2018 IMC® Ventilation and Duct Systems

Based on the 2018 International Mechanical Code® (IMC®)

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He has more than 20 years of experience in the manufacturing and construction industry where he has served as chief technical expert for regulatory, product standards, building code and product engineering matters.

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Apply the essential ventilation and duct system provisions and concepts of the 2018 *International Mechanical Code*®.

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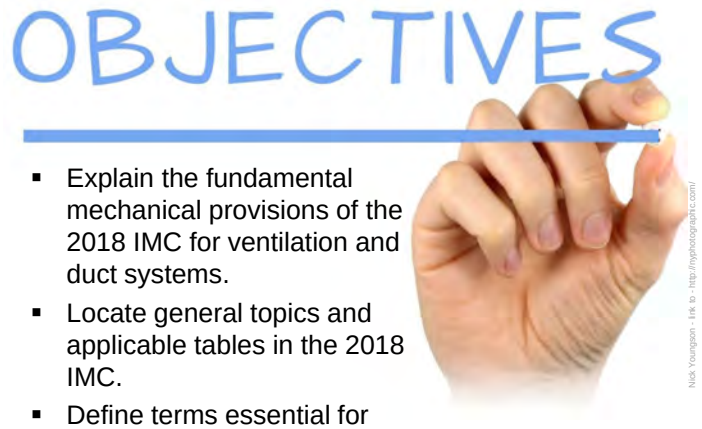

- Explain the fundamental mechanical provisions of the 2018 IMC for ventilation and duct systems.
- Locate general topics and applicable tables in the 2018 IMC.
- Define terms essential for correct code interpretation.

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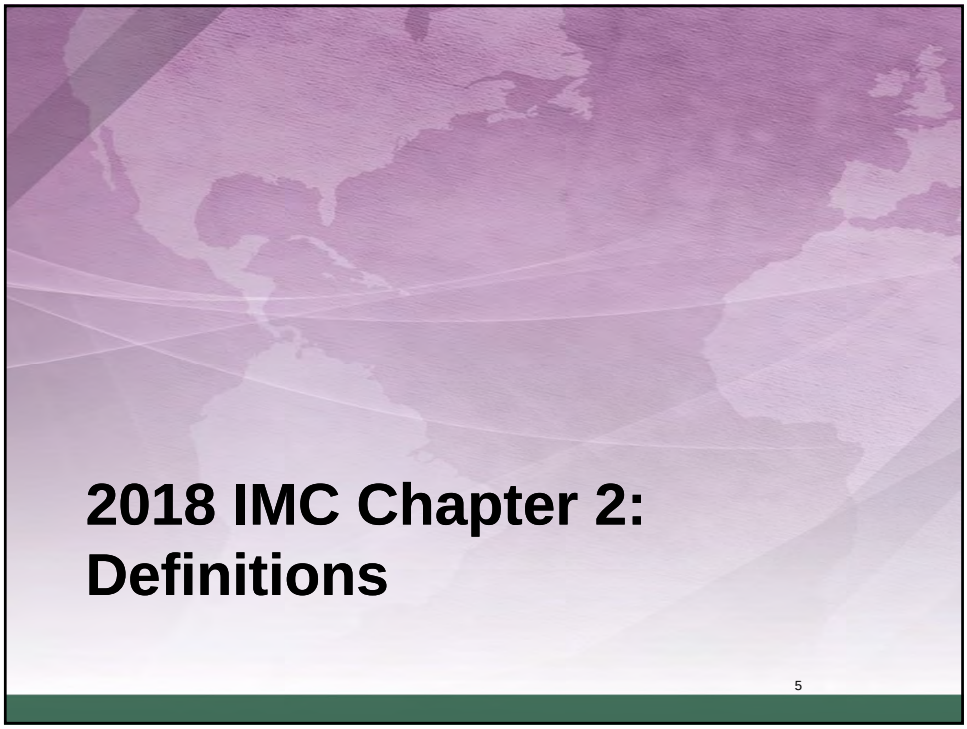

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Definitions

Some key definitions from the 2018 IMC include:

- ***Air Dispersion System***
- ***Breathing Zone***
- ***Environmental Air***

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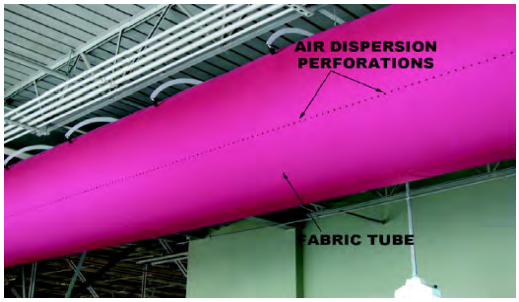
Air Dispersion System

Any diffuser system designed to both convey air within a room, space or area and diffuse air into that space while operating under positive pressure. Systems are commonly constructed of, but not limited to, fabric or plastic film.



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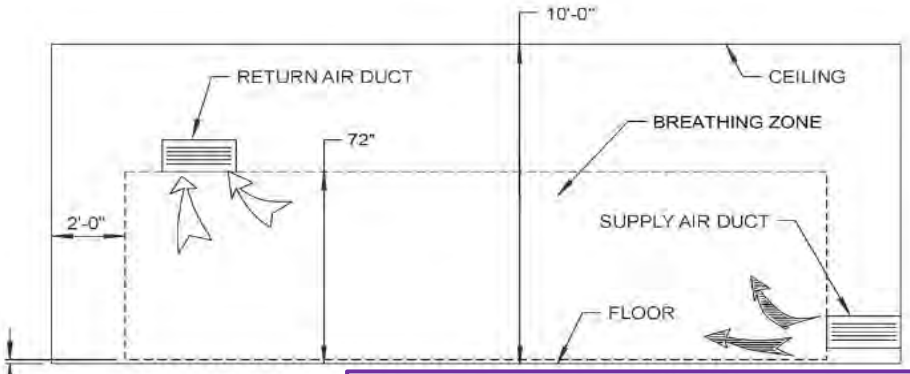
Breathing Zone



BREATHING ZONE. The region within an occupied space between planes 3 and 72 inches (76 and 1829 mm) above the floor and more than 2 feet (610 mm) from the walls of the space or from fixed air-conditioning *equipment*.

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Environmental Air

Air that is conveyed to or from occupied areas through ducts which are not part of the heating or air-conditioning system, such as ventilation for human usage, domestic kitchen range exhaust, bathroom exhaust, domestic clothes dryer exhaust and parking garage exhaust.

The types of air considered to be environmental air are included in this definition. These include typical building ventilation air, as required in Chapter 4, domestic kitchen and clothes dryer exhaust and exhaust air from both domestic and commercial bathrooms.

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2018 IMC Chapter 4: Ventilation

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Chapter 4: Introduction

- Ventilation controls air contaminants and moisture.
- Chapter 4 provides requirements for ventilation in buildings intended to be occupied when the space or room in the building is occupied.
- We will look into key areas and discuss details regarding the following:
  - Ventilation Requirements
  - Intake Opening Locations
  - Natural & Mechanical Ventilation

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Section 401 – General

- **401.2 – Ventilation required**
  - Method of ventilation to be provided, mechanical or natural, is the choice of the owner or designer.

401.2 Ventilation required. Every occupied space shall be ventilated by natural means in accordance with Section 402 or by mechanical means in accordance with Section 403. Where the air infiltration rate in a dwelling unit is less than 5 air changes per hour when tested with a blower door at a pressure of 0.2-inch water column (50 Pa) in accordance with Section R402.4.1.2 of the *International Energy Conservation Code*, the dwelling unit shall be ventilated by mechanical means in accordance with Section 403. Ambulatory care facilities and Group I-2 occupancies shall be ventilated by mechanical means in accordance with Section 407.

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Section 401 – General

- **401.3 – When required**
  - The mechanical ventilation system shall be designed with controls that provide for continuous ventilation air movement during the entire time that the building is occupied.

> **401.3 When required.** Ventilation shall be provided during the periods that the room or space is occupied.

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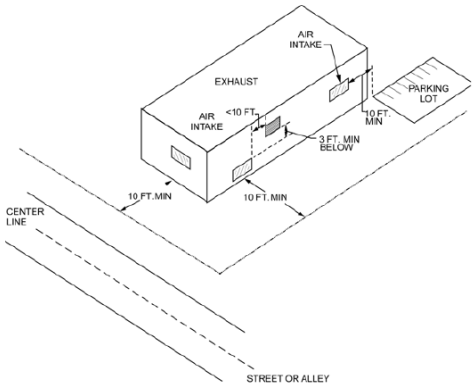
401.4 Intake openings

- Both this section and Section 501.3.1 addresses exhaust openings.
- These two sections must be applied in harmony because they both can affect the separation between intakes and exhaust openings.



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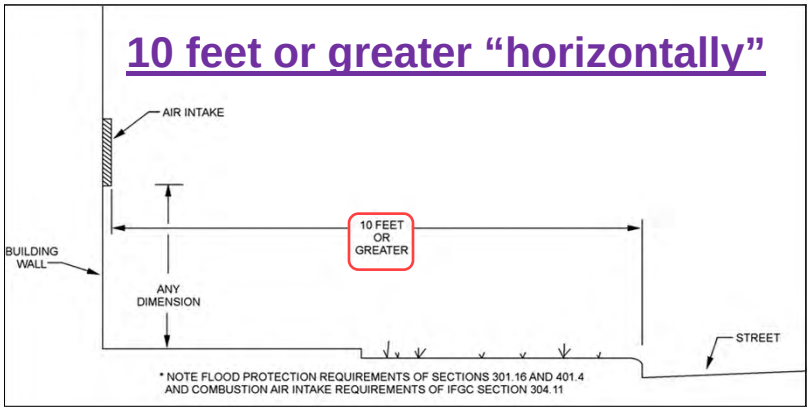
401.4 Intake Opening Location

10 feet or greater "horizontally"



There are no vertical height requirements for outdoor air intake openings where they are located 10 feet (3048 mm) or more horizontally from the source of contamination.

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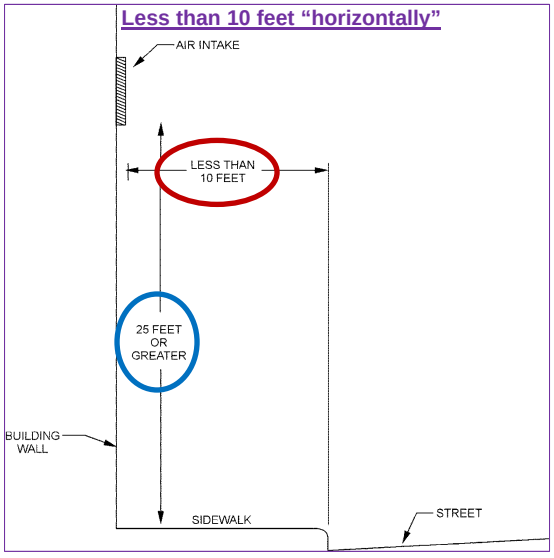
401.4 Intake Opening Location

Intake openings can be located less than 10 feet horizontally from streets, alleys, parking lots and loading docks provided that they are positioned more than 25 feet vertically above such locations.

Less than 10 feet "horizontally"



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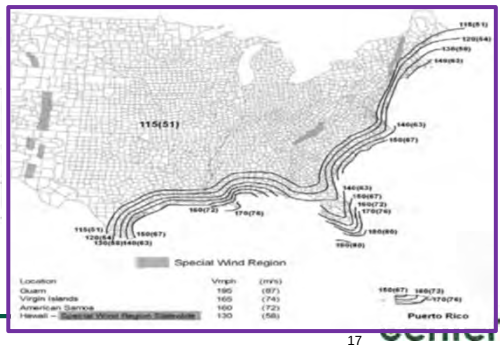
Section 401 – General

- **401.5 – Intake Opening Protection**
  - Provides specific criteria for various types of opening protection. In hurricane-prone regions, the opening protection must comply with AMCA 550 (Test Method for High Velocity Wind Driven Rain Resistant Louvers).

TABLE 401.5
OPENING SIZES IN LOUVERS, GRILLES AND SCREENS PROTECTING AIR INTAKE OPENINGS

OUTDOOR OPENING TYPE	MINIMUM AND MAXIMUM OPENING SIZES IN LOUVERS, GRILLES AND SCREENS MEASURED IN ANY DIRECTION
Intake openings in residential occupancies	Not < 1/4 inch and not > 1/2 inch
Intake openings in other than residential occupancies	> 1/4 inch and not > 1 inch

For SI: 1 inch = 25.4 mm.



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Section 401 – General

- **401.6 – Contaminant sources**
  - o Ducts cannot terminate in attics and crawl spaces
  - o Exhaust ducts must connect directly to terminals that pass through the building envelope to the outside atmosphere.
  - o ***Examples***: nail salons, indoor firing ranges, internal combustion engine repair shops and painting operations (see Section 502).

401.6 Contaminant sources. Stationary local sources producing air-borne particulates, heat, odors, fumes, spray, vapors, smoke or gases in such quantities as to be irritating or injurious to health shall be provided with an exhaust system in accordance with Chapter 5 or a means of collection and removal of the contaminants. Such exhaust shall discharge directly to an *approved* location at the exterior of the building.

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Section 402 – Natural Ventilation

- Natural ventilation requirements are also found in Section 1203.4 of the IBC.
- Section 402.2: Natural ventilation openings must be 4 percent of the floor area being ventilated.
- Bathtubs, showers, spas or similar bathing fixtures must be mechanically ventilated

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Section 403 – Mechanical Ventilation

- Addresses the mechanical means of ventilation.
- Mechanical ventilation is the alternative to providing natural ventilation.
- Mechanical ventilation systems must also comply with the applicable sections of Chapters 3, 5 and 6 of the code.

403.1 Ventilation system. Mechanical ventilation shall be provided by a method of supply air and return or *exhaust air* except that mechanical ventilation air requirements for Group R-2, R-3 and R-4 occupancies three stories and less in height above grade plane shall be provided by an exhaust system, supply system or combination thereof. The amount of supply air shall be approximately equal to the amount of return and *exhaust air*. The system shall not be prohibited from producing negative or positive pressure. The system to convey *ventilation air* shall be designed and installed in accordance with Chapter 6.

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Section 403 – Mechanical Ventilation

- **403.2 – Outdoor air required**
  - The minimum outdoor airflow rate shall be determined in accordance with Section 403.3.
  - This section includes an exception that allows a design professional to demonstrate to the code official that a proposed engineered system will provide air quality at least equivalent to that achievable by the ventilation rate method of Section 403.

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Section 403 – Mechanical Ventilation

- **403.2.1 – Recirculation of air**
  - The outdoor air required by Section 403.3 shall not be recirculated.
  - Only the ventilation air that is in excess of the required amount is allowed to be recirculated, with a few exceptions.
  - Table 403.3.1.1 prescribes outdoor air only and the occupant load calculation is determined by the table as opposed to the building code.

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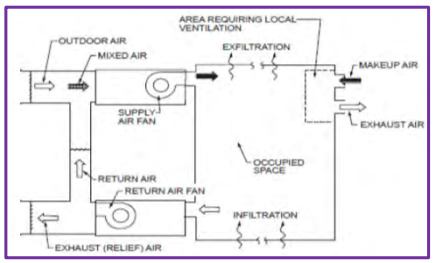
Section 403 – Mechanical Ventilation

- **403.2.1 – Recirculation of air**
  - The ventilation air amounts in excess of those specified by Table 403.3.1.1 can be recirculated except as listed in the 4 exceptions.



Exceptions

Recirculation from:

1. one dwelling to another
2. a swimming pool and deck areas
3. smoking lounges, and other areas designated by Note b in Table 403.3.1.1
4. bathrooms and other areas designated by Note g in Table 403.3.1.1

See Section 403.2.1 for specific details

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403.2.1, Table 403.3.1.1 Recirculation of Air

- The revisions to Section 403.2.1 and notes b and g of Table 403.3.1.1 clarify when recirculation of air within a space is permitted.

TABLE 403.3.1.1 Minimum Ventilation Rates

Occupancy Classification	Occupant Density #/1000 Ft²[a]	People Outdoor Airflow Rate in Breathing Zone, R_p Cfm/ Person	Area Outdoor Airflow Rate in Breathing Zone, R_a[a] Cfm/ Ft²[a]	Exhaust Airflow Rate Cfm/Ft²[a]
Public spaces				
Corridors			0.06	
Elevator car				1.0
Shower room (per shower head)[g]				50/20[f]
Smoking lounges[b]	70	60		
Toilet rooms—public[g]				50/70[g]

b. Mechanical exhaust required and the recirculation of air from such spaces is prohibited. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Item 3).

g. Mechanical exhaust is required and recirculation from such spaces is prohibited except that recirculation shall be permitted where the resulting supply airstream consists of not more than 10 percent air recirculated from these spaces. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Items 2 and 4).

Only portions of the table are shown for brevity and clarity.

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REFER TO ICC CODE BOOK

2018 IMC, Table 403.3.1.1 Pages 36-39

TABLE 403.3.1.1
MINIMUM VENTILATION RATES

OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/1000 FT² ᵃ ᵉ	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_a CFM/FT² ᵃ	EXHAUST AIRFLOW RATE CFM/FT² ᵃ
Correctional facilities				
Booking/waiting	50	7.5	0.06	—
Cells				
without plumbing fixtures	25	5	0.12	—
with plumbing fixtures[g]	25	5	0.12	1.0
Day room	30	5	0.06	—
Dining halls (see food and beverage service)	—	—	—	—
Guard stations	15	5	0.06	—
Dry cleaners, laundries				
Coin-operated dry cleaner	20	15	—	—
Coin-operated laundries	20	7.5	0.06	—
Commercial dry cleaner	30	30	—	—
Commercial laundry	10	25	—	—
Storage, pick up	30	7.5	0.12	—
Education				
Art classroom[g]	20	10	0.18	0.7
Auditoriums	150	5	0.06	—
Classrooms (ages 5-8)	25	10	0.12	—
Classrooms (age 9 plus)	35	10	0.12	—
Computer lab	25	10	0.12	—
Corridors (see public spaces)	—	—	—	—
Day care (through age 4)	25	10	0.18	—
Lecture classroom	65	7.5	0.06	—
Lecture hall (fixed seats)	150	7.5	0.06	—
Locker/dressing rooms[g]	—	—	—	0.25
Media center	25	10	0.12	—
Multiuse assembly	100	7.5	0.06	—
Music/theater/dance	35	10	0.06	—
Science laboratories[g]	25	10	0.18	1.0
Smoking lounges[b]	70	60	—	—
Sports locker rooms[g]	—	—	—	0.5
Wood/metal shops[g]	20	10	0.18	0.5
Food and beverage service				
Bars, cocktail lounges	100	7.5	0.18	—
Cafeteria, fast food	100	7.5	0.18	—
Dining rooms	70	7.5	0.18	—
Kitchens (cooking)[g]	—	—	—	0.7

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Table 403.3 Minimum Ventilation Rates

The application of Table 403.3.1.1 has become more complex than ever and requires the application of at least two mathematical equations for single-zone systems and several more for multiple-zone recirculating systems..

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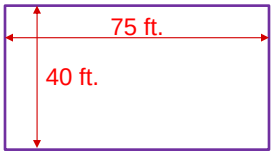
Application:

Example: Single Zone Recirculating System

A 3,000 square foot dining room is served by a rooftop air handling unit by means of ducted ceiling supply registers and ceiling return grilles.

Determine the system's outdoor air intake flow rate (V_{ot}) for the dining room.



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Application:

Example : Single Zone Recirculating System: Application

This dining room with a single rooftop unit is considered a single zone system. In order to determine the outdoor air intake flow rate (V_{ot}) for a single zone system using Equation 4-3, the breathing zone airflow rate (V_{bz}) of the occupied space must first be determined using Equation 4-1. Then, the zone airflow effectiveness (E_z) must be determined in accordance with Table 403.3.1.1.1.2. Next, the zone outdoor airflow rate (V_{oz}) must be determined using Equation 4-2. The outdoor air intake flow rate for a single zone system is then simply $V_{ot} = V_{oz}$, Equation 4-3.

TABLE 403.3.1.1
MINIMUM VENTILATION RATES

OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/1000 FT² [a]	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_a CFM/FT² [a]	EXHAUST AIRFLOW RATE CFM/FT² [a]
Food and beverage service				
Bars, cocktail lounges	100	7.5	0.18	—
Cafeteria, fast food	100	7.5	0.18	—
Dining rooms	70	7.5	0.18	—
Kitchens (cooking)[b]	—	—	—	0.7

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403.3.1.1.1.1 Breathing zone outdoor airflow

$V_{bz} = R_p P_z + R_a A_z$ *(Equation 4-1)*

- The equation sums the rate per person times the number of occupants and the rate per area times the square footage of the zone floor.

403.3.1.1.1.1 Breathing zone outdoor airflow. The outdoor airflow rate required in the *breathing zone* (V_{bz}) of the *occupiable space* or spaces in a zone shall be determined in accordance with Equation 4-1.

$$V_{bz} = R_p P_z + R_a A_z \qquad \textbf{(Equation 4-1)}$$

where:

A_z = Zone floor area: the *net occupiable floor area* of the space or spaces in the zone.

P_z = Zone population: the number of people in the space or spaces in the zone.

R_p = People outdoor air rate: the outdoor airflow rate required per person from Table 403.3.1.1.

R_a = Area outdoor air rate: the outdoor airflow rate required per unit area from Table 403.3.1.1.

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Application:

Example : Single Zone Recirculating System

Step 1: Determine occupant load (P_z) for the room for use in Equation 4-1:

No specific occupancy criterion is given for the dining room, therefore, from Table 403.3.1.1 for dining rooms, the default occupant density is used (70 occupants/1,000 sq ft):

$$3{,}000 \text{ sq ft} \times \frac{70 \text{ occupants}}{1{,}000 \text{ sq ft}} = 210 \text{ occupants} = P_z$$

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Application:

Example : Single Zone Recirculating System

Step 2: Determine the breathing zone outdoor airflow (V_{bz}) for the room:

First, the outdoor air rates for people (R_p) and area (R_a) must be obtained for the dining room from Table 403.3.1.1:

R_p = 7.5 cfm/person and R_a = 0.18 cfm/sq ft.

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Application:

Example : Single Zone Recirculating System

Step 2 (*continued*)

Equation 4-1 can now be solved:

$V_{bz} = R_p P_z + R_a A_z$

V_{bz} = [7.5 cfm/person x 210 people] + [0.18 cfm/sq ft x 3,000 sq ft]

V_{bz} = 2,115 cfm

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Application:

Step 3: Determine the zone outdoor airflow (V_{oz}):

It is given that the room is served by a rooftop air handling unit by means of ducted ceiling supply registers and ceiling return grilles, thus, the zone air distribution effectiveness (E_z), can be obtained from Table 403.3.1.1.1.2. In cooling mode E_z = 1.0 and in heating mode E_z = 0.8 (assume notes do not apply).

403.3.1.1.1.3 Zone outdoor airflow. The zone outdoor airflow rate (V_{oz}), shall be determined in accordance with Equation 4-2.

$$V_{oz} = \frac{V_{bz}}{E_z} \qquad \text{(Equation 4-2)}$$

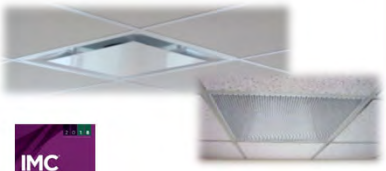

TABLE 403.3.1.1.1.2
ZONE AIR DISTRIBUTION EFFECTIVENESS[a,b,c,d]

AIR DISTRIBUTION CONFIGURATION	E_z
Ceiling or floor supply of cool air	1.0[e]
Ceiling or floor supply of warm air and floor return	1.0
Ceiling supply of warm air and ceiling return	0.8[f]
Floor supply of warm air and ceiling return	0.7
Makeup air drawn in on the opposite side of the room from the exhaust and/or return	0.8
Makeup air drawn in near to the exhaust and/or return location	0.5

For SI: 1 foot = 304.8 mm, 1 foot per minute = 0.00506 m/s, °C = [(°F) – 32]/1.8.
a. "Cool air" is air cooler than space temperature.
b. "Warm air" is air warmer than space temperature.
c. "Ceiling" includes any point above the breathing zone.
d. "Floor" includes any point below the breathing zone.

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Application:

Step 3 (*continued*)

Equation 4-2 can now be solved for the zone:

403.3.1.1.1.3 Zone outdoor airflow. The zone outdoor airflow rate (V_{oz}), shall be determined in accordance with Equation 4-2.

$$V_{oz} = \frac{V_{bz}}{E_z} \qquad \text{(Equation 4-2)}$$

$$V_{oz} = \frac{V_{bz}}{E_z}$$

Cooling Mode: $V_{oz} = \frac{2{,}115}{1.0} = 2{,}115 \text{ cfm}$

Heating Mode: $V_{oz} = \frac{2{,}115 \text{ cfm}}{0.8} = 2{,}644 \text{ cfm}$

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Application:

Example : Single Zone Recirculating System

As a result, the dining room requires 2,115 cfm of outdoor air in cooling mode and 2,644 cfm of outdoor air in heating mode. For system design purposes we must use the most restrictive value of V_{oz}, 2,644 cfm, to determine the system outdoor air intake flow rate (V_{ot}) required, Equation 4-3:

$V_{ot} = V_{oz} =$ **2,644 cfm**

403.3.1.1.2.1 Single zone systems. Where one air handler supplies a mixture of outdoor air and recirculated return air to only one zone, the system outdoor air intake flow rate (V_{ot}) shall be determined in accordance with Equation 4-3.

$V_{ot} = V_{oz}$ **(Equation 4-3)**

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403.3.1.2 Exhaust ventilation

- Table 403.3.1.1 has an additional column; an exhaust airflow cfm/feet^2 column.
- Required exhaust rate airflow must occur in addition to any other ventilation rates prescribed by the table.

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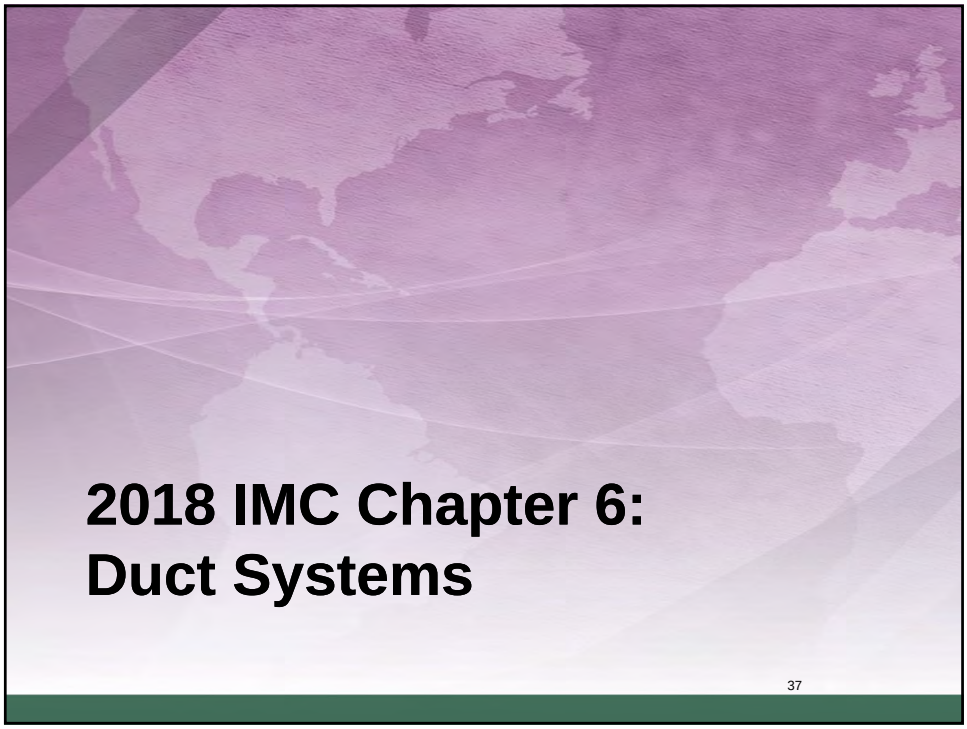

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Chapter 6: Introduction

This chapter regulates the materials and methods used for the construction and installation of the following:

- Ducts
- System controls
- Exhaust systems
- Fire protection systems
- Related components that affect the overall performance of a building's air distribution system

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Section 601 – General

- **Section 601.1 Scope**
  - Duct systems used for the movement of air in air-conditioning, heating, ventilating and exhaust systems shall conform to the provisions of this chapter except as otherwise specified in Chapters 5 and 7.
- **Section 601.2 – Air movement in egress elements**
  - This section prohibits exits and exit access corridors from being used as air distribution system ducts because of the potential for spreading smoke and fire into elements of the building's required means of egress.

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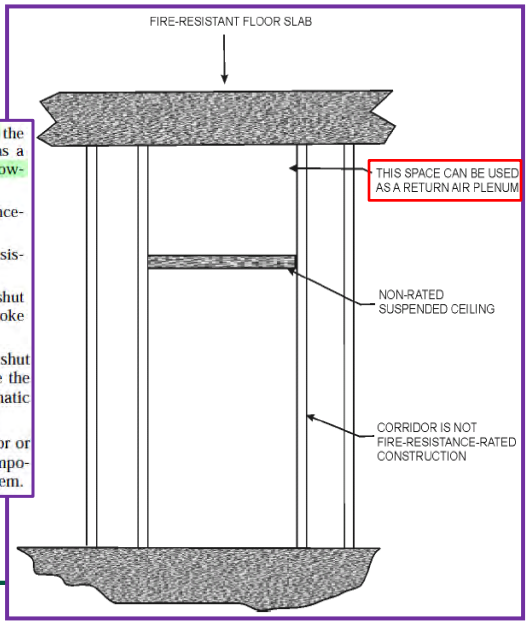
601.2 – Air movement in egress elements

[B] 601.2.1 Corridor ceiling. Use of the space between the corridor ceiling and the floor or roof structure above as a return air *plenum* is permitted for one or more of the following conditions:

1. The corridor is not required to be of fire-resistance-rated construction;
2. The corridor is separated from the *plenum* by fire-resistance-rated construction;
3. The air-handling system serving the corridor is shut down upon activation of the air-handling unit smoke detectors required by this code;
4. The air-handling system serving the corridor is shut down upon detection of sprinkler waterflow where the building is equipped throughout with an automatic sprinkler system; or
5. The space between the corridor ceiling and the floor or roof structure above the corridor is used as a component of an *approved* engineered smoke control system.



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Section 601 – General

- **601.4 - Contamination prevention**
- To prevent cross contamination:
  - Exhaust ducts under positive pressure **and** chimneys and vents are **not permitted** to extend into or pass through ducts or plenums.

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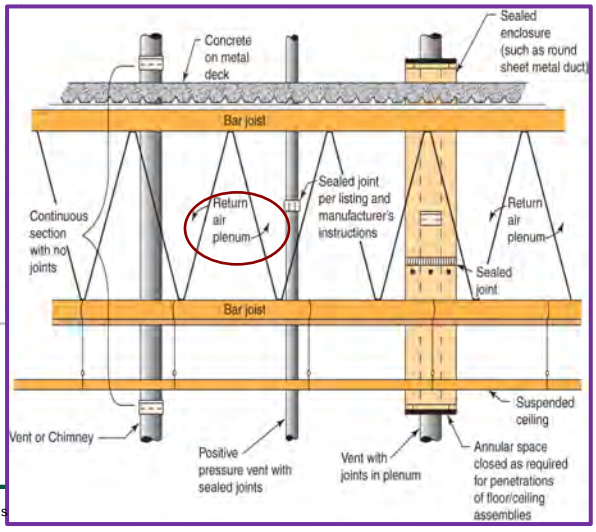
Section 601.4 - Contamination prevention

2018 IMC (601.4, Exception. 2)

2. This section shall not apply to chimneys and vents that pass through plenums where such venting systems comply with one of the following requirements:
   - 2.1. The venting system shall be listed for positive pressure applications and shall be sealed in accordance with the vent manufacturer's instructions.
   - 2.2. The venting system shall be installed such that fittings and joints between sections are not installed in the above ceiling space.
   - 2.3. The venting system shall be installed in a conduit or enclosure with sealed joints separating the interior of the conduit or enclosure from the ceiling space.



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Section 601.5

Return Air Openings

601.5 Return air openings. Return air openings for heating, ventilation and air-conditioning systems shall comply with all of the following:

1. Openings shall not be located less than 10 feet (3048 mm) measured in any direction from an open combustion chamber or draft hood of another appliance located in the same room or space.
2. Return air shall not be taken from a hazardous or insanitary location or a refrigeration room as defined in this code.
3. The amount of return air taken from any room or space shall be not greater than the flow rate of supply air delivered to such room or space.
4. Return and transfer openings shall be sized in accordance with the appliance or equipment manufacturer's installation instructions, ACCA Manual D or the design of the registered design professional.
5. Return air taken from one dwelling unit shall not be discharged into another dwelling unit.
6. Taking return air from a crawl space shall not be accomplished through a direct connection to the return side of a forced air furnace. Transfer openings in the crawl space enclosure shall not be prohibited.
7. Return air shall not be taken from a closet, bathroom, toilet room, kitchen, garage, boiler room, furnace room or unconditioned attic.

Exceptions:

1. Taking return air from a kitchen is not prohibited where such return air openings serve the kitchen and are located not less than 10 feet (3048 mm) from the cooking appliances.
2. Dedicated forced air systems serving only the garage shall not be prohibited from obtaining return air from the garage.

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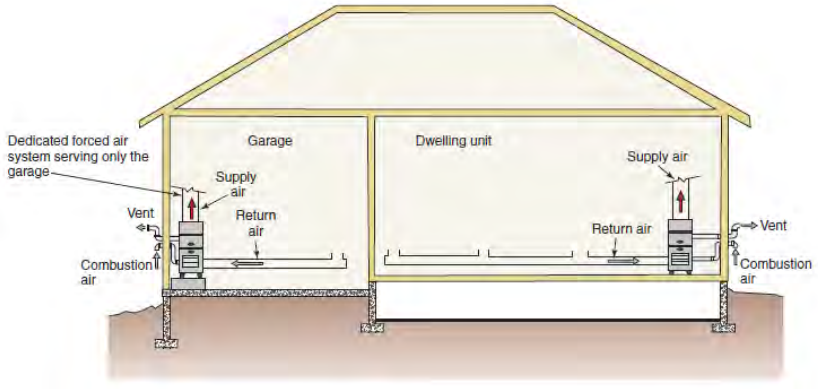
Return air openings – 601.5



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Section 602 – Plenums

- Plenums are restricted to spaces that are:
  - o uninhabitable
  - o unoccupiable
  - o interstitial spaces, or
  - o cavities
- Fuel fired appliances shall not be installed in plenums.
- Plenums are restricted to one fire area as defined by the International Building Code (IBC). This could require dedicated HVAC systems for each fire area.

45

Section 602 – Plenums

602.1 General. Supply, return, exhaust, relief and ventilation air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces and mechanical equipment rooms. Plenums shall be limited to one fire area. Air systems shall be ducted from the boundary of the fire area served directly to the air-handling equipment. Fuel-fired appliances shall not be installed within a plenum.

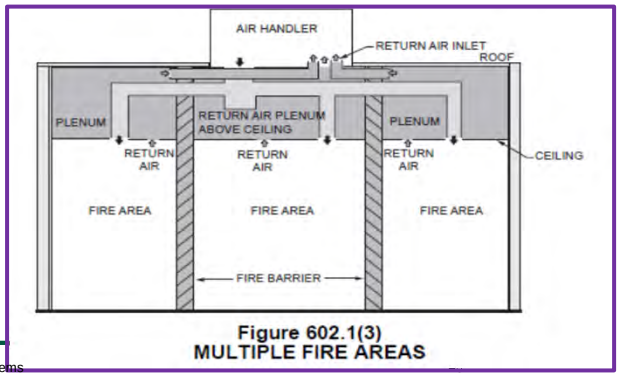

Figure 602.1(3)
MULTIPLE FIRE AREAS

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Section 602 – Plenums

- **602.2 – Construction**
  - Requires the plenum to be constructed of or formed by materials that are consistent with the materials allowed for the building's construction type.

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Section 602 – Plenums

- **602.2.1 – Materials within plenums**
  - Materials located within a plenum must be noncombustible or must have a flame spread index of 25 or less and a smoke developed index of 50 or less when tested in accordance with ASTM E 84 or UL 723.

Regardless of whether the plenum is constructed of or bounded by combustible or noncombustible materials

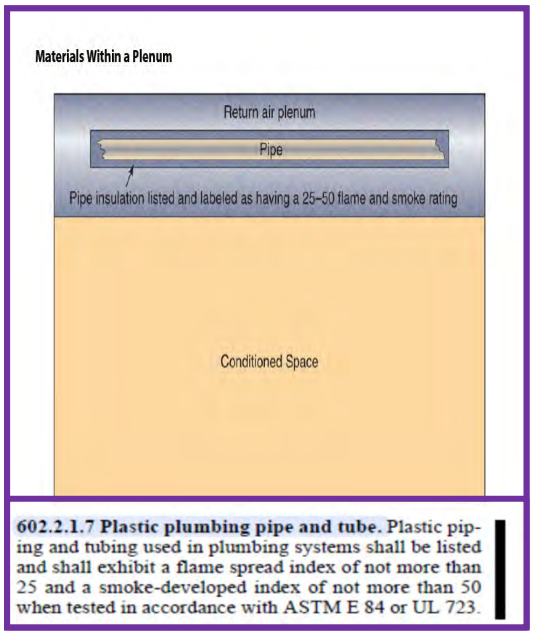
48

Sections 602.2.1 & 602.2.1.7

602.2.1 Materials within plenums. Except as required by Sections 602.2.1.1 through 602.2.1.7, materials within plenums shall be noncombustible or shall be listed and labeled as having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.

Previous editions of the code used the term "exposed within plenums" when addressing this issue. However, some designers and installers used that language to install plastic pipe and other combustible material with some insulation wrapped around it, claiming that the material was no longer exposed. If the wrapping material were to become damaged, loosened or destroyed in a fire, the combustible material could be exposed to the fire and produce hazardous smoke that would be spread to other parts of the building through the plenum.

The word "exposed" was deleted in the 2006 edition of the code to close this loophole.



602.2.1.7 Plastic plumbing pipe and tube. Plastic piping and tubing used in plumbing systems shall be listed and shall exhibit a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723.

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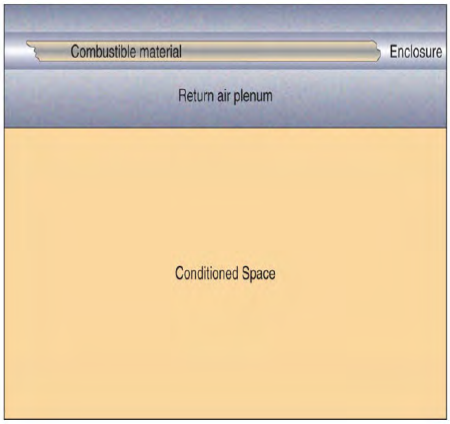
Section 602 – Plenums

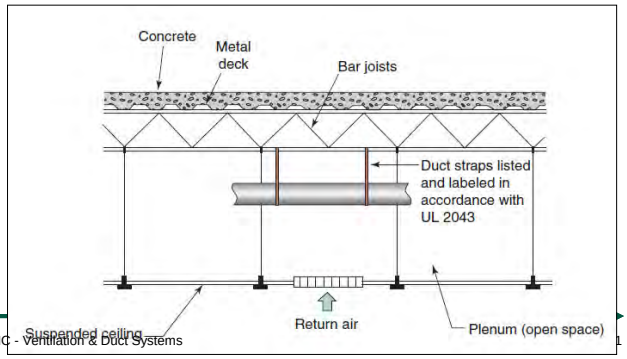
- **602.2.1 – Materials within plenums**
  - Code has exceptions that permit exposure of limited types of combustible materials used for these systems within the plenum.
  - Code permits combustible materials that are fully enclosed with materials that are listed and labeled for installation in a plenum.



50

Section 602 – Plenums

- **602.2.1.5 – Discrete plumbing and mechanical products in plenums**
  - Where discrete plumbing and mechanical products and appurtenances are located in a plenum and have exposed combustible material, they shall be listed and labeled for such use in accordance with UL 2043.



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Section 602 – Plenums

- **Section 602.2.1.6 – Foam plastic insulation**
  - Foam plastic insulation used as wall or ceiling finish in plenums must exhibit a flame spread index of 75 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E 84.
  - This section provides several options.
- **602.3 – Stud cavity and joist space plenums**
  - Use of this type of plenum is limited to return air from one floor level only for each independent stud cavity.

IMC 602.3 Item #6: Stud wall cavities in the outside walls of building envelope assemblies shall not be utilized as air plenums.

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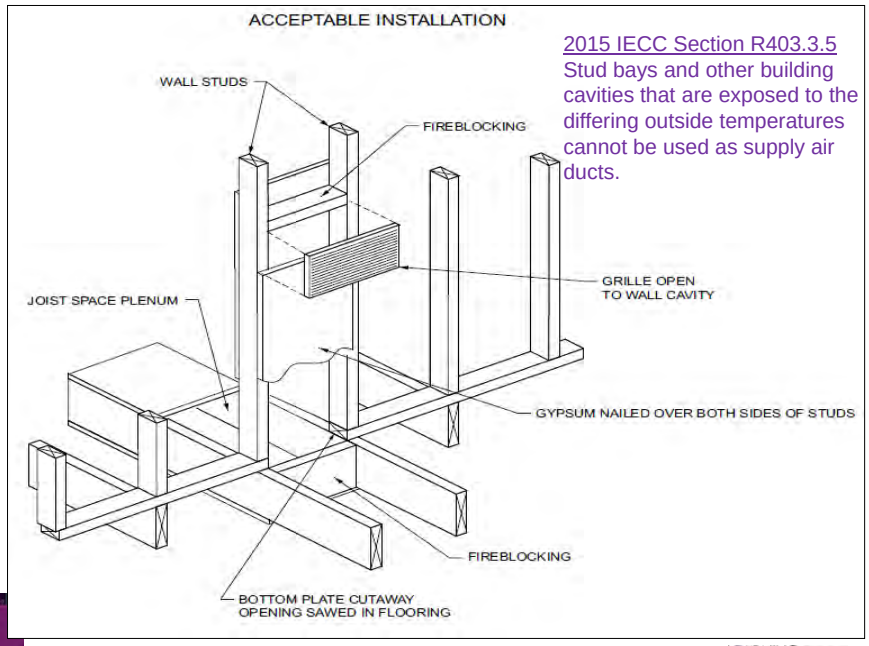

2015 IECC Section R403.3.5
Stud bays and other building cavities that are exposed to the differing outside temperatures cannot be used as supply air ducts.

53

Section 603 – Duct Construction and Installation

Ducts are constructed, braced, reinforced and installed such that they provide structural strength and durability, and do not affect fire protection requirements.

54

Section 603 – Duct Construction and Installation

- **603.2 – Duct sizing**
  - Sized in accordance with ACCA Manual D or other approved methods.
- **603.4 – Metallic ducts.**
  - **Constructed per SMACNA**
  - this section permits ducts, installed within a single dwelling unit, to be constructed with the minimum thickness as specified in Table 603.4.

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Table 603.4

TABLE 603.4
DUCT CONSTRUCTION MINIMUM SHEET METAL THICKNESS FOR SINGLE DWELLING UNITS[a]

ROUND DUCT DIAMETER (inches)	STATIC PRESSURE			
	½-inch water gage		1-inch water gage	
	Thickness (inches)		Thickness (inches)	
	Galvanized	Aluminum	Galvanized	Aluminum
< 12	0.013	0.018	0.013	0.018
12 to14	0.013	0.018	0.016	0.023
15 to 17	0.016	0.023	0.019	0.027
18	0.016	0.023	0.024	0.034
19 to 20	0.019	0.027	0.024	0.034
RECTANGULAR DUCT DIMENSION (inches)	**STATIC PRESSURE**			
	½-inch water gage		1-inch water gage	
	Thickness (inches)		Thickness (inches)	
	Galvanized	Aluminum	Galvanized	Aluminum
≤ 8	0.013	0.018	0.013	0.018
9 to10	0.013	0.018	0.016	0.023
11 to 12	0.016	0.023	0.019	0.027
13 to16	0.019	0.027	0.019	0.027
17 to 18	0.019	0.027	0.024	0.034
19 to 20	0.024	0.034	0.024	0.034

For SI: 1 inch = 25.4 mm, 1-inch water gage = 249 Pa.

a. Ductwork that exceeds 20 inches by dimension or exceeds a pressure of 1-inch water gage shall be constructed in accordance with SMACNA *HVAC Duct Construction Standards—Metal and Flexible*.

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Section 603 Duct Construction and Installation

- **603.5 – Nonmetallic ducts**
- **603.5.1 – Gypsum ducts**
- **603.6 – Flexible air ducts and flexible air connectors**
  - o Flexible air ducts, both metallic and nonmetallic, shall comply with Sections 603.6.1, 603.6.1.1, 603.6.3 and 603.6.4.
  - o Flexible air connectors, both metallic and nonmetallic, shall comply with Sections 603.6.2 through 603.6.4.

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Section 603 Duct Construction and Installation

- **603.6.1 – Flexible air ducts**
  - Flexible air duct labels are rectangular in shape. Flexible air ducts are not limited in length.

Class 0 - Air ducts and air connectors having surface burning characteristics of zero.

Class 1 - Air ducts and air connectors having a flame-spread index of not over 25 without evidence of continued progressive combustion and a smoke-developed index of not over 50.

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Section 603 Duct Construction and Installation

- **603.6.2 – Flexible air connectors**
  - Current air connector labels are oval in shape, thereby being readily distinguishable from flexible air duct labels.
- **603.6.2.1 –Connector length**
  - Flexible air connectors shall be limited in length to 14 feet .

59

Section 603 Duct Construction and Installation

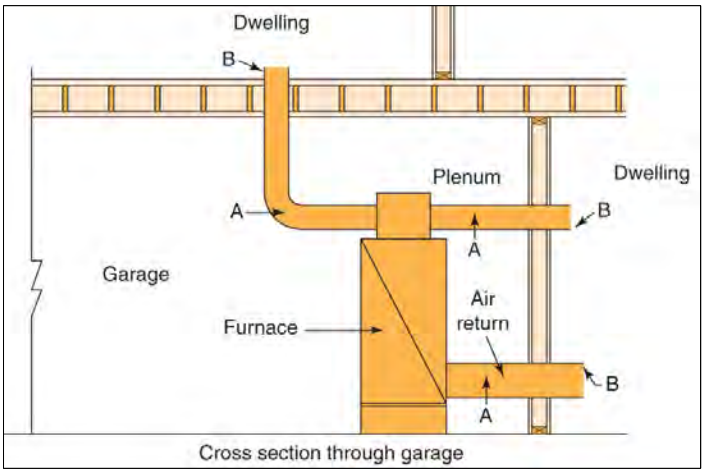
- **603.6.2.1 – Connector length**
- **603.6.3 – Air temperature**
- **603.7 – Rigid duct penetrations**
  - Ducts in a private garage that penetrate a wall or ceiling that separates a dwelling from a private garage must be continuous and constructed of sheet steel having a thickness of not less than 0.0187 inch (No. 26 gage). The duct must not have openings into the garage.

60

Duct penetration of a garage/dwelling separation

Ducts A - 26 gage galvanized steel with no openings into garage.

Ducts B - Any duct approved by the Mechanical Code.



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Section 603 Duct Construction and Installation

- **603.8 – Underground ducts**
- Ducts installed underground must be able to resist the following:
  - Forces imposed on them by materials that surround them
  - Forces created by floodwaters
  - Corrosion
- **603.8.3 – Plastic ducts and fittings**
  - Allowed underground only and are used for their corrosion and moisture resistant properties.

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Section 603 Duct Construction and Installation

- **Section 603.9 Joints, seams and connections**
- Shall be constructed as specified in:
  - Sheet Metal and Air Conditioning Contractors' National Association **(SMACNA)** HVAC Duct Construction Standards.
  - North American Insulation Manufacturers Association **(NAIMA)** Fibrous Glass Duct Construction Standards.
  - Ducts listed to UL 181 and metallic ducts shall have closure systems that comply with UL 181A or UL 181B.

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Section 603.9

- **Joints, seams and connections**

  Clarifies that unlisted duct tape is not allowed as a sealant on any type of a duct system.

Listed duct tape

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Section 603 Duct Construction and Installation

- **603.10 – Supports**
  - Ducts must be supported with approved hangers at a maximum spacing of 12 feet or by the approved system designed to meet the building code.
- **603.14 – Location**
  - Unless a duct is approved for underground installation, it must not be located within 4 inches of grade level.

> Unless a duct is approved for underground installation, it must not be located in or within 4 inches (102 mm) of the ground. The 4-inch (102 mm) clearance is considered adequate to keep the duct from contacting the ground and possible moisture, which can cause duct deterioration.

65

Section 603.17 – Air Dispersion System

An air dispersion system is a tubular-shaped exposed supply air system that is made of air impermeable fabric material. The system is:

- Fitted with air holes or nozzles to direct air into the area served by the duct
- Generally used in open ceiling installations where the floor or roof deck is visible
- Can be thought of as a duct and a diffuser all in one.

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Section 603.17

- **Air dispersion systems**

  Air dispersion systems as defined in Section 202 and recognized in UL 2518 are now permitted to be installed.

  - **Definition:** *Any diffuser system designed to both convey air within a room, space or area and diffuse air into that space while operating under positive pressure. Systems are commonly constructed of, but not limited to, fabric or plastic film.*

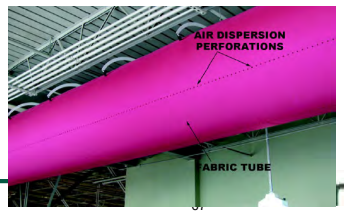

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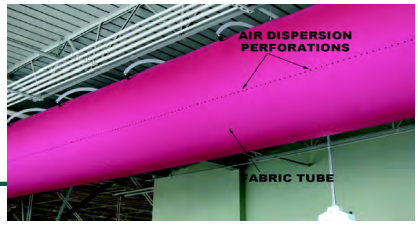
Photo courtesy of DuctSox

Figure 603.17

Air Dispersion System

Section 603.17 establishes criteria for the use of fabric air dispersion systems, limiting them to installation in exposed locations, prohibiting penetration of rated construction, requiring them to operate under positive pressure and to comply with UL 2518.



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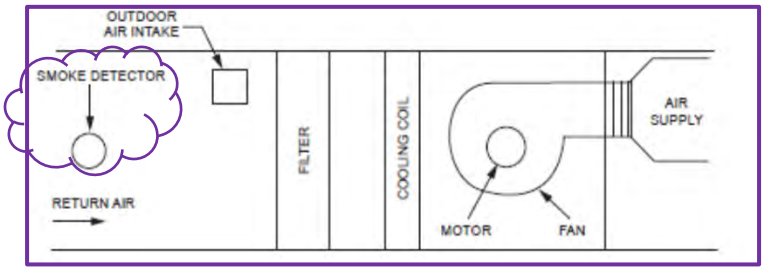
Section 606 – Smoke Detection Systems Control

- **606.2 Where required - smoke detectors**
  - The intent of this section is to prevent air distribution systems from distributing smoke to areas where the occupants might not be aware of the fire.
  - Requiring smoke detectors to be located in air distribution systems the hope is that the detector will sense any smoke and shut down the system before the smoke can be spread beyond the room of origin.

69

Section 606 – Smoke Detection Systems Control

- **606.2.1 – Return air systems**
  - Smoke detectors shall be installed in return air systems with a design capacity greater than 2,000 cfm, the detectors must be installed in the path of airflow before (upstream of) any filters, exhaust air connections, outdoor air connections or decontamination equipment that occur in the system.



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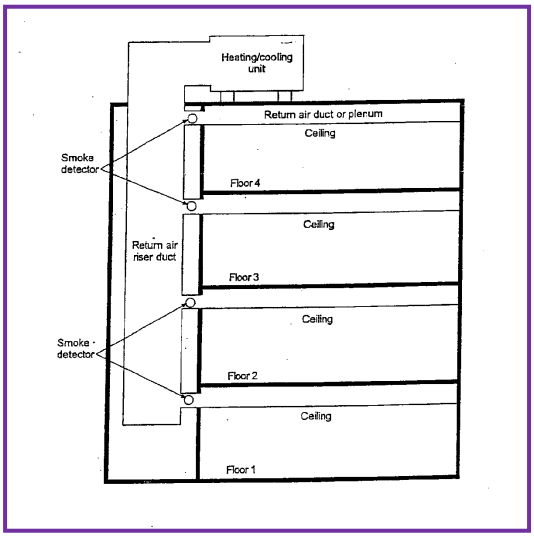
Section 606 – Smoke Detection Systems Control

- **606.2.3 – Return air risers**

Where a return air system with a design capacity greater than 15,000 cfm serves more than one story, the return air from each story must be monitored before intermixing the return in the common riser.



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Section 606 – Smoke Detection Systems Control

[F] 606.4.1 Supervision. The duct smoke detectors shall be connected to a fire alarm system where a fire alarm system is required by Section 907.2 of the *International Fire Code*. The actuation of a duct smoke detector shall activate a visible and audible supervisory signal at a constantly attended location. In facilities that are required to be monitored by a supervising station, duct smoke detectors shall report only as a supervisory signal, not as a fire alarm.

Exceptions:

1. The supervisory signal at a constantly attended location is not required where the duct smoke detector activates the building's alarm-indicating appliances.
2. In occupancies not required to be equipped with a fire alarm system, actuation of a smoke detector shall activate a visible and audible signal in an *approved* location. Duct smoke detector trouble conditions shall activate a visible or audible signal in an *approved* location and shall be identified as air duct detector trouble.

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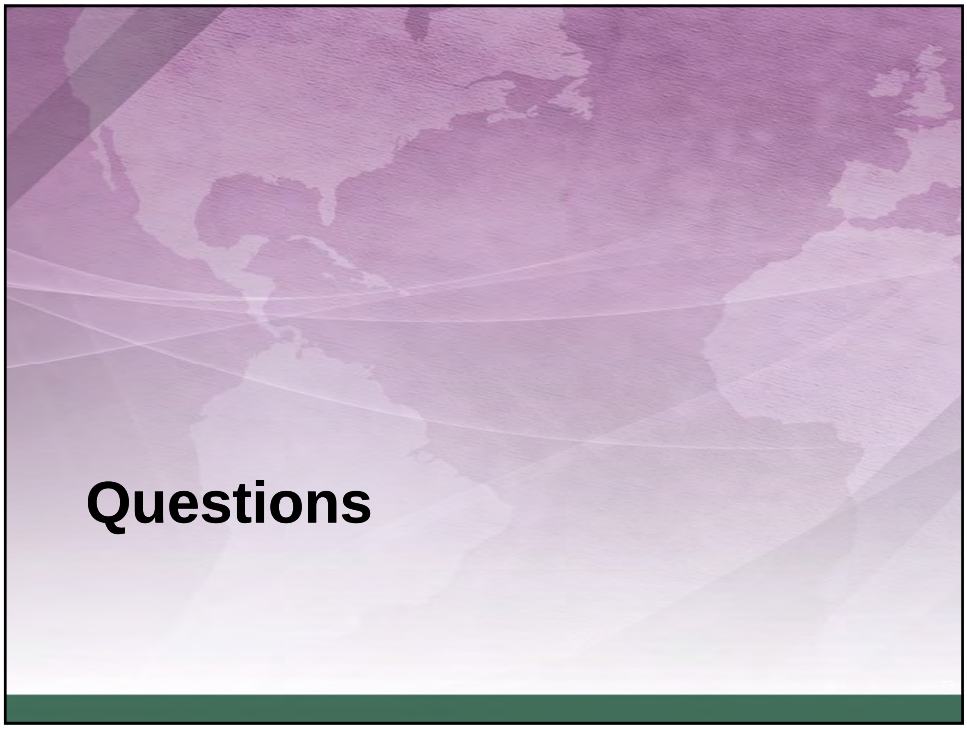

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