

Chapter 13: General Mechanical System Requirements

General Comments

This chapter contains the provisions that apply to various types of mechanical appliances. The approval of appliances and their proper installation is the main theme. Section M1301 states the scope of the chapter and addresses its relationship with the *International Mechanical Code*® (IMC®) and the *International Fuel Gas Code*® (IFGC®). Section M1302 indicates that all mechanical appliances must be listed and labeled by an approved agency. Section M1303 addresses the information that is needed on the labels. Section M1304 discusses the proper design of appliances considering the appliances' type of fuel and the geographical location of the installed appliance. Section M1305 addresses

access to installed appliances for servicing and potential replacement. Section M1306 contains the allowance for reduced clearances between appliances and combustible construction. Section M1307 contains the criteria for the safe installation of appliances. Section M1308 is a cross reference to the proper sections in the building portion of the code for the drilling and notching of structural members of the building.

Purpose

This chapter contains requirements for the safe and proper installation of mechanical equipment and appliances.

SECTION M1301 GENERAL

M1301.1 Scope. The provisions of this chapter shall govern the installation of mechanical systems not specifically covered in other chapters applicable to mechanical systems. Installations of mechanical *appliances, equipment* and systems not addressed by this code shall comply with the applicable provisions of the *International Mechanical Code* and the *International Fuel Gas Code*.

❖ This section provides general requirements for mechanical systems not specifically covered in other chapters of the code. In addition, it refers to the IMC and the IFGC for regulations governing equipment not addressed by the code.

M1301.1.1 Flood-resistant installation. In flood hazard areas as established by Table R301.2(1), mechanical *appliances, equipment* and systems shall be located or installed in accordance with Section R322.1.6.

❖ The local jurisdiction must fill in Table R301.2(1) upon adoption of the code, including the flood hazards information. Mechanical appliances, equipment, and systems that are located in flood hazard areas must be installed above the design flood elevation or must be designed and installed to prevent the entrance of water into the components and to resist the forces of the flood waters on the components (see commentary, Section R322.1.6).

M1301.2 Identification. Each length of pipe and tubing and each pipe fitting utilized in a mechanical system shall bear the identification of the manufacturer.

❖ The manufacturer is given the option of determining the type of marking for the material. If there is no applicable standard or the applicable standard does not

require that the material be identified, identification of the manufacturer is still required by the code. Where the code indicates compliance with an approved standard, the manufacturer must comply with the requirements for marking in accordance with the applicable standard.

M1301.3 Installation of materials. Materials shall be installed in strict accordance with the standards under which the materials are accepted and approved. In the absence of such installation procedures, the manufacturer's instructions shall be followed. Where the requirements of referenced standards or manufacturer's instructions do not conform to minimum provisions of this code, the provisions of this code shall apply.

❖ Mechanical components and materials are to be installed in accordance with the installation requirements of the applicable standard listed in the code. Where a standard is not provided, the manufacturer's instructions must be followed. For example, because there are very few standards available that regulate the installation of valves, the manufacturer's instructions must be used to install these components. The code trumps where a referenced standard or manufacturer's instructions are less stringent than the code. It is rare, but the code may contain requirements that are more restrictive than the installation instructions or product listing.

M1301.4 Plastic pipe, fittings and components. Plastic pipe, fittings and components shall be third-party certified as conforming to NSF 14.

❖ Plastic piping, fittings and plastic pipe-related components, including solvent cements, primers, tapes, lubricants and seals used in mechanical systems, must be tested and certified as conforming to NSF 14. This

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includes hydronic piping and fittings and plastic piping system components including but not limited to pipes, fittings, valves, joining materials, gaskets and appurtenances. This section does not apply to components that only include plastic parts such as brass valves with a plastic stem.

M1301.5 Third-party testing and certification. Piping, tubing and fittings shall comply with the applicable referenced standards, specifications and performance criteria of this code and shall be identified in accordance with Section M1301.2. Piping, tubing and fittings shall either be tested by an approved third-party testing agency or certified by an approved third-party certification agency.

❖ This section requires that all piping, tubing and fittings comply with the referenced standards. However, the provisions contained in Section 104.11 regarding the evaluation and approval of alternative materials, methods and equipment are still applicable (see commentary, Section 104.11). Additionally, the code has been revised to include requirements for third-party certification and testing of such products. “Third-party certified” indicates that the minimum level of quality required by the applicable standard is maintained and the product is often referred to as “listed.” “Third-party tested” indicates a product that has been tested by an approved testing laboratory and found to be in compliance with the standard. Although the code does not specifically state the identification or marking requirements, except for the manufacturer’s identification, the applicable referenced standard states the minimum information required. The identification or marking requirements typically include the name of the manufacturer, product name or serial number, installation specifications, applicable tests and standards, testing agency and labeling agency.

SECTION M1302 APPROVAL

M1302.1 Listed and labeled. *Appliances* regulated by this code shall be *listed* and *labeled* for the application in which they are installed and used, unless otherwise *approved* in accordance with Section R104.11.

❖ Mechanical appliances must be listed and labeled by an approved agency to show that they comply with applicable national standards. The code requires listing and labeling for appliances such as boilers, furnaces, space heaters, cooking appliances and clothes dryers. The code also requires listing for system components. The label is the primary, if not the only, assurance to the installer, the inspector and the end user that a similar appliance has been tested and evaluated by an approved agency and performed safely and efficiently when installed and operated in accordance with its listing.

The label is part of the information that the code official is to consider in the approval of appliances. The only exception to the labeling requirement occurs when the code official approves a specific appliance in

accordance with the authority granted in Section R104.11.

The requirement that appliances are to be used only in accordance with their listing is intended to prevent the use of products that have a listing for some application but are being used in a different application for which they have not been tested. An example would be a fan that is listed for use only as a bathroom exhaust fan but is installed for use as a kitchen exhaust hood fan or as a clothes dryer booster fan. Another potential misapplication could be an appliance that has been tested and listed for indoor installation only, but is installed outdoors. Such misapplications have the potential to create hazardous situations.

The code official should exercise extreme caution when considering the approval of unlisted appliances.

Approval of unlisted appliances must be based on some form of documentation that demonstrates compliance with the applicable standards or equivalence with an appliance that is listed and labeled to the applicable standards. Where no product standards exist, documentation must be provided to demonstrate that the appliance is appropriate for the intended use and will provide the same level of performance as would be expected from a similar appliance that is listed and labeled. Sometimes appliances are listed in the field on a case-by-case basis using requirements or outlines of investigation derived from relative appliance standards. One fundamental principle of the code is the reliance on the listing and labeling process to ensure appliance performance. Approvals granted in accordance with Section R104.11 must be justified with supporting documentation. To the code official, installer and end-user very little is known about the performance of an appliance that is not tested and built to an appliance standard.

SECTION M1303 LABELING OF APPLIANCES

M1303.1 Label information. A permanent factory-applied nameplate(s) shall be affixed to *appliances* on which shall appear, in legible lettering, the manufacturer’s name or trademark, the model number, a serial number and the seal or *mark* of the testing agency. A *label* also shall include the following:

1. Electrical *appliances*. Electrical rating in volts, amperes and motor phase; identification of individual electrical components in volts, amperes or watts and motor phase; and in Btu/h (W) output and required clearances.
2. Absorption units. Hourly rating in Btu/h (W), minimum hourly rating for units having step or automatic modulating controls, type of fuel, type of refrigerant, cooling capacity in Btu/h (W) and required clearances.
3. Fuel-burning units. Hourly rating in Btu/h (W), type of fuel *approved* for use with the *appliance* and required clearances.
4. Electric comfort-heating appliances. The electric rating in volts, amperes and phase; Btu/h (W) output rating; individual marking for each electrical component in

amperes or watts, volts and phase; and required clearances from combustibles.

- 5. Maintenance instructions. Required regular maintenance actions and title or publication number for the operation and maintenance manual for that particular model and type of product.

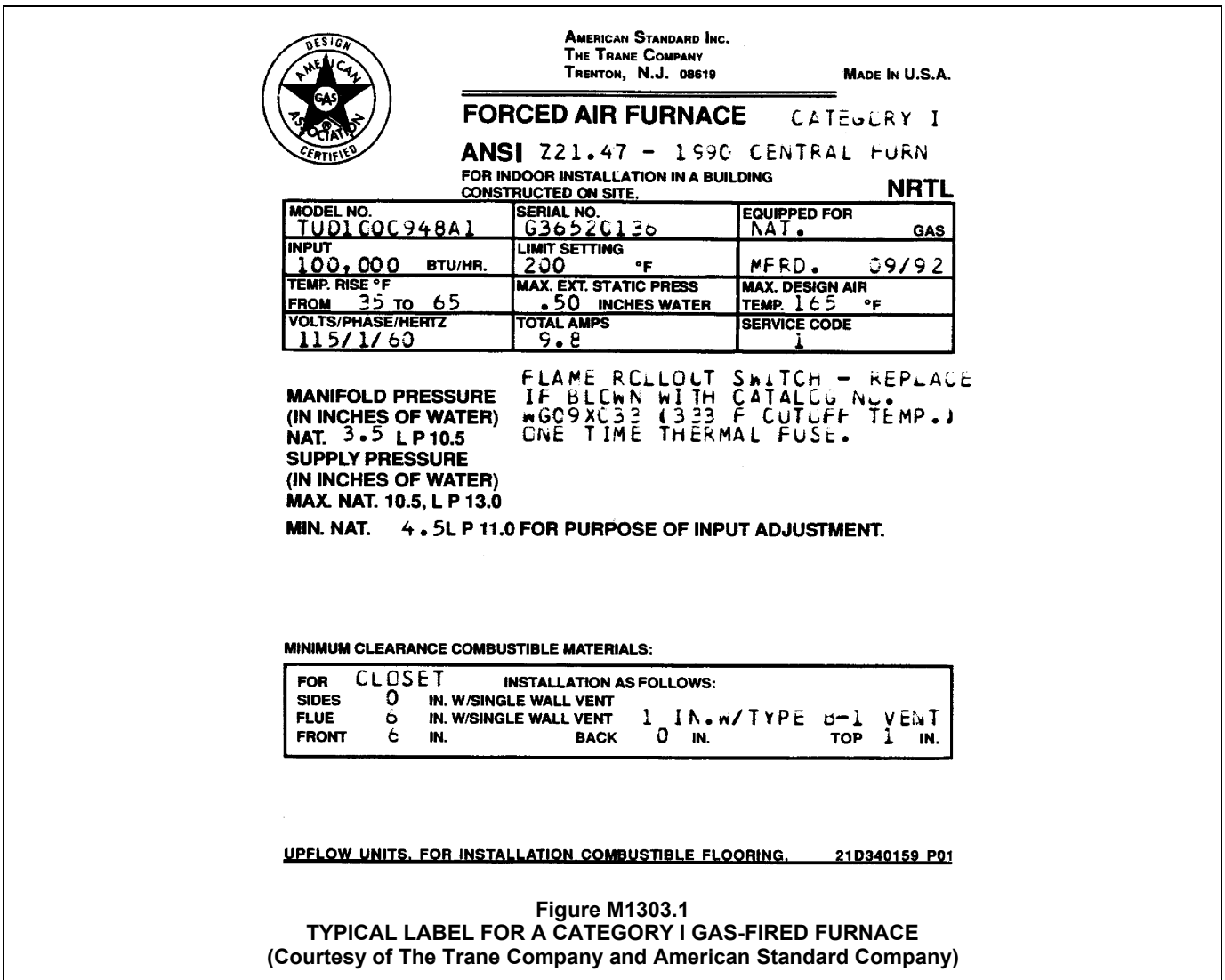
❖ This section requires that appliances have a label that is a permanent nameplate. In general, labels other than metal tags or plates usually consist of material that is similar in appearance to a decal, and the label, its adhesive and the printed information are all durable and water resistant. Because of the important information on a label, the label must be permanent, not susceptible to damage and legible for the life of the appliance. The standards appliances are tested to usually specify the required label material, the method of attachment and the required label information. The code requires that the label be affixed permanently and prominently on the appliance or equipment and specifies the information that must appear on the label. The manufacturer may be required by the relevant stan-

dard or may voluntarily provide additional information on the label (see Commentary Figure M1303.1).

**SECTION M1304
TYPE OF FUEL**

M1304.1 Fuel types. Fuel-fired *appliances* shall be designed for use with the type of fuel to which they will be connected and the altitude at which they are installed. *Appliances* that comprise parts of the building mechanical system shall not be converted for the use of a different fuel, except where *approved* and converted in accordance with the manufacturer's instructions. The fuel input rate shall not be increased or decreased beyond the limit rating for the altitude at which the *appliance* is installed.

❖ An element of information used for the approval of appliances is the label, which ensures that the appliance has been tested in accordance with a valid standard and performed acceptably when installed and operated in accordance with the appliance listing. Manufacturers usually design mechanical appliances to



operate on a specific type of fuel. Thus, the fuel used in the appliance test must be the type of fuel specified by the manufacturer on the label. When an appliance is converted to a different type of fuel, the original label that appears on the appliance is no longer valid. Because the original approval of the appliance was based in part on the label, the appliance is no longer approved for use.

Field conversions will more likely allow for the safe operation of the appliance if, as required, the conversion is approved by the code official and done in accordance with the manufacturer's installation instructions. Fuel conversions that are not performed correctly can cause serious malfunctions and hazardous operation. Before a fuel conversion is performed, the manufacturer must be contacted for installation instructions outlining the procedures to follow for proper operation of the appliance. In most cases, conversion kits from the manufacturer are available along with the installation instructions. Once a conversion has been completed, a supplemental label must be installed to update the information contained on the original label, thereby alerting any service personnel of the modifications that have been made.

All fuel-fired appliances are designed to operate with a maximum and minimum British thermal units per hour (Btu/h) input capacity. This capacity is field adjusted to suit the elevation because of the change in air density at different elevations. Alteration of Btu/h input beyond the allowable limits can result in hazardous over-firing or under-firing. Either condition can cause operation problems that include overheating, vent failure, corrosion, poor draft and poor combustion.

SECTION M1305 APPLIANCE ACCESS

M1305.1 Appliance access for inspection service, repair and replacement. *Appliances* shall be accessible for inspection, service, repair and replacement without removing permanent construction, other *appliances*, or any other piping or ducts not connected to the *appliance* being inspected, serviced, repaired or replaced. A level working space not less than 30 inches deep and 30 inches wide (762 mm by 762 mm) shall be provided in front of the control side to service an *appliance*.

❖ Because mechanical equipment and appliances require routine maintenance, repair and possible replacement, access is required. Additionally, manufacturer's installation instructions usually contain access recommendations or requirements. As a result, the provisions stated herein supplement the manufacturer's installation instructions.

The provisions of this section specify that access must be provided to components that require observation, inspection, adjustment, servicing, repair or replacement. Access is also necessary for operating procedures such as startup or shutdown. The level working space in front of the control side of the appli-

ance must be 30 inches (762 mm) wide and 30 inches (762 mm) deep to provide adequate space for the technician or inspector to safely perform the work.

The code states that "accessible" means "access that might require the removal of an access panel or similar removable obstruction." An appliance or piece of equipment is not accessible if any portion of the structure's permanent finish materials, such as drywall, plaster, paneling, built-in furniture or cabinets or any other similar permanently affixed building component, must be removed before access is achieved. In addition, removal of all or part of another appliance or the piping or duct or serving other appliances must not be necessary to perform the service, replacement or inspection of an appliance. Such an installation could result in unnecessarily high costs to the homeowner and improper or unsafe reassembly of other appliance and system components. This could also result in service personnel having to perform disassembly and reassembly of appliances and system components that are not within the personnel's area of expertise or licensed work.

The intent is to provide access to all components such as controls, gauges, burners, filters, blowers and motors that require observation, inspection, adjustment, servicing, repair or replacement.

M1305.1.1 Furnaces and air handlers. Furnaces and air handlers within compartments or alcoves shall have a minimum working space clearance of 3 inches (76 mm) along the sides, back and top with a total width of the enclosing space being not less than 12 inches (305 mm) wider than the furnace or air handler. Furnaces having a firebox open to the atmosphere shall have not less than a 6-inch (152 mm) working space along the front combustion chamber side. Combustion air openings at the rear or side of the compartment shall comply with the requirements of Chapter 17.

Exception: This section shall not apply to replacement *appliances* installed in existing compartments and alcoves where the working space clearances are in accordance with the *equipment* or *appliance* manufacturer's installation instructions.

❖ Furnaces and air handlers installed in compartments or alcoves must have clearances from the enclosure so that they can be removed, maintained or repaired as necessary. The minimum clearances specified in the code apply even though the manufacturer's instructions might permit a lesser clearance. Clearances provide access, ventilation, cooling of the appliance and equipment and protection for surrounding combustibles. The front (firebox) clearance helps protect combustibles against flame rollout and allows free movement of combustion air. The exception exempts replacement appliances and equipment installed in existing compartments or alcoves if the installation complies with the manufacturer's instructions. The manufacturer's installation instructions usually contain minimum workspace requirements and minimum clearances to surrounding construction that must be maintained.

M1305.1.2 Appliances in rooms. *Appliances* installed in a compartment, alcove, *basement* or similar space shall be accessed by an opening or door and an unobstructed passageway measuring not less than 24 inches (610 mm) wide and large enough to allow removal of the largest *appliance* in the space, provided there is a level service space of not less than 30 inches (762 mm) deep and the height of the *appliance*, but not less than 30 inches (762 mm), at the front or service side of the *appliance* with the door open.

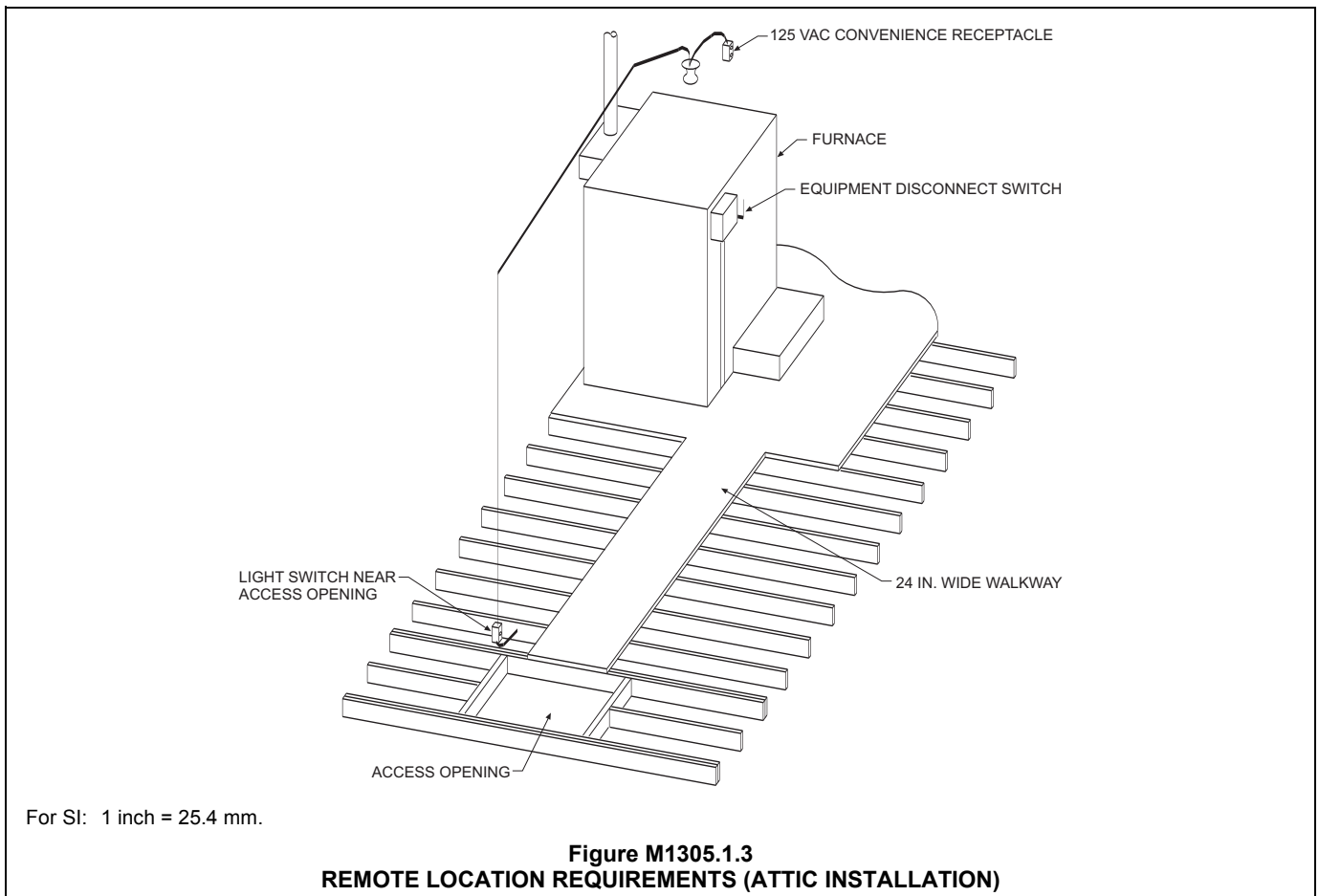
❖ This section specifies an access opening and passageway to afford service personnel reasonable access to appliances and to allow for the passage of system components. Quite often appliances such as furnaces, boilers and water heaters are installed in spaces with little or no forethought about future access for maintenance or replacement.

M1305.1.3 Appliances in attics. *Attics* containing *appliances* shall be provided with an opening and a clear and unobstructed passageway large enough to allow removal of the largest *appliance*, but not less than 30 inches (762 mm) high and 22 inches (559 mm) wide and not more than 20 feet (6096 mm) long measured along the centerline of the passageway from the opening to the *appliance*. The passageway shall have continuous solid flooring in accordance with Chapter 5 not less than 24 inches (610 mm) wide. A level service space not less than 30 inches (762 mm) deep and 30 inches (762 mm) wide shall be present along all sides of the

appliance where access is required. The clear access opening dimensions shall be not less than of 20 inches by 30 inches (508 mm by 762 mm), and large enough to allow removal of the largest *appliance*.

Exceptions:

1. The passageway and level service space are not required where the *appliance* can be serviced and removed through the required opening.
 2. Where the passageway is unobstructed and not less than 6 feet (1829 mm) high and 22 inches (559 mm) wide for its entire length, the passageway shall be not more than 50 feet (15 250 mm) long.
- ❖ There is not always sufficient room for mechanical equipment and appliances to be installed in spaces such as basements, alcoves, utility rooms and furnace rooms. In an effort to save floor space or simplify an installation, designers often locate appliances and mechanical equipment on roofs, in attics or in similar remote locations. Access to appliances and equipment could be difficult because of roof slope, stone roof ballast or the lack of a walking surface, such as might occur in an attic or similar space with exposed ceiling joists. The intent of this section is to require a suitable access opening, passageway and workspace that will allow reasonably easy access without endangering the service person (see Commentary Figure M1305.1.3).



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The longer the attic passageway, the more the service person will be exposed to extreme temperatures and the risk of injury. The attic access opening (typically a scuttle) must be large enough to allow the largest appliance in the attic to pass through such opening. For example, if an attic furnace is the largest appliance, the furnace itself should be able to be removed from the attic without having to disassemble the furnace. Of course, it is understood that ducts, plenums, cooling coil cabinets and other attachments might have to be disconnected from the furnace before removal is possible.

The first exception allows the passageway and level service space to be eliminated if the technician can reach the appliance through the access opening without having to step into the attic. The second exception allows the length of the passageway to be extended to 50 feet (15 250 mm) if there is at least 6 feet (1829 mm) of clear headroom for the entire length of the passageway. This is allowed because there is less danger of lengthy exposure to extreme temperatures if the service personnel can walk erect and unimpeded to the equipment rather than crawling.

Note that some appliances might not be listed for attic installation or might otherwise be unsuitable for such conditions.

M1305.1.3.1 Electrical requirements. A luminaire controlled by a switch located at the required passageway opening and a receptacle outlet shall be installed at or near the *appliance* location in accordance with Chapter 39. Exposed lamps shall be protected from damage by location or lamp guards.

❖ An appliance located in an attic is generally not easy to access. A lighting outlet and receptacle outlet encourage and facilitate appliance maintenance. The receptacle will accommodate power tools, drop lights and diagnostic instruments. Also, these provisions negate the need for extension cords, which can be hazardous to service personnel. The lighting outlet is to allow the attic space to be safely navigated and is not intended to provide the necessary lighting for servicing and repair of the appliances. Where exposed lamps (naked light bulbs) are installed as the required lighting outlets, they must be located out of harm's way or must be provided with a suitable lamp guard. If service personnel hit and break the lamp with their bodies, tools, parts or other objects, the result could be a shock and/or fire hazard, with the additional hazard of sudden darkness in a dangerous location.

M1305.1.4 Appliances under floors. Underfloor spaces containing *appliances* shall be provided with an unobstructed passageway large enough to remove the largest *appliance*, but not less than 30 inches (762 mm) high and 22 inches (559 mm) wide, nor more than 20 feet (6096 mm) long measured along the centerline of the passageway from the opening to the *appliance*. A level service space not less than 30 inches (762 mm) deep and 30 inches (762 mm) wide shall be present at the front or service side of the *appliance*. If the depth of the passageway or the service space exceeds 12 inches (305 mm) below the adjoining grade, the walls of the passageway shall

be lined with concrete or masonry extending 4 inches (102 mm) above the adjoining grade in accordance with Chapter 4. The rough-framed access opening dimensions shall be not less than 22 inches by 30 inches (559 mm by 762 mm), and large enough to remove the largest *appliance*.

Exceptions:

1. The passageway is not required where the level service space is present when the access is open, and the *appliance* can be serviced and removed through the required opening.
2. Where the passageway is unobstructed and not less than 6 feet high (1929 mm) and 22 inches (559 mm) wide for its entire length, the passageway shall not be limited in length.

❖ This section, which applies to crawl spaces, has concepts similar to those of Section M1305.1.3. The more difficult the access to appliances and equipment is, the less likely that the appliance or equipment will be inspected and serviced on a regular basis. Attic and crawl space installations suffer from the "out-of-sight, out-of-mind" syndrome.

The first exception has the same intent as the first exception of Section M1305.1.3. The second exception allows unlimited length of the passageway if there is at least 6 feet (1829 mm) of clear headroom for the entire length of the passageway (see commentary, Section M1305.1.3).

M1305.1.4.1 Ground clearance. *Equipment* and *appliances* supported from the ground shall be level and firmly supported on a concrete slab or other *approved* material extending not less than 3 inches (76 mm) above the adjoining ground. Such support shall be in accordance with the manufacturer's installation instructions. *Appliances* suspended from the floor shall have a clearance of not less than 6 inches (152 mm) from the ground.

❖ This section's requirement provides a buffer from the corrosive effects of an appliance's contact with the ground. If supported on the ground, the appliance is to rest on a material that will be a barrier between the appliance and the ground. Concrete is the material that is prescribed, but other approved materials could be used if they provide the same level of protection as the concrete. If the appliance is suspended from the floor assembly above the ground, a minimum separation of 6 inches (152 mm) is called out.

The slab or other support surface must be at least 3 inches (76 mm) above grade so that the appliance being supported will be well above grade and protected from prolonged exposure to moisture and soil. The 3-inch (76 mm) minimum also provides some protection against settling of the slab or support base.

M1305.1.4.2 Excavations. Excavations for *appliance* installations shall extend to a depth of 6 inches (152 mm) below the *appliance* and 12 inches (305 mm) on all sides, except that the control side shall have a clearance of 30 inches (762 mm).

❖ This section allows for appliances to be located below the level of the ground surface in underfloor areas.

Again, the concern is to provide a separation from the ground itself. Minimum clearances are provided in this section. The 30-inch-deep (762 mm) workspace is required for adequate access for servicing the appliance.

M1305.1.4.3 Electrical requirements. A luminaire controlled by a switch located at the required passageway opening and a receptacle outlet shall be installed at or near the *appliance* location in accordance with Chapter 39. Exposed lamps shall be protected from damage by location or lamp guards.

- ❖ This is the same requirement as found in Section M1305.1.3.1. Lighting and a power supply are required for the service of mechanical appliances. Note that Section E3902 requires ground fault circuit interrupter (GFCI) protection for crawl space receptacle outlets. Where exposed lamps (naked light bulbs) are installed as the required lighting outlets, they must be located out of harm's way or must be provided with a suitable lamp guard. If service personnel hit and break the lamp with their bodies, tools, parts or other objects, the result could be a shock and/or fire hazard, with the additional hazard of sudden darkness in a dangerous location.

SECTION M1306 CLEARANCES FROM COMBUSTIBLE CONSTRUCTION

M1306.1 Appliance clearance. *Appliances* shall be installed with the clearances from unprotected combustible materials as indicated on the *appliance label* and in the manufacturer's installation instructions.

- ❖ Requirements for clearances to combustibles are emphasized because of the potential fire hazard posed when those clearances are not observed. Maintaining an appropriate distance from the outer surface of an appliance or piece of equipment to combustible materials reduces the possibility of ignition of combustible materials. This section requires appliances to be installed with clearances from unprotected combustibles as indicated on the label for the listed appliance and the manufacturer's installation instructions. The minimum clearances to combustibles are specified in the manufacturer's installation instructions for a labeled appliance. Because an approved agency tests appliances in accordance with these instructions, the clearances required are necessary for the correct installation and operation of the appliance. Note, however, that this section does not include provisions or guidelines for the installation of unlisted appliances. Figure M1306.1 is a graphic image of the reduced clearances allowed by the code. It works in conjunction with Table M1306.2.

M1306.2 Clearance reduction. The reduction of required clearances to combustible assemblies or combustible materials shall be based on Section M1306.2.1 or Section M1306.2.2.

- ❖ See the commentary to Sections M1306.2.1 and M1306.2.2.

M1306.2.1 Labeled assemblies. The allowable clearance shall be based on an approved reduced clearance protective assembly that is listed and labeled in accordance with UL 1618.

- ❖ Listed and labeled clearance reduction assemblies are available that can be used to reduce clearances based on the testing and listing of the assemblies. Such assemblies may or may not require some field assembly. The manufacturer's instructions must be closely followed for assembly and installation in order to safely achieve the desired clearance reduction.

M1306.2.2 Reduction table. Reduction of clearances shall be in accordance with the *appliance* manufacturer's instructions and Table M1306.2. Forms of protection with ventilated air space shall conform to the following requirements:

1. Not less than 1-inch (25 mm) air space shall be provided between the protection and combustible wall surface.
2. Air circulation shall be provided by having edges of the wall protection open not less than 1 inch (25 mm).
3. If the wall protection is mounted on a single flat wall away from corners, air circulation shall be provided by having the bottom and top edges, or the side and top edges not less than 1 inch (25 mm).
4. Wall protection covering two walls in a corner shall be open at the bottom and top edges not less than 1 inch (25 mm).

- ❖ Heat-producing appliances and mechanical equipment must be installed with the required minimum clearances to combustible materials indicated by their listing label. It is not uncommon to encounter practical or structural difficulties in maintaining clearances. Therefore, clearance-reduction methods have been developed to allow, in some cases, reduction of the minimum prescribed clearance distance while achieving equivalent protection. An important understanding is that all prescribed clearances to combustibles are airspace clearances measured from the heat source to the face of the nearest combustible surface, even if that combustible surface is not visible. An example of that would be a wood stud wall located behind a metal panel. If installation of an appliance with the required clearances from combustibles is not possible, this section allows reduction of the clearances in accordance with Table M1306.2 if the appliance manufacturer's instructions allow the reductions to the extent desired. The table includes several forms of protection, depending on the extent of reduction. This section requires that a 1-inch (25 mm) air space be maintained between the protection and the combustible wall surface to allow unimpeded circulation of convection air needed to keep the temperature rise within acceptable limits. Most of the methods in Table M1306.2 depend on convective cooling as an essential part of the system (see Commentary Figure G2409.2).

When using the assemblies described in Table M1306.2, the clearance is measured as described in Note b. The required clearances are intended to be clear airspace, and therefore the space is not to be

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filled with insulation or any other material other than an assembly intended to allow clearance reduction. This is especially important where clearances are required from appliances and equipment that rely on the air-space for convection cooling to maintain their proper operating temperature.

The provisions contained in this section are based on the principles of heat transfer. Mechanical equipment or appliances producing heat can become hot, and many appliances have hot exterior surfaces by design. The heat energy is then radiated to objects surrounding the appliances or equipment. When mechanical equipment and appliances are tested, the minimum clearances are established so that radiant and, to a lesser extent, convective heat transfer do not represent an ignition hazard to adjacent surfaces and objects. This distance is called the “required clearance” to combustible materials. Appliance and equipment labels must specify minimum clearances in all directions.

This section permits the use of materials and systems as radiation shields, decreasing the amount of heat energy transferred to surrounding objects and reducing the required clearances between mechanical appliances and equipment to combustibles.

Plaster and gypsum by themselves are classified as noncombustible materials. Under continued exposure to heat, however, these materials will gradually decompose as water molecules are driven out of the material. Plaster on wood lath, plasterboard, sheetrock and drywall are all considered to be combustible materials when the code provisions are applied.

Additionally, gypsum wallboard has a paper face that has a flame spread index that is measurable in the ASTM E84 test. This alone identifies the need to classify gypsum wallboard as a combustible material for the purpose of requiring a separation from heat-producing equipment and appliances.

TABLE M1306.2. See page 13-9.

- ❖ The column headings of Table M1306.2 list required clearances without protection. The numbers to the right of each method indicate the permissible reduced clearance measured from the heat-producing appliances to the face of the combustible surface.

The rationale behind the methods of protection listed in Table M1306.2 is based on the ability of the protection to reduce radiant heat transmission from the appliance and equipment to the combustible material so that the temperature rise of the combustible material will remain below the maximum allowed.

Although the materials referred to in Table M1306.2 are common construction materials, confusion often arises over what satisfies the requirement for “insulation board” (Item 6 in the table), sometimes referred to as inorganic insulating board, noncombustible mineral board or noncombustible insulating board. These products are not made of carbon-based compounds.

Carbon-based compounds are those found in cellulose (wood), plastics and other materials manufactured from raw materials that once existed in living organ-

isms. Cement board materials must have a specified maximum “C” (conductance) value in addition to being noncombustible.

Note h specifies a maximum thermal conductivity of $\text{Btu}/(\text{h} \cdot \text{ft} \cdot ^\circ\text{F})$. Conductivity is the amount of heat in Btus that will flow each hour through a 1-foot-square (0.0929 m^2) slab of material, 1-inch (25 mm) thick with a 1°F temperature difference between both sides and is usually identified by the symbol k . Tables of k values usually do not include the area term in the dimensions for conductivity, and it must be understood that the value must be multiplied by the area to obtain the total Btu value.

Thermal conductance (overall) is the time rate of heat flow through a body not taking thickness into account and is usually identified by the symbol $C \text{ Btu}/(\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F})$.

Thermal resistance (overall) is the reciprocal of overall thermal conductance and is usually identified by the symbol $R \text{ (hour} \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu})$.

This translates into a minimum required insulation R -value of 1.0 (square foot \cdot hour \cdot $^\circ\text{F}$)/Btu per inch of insulating material. The methods in Table M1306.2 control heat transmission by reflecting heat radiation, retarding thermal conductance and providing convective cooling. Where sheet metal materials or metal plates are specified, the effectiveness of the protection can be enhanced by the reflective surface of the metal. Painting or otherwise covering the surface would reduce the metal’s ability to reflect radiant heat and, depending on the color, could increase heat absorption. The airspace between the protected surface and the clearance-reduction assembly allows convection air currents to cool the protection assembly by carrying away heat that has been conducted through the assembly. Where a clearance-reduction assembly must be spaced 1 inch (25 mm) off the wall, the top, bottom and sides of the assembly must remain open as required by Notes d and f to permit unrestricted airflow (convection currents). If the openings were not provided, the air-cooling effect would not take place, and the protection assembly would not be as effective in limiting the temperature rise on the protected surfaces. Ideally, the protection assembly should be open on all sides to provide maximum ventilation.

Spacers must be noncombustible. Spacers should not be placed directly behind the heat source because the location would increase the amount of heat conduction through the spacer, thus creating a “hot spot.” Figure M1306.2 specifically shows a noncombustible spacer arrangement.

The performance of a protective assembly when applied to a horizontal surface, such as a ceiling, will differ substantially from the same assembly placed in a vertical plane. Obviously, temperatures at a ceiling surface will be higher because of natural convection and because the air circulation between the method of protection and the protected ceiling surface will be substantially reduced or nonexistent. It is for these reasons that Table M1306.2 is divided into two application groups.