



**ANSI Z21.103-2017**

# **Unvented portable type gas camp heaters for indoor and outdoor use**



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**ANSI Z21.103-2017**  
***Unvented portable type gas camp  
heaters for indoor and outdoor use***



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# Preface

This is the first edition of ANSI Z21.103, *Unvented portable type gas camp heaters for indoor and outdoor use*.

This Standard was prepared by the Z21/CSA Joint Technical Subcommittee on Standards for Gas-Fired Refrigerators and Portable Camping Equipment, under the jurisdiction of the Technical Committee on Performance and Installation of Gas Burning Appliances and Related Accessories and the Strategic Steering Committee on Standards for Gas Appliances and Related Accessories, and had been formally approved by the Z21/83 Technical Committee and the American National Standards Institute.

**Interpretations:** The Strategic Steering Committee on Standards for Standards for Gas Appliances and Related Accessories has provided the following direction for the interpretation of standards under its jurisdiction: “The literal text shall be used in judging compliance of products with the safety requirements of this Standard. When the literal text cannot be applied to the product, such as for new materials or construction, and when a relevant committee interpretation has not already been published, CSA Group’s procedures for interpretation shall be followed to determine the intended safety principle.”

**Notes:**

- 1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*
- 2) *This Standard contains SI (Metric) units corresponding to the yard/pound quantities, the purpose being to allow the standard to be used in SI (Metric) units. (IEEE/ASTM SI 10, American National Standard for Metric Practice, or ISO 80000-1:2009, Quantities and units – Part 1: General, is used as a guide in making metric conversion from yard/pound quantities.) If a value for a measurement and a corresponding value in other units are stated, the first stated value is to be regarded as the requirement. The given corresponding value may be approximate. If a value for a measurement and a corresponding value in other units are both specified as a quoted marking requirement, the first stated unit, or both, are to be provided.*
- 3) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
- 4) *This publication was developed by consensus, which is defined by CSA Policy governing standardization – Code of good practice for standardization as “substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity.” It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this publication.*
- 5) *This Standard is subject to review five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to [inquiries@csagroup.org](mailto:inquiries@csagroup.org) and include “Proposal for change” in the subject line:*
  - a) *Standard designation (number);*
  - b) *relevant clause, table, and/or figure number;*
  - c) *wording of the proposed change; and*
  - d) *rationale for the change.*
- 6) *To submit a request for interpretation of this Standard, please send the following information to [inquiries@csagroup.org](mailto:inquiries@csagroup.org) and include “Request for interpretation” in the subject line:*
  - a) *define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;*
  - b) *provide an explanation of circumstances surrounding the actual field condition; and*
  - c) *where possible, phrase the request in such a way that a specific “yes” or “no” answer will address the issue.*

*Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are available on the Current Standards Activities page at [standardsactivities.csa.ca](http://standardsactivities.csa.ca).*



## History of the development of the standard for unvented portable type gas camp heaters for indoor and outdoor use

**Note:** *This History is informative and is not part of the Standard.*

This standard was based on coverage from the Standard for Portable Type Gas Camp Heaters, ANSI Z21.63/CSA 11.3, the CSA International requirement 4.98 for Gas-Fired Portable Heaters for Recreational and Commercial Use and the Standard for Unvented Room Heaters, ANSI Z21.11.2-2013. The creation of the Standard for Unvented Portable Type Gas Camp Heaters for Indoor and Outdoor Use, Z21.103, was needed to provide coverage for camp heaters which were specifically designed for indoor use in small recreational enclosures, having means for providing combustion air and ventilation such as fishing huts, trailers, and tents.

The Z21/83 Technical Committee approved the development of the standard on September 20, 2011. The Joint Technical Subcommittee on Standards for Gas-Fired Refrigerators and Portable Camping Equipment agreed to adopt the draft standard and distribute it for public review and comment dated September 2012.

At its September 25, 2013 meeting, the technical subcommittee recommended the proposed draft standard to the Z21/83 Technical Committee for approval.

This, the first edition of the Standard for Unvented Portable Type Gas Camp Heater for Indoor and Outdoor Use was approved by the Z21/83 Technical Committee on August 14, 2017 and by the American National Standards Institute, Inc. (ANSI) on DATE.

The following identifies the designation and year of this edition of the standard:

ANSI Z21.103-2017

# **ANSI Z21.103-2017**

## ***Unvented portable type gas camp heaters for indoor and outdoor use***

### **1 Scope**

#### **1.1**

This Standard applies to newly produced gas-fired unvented portable type gas camp heaters including the catalytic type, hereinafter referred to as either “heaters” or “portable heaters” having an input up to and including 18 000 Btuh (5.27 kW) using one or more fuel sources such as propane, butane, or identified propane and butane blended gases.

#### **1.2**

Portable heaters are intended for the following uses:

- a) indoor heating in small recreational enclosures, such as fishing huts, tents, and hunting blinds when such enclosures have adequate means for combustion air and ventilation and when:
  - i) used with disposable cylinder(s) of nominal water capacity of 2.7 lb (1.1 kg) [nominal 1 lb (0.45 kg)] LP-gas or less; or
  - ii) connected to a remote self-contained outdoor LP-gas supply system having a maximum size of 20 lb (9.1 kg) of fuel, that provides a regulated outlet pressure not exceeding 11 inches water column (2.74 kPa);
- b) emergency indoor home heating, when the space to be heated has adequate means for combustion air and ventilation and when used with disposable cylinder(s) of nominal water capacity of 2.7 lb (1.1 kg) [nominal 1 lb (0.45 kg)] LP-gas or less and such emergency indoor heaters identified for use in:
  - i) bedrooms when the heaters have an input setting of 10,000 Btu/hr or less (2 931 W); and
  - ii) bathrooms when the heaters have an input setting of 5,000 Btu/hr or less (1 465 W)
- c) outdoor heating, when provided with a self-contained LP-gas propane or butane supply system having a maximum size of 20 lb (9.1 kg) of fuel, that provides a regulated outlet pressure not exceeding 11 inches water column (2.74 kPa).

The construction of a heater for use with the above-mentioned gases is covered under Clause 4.

The performance of a heater for use with the above-mentioned gases is covered under Clause 5.

#### **1.3**

This Standard applies to heaters having a regulated outlet pressure not exceeding 5 psi.

#### **1.4**

Heaters and components employing materials or having forms of construction differing from those detailed in these provisions may be examined and tested according to the intent of the provisions, and if found to be satisfactorily equivalent, may be given recognition.

**1.5**

This Standard applies to heaters constructed entirely of new, unused parts.

**1.6**

All references to “psi” throughout this Standard are to be considered gauge pressures unless otherwise specified.

**1.7**

All accessories supplied with the appliance are to be evaluated with the appliance.

**1.8**

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.

**1.9**

Clause 2 contains a list of standards specifically referenced in this Standard, and sources from which these standards may be obtained.

**1.10**

This Standard contains SI (Metric) units corresponding to the yard/pound quantities, the purpose being to allow the standard to be used in SI (Metric) units. (IEEE/ASTM SI 10, *American National Standard for Metric Practice*, or ISO 80000-1:2009, *Quantities and units – Part 1: General*, is used as a guide in making metric conversion from yard/pound quantities.) If a value for a measurement and a corresponding value in other units are stated, the first stated value is to be regarded as the requirement. The given corresponding value may be approximate. If a value for a measurement and a corresponding value in other units are both specified as a quoted marking requirement, the first stated unit, or both, are to be provided.

**1.11**

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user shall satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

## 2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

### CSA Group

ANSI Z21.15-2009/CSA 9.1-2009

*Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves*

ANSI Z21.18-2007/CSA 6.3-2007 (R2012)

*Gas Appliance Pressure Regulators*

ANSI Z21.20-2005 (R2012)

*Automatic Gas Ignition Systems and Components*

ANSI Z21.21-2012/CSA 6.5-2012

*Automatic Valves for Gas Appliances*

ANSI Z21.77-2005/CSA 6.23-2005 (R2010)

*Manually Operated Piezo-Electric Spark Gas Ignition Systems and Components*

ANSI Z21.78-2005/CSA 6.20-2005 (R2010)

*Combination Gas Controls for Gas Appliances*

ANSI Z21.81-2005/CSA 6.25-2005

*Cylinder Connection Devices*

ANSI Z21.92-2001/CSA 6.29-2001 (R2012)

*Manually Operated Electric Gas Ignition Systems and Components*

CAN1-6.4-M79 (R2011)

*Automatic Gas Ignition Systems and Components*

### ASME (American Society of Mechanical Engineers)

ANSI/ASME B1.1-2003

*Unified Inch Screw Threads (UN and UNR Thread Form)*

ANSI/ASME B1.13M-2005

*Metric Screw Threads: M Profile*

ANSI/ASME B1.20.1-1983 (R2006)

*Pipe threads, General Purpose (Inch)*

ASME B36.10M-2004 (R2010)

*Welded and Seamless Wrought Steel Pipe*

### ASTM International

ASTM A53/A53M-12

*Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*



**CGA (Compressed Gas Association)**

ANSI/CGA V-1-2013

*Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections***UL (Underwriters Laboratories)**

UL 125-2009

*Standard for Valves for Anhydrous Ammonia and LP-Gas (Other than Safety Relief)*

UL 144-2010

*Standard for Pressure Regulating Valves for LP Gas*

UL 569-2009

*Standard for Pigtails and Flexible Hose Connectors for LP-Gas*

UL 969-1995

*Standard for Marking and Labeling Systems*

UL 2061-2008

*Standard for Adapters and Cylinder Connection Devices for Portable LP-Gas Cylinder Assemblies*

### 3 Definitions

The following definitions shall apply in this Standard:

**Accessory** — a compatible component supplied by the appliance manufacturer that will still allow safe operation of a unit, which is not necessarily provided with the appliance at the time of purchase.

**Angle of critical balance** — the minimum angle through which a heater must be tipped to cause the heater to tip over due to solely the force of gravity.

**Automatic valve for gas appliances** — an automatic or semi-automatic device consisting essentially of a valve and operator that controls the gas supply to the burner(s) during normal operation of an appliance. The operator may be actuated by application of gas pressure on a flexible diaphragm, by electrical means, by mechanical means, or by other means.

**Semi-automatic valve** — a valve that is opened manually and closed automatically, or vice versa.

**BTU** — abbreviation for British Thermal Unit. The quantity of heat required to raise the temperature of 1 pound of water 1°F.

**Burner** — a device for the final conveyance of the gas, or a mixture of gas and air, to the combustion zone.

**Catalyst** — a material used to promote a reaction between fuel gas and oxygen during the combustion process of a fuel gas, but which, itself, does not enter into the combustion process.

**Catalytic heater** — an open face, unvented heating appliance that utilizes a catalyst in the combustion process of a fuel gas.

**Catalytic pad** — a porous structure containing a catalyst through which a fuel gas passes.

**Combustion** — as used in this Standard, the rapid oxidation of fuel gases accompanied by the production of heat or heat and light.

**Combustion products** — constituents resulting from the combustion of a fuel gas with the oxygen of the air, including the inerts by excluding excess air.

**Controls** — devices designed to regulate the gas, air, water, or electrical supplies to a gas appliance, which may be manual, semi-automatic, or automatic.

**Cubic foot of gas** — the amount of gas that would occupy 1 ft<sup>3</sup> at a temperature of 60°F, if saturated with water vapor and under a pressure equivalent to that of 30 inches of mercury.

**Cylinder, fuel** — as used in this Standard, a container complying with the Department of Transportation specifications for containers used for the transportation and storage of liquid and/or vapor fuels.

**Discharge air openings** — an opening or a series of openings in the same plane separated by less than 1 inch of unbroken surface between openings through which heated air (excluding flue products) is discharged. For any opening through which ambient air is drawn in and discharged at a higher temperature through the same opening, the entire opening is to be deemed the discharge air opening.

**Equilibrium** — for the purpose of the combustion test specified in Clause 5.4, Combustion, equilibrium is considered to be reached after the following conditions are met:

- a) the heater is operated for a minimum of 8 hours when tested at 0.5 air change per hour, a minimum of 4 hours when tested at 1.0 air change per hour, and a minimum of 2 hours and 40 minutes when tested at 1.5 air changes per hour; and
- b) samples of the room air, withdrawn at a minimum of three consecutive ½ hour intervals after the minimum operating time for the specific test condition and analyzed for carbon monoxide in parts per million and for oxygen in percent by volume, do not indicate an increase of more than one part per million for carbon monoxide and a decrease of 0.16 percent by volume for oxygen between each consecutive reading.

**Excess air** — air that passes through the combustion chamber and the appliance flues in excess of that which is theoretically required for complete combustion.

**Extinguishment** — for the purpose of the combustion test specified in Clause 5.4, Combustion, extinguishment is considered to be reached when combustion of the gas supplied to the heater ceases to occur at the burner ports, within the burner body, within the burner venturi, and on the face of the burner orifice.

**Flue gases** — products of combustion and excess air.

**Heating value (total)** — the number of British Thermal Units produced by the combustion at constant pressure of 1 cubic foot of gas, when the products of combustion are cooled to the initial temperature of the gas and air, when the water vapor formed during combustion is condensed, and when all the necessary corrections have been applied.

**Hydrocarbon** — those compounds composed of carbon and hydrogen that form the primary constituents of various fuel gases.

**Hydrocarbon, unreacted (unburned fuel gas)** — that portion of the hydrocarbon fuel gases passing through a catalytic pad that do not react with oxygen during the combustion process.

**Infrared heater** — a heater that directs a substantial amount of its energy output in the form of infrared energy into the area being heated.

**Input rating** — the gas-burning capacity of an appliance in Btu per hour as specified by the manufacturer, based on sea level operation.

**Liquefied petroleum gases** — the terms “Liquefied Petroleum Gases”, “LPG”, and “LP-Gas” as used in this Standard mean and include any material that is composed predominantly of any of the following hydrocarbons or mixtures of them: propane, propylene, butanes (normal butane or isobutane), and butylenes.

**Lockup pressure** — as used in this Standard, the outlet pressure of a pressure regulation device under no flow conditions.

**Manifold** — the conduit of an appliance which supplies gas to the individual burner(s).

**Normal butane (N-butane), technical grade** — a liquefied petroleum gas composed of a minimum of 95 percent n-butane ( $C_4H_{10}$ ), which may contain other impurities such as isobutane, butylenes, and propane not in excess of 5 percent.

**Normal test pressures** — those pressures specified for testing purposes at which adjustment of burner ratings are made.

**Orifice spud** — a removable plug or cap containing an orifice which permits adjustment of the flow of gas by substitution of a spud with a different sized orifice.

**Pilot** — a small flame that is utilized to ignite the gas at the main burner(s).

**Pressure regulation device** — as used in this Standard, a control that provides regulation of a selected outlet pressure.

**Propane HD-5** — a special grade of liquefied petroleum gas composed of a minimum of 90 percent liquid volume of propane ( $C_3H_8$ ) and a maximum of 5 percent liquid volume of propylene ( $C_3H_6$ ).

**Safety shutoff system** — a system that will shut off the gas supply to the controlled burner(s) in the event of a supervised flame failure. This system may interrupt the flow of gas to the main burner(s) only, or to the pilot(s) and main burner(s) under its supervision.

**Secondary air** — the air externally supplied to the flame at the point of combustion.

**Specific gravity** — as applied to gas, the ratio of the weight of a given volume to that of the same volume of air, both measured under the same conditions.

**Valve, gas** — a manually operated valve that permits control of the flow of gas at any rate from none to full on.

## 4 Construction

### 4.1 General construction and assembly

#### 4.1.1

Construction features and the quality of the workmanship shall be in conformity with acceptable engineering practices.

#### 4.1.2

A heater shall be easy to light and operate without the danger of burning hands, when using normal precautions. The appliance shall be easy to handle without the danger of cutting hands, when using normal precautions.

#### 4.1.3

A heater shall be of such construction as to be secure against displacement, distortion, warping, or other damage, and shall be supported to maintain a fixed relationship between essential parts under normal and reasonable conditions of handling and usage to comply with these provisions. Parts not permanently secured shall be designed so that parts cannot be incorrectly assembled and cannot be improperly located or misaligned in removing or replacing during use, cleaning, or other servicing.

#### 4.1.4

If any indication is observed during the tests prescribed herein that the appliance will not continue to meet these provisions in normal usage, such supplementary tests shall be conducted that will provide safe and satisfactory service.

#### 4.1.5

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

#### 4.1.6

Fasteners shall be of corrosion-resistant material or shall have a metallic, corrosion-resistant coating suitable for the particular application.

#### 4.1.7

Bolts, nuts, and screws, except sheet-metal screws, used in the general assembly of the heater shall have threads conforming with the Standard for *Unified Inch Screw Threads (UN and UNR Thread Form)*, ASME B1.1 or ASME B1.13M, *Metric Screw Threads: M Profile*.

#### 4.1.8

Pipe threads shall conform with the Standard for *Pipe Threads, General Purpose (Inch)*, ASME B1.20.1.

#### 4.1.9

Valve bodies, regulators, casings, and other parts intended to maintain gas tightness to the atmosphere shall be made of material having a melting point of not less than 800°F (427 °C). Shaft seals, gaskets, and lubricants shall be exempt from this provision.



## 4.2 Stability

A heater shall either be constructed to comply with Clause 5.11, Stability, or the heater shall be fitted with a tip-over switch, which shall cause a complete shutoff of the gas and shall require a manual reset function to restart the gas supply.

## 4.3 Materials

### 4.3.1

Metallic structural parts of an unvented portable type gas camp heaters shall have a minimum thickness of 0.0195 in (0.4953 mm) or alternatively be constructed of materials that have known and demonstrable properties that provide the superior strength and corrosion resistance required for good design.

### 4.3.2

A heater shall have a corrosion-resistant finish.

### 4.3.3

Compounds used in making joints shall be listed by a national recognized testing agency as suitable for use with propane and butane.

### 4.3.4

Lubricants used in valves and controls shall be of a type suitable for propane and butane service, and capable of withstanding the service conditions to which the lubricants are subjected.

### 4.3.5

Running threads shall not be used.

### 4.3.6

Aluminum tubing shall not be used as gas conduit unless the tubing is located within the confines of the heater and is protected against possible damage from external forces or impact.

### 4.3.7

Piping employed as gas conduit shall comply with the Standard for *Welded and Seamless Wrought Steel Pipe*, ASME B36.10M, or the *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, ASTM A53.

### 4.3.8

Resilient materials, where used, shall be compatible with propane and butane at operating temperatures.

### 4.3.9

All nonmetallic, internal parts of gas controls shall not crack, harden, swell more than 25 percent, shrink more than 1 percent, lose more than 10 percent weight, or otherwise deteriorate sufficiently to permit leakage or cause malfunction when:

- a) parts made of a compound affected by aging are exposed to air for 70 hours at 212°F (100 °C); and
- b) parts are immersed for 70 hours in normal hexane.

**4.3.10**

Heater materials shall be suitable for the fuel gas and temperatures to which materials will be exposed.

**4.3.11**

Gas controls and gas supply tubing shall be rigidly supported to prevent turning or bending while connecting the heater to the gas supply.

**4.3.12**

Gas supply tubing shall have any bends smoothly made without appreciable reduction in the cross-sectional area.

**4.3.13**

Semi-rigid tubing employed as gas conduit shall have a minimum wall thickness in accordance with Table 1, Minimum Acceptable Wall Thickness For Nonferrous Semi-Rigid Tubing:

**Table 1**  
**Minimum acceptable wall thickness for nonferrous semi-rigid tubing**  
(See Clause 4.3.13.)

Outside diameter, minimum acceptable wall thickness,			
Inch	(mm)	Inch	(mm)
1/8	(3.2)	0.020	(0.51)
3/16	(4.8)	0.025	(0.64)
1/4	(6.4)	0.029	(0.74)
5/16	(7.9)	0.029	(0.74)
3/8	(9.5)	0.032	(0.81)
7/16	(11.1)	0.032	(0.81)
1/2	(12.7)	0.038	(0.97)

**4.4 Burners****4.4.1**

Burners or burner heads shall be designed for easy maintenance and cleaning without the use of special tools.

**4.4.2**

The design and materials used in the construction of the burner shall be such that the burner will not sag, distort, melt, exhibit appreciable corrosion or damage to any protective coating sufficient to expose the base metal, or show leakage of gas during any of the tests specified herein.

**4.4.3**

Burners shall be securely held in place.

**4.4.4**

Adjustable air shutters shall not be used.

**4.4.5**

The perimeter of the catalytic pad shall be assembled in such a manner as to preclude the passage of fuel gas through other than the surface of the catalytic material.

**4.4.6**

The gas diffusion layer or catalytic layer shall be homogenous.

**4.4.7**

The gas diffusion layer or catalytic layer shall not warp during any of the tests specified herein.

**4.4.8**

Damage to the catalytic layer shall not occur during normal cleaning and maintenance.

**4.5 Orifices and orifice fittings****4.5.1**

Only fixed orifices shall be provided.

**4.5.2**

Orifice fittings shall be positively secured to prevent misalignment.

**4.5.3**

Orifice spuds or orifice hoods shall be made of material capable of withstanding not less than 1,000°F (538 °C).

**4.5.4**

Pilot burners shall be provided with fixed orifices. Except for pilots that are part of an oxygen depletion sensitive (ODS) safety shutoff system, pilot orifices shall be readily removable without the use of special tools.

**4.6 Pilot burners and safety shutoff devices****4.6.1**

A heater shall have a safety shutoff device and an ignition device complying with the Standard for *Automatic Gas Ignition Systems and Components*, ANSI Z21.20.

**4.6.2**

Where a pilot burner is used, means shall be provided to prevent the flow of gas to the main burner while the pilot burner is being lighted.

**4.6.3**

Where used, pilot burners shall be placed so as to permit safe lighting without burning the hand.

#### 4.6.4

Tips of pilot burners used in conjunction with safety shutoff devices shall be made from AISI 416 steel or material having at least equivalent heat and corrosion-resistant characteristics.

Nickel alloys of greater than 1.0 percent nickel, because of catalytic cracking effect, are not acceptable.

#### 4.6.5

If a piezo-electric spark gas ignition device is used, the spark ignition device shall comply with the applicable provisions of the Standard for *Manually Operated Piezo-Electric Spark Gas Ignition Systems and Components*, ANSI Z21.77 • CSA 6.23 or the Standard for *Manually Operated Electric Gas Ignition Systems and Components*, ANSI Z21.92 • CSA 6.29.

#### 4.6.6

Pilot burners shall be mounted in a fixed position relative to the main burner ports.

#### 4.6.7

Pilot burner assemblies shall be constructed so it is impossible to direct the pilot in other than the correct direction.

#### 4.6.8

Adjustment screws for pilots shall be concealed, protected, or enclosed and fully accessible for servicing and adjustment.

#### 4.6.9

When the pilot gas supply line is taken from a horizontal line, the connection shall be either on the side or top. If taken from a vertical line, the connection shall be above the main burner supply line.

### 4.7 Oxygen depletion safety shutoff systems

#### 4.7.1

A heater shall be equipped with an oxygen depletion sensitive (ODS) safety shutoff system.

#### 4.7.2

The oxygen depletion sensitive (ODS) safety shutoff system shall shut off the gas supply to the pilot and main burners when the oxygen in the surrounding atmosphere is depleted to the percent concentration specified by the manufacturer, but not lower than 18.0 percent.

#### 4.7.3

The oxygen depletion sensitive (ODS) safety shutoff system shall not incorporate field adjustment means capable of changing the set point at which the system acts to shut off the gas supply to the heater.

### 4.8 Automatic valves and safety shutoff valves

#### 4.8.1

Automatic valves and safety shutoff valves, when provided, shall comply with the Standard for *Automatic Valves for Gas Appliances*, ANSI Z21.21 • CSA 6.5.

#### 4.8.2

Combination gas controls, when provided, shall comply with the Standard for *Combination Gas Controls for Gas Appliances*, ANSI Z21.78 • CSA 6.20.

#### 4.8.3

If a pilot burner is used, a safety shutoff valve shall be provided to shut off the main burner gas and the pilot gas.

### 4.9 Manually operated gas valves

#### 4.9.1

A heater shall be equipped with a manually operated burner gas valve(s) complying with the Standard for *Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves*, ANSI Z21.15 • CSA 9.1.

#### 4.9.2

The design of handles for taper plug and resilient seal type valves shall be such that the marking of the "OFF" position is clearly and unmistakably indicated.

#### 4.9.3

On needle valves, the direction of the open to closed rotation shall be clearly and unmistakably indicated to the user.

#### 4.9.4

The marking specified in Clauses 4.9.2 and 4.9.3 shall be Class I, II, or IIIA as specified in Clause 4.16.1.

#### 4.9.5

All valves shall close in the clockwise rotation.

#### 4.9.6

Needle valves shall be designed so that it is impossible to withdraw the valve stem completely in the normal operation of the valve.

#### 4.9.7

Manually operated gas valves shall be investigated for seat and external leakage at the following conditions:

- normal operating pressure at 0°F (–18 °C), 23 psi (159 kPa) and 140°F (60 °C), 290 psi (2000 kPa) when for use with unregulated propane;
- normal operating pressure at 40°F (4.4 °C), 3 psi (21 kPa) and 140°F (60 °C), 78 psi (538 kPa) when for use with unregulated butane;
- normal operating pressure at 0°F (–18 °C), 40°F (4.4 °C), and 140°F (60 °C) when for use with unregulated propane/butane mixture, the pressures to be determined; and
- when regulated, 20 percent and 150 percent of the normal regulator outlet pressure setting at the above ambient temperatures (as applicable for the fuel).

Leakage shall not exceed 12.2 in<sup>3</sup>/hr (200 cm<sup>3</sup>/h) when corrected to standard conditions.



#### 4.9.8

Manually operated gas valve bodies shall have a burst strength of 550 psi (3792 kPa).

#### 4.9.9

Manually operated gas valves shall withstand, without leakage, 6000 cycles of operation from fully closed to fully open to fully closed at 70°F (21.1 °C) and:

- a) 110 psi (758 kPa) for propane;
- b) 17 psi (117 kPa) for butane; and
- c) normal operating pressure for propane/butane mixtures.

Post-cycling leakage tests shall be conducted at 70°F (21.1 °C) at the above pressures (as applicable for the fuel). Leakage shall not exceed 12.2 in<sup>3</sup>/hr (200 cm<sup>3</sup>/h) when corrected to standard conditions.

#### 4.9.10

The torque required to shut off the control valve(s) shall not exceed 10 lbf times the knob turning radius in inches (1.13 N times the knob turning radius in meters).

The valve shall be cycled on and off to a torque equal to 20 lbf times the knob turning radius in inches (2.26 N times the knob turning radius in meters) for 10 cycles. The valve will then shut off bubble tight at a torque of 10 lbf times the knob turning radius in inches (1.13 N times the knob turning radius in meters).

#### 4.9.11

The appliance manufacturer shall demonstrate full control over the leak tightness and body strength of purchased manually operated gas valves. This may be accomplished through a quality system that is acceptable to the certification agency.

#### 4.9.12

Manual valves that comply with the Standard for *Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves*, ANSI Z21.15 • CSA 9.1, at the above temperature ranges need not comply with Clauses 4.9.7 through 4.9.10.

#### 4.9.13

Assembly of the valve on the appliance shall not involve the disassembly of operational or critical valve parts.

### 4.10 Gas pressure regulators

#### 4.10.1

Where a heater is for use with regulated pressure, the regulator shall be supplied by the appliance manufacturer, and, if the regulator is unlisted, the appliance shall be marked with the identifying marking of the regulator(s). Refer to Clause 4.16.3 h).

A heater shall be equipped with a pressure regulator complying with the Standard for *Pressure Regulating Valves for LP Gas*, UL 144. The regulator shall be installed in a location where the regulator will not attain a temperature above 130°F (54.4 °C) during the conduct of Clause 5.14, Wall, Floor, and Ceiling Temperatures.



Secondary pilot gas appliance pressure regulators, when provided on a heater, shall comply with the Standard for *Gas Appliances Pressure Regulators*, ANSI Z21.18 • CSA 6.3.

#### 4.10.2

The pressure regulator shall be permanently set to limit the outlet pressure to the designed inlet operating pressure of the appliance.

#### 4.10.3

Gas pressure regulators shall be investigated for external leakage at the following conditions:

- a) normal operating pressure at 0°F (−17.8 °C), 23 psi (159 kPa) and 140°F (60 °C), 290 psi (2000 kPa) when for use with unregulated propane;
- b) normal operating pressure at 40°F (4.4 °C), 3 psi (21 kPa) and 140°F (60 °C), 78 psi (538 kPa) when for use with unregulated butane; and
- c) normal operating pressure at 0°F (−17.8 °C), 40°F (4.4 °C) and 140°F (60 °C) when for use with unregulated propane/butane mixture, the pressures to be determined.

The leakage shall not exceed 12.2 in<sup>3</sup>/hr (200 cm<sup>3</sup>/h) when corrected to standard conditions.

#### 4.10.4

The body of a gas pressure regulator inlet portion shall have a burst strength of 550 psi (3792 kPa).

#### 4.10.5

A regulator shall have a predictable outlet pressure. Three samples shall be tested. Each regulator shall be set at the full open setting. Pressures for butane or propane/butane mixtures shall be determined by the testing agency. The outlet pressures measured at each regulator shall be within 20 percent of each other.

#### 4.10.6

The appliance manufacturer shall demonstrate full control over the leak tightness and inlet body strength of purchased gas pressure regulators. This may be accomplished through a quality system that is acceptable to the testing agency.

#### 4.10.7

Regulators that comply with the Standard for *Gas Appliances Pressure Regulators*, ANSI Z21.18 • CSA 6.3 at the above temperature ranges need not comply with Clauses 4.10.3 through 4.10.6.

#### 4.10.8

The inlet of the pressure regulator shall be fitted for attachment to:

- a) a connection No. 510 as specified in the Standard for *Compressed Gas Cylinder Valve Outlet and Inlet Connections*, CGA V-1;
- b) a CGA No. 791 Cylinder Connection Device and complying with the Standard for *Cylinder Connection Devices*, ANSI Z21.18 • CSA 6.25 or the Standard for *Adapters and Cylinder Connection Devices for Portable LP-Gas Cylinder Assemblies*, UL 2061;
- c) a CGA No. 810 Cylinder Connection Device and complying with the Standard for *Cylinder Connection Devices*, ANSI Z21.18 • CSA 6.25, or the Standard for *Adapters and Cylinder Connection Devices for Portable LP-Gas Cylinder Assemblies*, UL 2061;
- d) a CGA No. 600 Cylinder Connection Device as specified in the Standard for *Compressed Gas Cylinder Valve Outlet and Inlet Connections*, CGA V-1; or

- e) for heaters for use with butane and or propane/butane mixtures, the cylinder connection need not be of the type No. 600 Cylinder Connection Device if the heater is for use with a Non-refillable (Disposable) Type Metal Container Assemblies for Butane UL 147B cylinder specified by the manufacturer of the appliance.

#### 4.10.9

A heater designed for use with two pressure regulators equipped with a No. 600 connection and intended for use with two non-refillable (disposable) gas supply cylinders each having a nominal water capacity less than 2.5 lbs (1.1 kg) shall be designed to prevent back pressure from one regulator outlet to the other that could result in leakage of gas. The heater shall comply with the testing specified in Clause 5.9, Pressure Regulators.

#### 4.11 Hose and hose fittings

Hose and hose fittings for use with a heater shall be supplied by the manufacturer and shall comply with the Standard for *Pigtails and Flexible Hose Connectors for LP-Gas*, UL 569 or the Standard for *LP-Gas Hose*, UL 21.

The hose shall not exceed 12 ft (3.6 m) in length.

#### 4.12 Flow limiting devices

Except for No. 600 Connection, connection devices shall be equipped with a flow limiting device consisting of either:

- a) an excess flow check valve complying with the Standard for *Valves for Anhydrous Ammonia and LP-Gas (Other than Safety Relief)*, UL 125, and that activates at a flow of not more than 100 ft<sup>3</sup>/hr (2.83 m<sup>3</sup>/h) at a pressure of 100 psi (690 kPa) and has a bypass area that will not allow a flow greater than 10 ft<sup>3</sup>/h (0.28 m<sup>3</sup>/hr) at 100 psi (690 kPa); or
- b) a device other than an excess flow check valve, which will limit flow to 10 ft<sup>3</sup>/h (0.28 m<sup>3</sup>/hr) at 100 psi (690 kPa).

#### 4.13 Enclosures for self-contained propane gas supply systems

##### 4.13.1

An enclosure for a disposable LP gas cylinder, when provided, shall be ventilated by openings at the level of the cylinder connection and at the enclosure floor level. The effectiveness of the opening(s) for purposes of ventilation shall be determined with the LP gas supply cylinder in place. Ventilation shall be accompanied by one of the following:

- a) one side of the enclosure shall be completely open; or
- b) for an enclosure having four sides, a top, and a bottom:
  - i) at least two ventilation openings at cylinder connection level shall be provided in the sidewall, equally sized, spaced at 180 degrees (3.14 rad), and unobstructed. Each opening shall have a total free area of not less than 1/2 in<sup>2</sup> per pound (7.1 cm<sup>2</sup>/kg) of stored fuel capacity;
  - ii) ventilation opening(s) shall be provided at the enclosure floor level and shall have a total free area of not less than 1/2 in<sup>2</sup> per pound (7.1 cm<sup>2</sup>/kg) of stored fuel capacity. If ventilation openings at the enclosure floor level are in a sidewall, there shall be at least two openings. The bottom of the openings shall be at floor level. The openings shall be equally sized, spaced at 180 degrees (3.14 rad), and unobstructed; and
  - iii) every opening shall have minimum dimensions so as to permit the entrance of a 1/8 in (3.2 mm) diameter rod.

**4.13.2**

The enclosure for the LP-gas cylinder shall isolate the cylinder from the burner compartment to provide shielding from radiation and a flame barrier.

**4.13.3**

The design of a heater shall be such that:

- a) the LP-gas cylinder can be connected, disconnected, inspected, and tested inside the enclosure;  
and
- b) those connections that could be disturbed when installing the cylinder in the enclosure can be leak tested inside the enclosure.

**4.14 Guards, grilles, and screens****4.14.1**

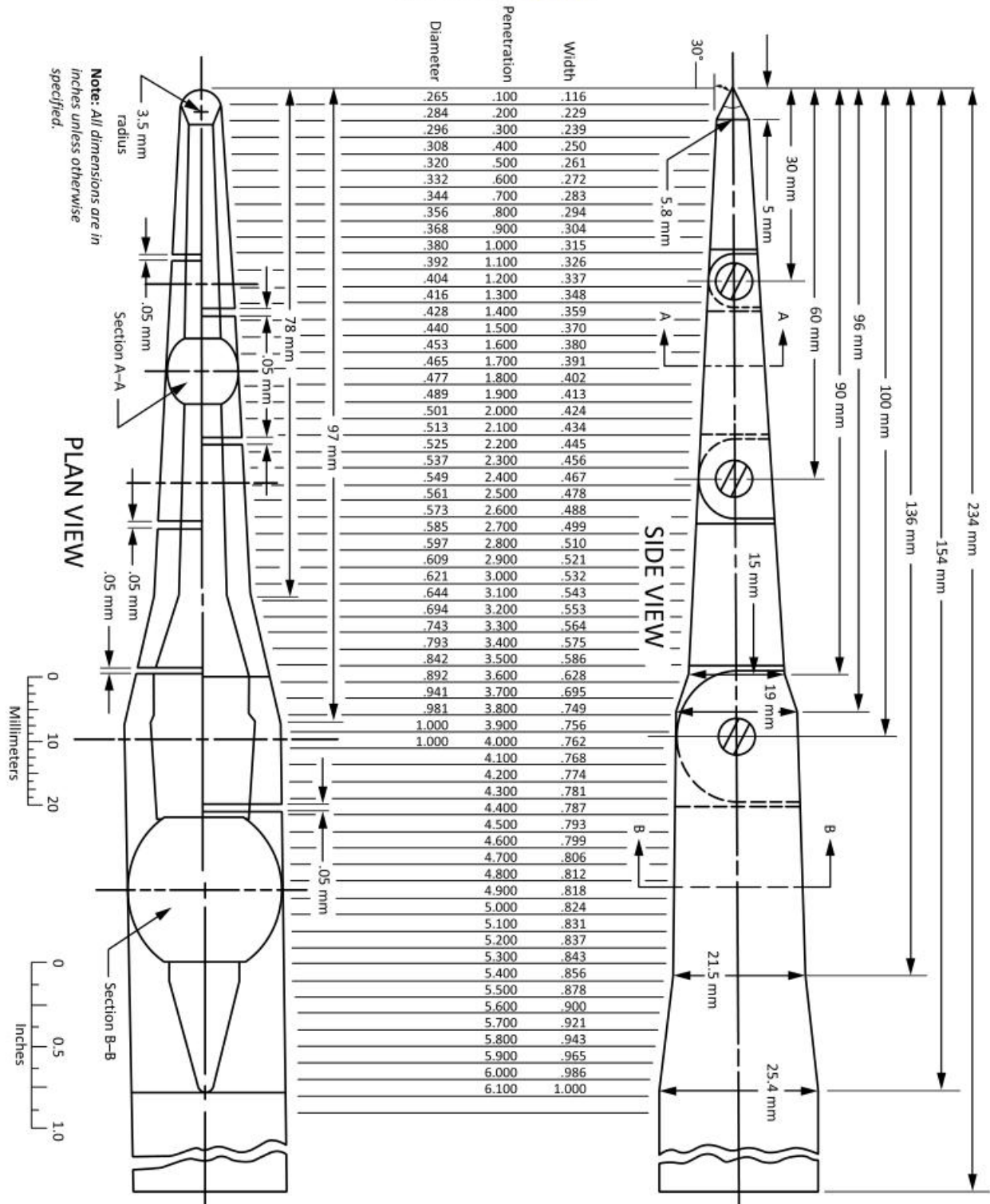
A heater shall be equipped with a protective canopy, guard, grille, or screen that will prevent direct contact between the heating element and combustible material, and also protect the heater against accidental damage.

**4.14.2**

A heater shall be equipped with a canopy, guard, grille, or screen that will protect the catalytic pad against damage from the insertion of a probe constructed as shown in Figure 1, Test probe used to determine protection of catalytic pad.



**Figure 1**  
**Test probe used to determine protection of catalytic pad**  
(See Clause 4.14.2.)



#### 4.14.3

Covers or wind baffles where supplied with the heater shall be designed against accidental closure.

#### 4.14.4

Guards, grilles, or screens shall be held securely in place.

### 4.15 Instructions

#### 4.15.1

Each heater shall be accompanied by detailed printed instructions and diagrams for proper assembly, maintenance, safe use, and operation.

The safety-related items included in the instructions shall be prominently displayed and shall precede the instructions concerning the functional use of the heater.

The instructions shall be marked with directions to the consumer to retain the instructions for future reference.

The instructions shall be reviewed by the testing agency for comprehensibility, accuracy, and compatibility with results of test.

Either the front cover or the first page of the instructions shall bear the following boxed warnings:



#### **WARNING**

#### **FIRE OR EXPLOSION HAZARD**

**If you smell gas:**

- 1. Do not attempt to light appliance.**
- 2. Extinguish any open flame.**
- 3. Disconnect fuel supply.**
- 4. Leave the area immediately.**
- 5. Allow gas to dissipate 5 minutes before relighting the appliance.**

**Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

**Failure to follow these instructions could result in fire or explosion, which could cause property damage, personal injury, or death.**

**WARNING****CARBON MONOXIDE POISONING MAY CAUSE DEATH OR INJURY**

**When used without adequate combustion and ventilation air, heater may give off excessive CARBON MONOXIDE, an odorless, poisonous gas.**

**This is an unvented gas-fired heater. The heater uses air (oxygen) from the area in which the heater is used. Adequate combustion and ventilation air must be provided. Refer to section (or page ).\***

*\* Include section or page number of the instructions where the information and examples will be found.*

"This heater is equipped with a SAFETY SYSTEM designed to turn off the heater if not enough fresh air is available."

**DO NOT TAMPER WITH THE SAFETY SYSTEM!**

"If heater shuts off, do not relight until you provide fresh air. If heater keeps shutting off, have the heater serviced. Keep burner and control compartment clean."

The letters used for the boxed warnings shall be boldfaced type having a minimum uppercase letter height of 0.120 in (3.05 mm). The minimum vertical spacing between lines of type shall be 0.046 in (1.17 mm).† Lowercase letters shall be compatible with the uppercase letter size specification.

*† This letter height and line spacing correspond to 12-point type.*

These instructions shall include:

- a) For all unvented portable type gas camp heaters:
  - i) The manufacturer's name and address, and the heater model, type, or series number.
  - ii) A statement specifying proper fuel withdrawal from the operating cylinder.
  - iii) Explicit information specifying proper clearances from combustible material.
  - iv) Directions for proper assembly and for assembly of field-installed parts and accessories supplied with the heater.
  - v) Lighting instructions and control operation, including pictorial representations, and a statement that the unvented portable type gas heater must not be exposed to flammable vapors or liquids during lighting.
  - vi) Maintenance instructions (including recommended frequency guidelines) suggesting:
    - 1) keeping the heater area clear and free from combustible materials, gasoline, and other flammable vapors and liquids;
    - 2) not obstructing the flow of combustion and ventilation air;
    - 3) visually checking burner flames, with an explanation of proper operating characteristics; and
    - 4) cleaning the heater, including special surfaces, with recommended cleaning agents, if necessary.
  - vii) Information for obtaining replacement parts and where they are obtainable.
  - viii) The specific size and capacity of the cylinder(s) to be used.



- ix) The LP-gas cylinder(s) must be constructed and marked in accordance with the specifications for LP-gas cylinders of the U.S. Department of Transportation (DOT).
- x) How to connect and disconnect the LP-gas cylinder(s) and the proper procedure for leak checking the cylinder connections and the heater.
- b) The instructions shall specify provisions for adequate combustion and ventilation air. This shall include:
  - i) The statement, "This heater can be used in a recreational enclosure only if the enclosure has a window or roof vent."
  - ii) Examples for determining the proper amount of open area needed in a window or roof vent for adequate combustion and ventilation air (1 in<sup>2</sup> at the ceiling and 1 in<sup>2</sup> at floor level per 1,000 Btu of input).
  - iii) The statement, "WARNING: If the recreational enclosure does not have a window or roof vent, DO NOT USE THIS HEATER inside."
  - iv) The statement, "When used without adequate combustion and ventilation air, this heater may give off excessive CARBON MONOXIDE, an odorless, poisonous gas.  
WARNING: Early signs of carbon monoxide poisoning resemble the flu, with headache, dizziness, and/or nausea. If you have these signs, the heater may not be working properly. Get fresh air at once! Have heater serviced.  
Some people—pregnant women, persons with heart or lung disease, anemia, those under the influence of alcohol, those at high altitudes—are more affected by carbon monoxide than others."
- c) The instructions for an indoor heater designed for emergency home heating use shall include:
  - i) A statement re-iterating the need for adequate combustion and ventilation air when the heater is used in a home and instructions to the reader to refer back to the section addressing these requirements.
  - ii) A statement that only disposable cylinders, marked with the proper fuel type approved for the appliance, can be used.
  - iii) A statement, "NEVER Bring a Refillable LP-Gas Cylinder Indoors. A Fire or Explosion can Occur Causing Property Damage, Serious Injury or Death."
  - iv) For propane/butane mixtures and butane fuel, canisters shall be specified by the manufacturer and tested with the heater for listing. The model number of the canister found to be acceptable and recommended by the manufacturer shall be identified in the manufacturer's instructions. The model under of the canister shall appear in the instructions.
  - v) "Do not leave this appliance unattended while it is in operation. Keep children and pets away from the appliance at all times."
- d) When an unvented portable type gas heater is equipped with a connections for use with disposable cylinders:
  - i) A statement that only cylinders marked with the proper fuel type approved for the heater must be used.
  - ii) A statement that specifies that the cylinder be disconnected when the heater is in storage.
- e) When a portable type gas heater is equipped with other than a connection for disposable cylinders:
  - i) A statement that specifies that the gas be turned off at the LP-gas supply cylinder when the heater is not in use.  
When the LP-gas supply cylinder is not disconnected from the heater, the heater and cylinder must be stored outdoors, in a well-ventilated space, out of the reach of children, and must not be stored in a building, garage, or any other enclosed area.

Storage of the heater indoors is permissible only if the cylinder is disconnected and removed from the heater. Cylinders must be stored outdoors, in a well-ventilated space, out of the reach of children, and must not be stored in a building, garage, or any other enclosed area.

- ii) A statement, "NEVER Bring a refillable LP-gas cylinder indoors, a fire or explosion can occur causing property damage, serious injury, or death."
- iii) A statement, a propane-fired portable heater used for emergency home use shall not be set at an input setting in excess of 5 000 Btu/hr (466 W) when located in a bathroom and shall not be set at an input setting of more than 10 000 Btu/Hr (2 931 W) when located in a bedroom. The corresponding settings for bedroom or bathroom use shall be clearly identified on or adjacent to the adjustment means. The manufacturer shall clearly identify in the instruction booklet the corresponding settings when used in a bathroom or bedroom.
- f) For an unvented portable type gas camp heater for use with a remote fuel cylinder:
  - i) A statement specifying the manufacturer's recommended kit number for the proper hose connectors and fittings necessary for connecting the appliance to a remote fuel cylinder.

#### 4.15.2

A catalytic heater shall be marked with the following boxed warning on Class IIIA marking material with letters on a contrasting background, located in a position where it can be easily read:

<b>WARNING:</b> Do not attempt to clean catalytic pad. Follow cleaning instructions
---

#### 4.15.3

Each catalytic heater shall bear the following warning, on Class IIIA marking material, in a location where it can be easily observed:

##### **WARNING**

"Do not use heater if the catalytic pad becomes torn or damaged. Continuous use may result in injury or death due to fire, explosion, or carbon monoxide poisoning. The heater must be serviced by a licensed and qualified service person."

#### 4.15.4

A heater for use with a maximum of two disposable 1 pound (maximum capacity) cylinders, the manufacturer shall include the definition of emergency use in the instructions as follows:

- a) The permanent heating system is temporarily out of service;
- b) Heat is necessary to prevent damage to the buildings or contents;
- c) The temporary heating equipment is not left unattended;
- d) The manufacturer shall include the instructions concerning ventilation and air supply as shown in Clause 4.15.1; and
- e) The portable heater used shall be discontinued and removed from the building at the time the permanently installed appliances are placed back in operation.

### 4.16 Marking

#### 4.16.1

Marking material shall be identified by class number and shall meet the following specifications. All metal marking materials shall be rustproof. All marking shall be suitable for application to surfaces upon

which applied and shall demonstrate suitable legibility as specified under Clause 5.18, Marking Material Adhesion and Legibility. The designation of any class of marking shall not preclude the use of marking of a lower number class.

#### Class I. Integral Marking

Marking that is embossed, cast, stamped, or otherwise formed in the part. This includes markings baked into an enameled surface.

#### Class IIA-1. Permanent Plate

Shall be made of metal having a minimum thickness of 0.012 in (0.30 mm) and shall be securely attached by mechanical means.

#### Class IIA-2. Permanent Plate

Shall be made of metal having a thickness of 0.006 to 0.012 in (0.15 to 0.30 mm) and shall have mechanical attachment means at all corners with a maximum spacing of 6 in (152 mm) between mechanical fasteners.

#### Class IIA-3. Permanent Plate

Shall be made of metal having a thickness less than 0.006 in (0.15 mm). Such plates shall be attached by means of nonwater-soluble adhesive, which will comply with Clause 5.18, Marking Material Adhesion and Legibility. These materials shall not be located on surfaces having temperatures exceeding 300°F (149 °C) as determined during conduct of Clause 5.14, Wall, Floor, and Ceiling Temperatures.

#### Class IIA-4. Permanent Plate

Shall be made of pressure-sensitive metal foil requiring no solvent or activator, provided such plates comply with Clause 5.18, Marking Material Adhesion and Legibility. These materials shall not be located on surfaces having temperatures exceeding 300°F (149 °C) as determined during conduct of Clause 5.14, Wall, Floor, and Ceiling Temperatures.

#### Class IIIA-1. Permanent Label

Shall be made of material not adversely affected by water, shall be attached by means of nonwater-soluble adhesive, and shall comply with Clause 5.18, Marking Material Adhesion and Legibility. These materials shall not be located on surfaces having temperatures exceeding 300°F (149 °C) as determined during conduct of Clause 5.14, Wall, Floor, and Ceiling Temperatures.

#### Class IIIA-2. Permanent Label

Shall be made of material not adversely affected by water, shall be attached by means of nonwater-soluble adhesive, and shall comply with Clause 5.18, Marking Material Adhesion and Legibility. These materials shall not be located on surfaces having temperatures exceeding 175°F (79.5 °C) as determined during conduct of Clause 5.14, Wall, Floor, and Ceiling Temperatures.

#### Class IIIA-3. Permanent Tag

Shall be made of material not adversely affected by water, shall be permanently secured by means of a flexible type fastener, and shall comply with Clauses 4.16.2 and 5.18, Marking Material Adhesion and



Legibility. These materials shall not be located where they will be exposed to temperatures exceeding 150°F (65.5 °C) as determined during conduct of Clause 5.14, Wall, Floor, and Ceiling Temperatures.

#### Class IIIB. Waterproof Marking

Shall be printed directly on the part with waterproof marking not adversely affected by a temperature of 175°F (79.5 °C). This marking shall not be used on surfaces having temperatures exceeding 175°F (79.5 °C) as determined during conduct of Clause 5.14, Wall, Floor, and Ceiling Temperatures.

#### Class IIIC. Waterproof Label

Shall be made of material not soluble in water and may use water-soluble adhesive for attachment means.

#### Class IV. Semi-Permanent Plate or Label

Shall be made of material which may be soluble in water and may use water-soluble adhesive for attachment means.

#### Class V. Printed Marking

Marking shall be clear and prominent and may be applied directly by any printing means.

#### Class VI. Attached Tags

### 4.16.2

For a heater of such design that space does not permit proper location of these markings, markings may be furnished on a metal tag or a Class IIIA-3 permanent tag attached to the heater.

Flexible type fasteners that are used to permanently attach markings to the heater shall be in accordance with the following:

- a) flexible type fasteners shall be permanently secured by tamper-resistant mechanical means such as one way screws, rivets, etc., to the marking plate or tag and to a part of the heater which is not removed for servicing;
- b) flexible type fasteners shall not attach to a gas carrying component, unless the gas carrying components withstand the test outlined in Clause 5.19.2;
- c) flexible type fasteners and markings shall be capable of withstanding the pull test outlined in Clause 5.19.1;
- d) flexible type fasteners shall be made of materials suitable for the temperatures to which they are exposed during normal operation of the heater; and
- e) markings secured to the appliances by a flexible type fastener shall have a statement,  
"Removal of this marking will void compliance of this heater with ANSI Z21.103 - ."

### 4.16.3

A heater shall bear a Class IIIA marking that is clearly and permanently marked with:

- a) The manufacturer's or distributor's name and location.
- b) The manufacturer's or distributor's model number of the appliance.
- c) The manufacturer's serial number, lot number, date stamp, or code, which will identify the appliance.
- d) The manufacturer's minimum and maximum input rating (Btu per hour), as applicable.
- e) Type of gas for which equipped: "LPG", "Propane", or "Butane", as applicable.

- f) The statement, as applicable:  
    "FOR INDOOR USE ONLY."  
    "FOR INDOOR/OUTDOOR USE."
- g) Clearances to combustible materials in integral inches.
- h) The identifying marking of the regulator(s) where the heater is for use with regulated pressure and the pressure regulator(s) is unlisted.
- i) If applicable, the statement "Also For Emergency Home Heating Use when the Heater is Used with a Disposable LP Cylinder. NEVER Bring a Refillable LP-Gas Cylinder Indoors. A Fire or Explosion can Occur Causing Property Damage, Serious Injury or Death".
- j) Identification of this Standard by indicating the edition of the standard, with the following marking:  
    "ANSI Z21.103 - (year) Camp Heater"
- k) The symbol of the organization making the tests for compliance with this Standard.
- l) Do not leave this appliance unattended while it is in operation.
- m) "A propane-fired portable heater used for emergency home use shall not be set at an input rating in excess of 5 000 Btu/hr (466 W) when located in a bathroom and shall not be set at an input rating of more than 10 000 Btu/Hr (2 931 W) when located in a bedroom."  
    The corresponding settings for bedroom or bathroom use shall be clearly identified on or adjacent to the adjustment means.

A heater shall have the following boxed warning labels on a Class IIIA material located where they can be easily seen by the user.

**WARNING**

When used without adequate combustion and ventilation air, heater may give off excessive CARBON MONOXIDE, an odorless, poisonous gas.

**DO NOT USE THIS HEATER UNTIL ALL NECESSARY PROVISIONS ARE MADE FOR COMBUSTION AND VENTILATION AIR. CONSULT THE WRITTEN INSTRUCTIONS PROVIDED WITH THE HEATER FOR INFORMATION CONCERNING COMBUSTION AND VENTILATION AIR.**

**DO NOT TAMPER WITH THE SAFETY SYSTEM!**

**CARBON MONOXIDE POISONING  
MAY LEAD TO DEATH**

If heater shuts off, do not relight until you provide fresh air. If heater keeps shutting off, have it serviced. Keep burner and control compartment clean.

The letters used for the boxed warnings shall be boldfaced type having a minimum uppercase letter height of 0.120 in (3.05 mm). The minimum vertical spacing between lines of type shall be 0.046 in (1.17 mm).<sup>\*</sup> Lowercase letters shall be compatible with the uppercase letter size specification.

<sup>\*</sup> This letter height and line spacing correspond to 12-point type.

#### 4.16.4

A heater specifically designed for direct connection to the fuel supply cylinder shall bear a clearly legible Class IIIA marking stating, "Do not connect to a remote gas supply."

#### 4.16.5

A heater specifically designed for connection to a refillable fuel cylinder shall bear a clearly legible Class IIIA marking stating, "If stored indoors, detach and leave cylinder outdoors."

#### 4.16.6

A heater for remote connection to a refillable self-contained LP-gas supply system or for direct connection to a disposable self-contained LP-gas supply system shall bear the following statement(s), as applicable, on Class IIIA marking material located so as to be easily read:

- a) A heater for remote connection to a refillable self-contained LP-gas supply system:  
"The gas supply must be turned off at the LP-gas supply cylinder when this heater is not in use."
- b) A heater for direct connection to a disposable self-contained LP gas supply system:  
"The LP gas supply cylinder must be disconnected when this heater is not in use."
- c) A heater with provisions for both remote connection to a refillable self-contained LP-gas supply system or direct connection to a disposable self-contained propane gas supply system:  
"When this heater is not in use: The gas supply must be turned off at the LP-gas supply cylinder when a refillable cylinder is used, or the LP gas supply cylinder must be disconnected when a disposable cylinder is used."
- d) The statement,  
"NEVER Bring a Refillable Propane-Gas Cylinder Indoors. A Fire or Explosion can Occur Causing Property Damage, Serious Injury or Death."

#### 4.16.7

For propane/butane mixtures and butane fuel, canisters shall be specified by the manufacturer and tested with the heater. A heater shall be marked with the model number of the canister found to be acceptable and recommended by the manufacturer.

#### 4.16.8

Catalytic heaters shall be marked with the following boxed warning on Class IIIA marking material with letters on a contrasting background, located in a position where it can be easily read:

**WARNING: Do not attempt to clean catalytic pad.  
Follow cleaning instructions.**

#### 4.16.9

Each catalytic heater shall bear the following warning, on Class IIIA marking material, in a location where it can be easily observed:



**WARNING**

**“Do not use heater if the catalytic pad becomes torn or damaged. Continuous use may result in injury or death due to fire, explosion, or carbon monoxide poisoning. The heater must be serviced by a licensed and qualified service person.”**

**4.16.10**

Refer also to Clauses 4.9.2, 4.9.3, and 4.9.4.

**5 Performance****5.1 General**

A heater submitted for test under these provisions shall be tested with the type or types of gases selected by the manufacturer as specified in Clause 5.2, Test Gases.

**5.2 Test gases**

In conducting the performance tests specified herein, gas with characteristics approximately as follows shall be used:

Propane Gas	2500 Btu/ft <sup>3</sup> (94.7 MJ/m <sup>3</sup> ) 1.53 Relative Density
Butane Gas	3260 Btu/ft <sup>3</sup> (124 MJ/m <sup>3</sup> ) 2.00 Relative Density

Heaters for use with propane only shall have all tests conducted with HD-5 Propane fuel.

Heaters for use with butane only shall have all tests conducted with butane gas.

These requirements also cover heaters equipped with a self-contained butane gas fuel supply. The fuel container is of the nonrefillable type and has a maximum capacity of more than 4 fluid oz (118 ml) but no more than 10 oz (296 ml) of butane. The maximum capacity in pounds of water is 1.08 lbs (0.49 kg). A heater may employ no more than two fuel containers. The fuel container is removable and replaceable in normal use. The butane fuel container shall comply with DOT 2P or 2Q requirements and shall be listed to the Standard for *Nonrefillable (Disposable) Type Metal Container Assemblies for Butane*, UL 147B.

Heaters for use with propane/butane mixtures shall be tested with the gas identified by the manufacturer. If the manufacturer specifies more than one canister model, each canister model number shall be provided by the manufacturer for testing.

If the manufacturer wishes that more than one gas composition ratio or canister be identified for use, each gas composition ratio or canister shall be tested in the heater.

## 5.3 Test pressures and burner adjustments

### 5.3.1

Unless otherwise stated, each test specified herein shall consist of a series of 3 tests; one at normal test pressure, one at a reduced pressure, and one at an increased pressure.

Test Pressures: Regulated

Propane	Reduced:	8/11 of nominal regulator setting or range.
and		
Butane	Normal:	11/11 of nominal regulator setting or range.
	Increased:	13/11 of nominal regulator setting or range.

### 5.3.2

Test pressures specified in Clause 5.3.1 shall be applied at the outlet of the regulator.

### 5.3.3

The input of a heater after a 15 minute warm-up period shall be within -0 to +10 percent of the manufacturer's specified input rate when tested at the normal test pressure.

## 5.4 Combustion

### 5.4.1

A heater shall not produce a concentration of carbon monoxide in excess of 0.02 percent in an air-free sample of the flue gases when the heater is tested in a room with approximately a normal oxygen supply, when tested in accordance with the following Method of Test.

#### Method of Test

The burner and primary air adjustments shall be made in accordance with Clause 5.3.3.

Means shall be employed to concentrate the flue gases by venting them through a single opening. Such means shall not affect secondary aeration. After the gas has been burning for 15 minutes, at normal inlet test pressure, the appropriate test shall be conducted, as follows:

For a heater equipped with an adjustable (limited adjustment) pressure regulator or an adjustable manual gas burner valve, or both, the manifold pressure of the heater shall be adjusted to a manifold pressure 15 percent below that obtained during burner adjustment. For a heater equipped with a fixed setting pressure regulator and a nonadjustable manual gas valve incapable of adjustment to other than the full on or full off position, the test shall be conducted at reduced inlet test pressure for all test gases in accordance with Clause 5.3.1. Following a brief purge period (at least 2 minutes), samples of the flue gases shall be secured.

The manifold pressure shall then be adjusted to provide an input rate of 109 percent of the manufacturer's specified input rate. Following a brief purge period (at least 2 minutes), another sample of the flue gases shall be secured. When the regulator outlet pressure cannot be adjusted readily, this increase in input rate may be obtained with the gas appliance pressure regulator removed or locked in its full open position.



The samples secured shall be analyzed for carbon monoxide and carbon dioxide. The carbon monoxide concentration in an air-free sample of the combustion products [CO(air-free)] in percent shall be calculated according to the following equation:

$$\text{CO}_{(\text{air-free})} = \frac{\text{UCO}_2}{\text{CO}_2} * (\text{CO})$$

in which:

UCO<sub>2</sub> = ultimate concentration of carbon dioxide for the fuel being burned in percent for natural gas (12.2 percent) and LP-gas (14.0 percent);

CO<sub>2</sub> = measured concentration of carbon dioxide in combustion products in percent; and

CO = measured concentration of carbon monoxide in combustion products in percent.

### 5.4.2

A heater shall not produce carbon monoxide in excess of 0.025 percent in a room with no air changes occurring during combustion of the amount of gas necessary to reduce the oxygen content of the room to a quantity equal to 15.1 percent by volume, corrected to 60°F (15.5 °C) and 30.0 inches mercury column (101.3 kPa) pressure when tested in accordance with the following Method of Test.

#### Method of Test

The burner and primary air adjustments shall be made in accordance with Clause 5.3.3. The oxygen depletion safety shutoff system shall be bypassed so it will not control gas flow. The heater shall be installed in a room constructed so as to prevent infiltration of air. The volume of the room shall be not less than 500 ft<sup>3</sup> (14.1 m<sup>3</sup>). Air circulation within the room shall be provided so the atmosphere of the room is evenly mixed and shall not interfere with the operation of the heater under test. Provision for measuring the average temperature of the room and for withdrawing samples of the atmosphere of the room shall also be provided.

The heater shall be operated for 15 minutes with the door of the room open and the room completely ventilated. The door shall then be sealed and the ventilation stopped. The heater shall be operated at the increased input rate specified in Clause 5.4.1. During the course of the test, oxygen, room temperature, and carbon monoxide shall be monitored.

When percent oxygen by volume indicates that the total oxygen contained in the closed room is within + 0.5 percent of that amount contained in the room at a concentration of 15.1 percent by volume at 60°F (15.5 °C) and 30.0 in Hg (101.3 kPa) pressure, the test shall be terminated. A sample withdrawn at the end of the test shall be analyzed for carbon monoxide and the increase in carbon monoxide concentration computed.

This test shall be repeated with the heater operating at a manifold pressure 15 percent below that obtained during burner adjustment.

### 5.4.3

A heater shall not produce carbon monoxide in excess of 250 ppm in a 500 ft<sup>3</sup> (2.84 m<sup>3</sup>) room with no air changes occurring during combustion of the amount of gas necessary to reduce the oxygen content of the room to a quantity equal to 15.1 percent by volume, corrected to 60°F (15.5 °C) and 30.0 inches mercury column (101.3 kPa) pressure when tested in accordance with the following Method of Test.

**Method of Test**

The oxygen depletion safety shutoff system shall be bypassed so that the safety shutoff system will not control gas flow.

The heater shall be installed in a 500 ft<sup>3</sup> (2.84 m<sup>3</sup>) room constructed so as to prevent infiltration of air. Provision for measuring the average temperature of the room and for withdrawing samples of the atmosphere of the room shall be provided.

The heater shall be operated for 15 minutes with the door of the room open and the room completely ventilated. The door shall then be sealed and the ventilation stopped. The heater shall be operated at the increased input rate specified in Clause 5.4.1.

During the course of the test, oxygen, room temperature, and carbon monoxide shall be monitored.

When percent oxygen by volume indicates that the total oxygen contained in the closed room is within + 0.5 percent of that amount contained in the room at a concentration of 15.1 percent by volume at 60°F (15.5 °C) and 30.0 inches mercury column (101.3 kPa) pressure, the test shall be terminated.

A sample withdrawn at the end of the test shall be analyzed for carbon monoxide and the increase in carbon monoxide concentration computed.

This test shall be repeated with the heater operating at a manifold pressure 15 percent below that obtained during burner adjustment.

**5.5 Hydrocarbon emission (for catalytic heaters only)****5.5.1**

The hydrocarbon emission of a catalytic heater shall be deemed satisfactory when a concentration of hydrocarbons (unreacted fuels expressed as propane) not in excess of 500 ppm is produced in a room with no air changes occurring during combustion of the amount of gas necessary to reduce the oxygen content of the room to a quantity equal to 19.4 percent (1.0 percent carbon dioxide) by volume, corrected to 60°F (15.6 °C) and 30.0 in Hg, when tested in accordance with the following Method of Test.

**Method of Test**

A heater shall operate at normal input for at least 1 hour before being subjected to the following tests.

The heater shall be tested in an adequately sized room constructed so as to prevent infiltration of air. The heater shall be operated outside the room for 15 minutes at increased inlet test pressure. Immediately following the warm-up period, the heater shall be placed in the room and continued in operation with the door sealed.

This test shall be conducted at increased inlet test pressure.

A sample of the room atmosphere shall be withdrawn at the start of the test and analyzed for oxygen or carbon dioxide and hydrocarbon emissions. During the test, sufficient samples shall be withdrawn and analyzed for oxygen or carbon dioxide to permit accurate determination of the end point of the test specified.

A sample of the room atmosphere shall be withdrawn when the oxygen concentration in the room reaches 19.4 percent (1.0 percent carbon dioxide) by volume corrected to 60°F (15.6 °C) and 30.0 in Hg.



This sample shall be analyzed for hydrocarbon emission, which shall not exceed a 500 ppm concentration.

This test shall be repeated with the heater operated with the inlet test pressure reduced by 15 percent.

If the heater is equipped with a valve intended for variable heat control, the heater shall be adjusted to the nominal low input setting of the heat control and tested as noted above.

### 5.5.2

A heater shall not produce a concentration of nitrogen dioxide ( $\text{NO}_2$ ) in excess of 0.002 percent in an air-free sample of the combustion gases when the heater system is operated at normal input rate and inlet test pressure, and tested in a room with a normal oxygen supply when tested in accordance with the following Method of Test.

#### Method of Test

The burner adjustment shall be made in accordance with Clause 5.3, Test pressures and burner adjustments. Means, as specified in Clause 5.5.4, shall be employed to concentrate the combustion gases by venting the combustion gases through a single opening. Such means shall not affect secondary aeration. After making the burner adjustment in accordance with Clause 5.3, the heater shall be operated at normal inlet test pressure for at least 20 minutes more. Samples of the combustion gases shall be secured and analyzed for carbon dioxide and nitrogen dioxide as specified in Clause 5.5.3.

### 5.5.3

#### Combustion sampling and analysis for measuring nitrogen dioxide ( $\text{NO}_2$ )

The concentration of nitrogen dioxide in the combustion products shall be measured by means of a chemiluminescent analyzer or equivalent instrument having a rated accuracy, reproducibility and/or precision less than or equal to  $\pm 1$  percent. The  $\text{NO}_2$  converter efficiency shall be verified as specified in South Coast Air Quality Management District (SCAQMD) Method 100.1. The range of the instrument shall be set such that the maximum expected concentration of  $\text{NO}_x$  is not greater than the upper range limit or less than 50 percent of the upper range limit.

The concentration of carbon dioxide in the combustion products shall be measured by means of an infrared analyzer or equivalent instrument having a rated accuracy, reproducibility and/or precision less than or equal to  $\pm 1$  percent. The range of the instrument shall be set as close as possible to, but not less than the maximum expected concentration of  $\text{CO}_2$  (2 percent). The instruments outlined above shall be zeroed and spanned before each test. The span gas used for this purpose shall have a value between 60 and 90 percent of the selected analyzer scale, but not less than 2 ppm NO. The span gas shall also have an accuracy less than or equal to  $\pm 1$  percent. The temperature of the combustion sample shall be kept above the dew point [approximately 140-150 °F (60-66 °C)] using a heated sample line. The sample shall also be dried using a method resulting in less than 1 percent  $\text{NO}_2$  loss (such as permeation dryer). Ice bath, dry-ice bath or chilled refrigeration systems are not appropriate drying methods as  $\text{NO}_2$  losses tend to exceed 1 percent.

The space in which the heater system is tested shall be adequately ventilated to ensure ambient  $\text{NO}_2$  levels are less than or equal to 2 percent of the selected NO/ $\text{NO}_x$  analyzer scale setting when the analyzer has been spanned to a range appropriate for measuring peak NO and  $\text{NO}_x$  concentrations. When the infrared analyzer does not automatically compensate for background carbon dioxide concentration (i.e.  $\text{CO}_2$  (background) = 0), background  $\text{CO}_2$  samples shall be recorded before and after each test. The frequency shall be a sample measurement every 30 seconds for 5 minutes before the test and a sample measurement every 30 seconds for 5 minutes after the test. The resulting 20 sample

measurements shall be averaged. This average background concentration of carbon dioxide [ $\text{CO}_2$  (background)] shall be used in the  $\text{NO}_2$  Air-Free calculation.

Ambient  $\text{NO}$  and  $\text{NO}_x$  and background  $\text{CO}_2$  measurements, as required above, shall be taken at points approximately 3 ft (0.914 m) away from the approximate midpoints of each of the four sides of the heater system. An equal number of measurements shall be taken at each point.

When the heater is operated in accordance with Clause 5.5.3, combustion samples shall be secured and analyzed for  $\text{CO}_2$ ,  $\text{NO}_x$  and  $\text{NO}$ . The frequency of the sample measurement shall be  $\text{CO}_2$  and  $\text{NO}_x$  measurements every 30 seconds for 5 minutes for a total of 10  $\text{CO}_2$  and 10  $\text{NO}_x$  measurements. Then  $\text{CO}_2$  and  $\text{NO}$  measurements every 30 seconds for 5 minutes for a total of 10  $\text{CO}_2$  and 10  $\text{NO}$  measurements.

The process shall be repeated three times for a total of 60  $\text{CO}_2$ , 30  $\text{NO}_x$  and 30  $\text{NO}$  measurements. Each group of measurements for  $\text{CO}_2$ ,  $\text{NO}_x$  and  $\text{NO}$  shall be averaged. These averages [ $\text{CO}_2(\text{meas})$ ,  $\text{NO}_x(\text{meas})$  and  $\text{NO}(\text{meas})$ ] shall be used in the  $\text{NO}_2$  Air-Free calculation. If the resultant  $\text{NO}_x$  (meas) is greater than the upper range limit or less than 50 percent of the selected chemiluminescent analyzer upper range limit, the test shall be determined to be invalid, and the test shall be repeated using a more accurate analyzer range setting. The nitrogen dioxide concentration in an air-free sample of the combustion products [ $\text{NO}_2$  (air-free)] in percent shall be calculated according to the following equation:

$$\text{NO}_2(\text{air-free}) = \left( \frac{UCO_2}{CO_2(\text{meas}) - CO_2(\text{background})} \right) [NO_x(\text{meas}) - NO(\text{meas})]$$

where

- $UCO_2$  = Ultimate concentration of carbon dioxide for the fuel being burned in percent for propane (14.0 percent);
- $CO_2(\text{meas})$  = Average measured concentration of carbon dioxide in combustion products in percent;
- $CO_2(\text{background})$  = Average measured concentration of carbon dioxide in background in percent;
- $NO_x(\text{meas})$  = Average measured concentration of  $\text{NO}_x$  in combustion products in percent; and
- $NO(\text{meas})$  = Average measured concentration of  $\text{NO}$  in combustion products in percent.

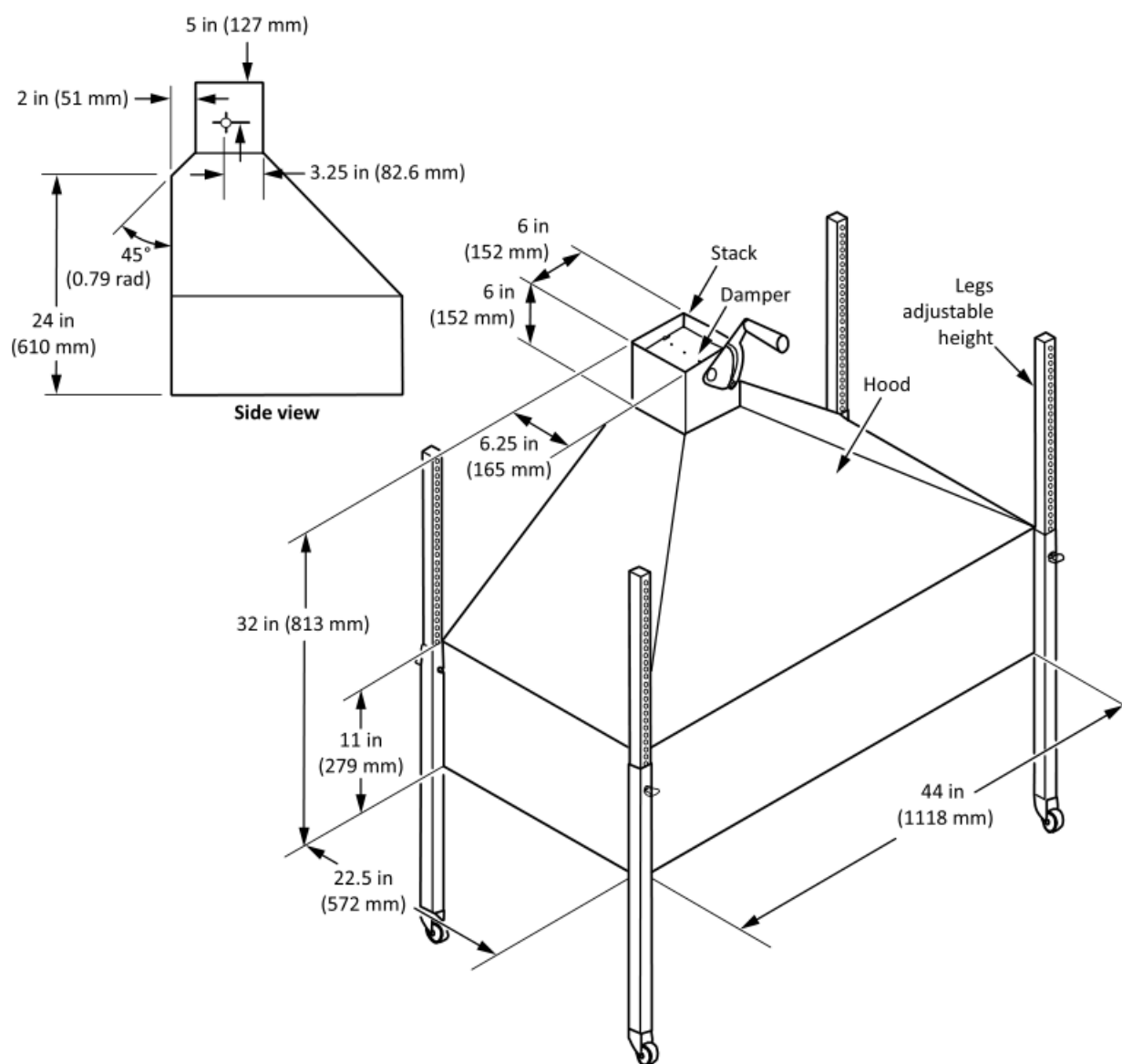
#### 5.5.4

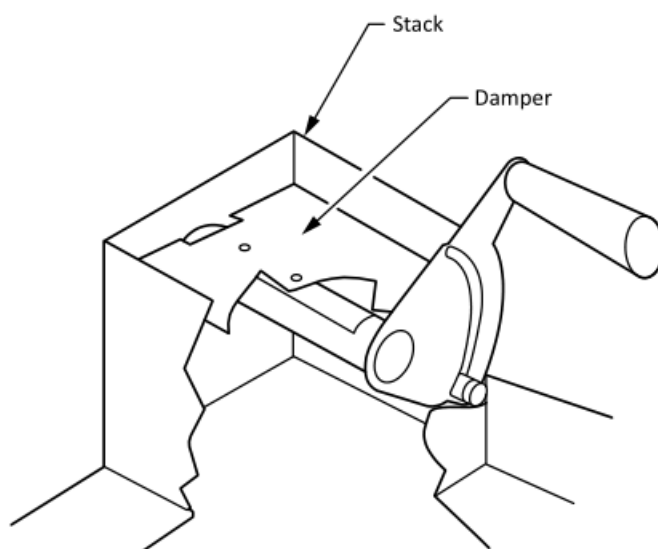
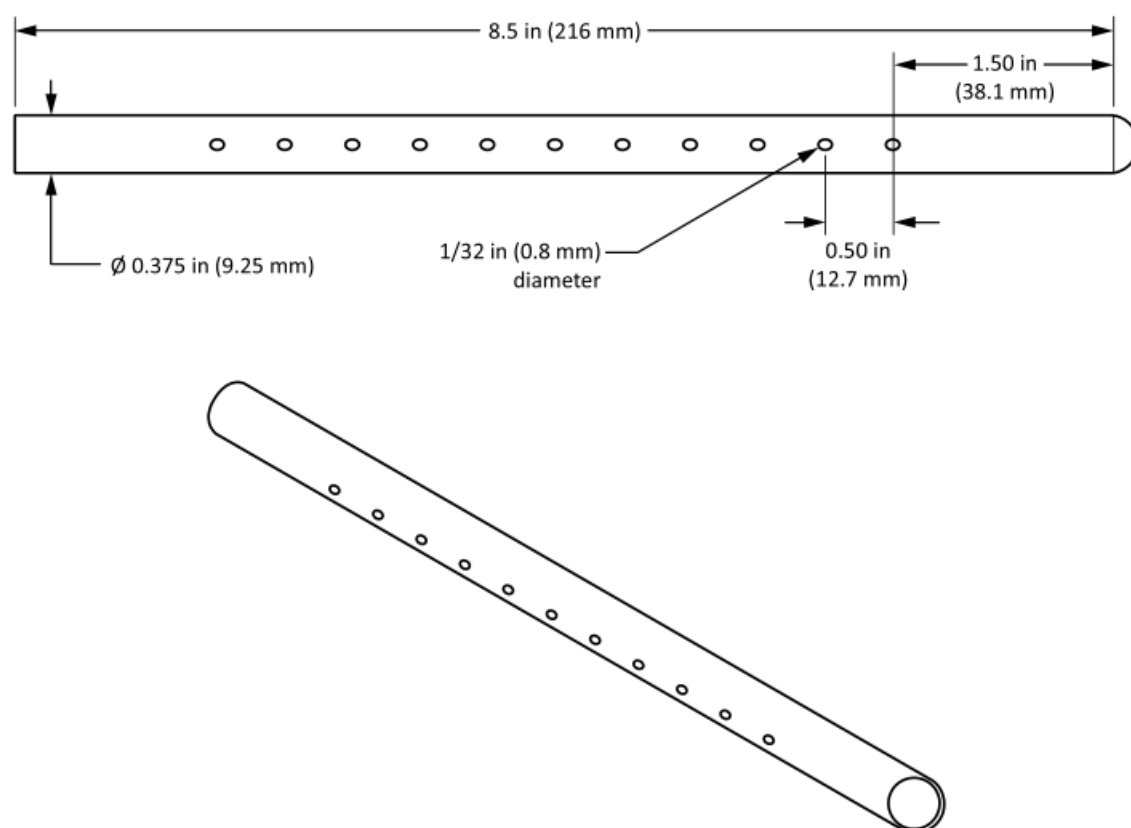
##### Sampling hood design and set-up

A hood with a damper, constructed as shown in Figure 2 and Figure 3, using a sample probe as shown in Figure 4 is to be used to collect combustion products for analysis in accordance with the requirements of Clauses 5.4.2 and 5.5.2. Adjustable draft reducing rear and sidewalls, and front panels shall also be provided to concentrate the combustion products. The hood, damper, rear and sidewalls, and front panels shall be constructed of stainless steel. The sample probe shall be constructed of stainless steel or quartz. The tubing and connectors between the probe and the combustion sample analyzing instruments shall be constructed of stainless steel or Teflon. The hood shall be placed over the heater system and adjusted for height so that the lower edge of the hood is level and at the same height as the top of the heater system. In the horizontal plane, the hood shall be placed so that it results in the highest sampled concentration of carbon dioxide. Progressively, the draft-reducing rear and side walls shall be added, damper adjustments made and front panels added to raise the sample concentration of carbon dioxide to no more than 2 percent, ensuring the combustion characteristics remain unchanged.



**Figure 2**  
**Hood assembly**



**Figure 3**  
**Damper****Figure 4**  
**Probe**

## 5.6 Burner operating characteristics

### 5.6.1

Burners shall not flash back:

- a) upon immediate ignition at normal, reduced, and increased test pressures;
- b) on heaters where pilots are not used, upon 2 to 5 seconds delayed ignition at normal test pressure;  
or
- c) during any of the other tests specified in these provisions.

### 5.6.2

Burners shall operate without depositing carbon during any tests specified in these requirements.

### 5.6.3

Burners shall not expel gas through air openings in mixer faces at normal test pressure nor at a pressure only high enough to support combustion at the ports.

## 5.7 Pilot operating characteristics

### 5.7.1

Where pilots are used, the provisions specified in Clauses 5.7.2, 5.7.3, 5.7.4, 5.7.5, 5.8.1, and 5.8.5 shall apply.

### 5.7.2

Pilot burner flames shall ignite the gas at the main burner(s) without delay.

### 5.7.3

Continuously burning pilot burner flames shall not be extinguished when the gas to the main burner(s) is turned on or off in a normal manner, either manually or by means of automatic devices.

### 5.7.4

Pilot burners shall show no carbon deposits during any test specified in Clause 4, Construction, when adjusted according to the manufacturer's printed instructions.

### 5.7.5

Bunsen-type pilot burners shall be constructed so that ignition of the main burner flame occurs in a normal manner, even though the pilot burner flame is burning at the orifice. A pilot burner that cannot be made to flash back under any conditions of test shall be considered as meeting this provision.

### 5.7.6

The pilot shall be adequately protected against drafts when tested in accordance with the following Method of Test.

#### Method of Test

The pilot shall be ignited and operated at normal inlet test pressure for a period of 15 minutes. By means of a fan or blower, a 3 mile-per-hour (1.34 m/s) wind shall be directed horizontally against the front and sides of the heater both on a plane with and below the pilot.

The pilot shall not lift, flash back, nor become extinguished during a period of 1 minute.

## 5.8 Pilot burners and shutoff devices

### 5.8.1

The pilot burner shall effect ignition of the gas at the main burner(s) under the conditions specified in the following tests. A pilot burner that becomes extinguished after having completed main burner ignition is considered as complying with this provision.

The following tests shall be conducted at normal test pressure:

- a) Single Flame Pilot Burners (Pilot burners that produce a single flame with substantially uniform contour under turndown conditions.)

The pilot burner shall effect ignition of the gas within 4 seconds from the time that gas is admitted to the main infrared burner(s), or within 4 seconds from the time a combustible mixture is present at the surface of the catalytic pad, when the pilot gas supply is reduced to an amount just sufficient to keep the valve of the safety shutoff device open, or just above the point of flame extinction, whichever represents the higher pilot gas rate.

A flame can be considered as being equivalent to a substantially uniform contour flame if its deviation from uniform contour is occasioned by a flame baffle(s) or channel(s).

- b) Multi-flame Pilot Burners (Pilot burners that produce a flame(s) with substantial variation in contour under turndown conditions).

The pilot burner shall effect ignition of the gas within 4 seconds from the time that gas is admitted to the main infrared burner(s), or within 4 seconds from the time a combustible mixture is present at the surface of the catalytic pad, when all the pilot flame ports except those for heating the thermal element are blocked, and the pilot gas supply is reduced to an amount just sufficient to keep the valve of the safety shutoff device open or just above the point of flame extinction, whichever represents the higher pilot gas rate.

The above test shall also be conducted under sufficient conditions of increased pilot burner input ratings to 4 seconds from the time that gas is admitted to the main infrared burner(s), or within 4 seconds from the time a combustible mixture is present at the surface of the catalytic pad, with the pilot burner input at any level from the turndown condition described above, up to and including that providing normal flow through the unblocked port(s) based on the manufacturer's specified normal input rating for the pilot burner. An approximately normal actuating flame can be obtained by removing the block from the ignition port(s).

With this block removed, the gas issuing from the ignition port(s) shall either not ignite or the flame shall be baffled in such a manner as to accomplish the ignition from only the actuating flame.

- c) Pilot Burner and Thermal Element Assemblies That Supply Electrical Energy for an Automatic Control System.

When the thermal element is the only source of power for operation of the automatic valve, the tests under a) and b) shall be conducted with the pilot burner flame adjusted to the minimum size required to open the automatic valve. This test condition shall be based on the performance of the system when only the thermal element and automatic valve are present. Under these conditions, the pilot burner shall effect ignition of the gas within 4 seconds from the time the gas is admitted to the main infrared burner(s), or within 4 seconds from the time a combustible mixture is present at the surface of the catalytic pad. Thermostats and any other system components that may be changed or added shall be excluded during this test.

When a multi-flame pilot burner is provided, the tests outlined under b) at increased pilot input ratings shall also be conducted.

- d) Recycling Pilot Burners (Gas Ignited).

In the case of pilot burners that operate every time the main burner is turned on or off, either manually or by automatic controls, the ignition flame(s) shall provide ignition of the gas within 4

seconds from the time that gas is admitted to the infrared main burner(s), or within 4 seconds from the time a combustible mixture is present at the surface of the catalytic pad, when the gas supply to the ignition flame is just sufficient to light the gas at the thermal heating ports.

### 5.8.2

A heater equipped with controls permitting ignition at less than full rate shall comply with the provisions of Clause 5.8.1 with the main burner gas input at full rate and at minimum turn-on rate.

### 5.8.3

The time required for the safety shutoff device to prove a supervised condition shall not exceed 5 minutes except for:

- a) those devices requiring a continually applied manual force to assume the "ON" position; and
- b) those devices that operate every time the main gas burner(s) with which they are used are turned on or off. In these two latter cases, the time shall not exceed 1 1/2 minutes, when tested in accordance with the following Method of Test.

#### Method of Test

This test shall be conducted at normal test pressure. With the device at room temperature, the gas at the burner(s) shall be ignited and the time required for the device to prove a supervised condition noted.

### 5.8.4

The time required for the safety shutoff device to shut off the gas supply shall not exceed 3 minutes when tested in accordance with the following Method of Test.

#### Method of Test

The heater shall be operated for 15 minutes at normal test pressure. All gas to the heater shall then be shut off and the time required for the safety shutoff valve to close noted.

### 5.8.5

When a pilot burner flame acts both as the actuating medium of the safety shutoff device and as the means for igniting the gas at the main burner(s), the construction shall be such that in case the pilot burner flame flashes back and burns at the orifice, the device shall operate either to shut off the supply in accordance with the test specified in Clause 5.8.4 or provide effective ignition of the gas at the main burner(s). A pilot burner that cannot be made to flash back under any conditions of test shall be interpreted as meeting this provision.

## 5.9 Pressure regulators

A heater designed for use with two pressure regulators intended for use with two LP-gas supply cylinders, each having a nominal water capacity less than 2.5 lbs (1.1 kg), shall be designed to prevent back pressure from one regulator outlet to the other that could result in leakage of gas in excess of 0.1 ft<sup>3</sup>/hr (0.786 cm<sup>3</sup>/sec) when tested in accordance with the following Method of Test.

#### Method of Test

The outlet of the regulator shall be connected to a pressure-controlled source of clean air. The inlet of the regulator shall be connected to a flow-measuring device, capable of accurately indicating flows up to 0.2 ft<sup>3</sup>/hr (1.6 cm<sup>3</sup>/sec).



With the regulator set to deliver its maximum rated outlet pressure, the pressure supplied to the outlet of the regulator shall be gradually increased to the setting of either the regulator's pressure relief valve or over pressure device. At no time shall the recorded flow rate measured at the inlet to the regulator exceed a flow equivalent to 0.1 ft<sup>3</sup>/hr (0.786 cm<sup>3</sup>/sec).

### 5.10 Oxygen depletion safety shutoff systems

An oxygen depletion safety shutoff system shall act to shut off the gas to the main and pilot burners when the oxygen level in the surrounding atmosphere is reduced to not less than 18.0 percent, when tested in accordance with the following Method of Test.

#### Method of Test

This test shall be conducted at barometric pressures between 28.5 and 30.5 inches mercury column (96.2 to 103.0 kPa).

The burner adjustments shall be made in accordance with Clause 5.3.3.

The heater shall be installed in a 500 ft<sup>3</sup> (2.84 m<sup>3</sup>) room constructed so as to prevent infiltration of air. Provisions shall be made for the determination of room air temperature and carbon dioxide (CO<sub>2</sub>) and/or oxygen (O<sub>2</sub>) concentrations. Room air temperature shall be measured with at least five thermocouples at different levels and plan locations. The thermocouples shall be shielded from direct radiation from the heater under test. Room atmosphere shall be sampled at the same locations. The average of five separate room atmosphere measurements, or a single measurement through the use of a manifold that mixes the samples, may be used.

The heater shall be operated for 15 minutes with the door of the room open and the room completely ventilated. The door shall then be sealed and the ventilation stopped. The appliance shall be operated at normal inlet test pressure. During the conduct of this test, the room air temperature shall be maintained at 80 ± 5°F (26.5 ± 3 °C).

A sample of the room atmosphere shall be withdrawn at the start of the test and analyzed for carbon dioxide (CO<sub>2</sub>) and oxygen (O<sub>2</sub>). The percent oxygen\* in the room atmosphere shall be continuously monitored during the entire test. When the oxygen depletion shutoff system acts to shut off the gas supply to the heater, the oxygen content of the room atmosphere, expressed in percent volume, shall not be less than 18.0 percent.

This test shall be repeated with the heater rating at both the reduced and increased inlet test pressures specified in Clause 5.3.1 with no change in adjustments.

*\* As an alternative to monitoring oxygen concentration, carbon dioxide concentration may be monitored and converted to percentage oxygen by use of the graph or formulae shown in Annex A (Relationship of Carbon Dioxide to Oxygen in the Closed Room Test Specified in Clause 5.4, Combustion, of this Standard).*

### 5.11 Stability

A heater shall remain stable when subject to the following Method of Test.

#### Method of Test

For each side of the heater, the angle of critical balance shall be determined. Starting from vertical, the heater shall be tipped to the point of critical balance on all sides. The tip over switch shall function to shut off the flow of gas before the angle of critical balance is reached. A heater shall be tipped in any direction at an angle of 15 degrees (0.26 rad) from the vertical and shall not tip over when released. A

heater for connection to an integral self-contained LP-gas supply system shall comply with this test with a full cylinder(s) in place and without the cylinder(s) in place.

### 5.12 Resistance to wind

A heater shall be so constructed that a 10 mph (4.5 m/s) wind, applied horizontally from any direction for a 10 minute period, will not cause a continuous burner flash back condition when subject to the following Method of Test.

#### Method of Test

The test area and suitable blower shall be arranged to provide a nominal velocity of 10 mph (4.5 m/s) over a cross-sectional area of at least the same size as the largest section of the heater. After this adjustment, the blower shall be shut off.

The heater shall be operated for 15 minutes at normal test pressure and then placed in the test area. The blower shall be operated for a period of 10 minutes. Following shut off of the blower, the heater shall continue or resume normal operation.

This test shall be repeated with various surfaces of the heater facing the wind. The required number of tests shall be left to the discretion of the testing agency.

A design that fails to operate continuously under wind conditions due to the inability of a proven pilot burner ignition system to remain in operation is considered to be in compliance with these provisions.

### 5.13 Handle and knob temperatures

Valve and handle temperatures shall not exceed 40°F (22.2 °C) above room temperature for metallic handles and 60°F (33.3 °C) for nonmetallic handles, after operating for a period of 1 hour at increased inlet pressure in a normal room temperature when tested in accordance to the following Method of Test. Carrying handles shall be in the rest position.

#### Method of Test

Temperatures of handles and knobs shall be measured by means of 24 AWG (0.20 mm<sup>2</sup>) iron-constantan thermocouples in firm contact (such as cementing or taping) with the handle or knob. Temperatures shall be measured on all portions of handles and knobs that are grasped and shall not exceed the temperatures specified above.

### 5.14 Wall, floor, and ceiling temperatures

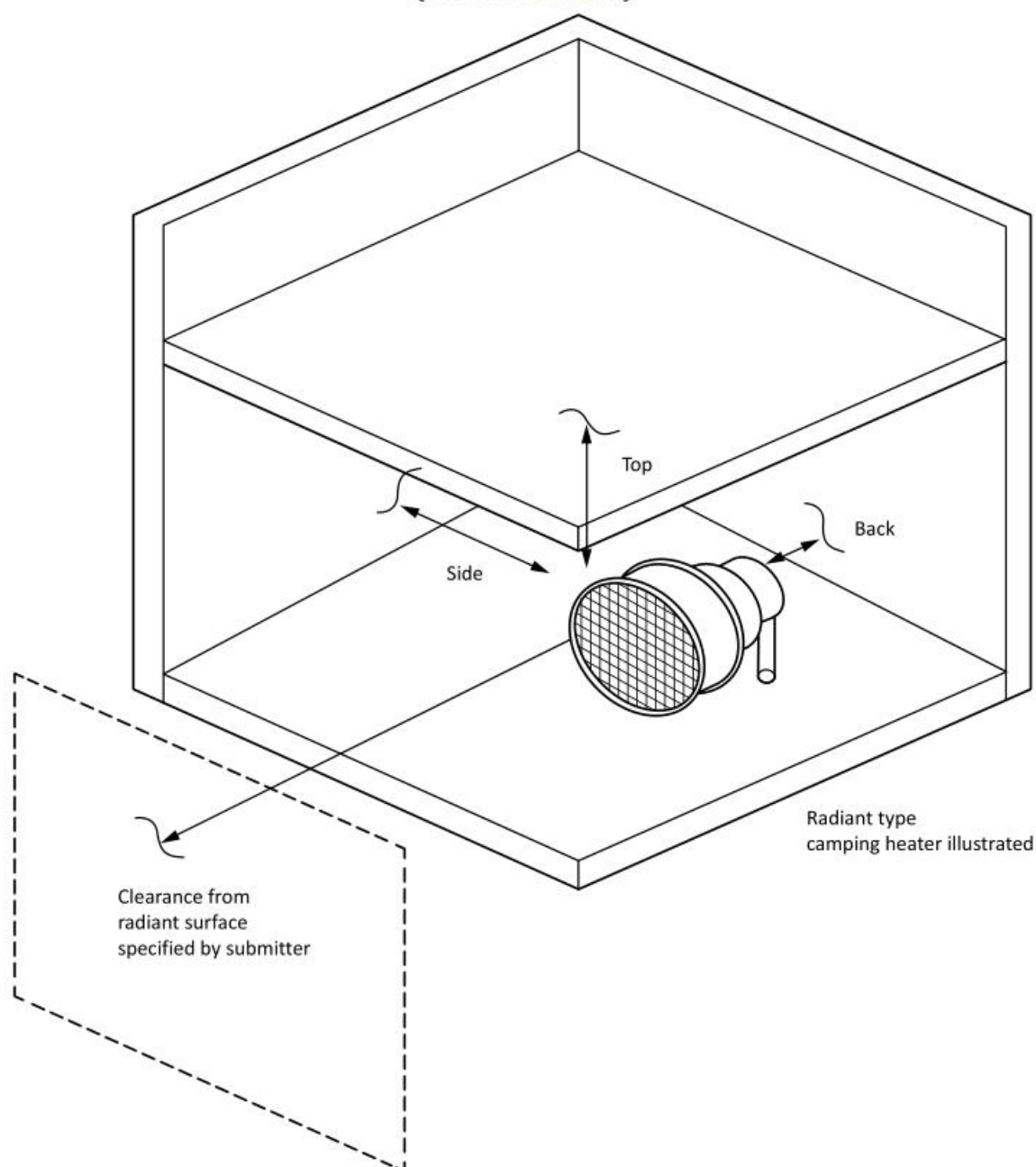
#### 5.14.1

The maximum temperature on walls and overhead combustible construction shall not have a rise of 117°F (47 °C) above room temperature and the maximum temperature on the floor shall not exceed 90°F (32 °C) above room temperature when the heater is tested at the manufacturer's specified clearances under the conditions of test described herein.

#### Method of Test

The heater shall be placed in a partial enclosure, as shown in Figure 5, Typical fire wall corner, at the minimum side and top clearances specified by the manufacturer. Horizontal and vertical clearances shall be measured from the heater casing. The heater shall be fired at the manufacturer's rated input. The test shall be conducted until equilibrium conditions are attained.

**Figure 5**  
**Typical fire wall corner**  
(See Clause 5.14.1.)



#### 5.14.2

The temperature of an integral LP cylinder(s) shall be monitored and at no time shall the cylinder temperature exceed 125 °F (51.67 °C) while the heater is operating or after it is turned off. Cylinder temperature shall be measured as an average of four equally spaced thermocouples mounted to the cylinder vapor space.



### 5.15 Surface temperatures

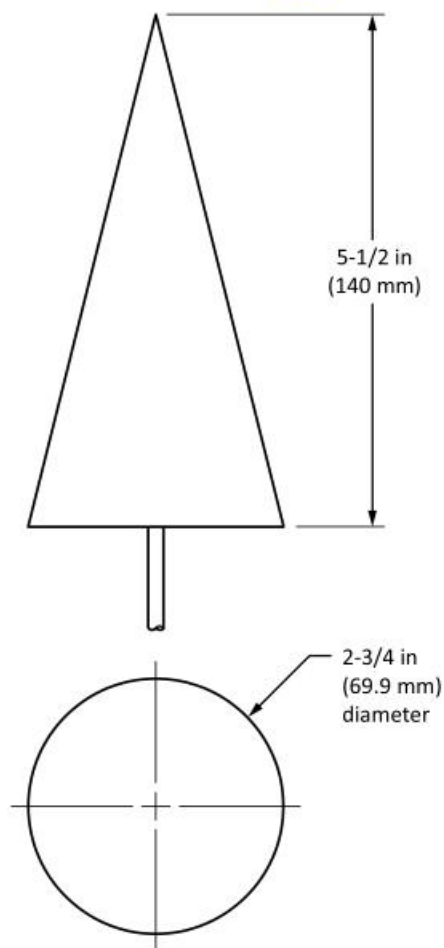
Guards and surfaces of the top, front, and sides of a heater, which can be contacted by the accessibility probe shown in Figure 6, Accessibility probe for heated surfaces, shall not have temperatures exceeding 140°F (78 °C) above room temperature when subject to the following Method of Test.

Discharge air openings, flue discharge openings, parts directly exposed to flames, or glowing surfaces through front openings, and parts within 2 in (50.8 mm) of these discharge air and front openings are exempt from this provision.

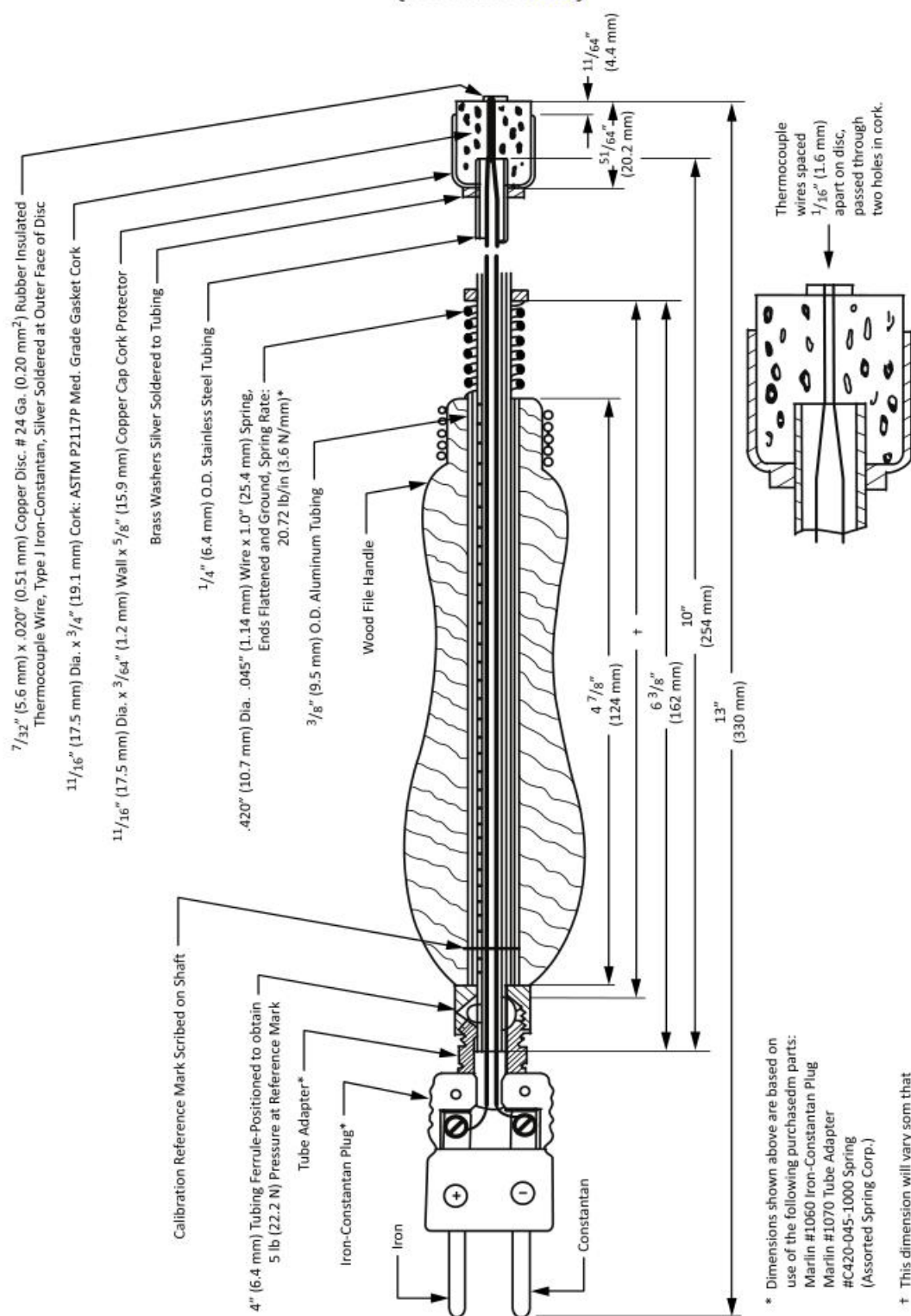
#### Method of Test

The heater shall be operated for a period of 1 hour in an open room at normal inlet test pressure. The surface temperatures shall be determined by means of the temperature-measuring probe shown in Figure 7, Temperature-measuring and accessibility probe.

**Figure 6**  
**Accessibility probe for heated surfaces**  
(See Clause 5.15.)



**Figure 7**  
**Temperature measuring and accessibility probe**  
(See Clause 5.15.)



\* Dimensions shown above are based on use of the following purchased parts:  
Marlin #1060 Iron-Constantan Plug  
Marlin #1070 Tube Adapter  
#C420-045-1000 Spring  
(Assorted Spring Corp.)

† This dimension will vary so that 5 lb (22.2 N) calibration will align with reference mark on probe shaft.



### 5.16 Temperature at discharge air opening

The average discharge air temperature (See Clause 3, Definitions) from any discharge air opening on a heater shall not exceed 180°F (100 °C) above room temperature when subject to the following Method of Test.

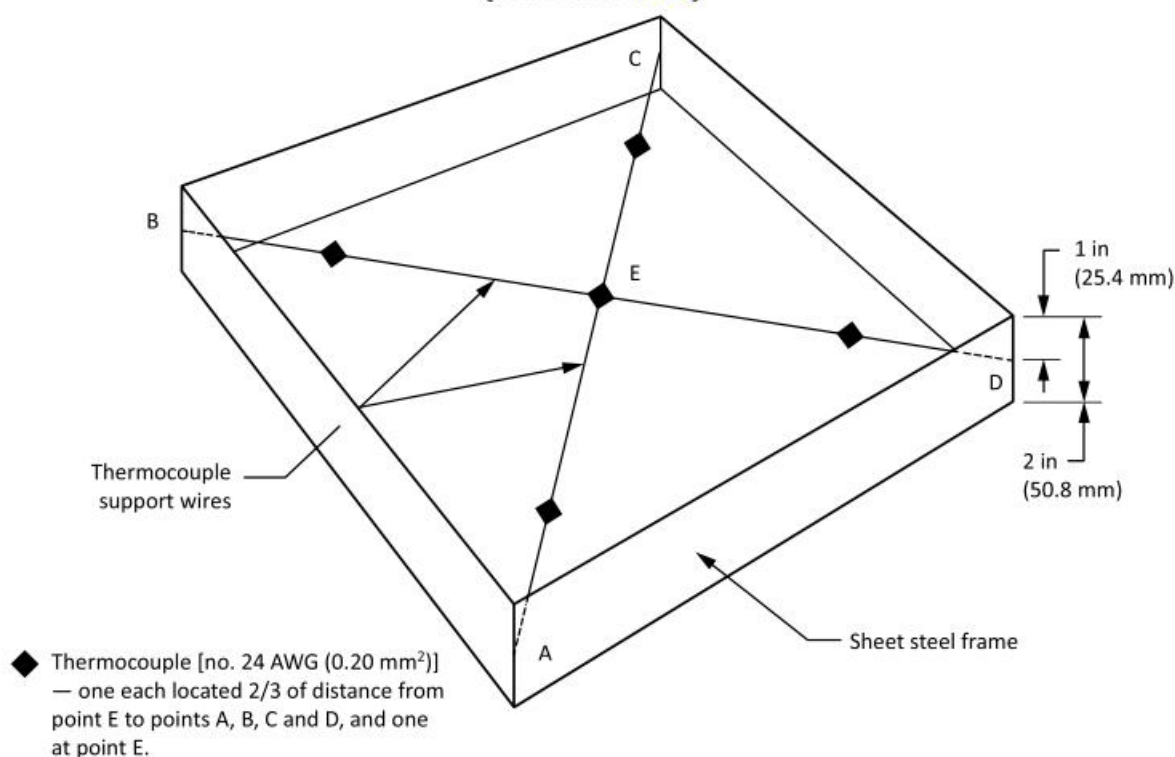
#### Method of Test

The average discharge air temperature shall be measured after 1 hour of operation in an open room at normal inlet test pressure.

A test device, as shown in Figure 8, Typical device for measuring discharge air temperatures, shall be used to determine the average outlet air temperature. When two adjacent sides of the discharge air opening are 12 in (305 mm) or greater, the test device shall have 12 in (305 mm) sides. When both dimensions are less than 12 in (305 mm), the device shall be the size of the discharge air opening. When one side of the discharge air opening is 12 in (305 mm) or more and the other side is less than 12 in (305 mm), the smaller side of the test device shall equal the smaller dimension of the discharge air opening, and the other side of the test device shall not be longer than the larger dimension of the discharge air opening and, in addition, shall not be longer than a size that would provide an area of 144 in<sup>2</sup> (0.09 m<sup>2</sup>) for the device. The test device shall be contoured to fit the discharge air opening. Five parallel connected bead-type 24 AWG (0.20 mm<sup>2</sup>) thermocouples shall be positioned on the thermocouple support wires as shown in Figure 5 and a distance of 1 in (25.4 mm) between the thermocouples and the discharge air opening shall be maintained.

When a discharge air opening exceeds an area of 144 in<sup>2</sup> (0.09 m<sup>2</sup>) as described above, the test device shall be located over that section of the discharge air opening, which will result in the highest average discharge air temperature.

**Figure 8**  
**Typical device for measuring discharge air temperatures**  
 (See Clause 5.16.)



### 5.17 Evaluation of clothing ignition potential

A heater shall be designed so it will not readily ignite clothing or flammable materials brought in contact with the appliance when subject to the following Method of Test.

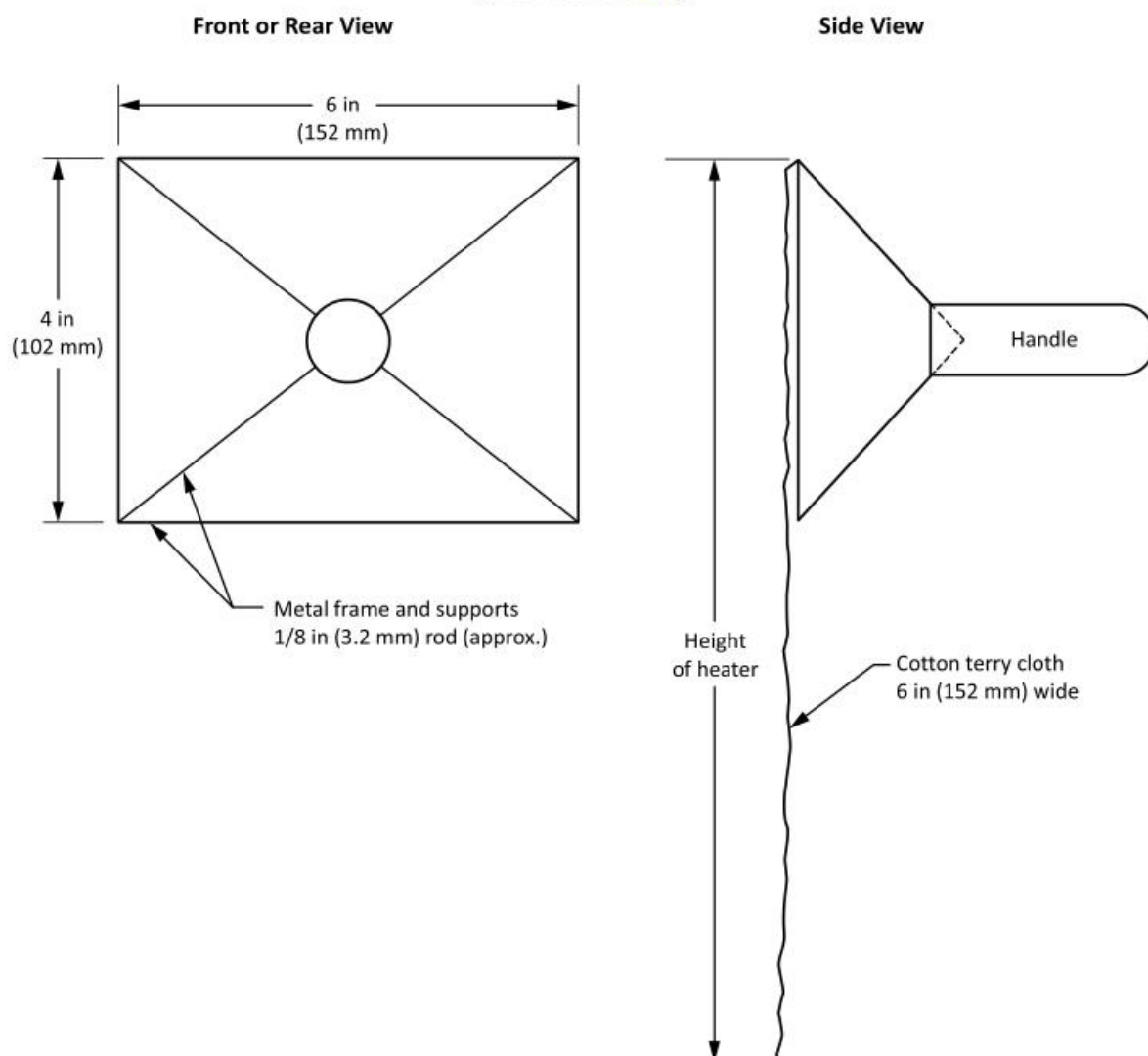
#### Method of Test

Safety guards, grilles, and screens provided as part of the heater by the manufacturer under Clause 4.15.1 shall be in place during this test.

One hundred percent white cotton terry cloth test material with a pile weave on both sides, nominal 9 oz/yd<sup>2</sup> (+/- 1 oz.) (0.27 kg/m<sup>2</sup>) and preconditioned at 30 percent relative humidity or less, at 75°F (24 °C) for at least 24 hours, shall be used. Test samples shall consist of a single layer of the test material, 6 in (152 mm) wide, and equal in length to the height of the heater. The heater shall be placed in operation and operated continuously for a period of 1 hour in an open room at normal inlet test pressure. A test sample shall be draped on a probe as shown in Figure 9, Probe for Evaluation of Clothing Ignition Potential. The probe, with its handle maintained in a horizontal position at all times and its axis at any vertical height with respect to the heater, shall be advanced toward the heater from any direction, including from above, until the frame of the probe contacts any surface or guard. The probe shall then be maintained in that position for 30 seconds. No flaming of the test material shall occur.

A previously unused test sample shall be used for each evaluation.

**Figure 9**  
**Probe for evaluation of clothing ignition potential**  
(See Clause 5.17.)



### 5.18 Marking material adhesion and legibility

Marking material recognized as complying with the Standard for *Marking and Labeling Systems*, UL 969, are exempt from this test.

The adhesive quality of Class IIA-3, IIA-4, IIIA-1, and IIIA-2 marking materials and the legibility of all Class II, IIIA, and IIIB marking materials (see Clause 4.16.1) shall not be adversely affected when the marking materials are exposed to heat and moisture as specified in the following Method of Test.

#### Method of Test

- a) Adhesive type marking materials shall be applied to the particular type of finish used on the heater in production. A sample metal panel of this finish shall be cleaned with a solvent and dried.  
Half of the panel shall be wiped with a clean cloth lightly oiled with SAE-30 medium machine oil.



Two samples of marking material shall be applied to the panel, one on the dry area and one on the oiled area. Test samples shall be applied with firm pressure unless the manufacturer's application instructions specify otherwise. All samples shall be allowed to set for 24 hours at room temperature. Each sample of marking material shall exhibit:

- i) good adhesion and no curling at edge;
  - ii) no illegible or defaced printing by rubbing with thumb or finger pressure; and
  - iii) good adhesion when a dull metal blade (as the back of a pocketknife blade) is held at 90 degrees (1.57 rad) to the applied marking and scraped across the edges of the marking.
- b) Non-adhesive type marking materials shall exhibit no illegible or defaced printing when rubbed with thumb or finger pressure. Two samples of marking material shall be tested.
- c) Samples shall then be placed in an oven for a period of two weeks with the oven temperature maintained at:
- i) 350°F (176.5 °C) for Class IIA-1, IIA-2, IIA-3, IIA-4, and IIIA-1 marking materials;
  - ii) 250°F (121 °C) for Class IIIA-2 and IIIB marking materials; or
  - iii) 225°F (107.2 °C) for Class IIIA-3 marking material.

Following the oven test, adhesion and legibility of the samples shall be checked again as specified in a) or b) above.

Samples shall then be immersed in water for a period of 24 hours, after which adhesion and legibility shall be rechecked as specified in a) and b) above.

Good adhesion and legibility qualities shall be obtained under all of the above test conditions. Final acceptance of marking materials shall be based on the suitability of the application of the marking material to the heater.

## 5.19 Permanently attached marking tags

### 5.19.1

Markings that are attached to the heater with a flexible type fastener in accordance with Clause 4.16.2 shall not become detached from the heater when subject to the following Method of Test.

#### Method of Test

A 25 lb (11 kg) weight shall be securely attached to the marking tag in such a way that it does not interfere with the attachment of the marking to the flexible type fastener. The heater shall be securely supported above the floor a sufficient distance to allow the flexible type fastener, marking tag, and attached weight to hang straight down without impact and without touching the floor for 60 seconds. The marking shall not become detached from the heater.

### 5.19.2

Markings that are attached to gas carrying components with a flexible type fastener in accordance with Clause 4.16.2 b) shall not cause damage or leakage to any of the heater's gas carrying components when subject to the following Method of Test.

#### Method of Test

A 50 lb (23 kg) weight shall be securely attached to the marking tag in such a way that it does not interfere with the attachment of the marking to the flexible type fastener. The heater shall be securely supported above the floor a sufficient distance to allow the flexible type fastener, marking tag, and attached weight to hang straight down without impact and without touching the floor for 60 seconds.



The marking may become detached from the heater, but there shall be no evidence of damage or leakage to any of the heater's gas carrying components.

## 5.20 Catalytic materials

The operating temperature of catalytic materials shall not exceed those for which the materials are designed when the heater is operated as outlined in the following Method of Test.

### Method of Test

This test shall be conducted at increased input rate.

The barometric pressures shall be between 28.5 and 30.5 in Hg column (96.2 to 103.0 kPa).

The oxygen depletion safety shutoff system shall be bypassed so it will not control gas flow. Any carbon formed shall remain during the conduct of this test.

At least 5, equally spaced, thermocouples shall be applied to the inside surface of the catalyst at points deemed most critical by the testing agency. The 5 points shall be distributed such that they are representative of the entire cross-sectional area of the catalyst in the plane furthest from the burner flame.

The heater shall be installed in a 1000 ft<sup>3</sup> (28.3 m<sup>3</sup>) room constructed so as to prevent the infiltration of air. Provisions shall be made for the determination of room air temperature, carbon dioxide (CO<sub>2</sub>) and/or oxygen (O<sub>2</sub>) concentrations. Room air temperature shall be measured with at least 5 thermocouples at different levels and plan locations. The thermocouples shall be shielded from direct radiation from the heater under test. Room atmosphere shall be sampled from the same locations. The average of 5 separate room atmosphere measurements, or a single measurement through the use of a manifold which mixes the samples, may be used.

Air circulation within the room shall be provided to evenly mix the atmosphere and not interfere with the operation of the heater under test. The air will be considered evenly mixed when the temperature readings, as indicated by the 5 thermocouples in the room, do not differ by more than 5°F (3 °C) during the tests. The heater shall be operated for 15 minutes with the door of the room open and the room completely ventilated. The door shall then be sealed and the ventilation stopped. During the conduct of this test, the room air temperature shall be maintained at 80 ± 5°F (26.5 ± 3 °C).

A sample of the room atmosphere shall be withdrawn at the start of the test and analyzed for CO<sub>2</sub> and/or O<sub>2</sub>. During the course of the test, room temperature, CO<sub>2</sub> and/or O<sub>2</sub> shall be monitored.

When the oxygen content in the room atmosphere, expressed in percent volume, reaches 18 percent, the maximum operating temperature of the catalytic material shall be recorded and shall not exceed the maximum operating temperature as specified by the manufacturer of the catalyst.

Any carbon deposits as a result of this test shall be removed prior to the conduct of any other test.

## 5.21 Catalyst longevity

The catalyst tiles provided with heater shall be subjected to the following Method of Test.

### Method of Test

The catalyst tiles shall be subjected to an air temperature of the lower of either: 1300°F (704.4 °C); or 800°F (426.7 °C) plus the maximum catalyst temperature measured during the conduct of Clause 5.22, Catalyst quality for a period of not less than 48 hours.

## 5.22 Catalyst quality

Evidence shall be provided in graphical form that a sample of the catalyst tiles has been tested and complies with the carbon monoxide (CO) conversion requirements specified in the following Method of Test.

### Method of Test

A test core sample of at least 1.2 in (30.5 mm) diameter shall be taken from the full catalyst monolith. The sample shall be subjected to EPA Method 25A using 1000 ppm of carbon monoxide (CO) gas continuously sampled at temperatures ranging from 100 °F (37.8 °C) to 500 °F (260 °C). The data shall indicate that the sample can achieve an outlet CO level of no more than 100 ppm prior to reaching the inlet gas temperature of 500 °F (260 °C).

## 6 Manufacturing and production tests

### 6.1

The following manufacturing and production tests are intended to provide the means for certifying agencies to uniformly apply quality control standards to all appliances certified as complying with the standard.

The manufacturer's test method(s) shall be capable of relating back to the test(s) specified in the standard where specific references are made.

### 6.2

The manufacturer shall check, inspect, and test the components and the assemblies of each appliance in the following manner:

- a) Inspect raw materials and purchased components using a sampling plan mutually acceptable to the manufacturer and the certifying agency. In addition to inspecting parts of the appliance, the manufacturer shall inspect LP-gas cylinders purchased for shipment with appliances.
- b) Test fire each burner, manifold, and control assembly for proper burner and gas valve operation and verify the gastightness of the manifold and control assembly.
- c) Verify that the perimeter of the catalytic pad is sealed to preclude the passage of fuel gas through other than the surface of the catalytic material (see Clause 4.4.5).
- d) This test shall be conducted on a completely assembled appliance, when practicable.

### 6.3

Using a sampling plan mutually acceptable to the manufacturer and certifying agency, the manufacturer shall also conduct the following tests on controls:

- a) test pressure regulating devices to determine compliance with Clause 4.10.5;
- b) test manual valves for continued operation to determine compliance with Clause 4.9.9;
- c) test nonmetallic internal parts of gas controls for compliance with Clause 4.3.9; and
- d) test each control for leakage as specified in Clause 4.9.7 (or Clause 4.9.10) and Clause 4.10.3 (or Clause 4.10.6) using a sampling plan mutually acceptable to the manufacturer and certifying agency.

Under this sampling plan, the frequency of conducting the tests specified in a) through c) above need not be the same.

## 6.4

Using a sampling plan mutually acceptable to the manufacturer and the certifying agency, completely assembled appliances shall be tested to determine satisfactory operation with respect to:

- a) burner operating characteristics (see Clause 5.6);
- b) pilot operating characteristics (see Clause 5.7);
- c) pilot burners and safety shutoff devices (see Clause 5.8);
- d) combustion (see Clause 5.4);
- e) handle and knob temperatures (see Clause 5.13); and
- f) oxygen depletion safety shutoff systems (see Clause 5.10).

The results of these tests shall be recorded and maintained by the manufacturer for review by the certifying agency.

Under this sampling plan, the frequency of conducting the tests specified in a) through c) above need not be the same.

The manufacturer's test method(s) shall be capable of relating back to the test(s) specified in the standard.



## Annex A (informative)

### ***Relationship of carbon dioxide to oxygen in the closed room test specified in Clause 5.4 of this Standard***

**Note:** This Annex is not a mandatory part of this Standard.

When a gas-burning appliance is operated in a room constructed so as to prevent the infiltration of air, the rate of increase in the percent carbon dioxide in the closed room atmosphere is directly proportional to the rate of decrease in the percent oxygen in that closed room atmosphere. The specific ratio between CO<sub>2</sub> and O<sub>2</sub> is dependent on the ultimate CO<sub>2</sub> resulting from the combustion of the particular fuel gas used. The ultimate CO<sub>2</sub>, which will vary as a result of the specific composition of the fuel gas, for each of the Test Gases specified in this Standard, is as follows:

Test gases	Ultimate CO <sub>2</sub>
A	12.2
B and C	11.82
D, E, F, and G	14.0

The following equations may be used to calculate the relative values of CO<sub>2</sub> and O<sub>2</sub> in the closed room atmosphere for a specific test gas.

$$x = 20.93 - (20.93/y_1)$$

$$y = (y_1/20.93) * (20.93 - x)$$

where

x = percent O<sub>2</sub>,

y = percent CO<sub>2</sub>, and

y<sub>1</sub> = ultimate percent CO<sub>2</sub>.

Using the above equations, the graph shown in Figure A.1 was developed as an example to show the relationship of oxygen to carbon dioxide in the atmosphere of a closed room in which a gas-fired appliance is operated on natural gas (Test Gas A) and on liquefied petroleum gases (Test Gases D and E) and LP gas-air mixtures (Test Gas G).



**Figure A-1**  
**Relationship of CO<sub>2</sub> to O<sub>2</sub> in the closed room tests**  
(See Clause 2.9.)

