



ANSI Z21.84-2012

Standard for Manually lighted, natural gas, decorative gas appliances for installation in solid-fuel burning fireplaces



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AMERICAN NATIONAL STANDARD
ANSI Z21.84-2012

Third Edition - 2012
This Standard is based on the Standard for
Manually lighted, natural gas, decorative gas appliances
for installation in solid-fuel burning fireplaces
ANSI Z21.84-2002
and ANSI Z21.84a-2003,
ANSI Z21.84b-2004

APPROVED



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Preface

This publication represents a basic standard for safe operation, substantial and durable construction, and acceptable performance of manually lighted, natural gas decorative gas appliances for installation in solid-fuel burning fireplaces. It is the result of years of experience in the manufacture, testing, installation, maintenance, inspection and research on manually lighted, natural gas, decorative gas appliances for installation in solid fuel-burning fireplaces designed for the utilization of gas. There are risks of injury to persons inherent in some appliances that, if completely eliminated, would defeat the utility of the appliance. The provisions in this standard are intended to reduce such risks while retaining the normal function of the appliance.

Nothing in this standard is to be considered in any way as indicating a measure of quality beyond compliance with the provisions it contains. It is designed to allow compliance of manually lighted, natural gas decorative gas appliances for installation in solid-fuel burning fireplaces, the safety construction and performance of which may exceed the various provisions specified herein. In its preparation, recognition has been given to possibilities of improvement through ingenuity of design. As technical advances take place, revisions may become necessary. When they are believed desirable, recommendations or suggestions should be forwarded to the CSA Group, 8501 East Pleasant Valley Road, Cleveland, Ohio 44131. A proposal form is provided in the back of this document.

Safe and satisfactory operation of manually lighted, natural gas, decorative gas appliances for installation in solid fuel-burning fireplaces depends to a great extent upon its proper installation, use and maintenance. It should be installed, as applicable, in accordance with the National Fuel Gas Code, ANSI Z223.1/NFPA 54; the (U.S.) Manufactured Home Construction and Safety Standard, Title 24 CFR, Part 3280, or when such standard is not applicable, Manufactured Home Installations, ANSI/NCSBCS A225.1 or the Standard for Manufactured Home Installations, Sites, and Communities, ANSI/NFPA 501A, manufacturers' installation instructions, and local municipal building codes.

Users of this American National Standard are advised that the devices/products/activities within its scope may be subject to regulation at the Federal, state or local level. Users are strongly urged to investigate this possibility through appropriate channels. In the event of a conflict with this standard, the Federal, state or local regulation should be followed.

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EFFECTIVE DATE: An organization using this standard for product evaluation as a part of its certification program will normally establish the date by which all products certified by that organization should comply with this standard.

History Of The Development Of The Standard For Manually Lighted, Natural Gas, Decorative Gas Appliances For Installation In Solid-Fuel Burning Fireplaces

(This History is informative and is not part of the standard.)

With the onset of the Free Trade Agreement between the United States and Canada on January 2, 1988, significant attention was given to the harmonization of the United States and Canadian safety standards addressing gas-fired equipment of residential, commercial and industrial applications. It was believed that the elimination of the differences between the standards would remove potential trade barriers and provide an atmosphere in which North American manufacturers could market more freely in the United States and Canada. The harmonization of these standards was also seen as a step toward harmonization with international standards. Joint subcommittees were established to facilitate the standards harmonization process between the United States and Canada.

At its October 20-21, 1994 meeting, the Z21/CGA Joint Subcommittee on Standards for Decorative Gas Appliances considered the development of a new standard for manually lighted, natural gas, decorative gas appliances for installation in solid-fuel burning fireplaces, and approved to distribute it for public review and comment, July 4, 1995.

The first draft manually lighted, natural gas, decorative gas appliance standard was based on current coverage from the IAS Requirement 7-94, Requirements for Manually Lighted Natural Gas, Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces.

Following reconsideration and modification of the proposed draft standard, in light of comments received, the joint decorative appliance subcommittee at its May 22, 1998 meeting, recommended the proposed draft standard to Accredited Standards Committee Z21/83.

The proposed draft standard for manually lighted, natural gas, decorative gas appliances for installation in solid-fuel burning fireplaces, as modified by the joint subcommittee, was approved by the Z21/83 Committee by letter ballot dated August 18, 1998.

The first edition of the American National Standard for Manually Lighted, Natural Gas, Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces was approved by the American National Standards Institute, Inc., on February 23, 1999.

Further revisions to the standard were developed in line with industry development. The second edition of manually lighted, natural gas decorative gas appliances for installation in solid-fuel burning appliances standard, which includes revisions deemed necessary in line with industry developments, was approved as an American National Standard by the American National Standards Institute, Inc., on June 26, 2002.

NOTE: *This 2012 edition of Z21.84 incorporates changes to the 2002 edition and addenda thereto. Changes, other than editorial, are denoted by a vertical line in the margin.*

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ANSI Z21.84-2012
***Manually lighted, natural gas, decorative gas
appliances for installation in solid-fuel
burning fireplaces***



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NOTE

This standard contains SI (Metric) equivalents to the yard/pound quantities, the purpose being to allow the standard to be used in SI (Metric) units. (Standard for use of the International System of Units (SI): The Modern Metric System, IEEE/ASTM SI 10 or Metric Practice Guide, CAN/CSA Z234.1 are used as a guide in making metric conversion from yard/pound quantities.) If a value for a measurement and an equivalent value in other units, the first stated is to be regarded as the requirement. The given equivalent value may be approximate. If a value for a measurement and an equivalent value in other units, are both specified as a quoted marking requirement, the first stated unit, or both shall be provided.

ANSI Z21.84-2012

Manually Lighted, Natural Gas, Decorative Gas Appliances For Installation In Solid-Fuel Burning Fireplaces

Part I: Construction

1.1 Scope

1.1.1

These requirements apply to manually lighted, natural gas, decorative gas appliances for installation in solid-fuel burning fireplaces, (see Part IV, Definitions), hereinafter referred to as appliances, for use with natural gas only, at a maximum input rating of 90,000 Btu/hr (26 376 W) (except as noted in 1.7, Piezo-Electric Ignitors), which are constructed entirely of new, unused parts and materials.

These appliances do not incorporate a pilot burner or an automatic gas ignition system. The main burner(s) is intended to be lighted by hand each time the appliance is used.

The construction of manually lighted, natural gas, decorative gas appliances for installation in solid-fuel burning fireplaces is covered under Part I.

The performance of manually lighted, natural gas, decorative gas appliances for installation in solid-fuel burning fireplaces is covered under Part II.

1.1.2

Manually lighted, natural gas, decorative gas, appliances for installation in solid-fuel burning fireplaces shall not be thermostatically controlled.

1.1.3

This standard does not cover unvented room heaters.

1.1.4

The use of the term “appliance” henceforth in this standard is in reference to a manually lighted, natural gas, decorative gas appliances, for installation in a solid fuel burning fireplace.

1.1.5

If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated value is to be regarded as the specification.

1.1.6

Exhibit B, List of Reference Standards, contains a list of standards specifically referenced in this standard and sources from which they may be obtained. It is the responsibility of the user of this standard to determine which referenced standard applies based on the requirements of the Authority Having Jurisdiction at the location of the installation.

1.2 General Construction And Assembly

1.2.1

The construction of an appliance, whether specifically covered in this standard or not, shall be in accordance with reasonable concepts of safety, substantiality and durability.

Component parts shall be secured against distortion, warpage or other damage, and supported to maintain a fixed relationship between essential parts under normal and reasonable conditions of handling and usage.

Component parts, i.e. burner media and decorative parts, not positively located shall be designed so that the method of assembly is apparent during installation, cleaning and servicing. (See 2.4, Combustion.)

All specifications as to construction set forth herein may be satisfied by the construction actually prescribed or such other construction as will provide at least equivalent performance.

1.2.2

Asbestos shall not be used in the construction of an appliance.

1.2.3

In submitting an appliance for test, the manufacturer may furnish a list of manufacturing tolerances applicable thereto and may have the appliance tested for compliance with this standard in both extremes of tolerances specified.

1.2.4

Exposed edges which might reasonably be contacted during normal adjustment or usage shall be smooth.

1.2.5

Bolts, nuts and screws employed in the assembly of an appliance shall not require the use of special tools (see Part IV, Definitions) for removal or replacement.

1.2.6

Fastening means, used for securing parts that may need servicing, shall be of a reusable type.

1.2.7

All sections concerning accessibility and visual checks shall be evaluated with the appliance installed as it would be in service in accordance with the manufacturer's instructions in a minimum sized fireplace (see 1.15.1-e, Instructions).

1.2.8

Controls shall be accessible for normal servicing and functional adjustment in position, and shall be replaceable during normal servicing. Manifold assemblies which permit removal of the control(s) intact shall be considered to meet this provision for servicing. Removal of an access panel or door to secure access to a control compartment shall be considered acceptable.

1.2.9

Appliances shall not be equipped with a flue collar or any other means for flue connections.

1.3 Materials

1.3.1

When sheet metal is used in the construction of an appliance, the thickness shall be in conformance with Table I, Minimum Thickness of Materials.

1.3.2

Materials shall be of such composition that they will not disintegrate to the extent that particles will separate and drop upon the burner and affect combustion.

1.4 Main Burners

1.4.1

The burner shall be a single casting or of an equally gastight and durable construction.

1.4.2

Burner ports shall be accurately made.

1.4.3

Ports shall be clear and free of burrs inside the burner.

1.4.4

Bolt holes shall not intersect gasways unless provision is made to provide gastightness.

1.4.5

Ribbon burners shall be constructed so the ribbon assembly is securely fixed in position.

1.4.6

Burners shall be mounted so they will not move out of their proper operating position.

1.4.7

The construction shall be such that the burner cannot be installed in other than the correct position.

1.4.8

Burners shall be easily removable without the use of special tools, for repair and cleaning.

1.4.9

If a burner tray is used, the means for fastening shall be accessible and shall be designed so that one person can perform the removal and replacement unassisted.

1.5 Primary Air Adjustment Means

1.5.1

It is recommended that air shutters, when provided, be of such design that they can be adjusted to have not more than two primary air openings, each approximating a circle near point of closure, or be of such design and construction as can be demonstrated to provide equally effective protection against stoppage by lint and dust.

1.5.2

Means shall be provided to fix air shutters securely in any desired position. Such means shall be conveniently accessible for adjustment with the burners in place and the appliance in operation.

1.5.3

Sheet-metal air shutters and locking screws shall be constructed of corrosion-resistant material or have a corrosion-resistant finish.

1.5.4

Sheet-metal air shutters shall be at least 0.0304 in (0.772 mm) thick.

1.5.5

Sheet-metal air shutters less than 0.0508 in (1.29 mm) thick shall have the outer edge turned at 90 degrees (1.57 rad).

1.6 Orifices And Orifice Fittings

1.6.1

Fixed orifices shall be provided for main burners.

1.6.2

Orifice fittings shall be readily accessible and positively secured to prevent misalignment with the burner mixer.

1.6.3

Orifice spuds and orifice spud holders shall be constructed of metal having a melting point of not less than 1450°F (788°C).

1.6.4

Main burner orifice spuds shall be threaded to their holders at least 3¹/₂ fully formed threads.

1.7 Piezo-Electric Ignitors

If a piezo-electric spark device is used for main burner ignition, it shall comply with the *Standard for Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components, ANSI Z21.77 • CSA 6.23*. Direct ignition of the main burner with a piezo-electric device shall be limited to appliances having input ratings of 40,000 Btu/hr or less.

If a manually operated electric gas ignition system is used for main burner ignition, it shall comply with the *Standard for Manually Operated Electric Gas Ignition Systems and Components, ANSI Z21.92 • CSA 6.29*. Direct ignition of the main burner shall be limited to appliances having input ratings of 40,000 Btu/hr or less.

1.8 Manual Gas Valves

1.8.1

A manual gas valve shall be provided to control the gas to the burner(s). If the valve is not an integral part of the appliance, it shall be provided with the appliance, along with instructions for proper installation of the valve (see 1.8.6 and 1.15.1-s). The manual gas valve shall require two actions to be put into operation.

1.8.2

Manual gas valves shall comply with the applicable provisions of the *Standard for Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves, ANSI Z21.15 • CSA 9.1*, or *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CSA 6.20*.

1.8.3

When the valve is exposed to view, lever or tee handles shall be at 90 degrees (1.57 rad) to the line of flow when in the "off" position and parallel when in the "on" position. If this cannot be done, if the valve handle only is exposed to view, or if a knob-type handle is used, the "on" and "off" positions or directions of rotation to open and close shall be clearly indicated by means of a Class IIIA or IIIB marking.

1.8.4

Removable handles shall be constructed so they cannot be attached so as to confuse the "on" and "off" positions.

1.8.5

Gas valves shall be located or constructed so they will not be liable to accidental change of setting.

1.8.6

The location of the burner gas valve and point of ignition shall be easily accessible and within convenient reaching distance of each other.

1.8.7

Latching type valves, if provided, shall be positive in their action, shall not require for their operation an axial displacement of the plug in contact with the barrel nor application of undue pressure on the plug which might cause the valve to stick, and shall permit ready operation with one hand, and accessibility to all parts for repair and replacement.

1.9 Gas Supply Lines

The following construction provisions apply to the gas supply lines within an appliance.

1.9.1

Steel pipe employed as gas conduit on an appliance shall comply dimensionally with the *Standard for Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10M*.

1.9.2

Piping tapped for gas valves or other branch supply lines shall provide a continuous run of not less than 3¹/₂ taper pipe threads in accordance with the *Standard for Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1*.

1.9.3

Series 300 stainless steel corrugated tubing used as part of a manifold assembly shall not be exposed to temperatures in excess of 900°F (482°C) when the appliance is operated as specified in 2.9, Handle Temperatures. The tubing shall demonstrate compliance with the Tubing Structure, Bending Test, and Bursting Test requirements specified in the *Standard for Connectors for Gas Appliances, ANSI Z21.24 • CSA 6.10*.

1.9.4

Ends of piping and tubing shall be carefully reamed and cleaned to remove obstructions and burrs. Bent supply piping shall have the bends smoothly made without any appreciable reduction in the cross-sectional area and shall reveal no imperfections occasioned by the bending process.

1.9.5

Copper semi-rigid tubing or tubing having internal copper surfaces, when used for conveying gas, shall be internally tinned or equivalently treated to resist corrosion by sulphur compounds.

1.9.6

Tubing and fittings used as gas conduits shall be capable of withstanding a temperature of 1,000°F (538°C) without melting.

Tubing and fittings used as gas conduits shall not be exposed to temperatures in excess of those specified in Table II, Maximum Tubing and Fitting Temperatures, when the appliance is operated as specified in 2.9, Handle Temperatures.

1.9.7

When aluminum tubing is used for pilot burner lines, it shall be Type 1100 or Type 3003 with temper either O (fully annealed) or F (as extruded).

1.9.8

Semi-rigid tubing employed as gas conduit shall have a wall thickness in accordance with Table III, Minimum Acceptable Wall Thickness for Nonferrous Semi-Rigid Tubing.

1.9.9

Gas supply piping to which connections are made for burners, lighters or other branch supply lines shall be readily removable, yet rigidly supported, to prevent turning or lateral displacement in making connection to the building piping or during the ordinary handling of the appliance.

1.9.10

Compounds used on threaded joints of gas piping shall be resistant to the action of liquefied petroleum gases.

1.9.11

Unions in gas lines shall be of the ground joint type.

1.9.12

A test gage connection shall be furnished downstream from the last main line gas control for measuring gas pressure at the burner. The connection shall be a minimum $\frac{1}{8}$ -inch NPT or cap with cleanly cut taper pipe threads in accordance with the *Standard for Pipe Threads, General Purpose (Inch)*, ANSI/ASME B1.20.1.

When the pressure tap is provided as part of the control, this pressure test gage connection shall be:

- a. A tapping sealed by a $\frac{1}{8}$ -inch NPT plug or cap with cleanly cut taper pipe threads in accordance with the *Standard for Pipe Threads, General Purpose (Inch)*, ANSI/ASME B1.20.1. If the plug is of the slotted type, it shall also incorporate square or hex flats; or
- b. A hose fitting with a minimum length of 0.355 in (9.02 mm) and a 0.355 in (9.02 mm) maximum/0.335 in (8.05 mm) minimum outside diameter and which incorporates a sealing means. The construction of the hose fitting shall incorporate an internal restriction not greater than 0.0394 in (1.0 mm) in diameter.

1.9.13

Sizes of gas connections to the inlet of the appliance shall not be less than $\frac{1}{4}$ inch standard pipe size or equivalent semi-rigid tubing size.

1.9.14

If the manifold has to be removed to replace a valve, the manifold shall be easily removable.

1.9.15

Where the use of bushings cannot be avoided, only those of the face or recessed type shall be used. Nesting of bushings is prohibited.

1.10 Thermostats And Automatic Valves

Thermostats, automatic valves, or other automatic cycling of the burner are not permitted.

1.11 Gas Appliance Pressure Regulators

1.11.1

A gas appliance pressure regulator, when provided, shall be equipped with a vent limiter.

1.11.2

If provided, gas appliance pressure regulators, including vent limiters, shall comply with the applicable construction provisions of the *Standard for Gas Appliance Pressure Regulators, Z21.18 • CSA 6.3*, or the *Standard for Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CSA 6.20*, as applicable.

1.11.3

If provided, a gas appliance pressure regulator shall be of either the limited adjustment or nonadjustable type (see Part IV, Definitions). The outlet pressure shall approximate that specified by the manufacturer (see 1.16.2-d).

1.11.4

If provided, the gas appliance pressure regulator shall be an assembled part of the manifold and located so as not to attain a temperature above 150°F (65.5°C) or a temperature in excess of that specified by the regulator manufacturer. These temperatures shall be determined in accordance with the test method specified in 2.9, Handle Temperatures (see 2.7.2).

1.12 Electrical Equipment And Wiring

The provisions of this section apply to all wiring and electrical components unless otherwise specified in this section.

An appliance requiring an electrical supply in excess of 30 volts at the appliance shall be factory wired or supplied with a wiring harness.* When an appliance is supplied with a wiring harness, a connection diagram (see Part IV, Definitions) showing the exact arrangement of the wiring shall be included.

1.12.1

Electrical equipment, wiring and accessories built-in or supplied by the manufacturer for direct attachment to the appliance shall be submitted for examination with the appliance.

* Wiring Harness. The electrical wiring supplied by the appliance manufacturer as an integral part of the appliance. An appliance requiring assembly at the place of installation shall be supplied with wiring necessary to interconnect the appliance control assembly. Such wiring may be supplied as individual lengths or cabled together, with ends stripped or provided with means for attachment to control terminals, and identified to correspond with the manufacturer's electrical diagrams in the installation instructions.

1.12.2

Electrical equipment and line-voltage and safety-circuit wiring supplied for use with and as a part of an appliance shall be of approved types and shall also be judged with respect to their suitability for the particular application, or shall be approved as an integral part of and with the appliance. All low-voltage wiring, except safety-circuit wiring, shall be suitable for the application and not less than 18 AWG (0.82 mm²) with neoprene, thermoplastic or equally durable insulation with a minimum thickness of 0.012 in (0.30 mm).

Electrical equipment and wiring listed or certified by a nationally recognized testing agency qualified to certify or list electrical equipment or wiring shall be deemed to be an approved type.

1.12.3

If a junction box is not provided, the electrical supply to the appliance shall consist of a three-conductor grounding type flexible heater type cord of at least 4 ft (1.22 m) free length terminating in a suitable approved attachment plug cap of the parallel blade grounding type, constructed in accordance with the applicable section of the *Standard for Wiring Devices- Dimensional Requirements, ANSI/NEMA WD6*. Flexible cords shall be connected to devices and to fittings so tension will not be transmitted to joints or terminal screws. This may be accomplished by an approved knot in the cord or by a special fitting designed for that purpose.

NOTE: As defined by the National Electrical Code, ANSI/NFPA 70, the term "ground" means the earth itself.

1.12.4

If a junction box is provided for the permanent connection of the line-voltage supply circuit, it shall have provisions to accommodate fittings for metal-clad cable or conduit and shall be located on a part of the assembly that does not require movement for servicing.

Unless the junction box is located so the temperature of the conductors within the box or surfaces of the box likely to be in contact with conductors will not exceed 63°F rise (17°C) when the appliance is tested under 1.12.37, the temperature rating of the wire required for installation shall be prominently displayed on the box by means of a Class V marking. During conduct of 1.12.37, all unused openings shall be closed. Ventilation of boxes used for connection of field wiring is not permissible.

The size of a junction box in which field-installed conductors are to be connected by splicing shall not be less than that indicated in Table IV, Free Space Per Conductor. A conductor passing through the box is counted as one conductor, and each conductor terminating in the box is also counted as one conductor. A field-furnished conductor for line-voltage circuits is considered to be not smaller than 14 AWG (2.1 mm²).

Junction boxes shall be fabricated in accordance with Table V, Minimum Average Thickness of Sheet-Metal Junction Boxes, except that steel shall not be less than 0.032 in (0.81 mm) thick [0.034 in (0.86 mm) thick if zinc coated] and nonferrous metal shall not be less than 0.045 in (1.14 mm) thick at points where conduit or metal-clad cable is to be connected.

1.12.5

Enclosures of approved devices which contain terminals for electrical connections need not comply with the free space specifications of 1.12.4. However, the space provided shall be sufficient to provide ample room for the distribution of wires and cables required for the proper wiring of the device.

1.12.6

The general construction and assembly of electrical equipment and wiring shall be of a neat and quality character. The wiring shall be positively located and supported. Electrical wiring shall be protected against damage from movable parts.

Factory wiring of a low-voltage safety circuit may be done with SP-2 cord having all neoprene insulation; SPT-2 cord; or appliance wiring material having neoprene, thermoplastic or equally durable insulation of equivalent thickness [$\frac{3}{64}$ in (1.2 mm)]; or "Power Limited Circuit Cable" if such wiring is shielded from damage.

Cords and other wiring material permitted in the preceding paragraphs shall be arranged to avoid being mechanically damaged, such as by closely following surfaces, and shall be supported.

1.12.7

Line-voltage and safety-circuit wiring except the supply cord, which is external to the appliance and which is a part of the appliance, shall be protected by metal conduit, metal-clad cable, or raceways. "Power Limited Circuit Cable" need not be provided with the protection specified above, if it is securely fastened to the appliance and follows the contour of the appliance.

1.12.8

Splices in wiring shall be located only in accessible junction boxes. Splices shall be made mechanically secure, soldered and suitably insulated with tape, or suitable fixture-type slicing connectors shall be employed. Provision shall be made to prevent accidental mechanical strain on splicing devices. (Strain relief is not necessary when wiring is done in conduit, metal-clad cable or raceways.)

1.12.9

Splicing devices and uninsulated live-metal parts having a potential in excess of 30 volts shall be installed within an enclosure having a cover or access panel provided with means for firmly securing it in place.

Terminals in a low-voltage safety circuit external to an appliance to which wiring is connected shall be enclosed to the extent specified above when accidental shorting would result in an unsafe condition.

Terminals in a low-voltage safety circuit within an appliance compartment or cavity to which factory wiring is connected need not otherwise be enclosed if such terminals are recessed and located so the terminals are shielded from accidental shorting or damage.

1.12.10

Strain relief shall be provided for all conductors leaving an enclosure. For low-voltage wiring, strain relief at the point of exit from an enclosure is not necessary if, by wire location or support, protection is provided against accidental strain.

1.12.11

An enclosure for uninsulated live parts at line voltage shall have no openings which are not closed when the appliance is installed, except an enclosure for parts other than a fuse or thermal cutout may have openings as needed for ventilation or for the device to function. Such openings shall prevent the entrance of a $\frac{33}{64}$ in (13.1 mm) diameter rod. If the distance measured from a straight edge placed across the outer face of any opening to the nearest uninsulated live part within the enclosure is 4 in (102 mm) or more, such openings shall prevent the entrance of a $\frac{49}{64}$ in (19.4 mm) diameter rod.

Such live-metal parts as indicated above shall not be located where contact could reasonably be made during normal servicing.

1.12.12

At all points where conduit or metal-clad cable terminate, conductors shall be protected from abrasion unless the design of the boxes or fittings is such as to afford such protection. In addition, an insulating bushing or its equivalent shall be provided between the conductors and the metal cover of metal-clad cable. The connector or clamp by which metal-clad cable is fastened to boxes or devices shall be such that the insulating bushing or its equivalent will be visible for inspection.

1.12.13

Wireways shall be smooth and entirely free from sharp edges, burrs, fins, etc., which may cause abrasion of the insulation on wiring. In order to prevent abrasion of the insulation, openings in metal walls through which insulated wires not in wireways pass shall be provided with smoothly rounded bushings or an acceptable metal grommet, or shall have smooth well-rounded surfaces as formed by rolling or extrusion of the metal around the opening. Bushings shall be phenolic, porcelain, hard fibre or other suitable material having a smoothly rounded surface.

1.12.14

Wiring shall be done with insulated conductors having current-carrying capacity,* voltage and temperature ratings consistent with their use. No conductor smaller than 18 AWG (0.82 mm²), or its equivalent, shall be used except in coils, resistance units or the internal wiring of electrical components.

1.12.15

Electrical connections which need to be broken to service controls shall be made in such a manner they may be disconnected and reconnected without breaking a soldered connection and without breaking or cutting the wire(s).

1.12.16

Connections from low-voltage electrical devices on the same appliance shall be made in such a manner as to be identifiable in the field.

1.12.17

The electrical circuit of low-voltage control equipment shall be free from and protected from grounds or short-circuiting when the accidental grounding of any circuit wiring could render any safety device inoperative.

1.12.18

A low-voltage circuit shall be supplied by an energy-limiting transformer or a combination of transformer and overcurrent protection device suitable for a Class 2 circuit (see Article 725, Section 725-31, *National Electrical Code, ANSI/NFPA 70*) or by a combination of transformer and fixed impedance having output characteristics suitable for a Class 2 circuit.

When an overcurrent protection device is used it shall be an integral part of the transformer or be located at the point where the circuit to be protected receives its supply, shall not be of the automatic-reclosing type and shall be trip-free from any reclosing mechanism. The device shall be inaccessible to tampering except for a replaceable fuse which is not interchangeable with a device of a higher current rating.

When a combination of transformer and fixed impedance is used, the electrical interconnection between the two shall be of wiring materials suitable for Class 1 circuits, unless the two components are incorporated in a single enclosure and located in a normally closed compartment.

A low-voltage supply shall not be obtained from a power source above 30 volts by the use of voltage-dropping resistors.

1.12.19

Detachable plug connectors shall not be used in circuits when disconnection or connection of the circuit may allow unsafe operation of the appliance.

* Current-carrying capacity can be determined from the ampacity tables appearing in Articles 310 and 400 of the *National Electrical Code, ANSI/NFPA 70*.

1.12.20

Unless supplied with insulation suitable for the highest voltage involved, insulated conductors of different circuits shall be separated by barriers or shall be segregated from each other and shall in any case be so separated or segregated from uninsulated current-carrying parts connected to different circuits.

Segregation of insulated conductors may be accomplished by clamping, routing or equivalent means which provides for the permanent separation of insulated or noninsulated current-carrying parts from those of different circuits.

1.12.21

The electrical clearance resulting from the assembly of parts into the complete equipment, including clearances to grounded metal or enclosure when assembled by the manufacturer and furnished as a part of the appliance, shall comply with the spacing specifications of Table VI, Electrical Clearances. Electrical clearances in components listed by a nationally recognized testing agency shall be deemed to comply with this provision.

1.12.22

Conductors or terminals for line voltage intended for connection to a neutral supply conductor shall be identified (e.g., finished a white or grey color, or given a metallic-plated coating substantially white in color, or ribbed). All other line-voltage conductors shall be finished in colors other than white or natural grey.

Any conductor intended solely for grounding purposes shall be identified by a covering finished in a continuous green color or a continuous green color with one or more yellow stripes, unless it be bare. Conductors having such coloring shall not be used for other than grounding purposes when terminating within an enclosure used for field connections.

1.12.23

The appliance shall be constructed so the enclosure, frame and similar noncurrent-carrying metal parts are electrically continuous to the point of connection of the equipment grounding means. This provision shall be deemed met when the electrical resistance between the point of connection of the equipment grounding means and any noncurrent-carrying metal part is not more than 0.1 ohm.

Method of Test

The electrical resistance between the point of connection of the equipment grounding means and each noncurrent-carrying metal part shall be determined by either a Wheatstone bridge or by measuring the potential drop between the two points when an alternating current of 20 amperes, derived from a power supply of not more than 12 volts, is passed between the two points and dividing the measured potential drop by the current. The electrical resistance shall not be more than 0.1 ohm. (Insulating resistant finishes may be scraped from the test points.)

1.12.24

Single pole switches of safety controls or protective devices shall not be wired to a grounded or neutral line.

1.12.25

Switches shall have current and voltage ratings not less than those of the circuit loads they control.

1.12.26

A lamp holder, fuse holder, switch or similar device, provided as part of an appliance, shall be mounted securely and prevented from turning by means other than friction between surfaces.

1.12.27

High-tension terminals for transformers and wire leads shall provide protection against electrical shocks.

1.12.28

High-tension terminals on transformers shall be located on the appliance so as to be free from contact with metal parts during normal use of the appliance.

1.12.29

High-tension leads shall be fabricated from cable suitable for the purpose and conforming to a nationally recognized standard. Such leads shall be provided at each end with brass loops, eyes or other equivalent means to facilitate positive connection. The leads may be integrally joined to the transformer windings, provided proper strain relief is furnished.

1.12.30

High-tension leads or cables shall be as short as possible, free from any sharp bends, and protected from rough usage, abrasion, and soakage with water or condensate.

1.12.31

Electrodes and bus bars of the noninsulated type shall be suspended away from metal parts and insulated and arranged so as to be free from arc-overs at any point throughout the assembly when an a.c. voltage 50 percent in excess of the maximum possible voltage to ground is impressed for a period of 1 minute between the normal point of transformer connection and ground. Such tests shall be conducted both before and after the other performance tests specified herein.

1.12.32

Electrodes or bus bars supporting electrodes shall be designed so they may be readily locked into proper position, and no adjustment of any mechanical nature shall be allowed in electrodes of this type.

1.12.33

Electrode tips shall be designed so extreme burning of the points will not result over a period of time.

1.12.34

Flexibility in electrodes at their outer ends may be permitted if designed to resist warping and accidental dislocation.

1.12.35

If electric ignition is used, the means for igniting the gas shall be designed and located so as to eliminate the collection of carbon or other materials, or the dislocation, distortion or burning of parts as the result of normal conditions of heating or vibration of parts.

1.12.36

Insulators shall consist of high-grade porcelain or equivalent noncombustible insulating material. Such insulating material shall be glazed or otherwise made impervious to internal collection of moisture from the gas and shall be readily cleanable. Insulators shall not be used where accumulations of carbon may form.

1.12.37

Electrical equipment and wiring shall be suitable for the temperatures to which they are exposed and the service to which they are subjected. Maximum allowable temperature rises of some typical wires and components are shown in Table VII, Maximum Allowable Rise Above Room Temperature for Various Component Parts.