



TOWN OF TRUCKEE COMMUNITY DEVELOPMENT DEPARTMENT BUILDING AND SAFETY DIVISION

Antifreeze Solutions in Residential Fire Sprinkler Systems

The 2013 edition of NFPA 13D, as amended by TIA 13-1, discourages the use of antifreeze solutions within residential fire sprinkler systems unless no other practical freeze protection options are available. It is now necessary to research and eliminate other freeze protection options prior to choosing antifreeze. This determination must be submitted to the fire and/or building departments with every submittal utilizing antifreeze solutions.

Construction considerations utilizing freeze protection options other than antifreeze should be started early in the home design process. The owner, architect, and contractor should be made aware that options are available for avoiding or minimizing the use of non-listed antifreeze solutions. These options may include, but are not limited to the following:

1. Maintaining the temperature in the areas where the fire sprinkler pipe is installed above 40°F and utilizing a wet pipe system.
2. Installing a dry pipe or pre-action fire sprinkler system.
3. Utilizing dry pendent or dry sidewall sprinklers extending from heated areas of the house into unheated areas.
4. Heat tracing systems on the pipe in the freezing areas of the house.
5. Limiting the extent of the antifreeze system to the smallest possible area.
6. Utilizing a listed antifreeze solution although none are available as of January 2014.

These options must be considered in each residence prior to selecting antifreeze as the only practical freeze protection solution.

When all other freeze protection options have been explored and eliminated, antifreeze solutions may be used in accordance with NFPA 13D section 9.2.2.2 (TIA 13-1) and the State Fire Marshal Information Bulletin IB13-009. Both of these documents require documentation be presented to the enforcing agency to substantiate the use of the antifreeze solution. This documentation must indicate that other freeze protection options were explored and eliminated as not practical. The documentation must also consider factors such as maximum concentration of antifreeze, minimum anticipated temperature, system pressure, maximum ceiling height, and sprinkler orifice size. Assistance with this determination may be found in the reports prepared by the NFPA Fire Protection Research Foundation (FPRF) at the following link <http://www.nfpa.org/antifreeze> .

The documentation should address the concerns listed below and provide a basis for the proposed antifreeze system.

Determination of use of Antifreeze Solutions in Residential Fire
Sprinkler Systems

1. What were the alternatives considered prior to selecting antifreeze to protect the residence? Why were these options not selected?
2. What is the minimum anticipated temperature at this site? This information can be obtained from websites such as <http://www.wunderground.com/climate/extremes.asp> and should be included with the submitted documentation.
3. What is the minimum concentration of antifreeze required to protect the system at this temperature? Reference NFPA 13D 2013 Table A.12.3.5 or manufacturer specific data.
4. What is the water pressure at this site? Some FPRF research suggests that optimum pressures in antifreeze systems are 50 psi or less.
5. What are the K factors of the sprinklers being utilized in the system design? Some FPRF research suggests that sprinklers with K factors of 4.20, or greater, are optimum for antifreeze systems.
6. What is the maximum ceiling height? Some FPRF research suggests that the optimum ceiling height for antifreeze systems is 20 feet, or less.

Proposed Antifreeze System

1. A premixed antifreeze system of (circle one) glycerine or propylene glycol at a concentration of _____% is proposed.
2. The minimum anticipated temperature at this site is _____ °.
3. The antifreeze manufacturer is _____.
4. The maximum system pressure is _____ psi.
5. The maximum ceiling height is _____ feet.
6. The proposed sprinkler is _____ with a K factor of _____.

I have reviewed the above list and have complied with all items and provided documentation as required and consistent with the TIA 13-1 and the IB13-009 as published by NFPA and the Office of the State Fire Marshal. I understand that if all the information required above is not shown on the plans or not submitted with the appropriate documentation, the Town of Truckee reserves the right to require additional documentation as determined by the Building Division.

—
Contractor and/or Engineers Name (Print) Title

—
Contractor and/or Engineer's Signature Date



Tentative Interim Amendment

NFPA® 13D
**Standard for the Installation of Sprinkler Systems in One- and Two-
Family Dwellings and Manufactured Homes**
2013 Edition

Reference: Section 9.2 and
A.9.2 **TIA 13-1**
(SC 12-8-28/TIA Log #1067)

Note: Text of the TIA issued and incorporated into the text of Section 9.2 and A.9.2, therefore no separate publication is necessary.

1. *Revise Section 9.2 and A.9.2 to read as follows:*

9.2* Antifreeze Systems.

9.2.1* Conformity with Health Regulations. The use of antifreeze solutions shall be in conformity with any state or local health regulations.

9.2.2* Antifreeze Solutions.

9.2.2.1 Except as permitted in 9.2.2.2, antifreeze solutions shall be listed for use in new sprinkler systems.

9.2.2.1.1 For existing systems, antifreeze solutions shall be limited to premixed antifreeze solutions of glycerine (chemically pure or United States Pharmacopoeia 96.5%) at a maximum concentration of 50% by volume, propylene glycol at a maximum concentration of 40% by volume, or other solutions listed specifically for use in fire protection systems.

9.2. 2.2* Premixed solutions of glycerine (chemically pure or United States Pharmacopoeia 96.5%) at a maximum concentration of 48% by volume or propylene glycol at a maximum concentration of 38% by volume shall be permitted to protect piping that is supplying sprinklers in a specific area of the dwelling unit, where acceptable to the Authority Having Jurisdiction.

9.2.2.1* Documentation shall be presented to the AHJ to substantiate the use of the antifreeze solution.

9.2.2.3 The concentration of antifreeze solutions shall be limited to the minimum necessary for the anticipated minimum temperature.

9.2.2.4* The specific gravity of the antifreeze solution shall be checked by a hydrometer with a scale having 0.002 subdivisions.

A.9.2.1 Antifreeze solutions can be used for maintaining automatic sprinkler protection in small, unheated areas. Antifreeze solutions are recommended only for systems not exceeding 40 gal (151 L). Because of the cost of refilling the system or replenishing small leaks, small, dry valves should be used where more than 40 gal (151 L) are to be supplied. Propylene glycol or other suitable material can be used as a substitute for priming water to prevent evaporation of the priming fluid and thus reduce ice formation within the system.

A.9.2.2 Listed nonmetallic sprinkler pipe and fittings should be protected from freezing with an antifreeze solution that is compatible with the nonmetallic material. Laboratory testing shows that glycol-based antifreeze solutions present a chemical environment detrimental to nonmetallic pipe.

Table A.12.3.5 Properties of Glycerine and Propylene Glycol for Existing Systems (Table A.9.2.2.1 unchanged)

A.9.2.2.1 The documentation should substantiate that the proposed use of premixed glycerine and propylene glycol antifreeze solutions is consistent with the FPRF testing for the specific installation parameters.

A.9.2.2.2 Examples of specific areas might include piping installed in an exterior wall or an unheated concealed space above a cathedral ceiling that cannot be protected with insulation or heat tracing. Premixed solutions of glycerine and propylene glycol should be used only where other freeze protection options are not practical. The specific areas protected by premixed glycerine and propylene glycol shall be limited to the greatest extent possible.

Propylene glycol and glycerin antifreeze solutions discharged from sprinklers have the potential to ignite under certain conditions. Research testing has indicated that several variables may influence the potential for large-scale ignition of the antifreeze solution discharged from a sprinkler. These variables include, but are not limited to, the concentration of antifreeze solution, sprinkler discharge characteristics, inlet pressure at the sprinkler, location of fire relative to the sprinkler, and size of fire at the time of sprinkler discharge. Research testing also indicates that propylene glycol or glycerin solutions can be used successfully with certain other combinations of these same variables. Given the need for additional testing to further define acceptable versus unacceptable scenarios, the use of propylene glycol and glycerin antifreeze solutions should only be considered when other sprinkler system design alternatives are not practical. If these solutions are used, all relevant data and information should be carefully reviewed and considered in the sprinkler system. The

following is a list of research reports that have been issued by the Fire Protection Research Foundation related to the use of antifreeze in sprinkler systems:

1. *Antifreeze Systems in Home Fire Sprinkler Systems – Literature Review and Research Plan*, Fire Protection Research Foundation, June 2010.
2. *Antifreeze Systems in Home Fire Sprinkler Systems – Phase II Final Report*, Fire Protection Research Foundation, December 2010.
3. *Antifreeze Solutions Supplied through Spray Sprinklers – Interim Report*, Fire Protection Research Foundation, February 2012. The following tables provide an overview of the testing.

Topic	Information
Scope of Sprinklers Tested	<p><u>The following sprinklers were used during the residential sprinkler research program described in the report dated December 2010:</u></p> <ul style="list-style-type: none"> • <u>Residential pendent style having nominal K-factors of 3.1, 4.9 and 7.4 gpm/psi^{1/2}</u> • <u>Residential concealed pendent style having a nominal K-factor of 4.9 gpm/psi^{1/2}</u> • <u>Residential sidewall style having nominal K-factors of 4.2 and 5.5 gpm/psi^{1/2}</u> <p><u>The following sprinklers were used during the spray sprinkler research program described in the report dated February 2012:</u></p> <ul style="list-style-type: none"> • <u>Residential pendent style having a nominal K-factor of 3.1 gpm/psi^{1/2}</u> • <u>Standard spray pendent style having nominal K-factors of 2.8, 4.2, 5.6 and 8.0 gpm/psi^{1/2}</u> • <u>Standard spray concealed pendent style having a nominal K-factor of 5.6 gpm/psi^{1/2}</u> • <u>Standard spray upright style having a nominal K-factor of 5.6 gpm/psi^{1/2}</u> • <u>Standard spray extended coverage pendent style having a nominal K-factor of 5.6 gpm/psi^{1/2}</u>
Antifreeze Solution Concentration	<p><u><50% Glycerine and <40% Propylene Glycol Antifreeze Solutions—Solutions were not tested.</u></p> <p><u>50% Glycerine and 40% Propylene Glycol Antifreeze Solutions—Large scale ignition of the sprinkler spray did not occur in tests with sprinkler discharge onto a fire having a nominal Heat Release Rate (HRR) of 1.4 MW. Large scale ignition of the sprinkler spray occurred in multiple tests with sprinkler discharge onto a fire having a nominal HRR of 3.0 MW.</u></p> <p><u>55% Glycerine and 45% Propylene Glycol Antifreeze Solutions – Large scale ignition of the sprinkler spray occurred in tests with sprinkler discharge onto a fire having a nominal HRR of 1.4 MW.</u></p> <p><u>>55% Glycerine and >45% Propylene Glycol Antifreeze Solutions -- Large scale ignition of the sprinkler spray occurred in tests with sprinkler discharge onto a fire having a HRR of less than 500 kW.</u></p> <p><u>70% Glycerine and 60% Propylene Glycol Antifreeze Solutions – Maximum antifreeze solution concentrations tested.</u></p>
Sprinkler Inlet Pressure	<p><u>Large scale ignition of the sprinkler discharge spray was not observed when the sprinkler inlet pressure was 50 psi or less for tests using 50% glycerine or 40% propylene glycol.</u></p>
Ceiling Height	<p><u>When discharging 50% glycerine and 40% propylene glycol antifreeze solutions onto fires having a HRR of 1.4 MW, no large scale ignition of the sprinkler spray was observed with ceiling heights up to 20 ft.</u></p>

	<u>When discharging 50% glycerine and 40% propylene glycol antifreeze solutions onto fires having a HRR of 3.0 MW, large scale ignition of the sprinkler spray was observed at a ceiling height of 20 ft.</u>
Fire Control	<u>The test results described in the test reports December 2010 and February 2012 indicated that discharging glycerine and propylene glycol antifreeze solutions onto a fire can temporarily increase the fire size until water is discharged.</u>
	<p><u>As a part of the residential sprinkler research described in report dated December 2010, tests were conducted to evaluate the effectiveness of residential sprinklers to control fires involving furniture and simulated furniture. The results of these tests indicated that 50% glycerine and 40% propylene glycol antifreeze solutions demonstrated the ability to control the furniture type fires in a manner similar to water.</u></p> <p><u>For standard spray type sprinklers, no tests were conducted to investigate the ability of these sprinklers to control the types and sizes of fires that these sprinklers are intended to protect.</u></p>

A.9.2.3 Many antifreeze solutions are heavier than water. At the point of contact (interface), provisions are required by 9.2.3 to prevent the diffusion of water into unheated areas. To avoid leakage, the quality of materials and workmanship should be superior, the threads should be clean and sharp, and the joints should be tight. Only metal-faced valves should be used.

Issue Date: August 9, 2012

Effective Date: August 29, 2012

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/codelist)

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NATIONAL FIRE PROTECTION ASSOCIATION



**California State Fire Marshal
Information Bulletin – IB13-009**

Issued: December 30, 2013

**ANTIFREEZE USE IN NFPA 13D (2013 EDITION) RESIDENTIAL
FIRE SPRINKLER SYSTEMS AS REFERENCED IN THE 2013
CALIFORNIA BUILDING STANDARDS CODE**

At the National Fire Protection Association (NFPA) Standards Council meeting August 2013, a final decision was made to issue the tentative interim agreement (TIA) 13-1, TIA Log #1067, on NFPA 13D 2013 edition, respectively to address to the use of antifreeze solutions within all NFPA 13D applications (One- and Two-Family Dwellings). This information is available for review on the NFPA website at <http://www.nfpa.org/antifreeze>.

The CAL FIRE – Office of the State Fire Marshal's (OSFM) adoption of the 2013 edition of NFPA 13D standard maintains the intent of the original of the OSFM emergency regulations adopted for the 2010 California Residential Code and NFPA 13D. The OSFM's emergency regulation limited the use of antifreeze solutions to only premixed solutions and placed limitations on the maximum concentrations. This most recent TIA issued by NFPA has led to some confusion regarding the use of non-listed antifreeze in new construction.

The following is provided to clarify the OSFM's adoption and intent:

1. NFPA 13D Section 9.2.2.1 does require the use of listed antifreeze.
2. NFPA 13D Section 9.2.2.1.1 allows non-listed antifreeze solutions in premix only with limitations on the concentration for existing systems.
3. NFPA 13D Section 9.2.2.2 provides an exemption for the enforcing agency to approve a nonlisted solution in the case of antifreeze concentrations for premixed Glycerine at or below 48% or premixed Propylene Glycol at or below 38% where documentation justifies the use of those concentrations for specific portions of the home (See reports listed below issued by the Fire Protection Research Foundation).
4. NFPA 13D Section 9.2.2.2.1 requires documentation be presented to the enforcing agency to substantiate the use of the antifreeze solution.

The OSFM's adoption of NFPA 13D specifically Section 9.2.2.1 and 9.2.2.2 does not prohibit nonlisted antifreeze, but rather affords the use of premixed solutions that maintain limited concentration levels.



California State Fire Marshal Information Bulletin – IB13-009

The OSFM strongly recommends reviewing the testing report for detailed information on the results and findings issued by the Fire Protection Research Foundation noted below. This research testing appears to indicate that alternatives to antifreeze should be used for newly installed residential fire sprinkler systems. Alternatives to antifreeze additives include dry pipe systems, additional insulation, and design considerations that do not expose pipes to freezing conditions. Should these or any other alternatives not be available for new construction, the OSFM suggests the provisions as indicated in NFPA 13D Section 9.2.2.2 may be used until such time a listed antifreeze solution is available. Again the solution should only be factory premixed and used with the approval of the local authority having jurisdiction.

If these solutions are used, all relevant data and information should be carefully reviewed and considered in the sprinkler system. The following is a list of research reports that have been issued by the Fire Protection Research Foundation related to the use of antifreeze in sprinkler systems:

1. *Antifreeze Systems in Home Fire Sprinkler Systems – Literature Review and Research Plan*, Fire Protection Research Foundation, June 2010.
2. *Antifreeze Systems in Home Fire Sprinkler Systems – Phase II Final Report*, Fire Protection Research Foundation, December 2010.
3. *Antifreeze Solutions Supplied through Spray Sprinklers – Interim Report*, Fire Protection Research Foundation, February 2012.

The above reports may be downloaded from the NFPA Fire Protection Research Foundation:

<http://www.nfpa.org/research/fire-protection-research-foundation/reports-and-proceedings/suppression/other-sprinkler-protection/antifreeze-solutions-supplied-through-spraysprinklers>

The above research demonstrated that large scale ignition of the sprinkler spray did not occur in tests with sprinkler discharge onto a fire having a nominal Heat Release Rate (HRR) of 1.4 MW with 50% Glycerine and 40% Propylene Glycol Antifreeze Solutions.

As more information is released by NFPA, the Standards Council and/or the Technical Committee, the OSFM will notify all interested parties. The sustained efforts of all stakeholders must focus on sharing information; working together; and continue to support the message that fire sprinklers are one of the most effective ways to save lives and property from fire; and to that end, assure the successful implementation of the 2013 California Residential Code and the residential fire sprinkler provisions.

For more information please visit our website <http://osfm.fire.ca.gov>

