved* rules or as required in the general and specific sections of this chapter for special occupancies and where applicable to the general requirements of the *International Mechanical Code.*

**[F] 417.2 Piping clearance.** Overhead heating pipes shall have a clearance of not less than 2 inches (51 mm) from combustible contents in the dryer.

**[F] 417.3 Insulation.** Where the operating temperature of the dryer is 175°F (79°C) or more, metal enclosures shall be

insulated from adjacent combustible materials by not less than 12 inches (305 mm) of airspace, or the metal walls shall be lined with 1/4-inch (6.35 mm) insulating mill board or other approved equivalent insulation.

[F] **417.4 Fire protection.** Drying rooms designed for high-hazard materials and processes, including special occupancies as provided for in Chapter 4, shall be protected by an approved automatic fire-extinguishing system complying with the provisions of Chapter 9.

**SECTION 418  
ORGANIC COATINGS**

[F] **418.1 Building features.** Manufacturing of organic coatings shall be done only in buildings that do not have pits or basements.

[F] **418.2 Location.** Organic coating manufacturing operations and operations incidental to or connected therewith shall not be located in buildings having other occupancies.

[F] **418.3 Process mills.** Mills operating with close clearances and that process flammable and heat-sensitive materials, such as nitrocellulose, shall be located in a detached building or noncombustible structure.

[F] **418.4 Tank storage.** Storage areas for flammable and combustible liquid tanks inside of structures shall be located at or above grade and shall be separated from the processing area by not less than 2-hour fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both.

[F] **418.5 Nitrocellulose storage.** Nitrocellulose storage shall be located on a detached pad or in a separate structure or a room enclosed with not less than 2-hour fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both.

[F] **418.6 Finished products.** Storage rooms for finished products that are flammable or combustible liquids shall be separated from the processing area by not less than 2-hour fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both.

**SECTION 419  
LIVE/WORK UNITS**

**419.1 General.** A live/work unit shall comply with Sections 419.1 through 419.9.

**Exception:** Dwelling or sleeping units that include an office that is less than 10 percent of the area of the dwelling unit are permitted to be classified as dwelling units with accessory occupancies in accordance with Section 508.2.

**419.1.1 Limitations.** The following shall apply to all live/work areas:

1. The live/work unit is permitted to be not greater than 3,000 square feet (279 m<sup>2</sup>) in area;

2. The nonresidential area is permitted to be not more than 50 percent of the area of each live/work unit.(;)

~~((3. The nonresidential area function shall be limited to the first or main floor only of the live/work unit; and~~

4. ~~Not more than five nonresidential workers or employees are allowed to occupy the nonresidential area at any one time.)~~

**419.2 Occupancies.** Live/work units shall be classified as a Group R-2 or Group R-3 occupancy. Separation requirements found in Section ~~(s 420 and)~~ 508 shall not apply within the live/work unit where the live/work unit is in compliance with Sections 419 and 420. Nonresidential uses which would otherwise be classified as either a Group H or S occupancy shall not be permitted in a live/work unit.

**Exception:** Storage shall be permitted in the live/work unit provided the aggregate area of storage in the nonresidential portion of the live/work unit shall be limited to 10 percent of the space dedicated to nonresidential activities.

**419.3 Means of egress.** Except as modified by this section, the means of egress components for a live/work unit shall be designed in accordance with Chapter 10 for the function served.

**419.3.1 Egress capacity.** The egress capacity for each element of the live/work unit shall be based on the occupant load for the function served in accordance with Table 1004.1.2.

**419.3.2 Spiral stairways.** Spiral stairways that conform to the requirements of Section 1009.12 shall be permitted.

**419.4 Vertical openings.** Floor openings between floor levels of a live/work unit are permitted without enclosure.

[F] **419.5 Fire protection.** The live/work unit shall be provided with a monitored fire alarm system where required by Section 907.2.9. ~~((and an))~~ An automatic sprinkler system shall be provided in accordance with:

1. Section ~~((903.2.8))~~ 903.3.1.2 or 903.3.1.3 for Group R occupancies in buildings with four or fewer dwelling units that do not exceed two stories in height that are less than 5,000 square feet in area; or
2. Section 903.3.1.1 for all other buildings.

**419.6 Structural.** Floor loading for the areas within a live/work unit shall be designed to conform to Table 1607.1 based on the function within the space. The nonresidential portion of the unit shall be designed for a live load of not less than 50 psf.

**419.7 Accessibility.** Accessibility shall be designed in accordance with Chapter 11 for the function served.

**Interpretation I419.7:** Accessibility provisions for Group M occupancies shall be applied unless the applicant specifies another occupancy.

**419.8 Ventilation.** The applicable ventilation requirements of the International Mechanical Code shall apply to each area within the live/work unit for the function within that space.

**419.9 Plumbing facilities.** The nonresidential area of the *live/work unit* shall be provided with minimum plumbing facilities as specified by Chapter 29, based on the function of the nonresidential area. Where the nonresidential area of the *live/work unit* is required to be *accessible* by Section 1103.2.13, the plumbing fixtures specified by Chapter 29 shall be *accessible*.

## SECTION 420 GROUPS I-1, R-1, R-2, R-3

**Note:** Seattle Electrical Code 625.27 requires that, in residential occupancies, a location be designated for future installation of a panelboard for electric vehicle charging systems with working clearances.

**420.1 General.** Occupancies in Groups I-1, R-1, R-2 and R-3 shall comply with the provisions of Sections 420.1 through 420.5 and other applicable provisions of this code.

**420.2 Separation walls.** Walls separating *dwelling units* in the same building, walls separating *sleeping units* in the same building and walls separating *dwelling* or *sleeping units* from other occupancies contiguous to them in the same building shall be constructed as *fire partitions* in accordance with Section 708.

**Interpretation I420:** Separation provisions of Section 508 apply in addition to the separation requirements of Section 420.

**420.3 Horizontal separation.** Floor assemblies separating *dwelling units* in the same buildings, floor assemblies separating *sleeping units* in the same building and floor assemblies separating *dwelling* or *sleeping units* from other occupancies contiguous to them in the same building shall be constructed as *horizontal assemblies* in accordance with Section 711.

**[F] 420.4 Automatic sprinkler system.** Group R occupancies shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.2.8. Group I-1 occupancies shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.2.6. Quick-response or residential automatic sprinklers shall be installed in accordance with Section 903.3.2.

**[F] 420.5 Smoke detection and fire alarm systems.** *Fire alarm* systems and *smoke alarms* shall be provided in Group I-1, R-1 and R-2 occupancies in accordance with Sections 907.2.6, 907.2.8 and 907.2.9, respectively. Single- or multiple-station *smoke alarms* shall be in accordance with Section 907.2.11.

**420.6 Roof-ceiling soffits.** Roof-ceiling soffits in *dwelling units* and *sleeping units* shall be provided with a minimum of  $\frac{1}{2}$ -inch (13 mm) gypsum wallboard in buildings of Types IIB, IIIB and VB construction.

**[W] 420.7 Subdivision of building spaces--smoke barriers.** Smoke barriers complying with Section 709 shall be installed on all floors of Group R-2 boarding homes or residential treatment facilities licensed by Washington state. The smoke barrier shall subdivide the floor into at least two compartments complying with Section 407.5.

**[W] 420.8 Adult family homes.** This section shall apply to all newly constructed *adult family homes* and all existing single-family homes being converted to *adult family homes*. This section shall not apply to those *adult family homes* licensed by the state of Washington Department of Social and Health Services prior to July 1, 2001.

**420.8.1 Submittal standards.** In addition to the requirements of Section 106, the submittal shall identify the project as a Group R-3 *adult family home*. A floor plan shall be submitted identifying the means of egress and the components in the means of egress such as stairs, ramps, platform lifts and elevators. The plans shall indicate the rooms used for clients and the sleeping room classification of each room.

**420.8.2 Sleeping room classification.** Each sleeping room in an *adult family home* shall be classified as one of the following:

1. Type S - Where the means of egress contains stairs, elevators or platform lifts.
2. Type NS1 - Where one means of egress is at grade level or a ramp constructed in accordance with Section 420.8.8 is provided.
3. Type NS2 - Where two means of egress are at grade level or ramps constructed in accordance with Section 420.8.8 are provided.

**420.8.3 Types of locking devices and door activation.** All bedrooms and bathroom doors shall be openable from the outside when locked. Every closet door shall be readily openable from the inside. Operable parts of door handles, pulls, latches, locks and other devices installed in *adult family homes* shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Pocket doors shall have graspable hardware available when in the closed or open position.

The force required to activate operable parts shall be 5.0 pounds (22.2 N) maximum. Required *exit* door(s) shall have no additional locking devices. Required *exit* door hardware shall unlock inside and outside mechanisms when exiting the building allowing reentry into the *adult family home* without the use of a key, tool or special knowledge.

**420.8.4 Smoke and carbon monoxide alarm requirements.** All *adult family homes* shall be equipped with smoke and carbon monoxide alarms installed as required in Section 908.7. Alarms shall be installed in such a manner so that the detection device warning is audible from all areas of the *dwelling* upon activation of a single alarm.

**420.8.5 Escape windows and doors.** Every sleeping room shall be provided with emergency escape and rescue windows as required by Section 1029. No alternatives to the sill height such as steps, raised platforms or other devices placed by the openings will be *approved* as meeting this requirement.

**420.8.6 Fire apparatus access roads and water supply for fire protection.** *Adult family homes* shall be served by fire apparatus access roads and water supplies in accordance with the *International Fire Code*.

**420.8.7 Grab bar general requirements.** Where facilities are designated for use by *adult family home* clients, grab bars for water closets, bathtubs and shower stalls shall be installed according to this section.

**420.8.7.1 Grab bar cross section.** Grab bars with a circular cross section shall have an outside diameter of  $1\frac{1}{4}$  inches minimum and 2 inches maximum. Grab bars with noncircular cross section shall have a cross section dimension of 2 inches maximum and a perimeter dimension of 4 inches minimum and  $4\frac{2}{3}$  inches maximum.

**420.8.7.2 Grab bar installation.** Grab bars shall have a spacing of  $1\frac{1}{2}$  inches between the wall and the bar. Projecting objects, control valves and bathtub or shower stall enclosure features above, below and at the ends of the grab bar shall have a clear space of  $1\frac{1}{2}$  inches to the grab bar.

**Exception:** Swing-up grab bars shall not be required to meet the  $1\frac{1}{2}$  inch spacing requirement.

Grab bars shall have a structural strength of 250 pounds applied at any point on the grab bar, fastener, mounting device or supporting structural member. Grab bars shall not be supported directly by any residential grade fiberglass bathing or showering unit. Acrylic bars found in bathing units shall be removed. Fixed position grab bars, when mounted, shall not rotate, spin or move and shall have a graspable surface finish.

**420.8.7.3 Grab bars at water closets.** Water closets shall have grab bars mounted on both sides. Grab bars can be a combination of fixed position and swing-up bars. Grab bars shall meet the requirements of Section 420.8.7. Grab bars shall mount between 33 inches and 36 inches above floor grade. Centerline distance between grab bars, regardless of type used, shall be between 25 inches minimum and 30 inches maximum.

**420.8.7.3.1 Fixed position grab bars.** Fixed position grab bars shall be a minimum of 36 inches in length and shall start 12 inches from the rear wall.

**420.8.7.3.2 Swing-up grab bars.** Swing-up grab bars shall be a minimum of 28 inches in length from the rear wall.

**420.8.7.4 Grab bars at bathtubs.** Horizontal and vertical grab bars shall meet the requirements of Section 420.8.7.

**420.8.7.4.1 Vertical grab bars.** Vertical grab bars shall be a minimum of 18 inches long and shall be

installed at the control end wall and head end wall. Grab bars shall mount within 4 inches of the exterior of the bath tub edge or within 4 inches within the bath tub. The bottom end of the bar shall start between 36 inches and 42 inches above floor grade.

**Exception:** The required vertical grab bar can be substituted with a floor to ceiling grab bar meeting the requirements of Section 420.8.7 at the control end and head end entry points.

**420.8.7.4.2 Horizontal grab bars.** Horizontal grab bars shall be provided at the control end, head end, and the back wall within the bathtub area. Grab bars shall be mounted between 33 inches and 36 inches above floor grade. Control end and head end grab bars shall be a minimum of 24 inches in length. Back wall grab bars shall be a minimum of 36 inches in length.

**420.8.7.5 Grab bars at shower stalls.** Where shower stalls are provided to meet the requirements for bathing facilities, grab bars shall meet the requirements of Section 420.8.7.

**Exception:** Shower stalls with permanent built-in seats are not required to have vertical or horizontal grab bars at the seat end wall. A vertical floor to ceiling grab bar shall be installed within 4 inches of the exterior of the shower aligned with the nose of the built-in seat.

**420.8.7.5.1 Vertical grab bars.** Vertical grab bars shall be a minimum of 18 inches in length and shall be installed at the control end wall and head end wall. Vertical bars shall be mounted within 4 inches of the exterior of the shower stall or within 4 inches of the inside of the shower stall. The bottom end of vertical bars shall be mounted between 36 inches and 42 inches above floor grade.

**420.8.7.5.2 Horizontal grab bars.** Horizontal grab bars shall be installed on all sides of the shower stall mounted between 33 inches and 36 inches above the floor grade. Horizontal grab bars shall be a maximum of 6 inches from adjacent walls. Horizontal grab bars shall not interfere with shower control valves.

**420.8.8 Ramps.** All interior and exterior ramps, when provided, shall be constructed in accordance with Section 1010 with a maximum slope of 1 vertical to 12 horizontal.

**Exception:** Where it is technically infeasible to comply with Section 1010, ramps in existing buildings being converted to use as *adult family homes* shall be permitted to comply with the following:

1. They shall have a maximum slope of 1 unit vertical in 12 units horizontal (8 percent slope).
2. Landings of at least 3 feet by 3 feet (914 mm by 914 mm) shall be provided at the top and bottom of the ramp, where doors open onto the ramp, and where the ramp changes direction.

**420.8.8.1 Handrails for ramps.** Handrails shall be provided for ramps in accordance with Section 1010.9.

**Exception:** Where it is technically infeasible to comply with Section 1010.9, ramps in existing buildings being converted to use as *adult family homes* are permitted to comply with the following:

1. Handrails shall be installed on both sides of ramps with a rise of more than 6 inches and a slope between 1 vertical to 12 horizontal and 1 vertical and 20 horizontal.
2. Handrail height, measured above the finished surface of the ramp slope, shall be not less than 34 inches (864 mm) and not more than 38 inches (965 mm).
3. Handrails shall comply with Section 1012.3.
4. Handrails where required on ramps shall be continuous for the full length of the ramp. Handrail ends shall be returned or shall terminate in newel posts or safety terminals. Handrails adjacent to a wall shall have a space of not less than  $1\frac{1}{2}$  inches (38 mm) between the wall and the handrails.

**420.8.9 Stair treads and risers.** Stair treads and risers shall be constructed in accordance with Section 1009.

**Exception:** Where it is technically infeasible to comply with Section 1009, stair treads and risers in existing buildings being converted to use as *adult family homes* shall be permitted to comply with the following:

1. The maximum riser height shall be  $7\frac{3}{4}$  inches (196 mm). The riser shall be measured vertically between leading edges of the adjacent treads. The greatest riser height within any flight of stairs shall not exceed the smallest by more than  $\frac{3}{8}$  inch (9.5 mm). Risers shall be vertical or sloped from the underside of the nosing of the tread above at an angle not more than 30 degrees (0.51 rad) from the vertical. Open risers are permitted provided that the opening between treads does not permit the passage of a 4-inch-diameter (102 mm) sphere. The opening between adjacent treads is not limited on stairs with a total rise of 30 inches (762 mm) or less.
2. The minimum tread depth shall be 10 inches (254 mm). The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than  $\frac{3}{8}$  inch (9.5 mm).
3. Winder treads shall have a minimum tread depth of 10 inches (254 mm) measured between the vertical planes of the foremost projection of adjacent treads at the intersections with the walkline. Winder treads shall have a minimum tread depth of 6 inches (152 mm) at any point within the clear

width of the stair. Within any flight of stairs, the largest winder tread depth at the walkline shall not exceed the smallest winder tread by more than  $\frac{3}{8}$  inch (9.5 mm). Consistently shaped winders at the walkline shall be allowed within the same flight of stairs as rectangular treads and do not have to be within  $\frac{3}{8}$  inch (9.5 mm) of the rectangular tread depth.

4. The radius of curvature at the nosing shall be no greater than  $\frac{9}{16}$  inch (14 mm). A nosing not less than  $\frac{3}{4}$  inch (19 mm) but not more than  $1\frac{1}{4}$  inches (32 mm) shall be provided on stairways with solid risers. The greatest nosing projection shall not exceed the smallest nosing projection by more than  $\frac{3}{8}$  inch (9.5 mm) between two stories, including the nosing at the level of floors and landings. Beveling of nosings shall not exceed  $\frac{1}{2}$  inch (12.7 mm). A nosing is not required where the tread depth is a minimum of 11 inches (279 mm).

**420.8.9.1 Handrails for treads and risers.** Handrails shall be installed on both sides of treads and risers numbering from one riser to multiple risers. Handrails shall comply with Section 1009.15.

**420.8.10 Shower stalls.** Where provided to meet the requirements for bathing facilities, the minimum size of shower stalls for an *adult family home* shall be 30 inches deep by 48 inches long.

## 420.9 Security from criminal activity in Group R.

**420.9.1 Group R occupancies other than one- and two-family dwellings.** All housing units except one- and two-family *dwellings* shall comply with Section 420.9.1.

**420.9.1.1 Definition.** For the purposes of this section, "housing unit" is any *dwelling unit* or guest room.

**420.9.1.2 Building entrance doors and locks.** Building entrance doors shall be without openings and shall be as capable of resisting forcible entry as a flush solid core wood door  $1\frac{3}{8}$  inches (35 mm) thick.

### Exceptions:

1. Building entrance doors are permitted to have visitor-observation ports that do not impair the fire resistance of the door.
2. Main entrance doors are permitted to be framed or unframed non-shattering glass, framed  $\frac{1}{4}$ -inch (6 mm) plate glass or other security glazing.
3. Building entrance doors other than main entrance doors are permitted to have glazed openings. Glazed openings shall have wire, grilles or security glazing to prevent operation of the door latch from outside by hand or instrument.

Building entrance doors shall be self-closing, self-locking and equipped with a dead-locking latch bolt



with at least a  $\frac{1}{2}$ -inch (13 mm) throw that shall penetrate the striker at least  $\frac{1}{4}$  inch (6 mm).

**Exceptions:**

1. Building entrance doors that open directly into a housing unit shall comply with Section 420.9.1.4.
2. Garage-to-building doors need not be self-locking when the garage-to-exterior door is equipped with an electrically-operated remote control device for opening and automatically closing.
3. When either the garage-to-exterior doors or garage-to-building doors are equipped for self-closing and self-locking, the other need not be so equipped.

**420.9.1.3 Locks.** All *exit* doors, including those from individual housing units, shall be openable from the interior without use of keys or special knowledge or effort.

**420.9.1.4 Housing unit doors and locks.** Doors from interior corridors to individual housing units shall not have glass openings and shall be as capable of resisting forcible entry as a flush solid core wood door  $1\frac{3}{8}$  (35 mm) inches thick.

Every entrance door to a housing unit shall have a dead bolt or dead-locking latch bolt with at least a  $\frac{1}{2}$ -inch (13 mm) throw that penetrates the striker not less than  $\frac{1}{4}$  inch (6 mm). In hotels and other multi-unit buildings that provide housing for rent on a daily or weekly basis, every entrance door to a housing unit shall also be provided with a chain door guard or barrel bolt on the inside.

**420.9.1.5 Observation ports.** Every entrance door to a housing unit, other than transparent doors, shall have a visitor-observation port. The port shall not impair the fire resistance of the door. Observation ports shall be installed not less than 54 inches (1372 mm) and not more than 66 inches (1676 mm) above the floor.

**420.9.1.6 Non-exit doors.** Doors to storage, maintenance and building service rooms shall be self-closing and self-locking.

**420.9.1.7 Sliding doors.** Dead bolts or other *approved* locking devices shall be provided on all sliding doors. These locks shall be installed so that the mounting screws for the lock cases are inaccessible from the outside.

**420.9.1.8 Windows.** Openable windows shall have operable inside latching devices.

**Exception:** Windows with sills located 10 feet (3048 mm) or more above grade, or 10 feet (3048 mm) or more above a deck, balcony or porch that is not readily accessible from grade except through a housing unit need not have operable inside latching devices.

**420.9.2 One- and two-family dwellings.** One- and two-family dwellings shall comply with Section 420.9.2.

**420.9.2.1 Building entrance locks.** Building entrance doors, including garage doors, shall be capable of locking. They shall be equipped with a dead-locking latch bolt with at least a  $\frac{1}{2}$ -inch (13 mm) throw that penetrates the striker not less than  $\frac{1}{4}$  inch (6 mm). Building entrance doors shall be openable from the inside without use of a key or special knowledge or effort.

**Exception:** Garage-to-exterior doors are permitted to be equipped with an electronically-operated remote control device for opening and closing in lieu of a dead-locking latch bolt. When garage-to-exterior doors are equipped with remote control devices, garage-to-building doors need not be capable of locking.

**420.9.2.2 Observation ports.** Every building entrance door, other than garage doors, shall have a visitor observation port or glass side light. Observation ports shall be installed at a height of not less than 54 inches (1372 mm) and not more than 66 inches (1676 mm) from the floor.

**420.9.2.3 Windows and sliding doors.** Dead bolts or other *approved* locking devices shall be provided on all sliding doors and openable windows. The lock shall be installed so that the mounting screws for the lock case are inaccessible from the outside.

**Exception:** Windows with sills located 10 feet (3048 mm) or more above grade, or 10 feet (3048 mm) or more above a deck, balcony or porch that is not readily accessible from grade except through a housing unit need not have operable inside latching devices.

**420.9.3 Alternate security devices.** Subject to the approval of the *building official*, alternate security devices are permitted to be substituted for those required by this Section 420.9. Alternate devices shall have equal capability to resist illegal entry. The installation of the device must not conflict with other requirements of this code and other ordinances regulating the safety of exiting.

## SECTION 421 HYDROGEN CUTOFF ROOMS

[F] **421.1 General.** Where required by the *International Fire Code*, hydrogen cutoff rooms shall be designed and constructed in accordance with Sections 421.1 through 421.8.

[F] **421.2 Definitions.** The following terms are defined in Chapter 2:

**GASEOUS HYDROGEN SYSTEM.**

**HYDROGEN CUTOFF ROOM.**

[F] **421.3 Location.** Hydrogen cutoff rooms shall not be located below grade.

[F] **421.4 Design and construction.** Hydrogen cutoff rooms shall be classified with respect to occupancy in accordance with Section 302.1 and separated from other areas of the building by not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* con-

structed in accordance with Section 711, or both; or as required by Section 508.2, 508.3 or 508.4, as applicable.

**[F] 421.4.1 Opening protectives.** Doors within the *fire barriers*, including doors to *corridors*, shall be *self-closing* in accordance with Section 716. Interior door openings shall be electronically interlocked to prevent operation of the hydrogen system when doors are opened or ajar or the room shall be provided with a mechanical exhaust *ventilation* system designed in accordance with Section 421.4.1.1.

**[F] 421.4.1.1 Ventilation alternative.** Where an exhaust system is used in lieu of the interlock system required by Section 421.4.1, exhaust *ventilation* systems shall operate continuously and shall be designed to operate at a negative pressure in relation to the surrounding area. The average velocity of *ventilation* at the face of the door opening with the door in the fully open position shall not be less than 60 feet per minute (0.3048 m/s) and not less than 45 feet per minute (0.2287 m/s) at any point in the door opening.

**[F] 421.4.2 Windows.** Operable windows in interior walls shall not be permitted. Fixed windows shall be permitted where in accordance with Section 716.

**[F] 421.5 Ventilation.** Cutoff rooms shall be provided with mechanical *ventilation* in accordance with the applicable provisions for repair garages in Chapter 5 of the *International Mechanical Code*.

**[F] 421.6 Gas detection system.** Hydrogen cutoff rooms shall be provided with an *approved* flammable gas detection system in accordance with Sections 421.6.1 through 421.6.3.

**[F] 421.6.1 System design.** The flammable gas detection system shall be *listed* for use with hydrogen and any other flammable gases used in the room. The gas detection system shall be designed to activate when the level of flammable gas exceeds 25 percent of the lower flammability limit (LFL) for the gas or mixtures present at their anticipated temperature and pressure.

**[F] 421.6.2 Operation.** Activation of the gas detection system shall result in all of the following:

1. Initiation of distinct audible and visual alarm signals both inside and outside of the cutoff room.
2. Activation of the mechanical *ventilation* system.

**[F] 421.6.3 Failure of the gas detection system.** Failure of the gas detection system shall result in activation of the mechanical *ventilation* system, cessation of hydrogen generation and the sounding of a trouble signal in an *approved* location.

**[F] 421.7 Explosion control.** Explosion control shall be provided in accordance with Chapter 9 of the *International Fire Code*.

**[F] 421.8 Legally required standby ((Standby)) power.** Mechanical *ventilation* and gas detection systems shall be connected to a legally required standby power system in accordance with Chapter 27.

## SECTION 422 AMBULATORY CARE FACILITIES

**422.1 General.** Occupancies classified as *ambulatory care facilities* shall comply with the provisions of Sections 422.1 through 422.7 and other applicable provisions of this code.

**422.2 Separation.** *Ambulatory care facilities* where the potential for four or more care recipients are to be *incapable of self-preservation* at any time, whether rendered incapable by staff or staff accepted responsibility for a care recipient already incapable, shall be separated from adjacent spaces, *corridors* or tenants with a *fire partition* installed in accordance with Section 708.

**422.3 Smoke compartments.** Where the aggregate area of one or more *ambulatory care facilities* is greater than 10,000 square feet (929 m<sup>2</sup>) on one *story*, the *story* shall be provided with a *smoke barrier* to subdivide the *story* into no fewer than two *smoke compartments*. The area of any one such *smoke compartment* shall be not greater than 22,500 square feet (2092 m<sup>2</sup>). The travel distance from any point in a *smoke compartment* to a *smoke barrier* door shall be not greater than 200 feet (60 960 mm). The *smoke barrier* shall be installed in accordance with Section 709 with the exception that *smoke barriers* shall be continuous from outside wall to an outside wall, a floor to a floor, or from a *smoke barrier* to a *smoke barrier* or a combination thereof.

**422.4 Refuge area.** Not less than 30 net square feet (2.8 m<sup>2</sup>) for each nonambulatory care recipient shall be provided within the aggregate area of *corridors*, care recipient rooms, treatment rooms, lounge or dining areas and other low-hazard areas within each *smoke compartment*. Each occupant of an *ambulatory care facility* shall be provided with access to a refuge area without passing through or utilizing adjacent tenant spaces.

**422.5 Independent egress.** A *means of egress* shall be provided from each *smoke compartment* created by smoke barriers without having to return through the *smoke compartment* from which *means of egress* originated.

**[F] 422.6 Automatic sprinkler systems.** *Automatic sprinkler systems* shall be provided for *ambulatory care facilities* in accordance with Section 903.2.2.

**[F] 422.7 Fire alarm systems.** A *fire alarm system* shall be provided for *ambulatory care facilities* in accordance with Section 907.2.2.

## SECTION 423 STORM SHELTERS

**423.1 General.** In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC-500.

**423.1.1 Scope.** This section applies to the construction of storm shelters constructed as separate detached buildings or constructed as safe rooms within buildings for the purpose of providing safe refuge from storms that produce high winds, such as tornados and hurricanes. Such structures shall be designated to be hurricane shelters, tornado shelters, or combined hurricane and tornado shelters.

**423.2 Definitions.** The following terms are defined in Chapter 2:

**STORM SHELTER.**

**Community storm shelter.**

**Residential storm shelter.**

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**SECTION 424  
CHILDREN'S PLAY STRUCTURES**

**424.1 Children's play structures.** Children's play structures installed inside all occupancies covered by this code that exceed 10 feet (3048 mm) in height and 150 square feet (14 m<sup>2</sup>) in area shall comply with Sections 424.2 through 424.5.

**424.2 Materials.** Children's play structures shall be constructed of noncombustible materials or of combustible materials that comply with the following:

1. *Fire-retardant-treated* wood complying with Section 2303.2.
2. Light-transmitting plastics complying with Section 2606.
3. Foam plastics (including the pipe foam used in soft-contained play equipment structures) having a maximum heat-release rate not greater than 100 kilowatts when tested in accordance with UL 1975 or when tested in accordance with NFPA 289, using the 20 kW ignition source.
4. Aluminum composite material (ACM) meeting the requirements of Class A *interior finish* in accordance with Chapter 8 when tested as an assembly in the maximum thickness intended for use.
5. Textiles and films complying with the flame propagation performance criteria contained in NFPA 701.
6. Plastic materials used to construct rigid components of soft-contained play equipment structures (such as tubes, windows, panels, junction boxes, pipes, slides and decks) exhibiting a peak rate of heat release not exceeding 400 kW/m<sup>2</sup> when tested in accordance with ASTM E 1354 at an incident heat flux of 50 kW/m<sup>2</sup> in the horizontal orientation at a thickness of 6 mm.
7. Ball pool balls, used in soft-contained play equipment structures, having a maximum heat-release rate not greater than 100 kilowatts when tested in accordance with UL 1975 or when tested in accordance with NFPA 289, using the 20 kW ignition source. The minimum specimen test size shall be 36 inches by 36 inches (914 mm by 914 mm) by an average of 21 inches (533 mm) deep, and the balls shall be held in a box constructed of galvanized steel poultry netting wire mesh.
8. Foam plastics shall be covered by a fabric, coating or film meeting the flame propagation performance criteria of NFPA 701.
9. The floor covering placed under the children's play structure shall exhibit a Class I interior floor finish clas-

sification, as described in Section 804, when tested in accordance with NFPA 253.

**[F] 424.3 Fire protection.** Children's play structures shall be provided with the same level of *approved* fire suppression and detection devices required for other structures in the same occupancy.

**424.4 Separation.** Children's play structures shall have a horizontal separation from building walls, partitions and from elements of the *means of egress* of not less than 5 feet (1524 mm). Children's playground structures shall have a horizontal separation from other children's play structures of not less than 20 feet (6090 mm).

**424.5 Area limits.** Children's play structures shall be not greater than 300 square feet (28 m<sup>2</sup>) in area, unless a special investigation, acceptable to the building official, has demonstrated adequate fire safety.

**SECTION 425  
WATERFRONT STRUCTURES:  
PIERS, WHARVES AND BUILDINGS**

**425.1 Scope.** Structures with at least 20 percent or 8,000 square feet (743 m<sup>2</sup>), whichever is greater, of their area over water shall comply with Section 425. They shall also comply with all other requirements of this code unless otherwise specified in Section 425. Unless otherwise specified, all wood dimensions are nominal size as defined in Section 202.

**Exceptions:**

1. Fire-resistance-rated walls specified in Section 425.7.6 are permitted to be used as one-hour fire-resistance-rated fire barriers and as a separation between repair garages not classified as Group S-1 and occupancies in Group A, including the specified opening protection in buildings of Types IIB, IV and VB construction.
2. Structures accessory to Group R-3 occupancies.
3. Floating homes that comply with the Seattle Residential Code.

See Chapter 36 of the *Fire Code* for additional requirements for fire protection systems for marinas.

**425.2 Definitions.** The following terms are defined in Chapter 2:

**COVERED BOAT MOORAGE.**

**PIER.**

**SUBSTRUCTURE.**

**SUPERSTRUCTURE.**

**WHARF.**

**425.3 Allowable area and height for waterfront structures.** The height of structures to be built over water shall be measured as provided in Title 23 of the Seattle Municipal Code, Sections 23.60.952 and 23.60.930 for Shoreline Districts. Height and area shall comply with the requirements of

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Table 503, except that the increases allowed in Section 507 are not applicable to waterfront structures.

**Exceptions:**

1. In covered boat moorages, the areas in Table 503 are permitted to be increased not more than 400 percent when an approved automatic sprinkler system is provided throughout.
2. Each covered area of a boat moorage is permitted to be considered a separate building subject to the following conditions:
  - 2.1. Maximum individual areas shall be 8,000 square feet (743 m<sup>2</sup>). The maximum width of connecting walkways shall be 10 feet (3048 mm).
  - 2.2. Walkways, finger piers and other decked areas shall not exceed 30 percent of the area of the roof that extends over water.
  - 2.3. Covered areas shall be separated by not less than 16 feet (4877 mm). The intervening areas are permitted to be used for moorage provided the adjacent covered areas comply with Item 2.4 below.
  - 2.4. Covered roof areas constructed in a manner that would trap smoke or hot gases shall be provided with the following:
    - 2.4.1. Vents or monitors of not less than 5 percent of the roof area.
    - 2.4.2. A draft stop of splined or tongue-and-groove planking not less than 1 inch (25 mm) in thickness, 1/2-inch (13 mm) exterior-type plywood or 26 gauge steel shall extend across the end of each roof area when the roof is closer than 30 feet (9144 mm) to an adjacent building. The draft stop shall extend to not less than 24 inches (610 mm) below the lower edge of the roof. A draft stop constructed in accordance with Section 421.5 shall be provided under the walkway at each location where draft stops are required at the end of roofed areas.

**425.4 Accessory uses.** Uses accessory to the principal occupancy shall be permitted, provided they are conducted in an area separated from the moorage area by not less than 16 feet (4877 mm) and the exposed side of the moorage area is protected by a one-hour fire-resistance-rated fire barrier extending 2 1/2 feet (762 mm) above the roof line. One-story superstructures shall be permitted for accessory uses but shall not exceed 1,000 square feet (93 m<sup>2</sup>) in area nor 20 feet (6096 mm) in height.

**Exception:** Storage is allowed in the moorage area, provided it conforms to the following:

1. One unprotected moorage equipment locker of not more than 150 cubic feet (115 m<sup>3</sup>) is permitted for each slip.

2. Where groups of three or more lockers are provided, they shall be separated from each other with one-hour fire-resistance-rated fire partitions, and openings in the separation shall have one-hour protection.
3. Storage of flammable liquids shall be in accordance with NFPA 31 and the Fire Code.

**425.5 Location on property.** Exterior walls shall have fire resistance and opening protection as determined by Section 705.

**Exceptions:**

1. Fire resistance-rated construction and opening protection required because of proximity to property lines are permitted to be omitted for waterfront structures that are located on the same property, separated by an unobstructed deck not less than 16 feet (4877 mm) wide, and have a draft stop constructed according to Section 425.6.2 installed in the substructure between the buildings.
2. In covered boat moorages, exterior walls that are built entirely over water are permitted to be of tongue-and-groove or splined planks not less than 2 inches (51 mm) in thickness, covered with 26 gauge sheet metal, 3/8-inch (9.5 mm) exterior type plywood or equivalent on both sides, regardless of proximity to property lines. Walls at the substructure are permitted to be constructed as specified in Section 425.6.2 for draft stops. Where such walls (even though part of such covered boat moorage) are built on land, this exception shall not apply.

**425.6 Substructure.**

**425.6.1 Construction.** Substructures are permitted to be of any type of construction permitted in this code subject to the area limitations of Section 425.3, except that, when constructed of wood, the members shall not be less than the following in any dimension, exclusive of piling:

MEMBER	SIZE UNLIMITED USE × 25.4 FOR mm	PIERS FOR BOAT MOORAGE ONLY, NOT EXCEEDING 10 FEET (3048 mm) IN WIDTH × 25.4 FOR mm
Caps and girders	8"	6"
Joists, beams and other members	4"	3"
Flooring or deck	3" T & G or splined or 4" square edged	2"
Bracing	3"	2"

For SI: 1 inch = 25.4 mm

**Note:** If the flooring or deck is under a roof or is used for parking, there shall be applied over the flooring or deck a tight-fitting wearing surface of softwood not less than 2 inches (51 mm) thick and not more than 6 inches (152 mm) wide, 1-inch (25 mm) thick hardwood, 2-inch (51 mm) thick asphaltic concrete or other material of equivalent fire resistance.

**Exception:** Covered piers used for moorage only need not have a wearing surface.

**425.6.2 Draft stops.** Draft stops shall be installed in all substructures constructed of combustible materials, exclu-

sive of piling and pile bracing. They shall be placed not more than 100 feet (2540 mm) apart measured along the main axis of the *pier* or *wharf*. They shall fit tightly around all joists, beams, etc., and extend from the underside of the deck to city datum if over salt water or to low water if over fresh water. See Section 425.7.7 for draft stops in *superstructures*.

*Substructure* draft stops shall be constructed of at least two layers of lumber not less than 2 inches (51 mm) in thickness laid with broken joints or materials of equal fire resistance.

#### 425.7 Superstructure.

**425.7.1 Construction.** *Superstructures* are permitted to be of any type of construction permitted by this code subject to the height and area limitations of Section 425.3 and the requirements of this section.

**425.7.2 Floors.** See Section 425.6.

**425.7.3 Exterior walls.** Exterior walls of Types IIA, IIB, III, IV and V buildings, when not subject to the requirements of Section 425.5 because of their proximity to property lines, are permitted to be constructed of matched or lapped lumber not less than 2 inches (51 mm) thick and not more than 6 inches (153 mm) wide, or not less than 1 inch (25 mm) thick with a weather covering of noncombustible material applied directly to the wood. Fireblocking is an assembly having a three-fourths-hour fire-protection rating when fire-resistive openings are required by Table 705.8 and 1027.

**425.7.4 Roof coverings.** Roof coverings shall be fire-retardant as specified in Chapter 15.

**425.7.5 Roof construction.** In Type IV buildings the roof is permitted to be constructed of corrugated galvanized steel attached directly to wood or steel purlins in lieu of that specified in Section 602.4.

**425.7.6 Fire-resistance-rated walls.** In Types IIA, IIB, III, IV and V buildings, there shall be at least one fire-resistance-rated wall from the deck to at least 3 feet (914 mm) above the roof for each 500 feet (152 m) of length. Areas greater than 100,000 square feet (9290 m<sup>2</sup>) shall be divided with such fire-resistance-rated walls. There shall be a draft stop constructed as specified in Section 425.6.2, installed in the *substructure* immediately below every required fire-resistance-rated wall when the deck is of combustible materials.

Fire-resistance-rated walls shall be constructed as required for two-hour fire-resistance-rated walls or are permitted to consist of at least two layers of tongue-and-groove or splined lumber, not less than 2 inches (51 mm) thick and not more than 6 inches (153 mm) wide, with a sheet of not less than No. 26 gauge galvanized steel or  $\frac{3}{8}$ -inch (3.2 mm) exterior type plywood between the two layers, placed vertically with broken joints, or equivalent fire-resistive construction.

Openings in fire-resistance-rated walls shall be protected by opening protectives having a one and one-half hour fire protection rating.

**425.7.7 Draft stops.** *Superstructure* draft stops shall be installed as specified in Section 718. *Substructure* draft stops constructed as specified in Section 425.6.2 shall be installed in line with the *superstructure* draft stops above. See Section 425.12 for draft curtain requirements.

**425.7.8 Means of egress.** Means of egress shall be provided as specified in Chapter 10.

#### Exceptions:

1. Where two means of egress are required from an occupancy, they shall not terminate on the same open deck.
2. An open deck is permitted to be considered an exit court and shall not be less than 10 feet (3048 mm) in width.
3. In Group A occupancies, the maximum travel distance shall not be more than 75 percent of that specified in Section 1016.
4. Boat moorages that have no sales, service or repair facilities are permitted to have a single means of egress not less than 3 feet (914 mm) wide and shall be exempt from the requirements of Section 1016 if a Class I standpipe is provided as specified in Section 425.9.

**425.8 Width of piers.** Floats, *piers* and walkways shall provide an aisle not less than 3 feet 6 inches (1067 mm) in width for the purpose of fire department access.

**Exception:** Floats, *piers* and walkways that are less than 40 feet (12 192 mm) in length and that are not open to the public.

**425.9 Standpipe systems.** A manual Class I standpipe system (or Class III standpipe system when *approved* by the fire code official) in accordance with NFPA Standard 14 shall be provided for *piers*, wharves, and floats where the hose lay distance from the fire apparatus to the most remote accessible portion of the *pier*, *wharf* or float exceeds 150 feet (45 720 mm). *Approved* plastic pipe may be used when installed underwater, or other *approved* method of protection from fire is provided. The standpipe piping shall be a minimum of 4 inches (102 mm), sized to provide a minimum of 500 gpm at 130 psi at the most remote hose connection, with a simultaneous flow of 500 gpm at the third most remote hose connection on the same pier while maintaining a maximum system pressure of 175 psi. Existing standpipe systems providing equivalent performance to the specification listed above may be acceptable when *approved* by the fire code official.

**425.9.1 Hose connections.** Hose connection stations on required standpipes shall be provided at the water end of the pier, *wharf*, or float, and along the entire length of the pier, *wharf*, or float at spacing not to exceed 150 feet (45 720 mm) and as close as practical to the land end.

**Exception:** The hose connection at the land end of the pier, *wharf* or float may be omitted when a hose connection is located within 150 feet (45 720 mm) of the fire apparatus access road.

Each hose connection shall consist of a valved  $2\frac{1}{2}$ -inch (64 mm) fire department hose outlet. Outlet caps shall

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have a predrilled  $\frac{1}{8}$ -inch (3.2 mm) hole for pressure relief and be secured with a short length of chain or cable to prevent falling after removal. Listed equipment shall be used.

**425.9.2 Hose stations.** Hose stations on required standpipes shall be provided at spacing not to exceed 100 feet, with the first hose station located as close as practicable to the land end of the pier. Each hose station shall have 100 feet of  $1\frac{1}{2}$ -inch hose mounted on a reel or rack and enclosed within an *approved* cabinet. A valved  $2\frac{1}{2}$ -inch fire department hose outlet shall be provided at each hose station. Outlet caps shall have a  $\frac{1}{8}$ -inch predrilled hole for pressure relief and be secured with a short length of chain or cable to prevent falling after removal. Listed equipment shall be used. Hose stations shall be labeled FIRE HOSE-EMERGENCY USE ONLY.

**425.9.3 Freeze protection.** Standpipe systems shall be maintained dry when subject to freezing temperatures, and always from November 1 through March 31. The  $1\frac{1}{2}$ -inch hose stations shall be tagged out-of-service when the system is drained. The main water supply control valve shall be readily accessible and clearly labeled so that the system may be quickly restored to full service during periods when the system is drained down.

**Exception:** Other methods of freeze protection, such as listed freeze valves, are permitted to be provided when *approved* by the fire code official.

### 425.10 Automatic sprinklers.

**425.10.1 Covered boat moorage.** Automatic sprinklers shall be provided for covered boat moorage exceeding 500 square feet in projected roof area per pier, *wharf* or float.

The sprinkler system shall be designed and installed in accordance with NFPA 13 for Extra Hazard Group 2 occupancy.

If sprinklers are required by this section, they shall be extended to any structure on the pier, *wharf* or float exceeding 500 square feet in projected roof area.

**425.10.2 Substructure.** Automatic sprinklers shall be installed under the *substructure* of every new waterfront structure in accordance with NFPA 307 and as specified in Chapter 9.

**Exception:** Sprinklers are not required in the following locations:

1. Combustible *substructures* whose deck area does not exceed 8,000 square feet (743.2 m<sup>2</sup>) supporting no *superstructures*.
2. Combustible *substructures* whose deck area does not exceed 8,000 square feet (743.2 m<sup>2</sup>) supporting *superstructures* not required to be provided with an *approved automatic sprinkler system* as specified in Section 425.10.3.
3. Noncombustible *substructures* with or without *superstructures*.
4. *Substructures*, over other than tidal water, where sprinkler heads cannot be installed with a minimum clearance of 4 feet (1219 mm) above mean high water.

5. *Substructures* resulting from walkways or finger piers that do not exceed 10 feet (3048 mm) in width.

**425.10.3 Superstructure.** Automatic sprinklers shall be provided in *superstructures* as specified in Chapter 9.

**425.10.4 Monitoring.** Sprinkler systems shall be monitored by an *approved* central station service.

**425.11 Smoke and heat vents.** *Approved* automatic smoke and heat vents shall be provided in covered boat moorage areas exceeding 2,500 square feet (232 m<sup>2</sup>) in area, excluding roof overhangs.

**Exception:** Smoke and heat vents are not required in areas protected by automatic sprinklers.

**425.11.1 Design and installation.** Where smoke and heat vents are required they shall be installed near the roof peak, evenly distributed and arranged so that at least one vent is over each covered berth. The effective vent area shall be calculated using a ratio of one square foot of vent to every fifteen square feet of covered berth area (1:15). Each vent shall provide a minimum opening size of 4 feet by 4 feet.

**425.11.2 Automatic operation.** 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.

**425.11.3 Gravity-operated drop out vents.** Gravity operated dropout vents shall fully open within five 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 five minutes.

**425.12 Draft curtains.** Draft curtains shall be provided in covered boat moorage areas exceeding 2,500 square feet (232 m<sup>2</sup>) in area, excluding roof overhangs.

**Exception:** Draft curtains are not required in areas protected by automatic sprinklers.

**425.12.1 Draft curtain construction.** Draft curtains shall be constructed of sheet metal, gypsum board or other *approved* materials that provide equivalent performance to resist the passage of smoke. Joints and connections shall be smoke tight.

**425.12.2 Draft curtain location and depth.** The maximum area protected by draft curtains shall not exceed 2,000 square feet (186 m<sup>2</sup>) or two *slips* or berths, whichever is smaller. Draft curtains shall not extend past the piling line. Draft curtains shall have a minimum depth of 2 feet (609 mm) below the lower edge of the roof and shall not extend closer than 8 feet (2438 mm) to the walking surface on the pier.

**425.13 Fire department connections.** Standpipe and sprinkler systems shall be equipped with not less than a two-way  $2\frac{1}{2}$ -inch fire department connection, which shall be readily visible and located at the fire department apparatus access. The fire department connection for Class I standpipe systems may be located at the shore end of the pier, *wharf*, or float if the distance between the fire apparatus access road and fire department connection is less than 150 feet (45 720 mm).

See Section 507 of the *International Fire Code* for requirements for fire hydrants.

**425.14 Marina fire protection confidence testing.** Standpipe and sprinkler systems shall be inspected and tested in compliance with the *International Fire Code*.

**425.15 Fire department access.** Fire department apparatus access lanes, not less than 20 feet wide and capable of supporting a 50,000-pound vehicle or 24,000 pounds per axle (HS20 loading), shall be provided and so located as to provide fire department apparatus access to within 50 feet travel distance to the shore end of all piers, wharves and floats.

## SECTION 426

### PRIVATE AND UTILITY TRANSFORMER VAULTS

**426.1 Scope.** Vaults housing private and utility transformers shall comply with the provisions of this chapter and Article 450 of the *Seattle Electrical Code*. The provisions of this chapter are minimum standards for all transformer vaults. Vaults containing utility transformers or equipment are required to comply with additional requirements of Seattle City Light.

**426.2 Definitions.** The following terms are defined in Chapter 2:

**PRIVATE TRANSFORMER VAULT.**

**UTILITY TRANSFORMER VAULT.**

**426.3 When required.**

**426.3.1 Utility transformers.** Transformer vaults are required for all utility transformers located inside a building. Seattle City Light shall approve the size, location, and layout of all utility vaults.

**Exception:** Vaults are not required for certain dry-type transformers rated 600 volts or less.

**426.3.2 Private transformers.** Transformer vaults are required for all oil-insulated private transformers. Vaults are required for other private transformers rated over 35,000 volts that are located inside a building.

**Exception:** Vaults are not required for certain oil-insulated private transformers in accordance with Sections 450.26 and 450.27 of the *Seattle Electrical Code*.

**Note:** Article 450, Part II of the Seattle Electrical Code contains requirements for transformers not required to be in a vault.

**426.4 Access to transformer vaults.**

**426.4.1 General access.** At least one door or hatch shall be provided in every vault. The opening shall be adequate in size to permit the installation and removal of the equipment located in the vault, and shall be kept unobstructed at all times. An unobstructed level area shall be provided at the entrance to all vaults. The level area shall be large enough to allow for movement of the transformer and equipment into and out of the vault.

**426.4.2 Utility transformer vault access.** *Utility transformer vaults* shall be accessible to Seattle City Light per-

sonnel at all times. If it is necessary to pass through locked doors to reach a vault, keys to those doors shall be kept in a key box that can be opened with the key to the transformer vault. The key box shall be mounted near the first door requiring a non-transformer door key. Persons other than Seattle City Light personnel shall not have access to *utility transformer vaults* without Seattle City Light personnel present.

All doors between the vault and the building exterior shall be large enough to accommodate the placement or removal of transformers. See Section 426.7.2 for doorway requirements.

*Utility transformer vaults* shall be located so that there is an equipment access path between the vault and the building exterior. The path shall comply with the following.

1. Sufficient horizontal and vertical clearance for the required transformer shall be provided;
2. The floor shall be smooth, without seams or ridges to impede transportation of heavy equipment;
3. There shall not be excessive slope as determined by Seattle City Light; and
4. The floor shall be designed to support the weight of the transformer and all equipment needed to move the transformer.

If Seattle City Light determines that it is infeasible to design a path in the prescribed manner, the building owner shall enter into a Transportation Agreement with Seattle City Light. The Transportation Agreement obligates the building owner to transport equipment between the right of way and the transformer vault whenever the Superintendent of Seattle City Light determines it is necessary, and to pay all costs for equipment transportation.

**Note:** The Transportation Agreement is a measure of last-resort and permitted only with prior Seattle City Light approval. A viable path for equipment transportation between the right-of-way and the transformer vault should be a primary design consideration.

**426.5 Location of transformer vaults.** Transformer vaults shall be located where they can be ventilated to the outside air without using flues or ducts wherever such an arrangement is practicable. Transformer vaults shall be dry and not subject to running, standing or infiltration of water.

Transformer vaults shall not be located where they are subject to flooding due to ground water without specific written approval by Seattle City Light.

**426.6 Construction.**

**426.6.1 Private transformer vaults.** *Private transformer vaults* shall comply with the following minimum requirements.

1. All *private transformer vaults* shall be of at least three-hour fire-resistive construction.

**Exception:** Subject to the approval of the *building official*, where the total capacity of private oil-insu-

lated transformers does not exceed  $112\frac{1}{2}$  kVA, the vault is permitted to be constructed of reinforced concrete not less than 4 inches (102 mm) thick.

2. Vault floors in contact with the earth shall be of concrete not less than 4 inches thick.
3. The transformer shall be anchored to inserts embedded in the concrete floor.
4. In pre-tensioned or post-tensioned concrete, cable locations shall be permanently marked on the surface of the concrete over the encased tendons.
5. Vault dimensions shall be adequate for required ventilation and working clearances.

**426.6.2 Utility transformer vaults.** *Utility transformer vaults* shall comply with the following minimum requirements. The Superintendent of Seattle City Light is authorized to adjust the requirements of this Section 426.6.2 when deemed necessary.

1. Floors, walls and ceilings of *utility transformer vaults* shall have at least a three-hour fire-resistance rating and shall be constructed of solid concrete or concrete-filled concrete masonry units at least 6 inches (152 mm) thick.
2. Vault floors shall be smooth with no pads.
3. Seismic anchor inserts shall be embedded in the floor and steel support channels shall be embedded in the ceiling when required by the Superintendent of Seattle City Light.
4. Pre-tensioned or post-tensioned concrete shall have the cable locations permanently marked on the surface of the concrete over the encased tendons.
5. Vault dimensions shall depend upon physical size and number of secondary connection devices, working clearances, and approval by the Superintendent of Seattle City Light.

#### **426.7 Openings into transformer vaults.**

**426.7.1 Protection of openings.** All doorways opening into a transformer vault from the building interior shall be protected by opening protectives having a fire-protection rating equal to that required for the vault.

**426.7.2 Doorways.** All doors shall be made of three-hour fire-resistance-rated steel and shall swing out of the vault 180 degrees. Doors that may be prevented from swinging 180 degrees outward as a result of blockage by vehicles or mobile equipment shall be protected by bollards. The bollards shall preserve the door swing area and shall not obstruct the doorway. Equipment access doorways shall be sized to accommodate the transformer placement and removal including the equipment necessary to place or remove the transformer.

Equipment access doorways to vaults containing only single-phase utility transformers shall have clear openings no less than 42 inches (1067 mm) wide and 6 feet 8 inches (2057 mm) high. Equipment access doorways for all other utility transformers shall be sized to accommodate the

transformer placement and as specified by Seattle City Light to allow equipment installation and removal.

Doorways for personnel access shall have clear openings of at least 36 inches (914 mm) wide and 6 feet 8 inches (2057 mm) high.

**426.7.2.1 Locks.** All doors shall be equipped with locks and shall be kept locked. Doors to *utility transformer vaults* shall be equipped with a cylinder capable of accepting the core provided by the utility. Personnel doors shall be equipped with panic bars, pressure plates, or other devices that are normally latched but open under simple pressure.

**426.7.2.2 Oil containment sill.** A removable oil containment sill shall be as high as necessary to contain the oil of one transformer but in no case less than 4 inches (203 mm) high or as specified by Seattle City Light for utility transformers. A sill shall be installed within the vault at each doorway after the installation of the transformer.

#### **426.8 Ventilation systems for transformer vaults.**

**426.8.1 General.** Ventilation systems shall be provided to dispose of heat from transformer total losses without creating a temperature rise that exceeds the transformer rating.

**426.8.2 Method of ventilation.** Ventilation shall be provided by either natural circulation or mechanical circulation.

**426.8.2.1 Natural circulation.** Transformer vaults containing up to three transformers of no more than 75 kVA each are permitted to be ventilated by natural circulation. The combined minimum net intake and exhaust vent area, exclusive of area occupied by screens, grating or louvers, shall not be less than 3 square inches (1935 mm<sup>2</sup>) per kVA of transformer capacity. The total required area shall be divided roughly equally between intake and exhaust. In no case shall either the intake or exhaust area be less than 72 square inches (46 452 mm<sup>2</sup>).

Approximately one half the total area required for ventilation openings shall be for intake air. Intake air vents shall be located in one or more openings in the lower portion of the perimeter vault walls. When the vault is located in a garage, any lower openings must be at least 18 inches above the garage floor level. The remaining one half of the required ventilation area shall be used to exhaust heat through one or more openings in the upper portion of the perimeter walls or roof of the vault. Intake openings shall be located on the opposite side of the vault from exhaust openings allowing air to flow longitudinally over the transformer and out of the vault.

**426.8.2.2 Mechanical circulation.** Positive or negative pressure ventilation systems shall supply a minimum of 1.6 cfm (.76 L/s) of air per kVA of transformer capacity. The fans shall be installed outside of the vault and shall be controlled by a thermostat located inside the vault.



The intake vents shall be located in the lower one half of the perimeter walls of the vault. When the vault is located in a garage, any lower intake openings must be at least 18 inches above the garage floor level and at least 18 inches above the vault floor.

The exhaust vents shall be in the roof or ceiling of the vault. Vents are allowed to be installed in a wall if the top of the vent is not less than 12 inches below the vault ceiling. The top of the outlet on the exterior of the building shall be at least as high as the top of the outlet from the vault.

The ventilation system shall cause air to flow longitudinally across the transformers. The vault ventilation system shall be controlled independently from the rest of the building ventilation.

For utility transformer vaults, mechanical ventilation systems shall be designed by the applicant. The capacity and location of the ventilation system shall be approved by the Superintendent of Seattle City Light.

**426.8.2.3 Temperature control.** A remote temperature controller shall be installed in utility transformer vaults that have mechanical ventilation systems. The controller shall activate the fan when the temperature in the vault exceeds 70°F (21°C), and shall turn the fan off when the temperature reaches 140°F (60°C).

A visible or audible alarm shall be installed outside each utility transformer vault that will be activated if the fan does not operate when the temperature controller calls for ventilation, or if the fan becomes inoperable. A sign shall be mounted near the alarm stating CALL SEATTLE CITY LIGHT WHEN ALARM SOUNDS or CALL SEATTLE CITY LIGHT WHEN LIGHT IS ON.

**426.8.3 Ventilation openings and duct terminations.** Ventilation openings and duct terminations shall comply with International Mechanical Code Section 501.2.1 Item 7, unless otherwise approved by the building official.

**426.8.3.1 Location of exhaust ventilation openings and exhaust duct terminations.** Exhaust ventilation openings and duct terminations shall be located not less than 10 feet (3048 mm) from fire escapes, required means of egress at the exterior of the building, elements of the exit discharge, combustible exterior wall coverings, unprotected openings, operable openings and property lines other than a public way. Exhaust outlets shall be located on the exterior of the building.

**Interpretation I426.8:** For purposes of this section, “property line” includes any property line separating one lot from another lot, but does not include any property line separating a lot from a public street or alley right-of-way. The separation distance may be measured to the opposite side of public streets and alleys

**426.8.3.2 Covering.** Ventilation openings shall be covered with durable metal gratings, screens or louvers. If operable intake louvers are provided on mechanically

ventilated transformer vaults, the louvers shall be controlled by the fan thermostat, i.e., the louvers shall be opened when the fan is energized.

**426.8.3.3 Opening protection.** Intake ventilation openings in the vault walls on the interior of the building shall be protected by automatic closing fire dampers having a fire-protection rating at least equal to that required for the vault. The actuating device on the fire damper should be made to function at a temperature of 140°F (60°C).

**426.8.3.4 Ventilation ducts.** Exhaust ventilation ducts, if used, shall be enclosed in construction having a fire-resistance rating at least equal to that required for the vault. Exhaust ducts shall extend from the vault to the outside of the building. An exhaust duct for a mechanically ventilated vault shall be used exclusively for ventilating the vault. No fire dampers shall be installed in exhaust ventilation ducts.

**426.9 Drainage for vaults.**

**426.9.1 General.** Drains are prohibited in all transformer vaults.

**426.9.2 Sumps.** All transformer vaults containing oil-insulated transformers shall have a dry sump. All sumps shall have an opening of at least 6 inches (152 mm) diameter, a depth of at least 12 inches (305 mm), and shall be equipped with a removable steel grate that is flush with the floor. Sumps shall have at least an 8 gallon (30 liter) capacity. Sump capacity may be greater where required by the utility. The sump shall have a grouted bottom. The sump shall be located near, but not directly behind, the personnel door and shall be out of the entry path for moving transformers in and out of the vault. The vault floor shall slope at least 1 inch in 10 feet (25 mm in 305 mm) toward the sump.

**426.10 Pipes and ducts in transformer vaults.** No pipes or ducts foreign to the electrical installation shall enter or pass through any transformer vault. Electrical conduits terminating at transformer vaults shall be sealed with listed three-hour fire-protection rated firestop material. Electrical conduits terminating at transformer vaults shall be installed to avoid channeling water into the vault. Electrical conduits entering the vault floor shall be rigid galvanized steel and shall extend no less than 18 inches (457 mm) into the vault or to the top of the containment sill, whichever is greater.

**426.11 Storage in transformer vaults.** No material shall be stored in any transformer vault.

**426.12 Sprinkler systems.** Sprinkler systems shall not be installed within a transformer vault. The vault must be maintained in a dry condition at all times.

**[F] SECTION 427  
MEDICAL GAS SYSTEMS**

**427.1 General.** Compressed gases at hospitals and similar facilities intended for inhalation or sedation, including but not limited to, analgesia systems for dentistry, podiatry, veterinary and similar uses, shall comply with Sections 427.2

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through 427.3 in addition to other requirements of *International Fire Code* Chapter 53.

**427.2 Interior supply location.** Medical gases shall be stored in areas dedicated to the storage of such gases without other storage or uses. Where containers of medical gases in quantities greater than the permit amount are located inside buildings, they shall be in a one-hour exterior room, a one-hour interior room or a gas cabinet in accordance with Section 427.2.1, 427.2.2 or 427.2.3, respectively. Rooms or areas where medical gases are stored or used in quantities exceeding the maximum allowable quantity per control area set forth in *International Fire Code* Section 2703.1 shall comply with the requirements for Group H occupancies.

**427.2.1 One-hour exterior rooms.** A one-hour exterior room shall be a room or enclosure separated from the remainder of the building by *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both, with a *fire-resistance rating* of not less than one hour. Openings between the room or enclosure and interior spaces shall be self-closing smoke- and draft-control assemblies having a *fire protection rating* of not less than one hour. Rooms shall have at least one exterior wall that is provided with at least two vents. Each vent shall not be less than 36 square inches (0.023 m<sup>2</sup>) in area. One vent shall be within 6 inches (152 mm) of the floor and one shall be within 6 inches (152 mm) of the ceiling. Rooms shall be provided with at least one automatic sprinkler to provide container cooling in case of fire.

**427.2.2 One-hour interior room.** When an exterior wall cannot be provided for the room, automatic sprinklers shall be installed within the room. The room shall be exhausted through a duct to the exterior. Supply and exhaust ducts shall be enclosed in a one-hour-rated shaft enclosure from the room to the exterior. *Approved* mechanical ventilation shall comply with the *International Mechanical Code* and be provided at a minimum rate of 1 cubic foot per minute per square foot [0.00508 m<sup>3</sup>/(s • m<sup>2</sup>)] of the area of the room.

**427.3 Exterior supply locations.** Oxidizer medical gas systems located on the exterior of a building with quantities greater than the permit amount shall be located in accordance with *International Fire Code* Section 6304.2.1.

## [W] SECTION 428 RECYCLABLE MATERIALS

**428.1 Definition.** The following term shall, for the purposes of this section and as used elsewhere in this code, have the meaning shown herein.

**RECYCLABLE MATERIALS.** Those solid wastes that are separated for recycling or reuse, such as papers, metals and glass.

**428.2 Storage space for recyclable materials.** All occupancies shall be provided with space for the storage of *recyclable materials* and solid waste.

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

The storage area shall be designed to meet the needs of the occupancy and efficiency of pick-up and shall be available to occupants and haulers.