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Halogenated Agent Extinguishing System Units

Underwriters Laboratories Inc. (UL)
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UL Standard for Safety for Halogenated Agent Extinguishing System Units, UL 1058

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Summary of Topics

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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UL 1058

Standard for Halogenated Agent Extinguishing System Units

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Fourth Edition

November 20, 2006

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at http://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover the construction and operation of halogenated agent fire extinguishing system units intended to be installed, inspected, tested, and maintained in accordance with the Standard for Halon 1301 Fire Extinguishing Systems, NFPA 12A and with the Standard for Halon 1211 Fire Extinguishing Systems, NFPA 12B.

1.2 These requirements also cover halogenated automatic extinguisher units that do not have a manual means of operation, and are intended to be used in accordance with the manufacturer's installation instructions. Automatic extinguisher units are not intended:

a) For use as a general substitute for preengineered or engineered halon extinguishing system units; or

b) For protection of fire risks larger than those specified in the manufacturer's instructions for a single unit by using multiple units.

1.3 A product that contains features, characteristics, components, materials, or systems new or different from those in use when the standard was developed, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this standard.

2 General

2.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

2.2 Where these requirements reference "extinguishing system unit," the requirements also apply to automatic extinguisher units unless specifically noted otherwise.

3 Glossary

3.1 For the purpose of these requirements, the following definitions apply.

3.2 AUTOMATIC EXTINGUISHER UNIT – A unit that:

a) Has no manual means of actuation and discharges extinguishing agent upon thermal actuation; and

b) Is intended for use in normally unoccupied spaces.

3.3 CYLINDER/VALVE ASSEMBLY – A container that incorporates a valve and which provides storage of the extinguishing agent and expellant (if applicable) until the valve is actuated. When actuated, the valve releases the agent into the distribution network of the extinguishing system.

3.4 DISCHARGE NOZZLE – A device that is used to uniformly distribute the extinguishing agent:

a) Over a specific area; or

b) Within a specific volume; or both.

3.5 DISCHARGE TIME – The time interval between the first appearance of liquid at the nozzle and the time at which the discharge becomes predominantly gaseous.

3.6 ENGINEERED SYSTEM – A system that requires individual calculation and design, in accordance with the extinguishing system unit manufacturer's instructions, to determine the flow rates, nozzle pressures, quantities of halon, and number and types of nozzles for effective extinguishing agent distribution and fire coverage.

3.7 EXPELLANT GAS – Dry nitrogen used to facilitate the discharge of the extinguishing agent at low temperatures.

3.8 EXTINGUISHING SYSTEM UNIT – Identified components that can be assembled into a system for the discharge of an extinguishing agent through fixed piping and nozzles for the purpose of extinguishing fires.

3.9 HALON 1211 (BROMOCHLORODI-FLUOROMETHANE, $CBrClF_2$) – A colorless, faintly sweet-smelling, and electrically nonconductive gas used as an extinguishing agent.

3.10 HALON 1301 (BROMOTRIFLUORO-METHANE, $CBrF_3$) – A colorless, practically odorless, and electrically nonconductive gas used as an extinguishing agent.

3.11 MANUAL MEANS OF ACTUATION – A means of system actuation in which the system operator initiates system discharge, either mechanically or electrically.

3.12 MASTER VALVE – A discharge valve that upon automatic or manual actuation operates other valves or devices in an extinguishing system.

3.13 OPERABLE PRESSURE RANGE – The pressure range corresponding to the pressures in the storage container at the specified minimum and maximum temperatures for which the extinguishing system unit is intended to be operable.

3.14 OPERATING PRESSURE – The pressure in a fully charged storage container at 70°F (21°C).

3.15 PREENGINEERED SYSTEM – A system that is tested in accordance with the limitations prescribed by the manufacturer for maximum and minimum pipe lengths, accessories, number of fittings, number and types of nozzles and nozzle placement, maximum areas, volumes, or both areas and volumes of protection.

3.16 PROOF TEST PRESSURE – The factory test pressure of each cylinder used to evaluate cylinder leakage and construction integrity. For Department of Transportation (DOT) approved cylinders, the factory test pressure is specified in the appropriate DOT specification. For ASME vessels, the factory test pressure is specified in Section VIII, Pressure Vessels, of the 1992 ANSI/ASME Boiler and Pressure Vessel Code. For non-DOT cylinders and non-ASME cylinders, the factory test pressure is three times the cylinder operating pressure at 70°F (21°C).

3.17 SELECTOR (DIRECTIONAL) VALVE – A device that is installed in the piping of an extinguishing system and that directs the flow of extinguishing agent to the appropriate protected volume. This valve is used only when more than one volume is being protected by a single extinguishing system.

3.18 TOTAL FLOODING SYSTEM – A system consisting of a supply of Halon 1301 or Halon 1211, arranged to discharge halon into the intended protected volume and to fill that volume to an effective halon concentration.

3.19 VAPOR TIME IMBALANCE – A situation in which the start of liquid discharge at a nozzle occurs after liquid discharge has been completed at any other nozzle in the system.

4 Components

4.1 Except as indicated in 4.2, a component of a product covered by this standard shall comply with the requirements for that component.

4.2 A component need not comply with a specific requirement that:

a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard; or

b) Is superseded by a requirement in this standard.

4.3 A component shall be used in accordance with its recognized rating established for the intended conditions of use.

4.4 Specific components are recognized as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions for which they have been recognized.

5 Design Manual

5.1 An engineered Halon 1301 extinguishing system unit shall be provided with a design manual that references the limitations determined by the calculation method and includes at least the following items:

a) A description of the general principles utilized in the calculation method.

b) Limitation on percent of agent in the pipe.

c) Limitations on minimum pipeline flow rates.

d) Limitations regarding the types of tee splits and attached fittings allowed. In addition, the allowable range of flow splits and information on the orientation and installation of tees for each type of split.

e) Method for determining a vapor time imbalance condition at each nozzle.

f) Minimum allowable design nozzle pressure.

g) Method for determining nozzle orifice area and selection of nozzle, as well as nozzle code information and maximum orifice area permitted in relation to the attached pipe area.

h) Nozzle area coverage limitations and information on location of nozzle in the protected area.

i) Range of filling weights for each size container.

j) Minimum and maximum design discharge time.

k) Operating temperature range limitations.

l) Description of the system design procedure and a sample problem indicating all computer input required and computer output information provided.

m) Equivalent length values of all fittings and all system equipment through which halon flows.

n) Reference to installation, operation, and maintenance.

o) The name of the manufacturer or private labeler or equivalent designation.

p) Date and manual designation number on each page.

q) If the calculation method is not valid at temperatures other than 70°F (21°C), appropriate cautionary information stating that an insufficient quantity of extinguishing agent flow may result if the storage temperature is expected to vary by more than 10°F (5.5°C) from 70°F.

6 Owner's Manual

6.1 If an owner's manual is provided with an extinguishing system unit, see 55.1, it shall include at least the following:

a) Clear indication that it is not to be considered a detailed installation, operation, and maintenance manual or design manual (if applicable).

b) Clear reference to the availability of the installation, operation, and maintenance manual and design manual by contacting the manufacturer.

c) A statement that the system periodically be inspected by qualified and trained personnel.

d) Information regarding the essentials needed to maintain the system in operation both before and after a fire.

e) A statement that no modifications are to be made to the system without consulting a qualified system designer who will refer to the detailed installation or maintenance manual. The statement shall include the following or equivalent wording: ″This system is made up of units tested within limitations contained in the detailed installation manual. The system designer must be consulted whenever changes are planned for the system or area of protection. An authorized installer or system designer must be consulted after the system has discharged.″

CONSTRUCTION

7 General

7.1 After discharge of the extinguishing agent is initiated, an extinguishing system unit shall maintain the maximum rate of application of the extinguishing agent without requiring a manual action.

7.2 All exposed parts of an extinguishing system, including the finishes on coated or painted parts, the assemblies of moving parts, the nameplates as secured in place, the mounting bracket, or the like, shall be resistant to commonly encountered atmospheric corrosive influences, and to galvanic corrosion, as determined by the Salt Spray Corrosion Test, Section 26.

7.3 If the deterioration, breakage or other malfunction of a material for an extinguishing system unit would cause the extinguishing system to become inoperable, the material shall not be susceptible to stress cracking.

7.4 As covered by these requirements, an extinguishing system unit may include:

a) Actuating assemblies;

b) An extinguishing agent storage container and valve assembly;

c) Discharge nozzle(s);

d) Indicators that show the condition of the extinguishing system;

e) A means for mounting the extinguishing system;

f) Manifold check valves;

g) Remote manual controls;

h) Selector valves; and

i) Other accessory equipment.

7.5 An extinguishing system unit shall have a minimum storage temperature of minus 65°F (minus 53.9°C), minus 40°F (minus 40°C), minus 20°F (minus 28.9°C), 0°F (minus 17.8°C), or 32°F (0°C); and a maximum storage temperature of 100°F (37.8°C), 120°F (48.9°C), 130°F (54.4°C), 150°F (65.6°C), or higher, except that the 100°F maximum storage temperature applies to an automatic extinguisher unit only.

7.6 A cylinder/valve assembly shall be of the stored-pressure type and shall employ a single chamber for both the extinguishing agent and the expellant gas.

7.7 If used as part of a multiple unit system, an extinguishing system unit shall be provided with a means for simultaneous operation of all system units.

7.8 The design concentrations for an extinguishing system unit and an automatic extinguisher unit shall be in accordance with the design concentrations specified in the Standard for Halon 1301 Fire Extinguishing Systems (National Fire Codes, Vol. 1, 1989), NFPA 12A-1992, or in the Standard for Halon 1211 Fire Extinguishing Systems (National Fire Codes, Vol. 1, 1989), NFPA 12B-1990, as applicable.

8 Electrically Operated Alarms

8.1 If an electrically operated alarm is used, it shall comply with the Standard for Audible Signal Appliances, UL 464.

9 Controls and Indicators

9.1 An extinguishing system shall be provided with:

a) An automatic and manual means of actuation; or

b) A manual means of actuation only.

An automatic extinguisher unit shall incorporate an automatic means of actuation.

9.2 An extinguishing system unit shall incorporate a pressure gauge for each pressure vessel containing a super pressurized agent, showing the pressure within the container. See Pressure Gauges and Indicators, Section 13.

9.3 If a manual means of actuation is provided (see 9.1) and it utilizes an electrical power source:

a) That electrical power source shall be independent of the power source for the automatic means of actuation; or

b) The power source may be used for both manual and automatic actuation, provided that it has an independent back-up source, such as a battery.

9.4 A control unit, such as a control panel, push-button station, and the like, used as part of an extinguishing system shall comply with the Standard for Control Units for Fire-Protective Signaling Systems, UL 864.

10 Pressure Vessels

10.1 A pressure vessel shall be fabricated of a material having rigidity, durability, and resistance to corrosion at least equivalent to:

a) An aluminum alloy, such as 6061-T6 or 6351-T6 (see the Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate, ASTM B209-93), having a minimum thickness of 0.028 inch (0.71 mm); or

b) An aluminum alloy, such as 1100, 1170, and 3003, having a minimum thickness of 0.028 inch; or

c) A mild steel alloy, such as SAE 1010, having a minimum thickness of 0.028 inch.

10.2 The requirements in this section do not apply to a pressure vessel marked as complying with DOT or ASME specifications, unless otherwise specifically indicated.

10.3 An extinguishing system pressure vessel under the jurisdiction of the Department of Transportation shall comply with the appropriate DOT specifications for shipping containers.

10.4 An extinguishing system pressure vessel that is not intended to be shipped with halon may be designed, constructed, inspected, certified and marked in accordance with Section VIII, Pressure Vessels, of the 1992 ANSI/ASME Boiler and Pressure Vessel Code.

10.5 For the purpose of these requirements, thickness measurements of the sidewall are to be measured on uncoated metal. The thickness of the dome and of the bottom is to be measured at several points after forming and before coating.

10.6 The minimum width of a brazed joint on the sidewall shall be at least four times the thickness of the sidewall.

10.7 Pressure vessels for use with Halon 1211 and with an operating pressure of 240 psi (1.65 MPa) or less at 70°F (21°C) and an internal volume not exceeding 1100 cubic inches (0.018 m^3) shall be constructed so that the stress in any part of the pressure vessel will not exceed 80 percent of the yield strength of the material or 50 percent of the ultimate tensile strength of the material when subjected to the proof test pressure specified in 23.2. (See 10.8 – 10.17).

Exception: Pressure vessels complying with 10.9 need not comply with this requirement.

10.8 With reference to the requirements of 10.7, the maximum allowable stress at proof pressure for commonly used materials and fabricating processes is as specified in Table 10.1.

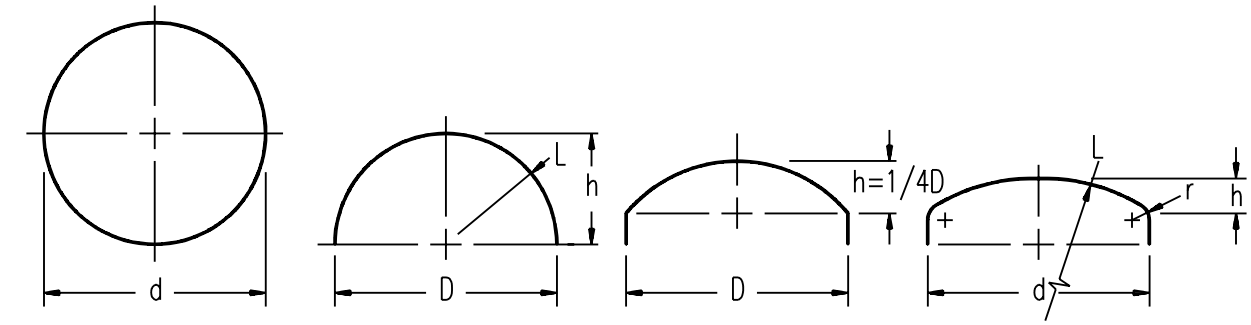
Table 10.1
Maximum allowable stress at proof pressure

Material	Maximum allowable stress,	
	psi	(MPa)
Copper brazed mild steel	25,000	(172)
Welded mild steel	27,000	(186)
Extruded 6061-T6, 6351-T6 aluminum	27,000	(186)
Extruded 3003 aluminum	16,000	(110)
Extruded 1100 aluminum	14,500	(100)
Extruded 1170 aluminum	11,000	(76)

10.9 If the metal and the maximum stress value of the fabricating method used is other than that specified in Table 10.1 or if the mode of use or construction is such that the values specified are not appropriate, pull tests are to be conducted to determine the yield and ultimate strength of the material. Test samples are to be taken either from stock material or from finished parts in accordance with Standard Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM A370-1994. If samples are taken from ruptured pressure vessels, the samples are to be taken in a direction perpendicular to the ruptured opening, as determined during the rupture test specified in 23.8. The values to be used in the equations for the design of the shell are to be based on a sufficiently large number of tests. The maximum allowable stress value is to be based upon the mean values resulting from the test series minus two unbiased standard deviations.

10.10 To determine the stress acting on the pressure vessel at the specified proof test pressure, the formulas specified in Figure 10.1 are to be used.

Figure 10.1
Stress determination formulas



Cylindrical Container Walls

$$S = \frac{Pd}{2t}$$

$$S = \frac{Pd}{4t} \text{ (sphere)}$$

Hemispherical Dome or Bottom

$$S = \frac{PL}{2t}$$

Ellipsoidal Dome or Bottom

$$S = \frac{PD}{2t}$$

Torispherical Dome or Bottom

$$S = \frac{0.885PL}{t}$$

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in which:

S = Stress at proof test pressure, psi (kPa)

P = Proof test pressure, psi (kPa)

d = Inside diameter (cylindrical portion of shell), inches (mm)

D = Inside diameter of dome or bottom, inches (mm)

L = Inside spherical radius or dish radius, inches (mm)

t = Material thickness, inches (mm)

r = "Knuckle" radius, inches (mm)

h = Distance from outside crest of head to tangent point with sidewall

10.11 If the pressure is applied to the convex side of an ellipsoidal or torispherical dome or bottom, the material thickness of the dome and bottom used for the calculations of 10.10 is to be multiplied by a factor of 1.67.

10.12 The material of the dome and bottom of a metal pressure vessel shall be of the same material as the sidewall of the pressure vessel and shall have a thickness after forming equal to or greater than the minimum measured wall thickness of the pressure vessel.

Exception No. 1: If the dome or bottom is formed integral with the sidewall, its thickness after forming may be less than the minimum measured sidewall thickness of the cylinder, but the measured dome or bottom thickness shall be at least 87 percent of the thickness of the sidewall (to allow for the reduction in thickness which may result from the forming process).

Exception No. 2: These requirements do not apply to pressure vessels with a flat dome or bottom as defined in 10.16.

10.13 A dome or bottom is considered to be integral with the sidewall if the distance from the point at which the dome or bottom is turned (the tangent point between the dome or bottom and the sidewall) to the nearest circumferential joint of the pressure vessel (excluding the collar) is greater than the radius of the sidewall to the center of the pressure vessel.

10.14 If a torispherical form dome or bottom is used, the knuckle radius r shall be not less than 6 percent of the inside dish radius L, and the cylinder diameter d shall be equal to or larger than the inside dish radius L. See Figure 10.1.

10.15 If either a flat dome or flat bottom is integral with the sidewall, the minimum thickness of the thinnest section of the dome or bottom shall be twice the minimum measured sidewall thickness. The minimum inside knuckle radius shall be 2.5 percent of the inside diameter of the sidewall.

10.16 For the purpose of these requirements, the shape of a dome or bottom is to be determined by calculating the ratio of the inside diameter of the dome or bottom to twice the distance from the outside crest of the head to the inside tangent point with the sidewall. The ratio (D/2h) then is to be applied as specified in Table 10.2.

Table 10.2
Shape determination of domes and bottoms

Ratio range	Shape
1.00 – 1.50	Hemispherical
1.51 – 3.00	Ellipsoidal
3.01 – 3.50	Torispherical
Greater than 3.50	Flat

10.17 A flat dome or bottom shall be used only on seamless pressure vessels or on pressure vessels having a linear sidewall length greater than 1-1/2 times the sidewall inside diameter.

11 Gaskets and ″O″ Rings

11.1 A gasket of a rubber-like material shall be of sufficient thickness to provide a compression-type seal. A seal, gasket, or an ″O″ ring that is continuously exposed to the extinguishing agent under pressure during intended service shall be made of a material compatible with the halon extinguishing agent. See Elastomeric Parts Test, Section 47, and One-Year Time Leakage Test, Section 30.

12 Filling Densities

12.1 Halon 1301 containers shall be charged to a filling density not greater than 70 pounds per cubic foot (1121 kg/m^3) at 70°F (21°C).

12.2 Halon 1211 containers shall be charged to a filling density not greater than 85 pounds per cubic foot (1362 kg/m^3) at 70°F (21°C).

13 Pressure Gauges and Indicators

13.1 An extinguishing system unit shall be equipped with a pressure gauge indicating the pressure in the chamber. The operating range of the gauge shall take into account the operating temperature-pressure relationship of the extinguishing system unit, except that the minimum operating pressure line may be higher than the pressure that corresponds to the minimum operating temperature.

Exception: The pressure gauge is not required for an extinguishing system unit that is filled with a halon extinguishing agent only and not charged with an expellant gas.

13.2 The pressure gauge face shall indicate the appropriate units for which the gauge is calibrated, such as psig, kPa, kg/cm^2, or any combination of pressure units.

13.3 For an extinguishing system unit that is intended to use Halon 1211, the maximum indicated gauge pressure shall be between 150 and 250 percent of the indicated operating pressure at 70°F (21°C), but not less than 140 percent of the pressure at 120°F (48.9°C). The gauge dial shall indicate, in green, the operable pressure range of the extinguishing system unit. The zero, operating, and maximum indicated gauge pressures shall be shown in numerals and with marks. The minimum use temperature shall be marked on the left side of the operable pressure range, a 70°F temperature value shall be marked at indicated charging pressure and the maximum use temperature shall be marked on the right side of the operable pressure range. The background of the gauge face in the area defined as being that above radial lines connecting each of the maximum and minimum markings to the center of the gauge shall be red. The arc of the dial from the zero pressure point to the lower end of the operable range shall read ″Recharge″. The arc of the dial from the higher end of the operable range to the maximum indicated pressure shall read ″Overcharged″. All numerals, letters, and characters in the recharge, operable, and overcharge portions of the dial shall be white. Pointers shall be yellow, and the tip of the pointer shall end in the arc of the pressure indicating dots, and shall have a maximum tip radius of 0.010 inch (0.25 mm). The minimum length of the pointer, from the center point of the dial to the tip, shall be 0.50 inch (12.7 mm). The minimum length of the arc from the zero pressure to the indicated charging pressure shall be 0.375 inch measured from the center line of the zero pressure mark to the center line of the indicated charging pressure mark.

13.4 For an extinguishing system unit that is intended to use Halon 1301, the maximum indicated gauge pressure shall be between 150 and 250 percent of the indicated operating pressure at 70°F (21°C), but not less than 120 percent of the pressure at 120°F (48.9°C). The zero, operating, and maximum indicated gauge pressures shall be shown in numerals and with marks. The minimum use temperature shall be marked on the left side of the operable pressure range, a 70°F temperature value shall be marked at indicated charging pressure and the maximum use temperature shall be marked on the right side of the operable pressure range. On the portion of the arc between the minimum use temperature and the operating pressure at 70°F, at least nine separate pressures shall be shown in marks and at least one of the marks shall be identified with a numerical pressure indication; the same identifications shall be made between the operating pressure at 70°F and the maximum use temperature. The portion of the arc between 90 and 110 percent of the charging pressure at 70°F shall be indicated in green. The background of the gauge face in the area defined as being that above radial lines connecting each of the maximum and minimum markings to the center of the gauge shall be red. The arc of the dial from the zero pressure point to the minimum use temperature marking shall read ″Recharge.″ The arc of the dial from the maximum use temperature to the maximum indicated pressure shall read ″Overcharged.″ All numerals, letters, and characters shall be black and the remaining background of the gauge shall be white. Pointers shall be yellow, and the tip of the pointer shall end in the arc of the pressure indicating dots, and shall have a maximum tip radius of 0.010 inch (0.25 mm). The minimum length of the pointer from center point of the dial to the tip shall be 0.375 inch (9.53 mm). The minimum length of the arc from the zero pressure to the indicated charging pressure shall be 1 inch (25.4 mm) measured from the center line of the zero pressure mark to the center line of the indicated charging pressure mark.

13.5 The mark used to indicate the operating pressure at 70°F (21°C) shall be not less than 0.025 inch (0.64 mm) nor more than 0.040 inch (1.02 mm) wide.

13.6 The pressure gauge face shall be marked to indicate: ″Use with _____ Only.″ The blank is to contain ″Halon 1211″ or ″Halon 1301,″ as applicable.

13.7 The pressure gauge shall be marked with the gauge manufacturer's identifying mark. The pressure gauge shall also be marked according to the following, as applicable, using a line extending as wide as, and of the same stroke thickness as, the manufacturer's identifying mark:

a) To indicate galvanic compatibility with aluminum valve bodies – a horizontal line above the manufacturer's identifying mark.

b) To indicate galvanic compatibility with brass valve bodies – a horizontal line below the manufacturer's identifying mark.

c) To indicate galvanic compatibility with aluminum and brass valve bodies – a line above and a line below the manufacturer's identifying mark, or only the manufacturer's identifying mark without any additional line.

13.8 A pressure gauge shall have a pressure relief that provides for venting in the event of a Bourdon Tube leak.

14 Puncturing Mechanisms

14.1 The parts of a puncturing mechanism, with the exception of unexposed springs and pins, shall be made of nonferrous metal or corrosion-resistant stainless steel.

15 Electrically Operated Valves and Pressure Switches

15.1 An electrically operated valve or pressure switch that is intended to operate an extinguishing system unit shall be acceptable for use in such application.

16 Siphon Tubes

16.1 A siphon tube shall be constructed of a material that is resistant to the corrosive effects of the extinguishing agent with which it is to be used. See 49.2.1 and 49.2.2.

16.2 Joints between the siphon tube and valve shall be constructed so that they do not disengage during use, such as by being threaded, locked in position by a setscrew, or the like.

16.3 The siphon tube shall be notched, scarfed, or otherwise prevented from restricting discharge in an unintended manner if the tip of the siphon tube is resting on the bottom of the shell.

17 Halon Agents

17.1 Halon 1211 and Halon 1301 shall comply with ISO 7201-1989 Part 1, Fire Protection – Fire Extinguishing Media – Halogenated Hydrocarbons – Part 1: Specifications for Halon 1211 and Halon 1301 Second Edition, (CEN EN27201-1:1994) and ISO 7201-1991 Part 2, Fire Extinguishing Media – Halogenated Hydrocarbons – Part 2: Code of Practice for Safe Handling and Transfer Procedures of Halon 1211 and Halon 1301 First Edition, (CEN EN27201-2:1994).

18 Expellant Gases

18.1 The expellant gas used in a stored-pressure extinguisher shall be nitrogen having a dew point of minus 60°F (minus 51.1°C) or less. The nitrogen shall be grade H, I, J, K, L, M, N, O, or P, as described in Table 1 of Commodity Specification for Nitrogen, CGA G10.1-1991.

19 Polymeric Materials and Nonmetallic Parts

19.1 A polymeric or other nonmetallic part, other than ″O″ ring or gasket, shall be evaluated on the basis of:

a) Mechanical strength, see Mounting Device Test, Section 31; Hydrostatic Pressure Test, Section 23; Burst Strength Test – Gauges and Indicators, Section 41; Nameplate Exposure Tests, Section 50;

b) Moisture absorption, see 49.3.1 and 49.3.2; Salt Spray Corrosion Test, Section 26; Nameplate Exposure Tests, Section 50;

c) Flammability, see 19.2;

d) Resistance to deterioration due to aging, see Aging Tests – Plastic Materials, Section 49; Nameplate Exposure Tests, Section 50;

e) Exposure to light, see 49.3.1 and 49.3.2; Nameplate Exposure Tests, Section 50; and

f) Exposure to the extinguishing agent, see 49.2.1 and 49.2.2.

19.2 With reference to flammability [see 19.1(c)], plastic materials shall be classified as Type 94HB, 94V-0, 94V-1, 94V-2, or 94-5V, when tested in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. Other nonmetallic materials shall have equivalent characteristics.

19.3 An anti-recoil device shall be supplied on the outlet of each pressurized extinguishing system unit storage container for shipping, handling, and storage purposes. The anti-recoil device shall be attached to the storage unit by a chain or other equivalent means.

19.4 A pressure switch intended for use with an extinguishing system unit shall be acceptable for use in such applications, as determined by the Performance tests specified in these requirements.

19.5 A pressure switch that provides the essential functions for the extinguishing system unit to achieve extinguishment shall:

a) Incorporate a manual reset; or

b) Be constructed to require recharging of the storage container before the pressure switch can be reset.

PERFORMANCE

20 General

20.1 Representative samples of an extinguishing system unit are to be subjected to the tests specified in Sections 21 – 52.

21 Discharge Test

21.1 An extinguishing system unit shall have a maximum discharge time of 10 seconds after being conditioned for 16 hours at an ambient temperature of 70°F (21°C). The discharge time for a preengineered extinguishing system unit is to be evaluated in accordance with the requirements in 21.2. The discharge time for an engineered extinguishing system unit is to be evaluated in accordance with Verification of Flow Calculation Method Test, Section 33.

21.2 A fully charged preengineered extinguishing system unit is to be connected to the piping arrangements simulating the most severe conditions allowed by the manufacturer's limitations, and then discharged. The discharge time is to be measured manually with a stopwatch or automatically by monitoring the pressure at the nozzle with a calibrated pressure transducer or equivalent and an attached chart recorder.

22 Valve Leakage Test

22.1 A cylinder discharge valve shall show no visible leakage while subjected to the cylinder proof test pressure for 1 minute. See 23.2.

22.2 A manifold check valve and selector valve shall show no leakage in excess of 1 fluid ounce per hour (0.008 mL/sec) per inch of nominal valve size when subjected to one-half the cylinder proof test pressure for 1 minute.

22.3 Prior to conducting this test, the valve is to be threaded in place after the container has been completely filled with water. Care is to be taken to expel all air from the test sample before pressure is applied.

22.4 The apparatus for these tests is to consist of a hand- or motor-operated hydraulic pump capable of producing the required test pressure, a test cage capable of containing the extinguishing system unit and its parts in the event of rupture, the necessary fittings for attachment to the test sample, a calibrated pressure gauge graduated in at least 20 psi (0.14 MPa) increments to at least 200 psi (1.38 MPa) greater than the test pressure, and the necessary valves, fittings, and the like, for regulating and maintaining the specified test pressure.

22.5 The pressure is to be increased at a rate of approximately 300 psi (2.07 MPa) per minute until the test pressure is attained. The pressure is then to be held for 1 minute.

23 Hydrostatic Pressure Test

23.1 An extinguishing system unit pressure vessel shall withstand for 1 minute, without rupture, a pressure of twice the proof test pressure as specified in 23.2.

23.2 With reference to the requirement of 23.1, the proof test pressure is to be determined as follows:

a) For a pressure vessel that is not tested and marked in accordance with the specifications of the DOT, the proof test pressure is to be three times the intended operating pressure at 70°F (21°C).

b) For a pressure vessel that is tested and marked in accordance with the specifications for shipping containers of the DOT, the proof test pressure is to be as specified in the applicable DOT specification.

c) For a pressure vessel that is tested and marked in accordance with ASME specifications, the proof test pressure is to be as specified in Section VIII, Pressure Vessels, of the 1992 ANSI/ ASME Boiler and Pressure Vessel Code.

d) The minimum proof pressure in any case is to be not less than twice the operating pressure or 120 psig (0.83 MPa), whichever is greater.

23.3 The pressure vessel of an extinguishing system unit that is not provided with a pressure relief and that when tested to rupture as described in 23.8 fractures:

a) Along circumferential joints between the top or bottom dome and the sidewall;

b) At the collar or collar joint; or

c) At the point of attachment of elbows or discharge fittings;

shall not rupture at a pressure of eight times the operating pressure at 70°F (21°C).

Exception: Fractures passing through welds but parallel to the longitudinal axis of a container are to be evaluated according to the requirements specified in 23.1. For the purpose of this requirement the heat affected zone of a weld is considered to be a part of the weld. The heat affected zone is considered that part of the cylinder affected by the welding process.

23.4 The flat dome or bottom of a pressure vessel that is not provided with a pressure relief shall withstand for 1 minute, without rupture, an internal pressure of eight times the rated working pressure of the vessel at 70°F (21°C). During this test, the vessel sidewall is to be restrained with a close fitting steel sleeve or similar device to prevent rupture of the sidewall.

23.5 There shall be no permanent volumetric expansion in excess of 10 percent of the total expansion of a pressure vessel of an extinguishing system unit when the pressure vessel is pressurized to the proof test pressure as specified in 23.2 (a), (b), (c), or (d) for 30 seconds and the pressure then released.

Exception No. 1: The test pressure for pressure vessels that have been proof pressure tested in accordance with 23.2 is to be 110 percent of the proof test pressure. See also 23.9.

Exception No. 2: A pressure vessel that is tested and marked in accordance with ASME specifications need not be subjected to permanent volumetric expansion testing.

23.6 A discharge valve assembly, manifold check valve, selector valve and any other pressure retaining device shall withstand, without rupture, damage, or permanent distortion, the pressure specified in 23.1. In addition, no parts shall be ″thrown,″ at a pressure less than or equal to eight times the maximum operating pressure at 70°F (21°C), from a system unit not protected by a pressure relief.

23.7 The apparatus for the tests specified in 23.1 – 23.6 is to consist of a hand- or motor-operated hydraulic pump capable of producing the required test pressure, a test cage that will contain the test sample and its parts in the event that parts are thrown off, necessary valves and fittings for attachment to the test sample, and the necessary valves, fittings, and the like, for regulating and maintaining the specified test pressure.

23.8 The test sample is to be filled with water and all air expelled. The pressure is to be increased at a rate of approximately 300 psig (2.07 MPa) per minute until the test pressure is obtained. This test pressure is to be held for 1 minute. The pressure then is to be increased until the container ruptures, to determine rupture characteristics as defined in 23.3.

23.9 To determine compliance with the requirements specified in 23.5, the test is to be conducted in accordance with Methods for Hydrostatic Testing of Compressed Gas Cylinders, CGA C-1-1975, and the water jacket test apparatus specified therein is to be used.

24 30-Day Elevated Temperature Test

24.1 An extinguishing system unit conditioned at its maximum storage temperature for a period of 30 days shall not show a leakage rate, expressed in ounces per year, greater than the minimum charge weight in pounds divided by 25.

24.2 An extinguishing system unit charged to its rated capacity with its extinguishing agent and expellant gas, if used, is to be weighed and stored in an oven for 30 days at its maximum storage temperature. It is then to be removed from the oven, conditioned at 70°F (21°C) for 24 hours, and checked for weight loss.

25 Temperature Cycling Test

25.1 A fully charged extinguishing system unit shall not show a leakage rate, expressed in ounces per year, greater than the minimum charge weight in pounds divided by 25.

25.2 The extinguishing system unit is to be maintained at the minimum storage temperature for 24 hours, then at the maximum storage temperature for 24 hours, and then again at the minimum storage temperature for 24 hours. The unit then is to be conditioned at 70°F (21°C) for 24 hours, after which it is to be checked for weight loss.

26 Salt Spray Corrosion Test

26.1 The following are to be subjected to the test described in 26.3 and 26.4.

a) A fully-charged extinguishing system unit, including attachments required for installation.

b) Any other operating components (that is, components having moving parts) that have externally exposed materials without corrosion resistance equivalent to polymeric material, brass or stainless steel.

26.2 After exposure, an extinguishing system unit shall comply with the following:

a) The extinguishing system unit shall show no evidence of corrosion on any surface, other than corrosion that can be easily wiped off after rinsing with tap water. If any part of the system has a corrosion resistant coating, the coating shall be intact and shall not be removable by rinsing with tap water or rubbing with a finger.

b) No galvanic corrosion shall be visible on the system unit.

c) If the system has a pressure gauge, the gauge shall not have moisture inside.

d) Shall operate as intended. When a component being tested is normally charged with halon, air or nitrogen or an equivalent shall be used in lieu of halon.

26.3 The test samples are to be supported vertically and exposed to salt spray (fog) using the Standard Practice for Operating Salt Spray (Fog) Testing Apparatus, ASTM B117-1994. The apparatus used for salt-spray exposure is to consist of a fog chamber, 48 by 30 by 36 inches (1.2 by 0.8 by 0.9 m) inside dimensions, having a salt solution reservoir, a supply of conditioned compressed air, a dispersing tower for producing a salt fog, sample supports, provision for heating the chamber, and necessary means of control. The dispersion tower is to be located in the center of the chamber and is to be supplied with salt solution and with warmed, humidified air at a pressure between 17 and 19 psig (117 and 131 kPa), to disperse the salt solution in the form of a fine mist or fog throughout the interior of the chamber. The temperature within the chamber is to be maintained between 92 and 97°F (33.3 and 36.1°C). Condensate accumulation on the cover of the chamber is not to be permitted to drop onto the test samples, and drops of the solution that fall from the samples are not to be recirculated but are to be removed through a drain located in the floor of the chamber.

26.4 The salt solution is to consist of 20 percent (by weight) of common salt (sodium chloride) and distilled water and the test duration is to be 240-hours. The pH value of this solution as collected after being sprayed in the test apparatus is to be between 6.5 and 7.2, and the specific gravity is to be between 1.126 and 1.157 at 95.5°F (35.3°C).

27 500 Cycle Operation Test

27.1 A discharge valve, including actuation devices, shall operate as intended for 500 operations without malfunction or damage. Following this test, the component shall show no leakage at the normal operation pressure at 70°F (21°C).

Exception: This test is not applicable to extinguishing system units of the fusible element type.

27.2 A selector valve, including actuation devices, shall operate as intended for 500 operations without malfunction or damage. Following this test, the valve shall comply with the Valve Leakage Test, Section 22.

27.3 The manual actuator, cable actuator (if provided) fitted with the maximum length of cable and maximum number of corner pulleys, and each electrical contact and relay (if provided) are to be included in this test.

27.4 Each extinguishing system unit to be tested is to be connected to a nitrogen source and fitted with a pressure-regulating device or other equivalent means and pressurized to the operating pressure at 70°F (21°C). The valve is to be cycled from fully closed to fully open 500 times.

27.5 After the cycling specified in 27.4, the discharge valve, including actuation devices, is to be subjected to an air or nitrogen under water leakage test at the operating pressure at 70°F (21°C), and there shall be no leakage from any component as evidenced by air or nitrogen bubbles. Sealing portions of the component may be cleaned before conducting this test. The inlet of the component is to be fitted with a pressure regulating device or other equivalent means and pressurized to its operating pressure at 70°F. The valve is then to be immersed in water and examined for leakage for 1 minute.

27.6 After the cycling specified in 27.4, a selector valve is to be subjected to leakage testing to determine compliance with the requirements of 27.2. The apparatus and test method used is to be as specified in 22.4 and 22.5.

28 Time Delay Verification Test

28.1 Time delay valves shall delay the actuation of a system within ±10 percent of the manufacturer's or private labeler's published delay time.

28.2 Five nonadjustable time delay valves are to be connected to a source of extinguishing agent and pressurized to the operating pressure at 70°F (21°C). A shutoff valve is to be fitted at the outlet of the container storing the extinguishing agent. The shutoff valve is to be opened, introducing the extinguishing agent into the inlet of the time delay valve. The elapsed time from shutoff valve opening to time delay valve activation is to be recorded.

28.3 An adjustable time delay valve is to be tested at the minimum and maximum delay settings and at one intermediate setting. The valve is to be tested three times at each setting.

29 Pressure-Operated Alarm Test

29.1 A pressure-operated alarm, such as a pressure-operated siren, pressure-operated horn, or the like, shall show no evidence of breakage of any of its parts when operated continuously for 50 hours at 100 psi (689 kPa) and when operated continuously for 1 hour at its maximum operating pressure. During the test period, the alarm shall receive no lubrication, adjustment, or the like.

29.2 An alarm shall produce a distinctive sound having an intensity of not less than 90 decibels at a distance of 10 feet (3.05 m) from the alarm.

29.3 The measurement is to be made with a sound level meter that complies with the requirements of the Specification for Sound-Level Meters, ANSI/ASI S1.4-1983 and Amendment S1.4A-1985 (ASA47). The ″C″ weighting network and fast response characteristics are to be used. The alarm is to be mounted in a position of normal use and operated at any pressure within its operating range. A microphone is to be located at a distance of 10 feet (3.05 m) from the alarm and positioned to receive the maximum sound level produced by the device. The measurement is to be made in a free field condition in order to minimize the effect of reflected sound energy. The ambient noise level is to be at least 10 decibels below the measured level produced by the alarm.

29.4 Free field conditions may be simulated by mounting the alarm not less than 10 feet (3.05 m) from the ground and with the microphone located 10 feet from the alarm and conducting the test outdoors on a clear day with the wind velocity not more than 5 miles per hour (2.24 m/s) and at ambient temperature of 15 to 25°C (59 to 77°F). Alternatively, an anechoic chamber of not less than 1000 cubic feet (28.3 m^3), with no dimension less than 7 feet (2.13 m), and with an absorption factor of 0.99 or greater between 100 hertz and 10 kilohertz for all surfaces, may be used for this measurement.

30 One-Year Time Leakage Test

30.1 After being stored at room temperature for a period of 1 year, a cylinder/valve assembly, including actuating components, shall not show leakage, expressed in ounces per year, in excess of the minimum charge weight in pounds divided by 25.

30.2 Representative samples of the cylinder/valve assembly, including actuating components, are to be placed in horizontal and vertical positions and their pressures checked after 1, 3, 6, and 12 months. Any loss in pressure or weight at constant ambient temperature is an indication of leakage.

31 Mounting Device Test

31.1 The mounting bracket for an extinguishing system cylinder/valve assembly that is not intended to be directly supported by the floor shall withstand for 5 minutes, without damage or permanent distortion, a static load, applied vertically downward, of five times the fully charged weight of the extinguishing system unit, but not less than 100 pounds (45.3 kg).

32 Area Coverage Test

32.1 General

32.1.1 An engineered or preengineered extinguishing system unit and an automatic extinguisher unit shall mix and distribute its extinguishing agent and shall totally flood an enclosure when tested in accordance with the requirements of 32.1.5 – 32.1.9 under the maximum design limitations and most severe installation limitations. See also 32.1.2. In addition to complying with the requirements specified in 32.1.5 – 32.1.9, an automatic extinguisher unit, when tested under the most severe installation limitations, shall also comply with the requirements specified in 32.2.1 – 32.2.3.

32.1.2 When tested as described in 32.1.5 – 32.1.9, an extinguishing system unit shall extinguish all fires within 1 minute after the end of system discharge. As an alternate, an extinguishing system unit that is not a fusible-element-actuated type shall achieve an extinguishing agent concentration of at least 3.4 percent within 1 minute after the end of system discharge. See 32.1.9.

32.1.3 The tests described in 32.1.5 – 32.2.3 consider the intended use and limitations of the extinguishing system unit, with specific reference to:

a) The area coverage of each nozzle;

b) The volume of protection, if applicable;

c) The operating temperature range of the system;

d) Location of nozzles in the protected area; and

e) Either length and size of piping and number of fittings to each nozzle, or minimum nozzle design pressure.

32.1.4 The enclosure for the tests is to be constructed of either indoor or outdoor grade minimum 3/8 inch (9.5 mm) thick plywood or equivalent material, except that plywood is to be used for the tests specified in 32.2.1.

32.1.5 An enclosure(s) is to be constructed having:

a) The maximum area and volume (if applicable) coverage for the extinguishing system unit; and

b) The minimum and maximum protected area height limitations.

Exception: For an engineered or preengineered system, the test enclosure(s) need not have the minimum and maximum height if the height limitation is not less than 2 feet (0.6 m) nor more than 30 feet (9.1 m) and the product is not an automatic extinguisher unit.

32.1.6 A preengineered type extinguishing system unit is to be assembled using its maximum piping limitations with respect to number of fittings and length of pipe, and an engineered-type extinguishing system unit is to be assembled using a piping arrangement that results in the minimum nozzle design pressure at 70°F (21°C). The extinguishing agent design concentration in the test enclosure(s) is to be 3.4 percent at the ambient temperature of the enclosure. The cylinder is to be filled to its maximum capacity. The cylinder used for these tests is to be conditioned, after charging, for at least 16 hours at the minimum storage temperature prior to the test.

Exception: For an extinguishing system unit that is rated for a maximum volume, the extinguishing agent design concentration in the test enclosure may be that which corresponds to that present at 70°F when the extinguishing system unit is protecting its maximum rated volume.

32.1.7 Three-inch (76.2-mm) diameter cans at least 4 inches (102 mm) high, and containing either heptane or heptane and water, are to be placed within 2 inches (50.8 mm) of the corners of the test enclosure(s) and directly behind the baffle (see below), and located vertically within 12 inches (305 mm) of the top or bottom of the enclosure, or both top and bottom if the enclosure permits such placement. If the cans contain heptane and water, the heptane is to be at least 2 inches deep. In addition, to simulate floor to ceiling partitions, a baffle is to be installed between the floor and ceiling in the center of the enclosure. The baffle is to be perpendicular to the direction of nozzle discharge, and be 20 percent of the length or width of the enclosure, whichever is applicable with respect to nozzle location. The heptane is to be ignited and allowed to burn for 30 seconds, after which the extinguishing system is to be manually actuated.

32.1.8 The heptane is to be commercial grade having the following characteristics:

a) Distillation –

1) Initial boiling point.....90°C (194°F)

2) 50 percent.....93°C (199°F)

3) Dry point.....96.5°C (208°F)

b) Specific gravity (60°F/60°F)

1) (15.6°C/15.6°C).....0.719

c) Reid vapor pressure.....2.0 psi

d) Research octane rating.....60

e) Motor octane rating.....50

32.1.9 As an alternate to extinguishment of the heptane fires as specified in 32.1.2, extinguishing agent concentration at the most remote corners of the test enclosure during and immediately following manual system discharge may be measured with a calibrated concentration metering device. The extinguishing agent concentrations measured in the test enclosure shall be at least 3.4 percent.

32.2 Automatic extinguisher units

32.2.1 An automatic extinguisher unit, when operated by the automatic means provided, shall extinguish the heptane fire specified in 32.2.2 within 1 minute after test fuel ignition.

32.2.2 The heptane test fuel is to be contained in a 2-1/2 square foot (0.23 m^2) square pan located within 2 inches (50.8 mm) of a corner of the test enclosure and in the most remote corner from the automatic extinguisher unit.

32.2.3 The test enclosure is to use plywood for the walls and ceiling and have two square openings each having an area of 1 square foot (0.09 m^2) to provide an oxygen source for the fire. One opening is to be located next to the 2-1/2 square foot (0.23 m^2) square pan with the top of the opening within 2 feet (0.6 m) of the floor. The other opening is to be located on the opposite wall directly across from the first opening, with the top of the opening within 2 inches (50.8 mm) of the ceiling.

33 Verification of Flow Calculation Method Test

33.1 An engineered Halon 1301 extinguishing system unit shall be tested as specified in 33.2 – 33.4 to determine that the manufacturer's calculation method accurately predicts the discharge time, nozzle pressure and distribution of the extinguishing agent. If the manufacturer's calculation method is capable of predicting the discharge time, nozzle pressure and distribution of the extinguishing agent at temperatures of other than 70°F (21°C), verification tests are to be conducted throughout the temperature range specified for the manufacturer's calculation method.

33.2 A minimum of three enclosures of varying volumes are to be constructed so that all limitations of the calculation method can be tested. A minimum of five different piping arrangements are to be installed, using Schedule 40 pipe, and tested to determine the accuracy of the calculation method. The following factors regarding the calculation method limitations and design considerations are to be included in establishing the piping arrangements:

a) The percentage of agent in the piping is to be as large as possible for the piping arrangement and at least one test is to be conducted using the piping arrangement that permits the greatest percentage of agent in the piping.

b) Minimum and maximum discharge time.

c) Minimum and maximum container fill density.

d) Minimum pipeline flow rates.

e) Variance of piping volume to each nozzle.

f) Maximum variance in nozzle pressures within a piping arrangement.

g) Maximum orifice area of nozzle relative to inlet pipe area.

h) Arrangement most likely to exhibit a vapor time-imbalance condition at the nozzle.

i) All types of tee splits, such as side-through tees, bullhead tees, and the like.

j) Minimum and maximum flow split for each type of tee split.

33.3 The cylinder is to be filled to the intended weight and the pressure is to be allowed to stabilize. The pressure container, piping, and enclosure are to be maintained at a temperature of 70°F (21°C) if possible. If not possible to maintain these items at a temperature of 70°F, the test may be conducted at a temperature other than 70°F, with appropriate temperature correction calculations, if agreeable to all concerned. The extinguishing system unit is then to be discharged. During discharge, pressure measurements are to be taken at the cylinder and nozzle(s), utilizing a calibrated pressure transducer or equivalent pressure measuring device attached to a recorder. The discharge time is to be measured by a stopwatch and verified by pressure chart recorders. One minute after the completion of extinguisher discharge, concentration measurements are to be taken in each enclosure with a calibrated concentration metering device and the weight of the discharged Halon 1301 is to be calculated.

33.4 The measured discharge time, nozzle pressure (as defined by the manufacturer's calculation method), and calculated halon weight shall not deviate from the predicted values by more than the following:

a) Discharge time: ±1.0 second.

b) Nozzle pressure: ±10 percent.

c) Weight of Halon 1301 discharged: minus 5, plus 10 percent.

34 Equivalent Length Determination

34.1 An engineered-type extinguishing system unit – including the discharge valve, siphon tube assembly, and components that are intended to be installed in the system discharge piping (except nozzles) – is to be tested as specified in 34.2 and 34.3 to determine the equivalent length of the attached pipe. The equivalent length determinations resulting from the test specified in 34.2 and 34.3 are to be included in the design manual. See Section 5, Design Manual.

34.2 Piezometers are to be installed on each end of the device and connected to a differential mercury manometer. The flow of water through the device is to be measured using a set of calibrated nozzles, or equivalent, connected to a single column mercury manometer.

34.3 At least four flow velocities greater than 10 feet per second (3.0 m/s) are to be established and the pressure drop between piezometers recorded for each velocity. The test is to be repeated with the devices removed from the line and the piezometers coupled together, and the pressure drop values so obtained are to be subtracted from the pressure drop values obtained with the devices in the line to obtain the pressure drop of the device. Using a Hazen-Williams coefficient of C=130, the equivalent length in feet of pipe is to be calculated.

35 High Pressure Discharge Test

35.1 An extinguishing system unit, including its discharge valve, brackets, manifold check valves, selector valves, and discharge piping, shall withstand without permanent distortion, rupture, or other malfunction that would render the device inoperable, the discharge test specified in 35.2.

35.2 The extinguishing system unit is to be filled with extinguishing agent and superpressurized with nitrogen to a pressure corresponding to the pressure of the system unit at the maximum storage temperature. The extinguishing system unit is to be connected to the minimum amount of piping and largest nozzle flow rate intended for the system. The extinguishing system unit is then to be installed and discharged. After discharge, the extinguishing system unit is to be visually examined for distortion or damage. This test is to be repeated for all possible extinguishing system unit operating positions.

36 Flexible Hose Low Temperature Test

36.1 A flexible hose assembly shall show no cracking or other damage when conditioned at the minimum storage temperature for 24 hours and then bent to the minimum bending radius recommended by the manufacturer.

36.2 The hose assembly is to be conditioned at its minimum storage temperature for 24 hours. The length of complete hose is then to be bent to the minimum bending radius recommended by the manufacturer within a time period of 8 to 12 seconds, while still in the cold chamber. Gloves are to be worn while handling the sample to minimize heat transfer to the sample. The hose sample is to be examined for evidence of cracking or other damage in the tube, cover, or reinforcement, and then subjected to a hydrostatic pressure test as specified in 23.1.

37 Operation Test of Manual Actuators and Manual Pull Stations

37.1 A manual actuator or manual pull station shall not require a pull or push of more than 40 pounds-force (178 N) nor a movement greater than 14 inches (356 mm) to release the extinguishing agent.

37.2 A manual pull station is to be fitted with the maximum length of cable and maximum number of corner pulleys.

37.3 A manual actuator that operates against the internal pressure of a system unit is to be tested with the system unit pressurized to simulate maximum operating pressure.

37.4 Following installation, the manual pull station or manual actuator is to be operated to determine compliance with 37.1.

38 Pneumatic Operation Test

38.1 A valve or other component intended to be pneumatically operated by a master valve or other pneumatic means shall operate as intended after being tested as specified in 38.2. A primary means of actuation that is intended to discharge multiple cylinder valve assemblies shall cause the operation of all the connected cylinder/valve assemblies to occur within a 1 second maximum time interval between operation of the first cylinder/valve assembly and the last cylinder/valve assembly.

38.2 A master valve and cylinder are to be filled and pressurized to their operating pressure at 70°F (21°C) and then conditioned at their minimum storage temperature for at least 16 hours. The maximum number of valves or other devices and the maximum amount and size of tubing or piping intended to be operated by the master valve are then to be installed and pressurized to the operating pressure (if applicable) that corresponds to the pressure at the maximum operating temperature. The system then is to be discharged.

39 Pressure Relief Tests

39.1 The frangible disc of an extinguishing system unit shall comply with the requirements specified in 39.2 and 39.3. A pressure-relief device other than a frangible disc shall comply with the requirements specified in 39.3.

39.2 Each of 30 frangible discs are to be subjected to a pressure that is increased at a rate of approximately 300 psig (2.1 MPa) per minute to a value of 85 percent of the rated bursting pressure, maintained at that pressure for at least 30 seconds, and then increased at a rate of no greater than 100 psig (689 kPa) per minute until the disc breaks. The mean bursting pressure of the discs plus two standard deviations shall not exceed the proof test pressure of the cylinder. See 23.2.

39.3 A pressure relief device shall prevent a cylinder and valve assembly from exploding when subjected to the fire exposure test specified in the Procedures for Testing of DOT Cylinder Pressure Relief Device System, CGA C-14-1992. Three cylinder and valve assemblies, charged to their maximum intended operating pressure at 70°F (21°C), are to be tested.

Exception: The fire exposure test need not be conducted if the pressure relief device is constructed and sized to comply with the flow capacity requirements as specified by the formulae in the Pressure Relief Device Standards Part 1 – Cylinder for Compressed Gases, CGA S-1.1-1994.

40 Calibration Test – Gauges and Indicators

40.1 The error of a pressure gauge at the indicated charging pressure shall not exceed ±4 percent of the charging pressure. At the upper and lower limits of the operable range, the error shall not exceed ±8 percent of the charging pressure. At the intermediate markings, the error shall not exceed ±6 percent of the charging pressure. At the zero pressure mark, the error shall not exceed plus 12, minus 0 percent of the charging pressure. At the maximum indicated pressure, the error shall not exceed ±15 percent of the charging pressure.

40.2 The pressure gauge or indicator is to be installed on a deadweight gauge tester, or on a piping apparatus having a master gauge with an accuracy of not less than 0.25 percent. The pressurizing medium may be oil, water, nitrogen, or air, but all tests on a gauge are to be conducted using the same medium. The pressure is to be applied to the gauge under test in uniform increments until the upper limit of the gauge is reached. The pressure then is to be reduced in the same increments until the zero point is reached. The applied pressure, the gauge or indicator reading, and net error are to be recorded for each increment in both the increasing and decreasing pressure conditions. Fifteen gauges are to be tested.

41 Burst Strength Test – Gauges and Indicators

41.1 A pressure gauge or an indicator shall withstand, for 1 minute without rupture, a pressure of six times the indicated operating pressure. In addition, if the Bourdon tube or pressure-retaining assembly bursts at a pressure less than eight times the indicated operating pressure, no parts of the device shall be thrown.

41.2 The sample gauge or indicator is to be attached to a hydraulic pressure pump after all air has been excluded from the test system. The sample is to be placed in a test cage and the pressure applied at a rate of approximately 300 psig per minute (2.1 MPa/min) until the required test pressure is reached. The pressure is to be held at this point for 1 minute and then increased until rupture occurs or a pressure of eight times the indicated operating pressure is reached, whichever occurs first. Five gauges are to be tested.

42 Overpressure Test – Gauges

42.1 The difference in readings of indicated operating pressure before and after a pressure gauge is subjected for 3 hours to a pressure of 110 percent of the indicated gauge capacity shall not exceed 4 percent of the indicated charge pressure.

42.2 The sample pressure gauge is to be subjected to the required test pressure for 3 hours. The pressure then is to be released and the gauges allowed to stand at zero pressure for 1 hour. Five gauges are to be tested. The gauges then are to be subjected to a calibration test. See Section 40, Calibration Test – Gauges and Indicators.

43 Impulse Test – Gauges

43.1 The difference in readings of indicated charge pressure before and after a pressure gauge is subjected to 1000 cycles of pressure impulse shall not exceed 4 percent of the indicated charging pressure.

43.2 The sample pressure gauge is to be attached to a regulated source of pressure, either air, nitrogen, or water. The pressure then is to be varied at a rate of 6 cycles per minute from 40 to 175 percent of the indicated operating pressure for Halon 1301 pressure gauges and 40 to 140 percent of the indicated operating pressure for Halon 1211 pressure gauges. The time for each complete increase/decrease pressure excursion is to be approximately 10 seconds. Five gauges are to be tested. The samples then are to be subjected to a calibration test. See Section 40, Calibration Test – Gauges and Indicators.

44 Pressure Gauge Relief Test

44.1 The pressure relief of a gauge (see 13.8) shall function at a pressure of 50 psig (345 kPa) or less within 24 hours. The minimum flow capacity of the pressure relief at 50 psig shall be not less than 1 liter per hour measured at 70°F (21°C).

44.2 This test is to be conducted with the Bourdon Tube cut completely through. The gauge is to be immersed under water with the gauge inlet connected to a regulated source of air or nitrogen. The supply pressure is to be maintained at 50 psig (345 kPa) until the pressure relief functions, or for 24 hours, whichever is shorter. The flow rate is to be measured with an inverted water column or other equivalent means. Twelve gauges are to be tested.

45 Water Resistance Test – Gauges and Indicators

45.1 A gauge or indicator for use on an extinguishing system unit shall remain watertight after being immersed in 1 foot (0.30 m) of water for 2 hours. Two gauges are to be tested.

46 Liquid Level Indicators

46.1 A liquid level indicator shall indicate the amount of extinguishing agent in the storage container within ±2.5 percent of the actual weight stored in the container when tested as specified in 46.2.

46.2 Sample extinguishing system units, utilizing pressure vessels of each diameter and of the longest length, are to be filled with the minimum and maximum fill density. The extinguishing system units are to be conditioned at the minimum rated storage temperature, at 70 ±10°F (21.1 ±5.5°C), and at the maximum rated storage temperature for 24 hours. Following each conditioning, the liquid level is to be measured and the weight in the container calculated based on the charts provided by the manufacturer. The weight calculated is then to be compared to the actual weight stored in the container, to verify that it is within ±2.5 percent of the actual weight.

47 Elastomeric Parts Test

47.1 An elastomeric part used to provide a seal shall have the following properties when tested as specified in the Standard for Gaskets and Seals, UL 157:

a) For silicone rubber (having poly-organo-siloxane as its constituent characteristic), a minimum tensile strength of 500 psi (3.4 MPa) and a minimum ultimate elongation of 100 percent.

b) For fluoroelastomers, a minimum tensile strength of 1000 psi (6.9 MPa) and a minimum ultimate elongation of 150 percent.

c) For natural rubber and synthetic rubber other than silicone rubber or fluoroelastomers, a minimum tensile strength of 1200 psi (8.3 MPa) and minimum ultimate elongation of 150 percent.

d) Those properties relating to maximum tensile set; minimum tensile strength and elongation after oven aging; and hardness after oven aging, all as specified in UL 157. The maximum service temperature used to determine the oven time and temperature for oven aging is considered to be 60°C.

e) After exposure to the extinguishing agent as specified in UL 157, a minimum tensile strength and minimum ultimate elongation of 60 percent of the original.

47.2 The Standard for Gaskets and Seals, UL 157, provides for the testing of either finished elastomeric parts or sheet or slab material. Sheet or slab material is to be tested when the elastomeric parts are O-rings having diameters of less than 1 inch (25.4 mm). The material tested is to be the same as that used in the product, regardless of whether finished elastomeric parts or sheet or slab material is tested.

48 10-Day Moist Ammonia Air Stress Cracking Test

48.1 After being subjected to the conditions described in 48.2 – 48.4, a brass part containing more than 15 percent zinc shall show no evidence of cracking when examined using 25X magnification.

Exception: Cracking is not prohibited when the cracking does not impact the ability of the product to comply with the requirements of this standard.

48.2 Each test sample is to be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses are to be applied to the sample prior to and maintained during the test. Samples with threads, intended to be used for installing the product in the field, are to have the threads engaged and tightened to the torque specified in Table 22A.1. Teflon tape or pipe compound are not to be used on the threads.

Table 48.1
Torque requirements for threaded connections

Nominal thread size, inches	Torque pound-inches (N·m)	
1	1200	(135.6)
1-1/4	1450	(163.8)
1-1/2	1550	(175.1)
2	1650	(186.4)
2-1/2	1750	(197.7)
3	1800	(203.4)

48.3 Three samples are to be degreased and then continuously exposed in a set position for ten days to a moist ammonia-air mixture maintained in a glass chamber approximately 12 by 12 by 12 inches (305 by 305 by 305 mm) having a glass cover.

48.4 Approximately 600 ml of aqueous ammonia having a specific gravity of 0.94 is to be maintained at the bottom of the glass chamber below the samples. The samples are to be positioned 1-1/2 in. (38.1 mm) above the aqueous ammonia solution and supported by an inert tray. The moist ammonia-air mixture in the chamber is to be maintained at atmospheric pressure and at a temperature of 93°F (34°C).

49 Aging Tests – Plastic Materials

49.1 Air-oven aging test

49.1.1 There shall be no cracking of a plastic valve, valve part, part subjected to the flow of halon, or bracket, after air-oven aging for 180 days at 212°F (100°C). Aged samples of the valve, valve part, bracket, or container shall perform as intended when tested as specified in 23.6 (valves and parts); Hydrostatic Pressure Test, Section 23 (containers); 31.1 (brackets); or the Burst Strength – Gauges and Indicators, Section 41 (pressurized gauge components). See 49.1.4 – 49.3.1.

49.1.2 Following air-oven aging for 90 days at 212°F (100°C), there shall be no cracking of a plastic siphon tube, and aged samples of the siphon tube shall perform as intended. Ring samples cut from the aged tube shall not exhibit a degradation in excess of 40 percent of the original tensile or ring crushing strength values.

49.1.3 If a plastic material cannot withstand the temperature specified in 49.1.1 and 49.1.2 without excessive softening, distortion, or deterioration, an air-oven aging test at a lower temperature for a longer period of time may be used. The equivalent time and temperature for 180 days at 212°F (100°C) is to be 430 days at 188.6°F (87.0°C). The equivalent time and temperature for 90 days at 212°F is to be 210 days at 188.6°F.

49.1.4 If plastic parts are attached to other parts or assemblies, the securement of the parts shall not be impaired after air-oven aging.

49.1.5 To determine the degradation of a plastic material used in a siphon tube, ring samples 1/2 inch (12.7 mm) wide are to be cut from the tube and subjected to air-oven aging. See 49.1.6. The ring samples then are to be subjected to a crush test between parallel flat plates using a machine that applies a compression load at a uniform rate of 0.2 inch (5 mm) per minute and records the load applied as a function of the deflection. The test also is to be conducted on unaged parts of identical size for comparative purposes. If the nature of the material is such that meaningful test results cannot be obtained, other tests, such as a tension test, are to be conducted.

49.1.6 The plastic valve parts and plastic siphon tube samples to be aged are to be supported in a full-draft, circulating-air oven that has been preheated at full draft to 212 ±1.8°F (100 ±1.0°C). Samples are not to touch one another or the sides of the oven. The samples of the plastic valve parts and siphon tube are to be aged for 180 and 90 days, respectively, at full draft and then allowed to cool in air at 73.4 ±3.6°F (23.0 ±2.0°C) for at least 24 hours before conducting any test or dimensional measurement. As used in this test, the term ″full draft″ refers to the oven used with inlet and outlet vents open and the air vent damper control at a setting that provides 250 to 350 air changes per hour.

49.2 Exposure to extinguishing agent test

49.2.1 Plastic siphon tubes that have been immersed for 90 days at 120°F (48.9°C) in the halon extinguishing agent in which they are to be used shall perform as intended when installed in test extinguishing system units. Ring samples cut from the tube and immersed for 90 days at 120°F in the halon extinguishing agent with which they are to be used shall not exhibit degradation in excess of 40 percent of the original tensile or ring crushing strength values.

49.2.2 Complete siphon tubes and ring samples, 1/2 inch (12.7 mm) wide and cut from unaged siphon tubes, are to be placed in a container filled with the halon extinguishing agent. The container of halon, with the samples in place, is to be capped and placed in a preheated oven at 120°F (48.9°C) for 90 days. After the test exposure, the samples are to cool in air at 73.4 ±3.6°F (23.0 ±2.0°C) for at least 24 hours before conducting any tests or dimensional measurements. The ring samples then are to be subjected to a crush test between two parallel flat plates on a testing machine that applies a compressive load at the uniform rate of 0.2 inch (5 mm) per minute and records the load as a function of the deflection. If the nature of the material is such that meaningful test results cannot be obtained, other tests, such as tensile tests, may be conducted.

49.3 Light and water test

49.3.1 There shall be no cracking of materials used for a plastic valve, exposed valve part, or bracket after exposure to light and water for 720 hours. Samples of the valve or valve part or bracket so exposed shall perform as intended when tested as specified in Hydrostatic Pressure Test, Section 23 (containers); 23.6 (valves and parts); Mounting Device Test, Section 31 (brackets); or the Burst Strength Tests – Gauges and Indicators, Section 41 (gauges). See 49.1.4. If a gauge or indicator is involved in this test, it shall remain watertight throughout the test.

49.3.2 The test apparatus is to be as specified Type D or Type DH in the Standard Practice for Operating Light Exposure Apparatus (Carbon-Arc Types) with or without water for Exposure of Nonmetallic Materials, ASTM G23-93. The temperature within the apparatus is to be 60 ±2°C (140 ±3.6°F).

49.3.3 During each operating cycle of 120 minutes, the specimens for exposure are to be exposed to light alone for 102 minutes and to light and water for 18 minutes. This conditioning is to last for 720 hours.

49.3.4 The specimens are then to be conditioned for 24 hours in air having a temperature of 60°C (140°F) and a relative humidity of 50 percent.

49.3.5 Conditioning procedures not described in 49.3.2 – 49.3.4 are to be as specified in the Standard Practice for Operating Light-and-Water Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics, ASTM D1499-92a.

50 Nameplate Exposure Tests

50.1 There shall be no significant deterioration of the legibility of a pressure-sensitive nameplate – such as darkening, fogging, or blistering – upon completion of the exposures specified in 50.2 (b) – (f) as compared to 50.2(a), nor shall there be any cracking or curling at the edges.

50.2 Prior to the exposures specified in (a) – (f) below, sample pressure-sensitive type nameplates are to be applied to test surfaces representative of the surface employed in the intended application. Curvature of this surface is to have the minimum radius anticipated in application. Exposures specified in (b) – (f) below are to be preceded by that specified in (a).

a) 72 hours at 23 ±1°C (73 ±1.8°F) and 50 ±2 percent relative humidity.

b) 24 hours at minus 54.9 ±2°C (minus 65 ±3.6°F) or minus 40°C (minus 40°F), depending on intended use.

c) 6 weeks at 60 ±2°C (140±3.6°F) and 97 ±3 percent relative humidity.

d) 90 days air-oven aging (mechanical convection) at 87 ±1°C (189 ±1.8°F).

e) 720 hours in ultraviolet light and water. See 49.3.2 and 49.3.3.

f) 48 hours immersion in distilled water.

51 Nameplate Adhesion Test

51.1 A pressure-sensitive nameplate containing required markings (see Section 54) shall have an average adhesion after being conditioned as specified in 50.2(a) of not less than 1 pound-force per linear inch (0.18 newton per linear millimeter) of nameplate width. Following the exposures specified in 50.2 (c) – (f), the average adhesion shall be not less than 1/2 pound-force per linear inch (0.09 newton per linear millimeter). The nameplate shall not be removable intact, showing signs of tearing, deformation or destruction of printed information when removal is attempted by hand following the exposure specified in 50.2(a).

51.2 Sample nameplates are to be affixed to test surfaces representative of the surface employed in the intended application. The surface is to have a curvature with the minimum radius anticipated in application. The results obtained from not less than three samples subjected to each exposure are to comprise an average. The samples then are to be subjected to each of the exposures specified in 50.2 (a), (c) – (f). After the exposure, the samples are to be conditioned for at least 24 hours at 23 ±1°C (73 ±1.8°F) and 50 ±2 percent relative humidity and the nameplate is to be pulled from the surface at an angle of 90 degrees to the surface and at a constant speed of 2.0 inches (50.8 mm) per minute by means of an Instron testing machine. The force to remove the nameplate is to be recorded automatically on a chart, and the average force is to be calculated in pounds per inch (N/mm x 0.175) width of nameplate.