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UL 2901

Outline of Investigation for Antifreeze Solutions for Use in Fire Sprinkler Systems

Issue Number: 1

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Summary of Topics

This first issue of the Outline of Investigation for Antifreeze Solutions for Use in Fire Sprinkler Systems, UL 2901, covers new requirements for antifreeze solutions intended to be used for fire sprinkler systems. This Outline includes requirements that address the stability of the solutions, the effect of the solutions when exposed to materials that can be expected in water based systems, human health and environmental impact assessment, fire performance, determination of hydraulic characteristics, marking and installation and minimum production specifications.

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INTRODUCTION

1 Scope

1.1 This Outline of Investigation covers requirements for the performance of antifreeze solutions for fire sprinkler systems.

1.2 These solutions are intended for use in wet pipe sprinkler systems subject to freezing for installation in accordance with the manufacturer's design and installation instructions and the Standard for Installation of Automatic Sprinkler Systems, NFPA 13; and inspected, tested and maintained in accordance with the Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems, NFPA 25.

2 Units of Measurement

2.1 The metric unit shall be designated as the official unit for purposes of this outline. Where values of measurement are specified in both SI and English units, either unit is used. In cases of dispute, the metric unit shall be used.

3 Undated References

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

CONSTRUCTION

4 General

4.1 Antifreeze solutions shall be formulated in such a manner to demonstrate the ability of the solution to not substantially contribute to the heat release rate of a fire when tested in accordance with Section 17, Exposure to Fire.

4.2 For antifreeze solutions having hydraulic flow characteristics dissimilar from water, the manufacturer's design and installation instructions shall include information regarding the appropriate methodologies and criteria for hydraulically calculating sprinkler systems using the antifreeze solution. See Section 19, Viscosity at Temperature Limitations and 22.1(d).

4.3 Hydrocarbon oils shall not be miscible in an antifreeze solution unless it can be demonstrated that the miscibility will not significantly impact the ability of the solution to comply with the requirements of this outline.

4.4 Antifreeze solutions shall be pre-mixed at the factory and shall not require additional mixing in the field or additional constituents in the field.

4.5 The maximum use temperature shall not be less than 150 °F (66 °C).

PERFORMANCE

5 General

5.1 Samples of antifreeze solutions that are representative of formulation and concentration shall be subjected to the tests in Sections 6 – 21.

6 Characterization Tests

6.1 An antifreeze solution shall be characterized by conducting the following tests, using the test methods and samples indicated in Table 6.1.

Table 6.1
Solution Characterization Tests

Test Description	Test Standard Reference	Antifreeze Samples
Pour Point	ASTM D97, Standard Test Method for Pour Point of Petroleum Products	Each Formulation, each concentration
Viscosity	ASTM D2983, Standard Test Method for Low-Temperature Viscosity of Lubricants Measured by Brookfield Viscometer	Each Formulation, most concentrated
Specific Gravity	ASTM D1429, Standard Test Methods for Specific Gravity of Water and Brine	Each Formulation, each concentration
pH	ASTM D1293, Standard Test Methods for pH of Water	Each Formulation, most concentrated
Freeze Point	ASTM D6660, Standard Test Method for Freezing Point of Aqueous Ethylene Glycol Base Engine Coolants by Automatic Phase Transition Method or equivalent differential scanning calorimetric methods	Each Formulation, each concentration

7 High Ambient Temperature Stability

7.1 An antifreeze solution shall maintain stability and not separate as evidenced by a change of more than 10% in the Pour Point, Viscosity, Specific Gravity, pH and Freeze Point after being exposed to a temperature of 158 °F (70°C) for 90 days.

7.2 For each concentration of antifreeze solution, at least two covered containers having a volume not less than 0.5 liters are to be filled with the antifreeze solution and placed in an air circulating oven for 90 days at a temperature of 158 ±4 °F (70 ±2 °C).

7.3 After the exposure, the sample solutions are to be subjected to the tests specified in Table 6.1.

8 Temperature Cycling Stability

8.1 An antifreeze solution shall maintain stability and not separate as evidenced by a change of more than 10% in the Pour Point, Viscosity, Specific Gravity, pH and Freeze Point after being exposed to a temperature cycling between intended use temperature extremes after 40 cycles.

8.2 For each concentration of antifreeze solution, at least two covered containers having a volume not less than 0.5 liters are to be filled with the antifreeze solution and placed in a temperature conditioned chamber capable of exposing the samples to temperature limitations for the concentrations indicated in the manufacturer's installation instructions. As indicated in 4.5, the maximum use temperature is not to be less than 150 °F (66 °F). The samples are to be cycled from the minimum to the maximum intended use temperatures once each 24 hours for a total of 40 cycles.

8.3 After the exposure the sample solutions are to be subjected to the tests specified in Table 6.1.

9 Electrical Conductivity

9.1 The electrical conductivity of an antifreeze solution shall not exceed 1000 $\mu\text{Siemens}/\text{cm}^2$ when tested in accordance with 9.2, unless it can be demonstrated that the solution exhibits electrical shock risks similar to water when discharged onto representative energized equipment typically found in dwelling units.

9.2 Each formulation and concentration of antifreeze solution shall be subjected to the conductivity test in accordance with ASTM D1125, Standard Test Methods for Electrical Conductivity and Resistivity of Water.

10 Corrosion Rate

10.1 An antifreeze solution at the minimum and maximum concentration shall not cause the corrosion rate, as determined in 10.2 and 10.3, to exceed 1.0 mils/year (0.025 mm/year) for the following materials:

- a) ASTM A108, Grade 1010 steel;
- b) ASTM B16, H02 (Half Hard) brass;
- c) Type 304 stainless steel; and
- d) Additional representative metallic materials other than steel, brass, bronze or stainless steel referenced in the manufacturer's instructions as being compatible with the antifreeze solution.

10.2 Test coupons of each material are to be prepared and exposed to the antifreeze solution using the method described in the Standard for Water Additives for Fire Control and Vapor Mitigation, NFPA 18A-2011 for investigating uniform corrosion.

10.3 The corrosion rate in mils per year is to be determined by calculating the weight loss over the exposed area of the sample coupon in accordance with the Standard on Water Additives for Fire Control and Vapor Mitigation, NFPA 18A.