

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 thicknesses of metal duct material shall be as listed in Table M1601.1.1(2). Galvanized steel shall conform to ASTM A 525.
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 RATING
0	0
1	25

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

TYPE OF DUCT	SIZE (inches)	MINIMUM THICKNESS (inch)	EQUIVALENT GALVANIZED SHEET GAGE	APPROXIMATE ALUMINUM B & S GAGE
Round ducts and enclosed rectangular ducts	14 or less	0.013	30	26
	over 14	0.016	28	24
Exposed rectangular ducts	14 or less	0.016	28	24
	over 14	0.019	26	22

For SI: 1 inch = 25.4 mm.

M1601.1.1.1 Building cavities used for return air duct or plenums. Building cavities used for return air duct or plenums shall conform to the following:

Exception: New construction for one- and two-family dwellings or additions to such buildings. Building framing cavities, closets, crawl spaces, and chases shall not be used as heated or cooled supply and return air enclosures. Ductwork may be housed or pass through these spaces.

1. Gypsum products are permitted to be used to construct return air ducts or plenums, provided that the air temperature does not exceed 125°F (52°C) and exposed surfaces are not subject to condensation.
2. Stud wall cavities and the spaces between solid floor joists to be utilized as air plenums shall comply with the following conditions:
 - 2.1. Such cavities or spaces shall not be utilized as a plenum for supply air.
 - 2.2. Such cavities or spaces shall not be part of a required fire-resistance-rated assembly.
 - 2.3. Stud wall cavities shall not convey air from more than one floor level.
 - 2.4. Stud wall cavities and joist space plenums shall comply with floor penetration protection requirements of this code.
 - 2.5. Stud wall cavities and joist space plenums shall be isolated from adjacent concealed spaces by tight-fitting fire blocking in accordance with Section R602.8 and sealed to prevent conveyance of air from other spaces.

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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) in thickness. 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 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 pouring any concrete. 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 Duct insulation materials. Duct insulation materials shall conform to the following requirements:

1. Duct coverings and linings shall have a flame-spread index not greater than 25, and a smoke-developed index not greater than 50 when tested in accordance with ASTM E 84. Specimens tested in accordance with ASTM E 84 shall be representative of the final composite material.
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 greater 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. 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*-values 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 duct wrap, 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.

M1601.2.2 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. Vibration isolators installed in ducts located in an unconditioned space shall be externally insulated in accordance with Section M1601.2.1, Item 3. Vibration isolators used in ducts penetrating the wall or ceiling separation between the dwelling and the garage shall be installed in accordance with Section R309.1.1.

M1601.3 Installation. Duct installation shall comply with Sections M1601.3.1 through M1601.3.9.

M1601.3.1 Joints and connections. All joints and connections shall be sealed and securely fastened in accordance with Sections M1601.3.1.1 and M1601.3.2.

M1601.3.1.1 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, 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.

Exception: Adjustable metal elbow gore, longitudinal pipe joints, integral seams within a boot fitting or similar fitting, and integral seams within a "Y" fitting.

M1601.3.1.2 Rigid fibrous glass ducts. Closure systems used to seal rigid fibrous glass duct joints shall comply with UL 181 A and shall be marked "181 A-P" for pressure-sensitive tape, "181 A-M" for mastic or "181 A-H" for heat-sensitive tape.

M1601.3.1.3 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, and shall be permitted to be cloth backed.

M1601.3.1.4 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.

M1601.3.2 Fastening. Duct connections to flanges of air distribution system equipment or sheet metal fittings shall be mechanically fastened. 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. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened per the manufacturers' installation instructions.

M1601.3.3 Support. Metal ducts shall be supported by 0.5-inch (12.7 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.

M1601.3.4 Fireblocking. Duct installations shall be fire-blocked in accordance with Section R602.8.

M1601.3.5 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.
3. Supply and return air ducts located in unconditioned spaces shall have insulation levels as specified in Table N1104.1(1).

M1601.3.6 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 1601.3.7 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.

M1601.3.8 Ducts located in garages. Ducts in garages shall comply with the requirements of Section R309.1.1.

M1601.3.9 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 R323.1.5.

M1601.4 Under-floor plenums. A crawl space shall not be used as a supply or return plenum.

M1601.4.1 Furnace controls. The furnace shall be equipped with an automatic control that will start the air-circulating fan when the air in the furnace bonnet reaches a temperature not greater than 150°F (66°C). The furnace shall additionally be equipped with an approved automatic control that limits the outlet air temperature to 200°F (93°C).

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 not be prohibited.

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) from 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 there is the presence of flammable vapors; 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 such 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 such rooms or spaces.
4. A closet, bathroom, toilet room, kitchen, garage, mechanical room, furnace room 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:
 - 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, provided that return-air inlets are located not less than 10 feet (3048 mm) from the firebox of such appliances.

M1602.3 Inlet opening protection. Outdoor air inlets shall be covered with screens having not less than 1/4-inch (6.4 mm) openings and not greater than 1/2-inch (12.7 mm) openings.

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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 air-flow shall not be considered as obstructions.

SECTION M1604 SMOKE AND FIRE DAMPERS

M1604.1 General. Where penetration of a fire-resistive assembly is beyond the scope of Section R317, the provisions of Section 607 in the *Oregon Mechanical Specialty Code* shall govern the protection of duct penetrations and air transfer openings in fire-resistance-rated assemblies.