MEETING LOG
DIRECTORATE FOR ENGINEERING SCIENCES

SUBJECT: Accredited National Standard on Performance and Installation of Gas-Burning Appliances and Related Accessories, Z21

PLACE: Mission Palms Hotel, Tempe, AZ

MEETING DATE: April 15, 1999

LOG ENTRY SOURCE: Donald W. Switzer DWS

ENTRY DATE: April 22, 1999

COMMISSION ATTENDEES:

Donald W. Switzer ES

NON-COMMISSION ATTENDEES: See attached attendee list

MEETING SUMMARY

The ANSI Z21/83 Committee sets performance standards for gas-burning appliances and their installation. Membership consists of experts in gas appliance design and natural and LP-gas fuel distribution, government agencies, and consumer representatives.

CPSC staff attended this meeting to support proposed changes to the Z21.10.1 Gas-Fired Water Heater Standard, and the Z21.63 Standard for Portable Type Gas Camp Heaters.

The Gas Appliance Manufacturers Association (GAMA) proposed a water heater flammable vapor ignition resistance test methodology to certify the performance of new technology gas-fried water heaters designed to resist the ignition of flammable vapors. CPSC staff assisted in developing the standard and finds it adequate. It is staff's belief that water heaters meeting the requirements of the proposed test methodology (section 2.38 attached, with appendices) will greatly reduce the hazard posed by water heaters igniting flammable vapors in the home. The vote on adopting this item was 22 for, 4 opposed and 3 abstaining. Twelve members of the Z21/83 Committee did not attend the meeting. They will be sent letter ballots. It is possible that when the absent member ballots are counted, this provision will not be accepted. Staff expects to have the final vote count, including the absentee votes within 45 days.

The CPSC staff recommended a number of changes to the standard for camping heaters, ANSI Z21.63 to address the hazard of carbon monoxide poisoning. The subcommittee adopted the

recommended changes and they were approved by the Z21/83. They are attached.

Z21/82 Committee (April 15, 1999) Meeting

Name	Attended	Absent
ROGER JASK (no vote)		X
FRANCES GAILEY, Ph.D.	A	
DAN CHRISTENSON	A	
CRAIG R. CHRISTENSEN	A	
W. ROSELLE HAMLETT	A	
ROBERT A. HAUSERMAN		X
DARYL L. HOSLER	A	
MARTIN PETCHUL		X
JACK D. REA		X
DONALD L. SHRADER	A	
LARRY WESTLING	A	
MATTHEW W. WILBER	A	
ROBERT S. CAVE	A	
EARL T. RHINEHART	A	
TOM RILEY (alternate)		X
JAMES M. JONES	A	
GEORGE A. PAPRITZ		X
ARMAND V. BRANDAO	A	
CHARLES W. ADAMS	A	
LORNE B. ALDEN		X
PAUL E. BEACH	A	
DANIEL J. CANCLINI	A	
JAY R. KATCHKA		X
GREGORY LYNCH		X
NORMAN E. MATTSON	A	
GORDON DAULEY	A	
JAMES MULLEN	A	
GARY J. POTTER	A	
DREW SMITH	A	

OTTO VAGO (alternate)		X
STUART PALMER		X
JOHN W. VANN (alternate) Not in attendance after noon	A	
R. MICHAEL MARTIN (no vote)	A	
ANDY JONES	A	
JEROME O. HENDRICKSON	A	
ALLEN R. INLOW represented by Robert Shepherd	A	
ROBERT KORDULAK (alt.)		X
JAMES F. SCHMID		X
LEE J. DORAN	A	
TERRY PENNELL		X
DAVID C. DELAQUILA (alt.)	A	
J. E. MARTIN (alt.)		X
THEORDORE C. LEMOFF	A	
WALTER G. LEIGHT		X
BRUCE J. SWIECICKI	A	
THOMAS J. HARRIS		X
HARRY JONES	A	
DONALD W. SWITZER (no vote)	A	
VICTOR J. FERRANTE (no vote)		X
NEIL ROLPH	A	
CYRUS NASSERI		X

Appendix G: Substantive Revisions to Standard Z21.63/ CSA 11.3, Portable Type Gas Camp Heaters

At the November 4-5, 1998 meeting of the (Interim CSA)/ ANSI Z21/83 Joint Subcommittee on Gas Refrigerators and Camping Equipment, the Joint Subcommittee adopted the following for distribution for public review and comment on Standard Z21.63/ CSA 11.3, Portable Type Gas Camp Heaters:

1. Revision of boxed warning in Clause 1.13.1, and Appendix A, Clause 1.13.1, to read:

FOR YOUR SAFETY

If you smell gas:

1. Do not attempt to light appliance.
2. Extinguish any open flame.
3. Disconnect from fuel Supply.

Rationale: Clarification.

2. It was noted that the Terry Cloth Ignition test was left out of the draft standard, and the Performance at High Altitude section should not have been in the standard. Section 2.12 was revised as follows:

"2.12 ~~PERFORMANCE AT HIGH ALTITUDE~~ EVALUATION OF CLOTHING IGNITION POTENTIAL

~~Lights Heaters tested to this standard shall also comply with CGA 2.17 Standard for Gas Fired Appliances for use at High Altitudes.~~

A ~~refrigerator~~ heater shall be designed so it will not readily ignite clothing or flammable materials brought in contact with the appliance.

Method of Test

Safety guards, grilles and screens provided as part of the appliance by the manufacturer under 1.13.1 shall be in place during this test.

One hundred percent white cotton terry cloth test material with a pile weave on both sides, nominal 8 ounces/yd^2 (0.27 kg/m^2) 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 inches (152 mm) wide, and equal in length to the height of the appliance.

A test sample shall be draped on a probe as shown in Figure 2. The ~~refrigerator~~ heater shall then be placed in operation and operated continuously for a period of 1 hour in an open room at normal inlet test pressure. Then the probe, with its handle maintained in a horizontal position at all times and its axis at any vertical height with respect to the appliance, shall be advanced toward the appliance 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."

Rationale: *Since this standard was modified to address only outdoor use, the draping test was revised to a clothing ignition test, as currently outlined in the ANSI Z21.11.2 standard. Terry cloth, rather than cheese cloth, was a material which better represented the type of fabric which may be subject to contact by the ~~refrigerator~~ heater.*

The Section on Performance on High Altitude was not meant to be included in this standard and has been deleted.

APPENDIX AA

RELATIONSHIP OF CARBON DIOXIDE TO OXYGEN IN THE CLOSED ROOM TEST SPECIFIED IN 2.4 OF THIS STANDARD

(This Appendix is informative and is not part of the 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_2 and O_2 is dependent on the ultimate CO_2 resulting from the combustion of the particular fuel gas used. The ultimate CO_2, 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_2
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_2 and O_2 in the closed room atmosphere for a specific test gas.

$$x = 20.93 - \left(\frac{20.93}{y_1}\right)$$

$$y = \frac{y_1}{20.93}(20.93 - x)$$

Where

x = percent O_2,

y = percent CO_2, and

y_1 = ultimate percent CO_2.

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).

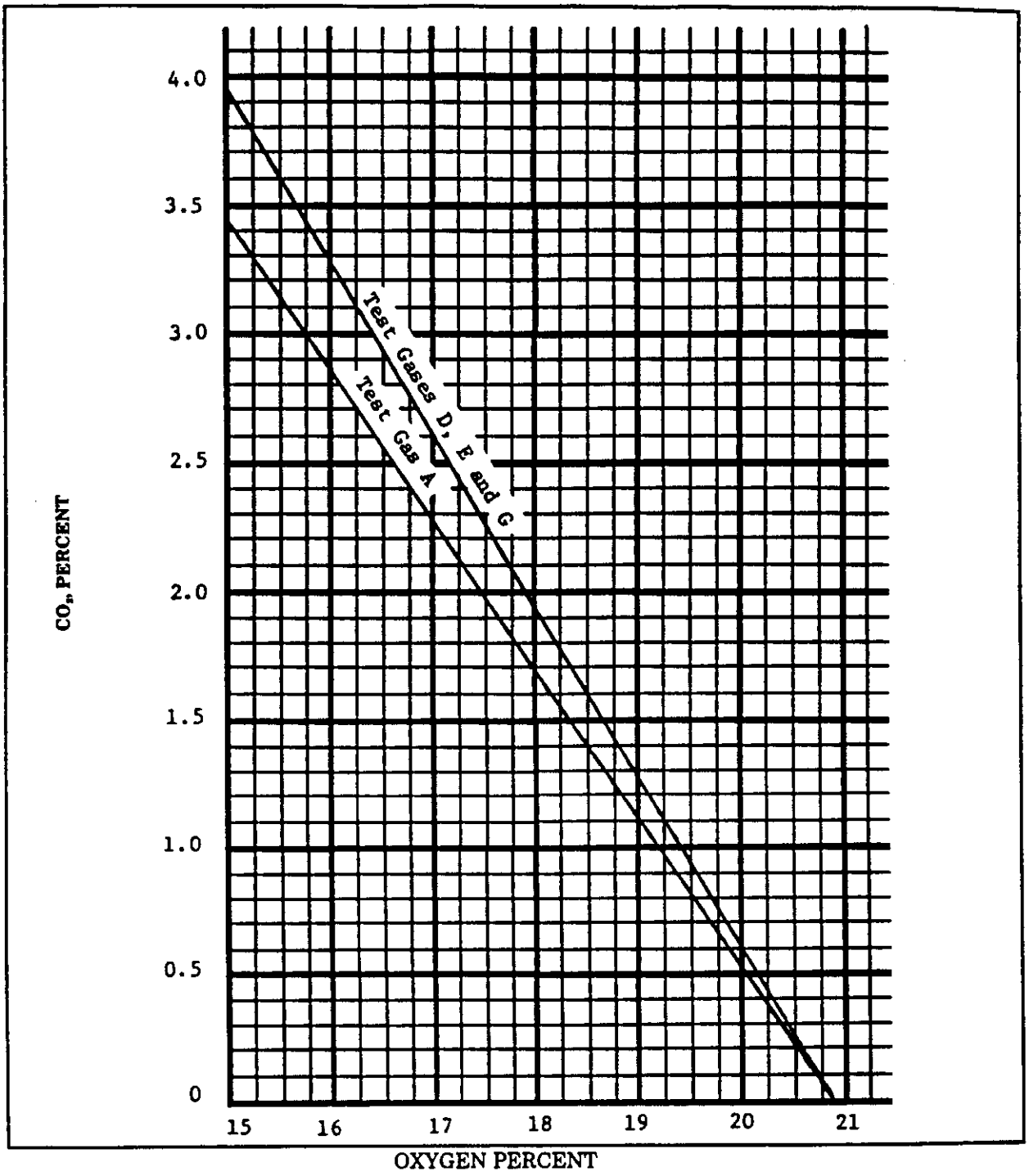


Figure A-1

Relationship of CO_2 to O_2 in the Closed Room Tests (See 2.9)

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 which permits control of the flow of gas at any rate from none to full on.

FIGURES

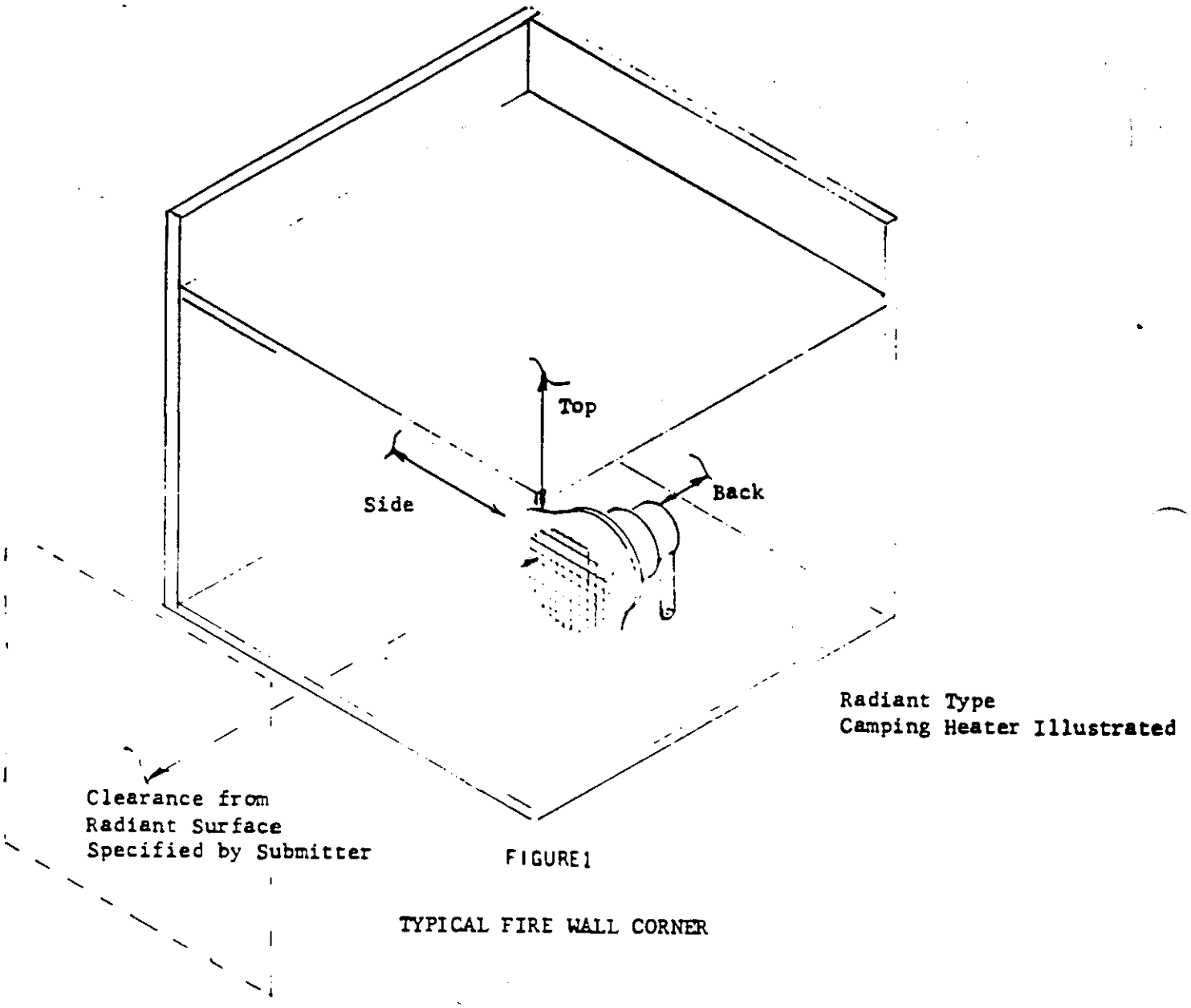


Figure 1. Typical Fire Wall Corner

FIGURES

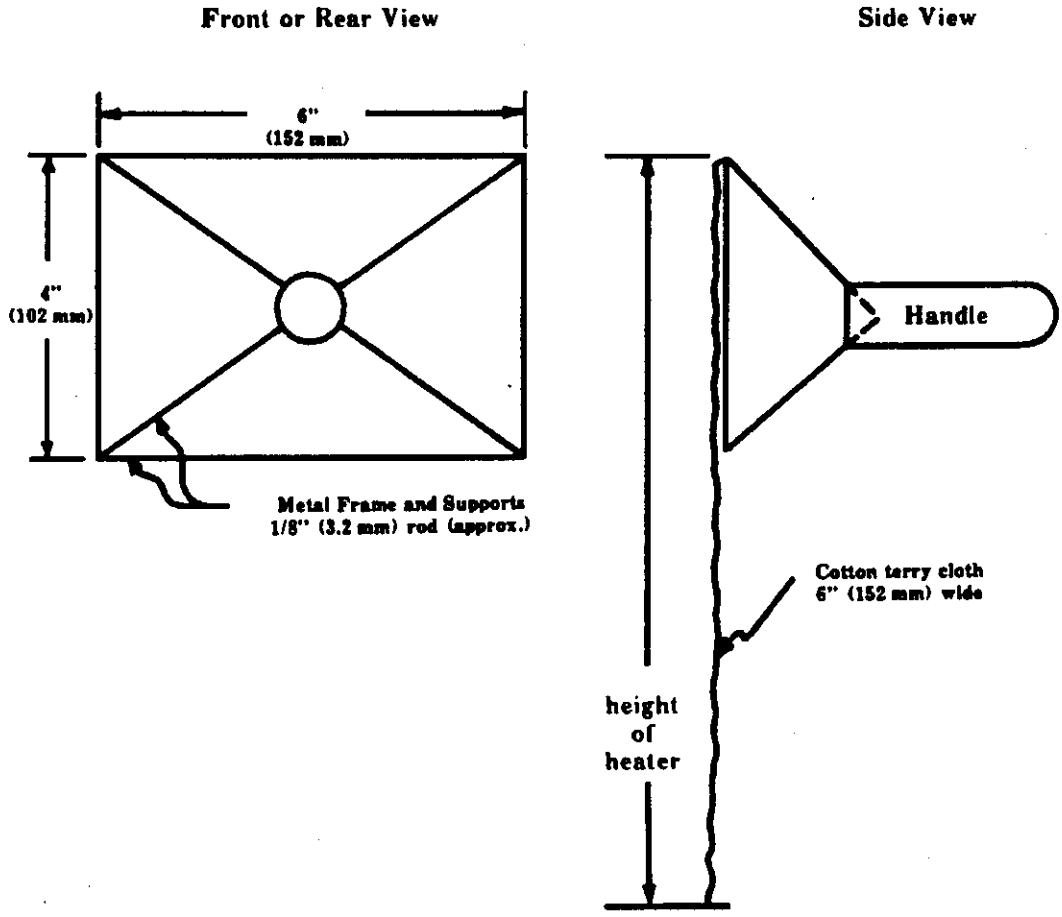


Figure 2. Probe for Evaluation of Clothing Ignition Potential

Rationale: Addition of Figure 2 for Evaluation of Clothing Ignition Potential.

distributed with the August 1998 review and comment text and provides background information on the proposed coverage.

Summary

The proposed revisions contained herein were recommended to the Z21/83 Committee by the Z21/(Interim CSA) joint water heater subcommittee.

Revisions to the volume I water heater standard, Z21.10.1•CSA 4.1:

May 1998 and Appendix A to the July 28-29, 1998 meeting

1. Completely eliminate the use of asbestos in the construction of water heaters (1.2.5);
2. Eliminate repetition within the standard by combining the separate references for construction and performance compliance (to each of the control standards), into single references (present 1.11.1, 1.16.1, 1.17.2, 1.19, 1.20, 1.22.1, 1.23.1, 2.6.1, 2.7.1, 2.8.1, 2.11, 2.12, 2.13, 2.14, 2.16.1, 2.16.2, 2.17, 2.18). References to the control standards have been simultaneously updated;
3. Specify a thermometer 6 inches from the top of the storage vessel to measure the water temperature rather than 1 inch from the outlet connection of the tank, on the basis that water temperatures are uniform throughout the tank during this calibration test for dial type thermostats (present 2.14.2). Present 2.15.3 is deleted as it is redundant to 2.14.2;
4. Specify placement of a thermocouple immediately after the flow restricting device, as the appropriate location where the water is thoroughly mixed when the temperature is measured during conduct of the Storage Temperature Limits tests (2.15);
5. Clarify use of a bead type thermocouple under the legs or base of an appliance during conduct of the Wall, floor and Ceiling Temperature tests (present 2.20);
6. Add a definition for "Safety Shutdown" (Part IV Definitions) for clarification; and

August 1998 and Appendix A to the January 19-20, 199 meeting

7. Add a method of test to evaluate a water heater designs ability to resist the ignition of flammable vapors outside the confines of the water heater (2.38, Figure 1, Figure 2, Figure 3 and Figure 4).

ITEM 18.
Z21/83 Committee Meeting
April 15, 1999

PROPOSED REVISIONS TO AMERICAN NATIONAL STANDARD/ CSA STANDARD FOR GAS WATER HEATERS, VOLUME I, STORAGE WATER HEATERS WITH INPUT RATINGS OF 75,000 BTU PER HOUR OR LESS, Z21.10.1•CSA 4.1

Action Requested

Approval of proposed revisions to American National Standard/ CSA Standard For Gas Water Heaters, Volume I, Storage Water Heaters With Input Ratings Of 75,000 Btu Per Hour Or Less, Z21.10.1•CSA 4.1, and accompanying rationale statements. If approved by the Committee and ANSI, these revisions will be issued as the first addenda to 21.10.1•CSA 4.1-1998.

Proposed Revisions

Attached are copies of the following documents:

a. Proposed Revisions to American National Standard/ CSA Standard For Gas Water Heaters, Volume I, Storage Water Heaters With Input Ratings Of 75,000 Btu Per Hour Or Less, Z21.10.1•CSA 4.1, labeled "For Review and Comment Only" and distributed during May 1998;

b. Appendix A to the minutes of the July 28-29, 1998 meeting of the Z21/(Interim CSA) Joint Subcommittee on Standards for Gas Water Heaters, outlining changes to the proposed revisions following a review of comments received on Item "a" above;

c. Proposed Revisions to American National Standard/ CSA Standard For Gas Water Heaters, Volume I, Storage Water Heaters With Input Ratings Of 75,000 Btu Per Hour Or Less, Z21.10.1•CSA 4.1, labeled "GAMA Test Method" and distributed For Review and Comment Only during August 1998;

d. Excerpts from Appendix A to the minutes of the January 19-20, 1999 meeting of the Z21/(Interim CSA) Joint Subcommittee on Standards for Gas Water Heaters, outlining changes to the proposed revisions following a review of comments received on Item "c" above; and

e. "Prefatory Statement for the GAMA Test Method". This information was

May 1998

FOR REVIEW AND COMMENT ONLY

Proposed revisions to

AMERICAN NATIONAL STANDARD/CSA STANDARD FOR GAS WATER HEATERS, VOLUME I, STORAGE WATER HEATERS WITH INPUT RATINGS OF 75,000 BTU PER HOUR OR LESS ANSI Z21.10.1• CSA 4.1

Note: The following draft revisions were adopted for distribution for review and comment by the Z21/CGA Joint Subcommittee on Standards for Gas Water Heaters at its August 13-14, 1997 meeting. These revisions are based on the harmonized Standard for Gas Water Heaters, Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less, ANSI Z21.10.1• CSA 4.1-1998, plus revisions recommended to the Z21/83 Committee at the August 13-14, 1997 meeting.

Additions and changes are "redlined" (underlined) and "strike-out" is used to show deletions (e.g., ~~proposed deletion~~).

a. Ⓟ$_1$ for an appliance having a pilot gas flow rate less than 0.50 but not less than 0.15 cubic foot per hour (less than 3.93 but not less than 1.18 cm^3/s); or

b. Ⓟ$_2$ or ▽$_3$ for an appliance having a pilot gas flow rate of 0.50 cubic foot per hour (3.93 cm^3/s) or greater.

RATIONALE: See "RATIONALE" following 1.11.1.

1.19 THERMOSTATS

Automatic storage type water heaters shall be equipped with a thermostatic control, mounted on the tank.

Thermostats shall be accessible for servicing or replacement and shall comply with ~~the applicable construction provisions~~ of the Standard for *Gas Appliance Thermostats, ANSI Z21.23*, or the Standard *CAN1-6.6, Gas Appliance Thermostats,* or the Standard *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CGA 6.20* and if electric switch type the safety Standard for *Temperature Indicating and Regulating Equipment, ANSI/UL 873* or CSA Standard *C22.2 No. 24, Temperature-Indicating And -Regulating Equipment.*

A thermostat shall have no setting higher than 180°F (82°C).

RATIONALE: See "RATIONALE" following 1.11.1.

1.20 AUTOMATIC VALVES

Automatic valves, when provided, shall be accessible for servicing and replacement and shall comply with ~~the applicable construction provisions~~ of the Standard for *Automatic Valves for Gas Appliances, ANSI Z21.21 • CGA 6.5* or *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CGA 6.20.*

RATIONALE: See "RATIONALE" following 1.11.1.

1.22 AUTOMATIC GAS SHUTOFF SYSTEMS

1.22.1 Each water heater shall be provided with an automatic gas shutoff system actuated by high water temperature as an integral part of the appliance. The automatic gas shutoff system shall be accessible for servicing or replacement and shall incorporate an automatic gas shutoff device which complies with ~~the applicable construction provisions~~ of the Standard for *Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22* or *CAN1-4.6, Automatic Gas Shut-Off Valves And Devices For Hot Water Supply Systems.*

RATIONALE: See "RATIONALE" following 1.11.1.

PART I
CONSTRUCTION

1.2 GENERAL CONSTRUCTION AND ASSEMBLY

1.2.5 Asbestos shall not be used in the construction of a water heater~~, unless it is contained, protected or combined in a binder material in a manner which will not permit asbestos fibers to become airborne under normal conditions of appliance use.~~

RATIONALE: The proposed revisions are intended to eliminate the use of asbestos in the construction of water heaters.

1.11 AUTOMATIC GAS IGNITION SYSTEMS

1.11.1 Automatic gas ignition systems (see Part IV, Definitions) and components shall comply with ~~the applicable construction provisions~~ of the Standard for *Automatic Gas Ignition Systems and Components, ANSI Z21.20* or *CAN1-6.4* or *CSA C22.2, No. 199, Combustion Safety Controls and Solid State Igniters for Gas and Oil Burning Equipment.*

If a piezo-electric spark device is used for pilot burner ignition, it shall comply with the American National Standard for *Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components, ANSI Z21.77 •CGA 6.23.*

RATIONALE: The proposed revisions are intended to eliminate repetition within the standard and be consistent with coverage in other harmonized appliance standards.

1.16 MANUALLY OPERATED GAS VALVES

1.16.1 Gas valves shall comply with ~~the applicable construction provisions~~ of the Standard for *Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves, ANSI Z21.15 • CGA 9.1* or the Standard for *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CGA 2.20.*

RATIONALE: See "RATIONALE" following 1.11.1.

1.17 GAS APPLIANCE PRESSURE REGULATORS

1.17.2 Gas appliance pressure regulators, including vent limiters when so equipped, shall comply with ~~the applicable construction provisions~~ of the Standard for *Gas Appliance Pressure Regulators, ANSI Z21.18 • CGA 6.3* or the Standard *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CGA 6.20.*

When a single gas appliance pressure regulator is used to control the pressure of both the pilot and main burner gas, it shall be of the type suitable for pilot and main burner load application as designated by the following symbol adjacent to the regulator model number:

PART II
PERFORMANCE

2.6 PILOTED IGNITION SYSTEMS

~~2.6.1 Pilot burners and safety shutoff devices shall comply with the applicable performance provisions of the Standard for *Automatic Gas Ignition Systems and Components, ANSI Z21.20* or *CAN1-6.4* or *CSA C22.2 No. 199, Combustion Safety Controls and Solid State Igniters for Gas and Oil Burning Equipment.*~~

~~If a piezo electric spark device is used for pilot burner ignition, it shall comply with the American National Standard for *Manually Operated Piezo Electric Spark Gas Ignition Systems and Components, ANSI Z21.77i•iCGA 6.23* or Standard *CAN1-6.4.*~~

(Present 2.6.2 through 2.6.12 become 2.6.1 through 2.6.11, unchanged.)

RATIONALE: See "RATIONALE" following 1.11.1.

2.7 PROVED IGNITION SYSTEMS

This section is applicable to a proved igniter which provides for ignition of the main burner gas.

~~2.7.1 Proved ignition systems shall comply with the applicable performance provisions of the Standard for *Automatic Gas Ignition Systems and Components, ANSI Z21.20* or *CSA C22.2 No. 199, Combination Safety Controls and Solid State Igniters for Gas and Oil Burning Eqipment.*~~

(Present 2.7.2 through 2.7.8--- become 2.7.1 through 2.7.7---, unchanged.)

RATIONALE: See "RATIONALE" following 1.11.1.

2.8 DIRECT IGNITION SYSTEMS

~~2.8.1 Direct ignition systems shall provide a valve sequence period of not more than 60 seconds and shall comply with the applicable performance provisions of the Standard for *Automatic Gas Ignition Systems and Components, ANSI Z21.20* or the Standard *CAN1-6.4* or *CSA C22.2 No. 199, Combination Safety Controls and Solid State Igniters for Gas and Oil Burning Eqipment.* For purposes of this test, the control manufacturer's specified maximum trial for ignition period and maximum valve sequence period shall be used.~~

(Present 2.8.2 through 2.8.7 become 2.8.1 through 2.8.6., unchanged.)

RATIONALE: See "RATIONALE" following 1.11.1.

1.23 RELIEF VALVES

For units destined for use in Canada, also refer to Exhibit G, Items Unique to Canada.

For units destined for use in the United States, also refer to Exhibit F, Items Unique to the United States.

1.23.1 Relief valves shall be accessible for servicing or replacement, and shall comply with ~~the applicable construction provisions~~ of the Standard for *Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22*, or the Standard *CAN1-4.4, Temperature, Pressure, Temperature And Pressure Relief Valves And Vacuum Relief Valves*.

RATIONALE: **See "RATIONALE" following 1.11.1.**

water temperature at the outlet connection shall be observed, and if this temperature is not 120 ±5°F (49 ±3°C), adjustment shall be made and the above procedure repeated until a water temperature within the limits specified is obtained.

The temperature of the water shall then be decreased to 70 ±2°F (21 ±1°C), and the thermostat dial set at the lowest marked position on the dial. The gas shall again be ignited and the outlet temperature at which the main gas supply is reduced to a minimum, or is shut off, observed. The outlet water temperature shall be within ±10°F (±5.5°C), of the temperature specified by the appliance manufacturer for the dial setting. This procedure shall be repeated with the thermostat set to the maximum position at which it can be set by the user. At this setting, the outlet water temperature shall be within ±10°F (±5.5°C) of the temperature specified by the appliance manufacturer for that setting.

RATIONALE: **There is no water flow specified for this test, tank water temperatures are uniform from top to bottom thus eliminating the need for a thermocouple at the 1 inch level of the tank.**

(Present 2.15 becomes 2.12, unchanged)

2.~~15~~12 **STORAGE HEATER TEMPERATURE LIMITS**

When a separate nonadjustable thermostat in the upper part of the water heater is provided by the manufacturer to limit the water temperature in the top part of the tank, in addition to the thermostat used to control the operation of the appliance, both thermostats shall be considered as a single thermostat for test purposes under this section.

2.~~15~~12.~~1~~ When water heaters are intended to deliver water at a temperature not in excess of 160°F (71°C), the outlet water temperature shall not rise more than 30°F (16.5°C) above the initial water temperature, and in no case shall the outlet water temperature exceed 190°F (88°C) when tested as specified in the following Method of Test.

Method of Test

The temperature adjustment means on thermostats provided with adjustable features for consumer use shall be set against the high stop, and the thermostat shall not be recalibrated during any part of this test. Other types of thermostats shall be tested as received.

The system shall be filled with water at 65 ± 5°F (18.5 ± 3°C). A quick-acting valve shall be installed on the outlet connection of the storage vessel. The minimum cross-sectional area through this valve shall be equal to or greater than that of a $^1/_4$ inch (6.4 mm) nipple. A flow restricting device shall be connected to the outlet of this valve. The flow restricting device shall be adjusted or constructed so as to maintain a flow rate of 3 gallons per minute (11.36 L/min.) during test draw periods. A thermocouple shall be placed in the outlet flow stream immediately after the flow restricting device. ~~A mercury thermometer graduated to 1°F (0.5°C) or a suitable thermocouple shall be placed in the outlet flow stream as close to the outlet connection of the storage vessel as practical~~. A

~~2.11 MANUALLY OPERATED GAS VALVES~~

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

RATIONALE: See "RATIONALE" following 1.11.1.

~~2.12 GAS APPLIANCE PRESSURE REGULATORS~~

~~Gas appliance pressure regulators shall comply with the applicable performance provisions of the Standard for *Gas Appliance Pressure Regulators, ANSI Z21.18i•iCGA 6.3,* or the Standard for *Combination Gas Controls for Appliances, ANSI Z21.78i•iCGA 6.20.* The manufacturer's specified hourly Btu rating(s) of the water heater shall be within the range of regulation capacity (see Part IV) of the regulator as determined under the above standards.~~

RATIONALE: See "RATIONALE" following 1.11.1.

~~2.13 AUTOMATIC VALVES~~

~~Automatic valves, when provided, shall comply with the applicable performance provisions of the Standard for *Automatic Valves for Gas Appliances, ANSI Z21.21i•iCGA 6.5* and *Combination Gas Controls for Gas Appliances, ANSI Z21.78i•iCGA 6.20.*~~

RATIONALE: See "RATIONALE" following 1.11.1.

2.~~14~~11 THERMOSTATIC CONTROL

~~2.14.1 Thermostats shall comply with the applicable performance provisions of the Standard for *Gas Appliance Thermostats, ANSI Z21.23,* or *CAN1 6.6 Gas Appliance Thermostats,* as appropriate, or the Standard for *Combination Gas Controls for Gas Appliances, ANSI Z21.78i•iCGA 6.20.*~~

RATIONALE: See "RATIONALE" following 1.11.1.

2.~~14~~11.2 Dials of thermostats provided with temperature markings shall be accurately calibrated.

Method of Test

A ~~mercury~~ thermometer shall be centrally located in the ~~graduated to 1°F (0.5°C) or a calibrated thermocouple shall be placed in the~~ storage vessel at a point 6 inches below the top of the tank ~~so the water temperature 1 inch (25.4 mm) from the outlet connection may be determined.~~ The system shall be filled with water at 70 ±2°F (21 ±1°C). The thermostat shall be set at the 120°F (49°C) setting, and the appliance operated at normal inlet test pressure until the gas supply is reduced to a minimum or, in the case of a snap-acting thermostat, until the main gas supply is shut off. The

During test, inlet water temperature shall be maintained at 65 ± 5°F (18.5 ± 3°C).

The appliance shall be operated at normal inlet test pressure with the test gas for which the highest rating is requested until the thermostat reduces the gas supply to the burner(s) to a minimum. The water temperature at the thermostat level shall be within the limits of 175-180°F (79.5-82°C). Water shall then be immediately drawn at the specified draw rate until the thermostat functions, and the maximum outlet temperature shall be recorded as the maximum initial temperature. This operation shall be repeated until a constant outlet water temperature is attained. When this condition has been reached the maximum outlet water temperature shall be recorded. The outlet water temperature shall not increase more than 20°F (11°C) above its maximum initial temperature, nor exceed 200°F (93.5°C).

RATIONALE: **In accordance with ASHRAE 41.1, the water should be thoroughly mixed before its temp is measured. This will be accomplished by placing the thermocouple immediately after the flow restricting device.**

2.15.3 Dials of thermostats provided with temperature markings shall be accurately calibrated.

Method of Test

A ~~mercury~~ thermometer shall be centrally located in the ~~graduated to 1EF (0.5EC) or a calibrated thermocouple shall be placed in the~~ storage vessel at a point 6 inches below the top of the tank ~~so the water temperature 1 inch (25.4 mm) from the outlet connection may be determined.~~ The system shall be filled with water at 70 ± 2EF (21±1°C). The thermostat shall be set at the 120°F (49°C) setting, and the appliance operated at normal inlet test pressure until the gas supply is reduced to a minimum or, in the case of a snap-acting thermostat, until the main gas supply is shut off. The water temperature at the outlet connection shall be observed, and if this temperature is not 120 ± 5°F (49 ± 3°C), adjustment shall be made and the above procedure repeated until a water temperature within the limits specified is obtained.

The temperature of the water shall then be decreased to 70 ± 2°F (21 ± 1°C), and the thermostat dial set at the lowest marked position on the dial. The gas shall again be ignited and the outlet temperature at which the main gas supply is reduced to a minimum, or is shut off, observed. The outlet water temperature shall be within ± 10°F (± 5.5°C), of the temperature specified by the appliance manufacturer for the dial setting. This procedure shall be repeated with the thermostat set to the maximum position at which it can be set by the user. At this setting, the outlet water temperature shall be within ± 10°F (± 5.5°C) of the temperature specified by the appliance manufacturer for that setting.

suitable thermocouple shall also be located in the storage vessel at the thermostat level. A water pressure regulator shall be located between the inlet connection to the storage vessel and the water supply line and adjusted so that, at a steady flow rate of 3 gallons per minute (11.36 L/min.), the pressure at the inlet connection will be 40 pounds per square inch (275.8 kPa). During the test, inlet water temperature shall be maintained at 65 ± 5°F (18.5 ± 3°C).

The appliance shall be operated at normal inlet test pressure with the test gas for which the highest rating is requested until the thermostat reduces the gas supply to the burner(s) to a minimum. The water temperature at the thermostat level shall be recorded. Water shall then be immediately drawn at the specified draw rate until the thermostat functions, and the maximum outlet temperature shall be recorded as the maximum initial temperature. This operation shall be repeated until a constant outlet water temperature is attained. When this condition has been reached, the maximum outlet water temperature shall be recorded. The outlet water temperature shall not increase more than 30°F (16.5°C) above its maximum initial temperature, nor exceed 190°F (88°C).

2.~~15~~12.2 When water heaters are intended to deliver outlet water at a temperature in excess of 160°F (71°C), the outlet water temperature shall not rise more than 20°F (11°C) above the initial water temperature, and in no case shall the outlet water temperature exceed 200°F (93.5°C) when tested as specified in the following Method of Test. (Also see 2.17.3 and 2.17.4.)

Method of Test

The appliance supplied for test shall be equipped with a thermostat calibrated between 175 and 180°F (79.5 and 82°C) at the thermostat level. The temperature adjustment means on thermostats provided with adjustable features for consumer used shall be set against the high stop, and it shall not be recalibrated during any part of this test. Other types of thermostats shall be tested as received.

The system shall be filled with water at 65 ± 5°F (18.5 ± 3°C). A quick-acting valve shall be installed on the outlet connection of the storage vessel. The minimum cross-sectional area through this valve shall be equal to or greater than that of a $^1/_4$ inch (6.4 mm) nipple. A flow restricting device shall be connected to the outlet of this valve. The flow restricting device shall be adjusted or constructed so as to maintain a flow rate of 3 gallons per minute (11.36 L/min.) during test draw periods. A thermocouple shall be placed in the outlet flow stream immediately after the flow restricting device. ~~A mercury thermometer graduated to 1°F (0.5°C) or a suitable thermocouple shall be placed in the outlet flow stream as close to the outlet connection of the storage vessel as practical~~. A suitable thermocouple shall also be located in the storage vessel at the thermostat level. A water pressure regulator shall be located between the inlet connection to the storage vessel and the water supply line and adjusted so that, at a steady flow rate of 3 gallons per minute (11.36 L/min.), the pressure at the inlet connection will be 40 pounds per square inch (275.8 kPa).

PART IV
DEFINITIONS

Safety Shutdown: The shutting off of the fuel as the result of the action of a safety control or the detection of an internal fault of the automatic gas ignition system.

RATIONALE: Used twice but not defined. Adding definition to clarify the standard.

RATIONALE: There is no water flow specified for this test, tank water temperatures are uniform from top to bottom thus eliminating the need for a thermocouple at the 1 inch level of the tank.

2.~~16~~ 13 TEMPERATURE LIMITING SYSTEMS

~~2.16.1 Automatic gas shutoff devices shall comply with the applicable performance provisions of the Standard for *Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22* or *CAN1 4.6, Automatic Gas Shut off Valves and Devices for Hot Water Supply Systems.*~~

RATIONALE: See "RATIONALE" following 1.11.1.

~~2.16.2 Temperature relief valves and temperature relief elements of combination valves, when provided, shall comply with the applicable performance provisions of the Standard for *Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22* or *CAN1 4.4 Temperature, Pressure, Temperature and Pressure Relief Valves, and Vacuum Relief Valves.*~~

(Present 2.16.3 through 2.16.6 become 2.13.1 through 2.13.4, unchanged.)

RATIONALE: See "RATIONALE" following 1.11.1.

~~2.17 PRESSURE RELIEF VALVES~~

~~Pressure relief valves and pressure relief elements of combination valves, when supplied, shall comply with the applicable performance provisions of the Standard for *Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22* or *CAN1 4.4 Temperature, Pressure, Temperature and Pressure Relief Valves, and Vacuum Relief Valves.*~~

RATIONALE: See "RATIONALE" following 1.11.1.

~~2.18 VACUUM RELIEF VALVES~~

~~Vacuum relief valves, when provided, shall comply with the applicable performance provisions of the Standard for *Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22* or *CAN1 4.4, Temperature, Pressure, Temperature and Pressure Relief Valves, and Vacuum Relief Valves.*~~

(Present 2.19 through 2.38 become 2.16 through 2.35, unchanged.)

RATIONALE: See "RATIONALE" following 1.11.1.

PART I
CONSTRUCTION

1.2 GENERAL CONSTRUCTION AND ASSEMBLY

1.2.5 (Proposed text and "Rationale" statement, unchanged.)

1.11 AUTOMATIC GAS IGNITION SYSTEMS

1.11.1 Automatic gas ignition systems (see Part IV, Definitions) and components shall comply with ~~the applicable construction provisions of~~ the Standard for *Automatic Gas Ignition Systems and Components, ANSI Z21.20* or *CAN1-6.4* or *CSA C22.2, No. 199, Combustion Safety Controls and Solid State Igniters for Gas and Oil Burning Equipment.*

If a piezo-electric spark device is used for pilot burner ignition, it shall comply with the American National Standard for *Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components, ANSI Z21.77 •CGA 6.23.*

(Proposed "Rationale" statement, unchanged.)

1.16 MANUALLY OPERATED GAS VALVES

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

(Proposed "Rationale" statement, unchanged.)

1.17 GAS APPLIANCE PRESSURE REGULATORS

1.17.2 Gas appliance pressure regulators, including vent limiters when so equipped, shall comply with ~~the applicable construction provisions of~~ the Standard for *Gas Appliance Pressure Regulators, ANSI Z21.18 • CGA 6.3* or the Standard *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CGA 6.20.*

When a single gas appliance pressure regulator is used to control the pressure of both the pilot and main burner gas, it shall be of the type suitable for pilot and main burner load application as designated by the following symbol adjacent to the regulator model number:

a. Ⓟ$_1$ for an appliance having a pilot gas flow rate less than 0.50 but not less than 0.15 cubic foot per hour (less than 3.93 but not less than 1.18 cm^3/s); or

APPENDIX A

to the Minutes of the July 28-29, 1998 Meeting of

Z21/(INTERIM CSA) JOINT SUBCOMMITTEE ON STANDARDS FOR GAS WATER HEATERS

Note: The proposed revisions to the harmonized Standard for Gas Water Heaters, Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less, distributed for review and comment during May 1998, were recommended to Accredited Standards Committee Z21 and the (Interim CSA) Standards Steering Committee by the joint subcommittee. The proposed revisions are based on the harmonized Standard for Gas Water Heaters, Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less, ANSI Z21.10.1•CSA 4.1-1998, and proposed Z21.10.1a•CSA 4.1a-.

Additions are "redlined" (shaded and underlined) and "strike-out" is used to show deletions (e.g. ~~proposed deletion~~).

For units destined for use in the United States, also refer to Exhibit F, Items Unique to the United States.

1.23.1 Relief valves shall be accessible for servicing or replacement, and shall comply with ~~the applicable construction provisions of~~ the Standard for *Relief Valves ~~and Automatic Gas Shutoff Devices~~ for Hot Water Supply Systems, ANSI Z21.22•CSA 4.4*~~, or the Standard CAN1-4.4, Temperature, Pressure, Temperature And Pressure Relief Valves And Vacuum Relief Valves~~.

(Proposed "Rationale" statement, unchanged.)

b. Ⓟ2 or ▽3 for an appliance having a pilot gas flow rate of 0.50 cubic foot per hour (3.93 cm^3/s) or greater.

(Proposed "Rationale" statement, unchanged.)

1.19 THERMOSTATS

Automatic storage type water heaters shall be equipped with a thermostatic control, mounted on the tank.

Thermostats shall be accessible for servicing or replacement and shall comply with ~~the applicable construction provisions of~~ the Standard for *Gas Appliance Thermostats, ANSI Z21.23*, or the Standard *CAN1-6.6, Gas Appliance Thermostats,* or the Standard *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CGA 6.20* and if electric switch type the safety Standard for *Temperature Indicating and Regulating Equipment, ANSI/UL 873* or CSA Standard *C22.2 No. 24, Temperature-Indicating And -Regulating Equipment.*

A thermostat shall have no setting higher than 180°F (82°C).

(Proposed "Rationale" statement, unchanged.)

1.20 AUTOMATIC VALVES

Automatic valves, when provided, shall be accessible for servicing and replacement and shall comply with ~~the applicable construction provisions of~~ the Standard for *Automatic Valves for Gas Appliances, ANSI Z21.21 • CGA 6.5* or *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CGA 6.20.*

(Proposed "Rationale" statement, unchanged.)

1.22 AUTOMATIC GAS SHUTOFF SYSTEMS

1.22.1 Each water heater shall be provided with an automatic gas shutoff system actuated by high water temperature as an integral part of the appliance. The automatic gas shutoff system shall be accessible for servicing or replacement and shall incorporate an automatic gas shutoff device which complies with ~~the applicable construction provisions~~ of the Standard for ~~*Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22 or CAN1-4.6, Automatic Gas Shut-Off Valves And Devices For Hot Water Supply Systems*~~ Z21.87/CSA 4.6

(Proposed "Rationale" statement, unchanged.)

1.23 RELIEF VALVES

For units destined for use in Canada, also refer to Exhibit G, Items Unique to Canada.

'roposed "Rationale" statement, unchanged.)

(2.13, Automatic Valves, deleted as proposed.)

(Proposed "Rationale" statement, unchanged.)

2.~~14~~ 12 THERMOSTATIC CONTROL

(2.14.1 deleted as proposed.)

(Proposed "Rationale" statement, unchanged.)

2.~~14~~12.~~2~~ Dials of thermostats provided with temperature markings shall be accurately calibrated.

Method of Test

A ~~mercury~~ thermometer shall be centrally located in the ~~graduated to 1°F (0.5°C) or a calibrated thermocouple shall be placed in the~~ storage vessel at a point 6 inches below the top of the tank; ~~so the water temperature 1 inch (25.4 mm) from the outlet connection may be determined.~~ The system shall be filled with water at 70 ±2°F (21 ±1°C). The thermostat shall be set at the 120°F (49°C) setting, and the appliance operated at normal inlet test pressure until the gas supply is reduced to a minimum or, in the case of a snap-acting thermostat, until the main gas supply is shut off. The water temperature ~~at the outlet connection~~ in the tank shall be observed, and if this temperature is not 120 ±5°F (49 ±3°C), adjustment shall be made and the above procedure repeated until a water temperature within the limits specified is obtained.

The temperature of the water shall then be decreased to 70 ±2°F (21 ±1°C), and the thermostat dial set at the lowest marked position on the dial. The gas shall again be ignited and the ~~outlet temperature~~ water temperature in the tank at which the main gas supply is reduced to a minimum, or is shut off, observed. The water temperature in the tank ~~outlet water temperature~~ shall be within ±10°F (±5.5°C), of the temperature specified by the appliance manufacturer for the dial setting. This procedure shall be repeated with the thermostat set to the maximum position at which it can be set by the user. At this setting, the water temperature in the tank ~~outlet water temperature~~ shall be within ±10°F (±5.5°C) of the temperature specified by the appliance manufacturer for that setting.

(Proposed "Rationale" statement, unchanged.)

(Present 2.15 becomes 2.13, unchanged)

2.13 STORAGE HEATER TEMPERATURE LIMITS

When a separate nonadjustable thermostat in the upper part of the water heater is provided by the manufacturer to limit the water temperature in the top part of the tank, in addition to the thermostat used to control the operation of the appliance, both thermostats shall be considered as a single thermostat for test purposes under this section.

2.13.1 (Proposed text unchanged.)

PART II
PERFORMANCE

2.6 PILOTED IGNITION SYSTEMS

(2.6.1 deleted as proposed.)

(Present 2.6.2 through 2.6.12 become 2.6.1 through 2.6.11, unchanged.)

(Proposed "Rationale" statement, unchanged.)

2.7 PROVED IGNITION SYSTEMS

(Proposed introductory paragraph, unchanged.)

(2.7.1 deleted as proposed.)

(Present 2.7.2 through 2.7.8 become 2.7.1 through 2.7.7, unchanged.)

(Proposed "Rationale" statement, unchanged.)

2.8 DIRECT IGNITION SYSTEMS

2.8.1 Direct ignition systems shall provide a valve sequence period of not more than 60 seconds. ~~and shall comply with the applicable performance provisions of the Standard for *Automatic Gas Ignition Systems and Components, ANSI Z21.20* or the Standard *CAN1 6.4* or *CSA C22.2 No. 199, Combination Safety Controls and Solid State Igniters for Gas and Oil Burning Eqipment*. For purposes of this test, the control manufacturer's specified maximum trial for ignition period and maximum valve sequence period shall be used.~~

(Present 2.8.2 through 2.8.7, unchanged.)

(Proposed "Rationale" statement, unchanged.)

(2.11, Manually Operated Gas Valves, deleted as proposed.)

(Proposed "Rationale" statement, unchanged.)

2.11 GAS APPLIANCE PRESSURE REGULATORS

~~Gas appliance pressure regulators shall comply with the applicable performance provisions of the Standard for *Gas Appliance Pressure Regulators, ANSI Z21.18•CGA 6.3*, or the Standard for *Combination Gas Controls for Appliances, ANSI Z21.78•CGA 6.20.*~~ The manufacturer's specified hourly Btu rating(s) of the water heater shall be within the range of regulation capacity (see Part IV) of the regulator as determined under 1.17.2.

~~A mercury thermometer shall be centrally located in the graduated to 1EF (0.5EC) or a calibrated thermocouple shall be placed in the storage vessel at a point 6 inches below the top of the tank so the water temperature 1 inch (25.4 mm) from the outlet connection may be determined. The system shall be filled with water at 70 ± 2EF (21±1°C). The thermostat shall be set at the 120°F (49°C) setting, and the appliance operated at normal inlet test pressure until the gas supply is reduced to a minimum or, in the case of a snap acting thermostat, until the main gas supply is shut off. The water temperature at the outlet connection shall be observed, and if this temperature is not 120 ± 5°F (49 ± 3°C), adjustment shall be made and the above procedure repeated until a water temperature within the limits specified is obtained.~~

~~The temperature of the water shall then be decreased to 70 ± 2°F (21 ± 1°C), and the thermostat dial set at the lowest marked position on the dial. The gas shall again be ignited and the outlet temperature at which the main gas supply is reduced to a minimum, or is shut off, observed. The outlet water temperature shall be within ± 10°F (± 5.5°C), of the temperature specified by the appliance manufacturer for the dial setting. This procedure shall be repeated with the thermostat set to the maximum position at which it can be set by the user. At this setting, the outlet water temperature shall be within ± 10°F (± 5.5°C) of the temperature specified by the appliance manufacturer for that setting.~~

~~RATIONALE: There is no water flow specified for this test, tank water temperatures are uniform from top to bottom thus eliminating the need for a thermocouple at the 1 inch level of the tank.~~

2.~~16~~ 14 TEMPERATURE LIMITING SYSTEMS

2.16.1 (Deleted as proposed.)

(Proposed "Rationale" statement, unchanged.)

(Present 2.16.3 through 2.16.6 become 2.14.1 through 2.14.4, unchanged.)

(Proposed "Rationale" statement, unchanged.)

(2.17, Pressure Relief Valves, deleted as proposed.)

(Proposed "Rationale" statement, unchanged.)

(2.18, Vacuum Relief Valves, deleted as proposed.)

(Proposed "Rationale" statement, unchanged.)

(Present 2.19 become 2.15, unchanged.)

(Proposed "Rationale" statement, unchanged.)

2.13.2 When water heaters are intended to deliver outlet water at a temperature in excess of 160°F (71°C), the outlet water temperature shall not rise more than 20°F (11°C) above the initial water temperature, and in no case shall the outlet water temperature exceed 200°F (93.5°C) when tested as specified in the following Method of Test. (Also see 2.17.3 and 2.17.4.)

Method of Test

The appliance supplied for test shall be equipped with a thermostat calibrated between 175 and 180°F (79.5 and 82°C) at the thermostat level. The temperature adjustment means on thermostats provided with adjustable features for consumer use~~d~~ shall be set against the high stop, and it shall not be recalibrated during any part of this test. Other types of thermostats shall be tested as received.

The system shall be filled with water at 65 ± 5°F (18.5 ± 3°C). A quick-acting valve shall be installed on the outlet connection of the storage vessel. The minimum cross-sectional area through this valve shall be equal to or greater than that of a $^1/_4$ inch (6.4 mm) nipple. A flow restricting device shall be connected to the outlet of this valve. The flow restricting device shall be adjusted or constructed so as to maintain a flow rate of 3 gallons per minute (11.36 L/min.) during test draw periods. A thermocouple shall be placed in the outlet flow stream immediately after the flow restricting device. ~~A mercury thermometer graduated to 1°F (0.5°C) or a suitable thermocouple shall be placed in the outlet flow stream as close to the outlet connection of the storage vessel as practical.~~ A suitable thermocouple shall also be located in the storage vessel at the thermostat level. A water pressure regulator shall be located between the inlet connection to the storage vessel and the water supply line and adjusted so that, at a steady flow rate of 3 gallons per minute (11.36 L/min.), the pressure at the inlet connection will be 40 pounds per square inch (275.8 kPa).

During test, inlet water temperature shall be maintained at 65 ± 5°F (18.5 ± 3°C).

The appliance shall be operated at normal inlet test pressure with the test gas for which the highest rating is requested until the thermostat reduces the gas supply to the burner(s) to a minimum. The water temperature at the thermostat level shall be within the limits of 175-180°F (79.5-82°C). Water shall then be immediately drawn at the specified draw rate until the thermostat functions, and the maximum outlet temperature shall be recorded as the maximum initial temperature. This operation shall be repeated until a constant outlet water temperature is attained. When this condition has been reached the maximum outlet water temperature shall be recorded. The outlet water temperature shall not increase more than 20°F (11°C) above its maximum initial temperature, nor exceed 200°F (93.5°C).

(Proposed "Rationale" statement, unchanged.)

~~2.15.3 Dials of thermostats provided with temperature markings shall be accurately calibrated.~~

~~Method of Test~~

When vent arrangement Style II (Figure 2) will not accommodate the manufacturer's specified clearances from the back wall of the enclosure for an appliance with a horizontal flue outlet, vent arrangement Style IIA (Figure 2) shall be used for the conduct of this test.

This test shall be conducted at the increased inlet test pressure. Water flow shall be regulated to stabilize the outlet water temperature corresponding to the high stop setting of the thermostat, ±5°F (± 3°C).

Test Condition A

The appliance shall be operated until equilibrium temperature conditions are attained. For a draft hood equipped water heater, the outlet of the test vent shall be progressively restricted until the vent gas temperature measured one foot down from the outlet reaches a maximum. All mechanically vented and direct vent water heaters shall be installed with their maximum listed vent length. The appliance shall be operated until equilibrium temperature conditions are attained.

The temperature indicated by each thermocouple shall then be read and, when compared with room temperature, shall not be more than 117°F (65°C) for the walls and ceiling above room temperature. The temperatures on the floor under the water heater shall not exceed 90°F (50°C) above room temperature.

Test Condition B

The appliance shall be installed in a closet as specified in 2.1.8.

If the lighting instructions call for the opening or removal of any door(s) to light a pilot, this test shall be conducted with removable door(s) removed, any sliding door(s) or hinged door(s) left fully open unless self closing. If the water heater has an interlock that will prevent operation without the door(s) being in their normal position, the door(s) shall be returned to their normal position.

For a draft hood equipped water heater, the relief opening of the draft hood shall be blocked. The vent pipe shall be restricted to produce a CO_2 concentration equal to that obtained during the conduct of 2.26.1 or 2.29.1, as applicable. A mechanically vented water heater shall have its vent outlet restricted to the maximum point that will allow the main burner to operate.

The appliance shall be operated until equilibrium temperature conditions are attained.

The temperature indicated by each thermocouple shall then be read and, when compared with room temperature, shall not be more than 117°F (65°C) for the walls and ceiling above room temperature. The temperatures on the floor under the water heater shall not exceed 90°F (50°C) above room temperature.

(Present 2.21 through 2.38 become [redacted] through [redacted], unchanged.)

(Proposed "Rationale" statement, unchanged.)

2.~~20~~ 16 WALL, FLOOR AND CEILING TEMPERATURES

The temperature of walls, ceiling and floor adjacent to or in contact with the water heater shall not exceed room temperature by more than 117°F (65°C). The temperatures on the floor under the water heater shall not exceed 90°F (50°C) above room temperature when measured as specified in the following methods of tests.

On an appliance marked for use only in installations where the floors are noncombustible, the temperatures on the floor need not comply with this provision (see 1.32.12).

Direct vent water heaters and water heaters that comply with 2.9, Heat Roll Out safety Shutoff Means, shall be tested under Test Condition A. All other water heaters shall be tested under Test Condition A and B.

Method of Test

Wall and ceiling temperatures shall be determined by means of a potentiometer and bead-type thermocouples. The thermocouples shall be made by contact welding No. 24 AWG (0.20 mm) iron-constantan thermocouple wires and clipping off the free ends beyond the junction. The junction and $^{3}/_{8}$ inch (9.5 mm) of the lead shall be exposed on the test surface, the remainder of the lead extending through the wall. Thermocouples shall be secured to the wall surface by staples over the insulated portion of the leads and held in thermal contact with the surface by a radiation-transparent adhesive tape finished in dull black.

Thermocouples shall be placed at horizontal and vertical intervals of 6 inches (152 mm) on the wall and ceiling surfaces. Additional thermocouples may be located at any other points deemed necessary by the testing agency.

Floor temperatures shall be determined by means of No. 24 AWG (0.20 mm) iron-constantan thermocouples, the junctions of which are copper discs $^{11}/_{32}$ inch (8.7 mm) in diameter and 0.022 inch (0.559 mm) thick, to which the thermocouple wires are silver-soldered $^{1}/_{8}$ inch (3.2 mm) apart. The surface of the copper discs shall be finished with clear varnish. The discs shall be embedded so their surfaces are flush with the surface of the floor at intervals of not more than 3 inches (76.2 mm). A bead type thermocouple shall also be placed under the legs or base of the appliance.

RATIONALE: Clarification of current practice.

For a direct vent appliance, the junctions shall be placed flush with the surface of the appliance casing. For structural elements having a free surface in the stud space enclosing the appliance or vent-air intake pipe, or an exposed wall, floor and ceiling surface, the thermocouples shall be held in thermal contact with the wood surface by a radiation-transparent adhesive tape finished in dull black.

The appliance shall be installed as specified in 2.1.8, when vent arrangement Style I (Figure 2) will not accommodate the manufacturer's specified ceiling clearances for an appliance with a vertical flue outlet, vent arrangement Style IA (Figure 2) shall be used for the conduct of this test.

PART IV
DEFINITIONS

(Proposed definition "Safety Shutdown" and "Rationale" statement, unchanged.)

except as follows. When a manufacturer's supplied terminal(s) for either the air intake, vent exhaust, or both is designed for installation so that all combustion air is derived from the outside atmosphere, or all flue gases discharge to the outside atmosphere, or both, then the terminal(s) shall be installed in accordance with the manufacturer's installation instructions and terminate on the outside of the test chamber. The water heater shall be tested with all access doors in their normal position. If the lighting instructions call for the opening or removal of any door (s) to light the pilot, and if the main burner(s) will operate with those door(s) removed or opened, the tests shall be repeated with removable door(s) removed, and sliding or hinged door(s) left in a fully open position unless self-closing. The water heater shall be supplied with water at a temperature of 70 degrees F plus or minus 10 degrees F.
A quick acting valve shall be located outside of the test room and shall be adjusted or constructed so as to maintain a flow rate of 5 gallons per minute. The quick acting valve shall be arranged so that it will open automatically when the appliance thermostat reduces the gas supply to the burner(s) to a minimum and will close when the appliance thermostat functions.

The water heater thermostat shall be set at the 120 F mark and the water heater operated until the gas supply to the main burner(s) is reduced to a minimum. Initiate water draw off and allow the thermostat to function and ignite the main burner(s). Wait one (1) minute before spilling winter blend gasoline from a full one gallon container with the opening near the floor, as shown in **FIGURE 2**, in the direction of the water heater. The gasoline container shall be at a distance of 20 inches from the water heater as shown in **FIGURE 1**, before being tipped over. Immediately, begin to record the hydrocarbon concentration in the room. At one (1) minute after the spill, move the mannequin three (3) times back and forth over a three (3) foot path at a speed of 3 feet per second. Repeat the mannequin movement after one (1) minute elapses and at one (1) minute intervals until the end of the test . Allow the test to continue until, either a) the water heater main burner(s) and pilot (if equipped) are inoperative, and flammable vapors no longer burn within the water heater, or b) the hydrocarbon concentrations at all four sensors shown in Figure 4 are below 50 per cent of the lower flammability limit (LFL) of 1.5 percent butane.

Following this test, it shall be determined that either the water heater is not capable of being returned to normal operation or, if the water heater is capable of normal operation, there is no damage other than that of a superficial nature to the water heater wiring and controls, and no safety control (function) has been rendered inoperative. If the water heater is capable of normal operation it shall be used for the remaining tests described in this section. Components intended by the manufacturer to be field serviceable may be replaced between tests. If the water heater is not capable of being returned to normal operation, a new test sample shall be used for the remaining tests.

The previous test shall then be repeated using the summer blend gasoline. The test procedure is the same as that described above for the winter blend gasoline except for the following:

a. Summer blend gasoline replaces the winter blend
b. There shall be no movement of the mannequin, and
c. The direction of the gasoline spill shall be away from the water heater with the opening near the floor.

If the water heater is capable of being returned to normal operation at the completion of the winter blend and summer blend tests, it shall be tested and shall comply with section 2.4 Combustion.

PROPOSED REVISION TO AMERICAN NATIONAL STANDARD FOR GAS WATER HEATER, VOLUME 1, STORAGE WATER HEATERS WITH INPUT RATING OF 75,000 BTU PER HOUR OR LESS

2.38 (ADDED) FLAMMABLE VAPORS IGNITION RESISTANCE

The design of a water heater shall be such that it shall not ignite flammable vapors outside of the water heater created by the spilling of both winter and summer blends of gasoline on to the floor of the test room described in the following method of test. This provision does not apply to water heaters for installation in recreational vehicles only.

METHOD OF TEST

These tests shall be conducted at normal inlet test pressure and input rating . The tests shall be conducted under the following three conditions with summer blend gasoline with a Reid Vapor Pressure of no more than 8 PSI and winter blend gasoline with a Reid Vapor Pressure not less than 13 PSI.

TEST CONDITION 1

The water heater shall be installed in a 6 ft. X 10 ft. X 8 ft. high room equipped with a suitable access door. The walls, ceiling and door of the room shall be constructed of fire resistant materials and the floor shall be made of metal and leveled to prevent the gasoline from forming puddles. A diagram of the test room is shown in **FIGURE 1.** The test room shall have:

a. Means to control the temperature of the floor to 70 degrees F plus or minus 10 degrees F.
b. A combustion and ventilation air opening of 1 square inch per 1,000 BTUH of input located 12 inches from the ceiling in the area of the wall shown in **FIGURE 1.**
c. Means to spill a measured amount of gasoline onto a specified area of the floor, using the one gallon gasoline can shown in **FIGURE 2.**
d. Provisions to provide pressure relief of the test room as shown is **FIGURE 1.**
e. A mannequin resembling a young boy and measuring approximately 48 inches in height. The mannequin shall be standing with its' legs spread a distance of approximately 14 inches with hands on hips. The depth of the mannequin shall be approximately 9 inches. The mannequin shall be
f. equipped with a means to move it back and forth over a 3 foot long track at a rate of 3 feet per second.
g. Instruments to continuously measure the average floor temperature, ambient air temperature, water heater flue gas temperature, and the hydrocarbon concentration (measured as Butane) at the 4 points in the room, shown in **FIGURE 3.**
h. Means to observe the water heater under test from outside the room.
i. A suitable fire extinguishing system.
j. Means to verify the Reid vapor pressure of the gasoline prior to testing.

The water heater shall be located in the test room in the location shown in **FIGURE -1.** The water heater shall be tested with the venting arrangements described in 2.25.5, as shown in **FIGURE 3,**

shall be used for the remaining tests described in this section. Components intended by the manufacturer to be field serviceable may be replaced between tests. If the water heater is not capable of being returned to normal operation, a new test sample shall be used for the remaining tests.

The previous test shall then be repeated using the summer blend gasoline. The test procedure is the same as that described above for the winter blend gasoline except for the following:

a. Summer blend gasoline replaces the winter blend
b. There shall be no movement of the mannequin, and
c. The direction of the gasoline spill shall be away from the water heater with the opening near the floor.

If the water heater is capable of being returned to normal operation at the completion of the winter blend and summer blend tests, it shall be tested and shall comply with section 2.4 Combustion.

TEST CONDITION 2

The appliance shall be installed as described under **TEST CONDITION 1**. The water heater the thermostat shall be set at the 120F mark and the appliance permitted to operate until the thermostat acts to reduce the gas supply to the main burner(s) to a minimum. The quick acting water valve located in the outlet of the water heater shall be rendered inoperative. Winter blend gasoline shall then be spilled on to the floor of the test room in the manner described under **TEST CONDITION 1**. Immediately after spilling the gasoline the quick acting water valve is returned to service and a draw equal to 5 gallons per minute is placed on the heater. At one (1) minute after the spill, move the mannequin three (3) times back and forth over a three (3) foot path at a speed of 3 feet per second. Repeat the mannequin movement after one (1) minute elapses and at one (1) minute intervals until the end of the test. Allow the test to continue until, either a) the water heater main burner(s) and pilot (if equipped) are inoperative, and flammable vapors no longer burn within the water heater, or b) the hydrocarbon concentrations at all four sensors shown in Figure 4 are below 50 per cent of the lower flammability limit (LFL) of 1.5 percent butane.. Following this test, it shall be determined that either the water heater is not be capable of being returned to normal operation or, if the water heater is capable of normal operation, there is no damage other than that of a superficial nature to the water heater wiring and controls, and no safety control (function) has been rendered inoperative. If the water heater is capable of normal operation it shall be used for the remaining tests described in this section. Components intended by the manufacturer to be field serviceable may be replaced between tests. If the water heater is not capable of being returned to normal operation, a new test sample shall be used for the remaining tests.

The previous test shall then be repeated using the summer blend gasoline. The test procedure is the same as that described above for the winter blend gasoline except for the following:

a. Summer blend gasoline replaces the winter blend
b. There shall be no movement of the mannequin, and
c. The direction of the gasoline spill shall be away from the water heater with the opening near the floor.

If the water heater is capable of being returned to normal operation at the completion of the winter blend and summer blend tests, it shall be tested and shall comply with section 2.4 Combustion.

TEST CONDITION 3

The appliance is installed as described under **TEST CONDITION 1** and operated until the thermostat acts to reduce the gas supply to the main burner(s) to a minimum. The Main burner is then prevented from operating by placing the gas control in the PILOT position or through similar means. Winter blend gasoline shall then be spilled on to the floor of the test room in the manner described under TEST **CONDITION 1** . One (1) minute after the gasoline is spilled, move the mannequin three (3) times back and forth over a three (3) foot path at a speed of 3 feet per second. Repeat the mannequin movement after one (1) minute elapses and at one (1) minute intervals until the end of the test. Allow the test to continue until, either a) the pilot (or other ignition means if so equipped) is inoperative, and flammable vapors no longer burn within the water heater, or b) 2 (two) hours have elapsed since the spilling of the gasoline and no ignition of flammable vapors has occurred. Following this test, it shall be determined that either the water heater is not be capable of being returned to normal operation or, if the water heater is capable of normal operation, there is no damage other than that of a superficial nature to the water heater wiring and controls, and no safety control (function) has been rendered inoperative. If the water heater is capable of normal operation it

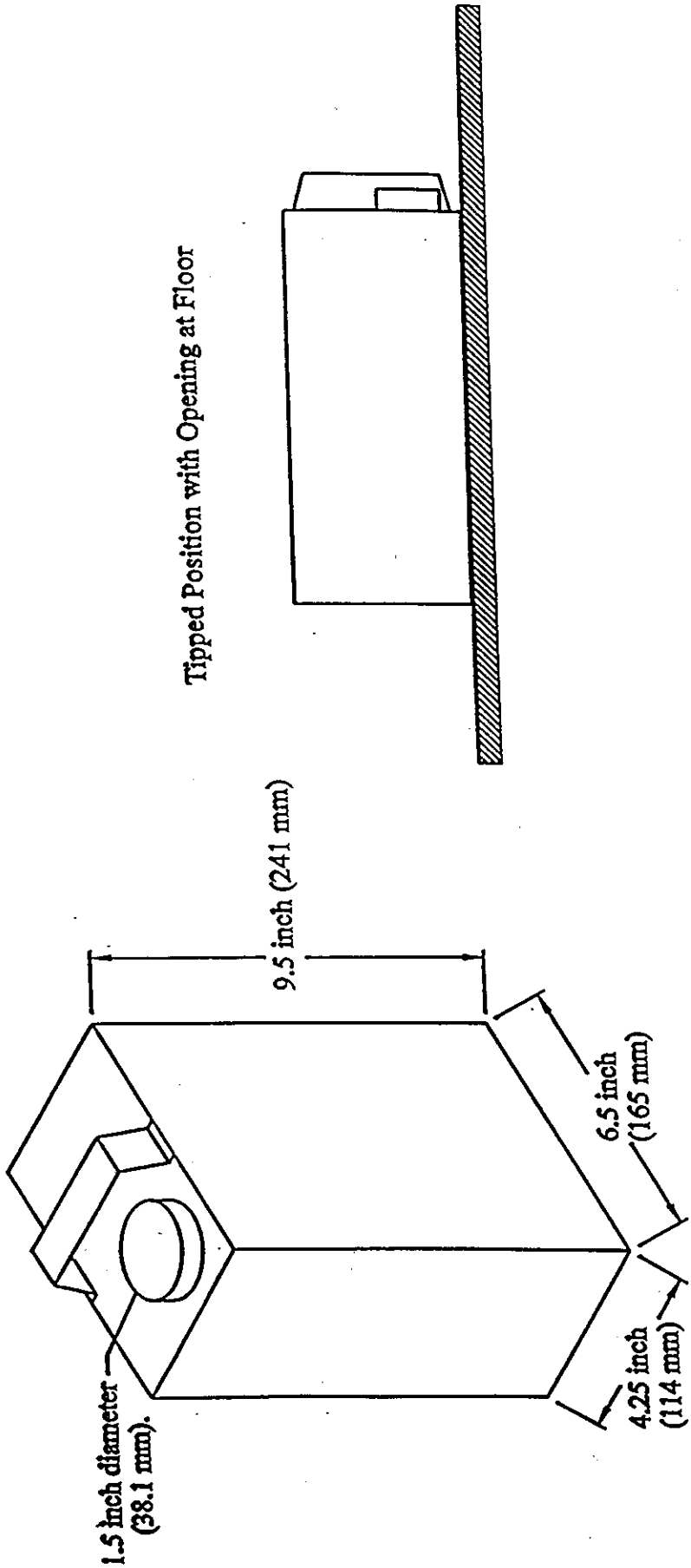


Figure 2 - Standard One Gallon Gas Can

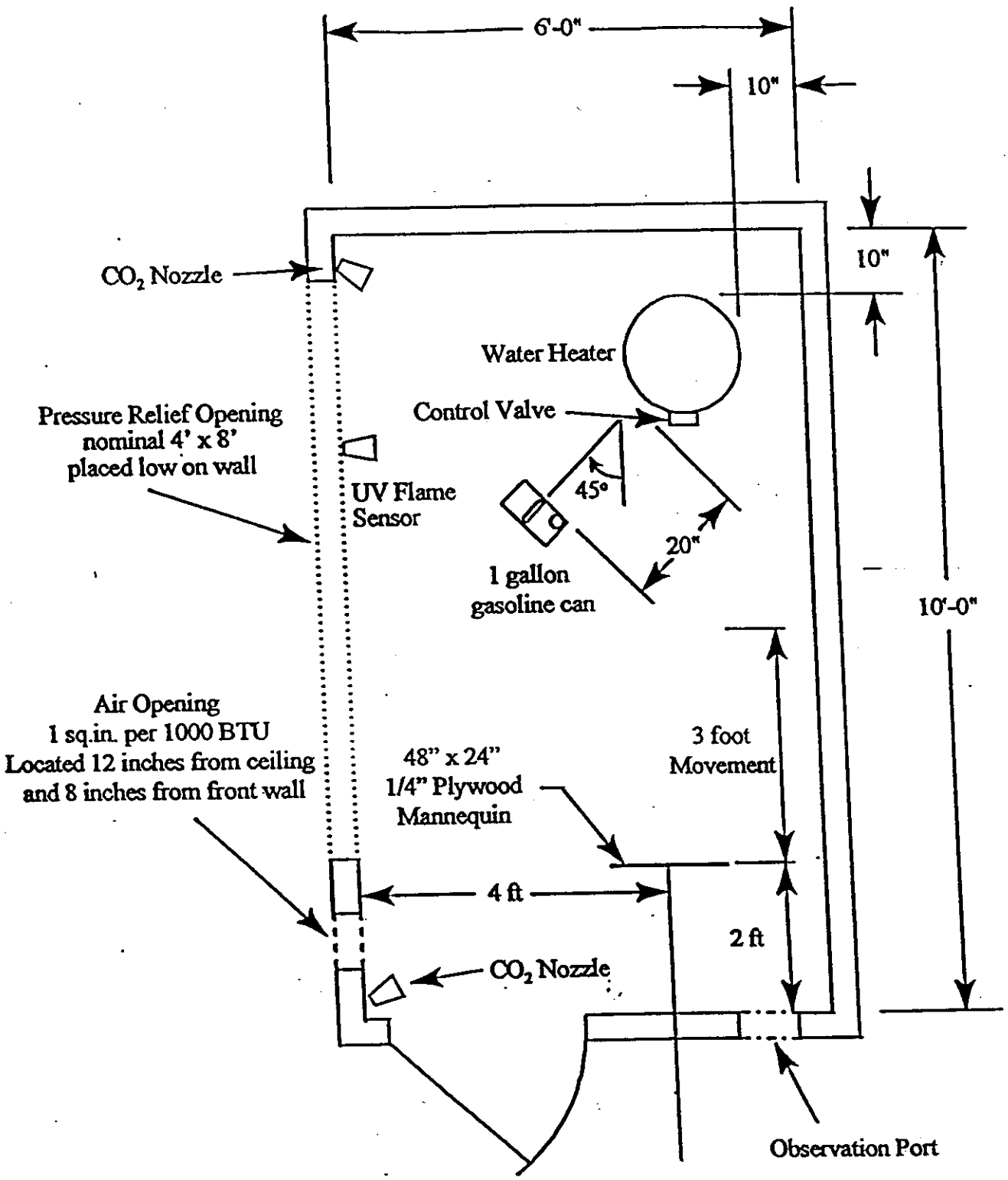


Figure 1 -Flammable Vapors Test Room

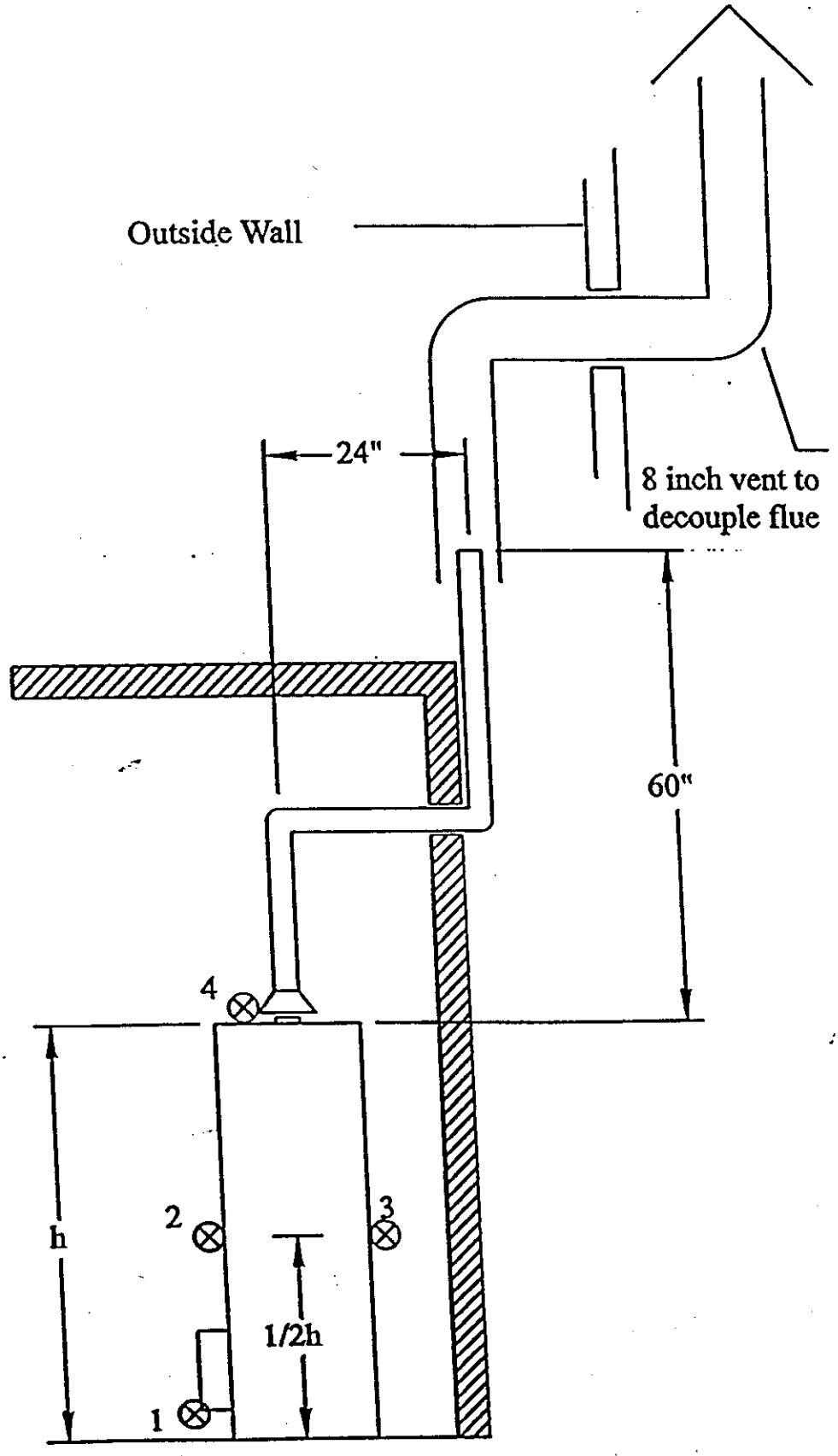


Figure 3 - Setup for Vent and Location of Hydrocarbon Sampling Points

mannequin shall be standing with its' legs spread apart a distance of approximately 17 ~~14~~ inches (432 mm) with hands on hips. The width of the mannequin shall be approximately 20 inches (508 mm). The depth of the mannequin shall be approximately 9 inches (2299 mm).

f. The mannequin shall be equipped with ~~a~~ means to move it back and forth over a straight 3 foot (.91 meter) ~~long track~~ path at a ~~rate~~ velocity of 3 feet (.91 meter) per second.

g. Instruments to continuously measure the following:
Average floor temperature
Ambient air temperature
The water heater's flue gas temperature
The bottom of flue gas baffle temperature *(if applicable)*
The inlet supply water temperature
The millivoltage output of the pilot *(if applicable)* ~~and~~
The hydrocarbon concentrations ~~(measured as Butane)~~ at the four (4) ~~points~~ tube sample locations in the room, shown in FIGURE 3.

h. Closed viewing means to observe the water heater under test from outside the room.

i. A suitable fire extinguishing system.

j. Means to verify the Reid vapor pressure of the gasoline prior to testing.

k. Means to control ambient air temperature inside the test room at the start of each test to 75 ± 5°F (24°C ± 3°C). The ambient air temperature outside the test room before, during and after each test shall be controlled to 75 ± 5°F (24°C ± 3°C).

The water heater shall be located in the test room in the location shown in FIGURE 1. The water heater shall be tested with the venting arrangements ~~described in 2.25.5, as~~ shown in FIGURE 3, except as follows. When a manufacturer's supplied terminal(s) for either the air intake, vent exhaust, or both ~~is~~ are designed for installation so that all ~~combustion~~ air is derived from the outside atmosphere, or all flue gases discharge to the outside atmosphere, or both, then the terminal(s) shall be installed in accordance with the manufacturer's installation instructions and terminate ~~on the~~ outside ~~of~~ the test room ~~chamber~~. The water heater shall be tested with all access doors in their normal position. If the lighting instructions call for the opening or removal of any door (s) to light the pilot, ~~and~~ if the main burner(s) will operate with those door(s) removed or opened, the tests shall be repeated with removable door(s) removed, and sliding or hinged door(s) left in a fully open position unless self-closing. The water heater shall be supplied with water at a temperature of ~~70 degrees F plus or minus 10 degrees F.~~ 70 ± 2°F (21 ± 1°C).

Hydrocarbon sample tubes shall be located in the test room on the water heater at the following locations: (See FIGURE 3):

1. At the lowest point in front of the water heater, on the side of the jacket not less than two (2) inches (51 mm) from the floor,
2. On the front of the water heater at a midpoint of the floor to jacket top height.

An energy cut-off device of the single use type shall not require more than one test as described above.

RATIONALE: Editorial revision correlate with terminology used through the standard.

2.38 (ADDED) FLAMMABLE VAPORS IGNITION RESISTANCE

The design of a water heater shall be such that it shall not ignite flammable vapors outside ~~of~~ the water heater created by the spilling of both winter and summer blends of gasoline onto the floor of the test room described in the following method of test. This provision does not apply to water heaters for installation in recreational vehicles only. The gasoline shall be tempered to 70 ± 2°F (21°C ± 1°C)

METHOD OF TEST

These tests shall be conducted at normal inlet test pressure and input rating. The tests shall be conducted under the following three conditions with summer blend gasoline with a Reid Vapor Pressure of no more than 8 psi and winter blend gasoline with a Reid Vapor Pressure not less than 13 psi. Gasoline should follow SAE, API and ASTM volatility grade definitions.

Prior to the first spill only, the water heater shall be filled with water at 70 ± 2°F (21 ± 1°C) and operated for 15 minutes at normal inlet test pressure. A sample of the flue gases shall then be secured at a point immediately preceding their discharge from the flue outlet of the water heater. The sample shall be analyzed and the carbon monoxide shall not be in excess of 0.04%, on an air free basis.

TEST CONDITION 1 (Main Burner Operation)
The water heater shall be installed according to the manufacturer's instructions in a 6 ft. x 10 ft. x 8 ft. (1.8 m x 3 m x 2.4 m) high room equipped with a suitable access door. The walls, ceiling and door of the room shall be constructed of fire resistant materials and the floor shall be made of corrosion resistant metal and leveled to prevent ~~the~~ gasoline from forming puddles. A diagram of the test room is shown in FIGURE 1. The test room shall have:

a. Means to control temperature of the floor to ~~70~~ 75 ± 5°F (24°C ± 3°C).

b. For water heaters that require air for combustion, ventilation, and dilution of flue gases from within the building:

   A combustion and ventilation air opening of ~~1~~ one (1) square inch (645 square mm) per 1,000 BTUH of input located 12 inches (305 mm) from the ceiling in the area of the wall shown in FIGURE 1.

c. Means to spill gasoline onto the floor (without splashing on the water heater) ~~a measured amount of gasoline onto a specified area of the floor~~, using the one (1) gallon (3.785 liter) gasoline ~~can~~ container shown in FIGURE 2.

d. Provisions to provide pressure relief of the test room as shown ~~is~~ in FIGURE 1.

e. A three-dimensional mannequin, as shown in Figure 4, ~~resembling a young boy and~~ measuring approximately 46 ~~48~~ inches (1168 mm) in height. The

2.2 TEST GASES

(Present "a" through "g" unchanged.)

h. When use with more than one gas is desired, the tests specified in 2.9 through 2.22 and 2.24, 2.25, 2.29, 2.36, 2.37 and 2.38 need be conducted with only one test gas provided there are no changes in the appliance or input rating which, in the opinion of the testing agency, would affect the results of these tests.

2.16 TEMPERATURE LIMITING SYSTEMS

2.16.4 An automatic gas shutoff system shall operate to shut off the gas to all burners, including the pilot burner(s), before the stored water temperature in the top 6 inches (152 mm) of the tank exceeds 210°F (99°C) when tested as specified in the following Method of Test.

Method of Test

When a separate nonadjustable thermostat in the upper part of the appliance is provided by the manufacturer to limit the water temperature in the top part of the tank in addition to the thermostat used to control the operation of the appliance, both thermostats shall be considered as a single thermostat for test purposes.

The appliance shall be set up for test as specified in 2.15.1 or 2.15.2, as applicable. In addition, a suitable thermocouple shall be centrally located in the storage vessel at a point 6 inches (152 mm) below the top of the tank and another thermocouple placed in the storage vessel so the water temperature within 1 inch (25.4 mm) of the temperature sensitive element of the automatic gas shutoff system can be determined.

The appliance shall be operated as specified in 2.15.1 or 2.15.2, as applicable. When a condition of constant outlet water temperature has been attained, the closing action of the thermostat(s) shall be nullified by blocking in the full open position or by other suitable means. The appliance shall be continued in operation until the automatic gas shutoff system functions or until the water temperature as indicated by the thermocouple 6 inches (152 mm) below the top of the tank exceeds 210°F (99°C), whichever occurs first. The temperature indicated by the thermocouple located adjacent to the temperature sensitive element of the automatic gas shutoff system shall also be recorded.

If the system is of the manual reset type, the water temperature indicated by the thermocouple adjacent to the temperature sensitive element of the system shall be adjusted to 120°F (49°C). The automatic gas shutoff system shall then be manually resettable to permit gas flow to the appliance.

This test shall be performed to obtain three determinations of cut-off temperature and reset temperature. This test shall be repeated at a flow rate of 25 percent of the ~~rated recovery capacity~~ recovery rating of the water heater to obtain three determinations of the cut-off and reset temperature under these conditions.

Excerpts from
APPENDIX A

to the Minutes of the January 19-20, 1999 Meeting of

Z21/(INTERIM CSA) JOINT SUBCOMMITTEE ON STANDARDS FOR GAS WATER HEATERS

Note: The proposed revisions to the harmonized Standard for Gas Water Heaters, Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less, distributed for review and comment during August 1998, were recommended to Accredited Standards Committee Z21/83 and the (Interim CSA) Standards Steering Committee by the joint subcommittee. The proposed revisions are based on the harmonized Standard for Gas Water Heaters, Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less, ANSI Z21.10.1•CSA 4.1-1998, plus proposed revisions recommended to the Z21/83 and the (Interim CSA) Standards Steering Committee at the joint subcommittees July 28-29, 1998 meeting.

intended by the manufacturer to be field serviceable may be replaced between tests. If the water heater is not capable of being returned to normal operation, a new ~~test sample shall~~ water heater may be used for the remaining tests.

Following each of the above tests, if the water heater is capable of normal operation, then the water heater shall be filled with water at 70 ± 2°F (21 ± 1°C). The water heater shall then be operated for 15 minutes at which time a sample of the flue gases shall be secured at a point immediately preceding their discharge from the flue outlet of the water heater. The sample shall then be analyzed and the carbon monoxide shall not be in excess of 0.04 percent, on an air free basis and the spread in CO_2 content in the flue gas sample measured before and after each test condition does not exceed 0.4 percent.

The previous test shall then be repeated using the summer blend gasoline. The test procedure is the same as that described above for the winter blend gasoline except for the following:

a. Summer blend gasoline replaces winter blend
b. There is ~~shall be~~ no movement of the mannequin, and
c. The ~~direction of the~~ gasoline ~~spill~~ container shall be tipped away from the water heater with the ~~opening near the floor~~ spout pointed in the direction of the tip.

~~If the water heater is capable of being returned to normal operation at the completion of the winter blend and summer blend tests, it shall be tested and shall comply with section 2.4 Combustion.~~

TEST CONDITION 2 (Main Burner Cycling)

(This test condition does not apply to water heaters equipped with a continuous ignition source.)

The ~~appliance~~ water heater shall be installed as described under TEST CONDITION 1. The ~~water heater the~~ thermostat shall be set at the ~~120F~~ 120°F (49°C) mark and the ~~appliance~~ water heater permitted to operate until the thermostat acts to reduce the gas supply to the main burner(s) to a minimum. ~~The quick acting water valve located in the outlet of the water heater shall be rendered inoperative. Winter Blend gasoline shall be spilled on to the floor of the test room in the manner described under Test Condition 1.~~ Set a one (1) gallon (3.785 liter) gasoline container, full of winter blend gasoline, 20 inches (51 mm) from the water heater. The spout of the container should be toward the water heater in the direction of the tip. (See FIGURE 1). Begin recording the flue gas temperatures, bottom of flue baffle temperatures *(if applicable)*, the millivoltage output of the pilot *(if applicable)* and hydrocarbon concentrations at the four (4) sample tube locations. Tip the gasoline container toward the water heater. (See FIGURE 2). Water shall ~~Immediately after spilling the gasoline the quick acting water valve is returned to service and a draw equal to 5 gallons per minute is placed on the heater. At one~~ then be drawn off at the specified flow rate. ~~At~~ One (1) minute after the spill, move the mannequin three (3) times back and forth over a straight three (3) foot (.91 meter) path at a ~~speed~~ velocity of three (3) feet (.91 meter) per second. Repeat the mannequin movement after one (1) minute elapses and at one (1) minute intervals until the end of the test. If the water heater cycles off on the thermostat, repeat the water draw cycle procedure. Allow the test to continue until, either a) the water heater's ~~main~~ burner(s) ~~and pilot (if equipped)~~ are ~~inoperative,~~ extinguished and ~~flammable vapors no longer burn within the water heater, or~~ there is no evidence of flame presence, b) the hydrocarbon

3. On the rear of the water heater at a midpoint of the floor to jacket top height.
4. On the top of the water heater's jacket.

If a manufacturer's supplied terminal for either the combustion air inlet and/or exhaust is designed for installation so that all combustion air is derived directly from the outside atmosphere and/or all flue gases discharge to the outside atmosphere, then the terminal shall be isolated from vapor concentrations.

A quick acting water valve shall be installed on the outlet water line located outside ~~of~~ the test room. ~~and~~ A flow restricting device shall be connected to the outlet of this valve. The flow restricting device shall be adjusted or constructed ~~so as~~ to maintain a flow rate of ~~5~~ 3 ± .25 gallons (11.36 ± .95 liters) per minute during water draw periods.

The water heater shall be filled with water at 70 ± 2°F (21 ± 1°C) and the thermostat ~~shall be set at~~ to the 120°F (49°C) mark. The water heater shall be operated until the gas supply to the main burner(s) is reduced to a minimum. ~~Initiate water draw off and allow the thermostat to function~~ Water shall then be drawn off at the specified flow rate until the thermostat functions and ~~ignite~~ the main burner(s) ignite. ~~Wait one (1) minute before spilling winter blend gasoline from a full one gallon container with the opening near the floor, as shown in FIGURE 2, in the direction of the water heater. The gasoline container shall be at a distance of 20 inches from the water heater as shown in FIGURE 1, before being tipped over.~~ Set a one (1) gallon (3.785 liter) gasoline container, full of winter blend gasoline, 20 inches (51 mm) from the water heater. The spout of the container should be toward the water heater in the direction of the tip. (See FIGURE 1). ~~Immediately~~ Begin ~~to~~ recording the flue gas temperatures, bottom of flue baffle temperatures *(if applicable)*, the millivoltage output of the pilot *(if applicable)* and hydrocarbon concentrations ~~in the room~~ at the four (4) sample tube locations. After the burners(s) have been in operation for at least one (1) minute, tip the gasoline container toward the water heater. (See FIGURE 2). ~~At~~ One (1) minute after the spill, move the mannequin three (3) times back and forth over a straight three (3) foot (.91 meter) path at a ~~speed~~ velocity of three (3) feet (.91 meter) per second. Repeat the mannequin movement after one (1) minute elapses and at one (1) minute intervals until the end of test. If the water heater cycles off on the thermostat, repeat the water draw cycle procedure. Allow the test to continue until, either a) the water heater's ~~main~~ burner(s) ~~and pilot (if equipped) are inoperative, and flammable vapors no longer burn within the water eater, or~~ are extinguished and there is no evidence of flame presence, ~~or~~ b) the hydrocarbon concentrations at all four (4) ~~sensors~~ sample tube locations shown in Figure ~~4~~ 3 are below 50 percent of the 1.8 percent lower flammability limit (LFL) of ~~1.5 percent~~ Butane, c) the water heater has operated in a flammable vapor rich environment for a substantial period of time and in the judgment of the testing agency the water heater will not ignite flammable vapors if allowed to continue to operate, or d) ignition of flammable vapors has occurred outside the water heater.

Following this test, it shall be determined that either the water heater is not capable of being returned to normal operation or, if the water heater is capable of normal operation, there is no damage other than that of a superficial nature to the water heater wiring and controls, and no safety control (function) has been rendered inoperative. If the water heater is capable of normal operation, it may ~~shall~~ be used for the remaining tests described in this section. Components

recording the flue gas temperatures, bottom of flue baffle temperatures *(if applicable)*, the millivoltage output of the pilot *(if applicable)* and hydrocarbon concentrations at the four (4) sample tube locations. Tip the gasoline container toward the water heater. (See FIGURE 2). One (1) minute after ~~the~~ gasoline is spilled, move the mannequin three (3) times back and forth over a straight three (3) foot (.91 meter) path at a ~~speed~~ velocity of three (3) feet (.91 meter) per second. Repeat the mannequin movement after one (1) minute elapses and at one (1) minute intervals until the end of ~~the~~ test. Allow the test to continue until, either a) the water heater's burner(s) are extinguished and there is no evidence of flame presence, ~~the pilot (or other ignition means if so equipped) is inoperative, and flammable vapors no longer burn within the water heater,~~ or b) ~~2 (two) hours have elapsed since the spilling of the gasoline and no~~ the hydrocarbon concentrations at all four (4) sample tube locations shown in Figure 3 are below 50 percent of the 1.8 percent lower flammability limit (LFL) of Butane, c) the water heater has been in the flammable vapor rich environment for a substantial period of time and in the judgment of the testing agency the water heater will not ignite flammable vapors if the test were to continue or d) ignition of flammable vapors has occurred outside the water heater~~.~~

Following this test, it shall be determined that either the water heater is not ~~be~~ capable of being returned to normal operation or, if the water heater is capable of normal operation, there is no damage other than that of a superficial nature to the water heater wiring and controls, and no safety control (function) has been rendered inoperative. If the water heater is capable of normal operation, it may ~~shall~~ be used for the remaining tests described in this section. Components intended by the manufacturer to be field serviceable may be replaced between tests. If the water heater is not capable of being returned to normal operation, a new ~~test sample shall~~ water heater may be used for the remaining tests.

Following each of the above tests, if the water heater is capable of normal operation, then the water heater shall be filled with water at 70 ± 2°F (21 ± 1°C). The water heater shall then be operated for 15 minutes at which time a sample of the flue gases shall be secured at a point immediately preceding their discharge from the flue outlet of the water heater. The sample shall then be analyzed and the carbon monoxide shall not be in excess of 0.04 percent, on an air free basis and the spread in CO_2 content in the flue gas sample measured before and after each test condition does not exceed 0.4 percent.

The previous test shall then be repeated using the summer blend gasoline. The test procedure is the same as that described above for the winter blend gasoline except for the following:

a. Summer blend gasoline replaces the winter blend
b. There shall be no movement of the mannequin, and
c. The ~~direction of the~~ gasoline container ~~spill~~ shall be away from the water heater with the ~~opening near the floor~~ spout pointed in the direction of the tip.

~~If the water heater is capable of being returned to normal operation at the completion of the winter blend and summer blend tests, it shall be tested and shall comply with section 2.4 Combustion.~~

concentrations at all four ~~sensors~~(4) sample tube locations shown in Figure 43 are below 50 percent of the 1.8 percent lower flammability limit (LFL) of ~~1.5 percent~~ Butane, c) the water heater has operated in a flammable vapor rich environment for a substantial period of time and in the judgment of the testing agency the water heater will not ignite flammable vapors if allowed to continue to operate, or d) ignition of flammable vapors has occurred outside the water heater.

Following this test, it shall be determined that either the water heater is not be capable of being returned to normal operation or, if the water heater is capable of normal operation, there is no damage other than that of a superficial nature to the water heater wiring and controls, and no safety control (function) has been rendered inoperative. If the water heater is capable of normal operation it ~~shall~~ may be used for the remaining tests described in this section. Components intended by the manufacturer to be field serviceable may be replaced between tests. If the water heater is not capable of being returned to normal operation, a new ~~test sample shall~~ water heater may be used for the remaining tests.

Following each of the above tests, if the water heater is capable of normal operation, then the water heater shall be filled with water at 70 ± 2°F (21 ± 1°C). The water heater shall then be operated for 15 minutes at which time a sample of the flue gases shall be secured at a point immediately preceding their discharge from the flue outlet of the water heater. The sample shall then be analyzed and the carbon monoxide shall not be in excess of 0.04 percent, on an air free basis and the spread in CO_2 content in the flue gas sample measured before and after each test condition does not exceed 0.4 percent.

The previous test shall then be repeated using the summer blend gasoline. The test procedure is the same as that described above for the winter blend gasoline except for the following:

a. Summer blend gasoline replaces the winter blend
b. There shall be no movement of the mannequin, and
c. The ~~direction of the~~ gasoline container ~~spill~~ shall be tipped away from the water heater with the spout pointed in the direction of the tip. ~~opening near the floor.~~

~~If the water heater is capable of being returned to normal operation at the completion of the winter blend and summer blend tests, it shall be tested and shall comply with section 2.4 Combustion.~~

TEST CONDITION 3 (Standby)

(This test condition only applies to water heaters equipped with a continuous ignition source.)

The ~~appliance~~ water heater is installed as described under TEST CONDITION 1 ~~and operated until the thermostat acts to reduce the gas supply to the main burner(s) to a minimum~~ . The thermostat shall be set at the 120°F (49°C) mark and the water heater permitted to operate until the thermostat acts to reduce the gas supply to the main burner(s) to a minimum. The main burner(s) shall not operate during this test. ~~main burner is then prevented from operating by placing the gas control in the PILOT position or through similar means. Winter blend gasoline shall then be spilled on to~~ Set a one (1) gallon (3.785 liter) gasoline container, full of winter blend gasoline, 20 inches (51 mm) from the water heater. The spout of the container should be toward the ~~floor of the test room in the manner described under TEST CONDITION 1.~~ water heater in the direction of the tip. (See FIGURE 1). Begin

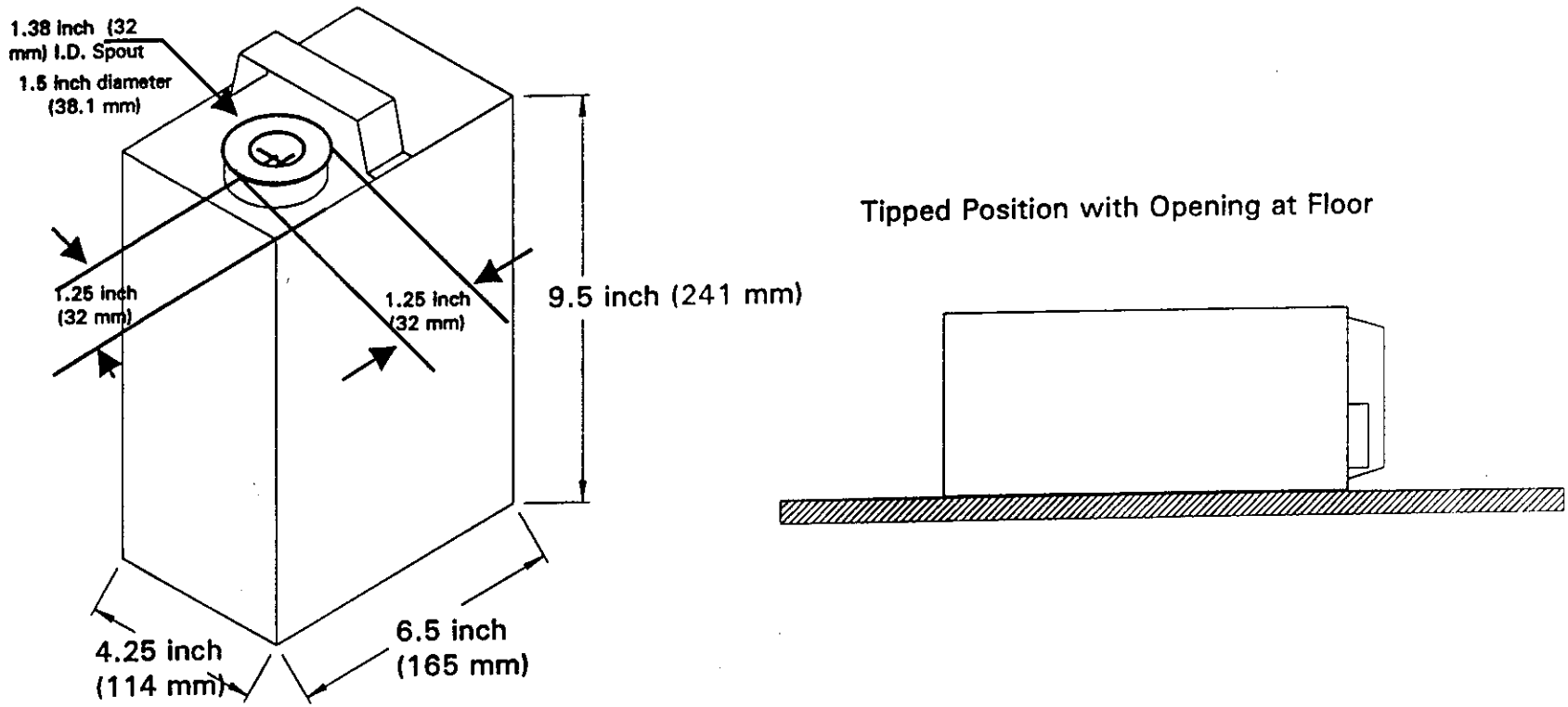


Figure 2 -Standard One Gallon (3.79 l) Gasoline Can

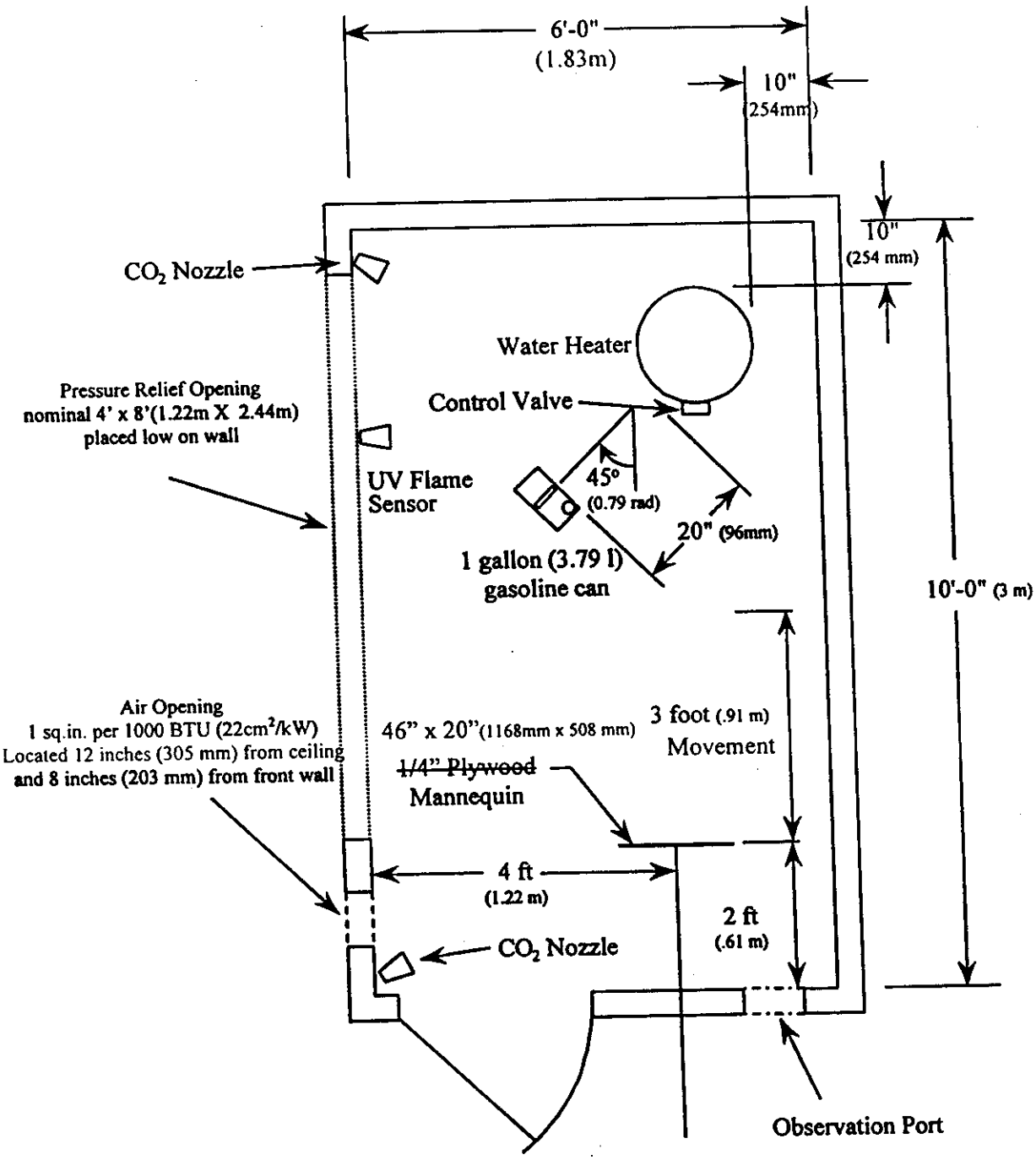


Figure 1 -Flammable Vapors Test Room

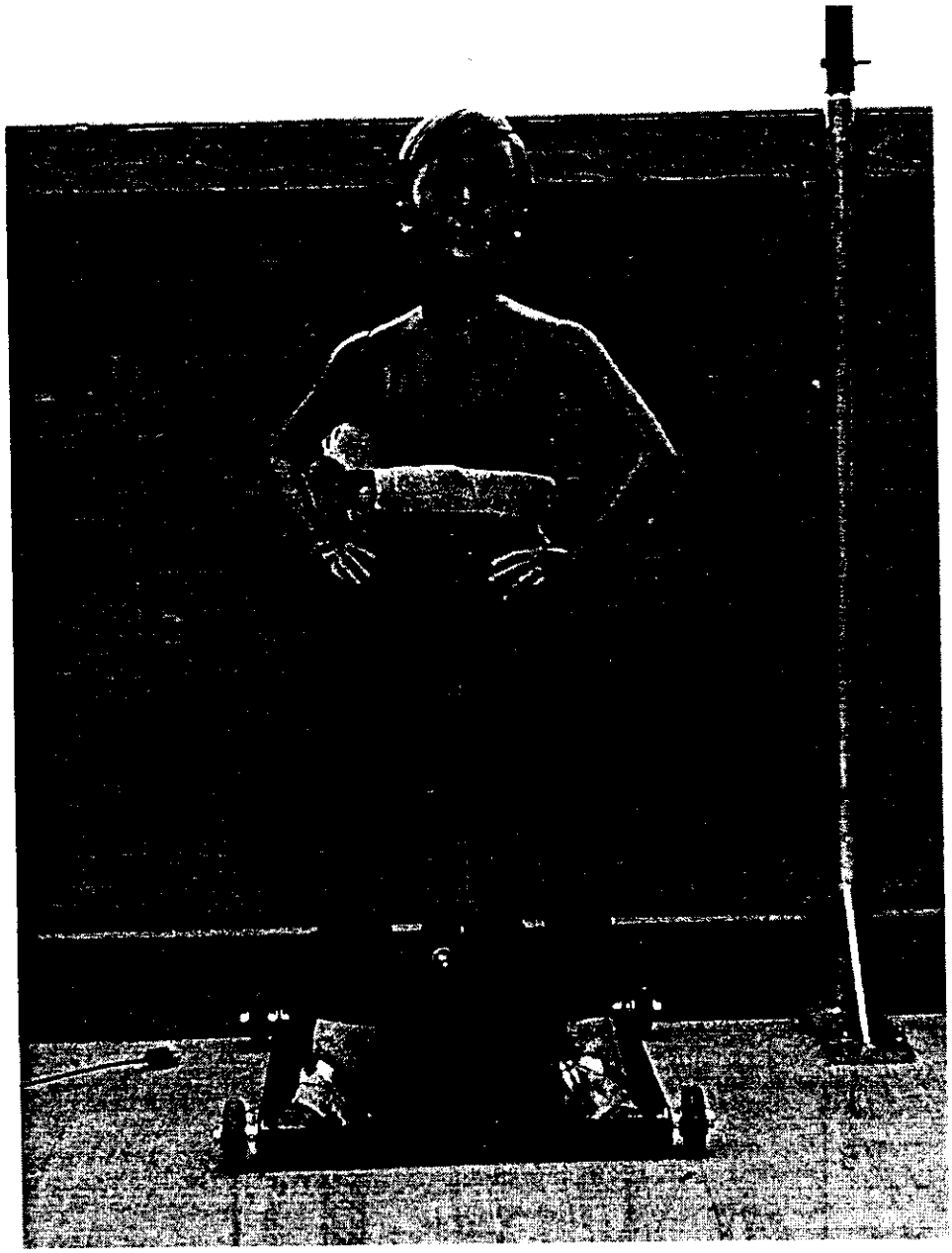


Figure 4. Mannequin

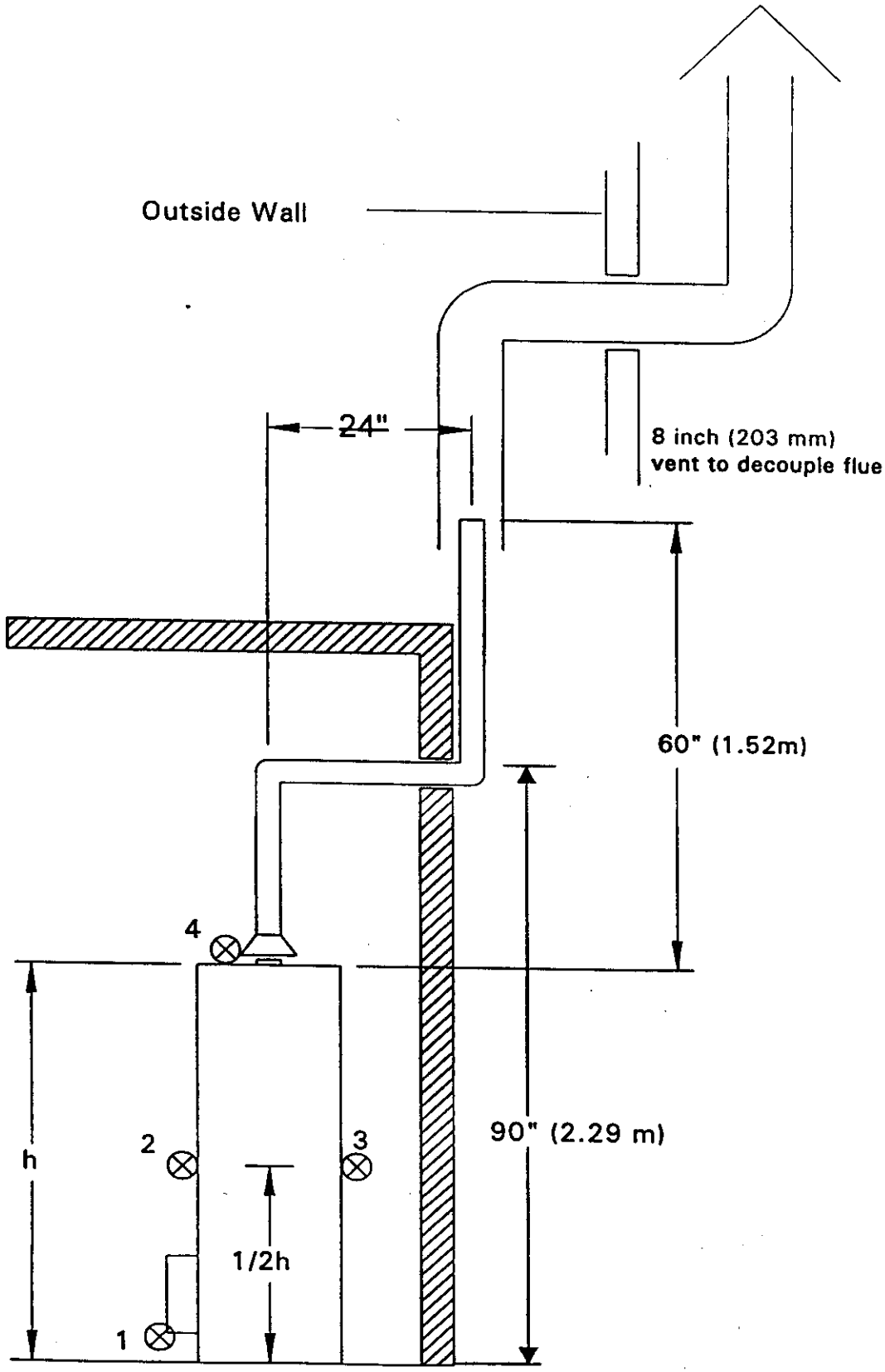


Figure 3. Setup for Vent and Location of Hydrocarbon Sampling Points

2.1 Typical Scenarios Identified

As a result of analyzing the incidents in a population of 53 million water heaters using the data bases shown above, there appear to be 7 typical scenarios where flammable vapors incidents with water heaters occur:

- 1 bathroom scenario,
- 2 utility room scenarios,
- 3 garage and basement scenarios and
- 1 garage scenario.

These scenarios occur in rooms ranging in size from small bathrooms up to larger rooms such as a garage. The casualty rate in small bathrooms was more than twice the average for all other gas-fired water heater flammable vapor ignition incidents.

The utility room scenarios are the second smallest room in which incidents were reported. The 2 utility room scenarios were characterized by:

- A 10 ft x 10 ft x 8 ft room,
- 1 gallon of gasoline for Scenario 1, spill outside room,
- 1-5 gallons of gasoline for Scenario 2, spill inside room,
- Movement was involved in Scenario 2 and
- Gas-fired water heater located in corner

In the detailed description of one actual Scenario 1 incident, a person using gasoline to remove stains from trousers performed the cleaning operation outdoors near an open door to the utility room. The day was windy and the person thought that would disperse the vapors. As the person lifted the trousers from the soak pot, a flame from the gas-fired water heater located behind a closed door ignited the gasoline flammable vapors. This incident highlights how air motion can amplify the danger from the flammable vapors.

Three garage and basement scenarios were characterized by:

- A 20 ft x 10 ft x 8 ft room,
- 1 quart - 5 gallons of gasoline,
- Activity or movement in the direct vicinity of the gas-fired water heater and
- Water heater located in corner.

One additional garage scenario was characterized by the following:

- A 20 ft x 10 ft x 8 ft room,
- Slow leakage of gasoline from a fuel tank,
- No activity or movement and
- Water heater in corner.

NOTE: The following material was submitted by theAGAResearch, A Division of Energy International, and adopted by the Z21/(Interim CSA) joint water heater subcommittee for distribution for review and comment at its July 28, 1998 meeting. The information expressed in this Attachment does not reflect any opinion of International Approval Services or the American Gas Association.

1. Objective

The objective of this report is to present the background, development and rationale for a test using gasoline to determine the resistance of gas-fired water heaters to ignite flammable vapors which are outside the appliance. This has been done by reviewing studies sponsored by the Gas Appliance Manufacturers Association (GAMA) and Gas Research Institute (GRI) that were aimed at identifying issues related to flammable vapors incidents. The report also compares and contrasts two test methods that are both currently being considered.

2. Background

The proposed gasoline-based tests to determine the resistance of a water heater to ignite flammable vapors both grew out of two related projects which were funded by the GRI and GAMA. The original test room at AGAResearch (AGAR) was built to support Task 2 of a GAMA project[1] conducted by A. D. Little (ADL). It was later used in support of a GRI project that was intended to develop a test method that uses butane as a surrogate for a flammable liquid spill[2]. The gasoline test method and test room has been improved continuously since then under funding from the Water Heater Consortium (WHC). The development of these test methods is a model of cooperative funding between GRI and the water heater industry.

The Gas Appliance Manufacturers Association (GAMA) began this overall research effort due to documented field problems involving property damage and injury to consumers. GAMA members then undertook a proactive program to improve consumer's awareness of the hazards associated with the misuse of gasoline with the consent of the US Consumer Products Safety Commission (CPSC). CPSC continues to monitor the development of a test to verify the resistance of water heaters to ignite flammable vapors outside the appliance, as well as the development of new water heater conceptual designs that are expected to pass it.

The first organized review of flammable vapors incidents involving gas-fired water heaters was sponsored by GAMA and conducted by ADL[3]. The overall goal of this effort was to develop a comprehensive document detailing the extent of the hazard and the effectiveness of mitigating measures. In performing this task, the following data resources were reviewed:

- 142 detailed incident reports from several sources (CPSC, NFPA & NEISS),
- National and state fire incident databases,
- 26 interviews with persons knowledgeable about incidents and
- Published reports on the subject.

flammable vapors*. One measure of the volatility is the Reid Vapor Pressure (RVP). A higher value for the RVP indicates that evaporation will occur faster. The composition of gasoline varies by brand, time and location but there are two generic gasolines that represent the extremes of volatility:

- "Summer blend" gasoline with a Reid Vapor Pressure of about 9 psi and
- "Winter blend" gasoline with a Reid Vapor Pressure of about 12-15 psi.

The winter blend gasoline is essentially, summer blend gas that has had butane added to it to increase the volatility. This presents practical problems for developing a test method using a consistent blend of gasoline. It is well understood that the volatility of the winter blend makes it very difficult to store while preserving it's RVP† since the butane is likely to be lost over time.

3.2 Large and Small Room Tests

Under the auspices of GAMA, 37 gasoline spill tests were conducted in the gasoline test facility, in the presence of operating gas-fired water heaters:

- 21 tests in a 10' x 20' x 8' room,
- 10 tests in a 6' x 10' x 8' room and
- 6 tests in an 8' x 8' x 8' room.

Results of these tests are presented in the GAMA Task 2 Report.

3.3 Conclusions

Task 2 of the GAMA study helped to understand the relative importance of the following factors that influence the potential ignition of flammable vapors by gas-fired water heaters:

- Spill surface,
- Floor and room temperature,
- Room size,
- Flammable vapor liquid composition and
- Ventilation rate.

The room experiments resulted in several conclusions including:

- A gasoline spill near a gas-fired water heater is likely to result in an ignition of the flammable vapors;
- Installation of a water heater on an 18" stand may delay but cannot guarantee elimination of the ignition of flammable vapors and

* The reader is reminded that ***liquid*** gasoline does not burn. It must be in the form of a gas to mix with oxygen and be flammable.

† Recently, a gasoline refinery was located that will provide consistent gasoline blends on a custom basis throughout the year.

The incidents in the garage and basement scenarios typically involve use of gasoline as cleaner, accidental spills and leaking storage containers.

2.2 Conclusions

The GAMA Task 1 work identified the following factors as important in incidents involving ignition of flammable vapors by gas-fired water heaters:

- Gasoline is the major cause of incidents;
- Room size and spill size affect the time to ignition and severity; and
- Motion in the room has a strong effect on the mixing of the vapors with the air.

It can be further concluded that the incidents occur in circumstances that include a wide range of unpredictable external variables that come together at the same time. To compound the problem, water heaters will operate on different cycles depending on their design and the owner's usage patterns. So, the water heater's propensity to draw in and ignite vapors varies in time in an unpredictable way as well. Overall, the final flammable vapor test method for gas-fired water heaters will need to be capable of incorporating as many of these factors as possible.

3. Initial Gasoline Test Room Studies

3.1 Gasoline and Lower Flammability Limit (LFL)

For a vapor mixture to be flammable it must reach a composition (mixture of fuel and oxygen) that can ignite and sustain combustion. This range of flammable composition of vapors and air is bounded by a lower and upper concentration of the vapor in air. The Lower Flammability Limit (LFL) is the lowest concentration of vapor that will support a flame. Below this level the mixture is too lean. The Higher Flammability Limit (HFL) is the maximum concentration of vapor that can support a flame, above which level the mixture is too rich.

Gasoline is a mixture of hydrocarbon and other compounds. The component with the highest vapor pressure is butane. Therefore, it is likely that the initial vapor cloud over a gasoline spill will be rich in butane. The LFL of butane is about 1.8% and the HFL about 8.4%. From a description of incidents, it seems that the LFL is the point at which most incidents occur. This is the level that is first achieved following a spill. However, it is also possible that ignition could be avoided somehow immediately after the spill. In this case, the concentration could possibly rise above the HFL. Should this occur, there is also a possibility of ignition as the concentration drops and becomes flammable again. It is also conceivable that the vapor concentration could remain within the flammable region for some period of time. In this case, ignition could occur at any time, until the concentration leaves the flammable region.

The time it takes to reach LFL after a spill is partially determined by the gasoline's volatility. Other factors include the size of the spill and room, temperature, air change rate and room air motion. Volatility refers to how quickly the liquid will evaporate, creating the

exterior structure. This duct acts to isolate the water heater vent from variable outdoor conditions such as temperature, rain, or wind and

- Mannequin is attached to a pneumatic cylinder with a three foot stroke length. Cylinder movement is manually controlled from the control room.

The following data is taken during a test:

- Temperature:
  1. Test chamber ambient,
  2. Water heater flue before the draft hood,
  3. Water within the heater at a level equal to the location of the T-P Valve
  4. Test chamber floor,
  5. Ambient at the combustion air inlet to the test room.

- Pressure:
  1. Differential between the test room and the exterior structure,
  2. Differential between the water heater vent and the exterior structure.

- Hydrocarbon Concentration (measured as butane) Sample Points:
  1. At the combustion air opening,
  2. At half the height of the water heater on the front,
  3. At half the height of the water heater on the back,
  4. On the top of the water heater near the draft hood.

- Miscellaneous:
  1. Relative humidity in the exterior structure at the combustion air inlet to the test room,
  2. Pilot millivoltage

- Rags soaked in gasoline can present ignition sources in small rooms.

In addition there were several general observations that provide an insight to these experiments.

- Air motion is an important accelerator of ignition. Without forced convection in the room, the vapors will diffuse slowly away from the spill and be diluted by the room's ventilation. Therefore, without an induced air movement, a false sense of security can result.

- While elevation of the water heater may delay ignition of the vapors, the ignition may release more force than for floor mounted water heaters. This is due to the larger volume of flammable vapors which are then present at the time of ignition.

- Room size, spill size and the ventilation rate have an important combined effect on the vapor profile over time

- Room temperature is not as important as room size, motion and size of the spill.

4. Gasoline Test Room Construction

4.1 History

The current flammable vapor test room at AGAR evolved over several years. The room was originally constructed to support the GAMA Task 2 work of ADL as described above. The structure had two rooms that could be used to perform tests in different volumes. The structure was wood frame with drywall construction and was housed under a plastic film structure. The larger part of the facility was abandoned and sealed off as the smaller room was settled on as the preferred test condition.

During the summer of 1997, construction began on a new, improved and automated structure reflecting the experience gained in the old room. This new room is sheltered under an improved plastic film structure and has proven to be much more reliable.

4.2 Description of Room

Figure 2 shows the floor plan for the test room. The room is:

- Constructed with metal studs covered with sheet metal,
- Foundation is a concrete pad embedded with hydronic heating coils,
- Floor is a single piece stainless steel,
- Pressure relief opening is covered with plastic or foil with perforations to minimize pressure buildup within the chamber,
- Water heater is vented through the back wall. The vent pipe is terminated within the outer plastic structure underneath an 8 inch diameter duct connected to the outside of the

particular, very different vapor profiles have been observed as different gas water heaters react to the spill. Unfortunately, the test can damage the water heater being tested.

Tests of WHC prototypes in the new room, as it was being developed, show that the facility has been improved. Similar water heaters produce similar results. The tests are also instructive in showing how much the water heater's size or operation can change the resulting vapor profile. The following discussion highlights results obtained in the new room from December 1997 through January 1998. In the interest of protecting the confidentiality of the manufacturers, the specific design differences in each test will not be discussed. But, they are all different and the reader should not expect the results to be exactly the same.

Figure 3 shows the vapor profile results for one test of Prototype 34. The test presented is for summer blend gasoline, without movement. The burner was on at the start of the test.

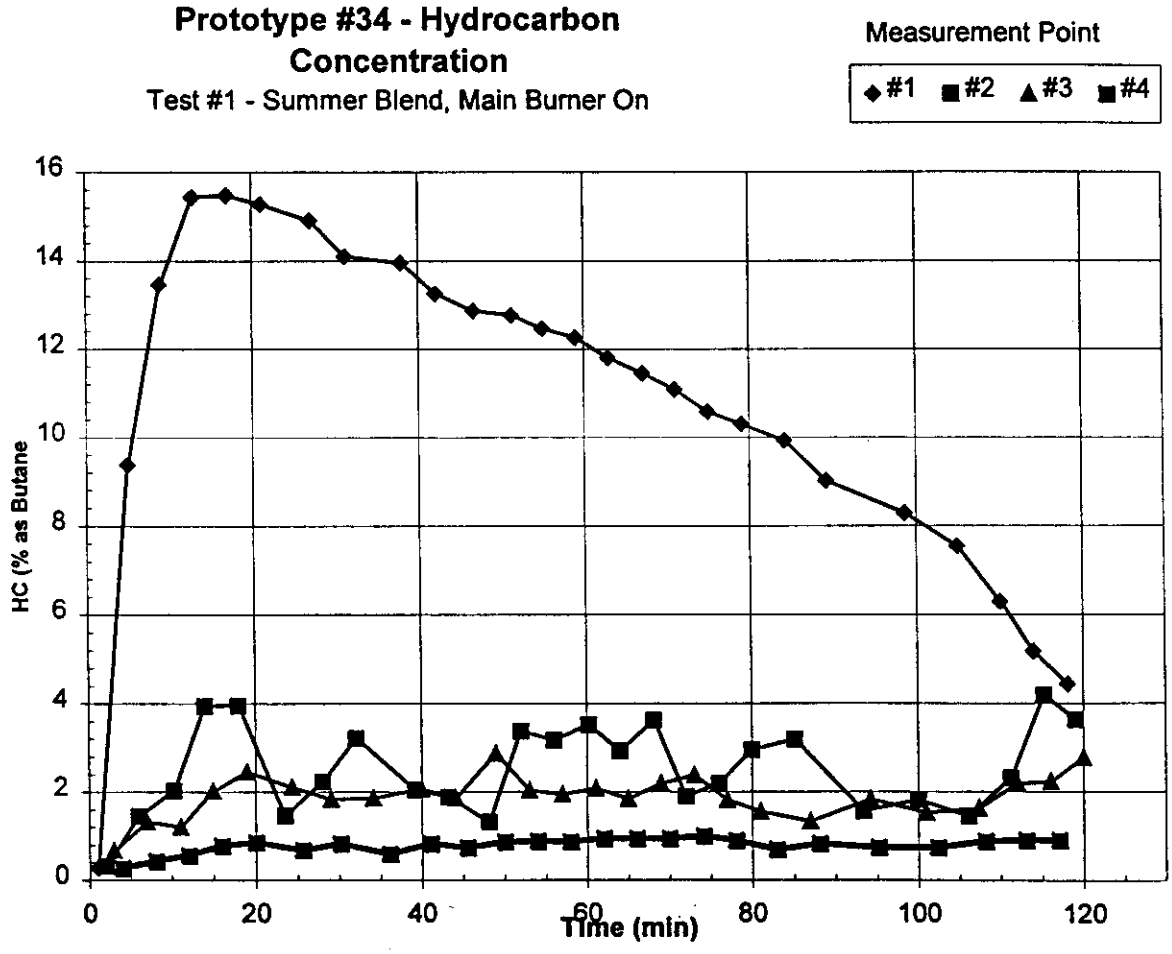


Figure 3

In Figure 3, the four traces are hydrocarbon concentrations at different elevations in the room. The hydrocarbon concentrations are measured as a butane equivalent. The sampling system used

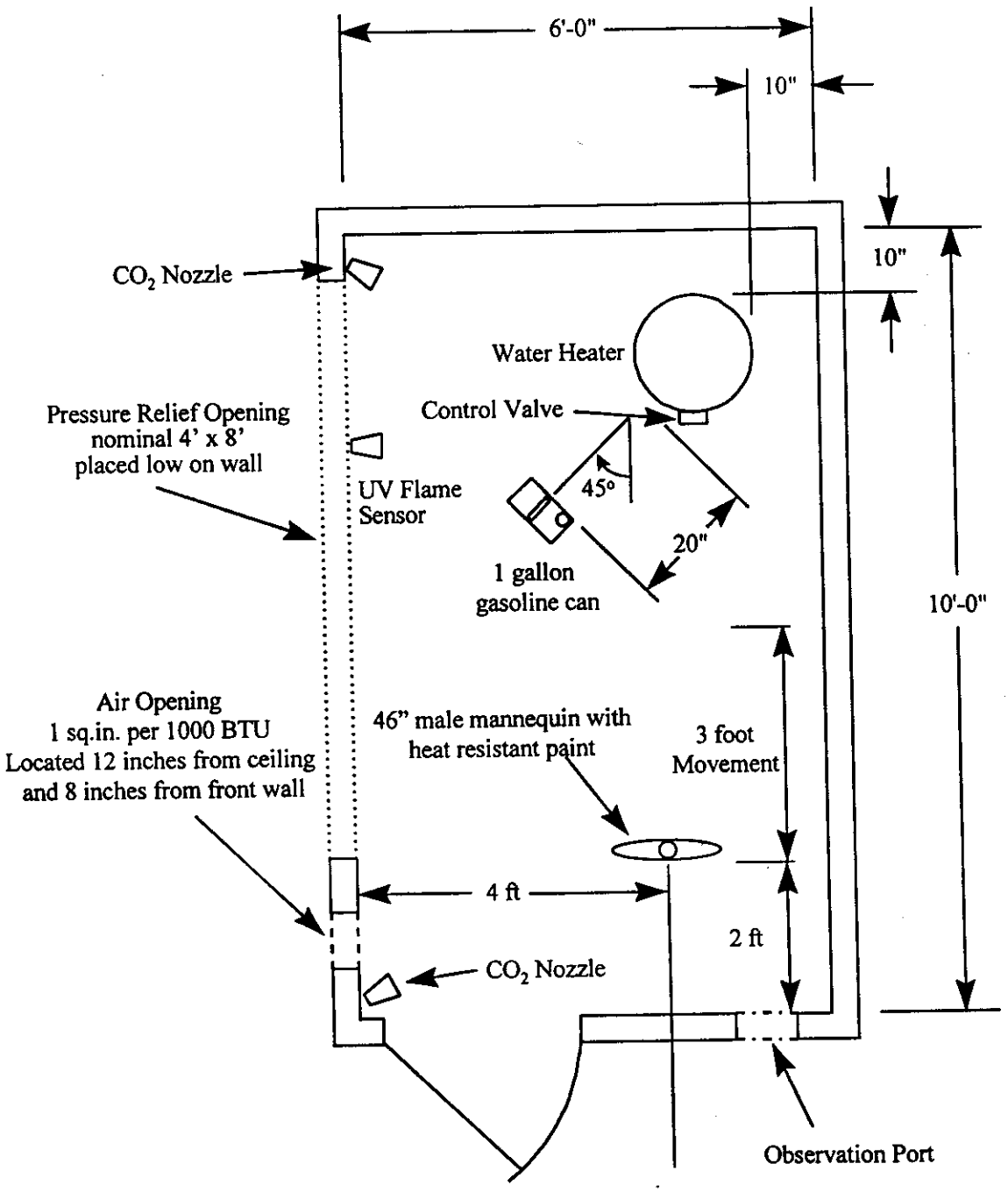


Figure 2 – Diagram of the Current Gasoline Test Room
[Housed Within Exterior Structure (Not Shown) To
Control Surrounding Ambient Conditions]

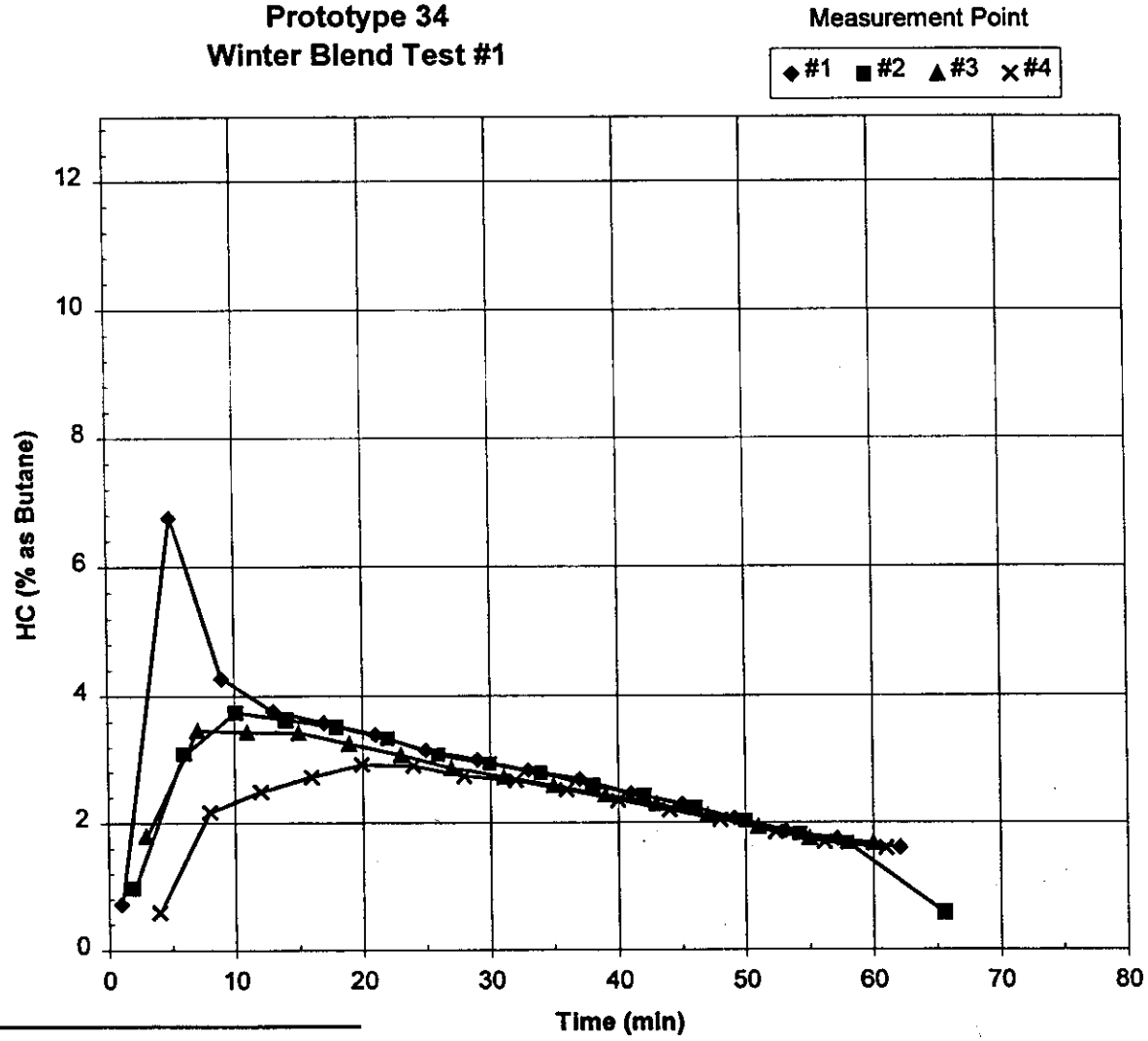
4.3 Test Results

The new test facility provides a stable platform for performing a variety of tests with gasoline. The results obtained thus far are dependent on the specific water heater - as it should be. In

Figures 5 and 6 present continued tests of the same water heater. In this case, the two tests use winter blend gasoline, with room air motion caused by the flat mannequin.[+] Both tests illustrate the different vapor profile caused by room air motion. In these tests, the vapor concentration rises quickly near floor level, represented by point 1. Note that the difference between the concentration near the floor and higher in the room diminishes more quickly compared to a test with no room air motion.

In these two tests, the vapor profiles are qualitatively quite similar. The difference in the absolute concentration is probably the result of the way the gasoline splashes at the start of the test. Despite the differences, the gasoline vapor at the level where the vapors can enter the heater was in the flammable range and the water heater passed the test both times.

It is certainly possible to design a standard way of spilling the gasoline. However, it is believed that spilling the gasoline by tipping over the container increases the realism of the test because of



[+] Early winter blend gasoline tests used a flat wooden silhouette shaped mannequin, which has since been replaced by a department store mannequin.

read each measurement point once every 3 to 5 minutes‡. The long sampling runs, in use at the time of these tests, also introduce a lag time between what is happening in the test room and when the measurement is recorded. The most important measurement point is #1, which is 3 inches above the floor and is closest to where the vapors are being pulled into the heater. Measurement points 2 to 4 are progressively higher in the room, as described in Section 4.2. Note that, a large difference in concentration exists for an extended period between point 1 and the rest of the room. This is characteristic of a test with no movement. The floor concentration rises immediately and then gradually decreases as the heater consumes the vapors.

Figure 4 presents the same data from a repeated test of the same heater. Comparing Figures 3 and 4, we see a good correspondence between the vapor profiles. And, in the end, the water heater passed the test both times.

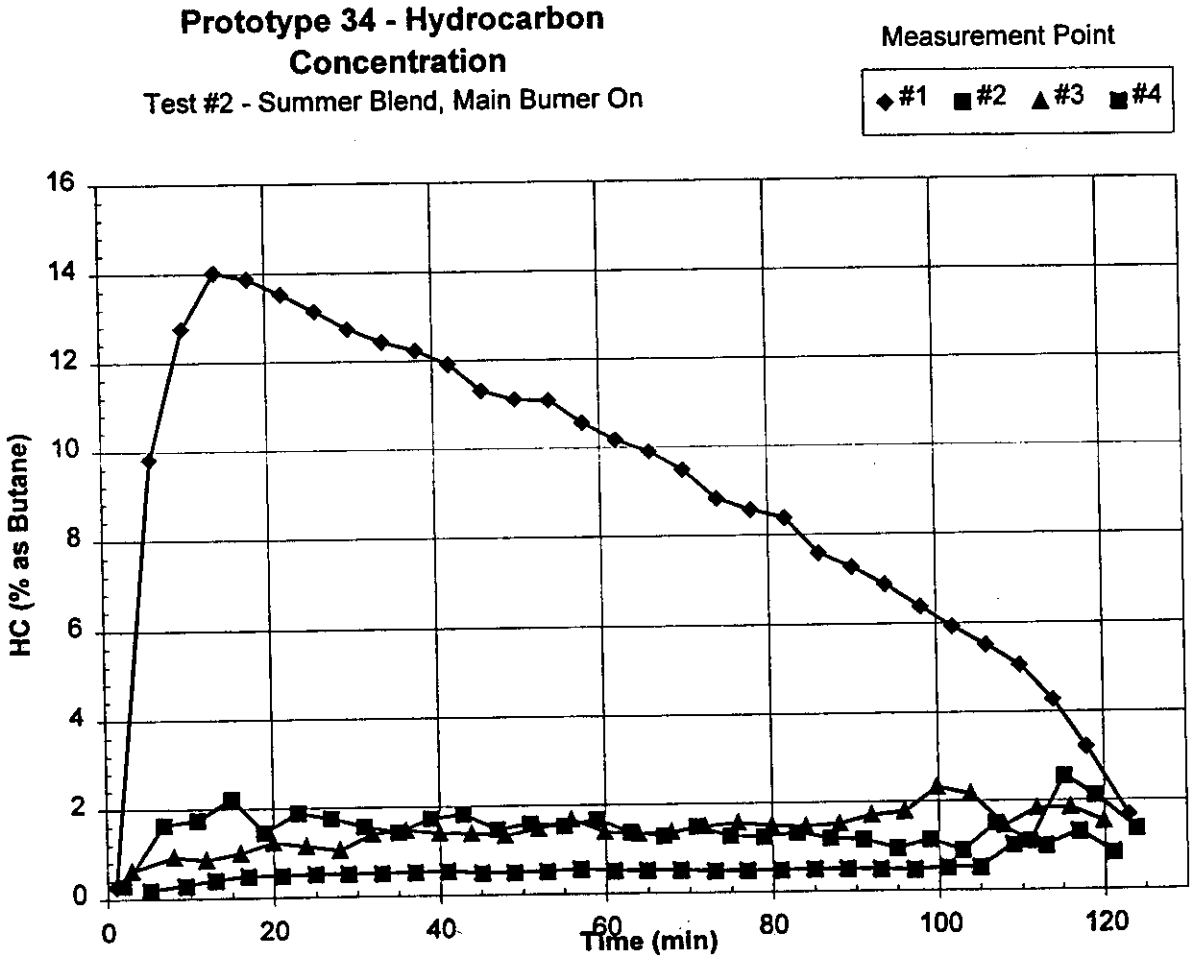


Figure 4

‡ New hydrocarbon analyzers which allow simultaneous measurements have now been installed and were used in test runs presented in Figures 7 and 8.

eventually ceased. However, in this case, the pilot did not drop out and the heater's main burner continued to cycle. This test was terminated after two hours with no ignition of the vapors in the room.

The tests in Figures 7 and 8 illustrate another important point. There are several different possible test outcomes which are all "passing." These possibilities include:

- All combustion in the heater is extinguished soon after the spill because the flammable vapors are above the higher flammable limit;
- Combustion of flammable vapors occurs in the heater for a period and then extinguishes itself and the normal burners; and
- Combustion of flammable vapors occurs in the heater until the source of the vapors is depleted.

In each case, there is no ignition in the room. So, from a safety aspect, the outcomes are equivalent.

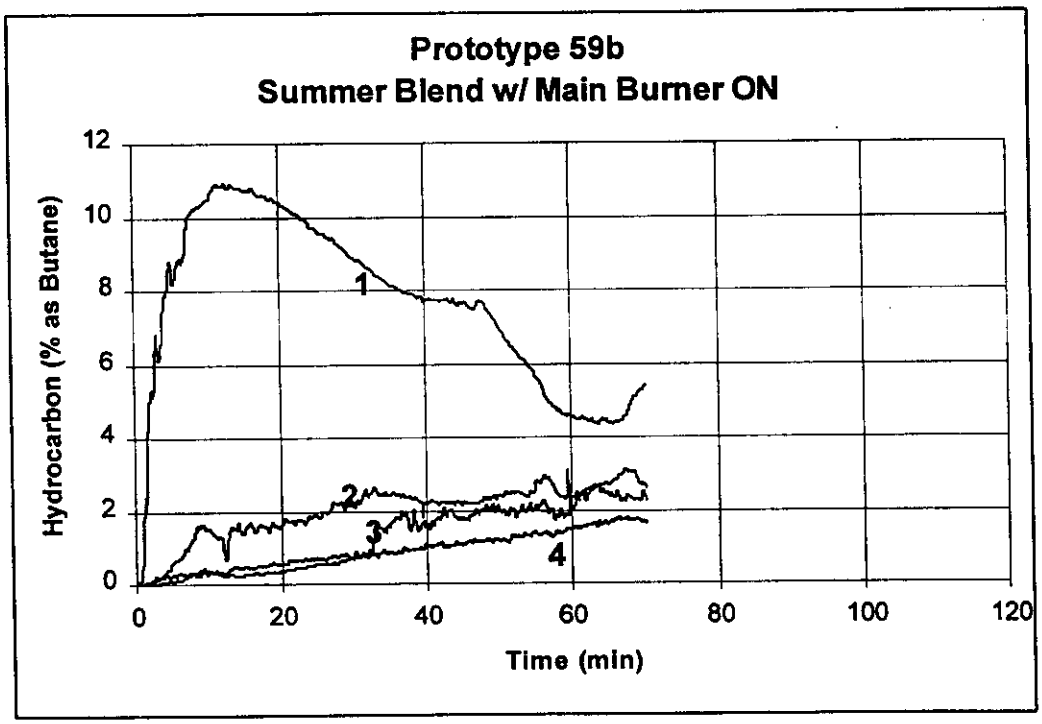


Figure 7

the splashing it creates.

Figure 5

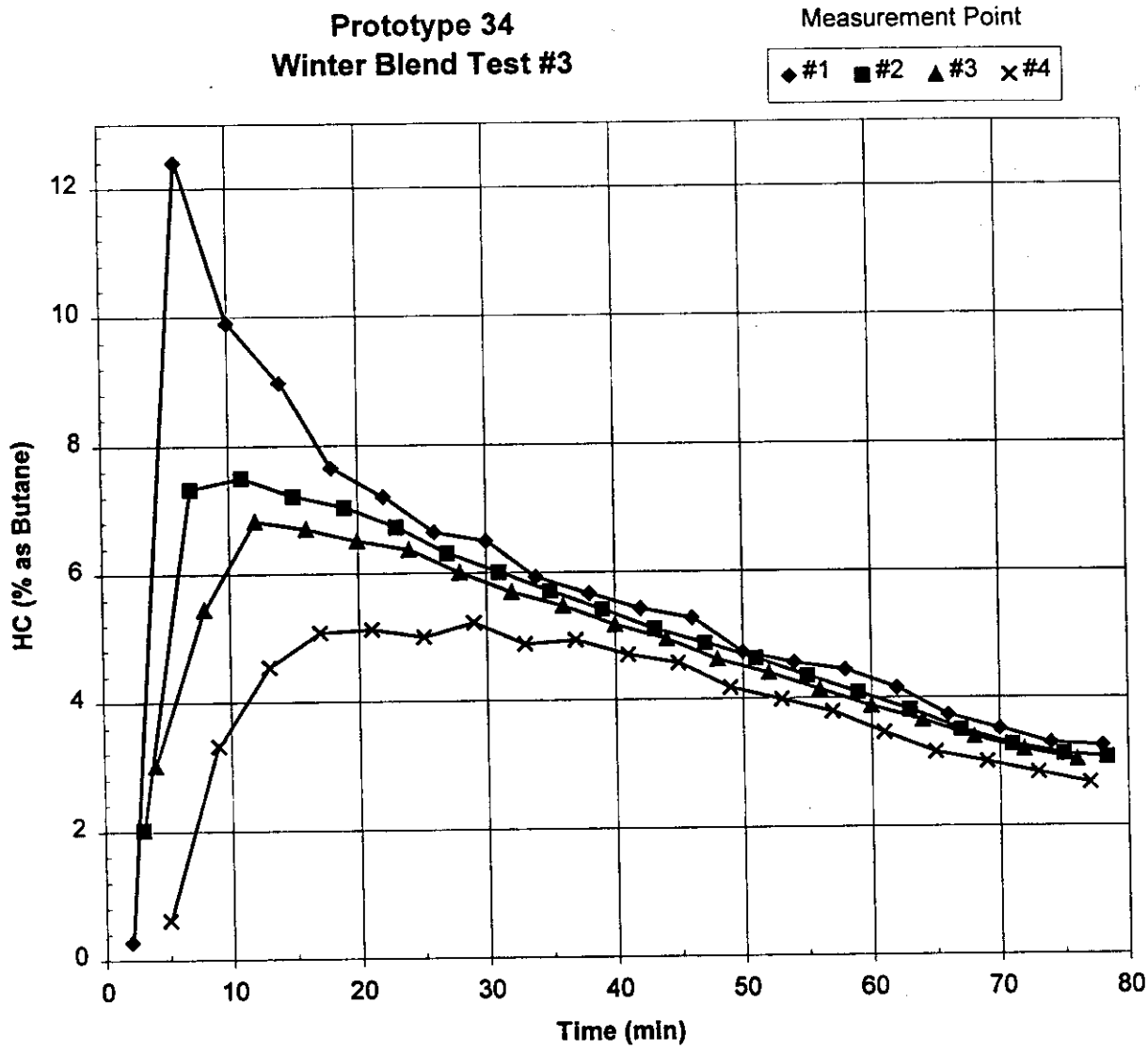


Figure 6

Recent tests also show that the vapor profiles can be changed by relatively minor heater design changes. Figures 7 and 8 present the results of two Summer blend tests. The same heater was used in each test, except they had slightly different burners that were being evaluated. In Figure 7, instrumentation indicated that gasoline vapors were burning in the combustion chamber. However, eventually all combustion was extinguished and the pilot dropped out. At this point, no subsequent ignition was possible and the test was terminated. In Figure 8, the test began much like the previous test. Gasoline vapor combustion occurred in the water heater but

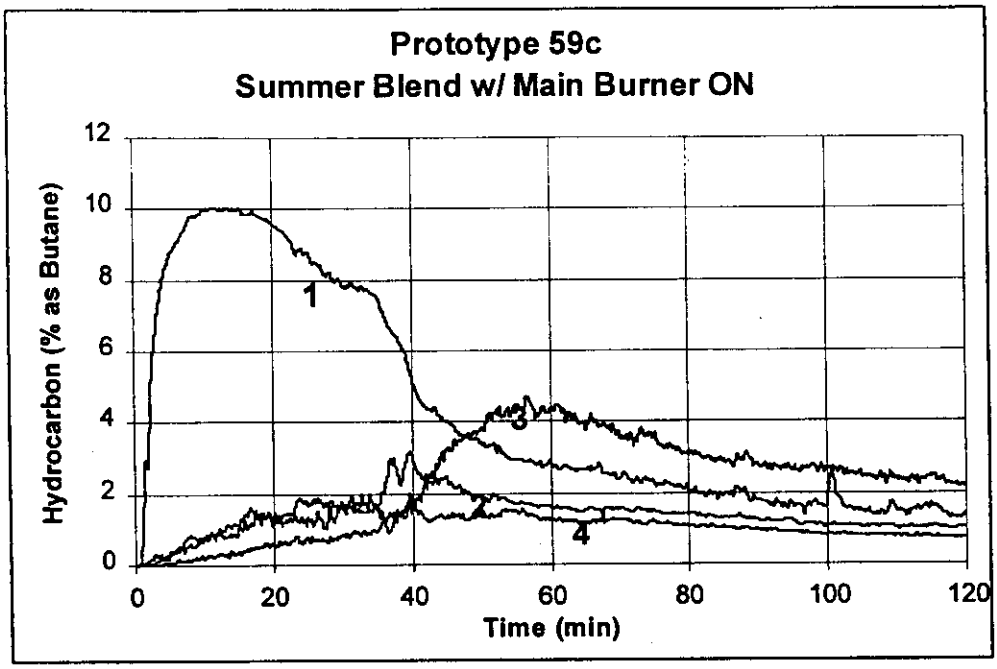


Figure 8

5. Conclusions

The gasoline test room, with a real gasoline spill, is more useful for the practical testing of water heaters in a way that includes the many design specific parameters of the appliances and, is most appropriate for testing water heaters in the latter stages of development and for certification purposes.

References

[1] Flammable Vapor Hazards Ignition Study, AD Little, July 15, 1993, GAMA Task 2 Report

[2] R.F. Topping and K.R. Benedek, Flammable Vapor Test Methodology Development for Gas-Fired Water Heaters, Arthur D. Little, Inc, Cambridge, Massachusetts, April, 1996, GRI-96/0102.

[3] Flammable Vapors Hazards Ignition Study, AD Little, June 16, 1993, GAMA Task 1 Report.

6. Specify that joint compounds are to be listed by a national recognized testing agency (1.4.3);

7. Provide appropriate references to acceptable standards for piping (1.4.5);

8. Prohibit the use of adjustable air shutters since they are no longer used in the industry (1.5.4, 2.3.3);

9. Require a safety shut-off device on all camp heaters since they are considered unattended appliances (1.7.1 and 1.7.2);

10. Provide for the use of disposable fuel cylinders when the heater is equipped with a manually operated burner gas valve (1.8.1);

11. Clarify requirements for testing components of heaters (1.8.7, through 1.8.12, 1.9.3 through 1.9.8 and Part IV, Definitions);

12. Add coverage for Flow Limiting Devices (1.11);

13. Update instruction manual and marking coverages consistent with technology and other standards (1.13 and 1.14);

14. Revise the combustion test to specify (a) a maximum CO level of 100 ppm and (b) a minimum oxygen level of 16 percent by volume, in an enclosed room with air exchange rates of 0.5, 1.0 and 1.5 per hour, following CPSC staff recommendations (2.4);

15. Coverage for unburned fuel and hydrocarbon emissions (2.5) is deleted from the Canadian standard in light of the revised combustion test;

16. Specify a tip test based on an examination of coverage contained in various North American and other standards (2.8);

17. Revise the evaluation criteria for the wind test from determining that burners do not extinguish to determining proper burner operation (2.9);

18. Replace the "Draping Test" (in the Canadian standard) with an "Evaluation of Clothing Ignition Potential Test" from the Z21.11.2 unvented heater standard, (2.12, Figure 2);

19. Update marking material adhesion and legibility testing to be consistent with other Z21/83 and CSA standards (2.13);

20. Add a pull test for "detached" markings attached to gas carrying components (1.14.2-c and 2.14);

21. Add Exhibit A, Items Unique to Canada, to address country specific issues; and

22. Add Part III, Manufacturing and Production Tests.

adopted

ITEM 21.
Z21/83 Committee Meeting
April 15, 1999

PROPOSED HARMONIZED AMERICAN NATIONAL STANDARD/ CSA STANDARD FOR PORTABLE TYPE GAS CAMP HEATERS, Z21.63•CSA 11.3

Action Requested

Approval of proposed harmonized American National Standard/ CSA Standard for Portable Type Gas Camp Heaters, Z21.63•CSA 11.3, and accompanying rationale statements. If approved by the Committee and ANSI, this will be issued as the first edition of Z21.63•CSA 11.3-.

Proposed Revisions

Attached are copies of the following documents:

a. Proposed harmonized American National Standard/ CSA Standard for Portable Type Gas Camp Heaters, Z21.63•CSA 11.3, Draft #2; and

b. Appendix G to the minutes of the November 4-5, 1998 meeting of the (Interim CSA)/Z21 Joint Subcommittee on Gas Refrigerators and Portable Camping Equipment.

Summary

Draft #2 of the proposed harmonized standard was recommended to the Z21/83 Committee by the (Interim CSA)/Z21 joint refrigerator and camping equipment subcommittee, at its November 4-5, 1998 meeting.

At the November 1998 meeting, the joint subcommittee noted two substantive changes that were required in the draft standard. These are shown in Appendix G. This coverage was distributed for review and comment in January 1999. A letter ballot requesting joint subcommittee approval to submit the revisions contained (in Appendix G) to the Z21/83 Committee and (Interim CSA) Standards Steering Committee closes March 4, 1999. An update on the subcommittee vote on this letter ballot will be provided to the Z21/83 Committee as soon as it is available.

Revisions to the portable camp heater standard, Z21.63•CSA 11.3:

1. Revise the Standard to apply only to heaters of the infrared type for outdoor use only on LP-gases (1.1.1, 1.13.2, 1.13.3, 1.14, 1.14.3-h, 1.16.5, 2.2 and 2.3). It no longer distinguishes between heaters for connection to a remote fuel supply or a self-contained fuel supply;
2. Allow the use of recycled materials but not the use of reconditioned parts (1.1.5);
3. Specify that all accessories must be supplied with the appliance (1.1.7);
4. Differentiate between taking precautions for operating the heater and handling the heater (1.2.2);
5. Add standards references for both English and metric threads (1.2.7 and 1.2.8);

APPENDIX F

DRAFT # 2 PROPOSED HARMONIZED STANDARD FOR PORTABLE TYPE GAS CAMP HEATERS

ANSI Z21.63/ CSA 11.3

Rationale:

1.1.4 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.

1.1.5 This standard applies to heaters constructed entirely of new, unused parts ~~and materials~~.

Rationale: *The intent of this clause is to allow the use of recycled materials but not the use of reconditioned parts.*

1.1.6 ~~All references to psi throughout this standard are to be considered gage pressures unless otherwise specified.~~

Rationale: *To eliminate any confusion to conversion of SI equivalents and to be consistent with the ASTM E-380 standard (reference 11/16/93 meeting minutes).*

1.1.7 ~~All accessories intended recommended by the manufacturer for use with appliances certified to this standard shall be supplied and tested on with the appliance for which it is used with.~~

Rationale: *This provision was added in recognition of the fact that camp heaters often have numerous accessories and to clarify that all accessories must be supplied and evaluated with the appliance.*

1.2 GENERAL CONSTRUCTION AND ASSEMBLY

1.2.1 Construction features and the quality of the workmanship shall be in conformity with acceptable engineering practices ~~and shall provide the results contemplated by these provisions~~.

Rationale: *The remainder of this sentence was deleted to improve the clarity of the provision.*

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

Rationale: *This provision was re-worded to differentiate between requirements for operating the heater and handling the heater.*

~~1.2.3 Removable parts shall be designed so that they cannot be readily replaced incorrectly.~~

Rationale: *This provision is not needed based on coverage currently outlined in 1.2.3 below,*

PART 1

CONSTRUCTION

1.1 SCOPE

1.1.1 This standard applies to unvented portable type gas camp heaters, of the ~~catalytic and~~ infra-red type only, up to and including a maximum input of ~~15,000~~ 12,000 Btuh (kW) using propane, butane and liquefied petroleum gases and mixtures thereof and intended for outdoor use. ~~either indoors or outdoors with propane and butane gases.~~

~~For the purpose of this standard, indoors refers to the interior of portable structures such as tents, tent trailers and fishing huts.~~

Rationale: *The scope of the camp heater standard should not make reference to indoor use of this product, therefore, the scope statement was revised to eliminate such terminology from the harmonized standard.*

1.1.2 This standard applies to portable type gas camp heaters having:

(a) a regulated pressure

(b) a non-regulated pressure

~~1.1.3 This standard applies to heaters:~~

~~(a) directly connected to the container~~

~~(b) remotely connected to the container~~

Rationale: Adds nothing to standard.

~~1.1.4 This standard does not apply to heaters incorporating or designed to be used with a fuel supply of 200 g (7 ounces) or less.~~

Rationale: *This provision is design restrictive, and was therefore, removed from the harmonized standard.*

~~1.1.4 Heaters which comply with the provisions will not necessarily be acceptable if when examined and tested are found to have other features which impair the results contemplated by these provisions.~~

1.4.1 Metallic structural parts of heaters shall have a minimum thickness of 0.0195 inches (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.

1.4.2 Heaters shall have a corrosion resistant finish.

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

Rationale: Reference to "listed by a nationally recognized testing agency" was added here, so the note (below) could be removed.

(b) 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.

(c) Running threads ~~with or without a luting~~ sealing ~~compound~~ shall not be used.

~~*Note: Before provision (c) is revised or deleted, the working group requests that the term "luting compound" be defined and the rational for including this provision be provided by the secretary.*~~

~~*The secretary responded on 2-10-97 indicating that although no documentation was available, a longstanding member of the organization indicated that a luting compound is like pipe dope, and the intent of the clause is to not permit the use of running threads under any circumstance.*~~

~~*Rationale: Based on the explanation above, the term "luting" was changed to "sealing".*~~

Rationale: Redundant wording.

~~NOTE: Pipe joint compounds complying to the current standard ULC 340 LABORATORY TEST REQUIREMENTS FOR JOINT COMPOUNDS shall be deemed to meet the provisions of clause 1.4.3 (a).~~

1.4.4 Aluminum ~~semi-rigid~~ tubing ~~or piping~~ shall not be used as gas conduit.

Rationale: This statement was revised to simplify and clarify the requirements of this provision.

1.4.5 Piping employed as gas conduit shall comply with the ~~current standard CSA B63 WELDED AND SEAMLESS STEEL PIPE~~ Standard for ***Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10M***, or CSA endorsed ASTM A53-97, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

therefore, it was removed from the harmonized standard.

1.2.3 The 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 so as to assure continued compliance with these provisions. Such parts not permanently secured shall be designed so that they cannot be incorrectly assembled and cannot be improperly located or misaligned in removing or replacing during use, cleaning or other servicing.

1.2.4 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.

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

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

Rationale: Carried over from the ANSI Standard.

1.2.7 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), ANSI/ASME B1.1.

Rationale: Add standards references for both English and metric screw threads.

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

Rationale: Add standards references for both English and metric pipe threads.

1.3 STABILITY

A heater shall either be constructed to comply with clause 23.8.1 or it shall be fitted with a tip-over switch which shall cause a complete shut-off of the gas immediately, and shall require a manual reset function to restart the gas supply.

Rationale: Incorrect clause reference.

1.4 MATERIALS

Rationale: *Adjustable Air shutters are no longer used in the industry (camping equipment).*

1.6 ORIFICES AND ORIFICE FITTINGS

~~1.7.1 Where the input is controlled by an orifice spud or hood which can be adjusted, the design shall be such that in the assembled equipment there will be a maximum open position beyond which the flow cannot be increased, or leakage occur. Refer to clause 2.3.3.~~

1.6.1 Only fixed orifices shall be provided.

1.6.2 Orifice fittings shall be positively secured to prevent misalignment.

Rationale: *Carried over from the ANSI Standard.*

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

1.7 PILOT BURNERS AND SAFETY SHUTOFF DEVICES

1.7.1 Heaters ~~with maximum rated inputs in excess of 3,000 Btuh (879W)~~ shall have a safety shut-off device complying with the ~~current standard CGA 6.4 AUTOMATIC BURNER IGNITION AND SAFETY SHUT-OFF DEVICES~~ Standards for *Automatic Gas Ignition Systems and Components, ANSI Z21.20 or CAN1-6.4.*

Note: Before considering a revision to 1.7.1, the working group requested that the rational for establishing the 3,000 Btuh criteria be provided by the secretary.

The secretary responded on 2-10-97 indicating that no documentation was available, and the number was fairly arbitrary.

Rationale: *Heaters are considered unattended appliances and should, therefore, be equipped with safety shutoff devices. Standard reference update.*

1.7.2 Ignition devices and safety shutoff systems shall comply with the applicable construction provisions of the Standards for *Automatic Gas Ignition Systems and Components, ANSI Z21.20 or CAN1-6.4.*

Rationale: *A reference to the applicable standards for ignition devices and safety shutoff systems is needed in the harmonized standard.*

1.7.3 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.

Rationale: *Standard reference update.*

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

1.4.7 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 placed in an oxygen bomb for 96 hours at 158°F (70°C) and a pressure of 300 psig (2068 kPa); and

(b) Parts are immersed for 70 hours in normal hexane.

Rationale: *Provisions for evaluating non-metallic, internal parts of gas controls are needed in the harmonized standard. This coverage was adopted from existing coverage outlined in the ANSI Z21.63-1978 standard (camp heaters).*

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

Rationale: *A provision for evaluating the general suitability of materials used in the construction of a camp heater is needed in the harmonized standard. This coverage was adopted from existing coverage outlined in the ANSI Z21.63-1978 standard (camp heaters).*

1.5 BURNERS

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

1.5.2 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, show leakage of gas during any of the tests specified herein.

1.5.3 Burners shall be securely held in place.

~~1.6 PRIMARY AIR CONTROL~~

~~1.6.1~~ 1.5.4 Adjustable air shutters shall not be used.

Rationale: This provision is not needed based on more definitive coverage proposed in 1.8.7 through 1.8.10 below. The proposed coverage was adopted from CGA Lab Interpretation Notice 94-002.

~~1.9.8 Needle valves shall be tested as a component of the heater.~~

Rationale: This provision is not needed based on more definitive coverage proposed in 1.8.7 through 1.8.10 below. The proposed coverage was adopted from CGA Lab Interpretation Notice 94-002.

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

~~1.8.7 Manually operated gas valves shall be investigated for seat and external leakage at the following conditions:~~

~~(a) 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;~~

~~(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;~~

~~(c) 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~~

~~(d) When regulated, 20% and 150% of the normal regulator outlet pressure setting at the above ambient temperatures (as applicable for the fuel).~~

~~The leakage shall not exceed 200 cc/hr when corrected to standard conditions.~~

~~1.8.8 Manually operated gas valve bodies shall have a burst strength of at least five times the vapour pressure of the fuel (or fuel mixture) at 70°F (21.1°C), 550 psi (3792 kPa) for propane and 85 psi (586 kPa) for butane).~~

~~1.8.9 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~~

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

~~1.8.4 Pilot burners shall be supported in such a manner that their position relative to the main burner is fixed.~~

~~1.8.5 Pilot burner assemblies shall be constructed so that it is impossible to direct the pilot flame in other than the correct direction.~~

Rationale: *Provisions 1.8.4 and 1.8.5 are not needed based on coverage currently outlined in 1.2.3, therefore, they were removed from the harmonized standard.*

1.7.5 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% nickel, because of catalytic cracking effect, are not acceptable.

1.8 MANUALLY OPERATED GAS VALVES

1.8.1 Heaters designed for use with disposable cylinders shall be equipped with a manually operated burner gas valves(s).

~~1.9.2 A heater having a valve attached to the end of a hose supplied by the manufacturer as part of the complete heater assembly shall be deemed to comply with clause 1.9.1 provided that the hose length does not exceed 3 ft (914 mm).~~

Rationale: *Manual valves on refillable cylinders serve to meet the function of a manually operated burner gas valve. The requirement for a safety shutoff valve on all heaters ensures safe lighting of the heater when used with a refillable cylinder.*

1.8.2 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.

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

1.8.4 The marking specified in clauses 1.8.2 and 1.8.3 shall be Class I, II or IIIA as specified in ~~Appendix A~~ 1.14.1.

1.8.5 All valves shall close in the clockwise rotation.

~~1.9.7 Taper plug and resilient seal valves shall be tested as a component of the heater.~~

and

The leakage shall not exceed 200 cc/hr when corrected to standard conditions.

1.9.4 The body of a gas pressure regulator inlet portion shall have a burst strength of at least five times the vapour pressure of the fuel (or fuel mixture) at 70°F (21.1°C) (550 psi (3792 kPa) for propane and 85 psi (586 kPa) for butane).

1.9.5 A regulator shall have a predictable outlet pressure. Three samples shall be tested. The regulators shall be set at their full open setting. Inlet pressures as stated in 2.3.1(b) shall be applied to all regulators. Pressures for propane/butane mixtures shall be determined by the certification agency. The outlet pressures measured at each regulator shall be within 20% of each other.

1.9.6 The appliance manufacturer shall demonstrate that they have 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 certification agency.

1.9.7 Regulators that comply with the Standard for *Gas Appliances Pressure Regulators, ANSI Z21.18•CGA 6.3* at the above temperature ranges need not comply with 1.9.3 through 1.9.6.

Rationale: *The proposed coverage outlined in 1.9.3 through 1.9.7 is added to define the manner in which a pressure regulator is tested as a component of the heater. The coverage was adopted from CGA Lab Interpretation Notice 94-002.*

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

a. Connection No. 510 as specified in the Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections, ANSI/CGA-V-1-1977; or

b. Connection No. 600 as specified in the Compressed Gas Association's Limited Standard Cylinder Valve Outlet Connection for Propane-Small Valve Series.

Rationale: *This coverage was retrieved from clause 1.1.5 of ANSI Z21.58.*

1.10 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, ANSI/UL 569*; or with to the current Standard, ~~CAN1-8.1~~ *Elastomeric Hose and Hose Couplings for Conducting Propane and Natural Gas*, CAN/CGA-8.1 or with the current Standard, ~~CAN1-8.3~~ *Thermoplastic Hose and Hose Couplings for Conducting Propane and Natural Gas*, CAN1-8.3. The hose length shall be limited to 6 feet (1.8 m).

(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 200 cc/hr when corrected to standard conditions.

1.8.10 The appliance manufacturer shall demonstrate that they have 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.

1.8.11 Manual Valves that comply with the Standard for *Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves, ANSI Z21.15 or CAN1-9.1 Manually Operated Gas (Appliance) Shut-Off Valves* at the above temperature ranges need not comply with 1.8.7 through 1.8.10.

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

Rationale: *The proposed coverage outlined in 1.8.7 through 1.8.12 is added to better define the manner in which a valve is tested as a component of the heater. The coverage was adopted from CGA Lab Interpretation Notice 94-002 and ANSI Z21.63.*

1.9 GAS PRESSURE REGULATORS

1.9.1 Where a heater is for use with regulated pressure, the regulator shall be supplied by the heater manufacturer, and the heater shall be marked with the identifying marking of the regulator(s). Refer to clause 1.14.3 (gh).

1.9.2 The pressure regulator shall be permanently stopped to limit the outlet pressure to the designed inlet operating pressure of the heater.

1.9.3 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;

(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;

~~1.13.3 Heaters for indoor operation above the floor level shall be marked with a warning as specified in clause 1.16.3 (h).~~

Rationale: *The scope of the camp heater standard was revised to eliminate the reference to indoor use of this product. Therefore, this clause no longer applies.*

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

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

~~1.14 CATALYTIC LAYER~~

~~1.14.1 The gas diffusion layer or catalytic layer shall be homogenous and completely sealed to the base of the burner.~~

~~1.14.2 The gas diffusion layer or catalytic layer shall not warp during any of the tests specified herein.~~

~~1.14.3 Damage to the catalytic layer shall not occur during normal cleaning and maintenance.~~

Rationale: *No longer in scope of standard.*

1.13 INSTRUCTIONS

1.13.1 Each heaters shall be accompanied by detailed printed instructions~~, in both English and French~~, and diagrams for the proper assembly, maintenance, safe use and ~~lighting~~ operation. ~~The instructions shall also stress the need for an adequate supply of fresh air for combustion and ventilation when used indoors.~~

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

The instructions shall be marked with directions to the consumer to retain them 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:

Rationale: *Standard reference update.*

~~1.12 EXCESS FLOW DEVICES~~

~~1.12.1 An excess flow device shall be installed in the connection to the cylinder valve outlet, and shall be one of the following:~~

~~(1) excess flow valve~~

~~(2) Ball check valve~~

~~(3) orifice of a #60 drill size.~~

~~1.11 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 Underwriters Laboratories 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 scfh (2.83 m^3/hr) at a pressure of 100 psi (690 kPa) and has a bypass area that will not allow a flow greater than 10 scfh (0.28 m^3/hr) at 100 psi (690 kPa); or~~

~~(b) a device other than an excess flow check valve, which will limit flow to 10 scfh (0.28 m^3/hr) at 100 psi (690 kPa).~~

Rationale: *Taken from ANSI Z21.58/CGA 1.6-M95.*

1.12 GUARDS, GRILLES AND SCREENS

1.12.1 Heaters 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.

~~1.13.2 Heaters for indoor operation on the flow shall meet the provisions of the cheesecloth drape test specified in clause 2.13.~~

Rationale: *The scope of the camp heater standard was revised to eliminate the reference to indoor use of this product. The test in 2.13.2 has been modified to a terry cloth clothing ignition potential test which is more realistic and adopted from ANSI Z21.11.2.*

Rationale: *Warning was changed to Danger to enforce the hazard of the situation. Editorial.*

Rationale: *Update of graphics to show heaters instead of charcoal grill. Editorial.*

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

These instructions shall include:

(a) For all heaters:

(1) The manufacturer's name and address, and the appliance model, type or series number.

(2) A statement specifying proper fuel withdrawal from the operating cylinder.

(3) Explicit information specifying proper clearances from combustible material.

(4) Directions for proper assembly and for assembly of field-installed parts and accessories supplied with the heater.

(5) Lighting instructions and control operation, including pictorial representations, and a statement that the heater must not be exposed to flammable vapors or liquids during lighting.

(6) Maintenance instructions (including recommended frequency guidelines) suggesting:

(a) Keeping heater area clear and free from combustible materials, gasoline and other flammable vapors and liquids.

(b) Not obstructing the flow of combustion and ventilation air.

(c) Visually checking burner flames, with an explanation of proper operating characteristics.

(d) Cleaning heater, including special surfaces, with recommended cleaning agents, if necessary.

(7) Information for obtaining replacement parts and where they are obtainable.

FOR YOUR SAFETY

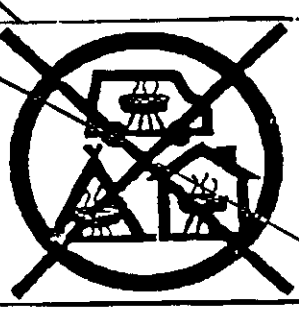
If you smell gas:

1. Do not attempt to light appliance.
2. Extinguish any open flame.

FOR YOUR SAFETY

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

WARNING



~~CARBON MONOXIDE HAZARD~~

~~This appliance can produce carbon monoxide which has no odour.~~

~~Using it in an enclosed space can kill you.~~

~~Never use this appliance in an enclosed space such as a camper, tent, car or home.~~

DANGER

CARBON MONOXIDE HAZARD

This appliance can produce carbon monoxide which has no odour.

Using it in an enclosed space can kill you.

Never use this appliance in an enclosed space such as a camper, tent, car or home.

and the ANSI Z21.63a-1981 (camp heater) and Z21.58-1994 (outdoor gas grill) standards. French requirements for Canadian instruction manuals moved to the Exhibit section.

1.14 MARKING

1.14.1 ~~The marking on heaters shall be Class I, II or IIIA, as specified in Appendix A.~~ 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 2.13. 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 enamelled surface.

Class IIA-1. Permanent Plate

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

Class IIA-3. Permanent Plate

Shall be made of metal having a thickness less than 0.006 inch (0.15 mm). Such plates shall be attached by means of nonwater-soluble adhesive which will comply with 2.13. These materials shall not be located on surfaces having temperatures exceeding 300°F (149°C) as determined during conduct of 2.11.

Class IIA-4. Permanent Plate

Shall be made of pressure-sensitive metal foil requiring no solvent or activator, provided such plates comply with 2.13. These materials shall not be located on surfaces having temperatures exceeding 300°F (149°C) as determined during conduct of 2.11.

Class IIIA-1. Permanent Label

(8) The specific size and capacity of the cylinder(s) to be used.

(9) 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) or Transport Canada.

(10) How to connect and disconnect the LP-gas cylinder(s) and the proper procedure for leak checking the cylinder connections and the appliance.

(b) When a heater is equipped with a No.600 Connection or other connections for use with disposable cylinders:

(1) A statement that only cylinders marked with the proper fuel type approved for the appliance must be used.

(2) A statement which specifies that the cylinder be disconnected when the heater is in storage.

(c) When a heater is equipped with other than a connection for disposable cylinders:

(1) A statement which 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.

(2) 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.

(d) For a heater for use with a remote fuel cylinder:

(1) A statement specifying the manufacturer's recommended kit number for the proper hose connectors and fittings necessary for connecting the heater to a remote fuel cylinder.

Rationale: *The instruction manual coverage required expansion and updating. The coverage outlined above is a combination of requirements outlined in the meeting minutes,*

permanent tag attached to the appliance. 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 2.14.2;

(c) Flexible type fasteners and markings shall be capable of withstanding the pull test outlined in 2.14.1;

(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 Z21.63•CAN1-11.3".

1.14.3 Gas heaters shall be bear a Class IIIB marking which 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 heater.

(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 "FOR OUTDOOR USE ONLY".

(g) Clearances to combustible materials, ~~in both English and French~~ in integral inches.

(h) The identifying marking of the regulator(s) where the heater is for use with regulated pressure.

~~(h) A caution, for those units for indoor operation above the floor level, and the~~

Shall be made of material not adversely affected by water, shall be attached by means of nonwater-soluble adhesive and shall comply with 2.13. These materials shall not be located on surfaces having temperatures exceeding 300°F (149°C) as determined during conduct of 2.11.

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 2.13. These materials shall not be located on surfaces having temperatures exceeding 175°F (79.5°C) as determined during conduct of 2.11.

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 2.14.2 and 2.13. These materials shall not be located where they will be exposed to temperatures exceeding 150°F (65.5°C) as determined during conduct of 2.11.

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 2.11.

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

1.14.2 All metal marking materials shall be rustproof. All markings shall be suitable for application to surfaces upon which applied. On an appliance of such design that space does not permit proper location of these markings, they may be furnished on a metal tag or a Class IIIA-3

⚠ DANGER	CARBON MONOXIDE HAZARD
	This appliance can produce carbon monoxide which has no odour. Using it in an enclosed space can kill you. Never use this appliance in an enclosed space such as a camper, tent, car or home.

Rationale: *Warning was changed to Danger to enforce the hazard of the situation. Editorial.*

Rationale: *Update of graphics to show heaters instead of charcoal grill. Editorial.*

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

~~1.16.5 A separate warning label, or metal tag, easily visible when the heater is in operation shall bear the following information, in both English and French, with the minimum letter size as specified. In 1/4" letters: "CAUTION:" In 1/8" letters: "This appliance consumes air. When used in any inside area, provide a fresh air opening of at least "x" square inches (mm²). Increase fresh air openings as marked for each additional appliance."~~

~~For the purpose of meeting this provision, the value of "x" shall be calculated and specified on the basis of 1 square inch per 1000 Btuh of input (2.2mm²/W of input).~~

Rationale: *The scope of the camp heater standard was revised to eliminate the reference to indoor use of this product.*

1.14.5 Heaters 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."

1.14.6 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."

1.14.7 Refer also to clauses 1.8.2, 1.8.3 and 1.8.4.

Rationale: *The marking coverage required expansion and updating. The coverage outlined above is a combination of requirements outlined in the meeting minutes, and the*

~~wording shall be equivalent to the following:~~

~~CAUTION: When used indoors mount at least 24 inches (610 mm) above floor.~~

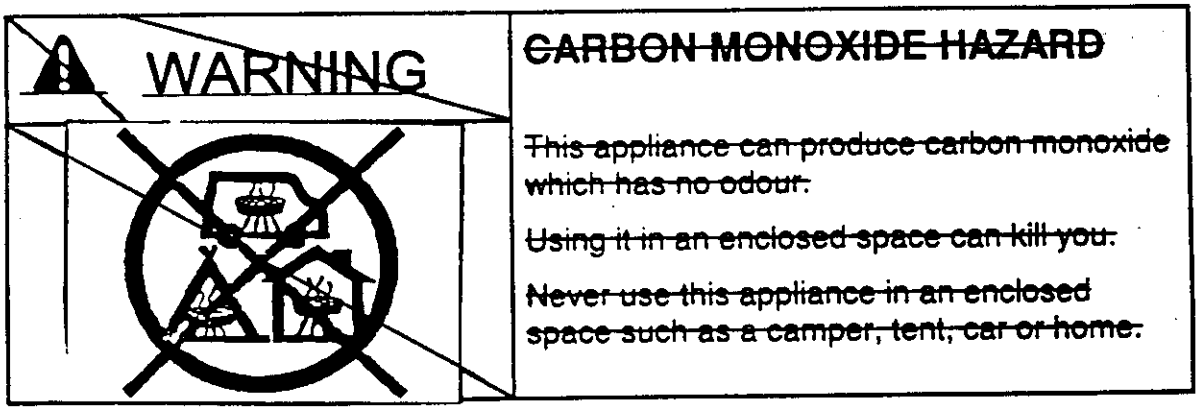
Rationale: *The scope of the camp heater standard was revised to eliminate the reference to indoor use of this product. Therefore, this clause no longer applies.*

(i) ~~The statement "PORTABLE CAMP HEATER"~~ Identification of this standard by indicating either this edition of the standard, or the most recent effective addenda thereto, with one of the following markings:

"ANSI Z21.63•CAN1-11.3-(year) Camp Heater",
"ANS Z21.63a•CAN1-11.3a-(year) Camp Heater", or
"ANS Z21.63b•CAN1-11.3b-(year) Camp Heater".

(j) The symbol of the organization making the tests for compliance with this standard.

1.14.4 ~~Where there is insufficient space on the heater, the information required in clauses 1.16.3 (f), (h) and 16.5 may be shown on a separate metal tag of not less than 0.012 inch (0.31 mm) thickness and permanently affixed to the heater.~~ A portable type gas camp heater shall have the following boxed warning label on a Class IIIA material located where it can be easily seen by the user.



PART II

PERFORMANCE

2.1 GENERAL

~~2.1.1 These provisions cover portable gas heaters for use with propane or butane.~~

Rationale: This type of statement should be included with the scope of the standard.

2.1.1 Portable gas heaters submitted for test under these provisions shall be tested with the type or types of gases selected by the manufacturer as specified in 2.2.

2.2 TEST GASES

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

Propane Gas 2500 Btu/ft^3 (94.7 MJ/m^3)
1.53 Relative Density

Butane Gas 3260 Btu/ft^3 (124 MJ/m^3)
2.00 Relative Density

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

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

Heaters for use with liquefied petroleum gases (80% propane/20% butane mix) shall have all tests conducted with propane gas. In addition, the tests specified in 2.4 and 2.5 shall be conducted with butane gas with no change in adjustment or orifice.

Heaters for use with liquefied petroleum gases (80% butane/20% propane mix) shall have all tests conducted with butane gas. In addition, the tests specified in 2.4 and 2.5 shall be conducted with propane gas with no change in adjustment or orifice.

Rationale: This provision was modified to recognize testing with propane, butane, and propane/butane mixtures.

2.3 TEST PRESSURES AND BURNER ADJUSTMENTS

2.3.1 Unless otherwise stated, each test specified herein shall consist of a series of 3 tests; one at

ANSI Z21.63a-1981 (camp heater) and Z21.58-1994 (outdoor gas grill) standards. French requirements for Canadian markings moved to the Exhibit section.

~~series of tests on any one test gas.~~

Rationale: *Primary air control means has been removed from the standard therefore this is no longer appropriate.*

~~2.3.4 A catalytic heater shall complete 80 hours of operation before testing is commenced.~~

Rationale: *Not in scope of standard.*

2.4 COMBUSTION

~~A heater shall produce negligible carbon monoxide. This provision shall be deemed met when the appliance does not, at any time and under continuous sampling, produce a CO/CO_2 ratio in excess of 0.0035 in the atmosphere of a closed room, at 77 ± 10°F (25 ± 5.5°C) in which the appliance is operated until the oxygen content of the room has been reduced to 15.1%.~~

~~The combustion of the heater shall be deemed satisfactory when heaters for use with propane or butane only and heaters for use with liquefied petroleum gases are tested when equipped for use with propane or butane as outlined in 2.2:~~

(a) ~~When operated to extinguishment in an enclosed room of 100 ft^3 (2.84 m^3) volume at air exchange rates of 0.5, 1.0 and 1.5 air changes per hour, the heater shall not deplete the oxygen level to below 16 percent by volume.~~

(b) When operated to extinguishment in an enclosed room of 100 ft^3 (2.84 m^3) volume at air exchange rates of 0.5, 1.0 and 1.5 air changes per hour, the maximum CO level shall at no time exceed 100 ppm.

Method of Test

~~(a) A closed room method of test shall be used exclusively.~~

~~(b) A room of not less than 100 Ft^3 (2.84 m^3) shall be used for tests and it shall be of sufficient volume to permit the operation of the test for 2 h before the oxygen is depleted to the specified value.~~

~~(c) The test room shall be constructed to prevent infiltration of air and have provisions for:~~

~~1. Air Temperature Control.~~

~~2. Adequate mixing of the air to prevent stratification without interfering with the normal operation of the appliance.~~

normal test pressure, one at a reduced pressure and one at an increased pressure.

(a) Test Pressures: Regulated

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

(b) Test Pressures: Non Regulated

For equipment using direct container pressure, either connected directly or remotely to container.

Propane	Reduced:	Container pressure at 0°F (-17.8°C) ambient. (vapour pressure 23.5 psig (162 kPa))
	Normal:	Container pressure at 77°F (25°C) ambient. (vapour pressure 122.3 psig (843 kPa))
	Increased:	Container pressure at 100°F (37.8°C) ambient. (vapour pressure 172 psig (1186 kPa))
Butane	Reduced:	Container pressure at 40°F (4.4°C) ambient. (vapour pressure 3 psig (20.7 kPa))
	Normal:	Container pressure at 77°F (25°C) ambient. (vapour pressure 21 psig (145 kPa))
	Increased:	Container pressure at 100°F (37.8°C) ambient. (vapour pressure 37.5 psig (259 kPa))

2.3.2 (a) For regulated heaters the test pressures specified in 2.3.1 shall be applied at the outlet of the regulator.

(b) For unregulated heaters the test pressure specified in 2.3.1 shall be applied at the heater inlet connection.

2.3.3 The input of the appliance after a 15 min warm-up period shall be within ±5% of the rated input when tested at the normal test pressure. ~~Adjustable orifices where provided shall be at the maximum flow position. When primary air control is provided, it shall be set to give a good flame at this adjustment and neither burner ratings nor primary air adjustments shall be changed during a~~

~~lower explosive limit.~~

~~2.5.2 The unburnt hydrocarbons emission at a level of 1% CO_2 as determined in the closed room test shall not exceed 15% of the fuel input a measured by the carbon balance method. (See method of test for calculation of percent unburnt fuel).~~

~~Method of Test~~

~~The appliance shall be operated in a closed room under the conditions outlined in clause 2.4.1 Method of Test.~~

~~The carbon monoxide and hydrocarbon content of the room atmosphere shall be recorded when the carbon dioxide of the room atmosphere reads as 1% CO_2.~~

~~At this point the hydrocarbon balance shall be determined as indicated by the following examples:~~

~~Test Results~~

~~CO_2~~	~~1%~~
~~CO~~	~~30 ppm~~
~~Hydrocarbons C_3H_8~~	~~400 ppm~~

~~Calculations~~

~~ppm as C~~

~~CO_2~~	~~10 000~~
~~CO~~	~~30~~
~~C_3H_8 (400 x 3)~~	~~1 200~~
	~~11 230~~

~~% unburnt hydrocarbon (C_3H_8) is therefore $\frac{1200}{11230} \times 100 = 10.7\%$~~

Rationale: *With the addition of the closed room combustion requirements and the addition of a requirement for a safety shutoff device on all heaters, this performance test is no longer needed.*

2.5 BURNER OPERATING CHARACTERISTICS

2.5.1 Burner shall not flash back:

(a) upon immediate ignition at normal, reduced, and increased test pressures.

~~3. Provisions for continuous sampling of the test room atmosphere.~~

~~The heater shall not be warmed up prior to being subjected to the following tests.~~

~~Heaters shall be tested when equipped with the test gas(es) specified in 2.2 to determine compliance with the oxygen limits specified in "a" and the carbon monoxide limits specified in "b" above when: (1) tested at increased inlet test pressure or, if a pressure regulator device is provided, at the maximum input rating in the range of reduced through increased inlet test pressures (see 1.9.5); and (2) tested at reduced inlet test pressure or, if a pressure regulator device is provided, at the minimum input rating in the range of reduced through increased inlet test pressures.~~

~~For all test conditions, tests are to be conducted on both the heater incorporating the maximum system conditions and the heater incorporating the minimum system conditions.~~

~~Heaters equipped with a valve intended for variable heat control shall have tests conducted for all test conditions on a heater incorporating the minimum system conditions and adjusted for the nominal low input setting.~~

~~For each test the heater shall be tested in a 100 ft^3 (2.84 m^3) room constructed so as to control the air exchange from 0 to at least 1.5 air changes per hour with an accuracy of 0.1 air changes per hour. The test room shall be designed to maintain a room temperature of 70 ± 5°F (21.1 ± 2.8°C). The test room shall be adjusted to establish the air exchange rate for the specific test. The heater shall then be ignited in the room and the room sealed to start the test.~~

~~A sample of the room air shall be withdrawn at the start of the test and analyzed for carbon monoxide, oxygen and carbon dioxide. During the test, sufficient samples shall be withdrawn and analyzed for carbon monoxide, oxygen and carbon dioxide to permit accurate determination of the oxygen and carbon monoxide levels as specified in "a" and "b" above.~~

~~The test shall continue equilibrium at which time the test shall be discontinued.~~

Rationale: *These revisions are proposed by the CPSC in an effort to reduce the number of accidents resulting from the use of camping heaters in confined, air tight spaces. The above text has been modified slightly to simply reference the revised test gas selection text outlined in 2.2.*

~~2.5 UNBURNED FUEL~~

~~2.5.1 The appliance when subjected to the closed room test under the conditions outlined in clause 2.4.1 Method of Test shall not emit unburnt fuel in a concentration exceeding 50% of the~~

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) Multiflame Pilot Burners (Pilot burners which 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 burner(s) 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 burner(s) 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).

Rationale: *Editorial.*

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 assure the ignition is accomplished from only the actuating flame.

(c) Pilot Burner and Thermal Element Assemblies Which 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 burner(s).

Thermostats and any other system components which may be changed or added shall be excluded during this test.

(b) upon two to five seconds delayed ignition at normal test pressure.

(c) during any of the other tests specified in these provisions.

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

2.5.3 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.

2.6 PILOT OPERATING CHARACTERISTICS

2.6.1 Where pilots are used, the provisions specified in 2.6.2, 2.6.3, 2.6.4, 2.6.5, 2.7.1, and 2.7.5 shall apply.

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

2.6.3 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.

2.6.4 Pilot burners shall show no carbon deposits during any test specified in Part II when adjusted according to the manufacturer's printed instructions.

2.6.5 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.

2.7 PILOT BURNERS AND SAFETY SHUTOFF DEVICES

2.7.1 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 which 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 which 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 burner(s) when the pilot gas supply is reduced to an

2.7.5 ~~In case the~~ 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 2.87.4 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.

2.8 STABILITY

Heaters not incorporating a tip-over switch shall be subjected to the following test:

Method of Test

The heater shall be tipped in any direction at an angle of 30 degrees from the vertical and it shall return to an upright position when released.

Where the heater is directly connected to a container, this test shall be conducted with the container full and then with the container empty.

~~A heater, to be mounted on a 20 pound propane cylinder and bearing a marking indicating that it~~ shall only be attached to a 20 pound cylinder, need not comply with the 30 degree tip test above, provided the heater when tipped in any direction at an angle of 15 degrees from the vertical, returns to an upright position when released. This test shall be conducted with the container full and with the container empty. This heater shall be marked in accordance with ~~1.16.7~~ 1.14.5.

Rationale: *The modified tip test coverage outlined above is adopted from the meeting minutes.*

The CGA Standards Committee in originally preparing the standard, envisaged designs of camping heaters which either were not directly connected to the propane cylinder or ones that were mounted directly on propane cylinders of 10 pounds or less. These heater designs, because of their lightness, are relatively unstable and upon being knocked, could easily fall over. A 30 degree tip test was therefore included in the standard. When considering a heater designed to be mounted directly on a 20 pound cylinder, because of the cylinder weight, more resistance to tipping is provided. A review of tip tests contained in other standards revealed the following:

- CGA 2.23	*Portable I.R. Heaters*	*15 degrees*
- CGA 2.14	*Construction Heaters*	*35 degrees*
- AS 2658	*Australian Standard for Portable Mobile Appliances*	*15 degrees*

When a multiflame 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 which 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 main burner(s) when the gas supply to the ignition flame is just sufficient to light the gas at the thermal heating ports.

2.7.2 Heaters equipped with controls permitting ignition at less than full rate shall comply with the provisions of clause 2.87.1 with the main burner gas input at full rate and at minimum turn-on rate.

2.7.3 The time required for the safety shutoff device to ~~turn on the gas supply~~ **prove a supervised condition** shall not exceed 5 minutes except for (1) those devices requiring a continually applied manual force to assume the "on" position, and (2) those devices which 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 ½ minutes.

Method of Test

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

Rationale: This provision was updated to more current terminology.

2.7.4 The time required for the safety shutoff device to ~~close~~ **shut off** the gas supply shall not exceed 3 minutes ~~for infrared radiant type heaters and 8 minutes for catalytic type heaters~~.

Rationale: Catalytic heaters are not covered in the scope of this standard.

Method of Test

The appliance 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 ~~device~~ **safety shutoff valve** to ~~shut off the gas supply is~~ **close** noted.

Rationale: This provision was updated to more current terminology.

90°F (50°C) rise) 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 1, 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.

~~2.12 DRAPING TEST~~

~~2.13.1 The draping test, with cheesecloth, shall be conducted in order to determine the acceptability of the surface temperatures of heaters intended for floor mounting. During the test period the cheesecloth shall not ignite.~~

~~2.12.1 The cheesecloth shall be dry and shall conform to the Canadian Government Specifications Board Specification 4-GP-81, Cloth: Cotton, Cheesecloth, for Type 2 cheesecloth. (Commercial Designation 32 x 28).~~

~~For type 2, the woven fabric count (yarns per inch) is not less than 30 in the warp and not less than 26 in the weft and the weight is not less than 1.0 ounces/yd^2 (34 g/m^2) and not more than 1.4 ounces/yd^2 (48 g/m^2).~~

~~The heater shall be placed in operation and operated continuously for a period of 1 ½ hours. Then the cheesecloth shall be draped loosely in a double layer, over the heater and extending, on all sides of the heater to the floor but of a length which will not permit folding over the floor. The test shall continue for a period of ½ hour.~~

2.12 PERFORMANCE AT HIGH ALTITUDE

~~Lights~~ Heaters tested to this standard shall also comply with CGA 2.17 Standard for Gas-Fired Appliances for use at High Altitudes.

2.13 MARKING MATERIAL ADHESION AND LEGIBILITY

~~2.13.1 No deterioration of the markings shall have occurred upon completion of all the tests.~~ 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 1.14.1) shall not be adversely affected when the marking materials are exposed to heat and moisture as specified in the following Method of Test.

- ANSI Z21.62/63	*Camp Heaters (2.5 lbs. cylinder size limit)*	*20 degrees*
- DIN-30686	*Portable Radiant Heaters for LPG*	*10 degrees*

A 15 degree tip test appears to be a reasonable limit for this particular type of equipment.

2.9 RESISTANCE TO WIND

A heater ~~without a safety shutoff device,~~ shall be so constructed that a 10 mph (4.5 m/s) wind, at a temperature of 77°F (25°C) applied horizontally from any direction for a 10 minute period will not cause a continuous burner ~~outage~~ flash back condition.

Method of Test

The test area and suitable blower shall be arranged to provide a uniform velocity of 10 mph (4.5 m/s) (± 10%) 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 shutoff 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.

Rationale: *The wind test was modified to stipulate that all heaters shall be subjected to the wind test. Since all heaters are required to employ a safety shutoff device, the heater will fail safe should burner outage occur, however, the burner should still operate properly under wind conditions.*

2.10 GAS VALVES AND CARRYING HANDLES

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 non-metallic handles after operating for a period of one hour at increased pressure, in a normal room temperature. Carrying handles shall be in the rest position.

2.11 WALL, FLOOR AND CEILING TEMPERATURES

The maximum temperature on walls, and overhead combustible construction shall not exceed 194°F (90°C) (normal ambient temperature 77°F (25°C) plus 117°F (65°C) rise) and the maximum temperature on the floor shall not exceed 167°F (normal ambient 77°F (25°C) plus

Final acceptance of marking materials shall be based on the ~~suitable~~ suitability of the application of the marking material to the heater.

Rationale: *The provisions for marking materials were updated to be consistent with other ANSI/CAN standards. An additional test temperature was also included for Class IIIA-3 Permanent Tags.*

2.14 PERMANENTLY ATTACHED MARKING TAGS

2.14.1 Markings which are attached to the heater with a flexible type fastener in accordance with 1.14.2 shall not become detached from the heater when tested as follows:

Method of Test

A 25 pound (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.

2.14.2 Markings which are attached to gas carrying components with a flexible type fastener in accordance with 1.14.2(b) shall not cause damage or leakage to any of the heater's gas carrying components when tested as follows:

Method of Test

A 50 pound (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 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.

Rationale: *Additional marking material coverage was added to cover the pull test for detached markings (Class IIIA-3 Permanent Tags) which are attached to gas carrying components [see 1.14.2(c)].*

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:

1. Good adhesion and no curling at edge;

2. No illegible or defaced printing by rubbing with thumb or finger pressure; and

3. 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 2 weeks with the oven temperature maintained at:

1. 350°F (176.5°C) for Class IIA-1, IIA-2, IIA-3, IIA-4 and IIIA-1 marking materials;

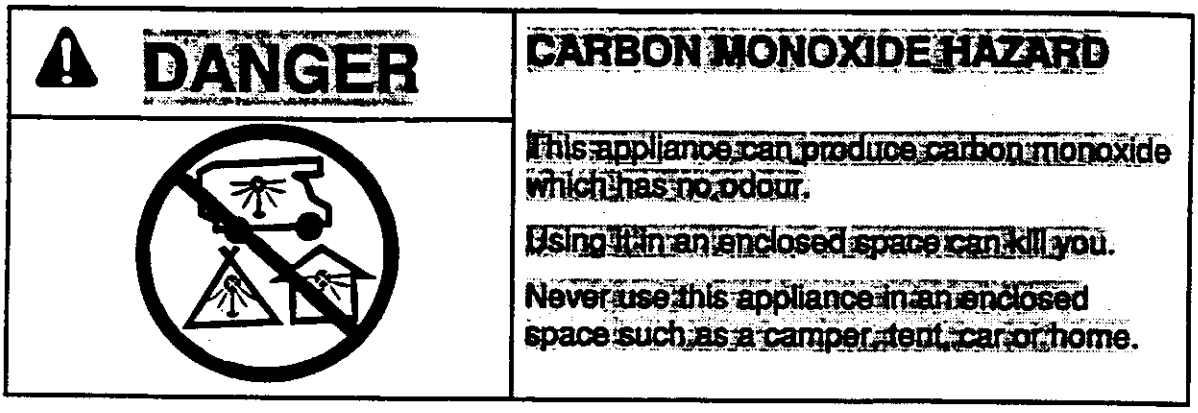
2. 250°F (121°C) for Class IIIA-2 and IIIB marking materials; or

3. 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.



Rationale: *Warning was changed to Danger to enforce the hazard of the situation. Editorial.*

Rationale: *Update of graphics to show heaters instead of charcoal grill. Editorial.*

1.14 MARKING

1.14.2 e. "Removal of this marking will void compliance of this heater with ANSI Z21.63/CAN1-11.3"

1.14.3 f. "FOR OUTDOOR USE ONLY"

1.14.3 i "ANSI Z21.63/CAN1-11.3 (year) Camp Heater".

1.14.4

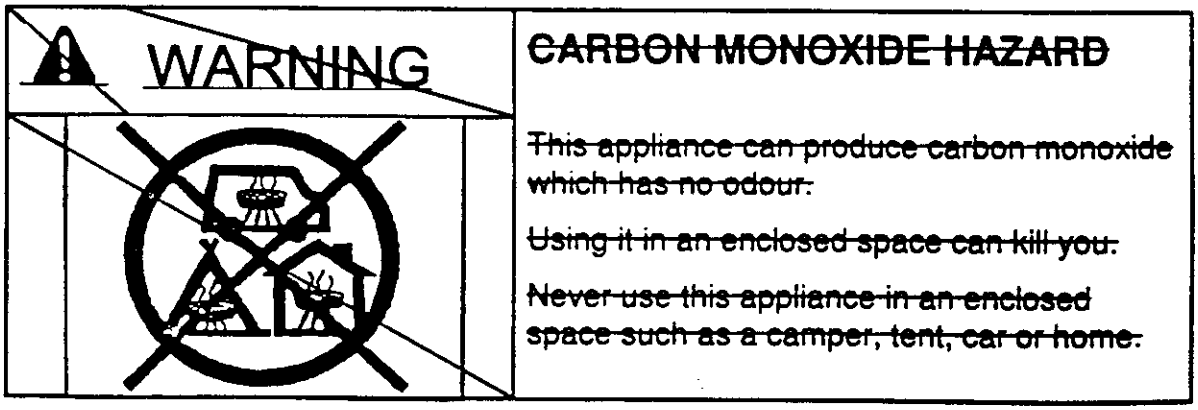


EXHIBIT A ITEMS UNIQUE TO CANADA

A.1 All instructions and marking provisions specified in this standard are required to be in a form easily understood in both English and French.

1.13 INSTRUCTIONS

The following clauses make reference to specific instructions and markings and are listed below in the English language. French translations will be provided prior to publication.

Rationale: Standard clause used for this exhibit in harmonized documents.

1.13.1

FOR YOUR SAFETY

If you smell gas:

1. Shut off gas to the appliance.
2. Extinguish any open flame.

FOR YOUR SAFETY

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

~~CARBON MONOXIDE HAZARD~~

~~This appliance can produce carbon monoxide which has no odour.~~

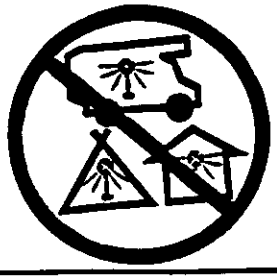
~~Using it in an enclosed space can kill you.~~

~~Never use this appliance in an enclosed space such as a camper, tent, car or home.~~

EXHIBIT B LIST OF REFERENCE STANDARDS

ANSI/ASME B1.1-~~1989~~	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI/ASME B1.20.1-~~1983 (R1992)~~	Pipe Threads, General Purpose (Inch)
ANSI/ASME B36.10M-~~1996~~	Welded and Seamless Wrought Steel Pipe
~~CSA B63~~ ~~ASTM A53-97~~	~~Welded and Seamless Steel Pipe~~ Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
CAN1-6.4	Automatic Gas Ignition Systems and Components
ANSI Z21.20	Automatic Gas Ignition Systems and Components
ANSI Z21.15-1992	Manually Operated Gas Valves for Appliances, Appliance Connector Valves, and Hose End Valves
ANSI Z21.18-1995/ CGA 6.3-M95	Gas Appliance Pressure Regulators
ANSI/ UL 569-1994	Pigtails and Flexible Hose Connectors for LP Gas
CAN/CGA 8.1-M86 (R1996)	Elastomeric Hose and Hose Couplings for Conducting Propane and Natural Gas
CAN1-8.3-77 (R1996)	Thermoplastic Hose and Hose Couplings for Conducting Propane and Natural Gas
UL 125 - 1993	Valves for Anhydrous Ammonia and LP-Gas (Other than Safety Relief)
CAN/CSA-B339-96	Cylinders, Spheres and Tubes for the Transportation of Dangerous Goods

Rationale: *Updated References.*

⚠ DANGER	CARBON MONOXIDE HAZARD
	This appliance can produce carbon monoxide which has no odour. Using it in an enclosed space can kill you. Never use this appliance in an enclosed space such as a camper, tent, car or home.

1.14.5 "Do not connect to a remote gas supply."

1.14.6 "If stored indoors, detach and leave cylinder outdoors."

A.2 Units of measurement required on printed instructions and markings shall include the SI (metric) values as a minimum.

COMMENT: Required by CGA Standards Steering Committee in all harmonized documents.

a. Burner Operating Characteristics (see 2.5),

b. Pilot Operating Characteristics (see 2.6),

c. Safety Shutoff Systems (see 2.7),

d. Combustion (see 2.4), and

e. Temperature of Handled Parts (see 2.10).

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

PART III

MANUFACTURING AND PRODUCTION TESTS

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

3.1 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 each control for leakage as specified in 1.8.6 (or 1.8.9) and 1.9.3 (or 1.9.6) using a sampling plan mutually acceptable to the manufacturer and certifying agency.~~

Rationale: *Moved to Section 3.2 d)*

b. Test fire each burner and manifold control assembly for proper burner and gas valve operation and verify the gastightness of the manifold and control assembly.

3.2 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 1.~~10~~9.5.

b. Test manual valves for continued operation to determine compliance with 1.9.88.9.

c. Test nonmetallic internal parts of gas controls for compliance with 1.4.7.

d. Test each control for leakage as specified in 1.8.67 (or 1.8.910) and 1.9.3 (or 1.9.6) using a sampling plan mutually acceptable to the manufacturer and certifying agency.

3.3 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:

PART IV

DEFINITIONS

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.

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 which would occupy 1 cubic foot at a temperature of 60°F, if saturated with water vapour 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 vapour fuels.

EXCESS AIR. Air which passes through the combustion chamber and the appliance flues in excess of that which is theoretically required for complete combustion.

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 vapour formed during combustion is condensed, and when all the necessary corrections have been applied.

INFRARED HEATER. A heater which 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 shall mean and include any material which 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 (C4H10) 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 which is utilized to ignite the gas at the main burner(s).

PRESSURE REGULATION DEVICE. As used in this standard, a control which 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.