

General Comments

A fundamental principle of the code is its dependence on the listing and labeling method of approval for appliances and equipment. Section 301.4 prohibits the installation of unlisted appliances except where approved in accordance with Section 104.

Purpose

Chapter 3 contains requirements for the safe and proper installation of mechanical equipment and appliances to ensure protection of life and property.

SECTION 301—GENERAL

301.1 Scope. This chapter shall govern the approval and installation of all *equipment* and *appliances* that comprise parts of the *building* mechanical systems regulated by this code in accordance with Section 101.2.

C This section states that this chapter governs the approval and installation of all mechanical equipment and appliances that are regulated by the code. Section 101.2 establishes the scope of application of the code (see commentary, Section 101.2).

301.2 Energy utilization. Heating, ventilating and air-conditioning systems of all structures shall be designed and installed for efficient utilization of energy in accordance with the *International Energy Conservation Code*.

C Appliances and equipment that use energy sources must be designed and installed to use energy efficiently. This is especially important where the energy is not a renewable source. Saving energy is a commendable goal regardless of the affordability or abundance of energy. Energy use, especially of nonrenewable energy, impacts the environment. The *International Energy Conservation Code*® (IECC®) is the applicable document for regulating the efficiency and performance of the appliances and heating, ventilating and air-conditioning (HVAC) systems. Special applications such as process heating or cooling should be designed for the maximum energy efficiency attainable.

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

C 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 a 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.

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

C 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 all 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 include only plastic parts such as brass valves with a plastic stem.

301.5 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 301.3. Piping, tubing and fittings shall either be tested by an *approved* third-party testing agency or certified by an *approved third-party certification agency*.

C The term “third party” refers to an outside organization with no financial or other interest in the outcome. The term “tested” means that the product or material was initially tested, a report or documentation was developed, but retesting at a later date is not performed. The term “certified” means that the product or material was initially tested and a program of periodic testing ensures that the product or material continues to meet the specified requirements. See definitions in Chapter 2 for “Third-party certified” and “Third-party tested.”

301.6 Fuel gas appliances and equipment. The approval and installation of fuel gas distribution piping and *equipment*, fuel gas-fired *appliances* and fuel gas-fired *appliance* venting systems shall be in accordance with the *International Fuel Gas Code*.

C With the development of the *International Fuel Gas Code*® (IFGC®) in 1997, the provisions that exclusively addressed fuel-gas installations were deleted from this code. The creation of the IFGC was the result of an agreement between the International Code Council® (ICC®) and the American Gas Association (AGA) to develop and maintain a stand-alone fuel gas code for the family of International Codes® (I-Codes®). With the support and input of the fuel gas industry, the IFGC is kept current

with new developments and technology in the fuel gas industry. Any code provision that addressed only a fuel-gas-related subject was removed from the code. Code provisions that could apply to other types of fuel (oil, kerosene, wood, coal, pellets, etc.) as well as fuel gas were modified to no longer refer to fuel-gas-related subjects. The IFGC is an inseparable partner to the IMC. Together, they cover all currently used fuels with the most up-to-date text possible.

301.7 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 104.

Exception: Listing and labeling of *equipment* and *appliances* used for refrigeration shall be in accordance with Section 1101.2.

C Mechanical appliances must be listed and labeled by an approved agency to show that they comply with the applicable national standards. The code requires listing and labeling for appliances such as boilers, furnaces, space heaters, direct-fired heaters, cooking appliances, clothes dryers, rooftop HVAC units, etc. The code also requires listing for system components as specifically stated in the text addressing those 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 has been determined to perform safely and efficiently where installed and operated in compliance with its listing.

The presence of a 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 is when the code official approves the use of a specific appliance with the authority granted in Section 104. 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 a particular application but are being used in an application for which they have not been tested. An example would be an appliance that is listed for indoor use only being installed outdoors. Another potential misapplication example could be a factory-built chimney that has been tested and listed for use only with wood-burning heating appliances being used as a grease duct. Such misapplications have the potential to create hazardous conditions.

Caution must be exercised when considering the approval of unlisted and unlabeled appliances in accordance with Section 104. Approval of unlabeled appliances must be based on documentation that demonstrates equivalence to appliances that are in compliance with the applicable standards or, where no product standards exist, that the appliance is appropriate for the intended use and will provide the same level of performance as would listed and labeled appliances. A fundamental principle of the code is the reliance on the listing and labeling process to ensure appliance performance; approvals granted in accordance with Section 104 must be well justified with supporting documentation. To the code official, the installer and the end-user, very little is known about the performance of an appliance that is not tested and built to an appliance standard.

301.8 Labeling. Labeling shall be in accordance with the procedures set forth in Sections 301.8.1 through 301.8.2.3.

C As the commentary for Section 301.7 states, the product label is the primary, if not the only, assurance to the code official that the appliance is safe for installation. The labeling of an appliance ensures that testing in compliance with an applicable standard has been performed and that the product will perform acceptably where installed and operated in accordance with the appliance's listing. Before an appliance or other component can be labeled, the code requires specific actions by qualified agencies and personnel. Sections 301.8.1 through 301.8.2.3 describe the requirements that must be complied with before a label can be issued for the appliance or equipment.

301.8.1 Testing. An *approved* agency shall test a representative sample of the mechanical *equipment* and *appliances* being labeled to the relevant standard or standards. The *approved* agency shall maintain a record of all of the tests performed. The record shall provide sufficient detail to verify compliance with the test standard.

C An approved agency is one that complies with the requirements of Sections 301.8.2.1 through 301.8.2.3 and is approved by the code official (see commentary, Section 301.8.2.1). The only way that an approved agency can verify that equipment and appliances meet the requirements of the relevant standard(s) is by testing of the appliance or equipment under controlled conditions in a testing laboratory. For mass-produced identical products, the approved agency rarely tests each product. Typically, a representative random sample of a "production run" of products is tested. For example, a test protocol might require that 3 units out of 1,000 units produced be tested. As long as the design and manufacturing processes for identically produced products do not change, the established sampling and testing frequency provides a high level of assurance that each produced product would pass the test if actually tested.

The approved agency is responsible for maintaining a record of specific information concerning the product tested, as well as the results of the tests performed. The test standards detail what information is important to record. The records provide proof that the testing was actually performed and that appliance or equipment met or exceeded the minimum requirements of the applicable product standards.

There are numerous standards, not all of which are specifically referenced in the code, applicable to various appliances and equipment. For this reason, the approved agency determines the standards to be used for testing and then, in turn, as the basis for labeling. Each standard contains safety requirements for a given appliance or piece of equipment and specifies tests that must be performed. The labeling agency must maintain sufficient detailed documentation to

demonstrate compliance with the test standard. The code official may require that copies of the test reports be submitted to determine the validity of the label.

Examples of the many standards that are used as a basis for testing and labeling include:

- UL 641—Low-Temperature Venting Systems, Type L.
- UL 727—Oil-Fired Central Furnaces.
- UL 1482—Room Heaters, Solid-Fuel Type.

The basis for a label is the requirement for testing a representative, perhaps identical, sample of the appliance to indicate conformance to a required standard. For this reason, the appliance must meet the requirements of the standard (see commentary, Section 304.1).

301.8.2 Inspection and identification. The *approved* agency shall periodically perform an inspection, which shall be in-plant if necessary, of the mechanical *equipment* and *appliances* to be labeled. The inspection shall verify that the labeled mechanical *equipment* and *appliances* are representative of the mechanical *equipment* and *appliances* tested.

C The approved agency whose identification insignia appears on the label is required to perform periodic in-plant inspections to verify that the manufactured product is equivalent to the sample that was tested. Because the label is good only for the products that were tested, the in-plant inspections are intended to discover any design changes or production quality control problems. If any discrepancies are found, the labeling agency would discontinue labeling of the particular product, and the manufacturer would be required to resolve the problem and, if necessary, have the revised product retested before the labeling process is resumed. The code official may require copies of the periodic inspection reports to determine that the in-plant inspections are being performed in compliance with the requirements for a labeled product.

Because appliances and equipment are tested under specific conditions of installation and operation in accordance with the manufacturer's instructions, the issuance of a label requires that these instructions be provided to the installer and end-user to ensure that the product is not misapplied or improperly installed. Because the code requires that the labeled appliances and equipment be installed and operated in accordance with the manufacturer's instructions, the instructions must be attached to or shipped with each appliance. In-plant inspections by the approved agency ensure that the instructions are being shipped with the product, that the design of the product has not substantially changed and that any change in manufacturing processes will not require a change in the testing protocol.

301.8.2.1 Independent. The agency to be *approved* shall be objective and competent. To confirm its objectivity, the agency shall disclose all possible conflicts of interest.

C As a part of the basis for a code official's approval of a particular labeling agency, the agency must demonstrate its independence from the manufacturer of the product as well as its competence to perform the required tests. The judgment of objectivity is linked to the financial and fiduciary independence of the agency. The competence of the agency is judged by its experience and organization, and the experience of its personnel. As a hypothetical example, the Acme Inspection Agency is testing oil-fired furnaces for the Real Hot Furnace Company. After some investigation, it is discovered that both Acme and Real Hot are subsidiaries of the same parent company. The inspection agency and manufacturer clearly have a relationship that is inappropriate from the standpoint of conflict of interest, and the objectivity of the inspection agency is sufficiently questionable for the code official to justify not approving Acme as a testing and labeling agency for equipment produced by the Real Hot Furnace Company.

While code officials could do their own investigations of testing agencies, many rely on accredited third-party evaluation services to perform such investigations. One such service is the ICC Evaluation Service® (ICC-ES®). ICC-ES evaluation reports are public documents, available free of charge on the World Wide Web, not only to building regulators and manufacturers, but also to contractors, specifiers, architects, engineers and anyone else with an interest in the building industry.

301.8.2.2 Equipment. An *approved* agency shall have adequate *equipment* to perform all required tests. The *equipment* shall be periodically calibrated.

C An agency must have proper equipment to perform the specific tests and inspections as required by the product and test standards. Referring to the example in the commentary for Section 301.8.2.1, if the Acme Inspection Agency had the facilities to test only fire doors, they would not be the appropriate agency for testing of an oil-fired furnace. Although this example is oversimplified, the point is that the inspection agency must have all of the necessary equipment to perform the testing required by the applicable standard.

The agency must also keep records of maintenance and calibration of their test and inspection equipment to demonstrate that the equipment can be relied on to produce accurate, consistent and reproducible results. Often testing apparatus, instruments and equipment must be capable of measurements using very small units of measure within a specified tolerance. To produce accurate, dependable readings and reliable test results, testing apparatus, many pieces of equipment and instruments must be routinely calibrated to established references, such as those maintained by the National Institute of Standards and Technology (NIST).

While code officials could question specific testing agencies with respect to their testing equipment, many rely on accredited third-party evaluation services to perform such verifications. One such service is the ICC-ES.

301.8.2.3 Personnel. An *approved* agency shall employ experienced personnel educated in conducting, supervising and evaluating tests.

C The competence of an inspection agency is based on the agency having the proper equipment to perform the test, as stated in Section 301.8.2.2, and also on the experience and abilities of its personnel. The best calibrated equipment can produce accurate results only when operated by experienced personnel who are trained to conduct, supervise and evaluate tests. For example, consider a newly formed agency that has employed individuals who do not have experience related to the testing to be conducted and have not been adequately trained. The code official may require information that demonstrates the agency personnel have the capability to properly perform the tests. The capabilities and experience of supervisory personnel overseeing their work are also important.

While code officials could question specific testing agencies with respect to their testing personnel, many rely on accredited third-party evaluation services to perform such verifications. One such service is the ICC-ES.

301.9 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, serial number and the seal or mark of the *approved* agency. A label shall include the following:

1. Electrical *equipment* and *appliances*: Electrical rating in volts, amperes and motor phase; identification of individual electrical components in volts, amperes or watts, motor phase; 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*: 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.

C This section requires that the label be a plate, tag or other item made and printed of materials that will have a permanence to last the intended life of the product. In general, label materials 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 given by a label, the intent is that the label be permanent, not susceptible to damage and legible for the life of the appliance or equipment to which it is attached. The standards that appliances are tested against usually specify the required label performance criteria, the method of attachment and required label information. The code requires that the label be affixed permanently and intends that the label be in a prominent location on the appliance or equipment. Although this section specifies the information that must appear on the label, relevant product standards might require additional information or the manufacturer might choose to provide additional information on the label. Commentary Figure 301.9 shows a typical appliance label.

Commentary Figure 301.9—Typical Label for a Category I Gas-Fired Furnace

AMERICAN STANDARD INC.
THE TRANE COMPANY
TRENTON, N.J. 08619 MADE IN U.S.A.

FORCED AIR FURNACE CATEGORY I
ANS Z21.47 - 1990 CENTRAL FURN
FOR INDOOR INSTALLATION IN A BUILDING
CONSTRUCTED ON SITE. NRTL

| | | |
|--------------------------------------|---|---------------------------------------|
| MODEL NO. TUDD9UR936A1 | SERIAL NO. C32519785 | EQUIPPED FOR NAT. GAS |
| INPUT 80,000 BTU/HR. | LIMIT SETTING 150 °F | MFRD. 09/92 |
| TEMP RISE °F FROM 30 TO 60 | MAX. EXT. STATIC PRESS 5.0 INCHES WATER | MAX. DESIGN AIR TEMP 130 °F |
| VOLTS/PHASE/HERTZ 115/1/60 | TOTAL AMPS 8.5 | SERVICE CODE 1 |

MANIFOLD PRESSURE (IN INCHES OF WATER)
NAT. 3.5 L P 10.5
SUPPLY PRESSURE (IN INCHES OF WATER)
MAX. NAT. 10.5, L P 13.0
MIN. NAT. 4.5 L P 11.0 FOR PURPOSE OF INPUT ADJUSTMENT.

LOW INPUT 52,000 BTU/HR

MINIMUM CLEARANCE COMBUSTIBLE MATERIALS:

| | | | |
|-------------------------------------|--------------------------|-------------|-----------------|
| FOR CLOSET INSTALLATION AS FOLLOWS: | | | |
| SIDES | 0 IN. W/SINGLE WALL VENT | | |
| FLUE | 6 IN. W/SINGLE WALL VENT | 1 IN. W/TYP | B-1 VENT |
| FRONT | 6 IN. | BACK | 0 IN. TOP 1 IN. |

UPFLOW UNITS FOR INSTALLATION COMBUSTIBLE FLOORING. 210240189.P01

(Courtesy of Trane U.S. Inc., an Ingersoll Rand Company)

301.10 Electrical. Electrical wiring, controls and connections to *equipment* and *appliances* regulated by this code shall be in accordance with NFPA 70.

C Field-installed power wiring and control wiring for appliances and equipment must be installed in accordance with the NEC (NFPA 70).

The power wiring includes all the wiring, disconnects, overcurrent protection devices, starters and related hardware used to supply electrical power to the appliance or equipment. The control wiring includes all the wiring, devices and related hardware that connect the main unit to all external controls and accessories, such as temperature and pressure sensors, thermostats, exhausters, equipment contactors, interlock controls and remote damper motors. The internal factory wiring of appliances and equipment is not covered by this section unless it is specifically addressed in NFPA 70; however, such wiring is covered by the testing and review performed by an approved agency as part of the labeling process.

The mechanical or electrical code official responsible for the inspection of appliances and equipment must be familiar with the applicable sections of NFPA 70.

301.11 Plumbing connections. Potable water supply and *building* drainage system connections to *equipment* and *appliances* regulated by this code shall be in accordance with the *International Plumbing Code*.

C Plumbing connections to appliances and equipment regulated by the code must be in accordance with the *International Plumbing Code*® (IPC®).

Hydronic systems normally require a means of supplying fill and makeup water to replace any water lost to evaporation, leakage or intentional draining. Where direct connections are made to the potable water supply, the connections must be isolated from the potable water source. This provision is intended to protect the potable water system from contamination by backflow when a direct connection is made to a hydronic system. Hydronic systems are normally pressurized, contain nonpotable water and fluids, and can contain conditioning chemicals or antifreeze solutions. Low-temperature hydronic fluids and cooling towers have also been associated with disease-causing organisms such as the Legionnaires' disease bacterium. The potable water system must be protected from potential contamination resulting from connection to hydronic systems, water-wash filter systems, cooling towers, solar systems, water-cooled heat exchangers, cooking appliances, ice makers, humidifiers, evaporative coolers, etc.

In addition, water heaters must also be considered as both mechanical appliances and plumbing appliances and, therefore, must comply with both this code and the IPC.

A water heater installation is complex in that it has a fuel or power supply; a chimney or vent connection, if fuel fired; a combustion air supply, if fuel fired; connections to the plumbing potable water distribution system; and controls and devices to prevent a multitude of potential hazards from conditions such as excessively high temperatures, pressures and ignition failure.

It is not uncommon for jurisdictions to issue both plumbing and mechanical permits for water heater installations or to require that the installer be licensed in both the plumbing and mechanical trades when performing such installations (see commentary, Section 1002). There is no way to avoid the "code crossover" for water heaters because they are clearly plumbing and mechanically related and under the purview of both plumbing and mechanical codes. This section also triggers the IPC for the drainage associated with mechanical appliances and equipment, such as those addressed in Section 307.

301.12 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 usage 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.

C Mechanical appliances are usually designed by the manufacturer to operate on one specifically designated type of fuel. 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 determined to perform acceptably when installed and operated in accordance with the appliance listing (see commentary, Section 301.8). The fuel used in the appliance test must be based on the type of fuel specified by the manufacturer. 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 is based in part on the label, the appliance is no longer approved for use.

Requiring approval of fuel conversions by the code official and requiring that they be in compliance with the manufacturer's installation instructions is the only way to ensure that the conversion will allow for the safe operation of the appliance. Fuel conversions that are not performed correctly can adversely affect the performance of burners, the venting of combustion gases and the proper clearance of combustibles.

Before a fuel conversion is performed, the manufacturer must be contacted to obtain installation instructions outlining the procedures to follow to ensure proper operation of the appliance. In most cases, conversion kits are available from the

manufacturer 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 service personnel to the modifications.

All fuel-fired appliances are designed to operate with a maximum and minimum heat energy input capacity. This capacity is field adjusted to suit the elevation because of the change in air density at different elevations. Alteration of heat energy input beyond the allowable limits can result in hazardous overfiring or underfiring. Either condition can cause operation problems that include overheating, vent failure, corrosion, poor draft and poor combustion.

301.13 Vibration isolation. Where vibration isolation of *equipment* and *appliances* is employed, an *approved* means of supplemental restraint shall be used to accomplish the support and restraint.

C Where vibration isolation connections are used in ducts and piping and where equipment is mounted with vibration dampers, support is required for the ducts, piping and equipment to maintain positioning and alignment and to prevent stress and strain on the vibration connectors and dampers.

301.14 Repair. Defective material or parts shall be replaced or repaired in such a manner so as to preserve the original approval or listing.

C Repair work must not alter the nature of appliances and equipment in a way that would invalidate the listing or conditions of approval. For example, replacement of safety control devices with different devices could alter the design and operation of an appliance from that intended by the manufacturer and the listing agency.

301.15 Wind resistance. Mechanical *equipment*, *appliances* and supports that are exposed to wind shall be designed and installed to resist the wind pressures determined in accordance with the *International Building Code*.

C Installations of mechanical equipment and appliances that are subject to wind forces must be designed to resist those forces. The wind pressures must be based on the wind provisions in the International Building Code® (IBC®) for the site. The requirements in the IBC are based on ASCE 7. The wind pressure requirements are based on the exposure of the building and wind speeds for that region.

[BS] 301.16 Flood hazard. For structures located in flood hazard areas, mechanical systems, *equipment* and *appliances* shall be located at or above the elevation required by Section 1612 of the *International Building Code* for utilities and attendant *equipment*.

Exception: Mechanical systems, *equipment* and *appliances* are permitted to be located below the elevation required by Section 1612 of the of the *International Building Code* for utilities and attendant equipment provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding up to such elevation.

C In flood hazard areas, mechanical systems, equipment and appliances must be elevated above the elevation specified in IBC Section 1612, which refers to ASCE 24. Exposure to water can damage most mechanical system components as well as cause serious appliance and equipment malfunctions. For example, the majority of appliance manufacturers require the replacement of safety controls or entire appliances that have been submerged in flood waters. See FEMA P-348 for additional guidance.

The exception to this section provides criteria for placing specific equipment below the required elevation. Exposure to water can cause deterioration of system components and serious appliance and equipment malfunctions. For example, most appliance manufacturers require the replacement of appliances that have been submerged in floodwater. Components such as pressure regulators, gas controls, motors and electronic circuitry can be ruined by exposure to water. To place equipment below the required elevation, the equipment must be designed to prevent the entry or accumulation of water and must be able to be restored to service with minimal cleaning and repair. Standard equipment that typically is installed at-grade is not designed to withstand the entry of water and would not meet the requirements of this exception. Appliances and system components designed for submersion might be difficult or impossible to obtain. Protecting equipment with a flood barrier or vault is considered dry floodproofing, which is not permitted in residential buildings or residential portions of mixed-use buildings.

[BS] 301.16.1 Coastal high-hazard areas and coastal A zones. In coastal high-hazard areas and coastal A zones, mechanical systems and *equipment* shall not be mounted on or penetrate walls intended to break away under flood loads.

C IBC Section 1612 requires exterior walls below elevated buildings to break away under flood loads in coastal high-hazard areas (Zone V) and coastal A Zones. Breakaway walls are designed and constructed to fail under flood loads in order to avoid transferring their loads and damaging the primary structural support of the building. Where mechanical or plumbing system components penetrate or are attached to the breakaway walls, they can prevent the walls from breaking away, thus transferring additional loads to the building and increasing flood damage. Also, damage to the mechanical systems is certain to occur where the walls fail as intended.