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 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 R104.11 regarding the evaluation and approval of alternative materials, methods and equipment are still applicable (see commentary, Section R104.11). Additionally, the code includes 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 where 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.

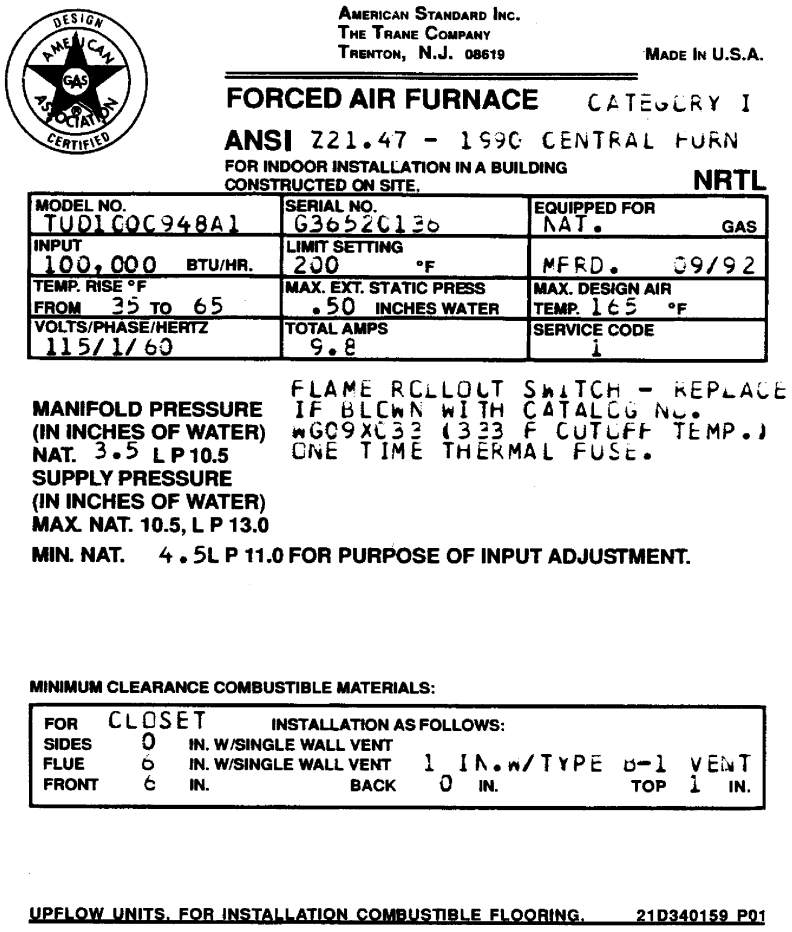
5. Maintenance instructions. Required regular maintenance actions and title or publication number for the operation and maintenance manual for that particular model and type of product.

❖ 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 standard 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.



Commentary Figure M1303.1
TYPICAL LABEL FOR A CATEGORY I GAS-FIRED FURNACE
(Courtesy of The Trane Company and American Standard Company)

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 located to allow for access 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 appliance 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 "access to" means "ready access or by a means that first requires the removal or movement of a panel, door or similar obstruction." An appliance or piece of equipment does not have access 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 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 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.

M1305.1.2 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 M1305.1.2). 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.

Exception 1 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. Exception 2 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 and from the equipment rather than crawling.

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

M1305.1.2.1 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.

M1305.1.3 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 (1829 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 M1305.1.2. 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.

Exception 1 has the same intent as Exception 1 of Section M1305.1.2. Exception 2 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 M1305.1.2).

M1305.1.3.1 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.

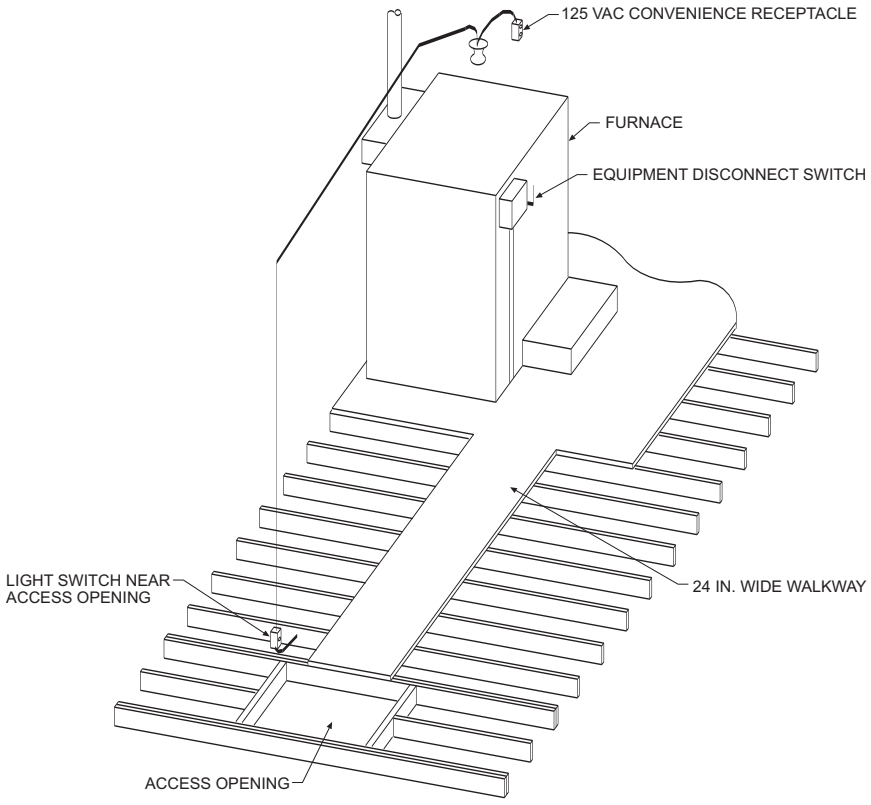
The slab or other support surface must be at least 3 inches (76 mm) above grade so that the appliance being supported will be well above grade and protected from prolonged exposure to moisture and soil. The 3-inch (76 mm) minimum also provides some protection against settling of the slab or support base.

M1305.1.3.2 Pit locations. Appliances installed in pits or excavations shall not come in direct contact with the surrounding soil and shall be installed not less than 3 inches (76 mm) above the pit floor. The sides of the pit or excavation shall be held back not less than 12 inches (305 mm) from the appliance. Where the depth exceeds 12 inches (305 mm) below adjoining grade, the walls of the pit or excavation shall be lined with concrete or masonry. Such concrete or masonry shall extend not less than 4 inches (102 mm) above adjoining grade and shall have sufficient lateral load-bearing capacity to resist collapse. Excavation on the control side of the appliance shall extend horizontally not less than 30 inches (762 mm). The appliance shall be protected from flooding in an approved manner.

❖ 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. Pits with a depth greater than 12 inches have to have supported walls to prevent a cave-in. Regardless of depth, pits must be protected from flooding because the appliance would be partially submerged, causing damage or hazardous operation. In some cases, a sump and pump might be necessary to prevent flooding. If a pit is in an area likely to flood, the installation of an appliance in such pit should be avoided, if possible. The 30-inch-deep (762 mm) workspace is required for adequate access for servicing the appliance.

M1305.1.3.3 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 M1305.1.2.1. 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



For SI: 1 inch = 25.4 mm.

Commentary Figure M1305.1.2
REMOTE LOCATION REQUIREMENTS (ATTIC INSTALLATION)

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 where 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 in the manufacturer's installation instructions. Because an approved agency tests appliances in accordance with the manufacturer's installation 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.

Figure M1306.1 shows the reduced clearances allowed by the code. It is used 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 airspace shall conform to the following requirements:

1. Not less than 1-inch (25 mm) airspace 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) airspace 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(2).

Where 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 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 aispace 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.

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 13-10.

❖ 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" (Items 2 and 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 organisms. Cement board materials must have a specified maximum "C" (conductance) value in addition to being noncombustible.

Note h specifies a maximum thermal conductivity. 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 [Btu/(h • ft^2 • °F)].

Thermal resistance (overall) is the reciprocal of overall thermal conductance and is usually identified by the symbol R [(h • ft^2 • °F)/Btu].

This translates into a minimum required insulation *R*-value of 1.0 (ft^2 • h • °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 where 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.

The manufacturer's instructions or label for many appliances will state an absolute minimum clearance, regardless of any clearance reduction method used. Those clearance requirements take precedence over Table M1306.2. For example, a typical wood-burning room heater will require in all cases an airspace clearance of at least 12 inches (305 mm), with no further reduction allowed.

The methods in Table M1306.2 are intended to be permanent installations properly supported to prevent displacement or deformation. Movement could adversely affect the performance of the protection method, thus posing a potential fire hazard.

The assemblies in Table M1306.2 are the product of experience and testing. To achieve predictable and dependable performance, the components of the various assemblies cannot be mixed, matched, combined, substituted or otherwise rearranged to comprise new assemblies, and materials cannot be substituted for those prescribed in the table. Any alter-

ations or substitutions could have an effect on the assembly, and its performance would have to be tested and approved.

As stated in Note b to the table, the reduced clearance is measured from the heat source to the combustible material, disregarding any intervening protection assembly.

Note l serves to remind the table user that Section M1306.2.3 puts severe limitations on reducing clearances to solid-fuel appliances.

M1306.2.3 Solid-fuel appliances. Table M1306.2 shall not be used to reduce the clearance required for solid-fuel *appliances* listed for installation with minimum clearances of 12 inches (305 mm) or less. For *appliances listed* for installation with minimum clearances greater than 12 inches (305 mm), Table M1306.2 shall not be used to reduce the clearance to less than 12 inches (305 mm).

❖ Because solid-fuel-burning appliances can produce high-intensity radiant heat and have wide variations in heat output, this section restricts the use of Table M1306.2 for types of solid-fuel-burning appliances that are listed for clearances of 12 inches (305 mm) or less. With small clearances, the protection method could be inadequate because of the radiation intensity, reradiation from the protection assembly and inability of the protection method to dissipate the heat energy at the rate received from the appliance. If the listed clearance is greater than 12 inches (305 mm), Table M1306.2 is applicable provided that the clearance is not reduced to less than 12 inches (305 mm). The bottom line is that clearance for solid-fuel appliances can never be less than 12 inches (305 mm).

SECTION M1307
APPLIANCE INSTALLATION

M1307.1 General. Installation of *appliances* shall conform to the conditions of their *listing* and *label* and the manufacturer's instructions. The manufacturer's operating and installation instructions shall remain attached to the *appliance*.

❖ Manufacturer's installation instructions are thoroughly evaluated by the listing agency verifying that a safe installation is prescribed. The listing agency can require that the manufacturer alter, delete or add information to the instructions as necessary to achieve compliance with applicable standards and code requirements. Manufacturer's installation instructions are an enforceable extension of the code and must be in the hands of the code official when an inspection takes place. Without access to the instructions, the code official would be unable to complete an inspection.

When an appliance is tested to obtain a listing and label, the approved agency installs the appliance in accordance with the manufacturer's installation instructions. The appliance is tested under these conditions; thus, the installation instructions become an integral part of the listing and labeling.

The listing and labeling process ensures that the appliance and its installation instructions are in compliance with applicable standards. Therefore, an installation in accordance with the manufacturer's instructions is required, except where the code requirements are more stringent. An inspector must carefully and completely read and comprehend the manufacturer's instructions to properly perform an installation inspection.

In some cases, the code will specifically address an installation requirement that is also addressed in the manufacturer's installation instructions. The code requirements may be the same or may exceed the requirements in the manufacturer's installation instructions, or the manufacturer's installation instructions could contain requirements that exceed those in the code. In all cases, the more restrictive requirements would apply.

Even if an installation appears to be in compliance with the manufacturer's instructions, the installation cannot be complete or approved until all associated components, connections and systems that serve the appliance or equipment are also in compliance with the applicable provisions of the code. For example, an oil-fired boiler installation must not be approved if the boiler is connected to a deteriorated, undersized or otherwise unsafe chimney or vent. Likewise, the same installation must not be approved if the existing oil piping is in poor condition or if the electrical supply circuit is inadequate or unsafe.

In the case of replacement installations, the intent of this section is to require new work associated with the installation to comply with the code without necessarily requiring full compliance for the existing, unchanged portions of the related ductwork, piping, electrical, venting and similar mechanical systems. For example, if a furnace is replaced in an existing building, the new work and connections involved with the replacement would be treated as new construction and the existing unaltered system components would be considered as existing mechanical systems. Existing mechanical systems are accepted on the basis that they are free from hazard although not necessarily compliant with current codes. The code is not retroactive except where specifically stated that it applies to existing systems.

Manufacturer's installation instructions are often updated and changed for various reasons, such as changes in the appliance or equipment design, revisions to the product standard and as a result of field experience related to existing installations. The code official should stay abreast of any changes by reviewing the manufacturer's instructions for every installation.

Equipment and appliances must be installed in accordance with the manufacturer's installation instructions. The manufacturer's label and installation instructions must be consulted in determining whether an appliance or piece of equipment can be installed and operated in a particular hazardous location. The manufacturer's installation instructions must be available on the job site when the equipment is being inspected.

TABLE M1306.2
REDUCTION OF CLEARANCES WITH SPECIFIED FORMS OF PROTECTION[a, c, d, e, f, g, h, i, j, k, l]

TYPE OF PROTECTION APPLIED TO AND COVERING ALL SURFACES OF COMBUSTIBLE MATERIAL WITHIN THE DISTANCE SPECIFIED AS THE REQUIRED CLEARANCE WITH NO PROTECTION (See Figures M1306.1 and M1306.2)	WHERE THE REQUIRED CLEARANCE WITHOUT PROTECTION FROM APPLIANCE, VENT CONNECTOR, OR SINGLE WALL METAL PIPE IS:									
	36 inches		18 inches		12 inches		9 inches		6 inches	
	Allowable clearances with specified protection (Inches)[b]									
	Use column 1 for clearances above an appliance or horizontal connector. Use column 2 for clearances from an appliance, vertical connector and single-wall metal pipe.									
	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2
$3^1/_2$-inch-thick masonry wall without ventilated airspace	—	24	—	12	—	9	—	6	—	5
$^1/_2$-inch insulation board over 1-inch glass fiber or mineral wool batts	24	18	12	9	9	6	6	5	4	3
Galvanized sheet steel having a minimum thickness of 0.0236-inch (No. 24 gage) over 1-inch glass fiber or mineral wool batts reinforced with wire or rear face with a ventilated airspace	18	12	9	6	6	4	5	3	3	3
$3^1/_2$-inch-thick masonry wall with ventilated airspace	—	12	—	6	—	6	—	6	—	6
Galvanized sheet steel having a minimum thickness of 0.0236-inch (No. 24 gage) with a ventilated airspace 1-inch off the combustible assembly	18	12	9	6	6	4	5	3	3	2
$^1/_2$-inch-thick insulation board with ventilated airspace	18	12	9	6	6	4	5	3	3	3
Galvanized sheet steel having a minimum thickness of 0.0236-inch (No. 24 gage) with ventilated airspace over 24 gage sheet steel with a ventilated space	18	12	9	6	6	4	5	3	3	3
1-inch glass fiber or mineral wool batts sandwiched between two sheets of galvanized sheet steel having a minimum thickness of 0.0236-inch (No. 24 gage) with a ventilated airspace	18	12	9	6	6	4	5	3	3	3

For SI: 1 inch = 25.4 mm, 1 pound per cubic foot = 16.019 kg/m^3, °C = [(°F)-32/1.8], 1 Btu/(h × ft^2 × °F/in.) = 0.001442299 (W/cm^2 × °C/cm).

a. Reduction of clearances from combustible materials shall not interfere with combustion air, draft hood clearance and relief, and accessibility of servicing.

b. Clearances shall be measured from the surface of the heat producing appliance or equipment to the outer surface of the combustible material or combustible assembly.

c. Spacers and ties shall be of noncombustible material. Spacers and ties shall not be used directly opposite appliance or connector.

d. Where all clearance reduction systems use a ventilated airspace, adequate provision for air circulation shall be provided as described. (See Figures M1306.1 and M1306.2.)

e. There shall be not less than 1 inch between clearance reduction systems and combustible walls and ceilings for reduction systems using ventilated airspace.

f. If a wall protector is mounted on a single flat wall away from corners, adequate air circulation shall be permitted to be provided by leaving only the bottom and top edges or only the side and top edges open with not less than a 1-inch air gap.

g. Mineral wool and glass fiber batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1,500°F.

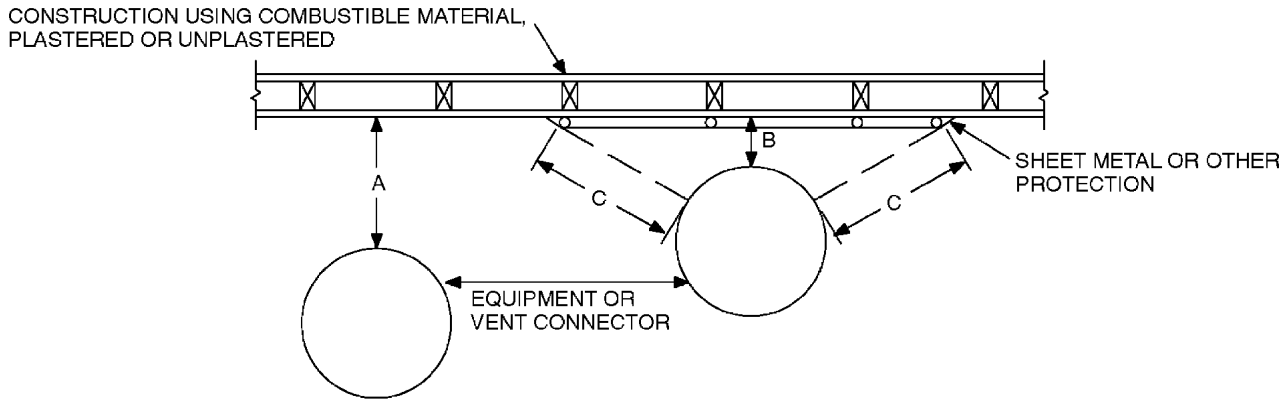
h. Insulation material used as part of a clearance reduction system shall have a thermal conductivity of 1.0 Btu inch per square foot per hour °F or less. Insulation board shall be formed of noncombustible material.

i. There shall be not less than 1 inch between the appliance and the protector. The clearance between the appliance and the combustible surface shall not be reduced below that allowed in this table.

j. All clearances and thicknesses are minimum; larger clearances and thicknesses are acceptable.

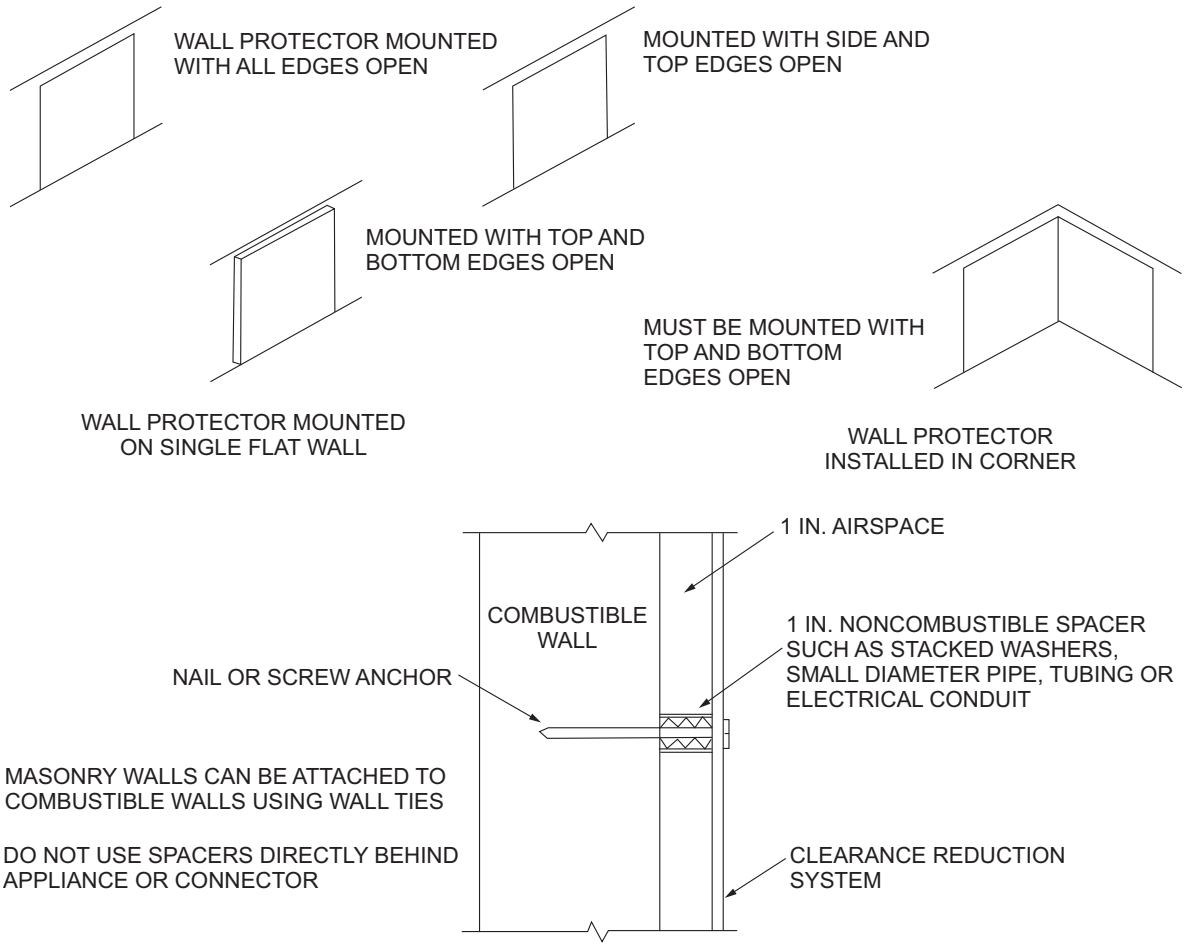
k. Listed single-wall connectors shall be permitted to be installed in accordance with the terms of their listing and the manufacturer's instructions.

l. For limitations on clearance reduction for solid-fuel-burning appliances see Section M1306.2.3.



Note: "A" equals the required clearance with no protection. "B" equals the reduced clearance permitted in accordance with Table M1306.2. The protection applied to the construction using combustible material shall extend far enough in each direction to make "C" equal to "A."

FIGURE M1306.1
REDUCED CLEARANCE DIAGRAM



For SI: 1 inch = 25.4 mm.

FIGURE M1306.2
WALL PROTECTOR CLEARANCE REDUCTION SYSTEM

M1307.2 Anchorage of appliances. *Appliances* designed to be fixed in position shall be fastened or anchored in an *approved* manner. In Seismic Design Categories D_0, D_1 and D_2, and in townhouses in Seismic Design Category C, water heaters and thermal storage units shall be anchored or strapped to resist horizontal displacement caused by earthquake motion in accordance with one of the following:

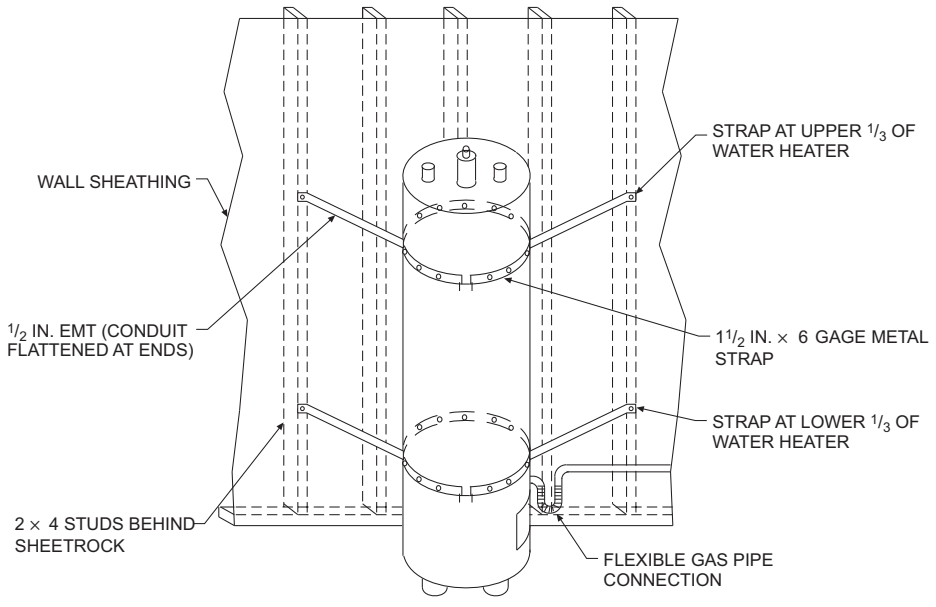
1. Anchorage and strapping shall be designed to resist a horizontal force equal to one-third of the operating weight of the water heater storage tank, acting in any horizontal direction. Strapping shall be at points within the upper one-third and lower one-third of the *appliance's* vertical dimensions. At the lower point, the strapping shall maintain a minimum distance of 4 inches (102 mm) above the controls.
2. The anchorage strapping shall be in accordance with the appliance manufacturer's recommendations.

❖ This section requires the anchorage of fixed appliances to prevent movement or the possible tipping over of the appliance. In areas of high seismic risk, water heaters must be secured directly to the building. Water heaters can weigh several hundred pounds, and if not properly secured, the water, gas and electrical connections may be damaged or severed, creating a hazardous situation. For example, a 40-gallon water heater will have a total weight that includes the weight of the empty heater plus the weight of the water (40 x 8.333 pounds). Commentary Figure M1307.2 shows a method of anchorage of a residential water heater that is known to have been used. Note that the required strapping must be substantial to resist lateral movement. Water heater manufacturers can provide details for such support and possibly support kits. The use of plumber's perforated hanger strap, also known as "holy iron," is commonly encountered and could be inadequate.

M1307.3 Elevation of ignition source. *Appliances* having an *ignition source* shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the floor in garages. For the purpose of this section, rooms or spaces that are not part of the *living space* of a *dwelling unit* and that communicate with a private garage through openings shall be considered to be part of the garage.

Exception: Elevation of the ignition source is not required for appliances that are listed as flammable-vapor-ignition resistant.

❖ To reduce the hazard of fire or explosion from gasoline and other chemical vapors that are likely to be stored in a garage, appliances having an ignition source must be elevated to keep the ignition source a safe distance above garage floors (see Commentary Figure M1307.3). It is not the intent of this section for the installer to measure the elevation from the surface of a dedicated appliance stand or other structure built to support the appliance where that stand or structure does not afford room for the storage of flammable liquids. Some flammable and combustible liquids typically associated with hazardous locations give off vapors that are denser than air and tend to collect near the floor. The 18-inch (457 mm) height requirement is intended to reduce the possibility of flammable vapor ignition by keeping the ignition sources elevated above the anticipated level of accumulated vapors. The 18-inch (457 mm) value is a minimum requirement and must be increased where required by the manufacturer's installation instructions.



NOTE: A MINIMUM 4-INCH CLEARANCE MUST BE MAINTAINED ABOVE THE WATER HEATER CONTROLS.

For SI: 1 inch = 25.4 mm.

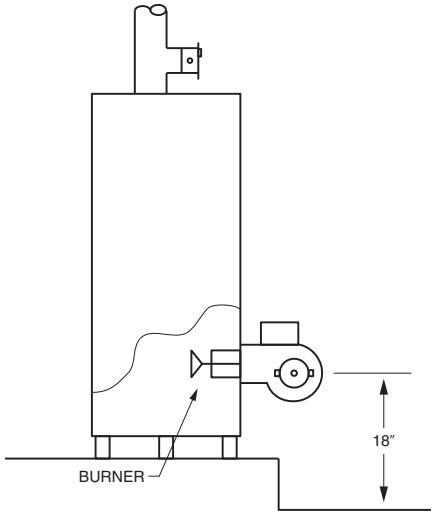
Commentary Figure M1307.2
ANCHORAGE OF WATER HEATER

This section will effectively prohibit the installation of most furnaces, boilers, space heaters, clothes dryers and water heaters directly on the floor of residential garages. [See Section G2408.2 regarding flammable-vapor-ignition-resistant (FVIR) appliances].

The accumulation of flammable vapors more than 18 inches (457 mm) deep is unlikely in most ventilated locations; therefore, maintaining all possible sources of ignition at least 18 inches (457 mm) above the floor will substantially reduce the risk of explosion and fire [see Commentary Figures G2408.2(1) and G2408.2(2)].

In the context of this section, a source of ignition could be a pilot flame, burner, burner igniter or electrical component capable of producing a spark. The term "ignition source" is defined and can be interpreted as meaning an intentional source of ignition in a fuel-fired appliance or an unintentional source of ignition for any flammable vapors that may be present in the space (see the definition of "Ignition source" in Section R202).

An appliance installed in a closet or room that is accessible only from the garage must be considered as part of the garage for application of this section. Even though the room may be separated from the garage by walls and a door, there are no practical means of making the door vapor tight nor is there any assurance that the door will remain closed during normal use. An appliance room that is accessed only from the outdoors or only from the living space would not be considered as part of the garage. Rooms such as utility rooms and laundry rooms that communicate with both the garage and the living space, and that are part of the living space, are not considered to be part of the garage (see the definition of "Living space" in Section 202).



For SI: 1 inch = 25.4 mm.

Commentary Figure M1307.3
OIL-FIRED WATER HEATER INSTALLATION IN A GARAGE

Appliances in the garage must be protected from impact by automobiles and elevation of the appliance may not be sufficient to guard against damage from impact unless the code official determines that the appliance platform is of substantial construction and the necessary height to be capable of protecting the appliance from impact.

The exception recognizes that new technology exists that allows appliances, such as water heaters, to be tested and listed as being FVIR and suitable for installation without the 18-inch (457 mm) elevation requirement. Note that while new gas-fired water heaters have FVIR technology that allows them to be installed on the floor without the 18-inch (457 mm) elevation (see commentary, Section G2408.2), to the author's knowledge, oil-fired and electric water heaters are not listed as FVIR.

M1307.3.1 Protection from impact. *Appliances* shall not be installed in a location subject to vehicle damage except where protected by *approved* barriers.

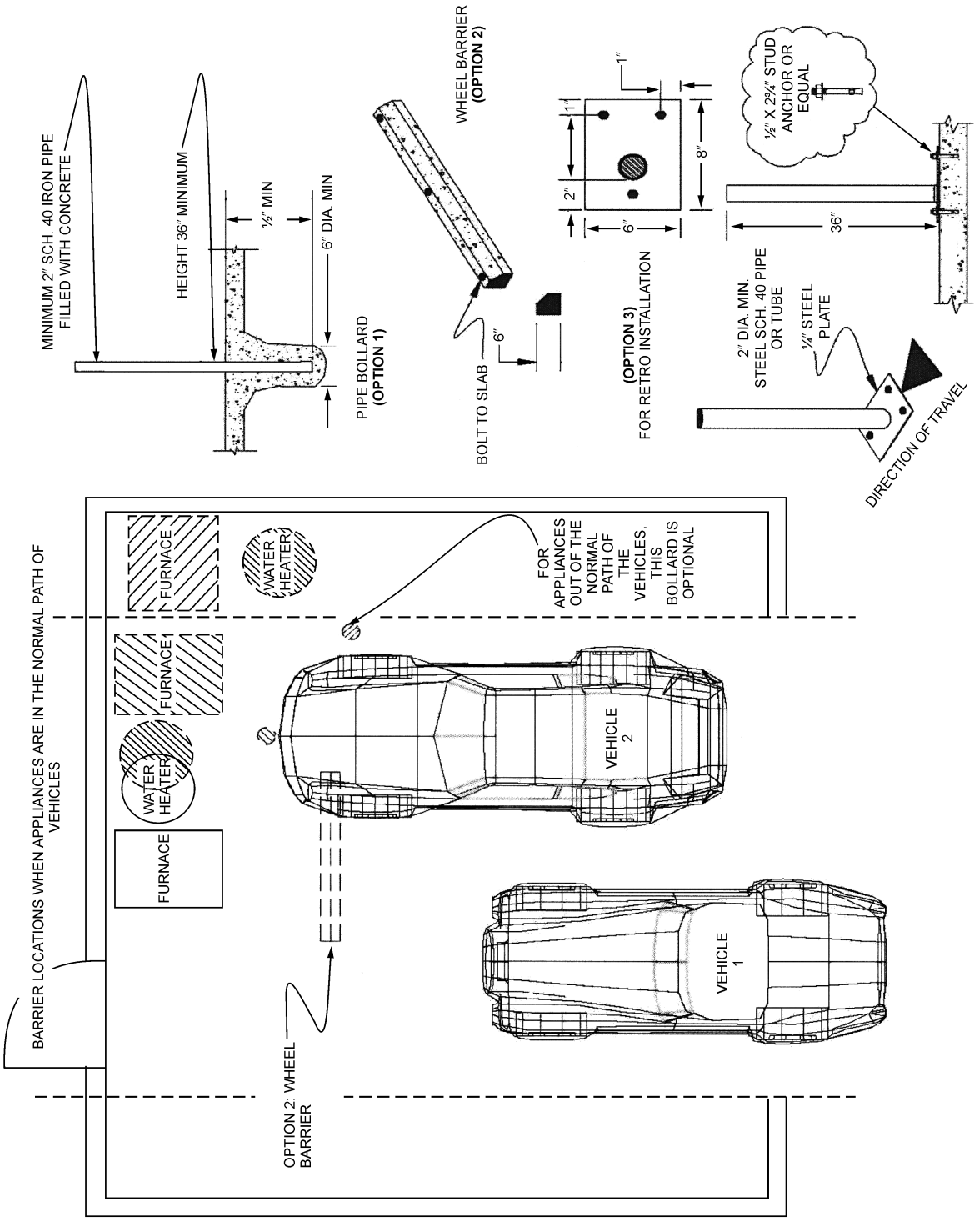
❖ Mechanical appliances installed in garages, carports and any other location where motorized vehicles are present must be protected from vehicular impact.

Although the code does not specify methods of protection, the most apparent method would be to locate the appliance where it could not be struck by a vehicle. A practical method of protection would be to place a formidable and permanent barrier between the motor vehicles and the appliance. This barrier could include such items as an effectively located vehicle wheel stop that is anchored in place, an elevated platform higher than the vehicle's bumpers or one or more concrete-filled steel pipes. Final approval of the method of protection is left to the local code official. See Commentary Figure M1307.3.1 for some commonly used methods of protection.

M1307.4 Hydrogen generating and refueling operations. *Ventilation* shall be required in accordance with Section M1307.4.1, M1307.4.2 or M1307.4.3 in private garages that contain hydrogen-generating *appliances* or refueling systems. For the purpose of this section, rooms or spaces that are not part of the *living space* of a *dwelling unit* and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

❖ The use of hydrogen to fuel vehicles and generate electricity in fuel cell appliances to replace petroleum-based fuels is a rapidly developing technology. Key factors in the increased use of hydrogen are the reduced atmospheric emissions associated with hydrogen and the nation's shift to renewable sources of energy.

Typically, the code official will encounter two classes of equipment—those that generate hydrogen for use by other equipment, such as vehicles, and those that use hydrogen as their energy input, such as fuel cell appliances. This section intends to minimize the potential for explosions by limiting the source of hydrogen gas and by requiring sufficient ventilation to dissipate any leakage.



Commentary Figure M1307.3.1
TYPICAL MOTOR VEHICLE IMPACT PROTECTION

For SI: 1 inch = 25.4 mm.

M1307.4.1 Natural ventilation. Indoor locations intended for hydrogen-generating or refueling operations shall be limited to a maximum floor area of 850 square feet (79 m^2) and shall communicate with the outdoors in accordance with Sections M1307.4.1.1 and M1307.4.1.2. The maximum rated output capacity of hydrogen-generating *appliances* shall not exceed 4 standard cubic feet per minute (1.9 L/s) of hydrogen for each 250 square feet (23 m^2) of floor area in such spaces. The minimum cross-sectional dimension of air openings shall be 3 inches (76 mm). Where ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect. In those locations, *equipment* and *appliances* having an *ignition source* shall be located so that the source of ignition is not within 12 inches (305 mm) of the ceiling.

❖ The 850-square-foot (79 m^2) maximum floor space used for hydrogen generation or refueling and the maximum rated output capacity of such appliances are intended to limit the amount of hydrogen gas that can accumulate in the space, thus minimizing the potential for explosions.

The location of an ignition source parallels the intent of Section M1307.3, but with respect to the ceiling instead of the floor. This section does not apply to spaces that house only vehicles and that do not contain hydrogen-generating or refueling operations. Because it is more buoyant, hydrogen will dissipate more quickly than natural gas and much more quickly than either propane or gasoline, both of which have vapors that are heavier than air and will linger at an accident site. However, hydrogen and natural gas can both accumulate in unventilated pockets at the top of indoor structures and could represent a risk in such situations.

Similarly, gasoline fumes can accumulate at the floor level in unventilated spaces, posing a different risk. Thus, ignition sources must be avoided at the top of any unventilated spaces for hydrogen gas. Also, hydrogen is odorless, colorless and burns with a flame that is not generally visible to the human eye. This means that it is unlikely that people will be able to detect unsafe conditions without appropriate instrumentation [similar to carbon monoxide (CO) accumulation in a structure].

M1307.4.1.1 Two openings. Two permanent openings shall be constructed within the garage. The upper opening shall be located entirely within 12 inches (305 mm) of the ceiling of the garage. The lower opening shall be located entirely within 12 inches (305 mm) of the floor of the garage. Both openings shall be constructed in the same exterior wall. The openings shall communicate directly with the outdoors and shall have a minimum free area of $^1/_2$ square foot per 1,000 cubic feet (1.7 m^2/1000 m^3) of garage volume.

❖ The location requirement will prevent the openings from being more than 12 inches (305 mm) tall because the required openings must be entirely within the 12 inches (305 mm) of wall space measured down from the ceiling and up from the floor. The openings must be in the same wall to help create a gravity flow of gases driven by the natural buoyancy of hydrogen gas. The bottom opening is an air inlet and the top opening is an air outlet.

M1307.4.1.2 Louvers and grilles. In calculating free area required by Section M1307.4.1, the required size of openings shall be based on the net free area of each opening. If the free area through a design of louver or grille is known, it shall be used in calculating the size opening required to provide the free area specified. If the design and free area are not known, it shall be assumed that wood louvers will have a 25-percent free area and metal louvers and grilles will have a 75-percent free area. Louvers and grilles shall be fixed in the open position.

❖ This section recognizes that louvers and grilles are usually installed over air inlets and outlets to prevent rain, snow and animals from entering the building. When louvers or grilles are used, the solid portion of the louver or grille must be considered when determining the unobstructed (net clear) area of the opening.

Air openings are sized based on a free, unobstructed area for the passage of air. Louvers or grilles placed over these openings reduce the area of the openings because of the area occupied by the solid portions of the grille or louver. The reduction in area must be considered because only the unobstructed area can be credited toward the required opening size.

The reduction in opening area caused by the presence of grilles or louvers will always require openings to be larger than determined from the sizing ratios of this chapter and larger than any duct of the minimum required size that might connect to these openings.

M1307.4.2 Mechanical ventilation. Indoor locations intended for hydrogen-generating or refueling operations shall be ventilated in accordance with Section 502.16 of the *International Mechanical Code*. In these locations, *equipment* and *appliances* having an *ignition source* shall be located so that the source of ignition is below the mechanical *ventilation* outlet(s).

❖ Section 502.16 of the IMC provides criteria for the design and operation of a mechanical ventilation system in repair garages for natural-gas-fueled and hydrogen-fueled vehicles. This section makes Section 502.16 of the IMC applicable to indoor spaces containing hydrogen-generating and/or refueling operations. This section requires that any ignition source be located below the mechanical exhaust outlet opening.

M1307.4.3 Specially engineered installations. As an alternative to the provisions of Sections M1307.4.1 and M1307.4.2, the necessary supply of air for *ventilation* and dilution of flammable gases shall be provided by an *approved* engineered system.

❖ The code is not intended to inhibit innovative ideas or technological advances. A comprehensive regulatory document such as a fuel gas code cannot envision and then address all future innovations in the industry. As a result, a code must be applicable to and provide a basis for the approval of an increasing number of newly developed, innovative materials, systems and methods for which no code text or referenced standards yet exist. The fact that a material, product or

method of construction is not addressed in the code is not an indication that prohibition of the material, product or method is intended. The code official is expected to apply sound technical judgment in accepting materials, systems or methods that, while not anticipated by the drafters of the current code text, can be demonstrated to offer equivalent performance. By virtue of its text, the code regulates new and innovative construction practices while addressing the relative safety of building occupants. The code official is responsible for determining whether a requested alternative provides a level of protection of the public health, safety and welfare as required by the code.

M1307.5 Electrical appliances. Electrical *appliances* shall be installed in accordance with Chapters 14, 15, 19, 20 and 34 through 43.

❖ Electrical appliances must be installed in accordance with the electrical provisions of Chapters 34 through 43 and the installation requirements for specific appliances in Chapters 14, 15, 19 and 20.

M1307.6 Plumbing connections. Potable water and drainage system connections to *equipment* and *appliances* regulated by this code shall be in accordance with Chapters 29 and 30.

❖ Many appliances addressed in the mechanical part of the code have potable water connections and/or drain connections. Chapters 29 and 30 contain provisions for such connections to protect the potable water supply from contamination and to protect the occupants from health hazards associated with improper connections to the sanitary drainage system.

SECTION M1308
MECHANICAL SYSTEMS INSTALLATION

M1308.1 Drilling and notching. Wood-framed structural members shall be drilled, notched or altered in accordance with the provisions of Sections R502.8, R602.6, R602.6.1 and R802.7. Holes in load-bearing members of cold-formed steel light-frame construction shall be permitted only in accordance with Sections R505.2.6, R603.2.6 and R804.2.6. In accordance with the provisions of Sections R505.3.5, R603.3.4 and R804.3.3, cutting and notching of flanges and lips of load-bearing members of cold-formed steel light frame construction shall not be permitted. Structural insulated panels (SIPs) shall be drilled and notched or altered in accordance with the provisions of Section R610.7.

❖ During mechanical system installation, it is usually necessary to penetrate structural members. The building chapters of the code regulate how these penetrations should be made so as not to weaken the structural members. The provisions of this section refer to those requirements, which are especially strict regarding the cutting and notching of steel members and prohibit the cutting and notching of flanges and lips of cold-formed, steel-framed, load-bearing members. See the commentary to the sections listed in the code text and also to Section P2603.2.

M1308.2 Protection against physical damage. Where piping will be concealed within light-frame construction assemblies, the piping shall be protected against penetration by fasteners in accordance with Sections M1308.2.1 through M1308.2.3.

Exception: Cast-iron piping and galvanized steel piping shall not be required to be protected.

❖ This section is intended to minimize the possibility of damage to refrigerant piping and other mechanical system piping from nails, screws or other fasteners. Because nails and screws sometimes miss the stud, rafter joist or top or sole plate, the shield must protect the pipe through the full width of the member and beyond for the specified distance. Commentary Figure M1308.2 shows typical shield plates. Cast-iron and galvanized steel pipe have wall thicknesses greater than the required thickness of the shield plate, which makes them inherently resistant to nail and screw penetrations. The same basic requirements exist in Section P2603.2.1 for plumbing piping and Section G2415.7 for gas piping (see commentary, Sections P2603.2.1 and G2415.7). Piping such as refrigerant and gas piping should not be run in close proximity to the underside of roof deck sheathing because there have been cases where roofing fasteners have penetrated such piping, especially during reroofing. See Section M1411.7.

M1308.2.1 Piping through bored holes or notches. Where *piping* is installed through holes or notches in framing members and is located less than $1^1/_2$ inches (38 mm) from the framing member face to which wall, ceiling or floor membranes will be attached, the pipe shall be protected by shield plates that cover the width of the pipe and the framing member and that extend 2 inches (51 mm) to each side of the framing member. Where the framing member that the piping passes through is a bottom plate, bottom track, top plate or top track, the shield plates shall cover the framing member and extend 2 inches (51 mm) above the bottom framing member and 2 inches (51 mm) below the top framing member.

❖ See the commentary to Section G2415.7.1.

M1308.2.2 Piping in other locations. Where piping is located within a framing member and is less than $1^1/_2$ inches (38 mm) from the framing member face to which wall, ceiling or floor membranes will be attached, the piping shall be protected by shield plates that cover the width and length of the piping. Where piping is located outside of a framing member and is located less than $1^1/_2$ inches (38 mm) from the nearest edge of the face of the framing member to which the membrane will be attached, the piping shall be protected by shield plates that cover the width and length of the piping.

❖ See the commentary to Section G2415.7.2.

M1308.2.3 Shield plates. Shield plates shall be of steel material having a thickness of not less than 0.0575 inch (1.463 mm) (No. 16 gage).

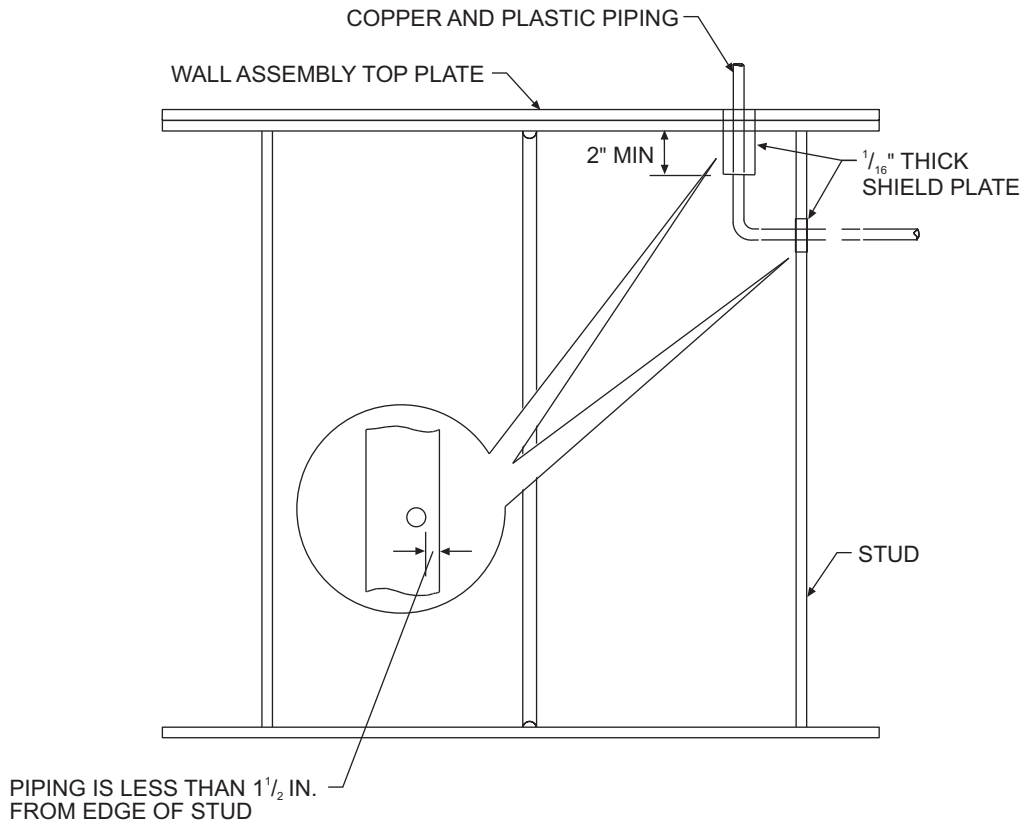
❖ See the commentary to Section G2415.7.3.

Bibliography

The following resource materials were used in the preparation of the commentary for this chapter of the code:

IFGC–18, *International Fuel Gas Code*. Washington, DC: International Code Council, 2017.

NFPA 70–17, *National Electrical Code*. Quincy, MA: National Fire Protection Association, 2016.



For SI: 1 inch = 25.4 mm.

Commentary Figure M1308.2
PIPE PROTECTION