Course Description

- This seminar addresses the provisions of the 2018 International Building Code® (IBC®) regarding the use of fire and smoke separations.

Objectives

- Upon completion, you will be better able to:
  1. Identify the general types of fire and smoke separations.
  2. Identify those specific components that make up fire and smoke separations.
  3. Determine where separations are required.
  4. Determine where separations are permitted as alternatives to other requirements.

Course Overview

- Module 1 – Fire and Smoke Protection Concepts
- Module 2 – Types of Fire and Smoke Separations
- Module 3 – Fire and Smoke Separation Components
- Module 4 – Fire and Smoke Separation Locations
Fire and Smoke Protection Concepts

- IBC uses fire and smoke assemblies and protectives for a variety of purposes:
  - Structural integrity maintenance.
  - Fire spread limitation.
  - Means of egress protection.
  - Radiant heat (exposure) protection.
  - Smoke movement restriction.

Structural Integrity

- Larger and/or high-hazard occupancy buildings require specified fire-resistance levels for structural members.
- IBC Chapter 6 “Type of Construction.”

Structural Fire Resistance

- Structural fire resistance intended to protect structural integrity of building elements during fires.
- Elements include:
  - Structural frame members.
  - Bearing walls.
  - Floor construction.
  - Roof construction.
Fire Spread Limitation

- Multiple conditions utilize fire-resistant separations to limit fire spread.
  - Complete and partial fire separations either mandated, or provided as an alternative, to address a variety of issues: generally hazardous occupancy or operations.
  - Vertical and/or horizontal separations typically require opening protectives and other components to achieve full separation.

Egress Protection

- Fire-resistance-rated and/or smoke-resistant construction is often mandated.
  - “Exit” portion of the means of egress is typically where such protection must be afforded.
  - Means of egress fire protection allows extended travel in large areas or multistory buildings.

Radiant Heat Protection

- To prevent building-to-building fire spread due to radiant heat transfer.
  - Fire-resistance-rated exterior walls required based on proximity to lot lines and other buildings on the same site.
  - Fire separation distance

Smoke Movement Restriction

- Smoke-resistant construction often mandated where occupants incapable of self preservation and protect-in-place methods are employed.
  - Institutional occupancies
    - Hospitals, nursing homes
    - Prisons, jails, reformatories
  - Other conditions require separation that includes both smoke- and fire-resistance.
Fire Protection Concepts

- List the IBC’s five primary protection concepts for fire- and smoke-resistant construction:
  - Structural integrity maintenance.
  - Fire spread limitation.
  - Means of egress protection.
  - Radiant heat (exposure) protection.
  - Smoke movement restriction.

Fire-resistant Separations

- IBC has variety of fire-resistant separation “types”.
- Each unique separation type serves a distinct purpose as reflected in its design details.

Fire and Smoke Separation Types

- Fire walls.
- Fire barriers.
- Fire partitions.
- Smoke barriers.
- Exterior walls.
- Horizontal assemblies.
Fire Walls

- Most complex and protective fire separation.
  - Typically selected by the designer to provide an alternative solution to code compliance, fire wall creates separate buildings in the same structure.
    - Oversize buildings
    - Incompatible use separations
  - A fire wall at the lot line between two adjacent buildings is permitted where a party wall was once required.
  - *Fire walls* required to be 2-, 3- or 4-hour assemblies.

Fire Barriers

- Most common means of separating portions of a building with fire-resistance-rated construction.
  - Used under both mandatory and optional conditions, *fire barriers* divide a building into separate areas for a variety of purposes where full separation is desired.
  - Are “vertical” assemblies.
  - *Fire barriers* must be 1-, 2-, 3- or 4-hour assemblies.

Fire Partitions

- Required where a limited degree of fire and smoke protection is warranted.
  - Typical in locations where separation is important in the initial stages of building evacuation.
  - *Fire partitions* are required to be minimum 1-hour assemblies
    - Allowances for $\frac{1}{2}$-hour assemblies under specified conditions.
Smoke Barriers

- Mandated where a high degree of both fire and smoke protection is desired.
- Used to create refuge compartments that allow occupants to safely await assistance or rescue.
- Must be minimum 1-hour assemblies while also providing a high degree of smoke resistance.

Exterior Walls

- Rated exterior walls provide separation from internal or external fires.
- Also often provide for the protection of outdoor exit travel.
- Must be minimum 1-, 2- or 3-hour assemblies if within fire separation distance.

Horizontal Assemblies

- Typically used with fire-resistance-rated wall assemblies to provide compartmentation in multistory buildings.
  - In most cases, the ceiling and floor work together, as well as independently, to provide the intended separation.
  - Required to be minimum ½-, 1-, 2-, 3-, or 4-hour fire-resistance-rated assemblies.

Smoke-resistant Separations

- In addition to the use of smoke barriers, the IBC also recognizes smoke partitions as a means to resist the passage of smoke.
  - Smoke partitions required where smoke movement of is a concern; however, fire is not primary consideration.
  - Smoke partitions are not required to have a fire-resistance rating.
Prescriptive Separations

- Mandated where limited degree of separation is desired. (IBC Table 721.1)
  - Not required to be tested and listed assemblies, these separation elements adequately serve a specific need.

- Applications include:
  - Gypsum board.
  - Nonrated floor construction.
  - Construction capable of restricting smoke migration.

Separation Types

1. Horizontal assemblies required to be minimum ½-, 1-, 2-, 3-, or 4-hour fire-resistance-rated assemblies. **TRUE**

2. A smoke partition must have a fire resistance rating of __0__ hours. **FALSE**

3. All exterior walls are required to be minimum 1-, 2- or 3-hour fire-resistance-rated assemblies. **FALSE**

4. Fire walls must have a minimum fire resistance rating of __2__ hours.

5. Exterior walls, if within the fire separation distance, must have a rating of __1__, __2__, __3__ or __3__ hours.

6. IBC Table __721.1__ allows the use of prescriptive materials in lieu of listed assemblies.

Components of Fire and Smoke Separations
Vertical Elements

- A variety of different walls and partition assemblies are established in the IBC to provide varying degrees of fire and/or smoke separation.

- In addition to vertical assemblies that are tested and listed as fire-resistance-rated, modified assemblies and prescriptive-based separation elements are selectively addressed throughout the code. Table 721.1

Wall assemblies such as fire walls, fire barriers, fire partitions, smoke barriers and exterior walls must be provided with fire-resistance ratings as determined in accordance with ASTM E119 or UL 263, or meet prescriptive specifications. Required fire-resistance ratings vary and are required based on the intended purpose of the separation.

Partial assemblies based on listed assemblies are also recognized in limited applications, typically where the potential hazard is assumed to exist only on one side of the separation element.  
- Control rooms
- Areas of Refuge
- Incidental spaces
- Shaft enclosures
- And more

Horizontal Elements

- Horizontal assemblies are also tested and listed assemblies that resist the spread of fire vertically.

- Fire-resistance-rated floors and floor/ceiling assemblies can provide varying degrees of fire-resistance.

- Non-rated horizontal elements also provide a significant level of separation and are regulated under a variety of conditions. (See 714.5 Penetrations and 717.6.3 Ducts)
**Vertical/Horizontal Combination**

- Vertical and horizontal elements used to completely separate one area from another.

**Doors**

- In a few cases, a prescriptive means of door protection is mandated.
  - For example, a solid-wood or honeycomb core doors of a specified thickness might be established as the minimum required door.

- At times, the code does not regulate door assemblies in a fire rated assembly.
  - The most common examples are:
    - fire-resistance-rated exterior walls where opening protection is not required
    - Loadbearing walls protected per Table 601

**Windows**

- Windows are typically regulated in the same manner as doors.
  - Fire-protection-rated glazing.
  - Fire-resistance-rated glazing.
  - **Fire-resistance-rated glazing** is regulated in much the same manner as fire-resistance-rated wall assemblies.
Windows

Fire-resistance-rated glazing is regulated in much the same manner as fire-resistance-rated wall assemblies, including testing in accordance with ASTM E 119 or UL 263.

There are situations in the code where nonrated glazing is permitted in fire/smoke separation walls, such as:
- where security glazing is needed - Group I-3,
- where smoke is the only concern - corridor walls in Group I-2, or
- where fire-resistance-rated exterior walls are permitted with unprotected openings.

Penetrations

- Penetrations must typically be protected by firestop systems rated to the same level as the element penetrated.
  - Through penetration of Membrane Penetration systems
- Prescriptive methods of penetration protection are also established.
  - steel pipe penetrations - protect annular space with concrete, grout or mortar

Joints

- Fire-resistant joint systems are REQUIRED where joints occur in separation walls requiring opening protection.
**Air Movement**

- Fire dampers, smoke dampers, combination dampers, ceiling radiation dampers and **corridor dampers** are selectively required in ducts and air openings in separation elements.
- Dampers may be omitted in a variety of situations where their use has been determined to be unnecessary.
- Non-rated floor assemblies may still require protection of duct penetrations (Section 717.6.3)

**Components**

1. All fire resistive assemblies must be listed in accordance with ASTM E119 or UL 263.  **FALSE**
2. Horizontal fire resistive elements include all of the following except:
   - a) Floor-ceiling assemblies
   - b) Roof-ceiling assemblies
   - c) Floor assemblies
   - d) Fire walls

3. Name two circumstances where non-rated glazing may be installed in separation walls.
   1. where security glazing is needed,
   2. where smoke is the only concern, or
   3. where fire-resistance-rated exterior walls are permitted with unprotected opening: **TRUE**

5. Fire-resistant joint systems are mandated where joints occur in separation walls requiring opening protection. **TRUE**
Separation Locations

- Building Size, Use and Components
- Means of Egress
- Fire Limitation Features
- Special Building Types
- Special Occupancies and Uses
- Special Building Features
- Hazardous Uses

Building Height & Area – 503.1

- Use of fire wall now limited to only the determination of permissible types of construction, based upon allowable building height and area.
- Designer option
- Fire wall no longer permitted as means to create separate, smaller buildings for other purposes of the code

Plan View

Building “A”
- Group B
- VB construction
- 9,000 sq ft
- 2 stories
- 40 ft (nonsprinklered)

Building “B”
- Group B
- IIB construction
- 23,000 sq ft
- 3 stories
- 55 ft (nonsprinklered)

Fire wall complying with Section 706

For ft: 1 foot = 304.8 mm, 1 square foot = 0.093 m².

Copyright 2017 International Code Council
For SI: 1 square foot = 0.0929 m².

**Fire Wall Application for Building Height and Area – Example #1**

- **Building "1"**
  - Area “A”
    - Group A-3
    - 4,000 sq. ft.
  - Area “B”
    - Group M
    - 10,000 sq. ft.

- **Building "2"**
  - Area “C”
    - Group B
    - 15,000 sq. ft.

**706.1.1 Party Walls – Exception #2**

- Required use of a party wall (fire wall) at the lot line between two adjacent buildings where there is joint service between the buildings is no longer required where:
  1. The aggregate height and area of the portions of the building located on both sides of the lot line do not exceed the maximum allowed, and
  2. Dedicated easements and contractual agreements that allow either owner access to the other portion of the building to maintain fire and safety systems are provided to the building official.

**Building Height & Area – 706.1.1**

- Fire walls nor party walls, are required to be used on lot lines dividing a building for ownership purposes.
Fire Wall Ratings – Table 706.4

- Rating requirements based on the buildings’ construction type(s) and occupancy classification(s).

<table>
<thead>
<tr>
<th>GROUP</th>
<th>FIRE-WALL FIRE-RESISTANCE RATINGS</th>
</tr>
</thead>
</table>
| A, B, E, H-4, I, R-1, R-2, U | 3
| F-1, H-3, H-5, M, S-1 | 3
| H-1, H-2 | 4
| F-2, S-2, R-3, R-4 | 2

- a. In Type II or V construction, walls shall be permitted to have a 2-hour fire-resistance rating.
- b. For Group H-1, H-2 or H-3 buildings, also see Sections 415 and 415.8.

Fire Walls

- Provide variety of other alternative solutions to the designer:
  - Multiple types of construction.
  - Reduction/elimination of fire protection features.
  - In IFC, fire walls may be used to reduce fire flow requirements.

Separated Occupancies – 508.4.4.1

- In a mixed-occupancy building, fire barriers and/or horizontal assemblies are utilized under the separated occupancies method.

- Table 508.4 establishes the minimum required fire-resistance for pairs of incompatible occupancies.

Separated Occupancies – Table 508.4

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- S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.
- NF = Buildings not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.
- R - Not required.
- NP = Not permitted.
- NS = No separation required.
- a. The required separation from areas used only for private or pleasure vehicles shall be reduced by 1 hour but not to be less than 1 hour.
- b. See Section 508.3.
- c. See Section 406.3.2.
- d. Separation is not required between occupancies of the same classification.
- e. See Section 422.2 for probability of fire hazards.
- f. The required fire separation criteria are based on the occupancy limits established in Chapter 9 for requiring fire protection systems shall also comply with Section 707.3.10 and Table 707.3.10 in accordance with Section 901.7.
Incidental Uses – 509.4.1

- Where an incidental use as listed on Table 509 is present, it must selectively be separated from other portions of the building by fire barrier and/or horizontal assembly as established by Table 509.

- In some cases, an alternative method of protection is permitted by the table.

Incidental Uses – 509.4.2

- Where Table 509 permits sprinkler protection without a fire barrier, incidental uses must be separated by construction capable of resisting the passage of smoke.

  - Doors/air openings regulated for smoke resistance.
**Horizontal Building Separation**  
Section 510.2, #1

- Where separate and distinct buildings are created **one above the other**, the buildings shall be separated with a minimum 3-hour **horizontal assembly**. -- Podium/platform construction.
- When separated and compliant with several other conditions, **buildings can be regulated independently for allowable area and number of stories, and fire wall continuity**.

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**Horizontal Separation - 510.2**

1. **Type IIA construction**
2. Occupancies can include Groups A (DCL <200), B, M, R1, and R2 in upper building.
3. Shafts, stair, ramp through horizontal assembly to have not less than 2-hour fire rating.
4. 3-hour horizontal assembly.
5. Fully sprinklered beneath horizontal assembly and permitted to be all occupancies except Group H.

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**Type IIA Group R-1 and R-2 Buildings – 510.5**

- Increase to 6 stories and 75 feet.
- 2-hour separations ≤ 3,000 ft².
Type IIA Group R-1 and R-2 Buildings - 510.6

- Where special height increases are applied for Type IIA Group R-1 and R-2 buildings, minimum 2-hour fire walls are required to segregate the exits.
- Allows nine stories and 100 feet.

Open Parking Beneath Groups A, I, B, M and R – 510.7.1

- Where special height and area allowances are permitted for open parking garages below Group A, I, B, M and R occupancies, means of egress for the upper occupancy shall be separated from the parking by minimum 2-hour fire barriers.

Group B or M with Group S-2 Open Parking Garage – 510.8, #1 and #7

- Where a Group B or M occupancy is located above an open parking garage and considered as separate buildings for type of construction purposes, in addition to other requirements, the buildings must be separated by a minimum 2-hour horizontal assembly.
Buildings on Same Lot – 503.1.2

- Where two or more buildings are located on the same lot, they shall be regulated as separate buildings, or as portions of a single building.
  - If regulated as separate buildings, the opposing exterior walls must be evaluated based on fire separation distance.

Exterior Walls – 705.5

- For separation purposes, exterior walls near lot lines, or other buildings on the same lot, are required to be fire-resistance-rated as set forth in Table 602.
  - The primary concern is radiant heat transfer from one building to another.
**Exterior Walls – Table 602**

<table>
<thead>
<tr>
<th>FIRE SEPARATION DISTANCE = X (feet)</th>
<th>TYPE OF CONSTRUCTION</th>
<th>OCCUPANCY</th>
<th>OCCUPANCY</th>
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<tr>
<td>&lt; 5</td>
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<td>5 ≤ X &lt; 30</td>
<td>IA</td>
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<td>Others</td>
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<tr>
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<td>IA, IB</td>
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<td>Others</td>
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<tr>
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<td>All</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.

**Exterior Walls – 705.5**

- The required fire-resistance rating of exterior walls with a fire-separation distance of more than 10 feet shall be rated for exposure from fire from the inside.
- The required fire-resistance rating of exterior walls with a fire-separation distance of less than or equal to 10 feet shall be rated for exposure from fire from both sides.
Shaft Enclosures – 713

- Shaft enclosures are a permissible method of protecting openings and penetrations through floor/ceiling and roof/ceiling assemblies.
- Shaft enclosures shall be constructed as fire barriers and/or horizontal assemblies.

Shaft Enclosure Fire Ratings – 713.4

- Shaft enclosures shall have a minimum fire-resistance rating of:
  - 2 hours where connecting 4 or more stories.
  - 1 hour where connecting 3 or fewer stories.
  - 2 hours where penetrating a floor assembly of two or more hours.

Chute Access and Discharge Rooms – 713.13.3 and 713.13.4

- Waste and linen chutes access openings must be located in rooms or compartments enclosed by not less than 1-hour fire barriers and/or horizontal assemblies.
- Discharge rooms shall be separated from the remainder of the building by fire barriers and/or horizontal assemblies having a rating equal to the shaft enclosure.

Hoistway Opening Protection – 3006.3, #1 and #2

- Where elevator lobbies are required, they shall be constructed with fire partitions.
- Where the building is fully sprinklered, smoke partitions may be used to separate the elevator lobby at each floor.
Building Use, Size & Components

1. The required fire-resistance rating of exterior walls with a fire-separation distance of more than 10 feet shall be rated for exposure from fire from the inside and outside. **TRUE**

2. Where special height increases are applied for Type IIA Group R-1 and R-2 buildings to allow nine story buildings, minimum 2-hour fire walls are required to segregate the exits.

Exit Access Stairways – 1019.3

- Exit access stairways to be enclosed by shaft enclosures (fire barriers) having a minimum fire-resistance ratings in accordance with Section 713:
  - 2-hour serving 4 stories or more.
  - 1-hour serving 2 or 3 stories.

- There are eight exceptions to this requirement!

Exit Access Ramps – 1019.3

- Exit access ramps are required to be enclosed with shaft enclosures (fire barriers) under the same conditions as for exit access stairways.

- Due to the limited use of ramps connecting 3 or more stories, the application of this provision is very limited.
Interior Exit Stairways and Ramps – 1023.2
- Enclosures for interior exit stairways and ramps shall be fire barriers and/or horizontal assemblies, with a minimum rating of:
  - 2 hours where connecting 4 or more stories.
  - 1 hour where connecting 3 or fewer stories.
- The enclosure shall have a fire-resistance rating not less than the floor assembly penetrated, but need not exceed 2 hours.

Extension of Interior Exit Stairways and Ramps – 1023.3.1
- A horizontal extension of an interior exit stairway or ramp, where required, shall be by an exit passageway constructed with fire barriers and/or horizontal assemblies.
- The exit passageway shall have a minimum fire-resistance rating equal or greater to that of the connected interior exit stairway or ramp.
- There shall be a fire door assembly between the exit passageway and exit stairway.

Extension of Interior Exit Stairways and Ramps
Section 1023.3.1
- A horizontal extension of an interior exit stairways or ramp, where required, shall be by an exit passageway constructed with fire barriers and/or horizontal assemblies.
- The exit passageway shall have a minimum fire-resistance rating equal or greater to that of the connected interior exit stairway or ramp.

Smokeproof Enclosures and Pressurized Stairways and Ramps – 1023.11.1
- Where required for high-rise buildings, underground buildings or aircraft-related occupancies, smokeproof enclosures and pressurized stairways may be extended by an exit passageway.
- Fire barriers and/or horizontal assemblies must have a minimum 2-hour fire-resistance rating.
Exit Passageways – 1024.3

- Exit passageways, where provided, shall be enclosed by fire barriers and/or horizontal assemblies with a minimum 1-hour fire-resistance rating.
- The rating cannot be less than that required for any connected interior exit stairway or ramp.

Horizontal Exits – 1026.2

- Horizontal exits, where provided, shall be constructed with fire walls, or by fire barriers with a minimum 2-hour fire-resistance rating.
- The separation shall extend vertically through the entire building unless floor assemblies have a minimum 2-hour fire-resistance rating.
- A horizontal exit creates refuge areas such that smoke protectives are also required.

Horizontal Exits – 1026.4

Exterior Exit Stairways and Ramps – 1027.6

- Exterior exit stairways and ramps shall be separated from the interior of the building consistent with the protection required for interior exit stairways and ramps.
- Fire barrier construction is required for those exterior walls adjacent to the exterior stairway or ramp.
**Exterior Stairways and Ramps – 1027.6**

Rating comes from Section 1023.7

<table>
<thead>
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<th>Rating comes from Section 1023.2</th>
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<tr>
<td>≥ 1-hr w/ 7/8-hr prot openings</td>
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<td>1-hr or 2-hr egress door as only opening</td>
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<td>≥ 10 ft</td>
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**Spaces under Grandstands and Bleachers – 1029.1.1.1**

- Usable spaces must be separated from grandstands and bleachers above by minimum 1-hour fire barriers and/or horizontal assemblies.
- **Not apply to:**
  - toilet rooms
  - small ticket booths
  - Accessory area < 1000 sf.

**Corridors – 1020.1**

- Corridors shall be fire-resistance rated in accordance with Table 1020.1.
- Corridor walls are required to be constructed as fire partitions.
  - Where interrupted by a lobby, foyer or reception area, the fire partition protection shall extend behind such spaces.

**Corridor Construction – Table 1020.1**

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<thead>
<tr>
<th>TABLE 1020.1 CORRIDOR FIRE-RESISTANCE RATING</th>
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<td>Without sprinkler system</td>
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<tr>
<td>H-1, H-2, H-3</td>
</tr>
<tr>
<td>H-4, H-5</td>
</tr>
<tr>
<td>A, B, E, F, M, S, U</td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>H-2²</td>
</tr>
<tr>
<td>L, L-3</td>
</tr>
<tr>
<td>L-4</td>
</tr>
</tbody>
</table>

- For requirements for occupancies in Group I-2, see Sections 407.2 and 407.3.
- For a reduction in the fire-resistance rating for occupancies in Group I-3, see Section 408.8.
- Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 where allowed.
- Buildings equipped throughout with an automatic sprinkler system in accordance with Section 603.3.1.3. See Section 903.2.8 for occupancies where automatic sprinkler systems are permitted in accordance with Section 603.3.1.1.

---

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Fire resistance continuous from point of entry to an exit and not interrupted by intervening rooms …

**Exception:**
Where interrupted by a lobby, foyer or reception area, the fire partition protection shall extend behind such spaces.

---

**Corridor Continuity – 1020.6**

---

**Egress Balconies – 1021.2**

- Exterior egress balconies shall be separated from the interior of the building by fire partitions and openings as required for corridors.
- Separation is not required where two specified conditions are met:
  - Two available stairways, and,
  - Dead-ends do not pass unprotected opening

---

**Areas of Refuge – 1009.6.4**

- Each area of refuge in an accessible means of egress shall be separated from the remainder of the story by a smoke barrier or horizontal exit.
- Areas of refuge must be designed to minimize the intrusion of smoke.
Exterior Area for Assisted Rescue – 1009.7.2

- Exterior walls separating an exterior area for assisted rescue from the interior of the building shall have a minimum fire-resistance rating of 1-hour, rated for exposure from the interior.
- Wall rating and opening protectives not required where building fully sprinklered

Egress Courts – 1028.4.2

- Exterior walls adjacent to an egress court shall have a minimum 1-hour fire-resistance rating for at least 10 feet above the walking surface where the court is less than 10 feet in width.
  - Exceptions, Egress court that:
    - serves an occupant load less than 10, and
    - serves other than a Group R-3 occupancy.
Enclosures under Interior Stairways – 1011.7.3
- Walls and soffits within enclosed usable spaces under enclosed and unenclosed interior stairways shall be protected by minimum 1-hour fire-resistance-rated construction, or the rating of the enclosure, whichever is greater.

Enclosures under Residential Interior Stairways 1011.7.3, Exception
- Spaces under stairways serving an individual Group R-2 or R-3 dwelling unit are required, at a minimum, to be protected on the enclosed side of the stairway with minimum \( \frac{1}{2} \)-inch gypsum board.

Enclosures under Exterior Stairways – 1011.7.4
- No enclosed usable space is permitted under an exterior exit stairway unless it is completely enclosed in 1-hour fire-resistance-rated construction.

Interior Exit Discharge – 1028.1, Exception 1.2
- Where an interior exit stairway is permitted to egress through a discharge level lobby or similar space, as one condition the discharge level must be separated from areas below by construction conforming to the fire-resistance rating of the enclosure.
### Interior Exit Discharge – 1028.1, Exception 1

1. **Entire area of level shall be separated from areas below by construction equivalent to the stair enclosure.**
2. **Egress path from exit stairway to discharge shall be sprinklered and all rooms and portions of the level having access to the egress path shall be sprinkled or separated from the egress path by construction equivalent to the stair enclosure.**
3. **Distance between exit access stair and exit discharge door shall be at least 30' or 1/4 length of overall diagonal of building, whichever is less.**

### Interior Exit Discharge – 1028.1, Exception 2.3

1. **Discharge level must be separated from areas below by construction conforming to the fire-resistance rating of the enclosure.**

### Fire Areas – 901.7

- Many of the sprinkler thresholds are based on size of fire area.
- Where buildings are divided into fire areas so as not to exceed the limits of Section 903 for requiring an automatic sprinkler system, the fire areas shall be separated by fire barriers and/or horizontal assemblies having a minimum fire-resistance rating as set forth in Table 707.3.10.
Fire Areas – 901.7

- The use of a **fire wall** to create separate, smaller buildings also creates smaller fire areas as well.
- Therefore, fire areas can be established by use of:
  - Fire Wall
  - Fire Barrier
  - Horizontal Assembly
- Or a combination of the above

Smokeproof Enclosures – 909.20.2

- A smokeproof enclosure shall be separated from the remainder of the building by minimum 2-hour **fire barriers and/or horizontal assemblies**.
- In addition, the vestibule must be separated from the stairway by minimum 2-hour **fire barriers and/or horizontal assemblies**.

Stair Pressurization Alternative – 909.20.6.1

- Smokeproof enclosure ventilation systems shall be isolated from the remainder of the building by minimum 2-hour **fire barriers and/or horizontal assemblies**.
- Protection shall be provided for equipment, control wiring, power wiring and ductwork.
Fire Command Center – 911.1.2

- Fire command centers, where required, shall be separated from the remainder of the building by minimum 1-hour fire barriers and/or horizontal assemblies.

Fire Pump Rooms – 913.2.1

- Fire pumps shall be located in rooms separated from all other portions of the building by minimum 2-hour fire barriers and/or horizontal assemblies.
  - In other than high-rise buildings, where the building is fully sprinklered, the fire barriers and/or horizontal assemblies must have a minimum 1-hour fire-resistance rating.

Fire Alarm Systems in Group R Occupancies – 907.2.8.1 & 907.2.9.1

- In select Group R occupancies not exceeding 2-stories, an otherwise-mandated fire alarm system may not be required where the units are separated from each other and the public and common areas by minimum 1-hour fire partitions.
  - Other conditions must also be met.
**Smoke Control Systems – 909.5**

- Where construction elements are used as a part of a smoke control system, *smoke barriers* shall be provided.
- The maximum allowable leakage area is to be calculated and reviewed for compliance.

**Mall/Anchor Building Separation – 402.4.2.2**

- An anchor building shall be separated from a covered or open mall building by a *fire wall*.
- Where the anchor building is 3 stories or less, minimum 2-hour *fire barriers* are permitted.

**Mall/Parking Garage Separation – 402.4.2.3**

- An attached parking garage shall be separated from a covered mall building, open mall building or anchor building by a minimum 2-hour *fire barrier* and/or *horizontal assembly*. 
Mall Tenant Separations – 402.4.2.1

- Each tenant space within a mall building shall be separate from other tenant spaces by a fire partition.
- No separation wall is required between the tenant space and the mall.

Standby Power Protection in High-rise Buildings – 403.4.8.1

- If a generator within the building is used for standby power in a high-rise building, it shall located in a separate room enclosed with minimum 2-hour fire barriers and/or horizontal assemblies.

Atrium Sprinkler Protection Section 404.3, Exception 1

- Sprinklers are required throughout a building containing an atrium.

EXCEPTION #1: Sprinkler protection is not required for areas adjacent to and above the atrium space provided that portion is separated from the atrium by minimum 2-hour fire barriers and/or horizontal assemblies.

Atrium Separation – 404.6

- Atrium spaces shall be separated from adjacent spaces by a minimum 1-hour fire barrier and/or horizontal assembly.
  - The 1-hour separation is not required under one of three exceptions,
    1. where glazed enclosure is protected by an automatic sprinkler system,
    2. ¾ hour glass block is utilized, or
    3. Open to not more than 3 stories
Atrium Separation – 404.6, Exception 1

- Areas requiring sprinkler protection between 4 inches and 12 inches away from the glass that covers entire surface
- Sprinkler protection required on both sides of glass, except only needed on room side when no walking surface on atrium side

Underground Building Compartmentation – 405.4

- A building with a floor level more than 60 feet below the lowest discharge level must be divided into at least two compartments, created through the use of smoke barriers.
- Elevators that serve more than one compartment shall be provided with an elevator lobby separated from each compartment by a smoke barrier.

Special Occupancies and Uses

- Private Garage Buildings – 406.3.1
  - Multiple 1,000-square-foot private garages are permitted within the same structure where each private garage is separated by minimum 1-hour fire barriers, horizontal assemblies, or both.
Garage Dwelling Separations – 406.3.4.1

- A private garage shall be separated from the dwelling unit by minimum ½-inch gypsum board on the garage side.
- Garages with habitable rooms above shall be separated by not less than 5/8-inch Type X gypsum board.

Group I-2 Smoke Compartments – 407.5

- Every story in a Group I-2 occupancy* where persons receive care or those having an occupant load of 50 or more shall be divided into at least two smoke compartments by smoke barriers.

*24-hour care for 5 or more who are incapable of self-preservation.

Group I-2 Corridors – 407.3

- Corridor walls in a Group I-2 occupancy shall be constructed as smoke partitions.
- Waiting areas and similar spaces constructed as required for corridors are permitted to be open to the corridor.
- Doors require no closing device but shall be positive latching and limit smoke.
Group I-2 Care Suites – 407.4.4.2

- Care suites shall be separated from other portions of the building by smoke partitions.

Group I-3 Smoke Compartments – 408.6

- Every story in a Group I-3 occupancy shall be divided into at least two smoke compartments by smoke barriers when:
  - used by residents for sleeping or
  - those stories having an occupant load of 50 or more

Prisons, jails, correctional facilities where persons are under restraint or security

Group I-3 Subdivision of Resident Housing Areas – 408.8

- In Occupancy Conditions 3 and 4*, each sleeping area shall be separated from adjacent common spaces by a smoke-tight partition where distance of travel from sleeping area to corridor exceeds 50 feet.

*3= free movement in smoke zone, 4 = free movement is restricted but occupants can be released remotely

Group I-3 Interior Exit Stairways – 408.3.8

- One interior exit stairway in each building is permitted to have glazing installed in doors and walls at each landing providing access to the stairway.
  - The total glazing is limited to 5,000 square inches per floor level.
  - Sprinkler protection is required to wet the glazing completely.
Aircraft Hangar Fire Areas – 412.3.6.2

- When determining the fire suppression requirements for aircraft hangars, established fire areas shall be separated by minimum 2-hour fire walls.

Aircraft Hangar Fire Areas – 412.3.6.2

- Support areas, such as offices, shops and storage rooms, which are separated from the aircraft servicing area by minimum 1-hour fire barriers are not required to be included in the determination of fire area size.

Aircraft Hangar Heating Equipment – 412.3.4

- Heating equipment in an aircraft hangar shall be:
  - placed in a separate room and
  - separated by minimum 2-hour fire barriers and/or horizontal assemblies.
Residential Aircraft Hangar Separation – 412.4.1

- An aircraft hangar attached to a dwelling must be separated by a minimum 1-hour fire barrier.

Residential Unit Wall Separations – 420.2

- In Group I-1*, R-1, R-2 and R-3, R-4, walls separating dwelling and sleeping units in the same building, as well as separating such units from other occupancies in the building, shall be constructed as fire partitions.

- Note: If designed as separated mixed-use the separation shall be a fire barrier between occupancies.

Residential Unit Floor Separations – 420.3

- In Group I-1, R-1, R-2 and R-3 occupancies, floor assemblies separating dwelling and sleeping units in the same building, as well as separating such units from other occupancies in the building, shall be constructed as horizontal assemblies.

Ambulatory Care Facilities Separation – 422.2

- Ambulatory care facilities where there are 4 or more individuals incapable of self-preservation shall be separated from adjacent spaces, corridors and tenants by fire partitions.

*Congregate care for more than 16 residents on 24 hour basis: assisted living, group homes, alcohol and drug centers.
Ambulatory Care Facilities Smoke Compartments – 422.3

- Where the aggregate area of one or more ambulatory care facilities exceeds 10,000 square feet, smoke barriers are required to create smoke compartments.
- No individual compartment is permitted to exceed 22,500 square feet.

1. Which walls are required to have a fire-resistance rating?
   All walls, except exterior and separating Group A-3 from lobby

2. What minimum type of wall is required?  **FIRE PARTITION**

3. What fire-resistance rating is required?  1
Stage Proscenium Wall – 410.2.4

- Where the stage height exceeds 50 feet, all portions of the stage shall be separated from the seating area by a proscenium wall with a minimum 2-hour rating, extending from the foundation to the roof (fundamentally a fire barrier).
- Proscenium opening to be protected by a fire curtain or other acceptable method.

Stage Support Areas Separation – 410.4.1

- The stage shall be separated from support areas, such as dressing rooms, workshops and storerooms, by fire barriers and/or horizontal assemblies.
  - Minimum 2-hour separation required for stage heights exceeding 50 feet.
  - Minimum 1-hour separation required for stage heights of 50 feet or less.

Stage Support Areas Separation – 410.5.2

- Support areas, such as dressing rooms, workshops and storerooms, shall be separated from each other by fire barriers and/or horizontal assemblies.
  - Minimum 1-hour separation required.
Platform Construction – 410.3

- Where space beneath a permanent platform is used for storage, or any other purpose other than equipment, plumbing or wiring, the floor assembly shall be at least one-hour construction.

Elevator Machine Rooms – 3005.4

- Elevator machine rooms and spaces shall be enclosed with fire barriers and/or horizontal assemblies.
  - The fire-resistance rating shall be not less than the required rating of the hoistway enclosure served by the machinery.

Fire Service Access Elevator Lobby – 3007.6.2

- In high-rise buildings provided with fire service access elevators, the elevator shall be provided with a lobby enclosed by a smoke barrier.
  - Elevator lobbies are not required at the level of exit discharge.

Occupant Evacuation Elevator Lobby – 3008.6.2

- In high-rise buildings provided with occupant evacuation elevators, the elevator shall be provided with a lobby enclosed by a smoke barrier.
  - Elevator lobbies are not required at the level of exit discharge.
Pedestrian Walkways – 3104.5

- Pedestrian walkways shall be separated from the interior of the attached buildings by minimum 2-hour fire barriers and/or horizontal assemblies.
- An alternate separation method addresses the walkway/building connections, including the use of a tempered, wired or laminated glass wall.

Tunnels – 3104.10

- Separation between a tunneled walkway and the building to which it is connected shall be not less than 2-hour fire-resistant construction.

Combustible Storage
Section 413

- 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 and
  - Openings protected by self-closing non-combustible or 1 3/4" thick solid wood core door

EXCEPTIONS: fire-resistance construction nor open protectives required in:
1. sprinklered spaces
2. Group R-3 and U occupancies
Control Areas – 414.2.4

- Where control areas are provided for the use or storage of hazardous materials, they shall be separated by fire barriers in accordance with Table 414.2.2.
- The floor assemblies separating control areas shall be minimum 2-hour horizontal assemblies.
  - Exception permits 1-hour assemblies under specified conditions.

Control Areas - Section 414.2.4

- Where control areas are provided for the use or storage of hazardous materials, they shall be separated by fire barriers in accordance with Table 414.2.2. (1- or 2-hour)
- The floor assemblies separating control areas shall be minimum 2-hour horizontal assemblies. (This includes supporting construction)
  - Exception for IIA, IIIA and VA construction permits 1-hour assemblies under specified conditions.

Control Areas – Table 414.2.2

<table>
<thead>
<tr>
<th>Floor Level</th>
<th>Percentage of the Standard Allowable Quantity</th>
<th>Number of Control Areas</th>
<th>Fire-Resistance Rating for Fire Barriers in Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above grade</td>
<td>100%</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Below grade</td>
<td>100%</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Grinding Rooms – 426.1.2

- Rooms used for grinding or other operations that produce combustible dusts shall be enclosed with fire barriers and/or horizontal assemblies.
- The required fire-resistance rating is based on the floor area of the room:
  - 2 hours, where 3,000 square feet or less.
  - 4 hours, where more than 3,000 square feet.
Group H-3 and H-4 Gas Rooms – 415.10.2

- Where Group H-3 or H-4 gas rooms are provided, they shall be separated from other areas by minimum 1-hour fire barriers and/or horizontal assemblies.

Highly Toxic Solids and Liquids – 415.10.4

- Where highly toxic solids and liquids are not stored in approved hazardous materials storage cabinets, they shall be isolated from other hazardous material storage by minimum 1-hour fire barriers and/or horizontal assemblies.

Group H-5 Fabrication Areas – 415.11.1.2

- Fabrication areas in Group H-5 occupancies shall be separated from:
  1. each other,
  2. from corridors and
  3. from other parts of the building
   by minimum 1-hour fire barriers and/or horizontal assemblies.

Flammable Finish Spray Rooms – 416.2

- In buildings used for the application of flammable finishes, spray rooms shall be enclosed with minimum 1-hour fire barriers and/or horizontal assemblies.
Manufacturing of Organic Coatings – 418

- In buildings used for the manufacture of organic coatings, a variety of fire separations are required using fire barriers and/or horizontal assemblies:
  - Storage areas for flammable and combustible liquid tanks: 2 hours
  - Nitrocellulose storage rooms: 2 hours
  - Storage rooms for finished products that are flammable or combustible liquids: 2 hours

Final Reflection

This slide will help the learner to reflect on the day and what they will take back to the job and apply.

- **What?** What happened and what was observed in the training?
- **So what?** What did you learn? What difference did this training make?
- **Now what?** How will you do things differently back on the job as a result of this training?

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Dampers

The damper requirements of the IBC are duplicated in Section 607 of the IMC

- IBC Section 717 (IMC 607) addresses both ducted and unducted (air transfer openings) systems
- Provisions of these sections address damper test standards, types of dampers, actuation, access and where the various dampers are required

Five general types of dampers

Each type of damper has a very specific application and is tested to show compliance with the intended application

- It is important to verify that the specified and installed damper is the correct damper for that application

Five types of dampers

- Fire damper
- Smoke damper
- Combination fire and smoke damper
- Corridor damper
- Ceiling radiation damper

Fire Damper

Smoke Damper

Combination Fire & Smoke Damper

Ceiling Radiation Damper

Corridor Damper
Damper test standards

Fire dampers - UL 555
Smoke dampers - UL 555S
Ceiling radiation dampers – UL 555C or tested as a part of FR-rated horizontal assembly
Combination damper – UL 555 and UL 555S

- All dampers are listed and must have a label
- Must be installed in accordance with manufacturer’s installation instructions
- Where smoke and fire damper are required, may use separate dampers or combination damper

Manufacturer’s Installation Instructions

- Must be followed for installation (717.2)
- Are a requirement of the listing
- Must be available for installation and inspection since variations occur between dampers and manufacturers
- Along with listing, they can help determine orientation and whether damper is allowed in a dynamic system

Dynamic Dampers

Intended to be installed where air may continue to move through the system
- Tested and labeled for specific airflow and pressure
- Must be capable of closing against the anticipated design conditions (airflow/pressure)
- Are allowed in “static” systems (airflow shutdown)

Dynamic Dampers

Are marked with airflow rating and a closing pressure rating
- Airflow in 1,000 fpm increments (2,000 fpm minimum)
- Closing pressure rating in 2-inch water gage increments (4-inch WG minimum)
Installed damper must exceed maximum anticipated airflow and pressure – which can vary from normal airflow conditions
Static vs. Dynamic Dampers

**STATIC RATED:** Not Tested with Airflow Through Damper

- Duct
- No Airflow

**DYNAMIC RATED:** Tested with Heated Airflow Through Damper

- Duct
- Heated Airflow
- 2000FPM @ 4”w.g.

Fire Damper Ratings

<table>
<thead>
<tr>
<th>TYPE OF PENETRATION</th>
<th>MINIMUM DAMPER RATING (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 3-hour fire-resistance-rated assemblies</td>
<td>1.5</td>
</tr>
<tr>
<td>3-hour or greater fire-resistance-rated assemblies</td>
<td>3</td>
</tr>
</tbody>
</table>

Smoke Damper Ratings

- Details are primarily found in UL 555S test standard
- May be used in static or dynamic systems but are designed to operate against an airflow and pressure (in order to limit air leakage)
- UL 555S test allows listing of Class III damper but IBC and IMC only allow Class I or Class II

Smoke Damper Ratings

<table>
<thead>
<tr>
<th>Class</th>
<th>4” in. WG</th>
<th>6” in. WG</th>
<th>8” in. WG</th>
<th>10” in. WG</th>
<th>12” in. WG</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>8.0</td>
<td>9.5</td>
<td>11.0</td>
<td>12.5</td>
<td>14.0</td>
</tr>
<tr>
<td>T</td>
<td>20.0</td>
<td>24.0</td>
<td>28.0</td>
<td>31.5</td>
<td>35.0</td>
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<tr>
<td>II</td>
<td>80.0</td>
<td>96.0</td>
<td>112.0</td>
<td>125.0</td>
<td>140.0</td>
</tr>
</tbody>
</table>

Smoke dampers are tested at elevated temperatures and must be labeled with the temperature used to determine the leakage ratings:

- Temperature ratings in increments of 100°F (250°F minimum)
  - 250°F rating is generally adequate, but Section 909.10 may require a higher rating for some smoke control systems.
Remember, fire dampers and smoke dampers are tested to different standards.

Verify by looking at the label that the correct damper is being used.

Fire damper and ceiling radiation damper actuation

Done by one of the following:
- Operating temperature approximately 50°F above normal temperature in the duct
- But not less than 160°F
- Operating temperature up to 350°F allowed for smoke control system
Smoke damper actuation

This reduced coverage smoke detection system is only allowed to control the smoke dampers installed within the corridor walls or ceiling.

Access and identification

Approved means of access must be provided:

- Large enough to permit inspection and maintenance
- Shall not reduce fire-resistance of assembly
- Be identified
Access and identification

Where dampers are required

- Section 717.5 lists locations where dampers are required for walls and specifies the type of damper required at each location.

- Section 717.6 specifies the location and type of damper required for horizontal assemblies.
Where dampers are required

Plans should specify the location and type of damper to be installed. Inspector should verify correct type of damper is at each location.

- Section 717.5 says:
  “where an assembly is required to have both fire dampers and smoke dampers, combination fire/smoke dampers or a fire damper and a smoke damper shall be provided.”

Ceiling radiation dampers

Ceiling radiation dampers (CRD) used to limit passage of fire and heat through opening in ceiling membrane of a fire-resistive assembly

- Test details in 717.3.1
  - Test to UL 555C, or
  - As part of the full horizontal assembly test

Since CRD limits amount of heat through them, cannot substitute a fire damper at this location

- CRDs don’t have hourly rating
  - Tested for use in specific assemblies, or are
  - Tested as alternate to a hinged door damper from assembly test

Quick reference – Damper requirements for walls

<table>
<thead>
<tr>
<th>Section</th>
<th>Wall type</th>
<th>Reference</th>
<th>Type of damper</th>
</tr>
</thead>
<tbody>
<tr>
<td>717.5.1 (IMC 607.5.1)</td>
<td>Fire walls</td>
<td>706.11</td>
<td>Fire damper</td>
</tr>
<tr>
<td>717.5.1.1 (IMC 607.5.1.1)</td>
<td>Fire wall – Horizontal exits</td>
<td>706.11</td>
<td>Fire damper, Smoke damper</td>
</tr>
<tr>
<td>717.5.2 (IMC 607.5.2)</td>
<td>Fire barriers</td>
<td>707.10</td>
<td>Fire damper</td>
</tr>
<tr>
<td>717.5.2.1 (IMC 607.5.2.1)</td>
<td>Fire barriers – Horizontal exits</td>
<td>707.10</td>
<td>Fire damper, Smoke damper</td>
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<tr>
<td>717.5.3 (IMC 607.5.3)</td>
<td>Shaft enclosures</td>
<td>713.10</td>
<td>Fire damper, Smoke damper</td>
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<tr>
<td>717.5.4 (IMC 607.5.3)</td>
<td>Fire partitions</td>
<td>708.9</td>
<td>Fire damper</td>
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<tr>
<td>717.5.4.1 (IMC 607.5.4)</td>
<td>Fire partitions – Corridors</td>
<td>708.9</td>
<td>Fire damper, Smoke damper</td>
</tr>
<tr>
<td>717.5.5 (IMC 607.5.4)</td>
<td>Smoke barriers</td>
<td>709.8</td>
<td>Smoke damper</td>
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<tr>
<td>717.5.6 (IMC 607.5.6)</td>
<td>Exterior walls</td>
<td>705.10</td>
<td>Fire damper</td>
</tr>
<tr>
<td>717.5.7 (IMC 607.5.7)</td>
<td>Smoke partitions</td>
<td>710.8</td>
<td>Smoke damper</td>
</tr>
</tbody>
</table>

Ceiling radiation dampers
Ceiling radiation dampers

- Three items allow CRD to be exempted
  - Tested to ASTM E 119 or UL 263 showing CRD not required
  - Exhaust duct penetration within wall cavity and complying with Section 714.5.2
  - Use of duct outlet protection system

UL 263 Duct outlet protection systems - Another way to eliminate a CRD

System A:
- Only permitted when specified within the individual horizontal assembly’s design

System B:
- May be used in any design that contains a steel duct protected by a hinged door damper in the test
  - Limited to equal or smaller size outlet than was tested with a hinged door damper

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Damper installation

Four aspects usually only addressed within the installation instructions are:
1. The space around a damper when it is installed in the opening.
2. The requirement for a sleeve if the damper is installed within a duct.
3. The attachment and potential break-away feature for any duct attached to the damper or sleeve.
4. Whether the opening through the assembly must be lined with some material such as gypsum board or may leave the framing members exposed.

Installation instructions will provide minimum annular space around damper
- Space is required to allow expansion and movement
  - Example: May require 1/8 inch per foot of damper on all sides
  - Gap is OK. It is tested this way
  - Filling required gap would void listing

Retaining angles:
- Generally cover annular space or gap
- Hold damper or sleeve in opening but allow for movement — if attached to wall they may void listing
- Generally overlap wall by 1 inch minimum
- Attachment is covered by item 7 of SMACNA table

Do not place sealants around/between retaining angles and assembly or damper unless indicated in listing or installation instructions
- Sealants could void listing
- Could restrict damper movement
- Always check listing if sealant is used/desired
**Sleeve for damper**

Use of a sleeve is not a specific code requirement

- Simplifies installation and ductwork attachment
- May come from factory or be field constructed
- Manufacturer’s installation instructions will address. See items 4, 5 and 6 from SMACNA table

- Thickness of sleeve generally increases based on duct size and type of connection to duct
- Manufacturer’s instructions should show
  - Thickness
  - Minimum extension
  - Details of how it is held into the opening

**Breakaway connections**

Connection to damper or damper sleeve must allow ductwork to breakaway and not pull damper from the opening

- Types of connections and locations are specified in installation instructions
- UL 555 shows various types of connections
- Test is required by UL 555

**Breakaway test – UL 555**

Damper remains in the rated wall after duct “breaks” away from the sleeve

Weight of sand in barrel varies. 220 pounds if duct 24 inches or less, 440 pounds if duct > 24 inches

**Preparation of opening**

Listing and manufacturer’s instructions will include details regarding preparation of opening

- Information is from item 13 of SMACNA table and dependent on testing
- No general code requirement either exempting or requiring

- Verify with manufacturer’s installation instructions
- As a general rule of thumb:
  - Many wood assemblies will require a layer of fire-resistive protection in the opening
  - Metal frame assemblies may not require protection
Maintenance and inspections

Once installed, dampers must be maintained to ensure they continue to function

- IMC 102.3 requires maintenance and does reference IFC
  - Similar provision from 2012 IBC 3401.2 lost in switch to IEBC
  - IFC 108, 701.5, 706.1 and 706.2 provide details

- IFC references NFPA 80 and NFPA 105 standards
  - These are “referenced standards” and “considered part of the requirements of this code.” (IFC 102.7, IBC 102.4 and IMC 102.8)
  - NFPA 80 – Fire
  - NFPA 105 – Smoke

<table>
<thead>
<tr>
<th>Damper maintenance and testing requirement</th>
<th>Frequency (when testing is required)</th>
<th>Code sections and references</th>
</tr>
</thead>
</table>
| General requirements for fire and smoke dampers | • Commissioning
  • End of first year
  • Every 4 years except in hospitals every 5 years | IFC Sections 108, 706.1 and 706.2
  NFPA 80 (Fire)
  NFPA 105 (Smoke) |

| Operational testing for smoke control systems (including dampers) | Dedicated systems:

  • Commissioning
  • Annually | IFC and IBC 909.18.3
  IFC 909.20.4 |

| Non-dedicated systems:

  • Commissioning
  (see IFC and IBC 909.18.3)
  • Annually | IFC and IBC 909.18.3
  IFC 909.20.5 |
Penetrations

Penetrations in fire-resistance-rated and/or smoke-resistant assemblies create breaches and potential weak points that could reduce the assembly’s effectiveness if not properly protected.
- Penetrations and the materials used to protect them must not reduce the assembly rating
- Section 714 regulates both rated assemblies, and nonfire-resistance-rated horizontal assemblies

Topics covered in Section 714

- Fire-resistance-rated walls – Section 714.4
- Fire-resistance-rated horizontal assemblies – Section 714.5
- Smoke barriers – Section 714.5.4 (applies to both walls and horizontal assemblies)
- Nonfire-resistance-rated horizontal assemblies – Section 714.6

Penetrations

No single item will work for every situation. Required systems depend on:
- Type and rating of base assembly
- Type, size and material of penetrant
- Type and thickness of any insulation on penetrant
- Material type and thickness of any sleeve
- Type of firestopping material used in firestop system

Systems also vary between different manufacturers and within individual product lines
- So don’t get complacent and assume all systems are equal or installed in similar manner

Definition – Annular space

Important to understand terminology and test methods
- Annular space
  - “The opening around the penetrating item”
  - Many assemblies include a minimum and maximum dimension
Annular space can vary

Definition
Membrane penetration
Through penetration

Definitions
There are a number of other definitions that code users should be familiar with:
- Through-penetration firestop system
- L Rating
- Mineral fiber
- Mineral wool

Just be certain to look at Chapter two when a term is shown in italics within the code.
Test standards

Code provides two basic methods to evaluate the performance of penetration firestop systems:
- Test as part of overall assembly (ASTM E 119 or UL 263), or
- Test penetration separately (ASTM E 814 or UL 1479)

- First option is seldom used
- Second option evaluates resistance to:
  - Development of through openings
  - Flaming on unexposed surface, and
  - Ability to limit thermal transmission through the penetration
- All four tests require hose stream test

Firestopping vs. fireblocking or draftstopping

- Section 714: firestopping for penetrations
- Section 718: fireblocking and draftstopping

Firestopping vs. fireblocking or draftstopping

714 Penetration firestops
- Protects penetrations into rated assemblies
- Applies to both combustible and noncombustible construction
- Typically a tested system

718 fireblocking or draftstopping
- Limits spread of fire within concealed spaces
- May be rated or non-rated construction
- Applies to combustible concealed locations
- Not tested, but use specific prescriptive/generic products that are deemed to be acceptable

Where penetration protection is required

Primary requirements are found in:
- 714.4 (Fire-resistance-rated walls)
- 714.5 (Horizontal assemblies)
- 714.6 (Nonfire-resistance-rated horizontal assemblies)
- 714.5.4 (Smoke barriers)

Those code sections address not only the type of penetrations required to be protected but also the acceptable methods of protection
Where penetration protection is required

Section 714 is referenced from a number of locations
- Sections 706.9 and 707.7 are examples – from fire wall and fire barrier provisions
- Section 712.1.4 – from the vertical openings provisions

Best to look at specific assembly section before looking at 714
- Sections 707.7.1 and 710.6 are examples
  - 707.7 does reference 714 but 707.7.1 prohibits certain penetrations or allows them in specific locations
  - 710.6 does not reference 714 for penetrations in smoke partitions

Penetration of fire-resistance-rated walls

Section 714.4 is the starting point
- Primary sections are
  - 714.4.1 (through penetrations)
  - 714.4.2 (membrane penetrations)
- Both contain exceptions
- Both ultimately point back to 714.4.1.1 and 714.4.1.2

Sections 714.4.1.1 and 714.4.1.2 allow:
- Test penetration as part of overall assembly (ASTM E 119 or UL 263), or
- Test penetration separately (ASTM E 814 or UL 1479)
- An F rating is required for systems

Penetration firestop systems

Are tested and listed systems
- Should be installed as tested and described in product directory and manufacturer’s instructions
- Deviations can impact performance

Tested systems help
- Demonstrate compliance with code requirements
- Provide installer with detailed installation requirements
- Provide inspector with document to use for inspection of the installation

Through penetrations – 714.4

General requirement is for tested system
- Exception limited to steel, ferrous or copper pipes, tubes or conduits
  - Offers two methods of protection
  - Focuses on protection of annular space
- Item 1 limited to concrete or masonry walls
Through penetrations
Section 714.4.1 Exception

Item 2 provides a number of options
- Can allow virtually any material to fill annular space (if tested)
- Type of wall is not limited to concrete or masonry
- Size of penetration is not limited
- Type of penetration is still limited

- Not easy to comply with since it basically requires testing and these are not listed products – test information often not available

Membrane penetrations

General requirement is for membrane penetrations to comply with through penetration provisions
- Six exceptions
  - Four applicable to electrical boxes
  - One for boxes other than electrical (e.g. washing machine hose connection boxes, hose cabinets, manual fire alarm pull boxes, dryer exhaust boxes, electrical panel boards, etc.)
  - One for sprinkler penetrations

Membrane penetrations

Three means of complying
- Tested as part of overall assembly (714.4.1.1)
- Tested separately for F rating (714.4.1.2)
- Comply with an exception (There are 6 in 714.4.2 or 2 in 714.4.1)
- Electrical boxes are one of the most common membrane penetrations

Back-to-back membrane penetrations

Membrane penetrations are different than through penetrations
- Generally code does not address how to deal with back-to-back penetrations
  - Exceptions 1 and 2 for outlet boxes do address this
- Membrane penetration not covered by one of the exceptions will essentially require same protection as through penetration
  - Consult manufacturer & listing if concerned with back-to-back items to see if added protection is needed
Penetrations of horizontal assemblies

IBC looks at horizontal assemblies as a means of compartmenting a building to minimize vertical spread of smoke or fire.

Penetration protection requirements apply to:
- Fire-resistance-rated assemblies (714.5.1 to 714.5.4)
- Nonfire-resistance-rated assemblies (714.6)

Penetration of horizontal assemblies

Protection requirements depend on type and location of the assembly:
- Horizontal assemblies may be a floor or a roof.
- May rely on some type of specific ceiling construction as integral part of rating.
  - Important to protect penetrations through any part integral to the fire-resistance rating – whether floor, roof or the ceiling membrane beneath them.
  - Sections 714.5 and 712.1.15 allow unprotected openings through roof deck/slab if not affecting structural integrity.

Fire-resistance-rated assemblies Scoping

Section 714.5 is horizontal assembly’s equivalent of Section 714.4 for walls.
- Due to exclusions in Sections 714.5 and 712.1.15, it does not include the roof of a roof/ceiling assembly or to a roof which is rated by itself.

Horizontal assemblies – Through penetrations

Section 714.5.1 provides two basic methods for evaluating through penetrations:
- Test as part of overall assembly (ASTM E 119 or UL 263), or
- Test penetration separately (ASTM E 814 or UL 1479).

These options were covered previously in Test Standard section and are the same as allowed for walls in 714.4.1.
- First option is seldom used.
Horizontal assemblies – Through penetrations

In lieu of general options, can use one of three exceptions

- Exception 1 is similar to Item 2 in Exception for walls in 714.4.1
  - Limited to steel, ferrous or copper conduits, pipes, tubes or vents; or to concrete or masonry items
  - Limited to a single floor
  - Testing per ASTM E119 or UL 263

Through penetration firestop systems – 714.5.1.2

Testing firestop systems in horizontal assemblies to ASTM E814 or UL 1479 differs from wall provisions since testing requires both an F and a T rating

- T rating is a higher performance criteria and more difficult to achieve than F rating
- T rating limits temperature increase through the penetrant and the firestop system; and does not lessen original assembly performance

Through penetration firestop systems – T Rating exceptions

Three options to eliminate T rating requirement

- Exception 1 relies on “insulation” protection that the wall provides
  - Allowed whether wall is rated or not
  - If wall beneath, must extend to floor – to contain penetrant
Through penetration firestop systems – T rating exceptions

Exception 2 applies to floor drains, tub drains and shower drains
- Must be contained and located within concealed space of horizontal assembly
- Exceptions only eliminate T rating (Not F rating)

Exception 2 – Eliminating T rating

Was added into code because it is conceptually similar to Exception 1 and ceiling helps shield penetrant
- Should only be used for horizontal assembly where ceiling is part of protection and rating
- Only applicable to the three specific drains. Should not use for other penetrants.

Through penetration firestop systems – T rating exception

Exception 3 limited to use with metal-enclosed electrical switchgear
- 4” maximum diameter metal penetrant
- Must go “directly” into enclosure
- Eliminates T rating – Still needs F rating or other exception

Membrane penetrations

As general requirement, membrane penetrations are protected the same as through penetrations
- Tested as part of overall assembly, or
- Tested to ASTM E 814 or UL 1479 as firestop system
- Eight exceptions permitted in lieu of general provisions

Code uses through penetration provisions even though these are membrane penetrations
Smoke barriers – 714.5.4

Smoke barrier provisions of Section 709 are referenced by a number of other code sections
- Generally used where occupants are unable to evacuate (hospitals, jails, ambulatory care facility), or to compartment building for smoke control system
- May be either walls or horizontal assemblies
  - Both 714.4 and 714.5 reference 714.5.4
- Generally require a 1-hour rating for barrier

Smoke barrier penetrations

Penetrations must be tested to UL 1479 and obtain an L rating
- L rating provides quantitative indication of system’s ability to resist passage of smoke
- System must be tested and listed to have an L rating – don’t assume something complies
  - Air leakage test is an optional test under UL 1479
  - ASTM E 814 test does not contain L rating test protocol

Smoke barrier penetrations

Air leakage (L rating) cannot exceed
- 5.0 cfm per square foot of penetration opening for each system, or
- A total leakage of 50 cfm for any 100 square feet of wall or floor area.
- L rating provides measurable criteria versus subjective provisions (limit, restrict, resist)
- L rating determined at both ambient temperature and at elevated temperature

Marking and identification
Section 703.7
**Maintenance – IFC 703.1 and 704.1**

Requires fire-resistance rating of construction “including…firestops…and fire-resistant joint systems” to be maintained.

- Requires visual inspection by owner on annual basis (IFC 701.5 and 701.6)
  - Not required for inaccessible concealed areas
- Repair or replaced if damaged or altered; protected if new penetration
  - Same intent as 2012 IBC 3401.2 and 3404.1 (lost these sections in 2015 IBC and IEBC)

**Joint - Definition**

IBC defines a joint as “the opening in or between adjacent assemblies that is created due to building tolerances, or is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading.”

- Put another way, the joint is the breach or opening in or between adjacent assemblies
- A joint system is used to fill the opening or breach

**Fire-resistant joint systems**

Section 715

**Joints – Locations & examples**

Examples:

- Gap between adjacent concrete tilt-up panels
- Head of wall/top of wall
- Floor and exterior curtain wall
- Expansion joint in floor
Joints – Locations & examples

Test joint systems using ASTM E 1966 or UL 2079
- Neither ASTM E119 nor UL 263 evaluate performance where wall and floor assemblies connect
- ASTM E 2307 used for floor/curtain wall

Joint firestop systems

Compliant systems
- Accommodate cyclical movement of adjacent assemblies
- Prevent the passage of flame and hot gases sufficient to ignited cotton waste on unexposed side of the assembly
- Will remain in place when subjected to the hose stream test

Test criteria – Section 715.3

ASTM E 1966 and UL 2079 are essentially equivalent
- Both focus on joint and ability to go through movement cycles
  - ASTM E 1966 does not evaluate smoke leakage so must use UL 2079 for L rating
- Nonsymmetrical wall joint systems must be tested from both sides, or from least fire-resistant side (similar to 703.2.1 wall test)
- Exception for exterior walls with fire separation distance greater than 10 feet.

Where required

Section 715.1 states joints “in or between fire-resistance-rated” walls or horizontal assemblies are required to be protected by approved systems
- Most locations are covered by this general requirement or the exception in 715.1
  - There are ten exempt locations in 715.1
- Sections 715.4 through 715.6 contain specific requirements for certain locations
Exception from 715.1

The exception in 715.1 list ten locations where joint systems are not required to be installed

- Most eliminate joint protection due to fact that some other code provision would allow a fire to circumvent the joint system
- Therefore code cannot justify requiring a joint system where the fire can bypass it by another route