

## CHAPTER 4

# SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

### SECTION 401 SCOPE AND DEFINITION

**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.

**401.2 Definition—Fire District.** The Fire District consists of that part of the city within the boundary described as follows:

Beginning at the intersection of the center line of Alaskan Way and Clay Street; thence northeasterly along the center line of Clay Street to an intersection with the center line of Denny Way; thence easterly along the center line of Denny Way to an intersection with the center line of Yale Avenue; thence southeasterly along the center line of Yale Avenue to an intersection with the center line of Interstate Highway 5; thence southerly and southeasterly along the centerline of Interstate 5 to an intersection with the center line of 7th Avenue South; thence southerly along the center line of 7th Avenue South to an intersection with the center line of Dearborn Street; thence westerly along the center line of Dearborn Street to an intersection with the center line of Airport Way; thence northwesterly along the cen-

ter line of Airport Way to an intersection with the center line of 4th Avenue South; thence southerly along the center line of 4th Avenue South to an intersection with the center line of South Royal Brougham Way; thence westerly along the center line of South Royal Brougham Way to an intersection with the center line of South Alaskan Way; thence southerly along the center line of South Alaskan Way to an intersection with the center line of South Massachusetts Street, thence westerly along the center line of South Massachusetts Street to the Outer Harbor Line in Elliott Bay, thence northerly and northwesterly along the Outer Harbor Line to an intersection with the center line of West Harrison Street, thence easterly along the center line of West Harrison Street to an intersection with the center line of Alaskan Way, then southeasterly along the center line of Alaskan Way to the point of beginning.

Buildings and structures located partially within and partially outside the Fire District are considered to be located in the Fire District.

### SECTION 402 COVERED MALL BUILDINGS

**402.1 Scope.** The provisions of this section shall apply to buildings or structures defined herein as covered 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 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 when they totally comply with other applicable provisions of this code.

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

**ANCHOR BUILDING.** An exterior perimeter building of a group other than H having direct access to a covered mall building but having required means of egress independent of the mall.

**COVERED MALL BUILDING.** A single building enclosing a number of tenants and occupants such as retail stores, drinking and dining establishments, entertainment and amusement facilities, passenger transportation terminals, offices, and other similar uses wherein two or more tenants have a main entrance into one or more malls. For the purpose of this chapter, anchor buildings shall not be considered as a part of the covered mall building.

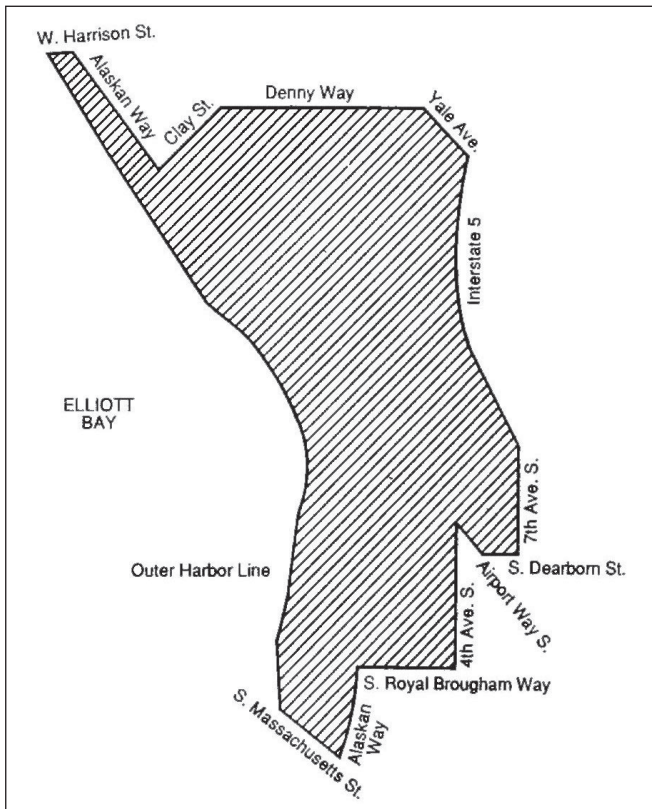


FIGURE 401.2  
CITY OF SEATTLE  
FIRE DISTRICT

**FOOD COURT.** A public seating area located in the mall that serves adjacent food preparation tenant spaces.

**GROSS LEASABLE AREA.** The total floor area designed for tenant occupancy and exclusive use. The area of tenant occupancy is measured from the centerlines of joint partitions to the outside of the tenant walls. All tenant areas, including areas used for storage, shall be included in calculating gross leasable area.

**MALL.** A roofed or covered common pedestrian area within a covered mall building that serves as access for two or more tenants and not to exceed three levels that are open to each other.

~~((402.3 Lease plan. Each covered mall building owner 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 Means of egress.** Each tenant space and the covered 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 this section, the requirements of this section shall apply.

**402.4.1 Determination of occupant load.** The occupant load permitted in any individual tenant space in a covered 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.

**402.4.1.1 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 mall building (excluding anchor buildings) and the occupant load factor as determined by the following equation.

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

where:

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

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

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

**402.4.1.3 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.

**402.4.1.4 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 mall building as calculated above.

**402.4.2 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 exceeds 75 feet (22 860 mm) or the tenant space has an occupant load

of 50 or more, not less than two means of egress shall be provided.

**402.4.3 Arrangements of means of egress.** Assembly occupancies with an occupant load of 500 or more shall be so located in the covered mall building 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.

**402.4.3.1 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.

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

The maximum distance of travel from any point within a mall to an exit shall not exceed 200 feet (60 960 mm).

**402.4.5 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 to separate exits. The minimum width of an exit passageway or corridor from a mall shall be 66 inches (1676 mm).

**Exception:** Dead ends not exceeding a length equal to twice the width of the mall measured at the narrowest location within the dead-end portion of the mall.

**402.4.5.1 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 715.4.7.3.

**402.4.6 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-resistance-rated fire barriers and 1-hour opening protectives.

**402.5 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.

**402.5.1 Minimum width.** The minimum width of the mall shall be 20 feet (6096 mm). The mall width shall be sufficient to accommodate the occupant load served. There shall be a minimum of 10 feet (3048 mm) clear exit width 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.

**402.6 Types of construction.** The area of any covered mall building, including anchor buildings, of Type I, II, III and IV construction, shall not be limited provided the covered mall building and attached anchor buildings and parking garages are surrounded on all sides by a permanent open space of not less than 60 feet (18 288 mm) and the anchor buildings do not exceed three stories in height. The allowable height and area of anchor buildings greater than three stores in height shall comply with Section 503, as modified by Sections 504 and 506. The construction type of open parking garages and enclosed parking garages shall comply with Sections 406.3 and 406.4, respectively.

**402.7 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.

**402.7.1 Attached garage.** 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 mall building by a fire barrier having a fire-resistance rating of at least 2 hours.

**Exception:** Where an open parking garage or enclosed parking garage is separated from the covered mall building or anchor building a distance greater than 10 feet (3048 mm), the provisions of Table 602 shall apply. Pedestrian walkways and tunnels which attach the open parking garage or enclosed parking garage to the covered mall building or anchor building shall be constructed in accordance with Section 3104.

**402.7.2 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.

**402.7.3 Anchor building separation.** An anchor building shall be separated from the covered mall building by fire walls complying with Section 705.

**Exception:** 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 covered mall building shall be separated by 2-hour fire-resistive fire barriers complying with Section 706.

**402.7.3.1 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 and IIB construction and the mall need not be protected.

**[F] 402.8 Automatic sprinkler system.** The covered mall building 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 following:

1. The automatic sprinkler system shall be complete and operative throughout occupied space in the covered mall building prior to occupancy of any of the tenant spaces. Unoccupied tenant spaces shall be similarly protected unless provided with approved alternate protection.

2. Sprinkler protection for the mall shall be independent from that provided for tenant spaces or anchors. Where tenant spaces are supplied by the same system, they shall be independently controlled.

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

**[F] 402.8.1 Standpipe system.** The covered mall building shall be equipped throughout with a standpipe system as required by Section 905.3.3.

**402.9 Smoke control.** A smoke control system shall be provided where required for atriums in Section 404.

**402.10 Kiosks.** Kiosks and similar structures (temporary or permanent) shall meet the following requirements:

1. Combustible kiosks or other structures shall not be located within the 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 100kW (105 Btu/h) when tested in accordance with the exhibit booth protocol in UL 1975.
  - 1.3. Aluminum composite material (ACM) having a flame spread index of not more than 25 and a smoke-developed index of not more than 450 when tested as an assembly in the maximum thickness intended for use in accordance with ASTM E 84.
2. Kiosks or similar structures located within the mall shall be provided with approved fire suppression and detection devices.
3. The minimum horizontal separation between kiosks or groupings thereof and other structures within the mall shall be 20 feet (6096 mm).
4. Each kiosk or similar structure or groupings thereof shall have a maximum area of 300 square feet (28 m<sup>2</sup>).

**402.11 Children's playground structures.** Structures intended as children's playgrounds that exceed 10 feet (3048 mm) in height and 150 square feet (14 m<sup>2</sup>) in area shall comply with the following.

**402.11.1 Materials.** Children's playground structures shall be constructed of noncombustible materials or of combustible materials that comply with the following:

1. Fire-retardant-treated wood.
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 kW when tested in accordance with UL 1975.
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) meeting the UL 94 V-2 classification when tested in accordance with UL 94.
7. Ball pool balls, used in soft-contained play equipment structures, having a maximum heat release rate not greater than 100 kW when tested in accordance with UL 1975. 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 playground structure shall exhibit a Class I interior floor finish classification, as described in Section 804, when tested in accordance with NFPA 253.

**402.11.2 Fire protection.** Children's playground structures located within the mall shall be provided with the same level of approved fire suppression and detection devices required for kiosks and similar structures.

**402.11.3 Separation.** Children's playground structures shall have a minimum horizontal separation from other structures within the mall of 20 feet (6090 mm).

**402.11.4 Area limits.** Children's playground structures shall not exceed 300 square feet (28 m<sup>2</sup>) in area, unless a special investigation has demonstrated adequate fire safety.

**402.12 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.

**[F] 402.13 ((Standby)) Emergency power.** Covered mall buildings exceeding 50,000 square feet (4645 m<sup>2</sup>) shall be provided with ((standby)) emergency power systems that are capable of operating the emergency voice/alarm communication system.

**[F] 402.14 Emergency voice/alarm communication system.** Covered mall buildings exceeding 50,000 square feet (4645

m<sup>2</sup>) in total floor area shall be provided with an emergency voice/alarm communication system. Emergency voice/alarm communication systems serving a mall, required or otherwise, shall be accessible to the fire department. The system shall be provided in accordance with Section 907.2.12.2.

**402.15 Plastic signs.** Plastic signs affixed to the storefront of any tenant space facing the mall shall be limited as specified in Sections 402.15.1 through 402.15.5.2.

**402.15.1 Area.** Plastic signs shall not exceed 20 percent of the wall area facing the mall.

**402.15.2 Height and width.** Plastic signs shall not exceed a height of 36 inches (914 mm), except if the sign is vertical, the height shall not exceed 96 inches (2438 mm) and the width shall not exceed 36 inches (914 mm).

**402.15.3 Location.** Plastic signs shall be located a minimum distance of 18 inches (457 mm) from adjacent tenants.

**402.15.4 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 meet the acceptance criteria of Section 803.2.1 when tested in accordance with NFPA 286.

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

**402.15.5 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 and the foam plastics shall have the physical characteristics specified in this section. Foam plastics used in signs installed in accordance with Section 402.14 shall not be required to comply with the flame spread and smoke-developed indexes specified in Section 2603.3.

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

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

**[F] 402.16 Fire department access to equipment.** Rooms or areas containing controls for air-conditioning systems, automatic fire-extinguishing systems or other detection, suppression or control elements shall be identified for use by the fire department.

## SECTION 403 HIGH-RISE BUILDINGS

**403.1 Applicability.** The provisions of this section shall apply to buildings with an occupied floor located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access and to buildings with no fire department vehicle access that have occupied floors more than 35 feet (10 668 mm) above grade plane.

**Exception:** The provisions of this section shall not apply to the following buildings and structures:

1. Airport traffic control towers in accordance with Section 412.
2. Open parking garages in accordance with Section 406.3.
3. Buildings with an occupancy in Group A-5 in accordance with Section 303.1.
4. Low-hazard special industrial occupancies in accordance with Section 503.1.1.
5. Buildings with an occupancy in Group H-1, H-2 or H-3 in accordance with Section 415.

**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 10 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/or 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.

[F] **403.2 Automatic sprinkler system.** Buildings and structures shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 and a secondary water supply where required by Section 903.3.5.2.

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

1. ~~Open parking garages in accordance with Section 406.3.~~
- 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 fire barriers consisting of not less than 1-hour fire-resistance-rated walls and 2-hour fire-resistance-rated floor/ceiling assemblies.

**403.3 Reduction in fire-resistance rating.** The fire-resistance-rating reductions listed in Sections 403.3.1 and 403.3.2 shall be allowed in buildings that have sprinkler control valves equipped with supervisory initiating devices and water-flow initiating devices for each floor.

**403.3.1 Type of construction.** The following reductions in the minimum construction type allowed in Table 601 shall be allowed as provided in Section 403.3:

1. For buildings not greater than 420 feet (128 m) in height, Type IA construction shall be allowed to be reduced to Type IB.

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

2. In other than Groups F-1, M and S-1, Type IB construction other than structural frame and bearing walls shall be allowed to be reduced to Type IIA.
3. The height and area limitations of the reduced construction type shall be allowed to be the same as for the original construction type.

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

**403.4 Emergency escape and rescue.** Emergency escape and rescue openings required by Section 1026 are not required.

[F] **403.5 Automatic fire detection.** Smoke detection shall be provided in accordance with Section 907.2.12.1.

[F] **403.6 Emergency voice/alarm communication systems.** An emergency voice/alarm communication system shall be provided in accordance with Section 907.2.12.2.

[F] **403.7 Fire department communications system.** A two-way fire department communications system shall be provided for fire department use in accordance with Section 907.2.12.3.

[F] **403.8 Fire command.** A fire command center complying with Section 911 shall be provided in a location approved by the fire department.

**403.9 Elevators.** Elevator operation and installation shall be in accordance with Chapter 30.

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

**[F] 403.10 No requirements.** (~~Standby power.~~ A standby power system complying with Section 2702 shall be provided for standby power loads specified in Section 403.10.2.

**403.10.1 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 706 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] 403.10.2 Standby power loads.** The following are classified as standby power loads:

1. ~~Power and lighting for the fire command center required by Section 403.8;~~
2. ~~Electrically powered fire pumps; and~~
3. ~~Ventilation and automatic fire detection equipment for smokeproof enclosures.~~

~~Standby power shall be provided for elevators in accordance with Sections 1007.4 and 3003.)~~

**[F] 403.11 Emergency power systems.** An emergency power system complying with Section 2702 and Section 403.11.2 shall be provided for emergency power loads specified in Section 403.11.1.

**[F] 403.11.1 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; (~~and~~)
5. Fire alarm systems;
6. ~~Power and lighting for mechanical equipment rooms and the fire command center required by Section 403.8;~~
7. ~~Electrically powered fire pumps;~~
8. ~~Ventilation and automatic fire detection equipment for smokeproof enclosures;~~
9. ~~Smoke control system; and~~
10. 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 emergency power.

**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.

**403.11.2 Special requirements for emergency power systems.** If the emergency system is a generator set inside a building, the system shall be located in a separate room enclosed with 2-hour fire-resistance-rated fire barrier assemblies. System supervision with manual start and transfer features shall be provided at the fire command center.

**Exception:** A generator set with a fuel tank system not exceeding 660 gallons (2498 L) is not required to be located in a rated room when installed in a sprinklered parking garage of Type I or II construction, unless a 1-hour separation is required to separate control areas in accordance with Table 307.7(1).

**403.12 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.

**403.12.1 Stairway communications 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 required stairway ((where the doors to the stairway are locked)).

**403.12.2 Stairway penthouses.** All required 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 for rescue purposes at the predesign conference.

**403.13 ((Smokeproof)) Smoke control in exit enclosures and elevator hoistways.** Every required stairway serving floors more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access shall comply with Sections 909.20 and 1020.1.7. Elevator hoistways shall comply with Section 707.14.

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

**403.15 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.

**403.16 Signs.**

**403.16.1 Elevator lobbies.** A sign shall be posted in every elevator lobby above each call switch noting that the elevators will be recalled to the building lobby on fire alarm. This sign shall warn persons not to use the elevator in the event of fire and shall direct them to use the stairway or give other appropriate directions for exiting.

**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.

**403.16.2 Main floor lobbies.** A sign indicating the number of each elevator shall be posted and maintained at each main floor elevator lobby and at alternate floors of recall, if provided.

**403.16.3 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.

**403.16.4 Other signs.** Other signs required by this code, including but not limited to stairway identification signs required by Section 1020.1.6 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 Exception 5 in Section 707.2, the provisions of this section shall apply to buildings or structures containing vertical openings defined herein as "Atriums."

**404.1.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in this code, have the meaning shown herein.

**ATRIUM.** An opening connecting two or more stories other than enclosed stairways, elevators, hoistways, escalators, plumbing, electrical, air-conditioning or other equipment, which is closed at the top and not defined as a mall. Stories, as used in this definition, do not include balconies within assembly groups or mezzanines that comply with Section 505.

**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 appropriate 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. 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.

**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 a 2-hour fire-resistance-rated fire barrier or horizontal assembly, 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.

**404.4 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.

**404.5 Enclosure of atriums.** Atrium spaces shall be separated from adjacent spaces by a 1-hour fire barrier constructed in accordance with Section 706 or a horizontal assembly constructed in accordance with Section 711, or both.

**Exceptions:**

1. A glass wall forming a smoke partition where automatic sprinklers are spaced 6 feet (1829 mm) or less along both sides of the separation wall, or on the room side only if there is not a walkway on the atrium side, and between 4 inches and 12 inches (102 mm and 305 mm) away from the glass and designed so that the entire surface of the glass is wet upon activation of the sprinkler system without obstruction. The glass shall be installed in a gasketed frame so that the framing system deflects without breaking (loading) the glass before the sprinkler system operates.
2. A glass-block wall assembly in accordance with Section 2110 and having a  $3/4$ -hour fire protection rating.
3. The adjacent spaces of any three floors of the atrium shall not be required to be separated from the atrium where such spaces are included in the design of the smoke control system.

**Code Alternate CA404.5:** 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 enclosed exits separated by one-half 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] 404.6 ((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 CA404.6:** Emergency power 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>).

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

**404.8 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 not exceed 200 feet (60 960 mm).

## SECTION 405 UNDERGROUND BUILDINGS

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

**Exceptions:**

1. One- and two-family dwellings, sprinklered in accordance with Section 903.3.1.3.
2. Parking garages 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 exceeding 1,500 square feet (139 m<sup>2</sup>) and has an occupant load less than 10.

**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 lowest level of exit discharge shall be divided into a minimum of 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 does not exceed 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 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 712. Doorways shall be protected by fire door assemblies that are automatic closing by smoke detection in accordance with Section 715.4.7.3 and are installed in accordance with NFPA 105 and Section 715.4.3. 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 715.4.7.3.

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

**[F] 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.

**[F] 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 Section 907.2.18.



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

[F] **405.7 Public address.** A public address system shall be provided where required by Section 907.2.19.1.

**405.8 Means of egress.** Means of egress shall be in accordance with Sections 405.8.1 and 405.8.2.

**405.8.1 Number of exits.** Each floor level shall be provided with a minimum of two exits. Where compartmentation is required by Section 405.4, each compartment shall have a minimum of one exit and shall also have an exit access doorway into the adjoining compartment.

**405.8.2 Smokeproof enclosure.** Every required stairway serving floor levels more than 30 feet (9144 mm) below its level of exit discharge shall comply with the requirements for a smokeproof enclosure as provided in Section 1020.1.7.

[F] **405.9 No requirements.** ~~((Standby power. A standby power system complying with Section 2702 shall be provided standby power loads specified in Section 405.9.1.~~

~~**405.9.1 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.~~

~~**405.9.2 Pick-up time.** The standby power system shall pick up its connected loads within 60 seconds of failure of the normal power supply.)~~

[F] **405.10 Emergency power.** An emergency power system complying with Section 2702 shall be provided for emergency power loads specified in Section 405.10.1.

[F] **405.10.1 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 3016.7. 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 emergency power.

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

## SECTION 406 MOTOR-VEHICLE-RELATED OCCUPANCIES

### 406.1 Private garages and carports.

**406.1.1 Classification.** Buildings or parts of buildings classified as Group U occupancies because of the use or character of the occupancy shall not exceed 1,000 square feet (93 m<sup>2</sup>) in area or one story in height except as provided in Section 406.1.2. 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.

**406.1.2 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>) when 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 when 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 building, provided each 3,000-square-foot (279 m<sup>2</sup>) area is separated by fire walls complying with Section 705.

**406.1.3 Garages and carports.** Carports shall be open on at least 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.

**406.1.4 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 a minimum 1/2-inch (12.7 mm) gypsum board applied to the

garage side. Garages beneath habitable rooms shall be separated from all habitable rooms above by not less than a  $\frac{5}{8}$ -inch Type X gypsum board or equivalent. 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  $1\frac{3}{8}$  inches (34.9 mm) thick, or doors in compliance with Section 715.4.3. 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 from the garage shall be constructed of a minimum 0.019-inch (0.48 mm) sheet steel 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.

#### 406.2 Parking garages.

**406.2.1 Classification.** Parking garages shall be classified as either open, as defined in Section 406.3, or enclosed and shall meet the appropriate criteria in Section 406.4. Also see Section 509 for special provisions for parking garages.

**406.2.2 Clear height.** The clear height of each floor level in vehicle and pedestrian traffic areas shall not be less than ((7 feet-(2134 mm))) 6 feet 6 inches (1981 mm). Vehicle and pedestrian areas accommodating van-accessible parking required by Section 1106.5 shall conform to ICC A117.1.

**406.2.3 Guards.** Guards shall be provided in accordance with Section 1013 at exterior and interior vertical openings on floor and roof areas where vehicles are parked or moved and where the vertical distance to the ground or surface directly below exceeds 30 inches (762 mm).

**406.2.4 Vehicle barriers.** Parking areas shall be provided with exterior or interior walls or vehicle barriers, except at pedestrian or vehicular accesses, designed in accordance with Section 1607.7. Vehicle barriers not less than 2 feet (607 mm) high shall be placed at the end of drive lanes, and at the end of parking spaces where the difference in adjacent floor elevation is greater than 1 foot (305 mm).

**Exception:** Vehicle storage compartments in a mechanical access parking garage.

**406.2.5 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).

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

**Exception:** Asphalt parking surfaces are permitted at ground level.

**[W]** ((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.))

**406.2.7 Mixed separation.** Parking garages shall be separated from other occupancies in accordance with Section 508.3.

**406.2.8 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 at least 18 inches (457 mm) above the floor.

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

#### 406.3 Open parking garages.

**406.3.1 Scope.** Except where specific provisions are made in the following subsections, other requirements of this code shall apply.

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

**MECHANICAL-ACCESS OPEN PARKING GARAGES.** Open parking garages employing parking machines, lifts, elevators or other mechanical devices for vehicles moving from and to street level and in which public occupancy is prohibited above the street level.

**OPEN PARKING GARAGE.** A structure or portion of a structure with the openings as described in Section 406.3.3.1 on two or more sides that is used for the parking or storage of private motor vehicles as described in Section 406.3.4.

**RAMP-ACCESS OPEN PARKING GARAGES.** Open parking garages employing a series of continuously rising floors or a series of interconnecting ramps between floors permitting the movement of vehicles under their own power from and to the street level.

**406.3.3 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 406.2.4.

**406.3.3.1 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 must be at least 20 percent of the total perimeter wall area of each tier. The aggregate length of the openings considered to be providing natural ventilation shall constitute a minimum of 40 percent of the perimeter of the tier. Interior walls shall be at least 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.

**406.3.4 Uses.** Mixed uses shall be allowed in the same building as an open parking garage subject to the provisions

of Sections 508.3, 402.7.1, 406.3.13, 509.3, 509.4 and 509.7.

**406.3.5 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 508.3.

**406.3.5.1 Single use.** When 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 406.3.5, along with increases allowed by Section 406.3.6.

**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 traffic areas shall not be 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.

**406.3.6 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.

Allowable tier areas in Table 406.3.5 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. At least three sides of each such larger tier shall have continuous horizontal openings not less than 30 inches (762 mm) in clear height extending for at least 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 at least 30 feet (9144 mm) for the full length of the opening, and standpipes shall be provided in each such tier.

Open parking garages of Type II construction, with all sides open, shall be unlimited in allowable area where the 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. 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 406.3.3.1. These openings shall be permitted to be provided in courts with a minimum width of 30 feet (9144 mm) for the full width of the openings.

**406.3.7 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 704.

**406.3.8 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 not be less than two 36-inch-wide (914 mm) exit stairways. Lifts shall be permitted to be installed for use of employees only, provided they are completely enclosed by noncombustible materials.

**406.3.9 Standpipes.** Standpipes shall be installed where required by the provisions of Chapter 9.

**406.3.10 Sprinkler systems.** Where required by other provisions of this code, automatic sprinkler systems and standpipes shall be installed in accordance with the provisions of Chapter 9.

**TABLE 406.3.5  
OPEN PARKING GARAGES AREA AND HEIGHT**

TYPE OF CONSTRUCTION	AREA PER TIER (square feet)	Ramp access	HEIGHT (in tiers)	
			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>.

**406.3.11 Enclosure of vertical openings.** Enclosure shall not be required for vertical openings except as specified in Section 406.3.8.

**406.3.12 Ventilation.** Ventilation, other than the percentage of openings specified in Section 406.3.3.1, shall not be required.

**406.3.13 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.

#### 406.4 Enclosed parking garages.

**406.4.1 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.

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

#### 406.5 Motor fuel-dispensing facilities.

**406.5.1 Construction.** Motor fuel-dispensing facilities shall be constructed in accordance with the *International Fire Code* and this section.

**406.5.2 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 minimum thickness of 0.010 inch (0.30 mm) or corrosion-resistant steel having a minimum base metal thickness of 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 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 station fuel dispensers, provided the panels are located at least 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 not exceed 1,000 square

feet (93 m<sup>2</sup>). The maximum area of any individual panel shall not exceed 100 square feet (9.3 m<sup>2</sup>).

**406.5.2.1 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.

#### 406.6 Repair garages.

**406.6.1 General.** Repair garages shall be constructed in accordance with the *International Fire Code* and this section. This occupancy shall not include motor fuel-dispensing facilities, as regulated in Section 406.5.

**406.6.2 Mixed uses.** Mixed uses shall be allowed in the same building as a repair garage subject to the provisions of Section 508.3.

**406.6.3 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.

**406.6.4 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.

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

**[F] 406.6.6 Gas detection system.** Repair garages used for repair of vehicles fueled by nonodorized gases, such as hydrogen and nonodorized LNG, shall be provided with an approved flammable gas-detection system.

**[F] 406.6.6.1 System design.** The flammable gas-detection system 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 explosive limit. Gas detection shall also be provided in lubrication or chassis repair pits of garages used for repairing nonodorized LNG-fueled vehicles.

**[F] 406.6.6.2 Operation.** Activation of the gas detection system shall result in all of the following:

1. Initiation of distinct audible and visual alarm signals 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] 406.6.6.3 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 when the system is interlocked with the gas detection system and cause a trouble signal to sound in an approved location.

## SECTION 407 GROUP I-2

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

**407.2 Corridors.** Corridors in occupancies in Group I-2 shall be continuous to the exits and 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 Spaces of unlimited area.** 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 for patient sleeping units, treatment rooms, hazardous or incidental use areas as defined in Section 508.2.
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 Nurses' stations.** Spaces for doctors' and nurses' charting, communications and related clerical areas shall be permitted to be open to the corridor, when such spaces are constructed as required for corridors.

**407.2.3 Mental health treatment areas.** Areas wherein mental health patients who are not capable of self-preservation are housed, or group meeting or multipurpose therapeutic spaces other than incidental use areas as defined in Section 508.2, 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 less than 500 square feet (46.5 m<sup>2</sup>) in area shall be permitted to be open to the corridor provided the gift shop and storage areas are fully sprinklered and storage areas are protected in accordance with Section 508.2.

**407.3 Corridor walls.** 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 508.2 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 715.4.

**407.3.2 Locking devices.** Locking devices that restrict access to the patient room from the corridor, and that are operable only by staff from the corridor side, shall not restrict the means of egress from the patient room except for patient rooms in mental health facilities.

**407.4 Smoke barriers.** Smoke barriers shall be provided to subdivide every story used by patients for sleeping or treatment and to divide other stories with an occupant load of 50 or more persons, into at least 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 not exceed 200 feet (60 960 mm). The smoke barrier shall be in accordance with Section 709.

**407.4.1 Refuge area.** At least 30 net square feet (2.8 m<sup>2</sup>) per patient shall be provided within the aggregate area of corridors, patient rooms, treatment rooms, lounge or dining areas and other low-hazard areas on each side of each smoke barrier. On floors not housing patients confined to a bed or litter, at least 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.

**407.4.2 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.

**[F] 407.5 Automatic sprinkler system.** Smoke compartments containing patient sleeping units shall be equipped throughout with an automatic fire sprinkler system in accordance with Section 903.3.1.1. The smoke compartments shall be equipped with approved quick-response or residential sprinklers in accordance with Section 903.3.2.

**[F] 407.6 Automatic fire detection.** Corridors in nursing homes (both intermediate care and skilled nursing facilities), detoxification facilities and spaces permitted to be open to the corridors by Section 407.2 shall be equipped with an automatic

fire detection system. Hospitals shall be equipped with smoke detection as required in Section 407.2.

**Exceptions:**

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

**407.7 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 patients and 6 net square feet (0.56 m<sup>2</sup>) for ambulatory patients and other occupants are located between the building and the fence. Such provided safe dispersal areas shall not be located less than 50 feet (15 240 mm) from the building they serve.

**[W] 407.8 Locks on exit doors.** Approved, listed locks without delayed egress shall be permitted in nursing homes or portions of nursing homes, provided that:

1. The clinical needs of one or more patients require specialized security measures for their safety;
2. The doors unlock upon actuation of an automatic sprinkler system or automatic fire detection system;
3. The doors unlock upon loss of electrical power controlling the lock or lock mechanism;
4. The lock shall be capable of being deactivated by a signal from a switch located in an approved location; and
5. There is a system, such as a keypad and code, in place to allow visitors, staff persons and appropriate residents to exit. Instructions for exiting shall be posted within 6 feet of the door.

## SECTION 408 GROUP I-3

**408.1 General.** Occupancies in Group I-3 shall comply with the provisions of this section and other applicable provisions of this code (see Section 308.4).

**408.2 Mixed occupancies.** Portions of buildings with an occupancy in Group I-3 that are classified as a different occupancy shall meet the applicable requirements of this code for such occupancies. Where security operations necessitate the locking of required means of egress, provisions shall be 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 high-hazard use.

**408.3 Means of egress.** Except as modified or as provided for in this section, the 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 not exceed 50 pounds (220 N) with a perpendicular force against the door of 50 pounds (220 N).

**408.3.3 Spiral stairs.** Spiral stairs that conform to the requirements of Section 1009.8 are permitted for access to and between staff locations.

**408.3.4 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, a minimum of 50 feet (15 240 mm) from the building with a net area of 15 square feet (1.4 m<sup>2</sup>) per person.

**408.3.5 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.

**408.3.6 Exit enclosures.** One of the required exit enclosures in each building shall be permitted to have glazing installed in doors and interior walls at each landing level providing access to the enclosure, provided that the following conditions are met:

1. The exit enclosure shall not serve more than four floor levels.
2. Exit doors shall not be less than <sup>3</sup>/<sub>4</sub>-hour fire door assemblies complying with Section 715.4
3. The total area of glazing at each floor level shall not exceed 5,000 square inches (3 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 fire 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 an area of refuge to the exterior 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 mechanism(s) 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 locks or less 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.

**408.5 Vertical openings.** Vertical openings shall be enclosed in accordance with Section 707.

**Exception:** A floor opening between floor levels of residential housing areas is permitted without enclosure protection between the levels, provided that both 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 to provide simultaneous egress for all occupants from all interconnected levels and areas.

The height difference between the highest and lowest finished floor levels shall not exceed 23 feet (7010 mm). Each story, considered separately, has at least one-half of its individual required means of egress capacity provided by exits leading directly out of that story without traversing another story within the interconnected area.

**408.6 Smoke barrier.** Occupancies in Group I-3 shall have smoke barriers complying with Section 709 to divide every story occupied by residents for sleeping, or any other story hav-

ing an occupant load of 50 or more persons, into at least 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 maximum number of residents in any smoke compartment shall be 200. The travel distance to a door in a smoke barrier from any room door required as exit access shall not exceed 150 feet (45 720 mm). The travel distance to a door in a smoke barrier from any point in a room shall not exceed 200 feet (60 960 mm).

**408.6.2 Refuge area.** At least 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 whenever 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 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 408.7.1 through 408.7.4.

**408.7.1 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).

**408.7.2 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.

**408.7.3 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 (77 419 mm<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.

**408.7.4 Smoke-tight doors.** Doors in openings in partitions required to be smoke tight by Section 408.7 shall be substantial doors, of construction that will resist the passage of smoke. Latches and door closures are not required on cell doors.

**408.8 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 ventilation (mechanical or natural) in accordance with Section 909 for each windowless smoke compartment.

## SECTION 409 MOTION PICTURE PROJECTION ROOMS

**409.1 General.** The provisions of this section 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 at least 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-conditioning sys-

tem, 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 at least 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 AND PLATFORMS

**410.1 Applicability.** The provisions of this section 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 words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

**FLY GALLERY.** A raised floor area above a stage from which the movement of scenery and operation of other stage effects are controlled.

**GRIDIRON.** The structural framing over a stage supporting equipment for hanging or flying scenery and other stage effects.

**PINRAIL.** A rail on or above a stage through which belaying pins are inserted and to which lines are fastened.

**PLATFORM.** A raised area within a building used for worship, the presentation of music, plays or other entertainment; the head table for special guests; the raised area for lecturers and speakers; boxing and wrestling rings; theater-in-the-round stages; and similar purposes wherein there are no overhead hanging curtains, drops, scenery or stage effects other than lighting and sound. A temporary platform is one installed for not more than 30 days.

**PROSCENIUM WALL.** The wall that separates the stage from the auditorium or assembly seating area.



**STAGE.** A space within a building utilized for entertainment or presentations, which includes overhead hanging curtains, drops, scenery or stage effects other than lighting and sound.

**410.3 Stages.** Stage construction shall comply with Sections 410.3.1 through 410.3.7.

**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.

**Exceptions:**

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 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 noncombustible 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 Galleries, gridirons, catwalks and pinrails.** 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 715. 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 of approved material or an approved water curtain complying with Section

903.3.1.1. The fire curtain shall be designed and installed to intercept hot gases, flames and smoke and to prevent a glow from a severe fire on the stage from showing on the auditorium side for a period of 20 minutes. The closing of the fire curtain from the full open position shall be accomplished in less than 30 seconds, with the last 8 feet (2438 mm) of travel requiring 5 or more seconds for full closure.

**410.3.5.1 Activation.** The curtain shall be activated by rate-of-rise heat detection installed in accordance with Section 907.10 operating at a rate of temperature rise of 15 to 20°F per minute (8 to 11°C per minute), and by an auxiliary manual control.

**410.3.5.2 Fire test.** A sample curtain with a minimum of two vertical seams shall be subjected to the standard fire test specified in ASTM E 119 for a period of 30 minutes. The curtain shall overlap the furnace edges by an amount that is appropriate to seal the top and sides. The curtain shall have a bottom pocket containing a minimum of 4 pounds per linear foot (5.9 kg/m) of batten. The exposed surface of the curtain shall not glow, and flame or smoke shall not penetrate the curtain during the test period. Unexposed surface temperature and hose stream test requirements are not applicable to the proscenium fire safety curtain test.

**410.3.5.3 Smoke test.** Curtain fabrics shall have a smoke-developed rating of 25 or less when tested in accordance with ASTM E 84.

**410.3.5.4 Tests.** The completed proscenium curtain shall be subjected to operating tests prior to the issuance of a certificate of occupancy.

**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 Type 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 other purpose other than equipment, wiring or plumbing, the floor construction shall not be 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 through 410.5.3.

**410.5.1 Separation from stage.** Where the stage height is greater than 50 feet (15 240 mm), 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 a fire barrier with not less than a 2-hour fire-resistance rating with approved opening protectives. For stage heights of 50 feet (15 240 mm) or less, the required stage separation shall be a fire barrier with not less than a 1-hour fire-resistance rating with approved opening protectives.

**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 fire barriers with not less than a 1-hour fire-resistance rating with approved opening protectives.

**410.5.3 Stage exits.** At least one approved means of egress shall be provided from each side of the stage and from each side of the space under the stage. At least one means of escape shall be provided from each fly gallery and from the gridiron. A steel ladder, alternating tread stairway or spiral stairway is permitted to be provided from the gridiron to a scuttle in the stage roof.

**[F] 410.6 Automatic sprinkler system.** Stages shall be equipped with an automatic fire-extinguishing system in accordance with Chapter 9. Sprinklers shall be installed under the roof and gridiron and under all catwalks and galleries over the stage. Sprinklers shall be installed in dressing rooms, performer lounges, shops and storerooms accessory to such stages.

**Exceptions:**

1. Sprinklers are not required under stage areas less than 4 feet (1219 mm) in clear height that are utilized exclusively for storage of tables and chairs, provided the concealed space is separated from the adjacent spaces by not less than  $\frac{5}{8}$ -inch (15.9 mm) Type X gypsum board.

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] 410.7 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 this section. Amusement buildings having an occupant load of less than 50 shall comply with the requirements for a Group B occupancy and this section.

**Exception:** Amusement buildings or portions thereof that are without walls or a roof and constructed to prevent the accumulation of smoke.

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

**411.2 Definition.** The following word and term shall, for the purpose of this section and as used elsewhere in this code, have the meaning shown herein.

**SPECIAL AMUSEMENT BUILDING.** A special amusement building is any temporary or permanent building or portion thereof that is occupied for amusement, entertainment or educational purposes and that contains a device or system that conveys passengers or provides a walkway along, around or over a course in any direction so arranged that the means of egress path is not readily apparent due to visual or audio distractions or is intentionally confounded or is not readily available because of the nature of the attraction or mode of conveyance through the building or structure.

**[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 can be initiated including the capability of manual initiation of requirements in Section 907.2.11.2.

**[F] 411.6 Emergency voice/alarm communications system.** An emergency voice/alarm communications system shall be provided in accordance with Sections 907.2.11 and 907.2.12.2, 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. 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 low-level exit signs and directional path markings 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 907.2.11.2.

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

**SECTION 412  
AIRCRAFT-RELATED OCCUPANCIES**

**412.1 Airport traffic control towers.**

**412.1.1 General.** The provisions of this section 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.

**412.1.2 Type of construction.** Airport traffic control towers shall be constructed to comply with the height and area limitations of Table 412.1.2.

**TABLE 412.1.2  
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.

**412.1.3 Egress.** A minimum of one exit stairway shall be permitted for airport traffic control towers of any height provided that the occupant load per floor does not exceed

15. The stairway shall conform to the requirements of Section 1009. The stairway shall be separated from elevators by a minimum distance of 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 a minimum of 0.15 inch of water column (43 Pa) and a maximum of 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 1009.11. The provisions of Section 403 do not apply.

**Exception:** Smokeproof enclosures as set forth in Section 1020.1.7 are not required where required stairways are pressurized.

**[F] 412.1.4 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] 412.1.5 Standby power.** A standby power system that conforms to Section 2702 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.

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

**412.2 Aircraft hangars.** Aircraft hangars shall be in accordance with Sections 412.2.1 through 412.2.6.

**412.2.1 Exterior walls.** Exterior walls located less than 30 feet (9 144 mm) from lot lines or a public way shall have a fire-resistance rating not less than 2 hours.

**412.2.2 Basements.** Where hangars have basements, the floor over the basement 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 the basement and the hangar. Access to the basement shall be from outside only.

**412.2.3 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.

**412.2.4 Heating equipment.** Heating equipment shall be placed in another room separated by 2-hour fire-resistance-rated construction. 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 at least 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 and at least 8 feet (2438 mm) above the floor in shops, offices and other sections of the hangar communicating with storage or service areas.
2. A single interior door shall be allowed, provided the sources of ignition in the appliances are at least 18 inches (457 mm) above the floor.

**412.2.5 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] 412.2.6 Fire suppression.** Aircraft hangars shall be provided with fire suppression as required by NFPA 409.

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

**412.2.7 Restrictions in the Fire District.** Aircraft hangars shall not be located in the Fire District defined in Section 401.2 unless work is limited to exchange of parts and maintenance requiring no open flame or welding.

**412.3 Residential aircraft hangars.** Residential aircraft hangars as defined in Section 412.3.1 shall comply with Sections 412.3.2 through 412.3.6.

**412.3.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in this code, have the meaning shown herein.

**RESIDENTIAL AIRCRAFT HANGAR.** An accessory building less than 2,000 square feet (186 m<sup>2</sup>) and 20 feet (6096 mm) in height, constructed on a one- or two-family residential property where aircraft are stored. Such use will be considered as a residential accessory use incidental to the dwelling.

**412.3.2 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 must be equipped with self-closing devices and conform to the requirements of Section 715 with at least a 4-inch (102 mm) noncombustible raised sill. Openings from a hangar directly into a room used for sleeping purposes shall not be permitted.

**412.3.3 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] 412.3.4 Smoke alarms.** Smoke alarms shall be provided within the hangar in accordance with Section 907.2.21.

**412.3.5 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 connect outside the structures.

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

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

**[F] 412.4 Aircraft paint hangars.** Aircraft painting operations where flammable liquids are used in excess of the maximum allowable quantities per control area listed in Table 307.7(1) shall be conducted in an aircraft paint hangar that complies with the provisions of Section 412.4.

**[F] 412.4.1 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.

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

**[F] 412.4.3 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]412.4.4 Storage.** Storage of flammable liquids shall be in a liquid storage room.

**[F] 412.4.5 Fire suppression.** Aircraft paint hangars shall be provided with fire suppression as required by NFPA 409.

**412.4.6 Ventilation.** Aircraft paint hangars shall be provided with ventilation as required in the *International Mechanical Code*.

**412.5 Heliports and helistops.** Heliports and helistops shall be permitted to be erected on buildings or other locations where they are constructed in accordance with this section.

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

**HELIPORT.** An area of land or water or a structural surface that is used, or intended for use, for the landing and taking off of helicopters, and any appurtenant areas that are used, or intended for use, for heliport buildings and other heliport facilities.

**HELISTOP.** The same as a “Heliport,” except that no fueling, defueling, maintenance, repairs or storage of helicopters is permitted.

**412.5.2 Size.** The landing area for helicopters less than 3,500 pounds (1588 kg) shall be a minimum of 20 feet (6096 mm) in length and width. The landing area shall be surrounded on all sides by a clear area having a minimum aver-

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

**412.5.3 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 1605.5.

**412.5.4 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 may be a fire escape or ladder leading to the floor below.

**412.5.5 Rooftop heliports and helistops.** Rooftop heliports and helistops shall comply with NFPA 418.

**412.5.6 Restrictions in the Fire District.** Heliports shall not be located in the Fire District defined in Section 401.2.

### 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 combustible 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.

#### Exceptions:

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

**413.3 Mini-storage warehouses.** In ministorage 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 nonrated in rooms 500 square feet (46.5 m<sup>2</sup>) or less in area and in sprinklered rooms of any size.

### SECTION 414 HAZARDOUS MATERIALS

**[F] 414.1 General.** The provisions of this section 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 also comply with 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.** Separate floor plans shall be submitted for buildings and structures with an occupancy in Group H, identifying the locations of anticipated contents and processes so as to reflect the nature of each occupied portion of every building and structure. A report identifying hazardous materials including, but not limited to, materials representing hazards that are classified in Group H to be stored or used, shall be submitted and the methods of protection from such hazards shall be indicated on the construction documents. The opinion and report shall be prepared by a qualified person, firm or corporation approved by the building official and shall be provided without charge to the enforcing agency.

**414.1.4 Pre-design conference.** Prior to application for a permit for a Group H-5 Occupancy, the applicant shall arrange a predesign 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 predesign 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 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.

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

**414.2.1 Construction requirements.** Control areas shall be separated from each other by fire barriers constructed in accordance with Section 706 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.

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

**414.2.4 Fire-resistance-rating requirements.** The required fire-resistance rating for fire barriers shall be in accordance with Table 414.2.2. The floor construction of the control area and the construction supporting the floor of the control area shall have a minimum 2-hour fire-resistance rating.

**Exception:** The floor construction of the control area and the construction supporting the floor of the control area are allowed to be 1-hour fire-resistance rated in buildings of Type 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 stories or less in height.

**[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] 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 in excess of the maximum allowable quantities per control area of Tables 307.1(1) and 307.1(2) shall be in accordance with Sections 414.5.1 through 414.5.5 of this code and 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
Below grade plane	1	100	4	1
	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. Fire barriers shall include walls and floors as necessary to provide separation from other portions of the building.

[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.

a. Hazard categories are as specified in the *International Fire Code*.

b. 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.

c. 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.

d. See Table 414.2.2 for design and number of control areas.

e. Allowable quantities for other hazardous material categories shall be in accordance with Section 307.

f. Maximum quantities shall be increased 100 percent in outdoor control areas.

g. 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.

h. 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.

i. 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.

j. Quantities are unlimited in an outdoor control area.

**TABLE [F] 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>.

- a. Control areas shall be separated from each other by not less than a 1-hour fire barrier wall.
- b. 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:
  - 1. 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.
  - 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.
- c. 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] 414.5.1 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 Automatic fire detection systems.** Group H occupancies shall be provided with an automatic fire detection system in accordance with Section 907.2.

**[F] 414.5.4 Standby or emergency power.** Where mechanical ventilation, treatment systems, temperature control, alarm, detection or other electrically operated systems are required, such systems shall be provided with an emergency or standby power system in accordance with this code, the *International Fire Code* and ((or)) the ((*International Code Council Electrical Code Administrative Provisions*)) *Seattle Electrical Code*.

**Exceptions:**

- 1. Storage areas for Class I and II oxidizers.
- 2. Storage areas for Class III, IV and V organic peroxides.
- 3. Storage, use and handling areas for highly toxic or toxic materials as provided for in the *International Fire Code*.
- 4. 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] 414.5.5 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 does not exceed 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 not be 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 increases permitted by Section 506 apply.

**[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 or exit enclosures, there shall be an emergency telephone sys-

tem, 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 also initiate a local audible alarm.

**[F] 414.7.3 Supervision.** Emergency alarm systems shall be supervised by an approved central, proprietary or remote station service or shall initiate an audible and visual signal at a constantly attended on-site location.

**[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 Deflagration	Required Not Required	Not Permitted Required

a. See Section 414.1.3.

b. See the *International Fire Code*.

c. As generated during manufacturing or processing. See definition of “Combustible dust” in Chapter 3.

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.

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

**[F] 415.1 Scope.** The provisions of this section 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 words and terms shall, for the purposes of this chapter and as used elsewhere in the code, have the meanings shown herein.

**[F] CONTINUOUS GAS-DETECTION SYSTEM.** A gas detection system where the analytical instrument is maintained in continuous operation and sampling is performed without interruption. Analysis is allowed to be performed on a cyclical basis at intervals not to exceed 30 minutes.

**[F] EMERGENCY CONTROL STATION.** An approved location on the premises where signals from emergency equipment are received and which is staffed by trained personnel.

**[F] EXHAUSTED ENCLOSURE.** An appliance or piece of equipment that consists of a top, a back and two sides providing a means of local exhaust for capturing gases, fumes, vapors and mists. Such enclosures include laboratory hoods, exhaust fume hoods and similar appliances and equipment used to locally retain and exhaust the gases, fumes, vapors and mists that could be released. Rooms or areas provided with general ventilation, in themselves, are not exhausted enclosures.

**[F] FABRICATION AREA.** An area within a semiconductor fabrication facility and related research and development areas in which there are processes using hazardous production materials. Such areas are allowed to include ancillary rooms or areas such as dressing rooms and offices that are directly related to the fabrication area processes.

**[F] FLAMMABLE VAPORS OR FUMES.** The concentration of flammable constituents in air that exceed 25 percent of their lower flammable limit (LFL).

**[F] GAS CABINET.** A fully enclosed, noncombustible enclosure used to provide an isolated environment for compressed gas cylinders in storage or use. Doors and access ports for exchanging cylinders and accessing pressure-regulating controls are allowed to be included.

**[F] GAS ROOM.** A separately ventilated, fully enclosed room in which only compressed gases and associated equipment and supplies are stored or used.

**[F] HAZARDOUS PRODUCTION MATERIAL (HPM).** A solid, liquid or gas associated with semiconductor manufacturing that has a degree-of-hazard rating in health, flammability or reactivity of Class 3 or 4 as ranked by NFPA 704 and which is used directly in research, laboratory or production processes that have as their end product materials that are not hazardous.

**[F] HPM FLAMMABLE LIQUID.** An HPM liquid that is defined as either a Class I flammable liquid or a Class II or Class IIIA combustible liquid.

**[F] HPM ROOM.** A room used in conjunction with or serving a Group H-5 occupancy, where HPM is stored or used and which is classified as a Group H-2, H-3 or H-4 occupancy.

**[F] IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH).** The concentration of air-borne contaminants which poses a threat of death, immediate or delayed permanent adverse health effects, or effects that could prevent escape from such an environment. This contaminant concentration level is established by the National Institute of Occupational Safety and Health (NIOSH) based on both toxicity and flammability. It generally is expressed in parts per million by volume (ppm v/v) or milligrams per cubic meter (mg/m<sup>3</sup>). If adequate data do not exist for precise establishment of IDLH concentrations, an independent certified industrial hygienist, industrial toxicologist, appropriate regulatory agency or other source approved by the code official shall make such determination.

**[F] LIQUID.** A material that has a melting point that is equal to or less than 68°F (20°C) and a boiling point that is greater than 68°F (20°C) at 14.7 pounds per square inch absolute (psia) (101 kPa). When not otherwise identified, the term “liquid” includes both flammable and combustible liquids.

**[F] LIQUID STORAGE ROOM.** A room classified as a Group H-3 occupancy used for the storage of flammable or combustible liquids in a closed condition.

**[F] LIQUID USE, DISPENSING AND MIXING ROOM.** A room in which Class I, II and IIIA flammable or combustible liquids are used, dispensed or mixed in open containers.

**[F] LOWER FLAMMABLE LIMIT (LFL).** The minimum concentration of vapor in air at which propagation of flame will occur in the presence of an ignition source. The LFL is sometimes referred to as “LEL” or “lower explosive limit.”

**[F] NORMAL TEMPERATURE AND PRESSURE (NTP).** A temperature of 70°F (21°C) and a pressure of 1 atmosphere [14.7 psia (101 kPa)].

**[F] PHYSIOLOGICAL WARNING THRESHOLD LEVEL.** A concentration of air-borne contaminants, normally expressed in parts per million (ppm) or milligrams per cubic meter, that represents the concentration at which persons can sense the presence of the contaminant due to odor, irritation or other quick-acting physiological response. When used in conjunction with the permissible exposure limit (PEL) the physiological warning threshold levels are those consistent with the classification system used to establish the PEL. See the definition of “Permissible exposure limit (PEL)” in the *International Fire Code*.

**[F] SERVICE CORRIDOR.** A fully enclosed passage used for transporting HPM and purposes other than required means of egress.

**[F] SOLID.** A material that has a melting point, decomposes or sublimates at a temperature greater than 68°F (20°C).

**[F] STORAGE, HAZARDOUS MATERIALS.**

1. The keeping, retention or leaving of hazardous materials in closed containers, tanks, cylinders or similar vessels, or
2. Vessels supplying operations through closed connections to the vessel.

[F] **USE (MATERIAL).** Placing a material into action, including solids, liquids and gases.

[F] **WORKSTATION.** A defined space or an independent principal piece of equipment using HPM within a fabrication area where a specific function, laboratory procedure or research activity occurs. Approved or listed hazardous materials storage cabinets, flammable liquid storage cabinets or gas cabinets serving a workstation are included as part of the workstation. A workstation is allowed to contain ventilation equipment, fire protection devices, detection devices, electrical devices and other processing and scientific equipment.

[F] **415.3 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] **415.3.1 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 Items 1 through 4 below. 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*.

1. Group H-1. Not less than 75 feet (22 860 mm) and not less than required by the *International Fire Code*.

**Exceptions:**

- (~~1. Fireworks manufacturing buildings separated in accordance with NFPA 1124.~~)
2. Buildings containing the following materials when separated in accordance with Table 415.3.1:
    - 2.1. Organic peroxides, unclassified detonable.
    - 2.2. Unstable reactive materials, Class 4.
    - 2.3. Unstable reactive materials, Class 3 detonable.

2.4. Detonable pyrophoric materials.

2. Group H-2. Not less than 30 feet (9144 mm) where the area of the occupancy exceeds 1,000 square feet (93 m<sup>2</sup>) and it is not required to be located in a detached building.
3. Groups H-2 and H-3. Not less than 50 feet (15 240 mm) where a detached building is required (see Table 415.3.2).
4. Groups 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 not be less than the distances required by Table 415.3.1.

[F] **415.3.2 Group H-1 and H-2 or H-3 detached buildings.** Where a detached building is required by Table 415.3.2, there are no requirements for wall and opening protection based on fire separation distance.

[F] **415.4 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 a basement, 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 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 both Group H-1 and H-4 occupancies.

[F] **415.4.1 Floors in storage rooms.** Floors in storage areas for organic peroxides, pyrophoric materials and unstable (reactive) materials shall be of liquid-tight, noncombustible construction.

**415.4.2 Restrictions in the Fire District.** Group H-1 occupancies shall not be located in the Fire District defined in Section 401.2.

[F] **415.5 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 415.3.2 shall be in buildings used for no other purpose, shall not exceed one story in height and shall be without basements, crawl spaces or other under-floor spaces.

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.

[F] **415.5.1 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.

SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

[F] TABLE 415.3.1  
 MINIMUM SEPARATION DISTANCES FOR BUILDINGS CONTAINING EXPLOSIVE MATERIALS

QUANTITY OF EXPLOSIVE MATERIAL <sup>a</sup>		MINIMUM DISTANCE (feet)		
		Lot lines <sup>b</sup> and inhabited buildings <sup>c</sup>		Separation of magazines <sup>d, e, f</sup>
Pounds over	Pounds not over	Barricaded <sup>d</sup>	Unbarricaded	
2	5	70	140	12
5	10	90	180	16
10	20	110	220	20
20	30	125	250	22
30	40	140	280	24
40	50	150	300	28
50	75	170	340	30
75	100	190	380	32
100	125	200	400	36
125	150	215	430	38
150	200	235	470	42
200	250	255	510	46
250	300	270	540	48
300	400	295	590	54
400	500	320	640	58
500	600	340	680	62
600	700	355	710	64
700	800	375	750	66
800	900	390	780	70
900	1,000	400	800	72
1,000	1,200	425	850	78
1,200	1,400	450	900	82
1,400	1,600	470	940	86
1,600	1,800	490	980	88
1,800	2,000	505	1,010	90
2,000	2,500	545	1,090	98
2,500	3,000	580	1,160	104
3,000	4,000	635	1,270	116
4,000	5,000	685	1,370	122
5,000	6,000	730	1,460	130
6,000	7,000	770	1,540	136
7,000	8,000	800	1,600	144
8,000	9,000	835	1,670	150
9,000	10,000	865	1,730	156
10,000	12,000	875	1,750	164
12,000	14,000	885	1,770	174
14,000	16,000	900	1,800	180
16,000	18,000	940	1,880	188
18,000	20,000	975	1,950	196
20,000	25,000	1,055	2,000	210
25,000	30,000	1,130	2,000	224
30,000	35,000	1,205	2,000	238
35,000	40,000	1,340	2,000	248

(continued)

**TABLE 415.3.1—continued**  
**MINIMUM SEPARATION DISTANCES FOR BUILDINGS CONTAINING EXPLOSIVE MATERIALS**

QUANTITY OF EXPLOSIVE MATERIAL <sup>a</sup>		MINIMUM DISTANCE (feet)		
		Lot lines <sup>b</sup> and inhabited buildings <sup>c</sup>		Separation of magazines <sup>d, e, f</sup>
Pounds over	Pounds not over	Barricaded <sup>d</sup>	Unbarricaded	
40,000	45,000	1,340	2,000	258
45,000	50,000	1,400	2,000	270
50,000	55,000	1,460	2,000	280
55,000	60,000	1,515	2,000	290
60,000	65,000	1,565	2,000	300
65,000	70,000	1,610	2,000	310
70,000	75,000	1,655	2,000	320
75,000	80,000	1,695	2,000	330
80,000	85,000	1,730	2,000	340
85,000	90,000	1,760	2,000	350
90,000	95,000	1,790	2,000	360
95,000	100,000	1,815	2,000	370
100,000	110,000	1,835	2,000	390
110,000	120,000	1,855	2,000	410
120,000	130,000	1,875	2,000	430
130,000	140,000	1,890	2,000	450
140,000	150,000	1,900	2,000	470
150,000	160,000	1,935	2,000	490
160,000	170,000	1,965	2,000	510
170,000	180,000	1,990	2,000	530
180,000	190,000	2,010	2,010	550
190,000	200,000	2,030	2,030	570
200,000	210,000	2,055	2,055	590
210,000	230,000	2,100	2,100	630
230,000	250,000	2,155	2,155	670
250,000	275,000	2,215	2,215	720
275,000	300,000	2,275	2,275	770

For SI: 1 pound = 0.454 kg, 1 foot = 304.8 mm, 1 square foot = 0.0929 m<sup>2</sup>.

- a. The number of pounds of explosives listed is the number of pounds of trinitrotoluene (TNT) or the equivalent pounds of other explosive.
- b. The distance listed is the distance to lot line, including lot lines at public ways.
- c. For the purpose of this table, an inhabited building is any building on the same lot that is regularly occupied by people. Where two or more buildings containing explosives or magazines are located on the same lot, each building or magazine shall comply with the minimum distances specified from inhabited buildings and, in addition, they shall be separated from each other by not less than the distance shown for "Separation of magazines," except that the quantity of explosive materials contained in detonator buildings or magazines shall govern in regard to the spacing of said detonator buildings or magazines from buildings or magazines containing other explosive materials. If any two or more buildings or magazines are separated from each other by less than the specified "Separation of Magazines" distances, then such two or more buildings or magazines, as a group, shall be considered as one building or magazine, and the total quantity of explosive materials stored in such group shall be treated as if the explosive were in a single building or magazine located on the site of any building or magazine of the group, and shall comply with the minimum distance specified from other magazines or inhabited buildings.
- d. Barricades shall effectively screen the building containing explosives from other buildings, public ways or magazines. Where mounds or revetted walls of earth are used for barricades, they shall not be less than 3 feet in thickness. A straight line from the top of any side wall of the building containing explosive materials to the eave line of any other building, magazine or a point 12 feet above the centerline of a public way shall pass through the barricades.
- e. Magazine is a building or structure, other than an operating building, approved for storage of explosive materials. Portable or mobile magazines not exceeding 120 square feet in area need not comply with the requirements of this code, however, all magazines shall comply with the *International Fire Code*.
- f. The distance listed is permitted to be reduced by 50 percent where approved natural or artificial barriers are provided in accordance with the requirements in Note d.

[F] TABLE 415.3.2  
REQUIRED DETACHED STORAGE

DETACHED STORAGE 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 as specified in Table 415.3.1 based on trinitrotoluene (TNT) equivalence of the material. For materials classified as explosives, see Chapter 33 the *International Fire Code*. For all other materials, the distance shall be as indicated in Section 415.3.1.
- b. "Maximum Allowable Quantity" means the maximum allowable quantity per control area set forth in Table 307.7(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 and Firearms (BATF) regulations or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles, providing the net explosive weight of individual articles does not exceed 1 pound.

[F] **415.5.2 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 fire sprinkler systems shall not be within such rooms or areas.

**415.5.3 Restrictions in the Fire District.** Group H-2 occupancies having a floor area in excess of 500 square feet (46.5 m<sup>2</sup>) are not permitted in the Fire District. Group H-3 occupancies having a floor area in excess of 1500 square feet (139 m<sup>2</sup>) are not permitted in the Fire District. See Section 401.2 for definition of Fire District.

[F] **415.6 Group H-2.** Occupancies in Group H-2 shall be constructed in accordance with Sections 415.6.1 through 415.6.4 and the *International Fire Code*.

[F] **415.6.1 Combustible dusts, grain processing and storage.** The provisions of Sections 415.6.1.1 through 415.6.1.6 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 120, NFPA 484, NFPA 654, NFPA 655, NFPA 664 and NFPA 85, and the *International Fire Code*.

[F] **415.6.1.1 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 height shall be 65 feet (19 812 mm) and except further that, in isolated areas, the maximum height of Type IV structures shall be increased to 85 feet (25 908 mm).

[F] **415.6.1.2 Grinding rooms.** Every room or space occupied for grinding or other operations that produce combustible dusts shall be enclosed with fire barriers that have not less than a 2-hour fire-resistance rating where the area is not more than 3,000 square feet (279 m<sup>2</sup>), and not less than a 4-hour fire-resistance rating where the area is greater than 3,000 square feet (279 m<sup>2</sup>).

[F] **415.6.1.3 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] **415.6.1.4 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] 415.6.1.5 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] 415.6.1.6 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 (9144 mm) 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 height shall be Type IV.

**[F] 415.6.2 Flammable and combustible liquids.** The storage, handling, processing and transporting of flammable and combustible liquids shall be in accordance with the *International Mechanical Code* and the *International Fire Code*.

**[F] 415.6.2.1 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 fire areas in accordance with the requirements of Section 508.3.3.

**[F] 415.6.2.1.1 Height exception.** Where storage tanks are located within only a single-story building, the height limitation of Section 503 shall not apply for Group H.

**[F] 415.6.2.2 Tank protection.** Storage tanks shall be noncombustible and protected from physical damage. A fire barrier wall or horizontal assemblies or both around the storage tank(s) shall be permitted as the method of protection from physical damage.

**[F] 415.6.2.3 Tanks.** Storage tanks shall be approved tanks conforming to the requirements of the *International Fire Code*.

**[F] 415.6.2.4 Suppression.** Group H shall be equipped throughout with an approved automatic sprinkler system, installed in accordance with Section 903.

**[F] 415.6.2.5 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 415.6.2.3 are used to store Class I, II and IIIA flammable and combustible liquids shall not be required to have a leakage containment area.

**[F] 415.6.2.6 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] 415.6.2.7 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] 415.6.2.8 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] 415.6.2.9 Explosion venting.** Where Class I liquids are being stored, explosion venting shall be provided in accordance with the *International Fire Code*.

**[F] 415.6.2.10 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] 415.6.3 Liquefied petroleum gas-distribution facilities.** The design and construction of propane, butane, propylene, butylene and other liquefied petroleum gas-distribution facilities shall conform to the applicable provisions of Sections 415.6.3.1 through 415.6.3.5.2. The storage and handling of liquefied petroleum gas systems shall conform to the *International Fire Code*. The design and installation of piping, equipment and systems that utilize liquefied petroleum gas shall be in accordance with the *International Fuel Gas Code*. Liquefied petroleum gas-distribution facilities shall be ventilated in accordance with the *International Mechanical Code* and Section 415.6.3.1.

**[F] 415.6.3.1 Air movement.** Liquefied petroleum gas-distribution facilities shall be provided with air inlets and outlets arranged so that air movement across the floor of the facility will be uniform. The total area of both inlet and outlet openings shall be at least 1 square inch (645 mm<sup>2</sup>) for each 1 square foot (0.093 m<sup>2</sup>) of floor area. The bottom of such openings shall not be more than 6 inches (152 mm) above the floor.

**[F] 415.6.3.2 Construction.** Liquefied petroleum gas-distribution facilities shall be constructed in accordance with Section 415.6.3.3 for separate buildings, Section 415.6.3.4 for attached buildings or Section 415.6.3.5 for rooms within buildings.

**[F] 415.6.3.3 Separate buildings.** Where located in separate buildings, liquefied petroleum gas-distribution facilities shall be occupied exclusively for that purpose or for other purposes having similar hazards. Such buildings shall be limited to one story in height and shall conform to Sections 415.6.3.3.1 through 415.6.3.3.3.

**[F] 415.6.3.3.1 Floors.** The floor shall not be located below ground level and any spaces beneath the floor shall be solidly filled or shall be unenclosed.

[F] **415.6.3.3.2 Materials.** Walls, floors, ceilings, columns and roofs shall be constructed of noncombustible materials.

[F] **415.6.3.3.3 Explosion venting.** Explosion venting shall be provided in accordance with the *International Fire Code*.

[F] **415.6.3.4 Attached buildings.** Where liquefied petroleum gas-distribution facilities are located in an attached structure, the attached perimeter shall not exceed 50 percent of the perimeter of the space enclosed and the facility shall comply with Sections 415.6.3.3 and 415.6.3.4.1. Where the attached perimeter exceeds 50 percent, such facilities shall comply with Section 415.6.3.5.

[F] **415.6.3.4.1 Fire separation.** Separation of the attached structures shall be provided by fire barriers having a fire-resistance rating of not less than 1 hour and shall not have openings. Fire barriers between attached structures occupied only for the storage of LP-gas are permitted to have fire door assemblies that comply with Section 715. Such fire barriers shall be designed to withstand a static pressure of at least 100 pounds per square foot (psf) (4788 Pa), except where the building to which the structure is attached is occupied by operations or processes having a similar hazard.

[F] **415.6.3.5 Rooms within buildings.** Where liquefied petroleum gas-distribution facilities are located in rooms within buildings, such rooms shall be located in the first story above grade plane and shall have at least one exterior wall with sufficient exposed area to provide explosion venting as required in the *International Fire Code*. The building in which the room is located shall not have a basement or unventilated crawl space and the room shall comply with Sections 415.6.3.5.1 and 415.6.3.5.2.

[F] **415.6.3.5.1 Materials.** Walls, floors, ceilings and roofs of such rooms shall be constructed of approved noncombustible materials.

[F] **415.6.3.5.2 Common construction.** Walls and floor/ceiling assemblies common to the room and to the building where the room is located shall be fire barriers with not less than a 1-hour fire-resistance rating and without openings. Common walls for rooms occupied only for storage of LP-gas are permitted to have opening protectives complying with Section 715. The walls and ceilings shall be designed to withstand a static pressure of at least 100 psf (4788 Pa).

**Exception:** Where the building, within which the room is located, is occupied by operations or processes having a similar hazard.

[F] **415.6.4 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] **415.7 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] **415.7.1 Gas rooms.** When gas rooms are provided, such rooms shall be separated from other areas by not less than a 1-hour fire barrier.

[F] **415.7.2 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] **415.7.3 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 a fire barrier having a fire-resistance rating of not less than 1 hour.

[F] **415.8 Group H-5.**

[F] **415.8.1 General.** In addition to the requirements set forth elsewhere in this code, Group H-5 shall comply with the provisions of Section 415.8 and the *International Fire Code*.

[F] **415.8.2 Fabrication areas.**

[F] **415.8.2.1 Hazardous materials in fabrication areas.**

[F] **415.8.2.1.1 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 415.8.2.1.1.

**Exception:** The quantity limitations for any hazard category in Table 415.8.2.1.1 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] **415.8.2.1.2 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] **415.8.2.2 Separation.** Fabrication areas, whose sizes are limited by the quantity of hazardous materials allowed by Table 415.8.2.1.1, shall be separated from each other, from corridors and from other parts of the building by not less than 1-hour fire barriers.

**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 at least  $\frac{3}{4}$  hour in accordance with Section 715.

[F] **415.8.2.3 Location of occupied levels.** Occupied levels of fabrication areas shall be located at or above the first story above grade plane.



[F] TABLE 415.8.2.1.1  
 QUANTITY LIMITS FOR HAZARDOUS MATERIALS IN A SINGLE FABRICATION AREA IN GROUP H-5<sup>a</sup>

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

- a. Hazardous materials within piping shall not be included in the calculated quantities.
- b. 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).
- c. Densely packed baled cotton that complies with the packing requirements of ISO 8115 shall not be included in this material class.
- d. The aggregate quantity of flammable, pyrophoric, toxic and highly toxic gases shall not exceed 9,000 cubic feet at NTP.
- e. The aggregate quantity of pyrophoric gases in the building shall not exceed the amounts set forth in Table 415.3.2.

**[F] 415.8.2.4 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 415.8.2.5).

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

**[F] 415.8.2.5 Shafts and openings through floors.** Elevator shafts, vent shafts and other openings through floors shall be enclosed when required by Section 707. 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.

**[F] 415.8.2.6 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 occupancy separations 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] 415.8.2.7 Transporting hazardous production materials to fabrication areas.** HPM shall be transported to fabrication areas through enclosed piping or tubing systems that comply with Section 415.8.6.1, through service corridors complying with Section 415.8.4, or in corridors as permitted in the exception to Section 415.8.3. The handling or transporting of HPM within service corridors shall comply with the *International Fire Code*.

**[F] 415.8.2.8 Electrical.**

**[F] 415.8.2.8.1 General.** Electrical equipment and devices within the fabrication area shall comply with the (~~*International Code Council Electrical Code Administrative Provisions*~~) *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 415.8.2.6 and where the number of air changes at any location is not less than three times that required by Section 415.8.2.6. The use of recirculated air shall be permitted.

**[F] 415.8.2.8.2 Workstations.** Workstations shall not be energized without adequate exhaust ventilation. See Section 415.8.2.6 for workstation exhaust ventilation requirements.

**[F] 415.8.3 Corridors.** Corridors shall comply with Chapter 10 and shall be separated from fabrication areas as specified in Section 415.8.2.2. Corridors shall not contain HPM and shall not be used for transporting such materials, except through closed piping systems as provided in Section 415.8.6.3.

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

1. Corridors. Corridors adjacent to the fabrication area where the alteration work is to be done shall comply with Section 1017 for a length determined as follows:
  - 1.1 The length of the common wall of the corridor and the fabrication area; and
  - 1.2 For the distance along the corridor to the point of entry of HPM into the corridor serving that fabrication area.
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.
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 fire-extinguishing system.

**[F] 415.8.4 Service corridors.**

**[F] 415.8.4.1 Occupancy.** Service corridors shall be classified as Group H-5.

**[F] 415.8.4.2 Use conditions.** Service corridors shall be separated from corridors as required by Section 415.8.2.2. Service corridors shall not be used as a required corridor.

**[F] 415.8.4.3 Mechanical ventilation.** Service corridors shall be mechanically ventilated as required by Section 415.8.2.6 or at not less than six air changes per hour, whichever is greater.

**[F] 415.8.4.4 Means of egress.** The maximum distance of travel from any point in a service corridor to an exit,

exit access corridor or door into a fabrication area shall not exceed 75 feet (22 860 mm). Dead ends shall not exceed 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] 415.8.4.5 Minimum width.** The minimum clear width of a service corridor shall be 5 feet (1524 mm), or 33 inches (838 mm) wider than the widest cart or truck used in the corridor, whichever is greater.

**[F] 415.8.4.6 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] 415.8.4.6.1 Service corridors.** An emergency alarm system shall be provided in service corridors, with at least one alarm device in each service corridor.

**[F] 415.8.4.6.2 Exit access corridors and exit enclosures.** Emergency alarms for exit access corridors and exit enclosures shall comply with Section 414.7.2.

**[F] 415.8.4.6.3 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] 415.8.4.6.4 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] 415.8.4.6.5 Alarm signals.** Activation of the emergency alarm system shall sound a local alarm and transmit a signal to the emergency control station.

**[F] 415.8.5 Storage of hazardous production materials.**

**[F] 415.8.5.1 General.** Storage of 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 1804.2 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] 415.8.5.2 Construction.**

**[F] 415.8.5.2.1 HPM rooms and gas rooms.** HPM rooms and gas rooms shall be separated from other areas by not less than a 2-hour fire barrier where the area is 300 square feet (27.9 m<sup>2</sup>) or more and not less than a 1-hour fire barrier where the area is less than 300 square feet (27.9 m<sup>2</sup>).

**[F] 415.8.5.2.2 Liquid storage rooms.** Liquid storage rooms shall be constructed in accordance with the following requirements:

1. Rooms in excess of 500 square feet (46.5 m<sup>2</sup>) shall have at least one exterior door approved for fire department access.
2. Rooms shall be separated from other areas by fire barriers having a fire-resistance rating of 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.
4. Rooms used for the storage of Class I flammable liquids shall not be located in a basement.

**[F] 415.8.5.2.3 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] 415.8.5.3 Location.** Where HPM rooms, liquid storage rooms and gas rooms are provided, they shall have at least 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] 415.8.5.4 Explosion control.** Explosion control shall be provided where required by Section 414.5.1.

**[F] 415.8.5.5 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] 415.8.5.6 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 <sup>3</sup>/<sub>4</sub> hour.

**[F] 415.8.5.7 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] 415.8.5.8 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.

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

ating devices are allowed to be used as emergency alarm-initiating devices.

**[F] 415.8.6 Piping and tubing.**

**[F] 415.8.6.1 General.** Hazardous production materials piping and tubing shall comply with this section and ASME B31.3.

**[F] 415.8.6.2 Supply piping and tubing.**

**[F] 415.8.6.2.1 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] 415.8.6.2.2 Location in service corridors.** Hazardous production materials supply piping or tubing in service corridors shall be exposed to view.

**[F] 415.8.6.2.3 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] 415.8.6.3 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 Section 415.8.6.2 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] 415.8.6.4 Identification.** Piping, tubing and HPM waste lines shall be identified in accordance with ANSI A13.1 to indicate the material being transported.

**[F] 415.8.7 Continuous gas detection systems.** A continuous gas detection system shall be provided for HPM gases when the physiological warning threshold level of the gas is at a higher level than the accepted PEL for the gas and for flammable gases in accordance with this section.

**[F] 415.8.7.1 Where required.** A continuous gas-detection system shall be provided in the areas identified in Sections 415.8.7.1.1 through 415.8.7.1.4.

**[F] 415.8.7.1.1 Fabrication areas.** A continuous gas-detection system shall be provided in fabrication areas when gas is used in the fabrication area.

**[F] 415.8.7.1.2 HPM rooms.** A continuous gas-detection system shall be provided in HPM rooms when gas is used in the room.

**[F] 415.8.7.1.3 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 when gases are not located in gas cabinets or exhausted enclosures.

**[F] 415.8.7.1.4 Corridors.** When 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] 415.8.7.2 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 the PEL or ceiling limit of the gas for which detection is provided. For flammable gases, the monitoring detection threshold level shall be vapor concentrations in excess of 20 percent of the lower explosive limit (LEL). Monitoring for highly toxic and toxic gases shall also comply with the requirements for such material in the *International Fire Code*.

**[F] 415.8.7.2.1 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] 415.8.7.2.2 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 distribution manifold, the shutoff valve for the branch line located in the piping distribution manifold enclosure shall automatically close.

**[F] 415.8.8 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.

**415.8.9 Emergency control station.** An emergency control station shall be provided in accordance with Sections 415.8.9.1 through 415.8.9.3.

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

**415.8.9.2 Staffing.** Trained personnel shall continuously staff the emergency control station.

**415.8.9.3 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 fire 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 1805.2.3.5 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 1805.2.3.5 of the *International Fire Code*.

**[F] 415.8.10 Emergency power system.** An emergency power system shall be provided in Group H-5 occupancies where required in Section 415.8.10.1. The emergency power system shall be designed to supply power automatically to required electrical systems when the normal electrical supply system is interrupted.

**[F] 415.8.10.1 Required electrical systems.** Emergency power 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 1805.2.3.5 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 1805.2.3.5 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] 415.8.10.2 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] 415.8.11 Automatic sprinkler system protection in exhaust ducts for HPM.**

**[F] 415.8.11.1 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 this section and the *International Mechanical Code*.

**[F] 415.8.11.2 Metallic and noncombustible nonmetallic exhaust ducts.** An approved automatic sprinkler system shall be provided in metallic and noncombustible nonmetallic exhaust ducts when 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] 415.8.11.3 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).

**Exceptions:**

1. Ducts listed or approved for applications without automatic fire sprinkler system protection.
2. Ducts not more than 12 feet (3658 mm) in length installed below ceiling level.

**[F] 415.8.11.4 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.

**[F] 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 spraying of flammable paints, varnishes and lacquers or other flammable materials or mixtures or compounds used for painting, varnishing, staining or similar purposes. Such construction and equipment shall comply with the *International Fire Code*.

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

**[F] FLAMMABLE VAPOR AREA.** An area in which the concentration of flammable constituents (vapor, gas, fume, mist or dust) in air exceeds 25 percent of their lower flam-

mable limit (LFL) because of the flammable finish processes operation. It includes:

1. The interior of spray booths.
2. The interior of ducts exhausting from spraying processes.
3. Any area in the direct path of spray or any area containing dangerous quantities of air-suspended powder, combustible residue, dust, deposits, vapor or mists as a result of spraying operations.
4. The area in the vicinity of dip tanks, drain boards or associated drying, conveying or other equipment during operation or shutdown periods.

The building official is authorized to determine the extent of the flammable vapor area, taking into consideration the material characteristics of the flammable materials, the degree of sustained ventilation and the nature of the operations.

**[F] LIMITED SPRAYING SPACE.** An area in which operations for touch-up or spot painting of a surface area of 9 square feet (0.84 m<sup>2</sup>) or less are conducted.

**[F] SPRAY BOOTH.** A mechanically ventilated appliance of varying dimensions and construction provided to enclose or accommodate a spraying operation and to confine and limit the escape of spray vapor and residue and to exhaust it safely.

**[F] SPRAY ROOM.** A room designed to accommodate spraying operations separated from the remainder of the building by a minimum 1-hour fire barrier.

**[F] SPRAYING SPACE.** An area in which dangerous quantities of flammable vapors or combustible residues, dusts or deposits are present due to the operation of spraying processes. The building official is authorized to define the limits of the spraying space in any specific case.

**416.2 Location of spray-finishing operations.** Spray-finishing operations conducted in buildings used for Group A, E, I or R occupancies shall be located in a spray room protected with an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 and separated vertically and horizontally from other areas in accordance with this Section 416. In other occupancies, spray-finishing operations shall be conducted in a spray room, spray booth or spraying space approved for such use.

**Exceptions:**

1. Automobile undercoating spray operations and spray-on automotive lining operations conducted in areas with approved natural or mechanical ventilation are exempt from the provisions of this Section 416 when approved and where using Class IIIA or IIIB combustible liquids.
2. In buildings other than Group A, E, I or R occupancies, approved limited spraying space in accordance with *International Fire Code* Section 1504.9.
3. Resin application areas used for manufacturing of reinforced plastics complying with *International Fire*

Code Section 1509 are not required to be located in a spray room, spray booth or spraying space.

Spray-finishing operations shall not be conducted in basements.

~~((F))~~ **416.((2))3 Spray rooms.** Spray rooms shall comply with the *International Fire Code* and Sections 1504.4 through 1504.8.

**416.3.1 Fire-resistance rating.** Spray rooms shall be enclosed with fire barriers with not less than a 1-hour fire-resistance rating.

**416.3.2 Floors.** Floors of spray rooms shall be waterproofed and drained in an approved manner. Combustible floor construction in spray rooms shall be covered by approved, noncombustible, nonsparking material, except where combustible coverings, including but not limited to thin paper or plastic and strippable coatings, are used over noncombustible materials to facilitate cleaning operations in spray rooms.

~~((F) 416.2.1))~~ **416.3.3 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.

**416.4 Spray booths.** The design and construction of spray booths shall comply with the *International Fire Code*, and Sections 416.4.1 through 416.4.6, Sections 416.6 through 416.11 and NFPA 33.

**416.4.1 Construction.** Spray booths shall be constructed of approved noncombustible materials. Aluminum shall not be used. Where walls or ceiling assemblies are constructed of sheet metal, single-skin assemblies shall be no thinner than 0.0478 inch (18 gauge) (1.2 mm) and each sheet of double-skin assemblies shall be no thinner than 0.0359 inch (20 gauge) (0.9 mm). Structural sections of spray booths are allowed to be sealed with latex-based or similar caulks and sealants.

**416.4.2 Surfaces.** The interior surfaces of spray booths shall be smooth; shall be constructed so as to permit the free passage of exhaust air from all parts of the interior, and to facilitate washing and cleaning; and shall be designed to confine residues within the booth. Aluminum shall not be used.

**416.4.3 Floor.** Combustible floor construction in spray booths shall be covered by approved, noncombustible, nonsparking material, except where combustible coverings, including but not limited to thin paper or plastic and strippable coatings, are used over noncombustible materials to facilitate cleaning operations in spray booths.

**416.4.4 Means of egress.** Means of egress shall be provided in accordance with Chapter 10.

**Exception:** Means of egress doors from premanufactured spray booths shall not be less than 30 inches (762 mm) in width by 80 inches (2032 mm) in height.

**416.4.5 Clear space.** Spray booths shall be installed so that all parts of the booth are readily accessible for cleaning. A

clear space of not less than 3 feet (914 mm) shall be maintained on all sides of the spray booth. This clear space shall be kept free of any storage or combustible construction.

**Exceptions:**

1. This requirement shall not prohibit locating a spray booth closer than 3 feet (914 mm) to or directly against an interior partition, wall or floor/ceiling assembly that has a fire-resistance rating of not less than 1 hour, provided the spray booth can be adequately maintained and cleaned.
2. This requirement shall not prohibit locating a spray booth closer than 3 feet (914 mm) to an exterior wall or a roof assembly, provided the wall or roof is constructed of noncombustible material and the spray booth can be adequately maintained and cleaned.

**416.4.6 Size.** The aggregate area of spray booths in a building shall not exceed the lesser of 10 percent of the area of any floor of a building or the basic area allowed for a Group H-2 occupancy without area increases. The area of an individual spray booth in a building shall not exceed the lesser of the aggregate size limit or 1500 square feet (139 m<sup>2</sup>).

**Exception:** One individual booth not exceeding 500 square feet (46.5 m<sup>2</sup>).

**416.5 Spraying spaces.** Spraying spaces shall be designed and constructed in accordance with the *International Fire Code*, and Sections 416.5.1 through 416.11.

~~((F) 416.3 Spraying spaces))~~ **416.5.1 Ventilation.** 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.))~~

**416.5.2 Floor.** Combustible floor construction in spraying spaces shall be covered by approved, noncombustible nonsparking material, except where combustible coverings, such as thin paper or plastic and strippable coatings, are used over noncombustible materials to facilitate cleaning operations in spraying spaces.

~~((F) 416.3.1))~~ **416.5.3 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))~~ **416.6 Fire protection.** An automatic fire-extinguishing system shall be provided in all spray, dip and immersing spaces and storage rooms and shall be installed in accordance with Chapter 9. Spray booths and spray rooms shall be protected by an approved automatic fire-extinguishing system complying with Chapter 9. Protection shall also extend to exhaust plenums, exhaust ducts and both sides of dry filters when such filters are used.

**416.7 Illumination.** Where spraying spaces, spray rooms or spray booths are illuminated through glass panels or other

transparent materials, only fixed luminaires shall be used as a source of illumination.

**416.7.1 Glass panels.** Panels for luminaires or for observation shall be of heat-treated glass, wired glass or hammered wire glass and shall be sealed to confine vapors, mists, residues, dusts and deposits to the flammable vapor area. Panels for luminaires shall be separated from the luminaire to prevent the surface temperature of the panel from exceeding 200°F (93°C).

**416.7.2 Exterior luminaires.** Luminaires attached to the walls or ceiling of a flammable vapor area, but outside of any classified area and separated from the flammable vapor areas by vapor-tight glass panels, shall be suitable for use in ordinary hazard locations. Such luminaires shall be serviced from outside the flammable vapor areas.

**416.7.3 Integral luminaires.** Luminaires that are an integral part of the walls or ceiling of a flammable vapor area are allowed to be separated from the flammable vapor area by glass panels that are an integral part of the luminaire. Such luminaires shall be listed for use in Class I, Division 2 or Class II, Division 2 locations, whichever is applicable, and also shall be suitable for accumulations of deposits of combustible residues. Such luminaires are allowed to be serviced from inside the flammable vapor area.

**416.8 Ventilation.** Mechanical ventilation of flammable vapor areas shall be provided in accordance with Section 502.7 of the *International Mechanical Code*.

**416.9 Waterwash spray booths.** Waterwash spray booths shall be of an approved design so as to prevent excessive accumulation of deposits in ducts and residue at duct outlets. Such booths shall be arranged so that air and overspray are drawn through a continuously flowing water curtain before entering an exhaust duct to the building exterior.

**416.10 Interlocks.** Interlocks for spray application finishes shall be in accordance with Sections 1504.8 through 1504.8.2.

**416.10.1 Automated spray application operations.** Where protecting automated spray application operations, automatic fire-extinguishing systems shall be equipped with an approved interlock feature that will, upon discharge of the system, automatically stop the spraying operations and workpiece conveyors into and out of the flammable vapor areas. Where the building is equipped with a fire alarm system, discharge of the automatic fire-extinguishing system shall also activate the building alarm notification appliances.

**416.10.1.1 Alarm station.** A manual fire alarm and emergency system shutdown station shall be installed to serve each flammable vapor area. When activated, the station shall accomplish the functions indicated in Section 1504.8.1.

**416.10.1.2 Alarm station location.** At least one manual fire alarm and emergency system shutdown station shall be readily accessible to operating personnel. Where access to this station is likely to involve exposure to danger, an additional station shall be located adjacent to an exit from the area.

**416.10.2 Ventilation interlock prohibited.** Air makeup and flammable vapor area exhaust systems shall not be interlocked with the fire alarm system and shall remain in operation during a fire alarm condition.

**Exception:** Where the type of fire-extinguishing system used requires such ventilation to be discontinued, air makeup and exhaust systems shall shut down and dampers shall close.

## 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 Chapter 4 for special occupancies and where applicable to the general requirements of Chapter 28.

[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.

[F] **418.5 Nitrocellulose storage.** Nitrocellulose storage shall be located on a detached pad or in a separate structure or a room enclosed with no less than 2-hour fire barriers.

[F] **418.6 Finished products.** Storage rooms for finished products that are flammable or combustible liquids shall be separated from the processing area by fire barriers having a



fire-resistance rating of at least 2 hours, and openings in the walls shall be protected with approved opening protectives.

## SECTION 419 GROUP I-1, R-1, R-2, R-3

**419.1 General.** Occupancies in Groups I-1, R-1, R-2 and R-3 shall comply with the provisions of this section and other applicable provisions of this code.

**419.2 Separation walls.** Walls separating dwelling units in the same building and walls separating sleeping units in the same building shall comply with Section 708.

**419.3 Horizontal separation.** Floor/ceiling assemblies separating dwelling units in the same buildings and floor/ceiling assemblies separating sleeping units in the same building shall be constructed in accordance with Section 711.

**419.4 Roof-ceiling soffits.** Roof-ceiling soffits in dwelling units and sleeping units shall be provided with a minimum of  $\frac{1}{2}$ -inch gypsum wallboard in buildings of Types IIB, IIIB and VB construction.

### 419.5 Security from criminal activity in Group R.

**419.5.1 Group R occupancies other than one- and two-family dwellings.** All housing units except one- and two-family dwellings shall comply with Section 419.5.1.

**419.5.1.1 Definition.** For the purposes of this section, "housing unit" is any dwelling unit or guest room.

**419.5.1.2 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 nonshattering glass, framed  $\frac{1}{4}$ -inch 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 419.5.1.4 below.
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.

**419.5.1.3 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.

**419.5.1.4 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  $1\frac{3}{8}$  inches (35 mm) 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  $\frac{1}{4}$  (6 mm) inch. 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.

**419.5.1.5 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.

**419.5.1.6 Nonexit doors.** Doors to storage, maintenance and building service rooms shall be self-closing and self-locking.

**419.5.1.7 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.

**419.5.1.8 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.

**419.5.2 One- and two-family dwellings.** One- and two-family dwellings shall comply with Section 419.5.2.

**419.5.2.1 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.

**419.5.2.2 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.

**419.5.2.3 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.

**419.5.3 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 419.5. 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 420 HYDROGEN CUTOFF ROOMS

**[F] 420.1 General.** When required by the *International Fire Code*, hydrogen cutoff rooms shall be designed and constructed in accordance with this section.

**[F] 420.2 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**[F] GASEOUS HYDROGEN SYSTEM.** An assembly of piping, devices and apparatus designed to generate, store, contain, distribute or transport a nontoxic, gaseous hydrogen-containing mixture having at least 95-percent hydrogen gas by volume and not more than 1-percent oxygen by volume. Gaseous hydrogen systems consist of items such as compressed gas containers, reactors and appurtenances, including pressure regulators, pressure relief devices, manifolds, pumps, compressors and interconnecting piping and tubing and controls.

**[F] HYDROGEN CUTOFF ROOM.** A room or space that is intended exclusively to house a gaseous hydrogen system.

**[F] 420.3 Location.** Hydrogen cut-off rooms shall not be located below grade.

**[F] 420.4 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 or as required by Section 508.2 or 508.3 as applicable.

**[F] 420.4.1 Opening protectives.** Doors within such fire barrier walls, including doors to corridors, shall be self-closing in accordance with Section 715. Interior door openings shall be electronically interlocked to prevent oper-

ation 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 420.4.1.1.

**[F] 420.4.1.1 Ventilation alternative.** When an exhaust system is used in lieu of the interlock system required by Section 420.4, 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) with a minimum of 45 feet per minute (0.2287 m/s) at any point in the door opening.

**[F] 420.4.2 Windows.** Operable windows in interior walls shall not be permitted. Fixed windows shall be permitted when in accordance with Section 715.

**[F] 420.5 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] 420.6 Gas detection system.** Hydrogen cutoff rooms shall be provided with an approved flammable gas-detection system in accordance with Sections 420.6.1 through 420.6.3.

**[F] 420.6.1 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] 420.6.2 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] 420.6.3 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] 420.7 Explosion control.** Explosion control shall be provided in accordance with Chapter 9 of the *International Fire Code*.

**[F] 420.8 Standby power.** Mechanical ventilation and gas detection systems shall be connected to a standby power system in accordance with Chapter 27.

## SECTION 421 WATERFRONT STRUCTURES: PIERS, WHARVES AND BUILDINGS

**421.1 General.**

**421.1.1 Scope.** Structures with at least 20 percent or 8000 square feet (743 m<sup>2</sup>), whichever is greater, of their area over water shall comply with Section 421. They shall also com-

ply with all other requirements of this code unless otherwise specified in this Section 421. Unless otherwise specified, all wood dimensions are nominal size as defined in Section 2302.

**Exception:** Fire-resistance-rated walls specified in Section 421.6.6 are permitted to be used as 1-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.

See also Chapter 46 of the Fire Code.

**421.1.2 Definitions.** For the purposes of this Section 421, certain terms are defined as follows:

**COVERED BOAT MOORAGE.** A pier or system of floating or fixed accessways to which vessels on water may be secured, which is covered by a roof.

**DOCK.** A natural open or artificially closed basin in which vessels may remain afloat when berthed at a wharf or pier.

**PIER.** A structure, usually of greater length than width, of timber, stone, concrete or other material, having a deck and projecting from the shore into waters so that vessels may be moored alongside for loading, unloading, storage, repairs or commercial uses.

**SUBSTRUCTURE.** The portion of the construction below and including the deck immediately above the water.

**SUPERSTRUCTURE.** The portion of construction above the deck.

**Exception:** Covered boat moorage.

**WHARF OR QUAY.** A structure of timber, stone, concrete or other material having a platform built along and parallel to waters so that vessels may be moored alongside for loading, unloading, storage, repair or commercial uses.

**421.2 Allowable area and height for waterfront structures.**

The height of structures to be built over water shall be measured from the elevation of ordinary high water 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 Table 503, except that the increases allowed in Section 507.1 and 507.2 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 8000 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.

**421.3 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 1-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 1000 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 (4.25 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 1-hour fire-resistance-rated fire partitions, and openings in the separation shall have 1-hour protection.
3. Storage of flammable liquids shall be in accordance with NFPA 31 and the Fire Code.

**421.4 Location on property.** Exterior walls shall have fire resistance and opening protection as determined by Section 704.

**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 421.5.2 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 421.5.2 for draft stops. Where such walls (even though part of such covered boat moorage) are built on land, this exception shall not apply.

**421.5 Substructure.**

**421.5.1 Construction.** Substructures are permitted to be of any type of construction permitted in this code subject to the area limitations of Section 421.2, except that, when constructed of wood, the members shall not be less than the following in any dimension, exclusive of piling:

**TABLE 421.5.1  
SUBSTRUCTURE CONSTRUCTION**

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; 1 foot = 304.8 mm.

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.

**421.5.2 Draft stops.** Draft stops shall be installed in all substructures constructed of combustible materials, exclusive 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 421.6.7 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 thick-

ness laid with broken joints or materials of equal fire resistance.

**421.6 Superstructure.**

**421.6.1 Construction.** Superstructures are permitted to be of any type of construction permitted by this code subject to the height and area limitations of Section 421.2 and the requirements of this section.

**421.6.2 Floors.** See Section 421.5.

**421.6.3 Exterior walls.** Exterior walls of Types IIA, IIB, III, IV and V buildings, when not subject to the requirements of Section 421.4 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 (152 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 required as specified in Section 717. Openings in exterior walls shall be protected by a fire assembly having a 3/4-hour fire-protection rating when fire-resistive openings are required by Table 704.8 and 1024.5.2.

**421.6.4 Roof coverings.** Roof coverings shall be fire-retardant as specified in Chapter 15.

**421.6.5 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.

**421.6.6 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 421.5.2, 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 2 layers of tongue-and-groove or splined lumber, not less than 2 inches (51 mm) thick and not more than 6 inches (152 mm) wide, with a sheet of not less than No. 26 gauge galvanized steel or 3/8-inch (9.5 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 1 1/2 hour fire protection rating.

**421.6.7 Draft stops.** Superstructure draft stops shall be installed as specified in Section 717. Substructure draft stops constructed as specified in Section 421.5.2 shall be installed in line with the superstructure draft stops above. See Section 421.11 for draft curtain requirements.

**421.6.8 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 1015.
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 421.8.

**421.7 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.

**421.8 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 (31.5 L/s) at 130 psi (896 kPa) at the most remote hose connection, with a simultaneous flow of 500 gpm (31.5 L/s) at the third most remote hose connection on the same pier while maintaining a maximum system pressure of 175 psi (1207 kPa). Existing standpipe systems providing equivalent performance to the specification listed above may be acceptable when approved by the fire code official.

**421.8.1 Hose connections.** Hose connections 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 2-1/2-inch (64 mm) fire department hose outlet. Outlet caps shall have a predrilled 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.

**421.8.2 Hose stations.** Hose stations on required standpipes shall be provided at spacing not to exceed 100 feet (30 480 mm), with the first hose station located as close as practicable to the land end of the pier. Each hose station

shall have 100 feet (30 480 mm) of 1-1/2-inch (38 mm) hose mounted on a reel or rack and enclosed within an approved cabinet. A valved 2-1/2-inch (64 mm) fire department hose outlet shall be provided at each hose station. Outlet caps shall have a 1/8-inch (3.2 mm) 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.

**421.8.3 Freeze protection.** Standpipe systems shall be maintained dry when subject to freezing temperatures, and always from November 1 through March 31. The 1-1/2-inch (38 mm) 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.

**421.9 Automatic sprinklers.**

**421.9.1 Covered boat moorage.** Automatic sprinklers shall be provided for covered boat moorage exceeding 500 square feet (46.5 m<sup>2</sup>) 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 (46.5 m<sup>2</sup>) in projected roof area.

**421.9.2 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.

**Exceptions:**

1. Combustible substructures whose deck area does not exceed 8000 square feet (743.2 m<sup>2</sup>) supporting no superstructures.
2. Combustible substructures whose deck area does not exceed 8000 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 421.9.3.
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.

**421.9.3 Superstructure.** Automatic sprinklers shall be provided in superstructures as specified in Chapter 9.

**421.9.4 Monitoring.** Sprinkler systems shall be monitored by an approved central station service.

**421.10 Smoke and heat vents.** Approved automatic smoke and heat vents shall be provided in covered boat moorage areas exceeding 2500 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.

**421.10.1 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 1 square foot of vent to every 15 square feet of covered berth area (1:15). Each vent shall provide a minimum opening size of 4 feet × 4 feet (1219 mm × 1219 mm).

**421.10.2 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.

**421.10.3 Gravity-operated drop out vents.** Gravity operated dropout vents shall fully open within 5 minutes after the vent cavity is exposed to a simulated fire represented by a time-temperature gradient that reaches an air temperature of 500°F (260°C) within 5 minutes.

**421.11 Draft curtains.** Draft curtains shall be provided in covered boat moorage areas exceeding 2500 square feet (232 m<sup>2</sup>) in area, excluding roof overhangs.

**Exception:** Draft curtains are not required in areas protected by automatic sprinklers.

**421.11.1 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.

**421.11.2 Draft curtain location and depth.** The maximum area protected by draft curtains shall not exceed 2000 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.

**421.12 Fire department connections.** Standpipe and sprinkler systems shall be equipped with not less than a two-way 2½-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 Chapter 46 of the *Seattle Fire Code* for requirements for fire hydrants.

**421.13 Marina fire protection confidence testing.** Standpipe and sprinkler systems shall be inspected and tested in compliance with the *Seattle Fire Code*.

**421.14 Fire department access.** Fire department apparatus access lanes, not less than 20 feet wide (6096 mm) and capable of supporting a 50,000-pound (22 680 kg) vehicle or 24,000 pounds (610 866 kg) per axle (HS20 loading), shall be pro-

vided and so located as to provide fire department apparatus access to within 50 feet (15 240 mm) travel distance to the shore end of all piers, wharves and floats.

## SECTION 422

### PRIVATE AND UTILITY TRANSFORMER VAULTS

**422.1 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.

#### 422.2 Definitions.

**PRIVATE TRANSFORMER VAULT.** Vaults that containing transformer equipment that is not owned by Seattle City Light or other electric power utility.

**UTILITY TRANSFORMER VAULT.** Vaults containing transformer equipment owned by Seattle City Light or other electric power utility.

#### 422.3 When required.

**422.3.1 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.

**422.3.2 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 Article 450 of the *Seattle Electrical Code*.

#### 422.4 Access to transformer vaults.

**422.4.1 General access.** At least one opening, which may be a door or a hatch, shall be provided to 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.

**422.4.2 Utility transformer vault access.** Utility transformer vaults shall be accessible to Seattle City Light personnel 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 nontransformer 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 422.7.2 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. The Agreement shall become part of the property title.

**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.

**422.5 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.

#### 422.6 Construction.

**422.6.1 Private transformer vaults.** Private transformer vaults shall comply with the following minimum requirements.

1. All private transformer vaults shall be of at least 3-hour fire-resistive construction.

**Exceptions:** Subject to the approval of the building official, where the total capacity of private oil-insulated transformers does not exceed 112½ 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 (102 mm) thick.
3. The transformer shall be anchored to inserts embedded in the concrete floor.
4. In pretensioned or posttensioned 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.

**422.6.2 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 422.6.2 when deemed necessary.

1. Floors, walls and ceilings of utility transformer vaults shall have at least a 3-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. Pretensioned or posttensioned 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 and working clearances, and shall be approved by the Superintendent of Seattle City Light.

#### 422.7 Openings into transformer vaults.

**422.7.1 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.

**422.7.2 Doorways.** All doors shall be made of 3-hour fire-resistance-rated steel and shall swing out of the vault 180 degrees (3.14 rad). Doors that may be prevented from swinging 180 degrees (3.14 rad) 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 (2032 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 (2032 mm) high.

**422.7.2.1 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.

**422.7.2.2 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 (102 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.

#### **422.8 Ventilation systems for transformer vaults.**

**422.8.1 General.** Ventilation systems shall be provided to dispose of heat from transformer total losses without creating a temperature rise that exceeds the transformer rating.

**422.8.2 Method of ventilation.** Ventilation shall be provided by either natural circulation or mechanical circulation.

**422.8.2.1 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 exterior vault walls. When the vault is located in a garage, any lower openings must be at least 18 inches (457 mm) above the garage floor level. The remaining one half the required ventilation area shall be used to exhaust heat through one or more openings in the upper portion of the exterior 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. Intake openings shall not be located in the ceiling of the vault.

**422.8.2.2 Mechanical circulation.** Positive or negative pressure ventilation systems shall supply a minimum of 1.6 cfm (0.76 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 exterior walls of the vault. When the vault is located in a garage, any lower openings must be at least 18 inches (457 mm) above the garage floor level. The exhaust vents shall be in the roof or ceiling of the vault or in the upper one half of the vault walls. 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.

**422.8.2.3 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.

**422.8.3 Ventilation openings and duct terminations.** Ventilation openings and duct terminations shall comply with Sections 422.8.3.1 through 422.8.3.4, unless otherwise approved by the building official.

**422.8.3.1 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, combustible materials, unprotected openings and property lines. Exhaust outlets shall be located on the exterior of the building.

**422.8.3.2 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.

**422.8.3.3 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).

**422.8.3.4 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.

#### **422.9 Drainage for vaults.**

**422.9.1 General.** Drains are prohibited in all transformer vaults.

**422.9.2 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 into 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.

**422.10 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 3-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.

**422.11 Storage in transformer vaults.** No material shall be stored in any transformer vault.

**422.12 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 423 MEDICAL GAS SYSTEMS

**423.1 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 this section in addition to other requirements of *International Fire Code* Chapter 30.

**423.2 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 1-hour exterior room, a 1-hour interior room or a gas cabinet in accordance with Section 423.2.1, 423.2.2 or 423.2.3. Rooms or areas where hazardous 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.

**423.2.1 One-hour exterior rooms.** A 1-hour exterior room shall be a room or enclosure separated from the remainder of the building by fire barriers with a fire-resistance rating of not less than 1 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 1 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.

**423.2.2 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 1-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.

**423.2.3 Gas cabinets.** Gas cabinets shall be constructed in accordance with *International Fire Code* Section 2703.8.6 and the following:

1. The average velocity of ventilation at the face of access ports or windows shall not be less than 200 feet per minute (1.1 m/s) with a minimum of 150 feet per minute (0.8 m/s) at any point of the access port or window.
2. Connected to an exhaust system.
3. Internally sprinklered.

**423.3 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 4004.2.1.

#### [W] SECTION 424 RECYCLABLE MATERIALS

**424.1 Definition.** Recyclable materials are those solid wastes that are separated for recycling or reuse, such as papers, metals and glass.

**424.2 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, efficiency of pick-up, and shall be available to occupants and haulers.

