

2021 Virginia Construction Code

CHAPTER 7 FIRE AND SMOKE PROTECTION FEATURES

SECTION 717 DUCTS AND AIR TRANSFER OPENINGS

717.1 General.

The provisions of this section shall govern the protection of duct penetrations and air transfer openings in assemblies required to be protected and duct penetrations in nonfire-resistance-rated floor assemblies.

717.1.1 Ducts and air transfer openings.

Ducts transitioning horizontally between *shafts* shall not require a *shaft enclosure* provided that the duct penetration into each associated *shaft* is protected with *dampers* complying with this section.

717.1.2 Ducts that penetrate fire-resistance-rated assemblies without dampers.

Ducts that penetrate fire-resistance-rated walls and are not required by this section to have *fire dampers* shall comply with the requirements of [Sections 714.3](#) through [714.4.3](#). Ducts that penetrate *horizontal assemblies* not required to be contained within a *shaft* and not required by this section to have *fire dampers* shall comply with the requirements of [Sections 714.5](#) through [714.6.2](#).

717.1.2.1 Ducts that penetrate nonfire-resistance-rated assemblies.

The space around a duct penetrating a nonfire-resistance-rated floor assembly shall comply with [Section 717.6.3](#).

717.2 Installation.

Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling radiation dampers located within air distribution and smoke control systems shall be installed in accordance with the manufacturer's instructions, the *dampers'* listing and [Sections 717.2.1](#) through [717.2.3](#).

717.2.1 Smoke control system.

Where the installation of a *fire damper* will interfere with the operation of a required smoke control system in accordance with [Section 909](#), *approved* alternative protection shall be utilized. Where mechanical systems including ducts and *dampers* utilized for normal building ventilation serve as part of the smoke control system, the expected performance of these systems in smoke control mode shall be addressed in the rational analysis required by [Section 909.4](#).

717.2.2 Hazardous exhaust ducts.

Fire dampers for hazardous exhaust duct systems shall comply with the [International Mechanical Code](#).

717.2.3 Static dampers.

Fire dampers and ceiling radiation dampers that are listed for use in static systems shall only be installed in heating, ventilation and air-conditioning systems that are automatically shut down in the event of a fire.

717.3 Damper testing, ratings and actuation.

Damper testing, ratings and actuation shall be in accordance with [Sections 717.3.1](#) through [717.3.3](#).

717.3.1 Damper testing.

Dampers shall be listed and labeled in accordance with the standards in this section.

1. *Fire dampers* shall comply with the requirements of [UL 555](#).
2. *Smoke dampers* shall comply with the requirements of [UL 555S](#).
3. *Combination fire/smoke dampers* shall comply with the requirements of both [UL 555](#) and [UL 555S](#).
4. *Ceiling radiation dampers* shall comply with the requirements of [UL 555C](#) or shall be tested as part of a fire-resistance-rated floor/ceiling or roof/ceiling assembly in accordance with [ASTM E119](#) or [UL 263](#).
5. *Corridor dampers* shall comply with requirements of both [UL 555](#) and [UL 555S](#). *Corridor dampers* shall demonstrate acceptable closure performance when subjected to 150 feet per minute (0.76 mps) velocity across the face of the *damper* during the [UL 555](#) fire exposure test.

717.3.2 Damper rating.

Damper ratings shall be in accordance with [Sections 717.3.2.1](#) through [717.3.2.4](#).

717.3.2.1 Fire damper ratings.

Fire dampers shall have the minimum rating specified in [Table 717.3.2.1](#).

TABLE 717.3.2.1
FIRE DAMPER RATING

TYPE OF PENETRATION	MINIMUM DAMPER RATING (hours)
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Less than 3-hour fire-resistance-rated assemblies	1.5
3-hour or greater fire-resistance-rated assemblies	3

717.3.2.2 Smoke damper ratings.

Smoke damper leakage ratings shall be Class I or II. Elevated temperature ratings shall be not less than 250°F (121°C).

717.3.2.3 Combination fire/smoke damper ratings.

Combination fire/smoke dampers shall have the minimum rating specified for *fire dampers* in [Table 717.3.2.1](#) and shall have the minimum rating specified for *smoke dampers* in [Section 717.3.2.2](#).

717.3.2.4 Corridor damper ratings.

Corridor dampers shall have the following minimum ratings:

1. One-hour *fire-resistance rating*.
2. Class I or II leakage rating as specified in [Section 717.3.2.2](#).

717.3.3 Damper actuation.

Damper actuation shall be in accordance with [Sections 717.3.3.1](#) through [717.3.3.5](#) as applicable.

717.3.3.1 Fire damper actuation.

[Primary heat responsive devices used to actuate](#) *fire dampers* shall meet one of the following requirements:

1. The operating temperature shall be approximately 50°F (10°C) above the normal temperature within the duct system, but not less than 160°F (71°C).
2. The operating temperature shall be not more than 350°F (177°C) where located in a smoke control system complying with [Section 909](#).

717.3.3.2 Smoke damper actuation.

The *smoke damper* shall close upon actuation of a *listed smoke detector* or detectors installed in accordance with [Section 907.3](#) and one of the following methods, as applicable:

1. Where a *smoke damper* is installed within a duct, a *smoke detector* shall be installed inside the duct or outside the duct with sampling tubes protruding into the duct. The detector or tubes within the duct shall be within 5 feet (1524 mm) of the *damper*. Air outlets and inlets shall not be located between the detector or tubes and the *damper*. The detector shall be *listed* for the air velocity, temperature and humidity anticipated at the point where it is installed. Other than in mechanical smoke control systems, *dampers* shall be closed upon fan shutdown where local smoke detectors require a minimum velocity to operate.
2. Where a *smoke damper* is installed above *smoke barrier* doors in a *smoke barrier*, a spot-type detector shall be installed on either side of the *smoke barrier* door opening. The detector shall be *listed* for releasing service if used for direct interface with the *damper*.
3. Where a *smoke damper* is installed within an air transfer opening in a wall, a spot-type detector shall be installed within 5 feet (1524 mm) horizontally of the *damper*. The detector shall be *listed* for releasing service if used for direct interface with the *damper*.
4. Where a *smoke damper* is installed in a corridor wall or ceiling, the *damper* shall be permitted to be controlled by a smoke detection system installed in the *corridor*.
5. Where a smoke detection system is installed in all areas served by the duct in which the *damper* will be located, the *smoke dampers* shall be permitted to be controlled by the smoke detection system.

717.3.3.3 Combination fire/smoke damper actuation.

Combination fire/smoke damper actuation shall be in accordance with [Sections 717.3.3.1](#) and [717.3.3.2](#). *Combination fire/smoke dampers* installed in smoke control system *shaft* penetrations shall not be activated by local area smoke detection unless it is secondary to the smoke management system controls.

717.3.3.4 Ceiling radiation damper actuation.

The operating temperature of a *ceiling radiation damper* actuation device shall be 50°F (27.8°C) above the normal temperature within the duct system, but not less than 160°F (71°C).

717.3.3.5 Corridor damper actuation.

Corridor damper actuation shall be in accordance with [Sections 717.3.3.1](#) and [717.3.3.2](#).

717.4 Access and identification.

[Access and identification of fire and](#) *smoke dampers* shall comply with [Sections 717.4.1](#) through [717.4.2](#).

717.4.1 Access.

[Fire and smoke dampers](#) shall be provided with an approved means of access that is large enough to permit inspection and maintenance of the *damper* and its operating parts. *Dampers* equipped with fusible links, internal operators, or both

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shall be provided with an access door that is not less than 12 inches (305 mm) square or provided with a removable duct section.

717.4.1.1 Access openings.

The access shall not affect the integrity of *fire-resistance-rated* assemblies. The access openings shall not reduce the *fire-resistance rating* of the assembly. Access doors in ducts shall be tight fitting and suitable for the required duct construction.

717.4.1.2 Restricted access.

Where space constraints or physical barriers restrict access to a damper for periodic inspection and testing, the *damper* shall be a single- or multi-blade type *damper* and shall comply with the remote inspection requirements of NFPA 80 or NFPA 105.

717.4.2 Identification.

Access points shall be permanently identified on the exterior by a label having letters not less than $\frac{1}{2}$ inch (12.7 mm) in height reading: "FIRE/SMOKE DAMPER," "SMOKE DAMPER" or "FIRE DAMPER."

717.5 Where required.

Fire dampers, smoke dampers, combination fire/smoke dampers, ceiling radiation dampers and corridor dampers shall be provided at the locations prescribed in Sections 717.5.1 through 717.5.7 and 717.6. 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.

717.5.1 Fire walls.

Ducts and air transfer openings permitted in *fire walls* in accordance with Section 706.11 shall be protected with *listed fire dampers* installed in accordance with their listing.

717.5.1.1 Horizontal exits.

A *listed smoke damper* designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a *fire wall* that serves as a *horizontal exit*.

717.5.2 Fire barriers.

Ducts and air transfer openings of *fire barriers* shall be protected with *listed fire dampers* installed in accordance with their listing. Ducts and air transfer openings shall not penetrate enclosures for *interior exit stairways* and *ramps* and *exit passageways*, except as permitted by Sections 1023.5 and 1024.6, respectively.

Exceptions: *Fire dampers* are not required at penetrations of *fire barriers* where any of the following apply:

1. Penetrations are tested in accordance with ASTM E119 or UL 263 as part of the fire-resistance-rated assembly.
2. Ducts are used as part of an *approved* smoke control system in accordance with Section 909 and where the use of a *fire damper* would interfere with the operation of a smoke control system.
3. Such walls are penetrated by *fully* ducted HVAC systems, have a required *fire-resistance rating* of 1 hour or less, are in areas of other than Group H and are in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2. For the purposes of this exception, a *fully* ducted HVAC system shall be a duct system for conveying supply, return or exhaust air as part of the structure's HVAC system. Such a duct system shall be constructed of sheet steel not less than No. 26 gage thickness and shall be continuous from the air-handling appliance or equipment to the air outlet and inlet terminals. *Nonmetal flexible air connectors shall be permitted in the following locations:*

- 3.1. At the duct connection to the air handling unit or equipment located within the mechanical room in accordance with Section 603.9 of the *International Mechanical Code*.
- 3.2. From an overhead metal duct to a ceiling diffuser within the same room in accordance with Section 603.6.2 of the *International Mechanical Code*.

717.5.2.1 Horizontal exits.

A *listed smoke damper* designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a *fire barrier* that serves as a *horizontal exit*.

717.5.3 Shaft enclosures.

Shaft enclosures that are permitted to be penetrated by ducts and air transfer openings shall be protected with approved fire and smoke dampers installed in accordance with their listing.

Exceptions:

1. Fire and smoke dampers are not required where steel exhaust subducts extend at least 22 inches (559 mm) vertically in exhaust shafts, provided there is a continuous airflow upward to the outside.
2. Fire dampers are not required where penetrations are tested in accordance with ASTM E119 as part of the

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fire-resistance-rated assembly.

3. Fire and smoke dampers are not required where ducts are used as part of an approved smoke control system in accordance with Section 909.
4. Fire and smoke dampers are not required where the penetrations are in parking garage exhaust or supply shafts that are separated from other *building* shafts by not less than 2-hour fire-resistance-rated construction.
5. Smoke dampers are not required where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

717.5.3.1 Continuous upward airflow.

Fire dampers and smoke dampers shall not be installed in shafts that are required to maintain a continuous upward airflow path where closure of the damper would result in the loss of the airflow.

717.5.4 Fire partitions.

Ducts and air transfer openings that penetrate *fire partitions* shall be protected with *listed fire dampers* installed in accordance with their listing.

Exceptions: In occupancies other than Group H, *fire dampers* are not required where any of the following apply:

1. *Corridor* walls in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2 and the duct is protected as a *through penetration* in accordance with Section 714.
2. Tenant partitions in *covered and open mall buildings* where the walls are not required by provisions elsewhere in the code to extend to the underside of the floor or roof sheathing, slab or deck above.
3. The duct system is constructed of *approved materials* in accordance with the *International Mechanical Code* and the duct penetrating the wall complies with all of the following requirements:
 - 3.1. The duct shall not exceed 100 square inches (0.06 m²).
 - 3.2. The duct shall be constructed of steel not less than 0.0217 inch (0.55 mm) in thickness.
 - 3.3. The duct shall not have openings that communicate the *corridor* with adjacent spaces or rooms.
 - 3.4. The duct shall be installed above a ceiling.
 - 3.5. The duct shall not terminate at a wall register in the fire-resistance-rated wall.
 - 3.6. A minimum 12-inch-long (305 mm) by 0.060-inch-thick (1.52 mm) steel sleeve shall be centered in each duct opening. The sleeve shall be secured to both sides of the wall and all four sides of the sleeve with minimum 1½-inch by 1½-inch by 0.060-inch (38 mm by 38 mm by 1.52 mm) steel retaining angles. The retaining angles shall be secured to the sleeve and the wall with No. 10 (M5) screws. The *annular space* between the steel sleeve and the wall opening shall be filled with mineral wool batting on all sides.
4. Such walls are penetrated by ducted HVAC systems, have a required *fire-resistance rating* of 1 hour or less, and are in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2. For the purposes of this exception, a ducted HVAC system shall be a duct system for conveying supply, return or exhaust air as part of the structure's HVAC system. Such a duct system shall be constructed of sheet steel not less than No. 26 gage thickness and shall be continuous from the air-handling appliance or equipment to the air outlet and inlet terminals.

717.5.4.1 Corridors.

Duct and air transfer openings that penetrate *corridors* shall be protected with *dampers* as follows:

1. A *corridor damper* shall be provided where *corridor* ceilings, constructed as required for the *corridor* walls as permitted in Section 708.4, Exception 3, are penetrated.
2. A *ceiling radiation damper* shall be provided where the ceiling membrane of a fire-resistance-rated floor-ceiling or roof-ceiling assembly, constructed as permitted in Section 708.4, Exception 2, is penetrated.
3. A *listed smoke damper* designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a *corridor* enclosure required to have smoke and draft control doors in accordance with Section 716.2.2.1.

Exceptions:

1. *Smoke dampers* are not required where the building is equipped throughout with an approved smoke control system in accordance with Section 909, and *smoke dampers* are not necessary for the operation and control of the system.
2. *Smoke dampers* are not required in *corridor* penetrations where the duct is constructed of steel not less than 0.019 inch (0.48 mm) in thickness and there are no openings serving the *corridor*.

717.5.5 Smoke barriers.

A *listed smoke damper* designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a *smoke barrier*. *Smoke dampers* and smoke damper actuation methods shall comply with Section

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717.3.3.2.

Exceptions:

1. *Smoke dampers* are not required where the openings in ducts are limited to a single *smoke compartment* and the ducts are constructed of steel.
2. *Smoke dampers* are not required in *smoke barriers* required by [Section 407.5](#) for Group I-2, Condition 2—where the HVAC system is fully ducted in accordance with [Section 603](#) of the *International Mechanical Code* and where buildings are equipped throughout with an *automatic sprinkler system* in accordance with [Section 903.3.1.1](#) and equipped with quick-response sprinklers in accordance with [Section 903.3.2](#).

717.5.6 Exterior walls.

Ducts and air transfer openings in fire-resistance-rated *exterior walls* required to have protected openings in accordance with [Section 705.10](#) shall be protected with *listed fire dampers* installed in accordance with their listing.

717.5.7 Smoke partitions.

A *listed smoke damper* designed to resist the passage of smoke shall be provided at each point that an air transfer opening penetrates a *smoke partition*. *Smoke dampers* and *smoke damper* actuation methods shall comply with [Section 717.3.3.2](#).

Exception: Where the installation of a *smoke damper* will interfere with the operation of a required smoke control system in accordance with [Section 909](#), *approved* alternative protection shall be utilized.

717.6 Horizontal assemblies.

Penetrations by ducts and air transfer openings of a floor, floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly shall be protected by a shaft enclosure that complies with [Section 713](#) or shall comply with [Sections 717.6.1](#) through [717.6.3](#).

717.6.1 Through penetrations.

In occupancies other than Groups I-2 and I-3, a duct constructed of approved materials in accordance with the *International Mechanical Code* that penetrates a fire-resistance-rated floor/ceiling assembly that connects not more than two *stories* is permitted without *shaft enclosure* protection, provided that a *listed fire damper* is installed at the floor line or the duct is protected in accordance with [Section 714.5](#). For air transfer openings, see [Section 712.1.9](#).

Exception: A duct is permitted to penetrate three floors or less without a *fire damper* at each floor, provided that such duct meets all of the following requirements:

1. The duct shall be contained and located within the cavity of a wall and shall be constructed of steel having a minimum wall thickness of 0.0187 inches (0.4712 mm) (No. 26 gage).
2. The duct shall open into only one *dwelling unit* or *sleeping unit* and the duct system shall be continuous from the unit to the exterior of the building.
3. The duct shall not exceed 4-inch (102 mm) nominal diameter and the total area of such ducts shall not exceed 100 square inches (0.065 m²) in any 100 square feet (9.3 m²) of floor area.
4. The *annular space* around the duct is protected with materials that prevent the passage of flame and hot gases sufficient to ignite cotton waste where subjected to [ASTM E119](#) or [UL 263](#) time-temperature conditions under a minimum positive pressure differential of 0.01 inch (2.49 Pa) of water at the location of the penetration for the time period equivalent to the *fire-resistance rating* of the construction penetrated.
5. Grille openings located in a ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly shall be protected with a *listed ceiling radiation damper* installed in accordance with [Section 717.6.2.1](#).

717.6.2 Membrane penetrations.

Ducts and air transfer openings constructed of *approved* materials in accordance with the *International Mechanical Code* that penetrate the ceiling membrane of a fire-resistance-rated floor/ceiling or roof/ceiling assembly shall be protected with one of the following:

1. A *shaft enclosure* in accordance with [Section 713](#).
2. A *listed ceiling radiation damper* installed at the ceiling line where a duct penetrates the ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly.

Exceptions:

1. A fire-resistance-rated assembly tested in accordance with [ASTM E119](#) or [UL 263](#) showing that *ceiling radiation dampers* are not required in order to maintain the *fire-resistance rating* of the assembly.
2. Where exhaust duct or outdoor air duct penetrations protected in accordance with [Section 714.5.2](#) are located within the cavity of a wall and do not pass through another dwelling unit or tenant space.
3. Where duct and air transfer openings are protected with a duct outlet penetration system tested as part of a fire-resistance-rated assembly in accordance with [ASTM E119](#) or [UL 263](#).

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3. A listed ceiling radiation damper installed at the ceiling line where a diffuser with no duct attached penetrates the ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly.

Exceptions:

1. A fire-resistance-rated assembly tested in accordance with [ASTM E119](#) or [UL 263](#) showing that ceiling radiation dampers are not required in order to maintain the fire-resistance rating of the assembly.
2. Where duct and air transfer openings are protected with a duct outlet penetration system tested as part of a fire-resistance-rated assembly in accordance with [ASTM E119](#) or [UL 263](#).

717.6.2.1 Ceiling radiation dampers testing and installation.

Ceiling radiation dampers shall be tested in accordance with [Section 717.3.1](#). Ceiling radiation dampers shall be installed in accordance with the details specified in the fire-resistance-rated assembly and the manufacturer's instructions and the listing.

717.6.2.1.1 Dynamic systems.

Only ceiling radiation dampers labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire.

717.6.2.1.2 Static systems.

Static ceiling radiation dampers shall be provided with systems that are not designed to operate during a fire.

Exceptions:

1. Where a static ceiling radiation damper is installed at the opening of a duct, a smoke detector shall be installed inside the duct or outside the duct with sampling tubes protruding into the duct. The detector or tubes in the duct shall be within 5 feet (1524 mm) of the damper. Air outlets and inlets shall not be located between the detector or tubes and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed. Other than in mechanical smoke control systems, dampers shall be closed upon fan shutdown where local smoke detectors require a minimum velocity to operate.
2. Where a static ceiling radiation damper is installed in a ceiling, the ceiling radiation damper shall be permitted to be controlled by a smoke detection system installed in the same room or area as the ceiling radiation damper.
3. A static ceiling radiation damper shall be permitted to be installed in a room where an occupant sensor is provided within the room that will shut down the system.

717.6.2.2 Equipment shutdown.

Where ceiling radiation dampers are listed as static dampers, the HVAC equipment shall be effectively shut down to stop the airflow prior to the damper closing using one of the following methods:

1. A duct detector installed in the return duct.
2. An area smoke detector interlocked with the HVAC equipment.
3. A listed heat sensor installed in the return duct.

717.6.3 Nonfire-resistance-rated floor assemblies.

Duct systems constructed of approved materials in accordance with the [International Mechanical Code](#) that penetrate nonfire-resistance-rated floor assemblies shall be protected by any of the following methods:

1. A shaft enclosure in accordance with [Section 713](#).
2. The duct connects not more than two stories, and the annular space around the penetrating duct is protected with an approved noncombustible material that resists the free passage of flame and the products of combustion.
3. In floor assemblies composed of noncombustible materials, a shaft shall not be required where the duct connects not more than three stories, the annular space around the penetrating duct is protected with an approved noncombustible material that resists the free passage of flame and the products of combustion and a fire damper is installed at each floor line.

Exception: Fire dampers are not required in ducts within individual residential dwelling units.

717.7 Flexible ducts and air connectors.

Flexible ducts and air connectors shall not pass through any fire-resistance-rated assembly. Flexible air connectors shall not pass through any wall, floor or ceiling.