NC Department of Insurance
Office of the State Fire Marshal - Engineering Division
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Duct Penetrations Through Fire-Resistance-Rated Vertical Assemblies

Code: 2018 NC Mechanical Code **Date:** December 21, 2023
Section: 607.5, 607.5.1, 607.5.2, 607.5.3, 607.5.6
Code: 2018 NC Building Code
Section: 717.5, 717.5.1, 717.5.2. 717.5.4, 717.5.6

This web interpretation addresses duct penetrations through fire-resistance-rated vertical assemblies: please refer to the table of contents below for questions which are addressed in this interpretation. Please note that this web interpretation is limited to the fire damper exceptions contained within NCMC Section 607.5. As such, specific systems which may prohibit fire dampers, including hazardous exhaust systems, smoke control systems and dryer exhaust systems, are not addressed in this interpretation except where such systems are specifically mentioned in NCMC Section 607.5. This interpretation does not address duct penetrations of rated horizontal assemblies, rated membrane assemblies, corridors or smoke barriers. It also does not address smoke damper, corridor damper or radiation damper requirements.

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Question:

When are fire dampers required in ducts penetrating vertical fire-resistance-rated assemblies?

Answer:

Duct penetrations through fire walls, fire barriers, fire partitions and fire-resistance-rated exterior walls required to have protected openings must be protected with listed fire dampers installed in accordance with their listing per Section 607.5 of the NCMC. Please refer to the follow-up questions below for further information and exceptions to this requirement.

Duct and Air Transfer Penetrations through Fire Walls

Follow-up question #1:

Are there any exceptions which would allow a duct or air transfer opening to penetrate a fire wall without a fire damper?

Answer:

There are no exceptions which would allow a duct or air transfer opening to penetrate a fire wall without a fire damper.

Section 706.11 of the NCBC allows the penetration of fire walls by ducts and air transfer openings if the walls are not on a lot line, provided that the penetrations comply with NCBC Section 717 and that the size and aggregate width of all openings do not exceed the limitations of NCBC Section 706.8. NCBC Section 717.5.1 addresses requirements specifically for ducts and air transfer openings which penetrate fire walls, and it requires those penetration to be protected with listed fire dampers installed in accordance with their listing, with no exceptions.

Duct and Air Transfer Penetrations through Fire Barriers:

Follow-up question #2

Are there any exceptions which would allow a duct or air transfer opening to penetrate a fire barrier without a fire damper?

Answer:

NCMC Section 607.5.2 has three exceptions which allow duct and air transfer penetrations of fire barriers without the use of fire dampers. When these exceptions are applied, the duct penetrating the rated assembly shall comply with the requirements of Sections 714.2 through 714.3.3 of the NCBC per NCMC Section 607.1.2.

Fire Barrier Exception 1:

Exception 1 states that fire dampers are not required when the penetrations are tested in accordance with ASTM E119 or UL 263 as part of the fire-resistance-rated assembly.

This exception requires the rated assembly and opening to be tested as one assembly and still pass the ASTM E119 or UL 263 fire test without a damper protecting the opening. If the assembly passed the applicable test with an unprotected opening, then a fire damper would not be required per this exception.

Fire Barrier Exception 2:

Exception 2 states that fire dampers are not required if fire barriers are penetrated by ducts used as part of an approved smoke control system in accordance with NCMC Section 513 and if the fire damper would interfere with the operation of the smoke control system. Per NCMC 607.2.1, approved alternative protection shall be used in lieu of fire dampers if the dampers cannot be installed without compromising the smoke control system. A smoke control system must function in the event of an emergency, so dampers which could prevent the system from functioning must not be installed. However, the rated fire assembly must still be protected, and if a fire damper cannot be installed in the penetration without compromising the smoke control system, an alternative protection method must be provided to ensure that fire and heat transfer does not occur through the fire barrier.

There are no prescriptive alternative protection methods described in Section 607.2.1: some examples of alternative protection methods that could be considered for approval are listed through-penetration protection assemblies or fire-resistance duct enclosure assemblies. These examples are provided for informational purposes only and are not intended to limit alternative protection options to just these examples or to imply that these examples will work for every smoke control system installation. Installation conditions will vary based on the type of construction, the rating of the assemblies being penetrated, along with other factors, and as such an alternative protection method used for one system may not work for another.

Exception 2 is only applicable to smoke control systems required by the North Carolina Building Code or the North Carolina Fire Code: if a smoke control system is installed but it is not required by code, then this exception is not applicable and fire dampers shall be provided as required unless another exception is utilized.

Fire Barrier Exception 3:
Exception 3 states that a fire damper is not required when a fire barrier is penetrated by a duct when ALL of the following conditions are met:

1. The fire barrier is rated 1 hour or less.
2. The fire barrier is not in a Group H area.
3. The fire barrier is in a building equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 of the NCBC.
4. The fire barrier is penetrated by a ducted HVAC system. For the purposes of this exception, a ducted HVAC system is defined as a duct system for the structure's HVAC system, and that is constructed of sheet steel not less than 26 gage thickness and is continuous from the air-handling appliance or equipment to the air outlet and inlet terminals.

This exception prescribes additional protection measures and restrictions on the installation conditions so that the fire barrier penetration is adequately protected without providing a fire damper. Please refer to Follow-up Question #3 for further information about the fully ducted HVAC system requirement.

Duct and Air Transfer Penetrations through Fire Barriers
Follow-up question #3:
Can flexible air ducts or flexible air connectors, metallic or nonmetallic, be installed in a ducted HVAC system as defined by Exception 3 of NCMC Section 607.5.2 and still utilize the exception?

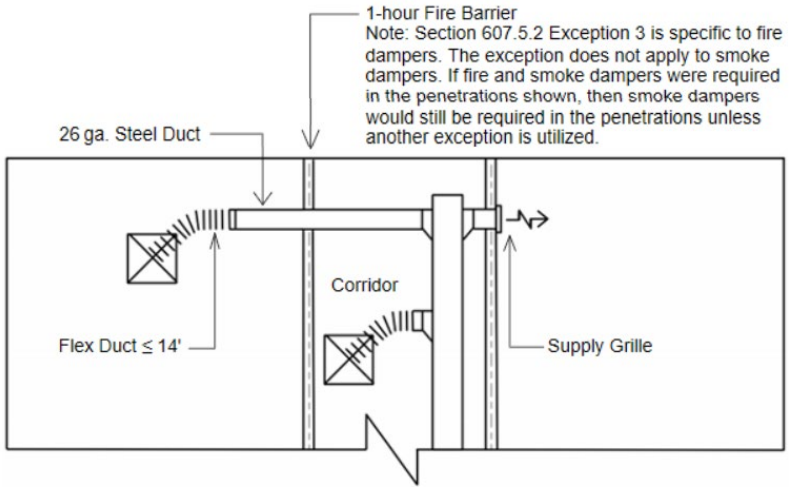
Answer:
Yes, under certain conditions. In order to provide an acceptable alternative level of protection for the fire barrier penetration in lieu of a fire damper, Exception 3 in part requires that the duct system be constructed of a minimum 26-gauge sheet steel and continuous from the appliance to the air outlets and inlets. The 2021 IMC provided additional language to Section 607.5.2 which allows nonmetallic flexible connections and air connectors as part of a ducted system as defined by Exception 3 under two conditions.

The first condition allows nonmetallic flexible connections which connect a duct to an air handling unit or equipment located within a mechanical room, in accordance with NCMC Section 603.6. The second condition allows nonmetallic flexible air connectors that connect an overhead metal duct to a ceiling diffuser where the metal duct and ceiling diffuser are located within the same room. The air connectors must be in accordance with NCMC Section 603.6.2. Per Section 603.6.2, the air connectors shall be tested in accordance with UL 181, listed and labeled as Class 0 or Class 1 flexible air connectors, installed in accordance with Section 304.1, limited in length to 14 feet, and shall not pass through any wall, floor or ceiling.

The continuous sheet steel duct is required to ensure that the integrity of the fire separation will not be compromised by discontinuous ducts or the failure of ducts in the event of a fire. The duct is permitted to terminate at a wall register in the rated wall. The metal duct is not required to be protected by a ceiling. As the metal duct is allowed to be directly exposed to the room, there is little additional hazard created by having a section of flexible air connector between the sheet

steel metal duct and an opening in the ceiling. The intent of Section 607.5.2 Exception 3 of the NCMC is thus considered to have been met so long as the sheet steel duct is continuous through the fire barrier penetration back to the appliance and the air connectors are installed in accordance with NCMC Section 603.6.2.

The language added to Section 607.5.2 Exception 3 in the 2021 IMC is specific to nonmetallic flexible air connectors: however, as both metallic and nonmetallic air connectors are required to be tested and listed to the UL 181 standard, metallic air connectors may be utilized when installed under the conditions specified above. Flexible air ducts are also tested in accordance with UL 181, but they must pass additional tests that flexible air connectors are excluded from, such as the flame penetration test, the puncture test, and the impact test as defined by the standard, in order to be listed as flexible air ducts. As such, metallic or nonmetallic flexible air ducts may also be used to make the final connection to an air terminal device so long as they meet the listing requirements of NCMC Section 603.6.1 and when installed under the conditions specified by Section 603.6.2, including the 14' length restriction. Please refer to Example 1 for further information.



Example 1: A fully ducted system in a fully sprinklered building where the only flexible duct in the system is used to connect the air terminal to the system after the 26 ga. duct penetrated the 1-hour fire barrier. The design shown is compliant with NCMC Section 607.5.2, Exception 3.

Duct and Air Transfer Penetrations through Fire Partitions

Follow-up question #4:

Are there any exceptions which would allow a duct or air transfer opening to penetrate a fire partition without a fire damper?

Answer:

NCMC Section 607.5.3 has four exceptions for when fire dampers are not required at duct and air transfer penetrations of fire partitions. These exceptions are not applicable for Group H

occupancies. When these exceptions are applied, the duct shall comply with the requirements of Sections 714.2 through 714.3.3 of the NCBC per NCMC Section 607.1.2.

Fire Partition Exception 1:
Exception 1 states that fire dampers are not required in corridor walls in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 of the NCBC and the duct is protected as a through penetration in accordance with Section 714 of the NCBC.

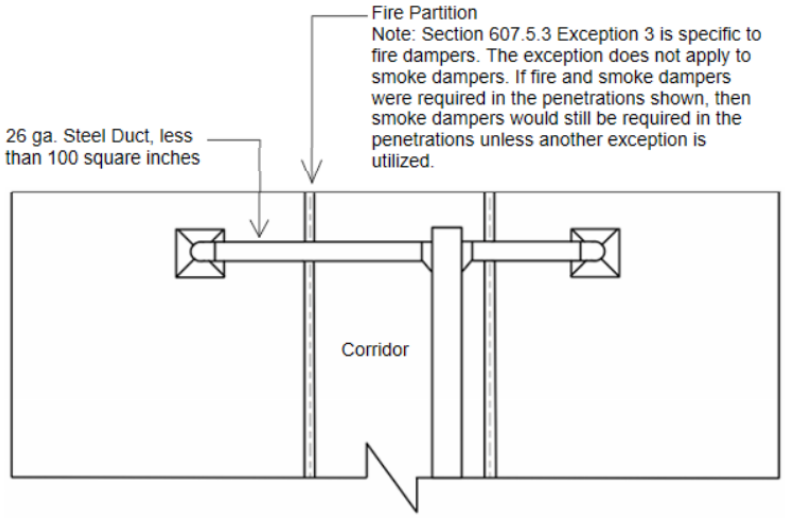
Please note that Exception 1 is specific to corridor walls. This exception also does not address corridor ceilings or floors, and it does not exempt the penetration from smoke dampers if openings in the corridor wall are required to have smoke dampers per NCMC Section 607.5.4.

Fire Partition Exception 2:
Exception 2 states that fire dampers are not required in tenant partitions in covered and open mall buildings where the walls are not required by the NCBC to extend to the underside of the floor or roof sheathing, slab or deck above.

Fire Partition Exception 3:
Exception 3 states that fire dampers are not required when the duct system is constructed of approved materials in accordance with Section 603 and the duct penetrating the wall complies with ALL of the following requirements:

1. The duct shall not exceed 100 square inches (0.06 m^2).
2. The duct shall be constructed of steel not less than 0.0217 inch (0.55 mm) in thickness.
3. The duct shall not have openings that communicate the corridor with adjacent spaces or rooms.
4. The duct shall be installed above a ceiling.
5. The duct shall not terminate at a wall register in the fire-resistance-rated wall.
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 rock (mineral) wool batting on all sides.

This exception prescribes additional protection measures and restrictions on the installation conditions to ensure that the fire partition penetration is adequately protected without providing a fire damper. Please note that this section prescribes the required through-penetration protection in lieu of the general requirement of NCMC Section 607.1.2. Refer to Follow-up Question #5 for further information about the duct material requirement. Please refer to Example 2 and Example 3 for further information.



Example 2: An unsprinklered building. The design shown is compliant with NCMC Section 607.5.3, Exception 3. The duct penetrating the wall meets the requirements of the exception and there are no communicating openings with the corridor.

Fire Partition Exception 4:
Exception 4 states that a fire damper is not required when a fire partition is penetrated by a duct when ALL of the following conditions are met:

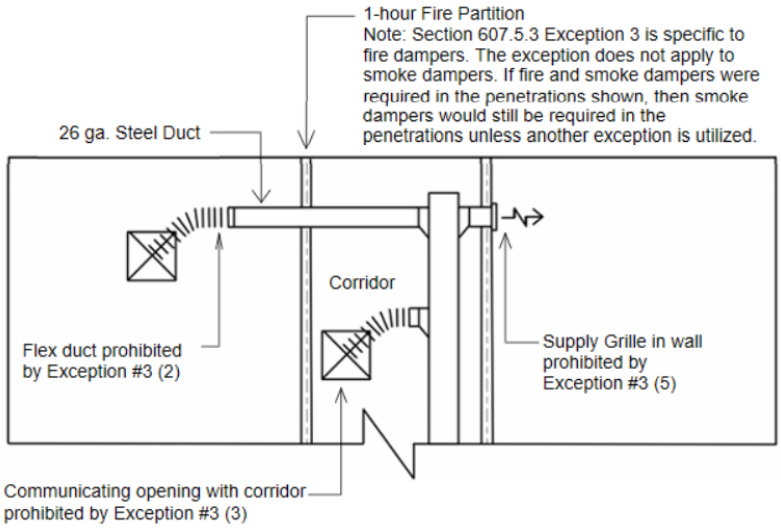
1. The fire barrier is rated 1 hour or less.
2. The fire barrier is not in a Group H area.
3. The fire barrier is in a building equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 of the NCBC.
4. The fire barrier is penetrated by a ducted HVAC system. For the purposes of this exception, a ducted HVAC system is defined as a duct system for the structure's HVAC system, and that is constructed of sheet steel not less than 26 gage [0.0217 inch (0.55mm)] thickness and is continuous from the air-handling appliance or equipment to the air outlet and inlet terminals.

Exception 4 of NCMC Section 607.5.3 has the same conditions as Exception 3 of NCMC Section 607.5.2. Please refer to Follow-up Question #3 for further information.

<u>Duct and Air Transfer Penetrations through Fire Partitions</u>
Follow-up question #5:
Can flexible air ducts or flexible air connectors be installed to make the final connection to an air terminal after the 26-gauge duct has penetrated the rated partition and still utilize Exception 3 of NCMC Section 607.5.3?

Answer:
No. In order to provide an acceptable alternative level of protection for the fire partition penetration in lieu of a fire damper, Exception 3 in part requires that the duct which penetrates the rated partition be constructed of 26-gauge steel and that the penetrating duct be installed above a ceiling. This exception also prohibits the duct from terminating at the rated partition. As

the duct is prohibited from terminating at the rated partition and as it cannot be exposed within the room, the steel duct must extend from the rated penetration to the air terminal in order to comply with the requirements of this exception. Please refer to Example 2 and Example 3 for further information.



Example 3: An unsprinklered building. The design shown is not compliant with NCMC Section 607.5.3, Exception 3, as there are communicating openings in the corridor, the flex duct does not meet the material requirements, and the duct terminates at a wall register.

Duct and Air Transfer Penetrations through Fire Partitions

Follow-up question #6:

Can flexible air ducts or flexible air connectors, metallic or nonmetallic, be installed in a ducted HVAC system as defined by Exception 4 of Section 607.5.3 and still utilize the exception?

Answer:

Exception 4 of NCMC Section 607.5.3 has the same conditions as Exception 3 of NCMC Section 607.5.2. Please refer to the commentary under Follow-Up Question #3 for further information. As a note, the 2021 IMC did not include the additional language allowing nonmetallic air connections under Exception 4 of NCMC Section 607.5.3, but the interpretation for Exception 3 of NCMC Section 607.5.2 is still applicable to NCMC Section 607.5.3.

Duct and Air Transfer Penetrations through Fire-Resistance-Rated Exterior Walls
Follow-up question #7

Are there any exceptions which would allow a duct or air transfer opening to penetrate a fire-resistance-rated exterior wall without a fire damper?

Answer:

If the fire-resistance-rated exterior wall is required to have protected openings in accordance with Section 705.10 of the NCBC, then ducts and air transfer openings shall be protected in accordance with NCBC Section 717. NCBC Section 705.10 has one exception to this requirement which allows foundation vents that are installed in accordance with NCBC requirements.

Refer to NCBC 705.8 for further information on protected openings.