

CHAPTER 16

DUCT SYSTEMS

SECTION M1601 DUCT CONSTRUCTION

M1601.1 Duct design. *Duct systems* serving heating, cooling and *ventilation equipment* shall be fabricated in accordance with the provisions of this section and ACCA Manual D or other *approved* methods.

M1601.1.1 Above-ground duct systems. Above-ground *duct systems* shall conform to the following:

1. *Equipment* connected to *duct systems* shall be designed to limit discharge air temperature to a maximum of 250°F (121°C).
2. Factory-made air ducts shall be constructed of Class 0 or Class 1 materials as designated in Table M1601.1.1(1).
3. Fibrous duct construction shall conform to the SMACNA *Fibrous Glass Duct Construction Standards* or NAIMA *Fibrous Glass Duct Construction Standards*.
4. Minimum thickness of metal duct material shall be as listed in Table M1601.1.1(2). Galvanized steel shall conform to ASTM A 653.
5. *Duct systems* shall be constructed of materials having a flame spread index not greater than 200.

**TABLE M1601.1.1(1)
CLASSIFICATION OF FACTORY-MADE AIR DUCTS**

DUCT CLASS	MAXIMUM FLAME-SPREAD INDEX
0	0
1	25

M1601.1.1.1 Use of building cavities in new construction. The use of building cavities for air ducts, or plenums is not allowed in new construction or in an addition to an existing structure.

M1601.1.1.2 Use of building cavities in existing buildings. The use of building cavities for air duct, or plenums is allowed in the alteration or remodel of an existing structure. Gypsum products are permitted to be used to construct air ducts or plenums provided that the air temperature does not exceed 125°F (52°C) and exposed surfaces are not subject to condensation.

Stud wall cavities and the spaces between solid floor joists to be utilized as air ducts or plenums shall comply with the following conditions:

1. Such cavities or spaces shall not be utilized as a duct or plenum for supply air.
2. Such cavities or spaces shall not be part of a required fire-resistance-rated assembly.
3. Stud wall cavities shall not convey air from more than one floor level.
4. Stud wall cavities and joist space ducts or plenums shall comply with floor penetration protection requirements of this code.
5. Stud wall cavities and joist space ducts or plenums shall be isolated from adjacent concealed spaces by tight-fitting fireblocking in accordance with Section R302.11, and sealed to prevent conveyance of air from other spaces.

M1601.1.2 Underground duct systems. Underground *duct systems* shall be constructed of *approved* concrete, clay, metal or plastic. The maximum duct temperature for plastic ducts shall not be greater than 150°F (66°C). Metal ducts shall be protected from corrosion in an *approved* manner or shall be completely encased in concrete not less than 2 inches (51 mm) thick. Nonmetallic ducts shall be installed in accordance with the manufacturer's installation instructions. Plastic pipe and fitting materials shall conform to cell classification 12454-B of ASTM D 1248 or ASTM D 1784

**TABLE M1601.1.1(2)
GAGES OF METAL DUCTS AND PLENUMS USED FOR HEATING OR COOLING**

DUCT SIZE	GALVANIZED		ALUMINUM
	Minimum Thickness (inches)	Equivalent Galvanized Sheet No.	Minimum Thickness (inches)
Round ducts and enclosed rectangular ducts 14 inches or less 16 and 18 inches 20 inches and over	0.0157	28	0.0175
	0.0187	26	0.018
	0.0236	24	0.023
Exposed rectangular ducts 14 inches or Over 14 ^a inches	0.0157	28	0.0175
	0.0187	26	0.018

For SI: 1 inch = 25.4 mm.

a. For duct gages and reinforcement requirements at static pressures of 1/2 inch, 1 inch and 2 inches w.g., SMACNA *Duct Construction Standard*, Tables 2-1; 2-2 and 2-3 shall apply.

and external loading properties of ASTM D 2412. All ducts shall slope to an accessible point for drainage. Where encased in concrete, ducts shall be sealed and secured prior to any concrete being poured. Metallic ducts having an *approved* protective coating and nonmetallic ducts shall be installed in accordance with the manufacturer's installation instructions.

M1601.2 Factory-made ducts. Factory-made air ducts or duct material shall be *approved* for the use intended, and shall be installed in accordance with the manufacturer's installation instructions. Each portion of a factory-made air duct system shall bear a *listing* and *label* indicating compliance with UL 181 and UL 181A or UL 181B.

M1601.2.1 Vibration isolators. Vibration isolators installed between mechanical *equipment* and metal ducts shall be fabricated from *approved* materials and shall not exceed 10 inches (254 mm) in length.

M1601.3 Duct insulation materials. Duct insulation materials shall conform to the following requirements:

1. Duct coverings and linings, including adhesives where used, shall have a flame spread index not higher than 25, and a smoke-developed index not over 50 when tested in accordance with ASTM E 84 or UL 723, using the specimen preparation and mounting procedures of ASTM E 2231.

Exception: Spray application of polyurethane foam to the exterior of ducts in *attics* and crawl spaces shall be permitted subject to all of the following:

1. The flame spread index is not greater than 25 and the smoke-developed index is not greater than 450 at the specified installed thickness.
 2. The foam plastic is protected in accordance with the ignition barrier requirements of Sections R316.5.3 and R316.5.4.
 3. The foam plastic complies with the requirements of Section R316.
2. Duct coverings and linings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C 411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250°F (121°C).
 3. External duct insulation and factory-insulated flexible ducts shall be legibly printed or identified at intervals not longer than 36 inches (914 mm) with the name of the manufacturer, the thermal resistance *R*-value at the specified installed thickness and the flame spread and smoke-developed indexes of the composite materials. Spray polyurethane foam manufacturers shall provide the same product information and properties, at the nominal installed thickness, to the customer in writing at the time of foam application. All duct insulation product *R*-values shall be based on insulation only, excluding air films, vapor retarders or other duct components, and shall be based on tested *C*-values at 75°F (24°C) mean temperature at the installed thickness, in accordance with recognized industry procedures. The installed thickness

of duct insulation used to determine its *R*-value shall be determined as follows:

- 3.1. For duct board, duct liner and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.
- 3.2. For ductwrap, the installed thickness shall be assumed to be 75 percent (25-percent compression) of nominal thickness.
- 3.3. For factory-made flexible air ducts, The installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.
- 3.4. For spray polyurethane foam, the aged *R*-value per inch measured in accordance with recognized industry standards shall be provided to the customer in writing at the time of foam application. In addition, the total *R*-value for the nominal application thickness shall be provided.

M1601.4 Installation. Duct installation shall comply with Sections M1601.4.1 through M1601.4.7.

M1601.4.1 Joints and connections. All joints and connections shall be sealed and securely fastened in accordance with Sections M1601.4.1.1 through M1601.4.2.

M1601.4.1.1 Sealants. All joints of duct systems used in the heating or cooling of a conditioned space shall be sealed by means of tapes, mastics, aerosol sealant, liquid sealants, gasketing or other approved closure systems. Where mastic is used to seal openings greater than 1/4 inch (6.4 mm), a combination of mastic and mesh shall be used.

Exceptions:

1. Adjustable metal elbow gore, longitudinal pipe joints, integral seams within a boot fitting or similar fitting, and integral seams within a "Y" fitting.
2. Spray polyurethane foam shall be permitted to be applied without additional joint seals.

M1601.4.1.2 Rigid fibrous glass ducts. Closure systems used to seal rigid fibrous glass duct joints shall comply with UL 181A and shall be marked "181 A-P" for pressure-sensitive tape, "181 A-M" for mastic or "181 A-H" for heat-sensitive tape.

M1601.4.1.3 Flexible air ducts. Closure systems used to seal flexible air duct joints and flexible air connector joints shall comply with UL 181B and shall be marked "181 B-FX" for tape or "181 B-M" for mastic. Tape shall be a minimum of 12 mil (0.38 mm) total thickness.

M1601.4.1.4 Metal to metal ducts. Closure systems used to seal metal to metal duct joints shall comply with UL 181B and shall be marked "181 B-FX" for tape or "181 B-M" for mastic. Tape shall be a minimum of 12 mil (0.38 mm) total thickness, and shall include butyl rubber adhesive/sealant. Joints of metal to metal duct systems and their components shall not be sealed with cloth backed tapes. Closure systems used to seal metal

ductwork shall be installed in accordance with the manufacturer's installation instructions.

Exception: Continuously welded and locking type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column (500 Pa) pressure classification shall not require additional closure systems.

M1601.4.2 Fastening. Duct connections to flanges of air distribution system equipment or sheet metal fittings shall be mechanically fastened. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked 181B-C. Crimp joints for round ducts shall have a contact lap of at least 1.5 inches (38 mm) and shall be mechanically fastened by means of at least three sheet metal screws or rivets equally spaced around the joint.

Exception: Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.

M1601.4.3 Plastic duct joints. Joints between plastic ducts and plastic fittings shall be made in accordance with the manufacturer's installation instructions.

M1601.4.4 Support. Metal ducts shall be supported by 1/2-inch (13 mm) wide 18-gage metal straps or 12-gage galvanized wire at intervals not exceeding 10 feet (3048 mm) or other *approved* means. Nonmetallic ducts shall be supported in accordance with the manufacturer's installation instructions.

M1601.4.5 Fireblocking. Duct installations shall be fireblocked in accordance with Section R302.11.

M1601.4.6 Duct insulation. Duct insulation shall be installed in accordance with the following requirements:

1. Exterior *duct systems* shall be protected against the elements.
2. Duct coverings shall not penetrate a fireblocked wall or floor.

M1601.4.7 Factory-made air ducts. Factory-made air ducts shall not be installed in or on the ground, in tile or metal pipe, or within masonry or concrete.

M 1601.4.8 Duct separation. Ducts shall be installed with at least 4 inches (102 mm) separation from earth except where they meet the requirements of Section M1601.1.2.

Exception: When approved ground cover is placed between earth and the duct a minimum of 1 inch (25.4 mm) separation from the earth shall be allowed.

M1601.4.9 Ducts located in garages. Ducts in garages shall comply with the requirements of Section R302.5.2.

M1601.4.10 Flood hazard areas. In areas prone to flooding as established by the local jurisdiction, *duct systems* shall be located or installed in accordance with Section R322.1.6.

M1601.5 Under-floor plenums. A crawl space shall not be used as a supply or return air plenum.

M1601.6 Independent garage HVAC systems. Furnaces and air-handling systems that supply air to living spaces shall not supply air to or return air from a garage.

SECTION M1602 RETURN AIR

M1602.1 Return air. Return air shall be taken from inside the *dwelling*. Dilution of return air with outdoor air shall be permitted.

M1602.1.1 Required area. The total unobstructed area of return ducts or openings to a warm-air furnace shall be in accordance with the manufacturer's installation instructions, or not less than 2 square inches (1290 mm²) for each 1,000 Btu/h (293 W) output rating of the furnace.

M1602.2 Prohibited sources. Outdoor and return air for a forced-air heating or cooling system shall not be taken from the following locations:

1. Closer than 10 feet (3048 mm) to an *appliance* vent outlet, a vent opening from a plumbing drainage system or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside air inlet.
2. Where flammable vapors are present; or where located less than 10 feet (3048 mm) above the surface of any abutting public way or driveway; or where located at grade level by a sidewalk, street, alley or driveway.
3. A room or space, the volume of which is less than 25 percent of the entire volume served by the system. Where connected by a permanent opening having an area sized in accordance with ACCA Manual D, adjoining rooms or spaces shall be considered as a single room or space for the purpose of determining the volume of the rooms or spaces.

Exception: The minimum volume requirement shall not apply where the amount of return air taken from a room or space is less than or equal to the amount of supply air delivered to the room or space.

4. A closet, bathroom, toilet room, kitchen, garage, mechanical room, boiler room, furnace room, unconditioned *attic* or other *dwelling unit*.
5. A room or space containing a fuel-burning *appliance* where such room or space serves as the sole source of return air.

Exceptions:

1. The fuel-burning *appliance* is a direct-vent *appliance* or an *appliance* not requiring a vent in accordance with Section M1801.1 or Chapter 24.
2. The room or space complies with the following requirements:

DUCT SYSTEMS

- 2.1. The return air shall be taken from a room or space having a volume exceeding 1 cubic foot for each 10 Btu/h (9.6 L/W) of combined input rating of all fuel-burning *appliances* therein.
 - 2.2. The volume of supply air discharged back into the same space shall be approximately equal to the volume of return air taken from the space.
 - 2.3. Return-air inlets shall not be located within 10 feet (3048 mm) of any *appliance* firebox or draft hood in the same room or space.
3. Rooms or spaces containing solid-fuel burning *appliances*, if return-air inlets are located not less than 10 feet (3048 mm) from the firebox of those *appliances*.
- > 6. An unconditioned crawl space by means of direct connection to the return side of a forced air system.

M1602.3 Inlet opening protection. Outdoor air inlets shall be covered with screens having openings that are not less than $\frac{1}{4}$ inch (6.4 mm) and not greater than $\frac{1}{2}$ inch (12.7 mm).

SECTION M1603 SUPPLY AIR

M1603.1 General. The minimum unobstructed total area of supply ducts from a warm-air furnace shall be in accordance with the manufacturer's installation instructions, or shall not be less than 2 square inches (1290 mm²) for each 1,000 Btu/h (293 W) output rating of the furnace. Dampers, grilles or registers installed for the purpose of controlling the supply airflow shall not be considered as obstructions.

SECTION M1604 SMOKE AND FIRE DAMPER

M1604.1 General. Where penetration of a fire-resistive assembly is beyond the scope of Section R302.4, the provisions of Section 607 in the *Mechanical Code* shall govern the protection of duct penetrations and air transfer openings in fire-resistance-rated assemblies.