LFP® Antifreeze
Listed Antifreeze for Sprinkler Systems

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1. Attendee must register/sign in with all required info.
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3. Attendee must actively participate in classroom discussions via polling and chat
4. Attendee must achieve a passing score of 70% or higher on the final assessment (within 24 hrs.)
5. Successful completion will earn attendee 0.1 CEU

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Johnson Controls

Bansul | AquaMist | Chemguard | Grinnell

Mycco | Sibur | Pyro-Chem | SABO Foam

SprinkCAD | Tyco | [Icons]
Learning Records

If you need copies of your records from class or the learning record policy, please contact Talya Pacheco:
training@tycofp.com
401-781-8220 ext 0500
1467 Elmwood Avenue
Cranston, RI 02910

Objectives

- Discuss features and benefits of Tyco LFP® Antifreeze
- Describe the differences between existing antifreeze solutions and Tyco LFP® Antifreeze
- Review NFPA requirements for use of antifreeze in systems
- Review proper installation and maintenance practices
Poll #1

NFPA 13, 2019 Edition

Protection of Piping Against Freezing
(13:19, 16.4.1)

If systems cannot be maintained at or above 40°F (4°C):

- Listed Antifreeze
- Insulation
- Listed, Supervised Heat trace
- Dry Pipe or Preaction System
- PE Verified Heat-loss Calculations

Options for Protecting Piping Against Freezing
Addressing a Life Safety Concern

Serious Incidents Involving Antifreeze

- **1997: Bethel, ME**  
  - Flash fire caused by vapors of propylene glycol-water solution interacting with natural gas fired heaters  
  - Fire extinguished when plain water discharged  
  - Occupants treated for smoke inhalation and thermal skin burns

- **2002: Monmouth, NJ**  
- **2006: Denver, CO**  
- **2009: Truckee, CA**  
  - A kitchen fire activated a sprinkler system containing glycerin-based antifreeze, which ignited the flames and caused a fireball  
  - Tenant fatality

- **2010: Herriman, UT**  
  - Lit matches activated a sprinkler system containing polypropylene glycol  
  - One child and one adult suffered second- and third-degree burns


Antifreeze Combustibility

**Details**

- Testing and Heat Release Rates
  - Residential pendent, concealed and sidewall sprinklers
  - K-factors between 3.1 and 7.4 tested
  - Solutions of glycerin and propylene glycol were tested
    - Glycerin — from 50% – 70% concentration by volume
    - Propylene Glycol — from 40% – 60% concentration by volume

**Findings**

- Large-scale ignition was found to occur in various situations
  - 50% glycerin & 40% propylene glycol w/ HRR of 3.0 MW
  - 55% glycerin & 45% propylene glycol w/ HRR of 1.4 MW
  - >55% glycerin & >45% propylene glycol w/ HRR of <0.5 MW

**Results**

<table>
<thead>
<tr>
<th>Antifreeze Mixture</th>
<th>Freezing Point</th>
<th>Density at 68°F</th>
<th>Energy Released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>32 °F</td>
<td>0.998 kg/l</td>
<td>357 MJ</td>
</tr>
<tr>
<td>Glycerin</td>
<td>-22 °F</td>
<td>1.146 kg/l</td>
<td>596 MJ</td>
</tr>
<tr>
<td>Propylene Glycol</td>
<td>-22 °F</td>
<td>1.063 kg/l</td>
<td>629 MJ</td>
</tr>
</tbody>
</table>

Fig. 2 – HRR v Time for water and 50% water/glycol
Current NFPA Antifreeze Rules

<table>
<thead>
<tr>
<th></th>
<th>Propylene Glycol</th>
<th>Glycerin</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 13 (13:19, 8.6.2)</td>
<td>Shall Be Listed for Use in Sprinkler Systems</td>
<td>Shall Be Listed for Use in Sprinkler Systems</td>
</tr>
<tr>
<td>NFPA 25 installed prior 9/30/2012 (25:20, 5.3.4.4.1)</td>
<td>Premixed Non-listed 30% by Volume Until 9/30/2022</td>
<td>Premixed Non-listed 38% by Volume Until 9/30/2022</td>
</tr>
<tr>
<td>NFPA 25 installed after 9/30/2012 (25:20, 5.3.4.4)</td>
<td>Listed Antifreeze</td>
<td>Listed Antifreeze</td>
</tr>
<tr>
<td>NFPA 13R (13R:19, 5.4.2)</td>
<td>Follow NFPA 13</td>
<td>Follow NFPA 13</td>
</tr>
<tr>
<td>NFPA 13D (13D:19, 9.2.2)</td>
<td>Listed or 38% When Deemed Acceptable by AHJ</td>
<td>Listed or 48% When Deemed Acceptable by AHJ</td>
</tr>
</tbody>
</table>

New listed solutions NOT required to be Glycerin- or Glycol-based, as long as they pass UL 2901

UL 2901 Test Protocol for Antifreeze

- General
- Characterization Tests
- High Ambient Temperature Stability
- Temperature Cycling Stability
- Electrical Conductivity
- Corrosion Rate
- Pit Depth Corrosion
- Exposure to Elastomeric Materials
- Stress Corrosion
- Impact of Galvanic Action
- Compatibility with Polymeric Materials
- Toxicity
- Exposure to Fire
- Fire Fighting Effectiveness
- Viscosity at Temperature Limitations
- Resistance to Leakage

Test protocol recently finalized by UL, in development since 2011
Tyco LFP® Antifreeze

**Benefits**
- Easy installation & maintenance
- Cost-effective
- Helps meet NFPA 13, 13R, 13D & 25
- UL Listed
- 5-gal. pail
- 30-gal. drum
- Non-toxic
- Compatible with most system materials
- Minimum use temperature: -10°F (-23.3°C)

**Features**
- Listed for use in residential, commercial and storage applications*
- Minimum use temperature
- 25-gal. pail
- 30-gal. drum
- Helps meet NFPA 13, 13R, 13D & 25
- UL Listed
- 5-gal. pail
- 30-gal. drum
- Non-toxic
- Compatible with most system materials
- Minimum use temperature: -10°F (-23.3°C)

*Not listed for extra hazard occupancies, flammable liquid protection or systems using ESFR Sprinklers

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**Minimum Use Temperature**

**Unlisted Solution Confusion**
Existing “unlisted” antifreeze reference multiple temperature values with no guidance on which to follow or what various temperatures mean.

**Listed Solution Clarity**
UL Standards call for Minimum Use Temperature: the value that allows the sprinkler system to operate as intended.

**Allowable Temperature Range:**
- Minimum Use Temperature: -10°F (-23.3°C)
- Max Use Temperature: 150°F (65°C)
Common Misconceptions

Antifreeze is....

**Toxic**

Tyco LFP® Antifreeze is:

- Safe
- Non-toxic*
- Easily disposed of at local waste water treatment centers

*For the purposes of this product, non-toxic means that acute exposure to ingredients in the LFP® Antifreeze does not pose a risk of adverse effects in humans or the environment following short-term exposure.

**Expensive**

Tyco LFP® Antifreeze is:

- A very cost-effective way to protect a piping system from cold environments
- Alternatives, such as dry pipe systems and heat tracing, can:
  - Be expensive
  - Require monitoring
  - Require maintenance
  - Create design challenges in some situations

**Hard to Work With & Maintain**

Tyco LFP® Antifreeze is:

- Easy to install and compatible with most common fire protection piping system materials using a small pump
- Following NFPA 25, the system can be quickly checked annually and does not need to be replaced unless the material is diluted or out of spec.

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Technical Details

Tyco LFP® Antifreeze
Pre-mixed antifreeze solution

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Liquid, colorless</td>
</tr>
<tr>
<td>Minimum Use Temperature</td>
<td>-10°F (−23.3°C)</td>
</tr>
<tr>
<td>Refractive Index</td>
<td>1.3960 – 1.3995</td>
</tr>
<tr>
<td>pH</td>
<td>7 – 8</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.122 – 1.129</td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td>1000 – 1400 microsiemens/cm</td>
</tr>
<tr>
<td>Compatible Piping</td>
<td>CPVC, PEX, steel, brass, stainless steel, black steel, copper, cast iron, fusion bonded epoxy coated materials</td>
</tr>
<tr>
<td>Compatible Materials</td>
<td>EPDM natural rubber, SBR, BUNA-N elastomeric materials</td>
</tr>
</tbody>
</table>

See Tech Data Sheet TFP1680 for full details
Tyco LFP® Antifreeze
Testing Requirements and Usage Limitations

<table>
<thead>
<tr>
<th>Volume Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NFPA 13D</strong></td>
</tr>
<tr>
<td>• No volume limitations</td>
</tr>
<tr>
<td>• Antifreeze may only be used in above-ground piping</td>
</tr>
<tr>
<td><strong>NFPA 13R</strong></td>
</tr>
<tr>
<td>• No volume limitations</td>
</tr>
<tr>
<td>• Dwelling-only buildings are limited to above-ground use of antifreeze</td>
</tr>
<tr>
<td><strong>NFPA 13R Mixed-Use Occupancies</strong></td>
</tr>
<tr>
<td>• No volume limitations for system size in buildings containing only dwellings</td>
</tr>
<tr>
<td>• System size limitation of 40 gal. for sprinkler systems in non-dwelling buildings</td>
</tr>
<tr>
<td>• System size limitation of 40 gal. in mixed-use occupancies fed by a single sprinkler system</td>
</tr>
<tr>
<td>• If future building renovations result in occupancy classification changes, a fire sprinkler system evaluation must be performed to determine if any changes are required for the use of antifreeze</td>
</tr>
<tr>
<td>• Only above-ground piping may be filled with antifreeze</td>
</tr>
<tr>
<td><strong>NFPA 13</strong></td>
</tr>
<tr>
<td>• Buildings with occupancy classifications of Light Hazard and Ordinary Hazard Group 1 and 2 are limited to a sprinkler system volume of 40 gal.</td>
</tr>
<tr>
<td>• Storage applications using non-ESFR sprinklers are limited to a sprinkler system volume of 40 gal.</td>
</tr>
<tr>
<td>• LFP® antifreeze is not listed for use in protecting Extra Hazard occupancies, flammable liquids or use with ESFR sprinklers.</td>
</tr>
</tbody>
</table>

Poll #2
Installation Instructions

**New Systems**
- Ensure system is air-tight.
- Test LFP® Antifreeze using a refractometer and/or hydrometer to demonstrate compliance to property ranges.
- Fill system with LFP® Antifreeze.
- Pull a sample from the top and bottom sampling valves and test using a refractometer and/or hydrometer to demonstrate compliance to property ranges.

**Existing Systems**
- Inspect all sprinklers for mechanical damage, corrosion, and evidence of leakage.
- Flush branch lines and mains to avoid contamination.
- Test LFP® Antifreeze before installing into the system, using a refractometer and/or hydrometer to demonstrate compliance to property ranges.
- Fill system with LFP® Antifreeze.
- Test the system again to verify solution is not diluted.

*Automatic sprinkler antifreeze systems to be inspected, tested and maintained by a qualified inspection, testing and maintenance service.*

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Maintenance Instructions

- Use a hydrometer and a graduated cylinder to test the specific gravity or use a refractometer to test the refractive index.

Acceptable Property Ranges of LFP® Antifreeze

<table>
<thead>
<tr>
<th>Concentration of LFP Antifreeze %</th>
<th>Specific Gravity at Approximately 77°F (25°C)</th>
<th>Refractive Index at 77°F (25°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1.122 – 1.129</td>
<td>1.396 – 1.3995</td>
</tr>
</tbody>
</table>
Video: How to Use a Refractometer

Video: How to Use a Hydrometer
**Hydraulic Calculations**

- Both methods should be calculated and the most conservative result used.

- Darcy-Weisbach method can more accurate by accounting for the difference in viscosity in systems:
  - Larger than 40 gallons
  - Experiencing continued low temperatures

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**Acceptable Property Ranges of LFP® Antifreeze**

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</tbody>
</table>

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**Video: How to Use a Hydrometer**

![Image of hydrometer measurement]

- Video: How to Use a Hydrometer

- Hydrometer reading: 1.128
Hydraulic Calculations

- For systems greater than 40 gal (151 L), use an adjusted k-factor in system design:

\[ K_A = 7.9 K_W \sqrt{1/\gamma_A} \]

Where
- \( K_A \) = sprinkler k-factor discharging the antifreeze solution
- \( K_W \) = sprinkler k-factor discharging water
- \( \gamma_A \) = density of the antifreeze solution at the temperature used for testing in lb/ft³

NFPA 13 Antifreeze Supply Piping Arrangements

- NFPA 13 outlines requirements for antifreeze system piping if three conditions are not met:

1. The antifreeze system has an automatic pressure pump or other device to maintain a higher pressure on the system side than on the supply side of the water supply check valve separating the antifreeze system
2. The antifreeze system has a method to automatically release solution in the case of thermal expansion and over pressurization
3. A method to automatically supply premixed solution as needed to restore system pressure due to thermal contraction is in place
NFPA 13 Antifreeze Supply Piping Arrangements

Expansion Tanks

- An expansion tank is recommended on all systems including existing systems

<table>
<thead>
<tr>
<th>Initial Fluid Volume (gal)</th>
<th>Temperature Change (°F)</th>
<th>Expansion/Contraction (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>30°F-70°F</td>
<td>0.2 - 0.1</td>
</tr>
<tr>
<td>28</td>
<td>0°F-80°F</td>
<td>0.4 - 0.3</td>
</tr>
<tr>
<td>26</td>
<td>-20°F-100°F</td>
<td>0.8 - 0.5</td>
</tr>
<tr>
<td>30</td>
<td>-40°F-120°F</td>
<td>1.1 - 0.8</td>
</tr>
<tr>
<td>35</td>
<td>-60°F-140°F</td>
<td>1.5 - 0.8</td>
</tr>
<tr>
<td>40</td>
<td>-80°F-160°F</td>
<td>1.9 - 1.2</td>
</tr>
<tr>
<td>45</td>
<td>-100°F-180°F</td>
<td>2.4 - 1.5</td>
</tr>
<tr>
<td>50</td>
<td>-120°F-200°F</td>
<td>2.9 - 2.0</td>
</tr>
<tr>
<td>55</td>
<td>-140°F-220°F</td>
<td>3.5 - 2.5</td>
</tr>
<tr>
<td>60</td>
<td>-160°F-240°F</td>
<td>4.1 - 3.0</td>
</tr>
<tr>
<td>65</td>
<td>-180°F-260°F</td>
<td>4.8 - 3.5</td>
</tr>
<tr>
<td>70</td>
<td>-200°F-280°F</td>
<td>5.6 - 4.0</td>
</tr>
<tr>
<td>75</td>
<td>-220°F-300°F</td>
<td>6.4 - 4.5</td>
</tr>
<tr>
<td>80</td>
<td>-240°F-320°F</td>
<td>7.2 - 5.0</td>
</tr>
<tr>
<td>85</td>
<td>-260°F-340°F</td>
<td>8.0 - 5.5</td>
</tr>
<tr>
<td>90</td>
<td>-280°F-360°F</td>
<td>8.8 - 6.0</td>
</tr>
<tr>
<td>95</td>
<td>-300°F-380°F</td>
<td>9.6 - 6.5</td>
</tr>
<tr>
<td>100</td>
<td>-320°F-400°F</td>
<td>10.4 - 7.0</td>
</tr>
<tr>
<td>105</td>
<td>-340°F-420°F</td>
<td>11.2 - 7.5</td>
</tr>
<tr>
<td>110</td>
<td>-360°F-440°F</td>
<td>12.0 - 8.0</td>
</tr>
<tr>
<td>115</td>
<td>-380°F-460°F</td>
<td>12.8 - 8.5</td>
</tr>
<tr>
<td>120</td>
<td>-400°F-480°F</td>
<td>13.6 - 9.0</td>
</tr>
</tbody>
</table>

Interpolation Example for 40 gal, 100°F change:

\[ y = y_0 + (x - x_0) \left( \frac{y_1 - y_0}{x_1 - x_0} \right) \]

\[ x - x_0 = 40 - 25 = 15 \]
\[ y_1 - y_0 = 1.9 - 1.0 = 0.9 \]
\[ x_1 - x_0 = 50 - 25 = 25 \]
\[ x = 40 \quad y = 7 \]
\[ x_1 = 50 \quad y_1 = 1.9 \]
\[ y = 1.0 + 15 \left( \frac{0.9}{25} \right) \]
\[ y = 1.54 \text{ gallons} \]
System Tags

- A system tag must be present on an antifreeze system main valve identifying the following:
  - Type and manufacturer of solution used
  - Volume of antifreeze used
  - Percent concentration by volume of antifreeze used

100% - Premixed

Tag design is available on tyco-fire.com

Poll #3
Resources

For more information, visit
www.tyco-fire.com/LFP

Or contact JCI Technical Services at
TechServ@ici.com
1-800-381-9312

www.onlinetechxchange.com
Training@tycofp.com