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UL 2166P

**Outline of Investigation for Plastic Pipe and Fitting Assemblies used as
Self-Contained Automatic Extinguisher Units for Total Flooding
Applications**

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Summary of Topics

This is the second issue of the Outline of Investigation for Plastic Pipe and Fitting Assemblies used as Self-Contained Automatic Extinguisher Units for Total Flooding Applications, UL 2166P.

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INTRODUCTION

1 Scope

1.1 These requirements cover the construction and performance of plastic pipe and fitting assemblies used as automatic extinguisher units containing halocarbon clean agent. Automatic extinguisher units do not have a manual means of operation, and are intended to be used in accordance with the manufacturer's installation instructions and inspected, tested, and maintained in accordance with the Standard on Clean Agent Fire Extinguishing Systems, NFPA 2001. These automatic extinguisher units are not intended:

- a) For use as a general substitute for pre-engineered or engineered clean agent 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.

1.2 The joints formed with the use of pipe and fittings covered by this Outline of Investigation are to be fusion welded and are intended to prevent rotation and separation under pressure.

1.3 Halocarbon clean agents used with these automatic extinguisher units are required to comply with the requirements for construction and performance as contained in the Standard for Halocarbon Clean Agent Extinguishing System Units, UL 2166.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this Outline of Investigation shall comply with the requirements for that component.

2.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this Outline of Investigation, or
- b) Is superseded by a requirement in this Outline of Investigation.

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

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as temperatures not exceeding specified limits, and shall be used only under those specific conditions.

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3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this Outline of Investigation shall be interpreted as referring to the latest edition of that code or standard.

UL Standards

UL 199

Automatic Sprinklers for Fire-Protection Service

UL 969

Marking and Labeling Systems

UL 2166

Halocarbon Clean Agent Extinguishing System Units

5 Glossary

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

5.2 AUTOMATIC EXTINGUISHER UNIT, DISPOSABLE – A plastic pipe and fitting assembly with mounting bracket that:

- a) Has no manual method of actuation;
- b) Has an automatic thermal method of actuation;
- c) Is intended for use in normally unoccupied spaces;
- d) Is limited to a single protected area as specified in 1.2; and
- e) Is not capable of nor intended to undergo complete maintenance including internal inspection, replacement of parts, and hydrostatic testing.

5.3 CLEAN AGENT – Electrically nonconducting, volatile, or gaseous fire extinguishant that does not leave a residue upon evaporation. The word "agent" as used in this document shall mean "clean agent" unless otherwise indicated.

5.4 DESIGN CONCENTRATION – The percent of extinguishing agent in air per unit of protected volume, including a safety factor, required for total flooding system design purposes.

5.5 DISCHARGE PORT – The opening on a plastic pipe and fitting assembly from which extinguishing agent exits providing uniform distribution:

- a) Over a specific area and
- b) Within a specific volume.

5.6 DISCHARGE TIME – The time interval between activation and the end of extinguishing agent exiting from the discharge port.

5.7 DISCHARGE TIME, MAXIMUM – The longest discharge time specified by the manufacturer; but, not greater than 10 seconds for Class A surface fire hazards, Class B fire hazards, and Class C fire hazards as defined in NFPA 2001.

5.8 EXPELLANT GAS – An inert gas used to facilitate the discharge of a superpressurized clean agent at low temperatures.

5.9 EXTINGUISHING CONCENTRATION – The minimum percent of extinguishing agent in air per unit of protected volume, excluding a safety factor, required to extinguish fire in total flooding applications involving a particular fuel under defined experimental conditions.

5.10 HEPTANE – A commercial grade hydrocarbon used as a test fuel with a minimum initial boiling point of 88°C (190°F), maximum dry point of 100°C (212°F), and a specific gravity (60°F/60°F) (15.6°C/15.6°C) of 0.69 – 0.73.

5.11 JOINT, FUSION WELDED - The connection between plastic pipe end and fitting.

5.12 METHOD OF ACTUATION, AUTOMATIC – A means of actuation that results in extinguishing agent discharge without the necessity of human intervention, such as a thermal actuating mechanism.

5.13 MOUNTING BRACKET – A device intended to attach a plastic pipe and fitting assembly used as an automatic extinguisher unit to the enclosure structure and maintains the unit orientation during discharge.

5.14 OPERATING PRESSURE – The pressure in a fully charged plastic pipe and fitting assembly used as an automatic extinguisher unit at 21°C (70°F).

5.15 OPERATING PRESSURE RANGE – The pressure range corresponding to the pressures within the plastic pipe and fitting assembly at the specified minimum and maximum temperatures for which the automatic extinguisher unit is intended to be operated.

5.16 OPERATING TEMPERATURE RANGE – The temperature range inclusive of the minimum and maximum temperatures for which the automatic extinguisher unit is intended to be stored, used, and operated.

5.17 PLASTIC FITTING – Devices used to close pipe ends, molded to specification, are of different various types (for example, caps, plugs, and transition fittings), and used in the storage of extinguishing agent.

5.18 PLASTIC PIPE – Round tube that is extruded to specification, used in the storage of extinguishing agent, and forms the discharge port upon actuation.

5.19 PLASTIC PIPE AND FITTING ASSEMBLY – Plastic pipe and fittings fusion welded to provide a storage container for the extinguishing agent and expellant (when applicable) until actuated, forming a discharge port for release of the agent.

5.20 PROTECTED VOLUME – For fire tests, the volume within the protected enclosure, minus the volume of any permanent impermeable building elements within the enclosure.

5.21 TOTAL FLOODING – A plastic pipe and fitting assembly used as an automatic extinguisher unit arranged to discharge an extinguishing agent into and throughout an enclosed space to achieve a uniform distribution of the extinguishing agent.

CONSTRUCTION

6 Operating Temperature Range

6.1 Where U.S. customary units are employed, the minimum storage temperature of an automatic extinguisher unit shall be 32°F (0°C), 0°F (minus 17.8°C), or lower in increments of 10°F (5.5°C); and a maximum storage temperature of either 100°F (37.8°C), 120°F (48.9°C), 130°F (54.4°C), or higher in increments of 10°F (5.5°C).

6.2 Where SI (System International) units are employed, the minimum storage temperature of an automatic extinguisher unit shall be 0°C (32°F), -20°C (minus 4°F) or lower in increments of 5°C (9°F); and a maximum storage temperature of 37.8°C (100°F), 50°C (122°F), or higher in increments of 5°C (9°F).

7 Pipe

7.1 Pipe shall be 1 NPS or smaller, plastic, and have corrosion resistance at least equivalent to brass, bronze, or austenitic stainless steel.

7.2 The plastic pipe shall be free from visible cracks, holes, foreign inclusions, or other defects.

8 Fittings

8.1 Fittings shall be 1 NPS or smaller, plastic, or plastic with an integral metallic insert for transition to a pressure gauge; and have corrosion resistance at least equivalent to brass, bronze, or austenitic stainless steel.

8.2 The fittings shall be free from visible cracks, holes, foreign inclusions, or other defects.

8.3 The fittings shall be of the configuration type (e.g., caps, plugs, and transition fittings). Transition fittings are intended to include an integral metallic, corrosion resistant insert having threads conforming to an international standard.

9 Joints

9.1 The pipe-to-fitting joint formed shall be of the heat fusion type and prevent rotation or separation under pressure.

10 Halocarbon Clean Agents

10.1 For the purpose of halocarbon clean agents, the construction requirements contained in UL 2166 apply.

10.2 If the plastic pipe and fitting assemblies are intended for Class A surface fires, then in addition to the plastic pipe and fitting assemblies complying with the requirements contained herein; the halocarbon clean agent shall comply with the requirements for construction and performance, as contained in UL 2166 for Class A Fire Extinguishing Tests.

11 Expellant Gases

11.1 For the purpose of expellant gases, the construction requirements contained in UL 2166 apply.

12 Pressure Gauges

12.1 For the purpose of pressure gauges, the construction requirements contained in UL 2166 apply.

Exception: A pressure gauge is not required for an automatic extinguisher unit that is filled with a halocarbon clean agent only and not charged with an expellant gas.

13 Pipe and Fitting Assemblies

13.1 Plastic pipe and fitting assemblies filled with the intended halocarbon clean agent and expellant gas (as applicable) serve as the clean agent storage container pressure vessel, distribution piping, and discharge port (when ruptured due to the application of heat).

13.2 Plastic pipe and fitting assemblies, plastic mounting brackets, and outdoor use plastic nameplates (as applicable) shall be evaluated on the basis of:

- a) Mechanical strength: see Mounting Device Test; Hydrostatic Pressure Test, Burst Strength Test – Gauges, Nameplate Exposure Tests;
- b) Moisture absorption: Nameplate Exposure Tests;
- c) Resistance to deterioration due to aging: see Aging Tests – Plastic Materials; Nameplate Exposure Tests;
- d) Exposure to light: see Aging Tests – Plastic Materials; Nameplate Exposure Tests;
- e) Exposure to the clean agent: see Aging Tests – Plastic Materials.

14 Filling Densities

14.1 The maximum and minimum filling densities of clean agent within the plastic pipe and fitting assemblies as specified by the manufacturer at the normal operating temperature range corresponding to the operating pressure range.

PERFORMANCE

15 General

15.1 Representative samples of automatic extinguisher units shall be subjected to the performance tests.

16 Discharge Test

16.1 Samples representative of each plastic pipe and fitting assembly design shall have a discharge time of no longer than 10 seconds.

16.2 Each sample, charged to its maximum fill density at 70°F (21°C), shall be conditioned to 70 ±5°F (21 ±2.8°C) by holding in a room maintained at the conditioning temperature for at least 16 hours.

16.3 Following conditioning, each sample shall be installed in a protected volume. The temperature within the protected volume shall be increased by a gas burner fire located and constructed as described in UL 199 Room Sensitivity Test.

16.4 The fully charged plastic pipe and fitting assembly is 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.

17 Hydrostatic Pressure Test

17.1 Samples representative of each plastic pipe and fitting assembly design shall withstand for 1 minute, without rupture, a pressure of six times the operating pressure at 70°F (21°C). Each sample shall rupture without throwing parts when subjected to a rupture pressure equal to or less than eight times the operating pressure at 70°F (21°C).

17.2 Each sample shall be filled with water, vented of all entrapped air, attached to a hydrostatic pressure test apparatus, and the pressure increased until a pressure of six times the operating pressure at 70°F (21°C) is achieved and maintained for 1 minute. Following this pressure application, the pressure shall be increased until rupture of each sample occurs and this pressure shall be recorded.

17.3 The hydrostatic pressure test apparatus shall consist of a hand- or motor-operated hydraulic pump capable of producing the required test pressure, a test cage that contains each sample and its parts in the event that parts are thrown off, valves and fittings for attachment to each test sample, and the valves, fittings, and other fixtures, for regulating and maintaining the specified test pressures.

18 One-Year Time Leakage Test

18.1 Samples representative of each plastic pipe and fitting assembly design, following conditioning at 72 ±7°F (22.2±3.9°C) for 360 days, shall not show:

- a) Leakage greater than 0.25 percent of the minimum charge weight; nor
- b) Signs of degradation or corrosion to components caused by exposure to the clean agent under storage conditions, and pressurized to their operating pressure at 70°F (21°C).

18.2 Each sample, charged within its fill density range at 70°F (21°C), shall be maintained at 72 ±7°F (22.2 ±3.9°C) for 360 days. Each sample is then to be checked for weight and pressure loss (if fitted with a pressure gauge) after 1, 3, 6, and 12 months. At least one sample shall be discharged, disassembled and examined.

19 Thirty-Day Elevated Temperature Test

19.1 Samples representative of each plastic pipe and fitting assembly design, following conditioning at its maximum storage temperature for 30 days, shall not show:

- a) Leakage greater than 0.021 percent of the minimum charge weight; nor
- b) Signs of degradation or corrosion to components caused by exposure to the clean agent under storage conditions, and pressurized to their operating pressure at 70°F (21°C).

19.2 Each sample, charged to its maximum fill density at 70°F (21°C), shall be checked for weight and pressure (if fitted with a pressure gauge) following any stabilization conditioning and maintained at the maximum storage temperature for 30 days. Each sample is then to be checked for weight and pressure loss (if fitted with a pressure gauge) following any stabilization conditioning. At least one sample shall be discharged, disassembled and examined.