Antifreeze Update
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Antifreeze

• Propylene Glycol and Glycerin have been used for at least 60 years as antifreeze solutions for fire protection systems
• Pure Propylene Glycol and Glycerin are combustible liquids
  – Propylene Glycol – flash point: 210°F
  – Glycerin – flash point: 350°F
  – Canola Oil – flash point: 620°F

Antifreeze Tests

• SP Labs in Sweden (2000) – using fine spray nozzles, the lab reports that antifreeze can add to heat release rate of a fire
• Viking (2000) – achieves ESFR listing with 50% propylene glycol
• Viking (2001) – passes UL 1626 residential sprinkler fire test with 50% propylene glycol

Antifreeze Incidents

• New Jersey Restaurant (2001) – heater on a patio causes a sprinkler to open, what is believed to be 100% antifreeze discharges on heater and starts a fire
• Truckee, CA (2009) – fire in a kitchen, food on the stove (oil)
  – Sprinkler opens and there are reports of a flash fire
  – Design of sprinkler system was 50-50 (Glycerin), but tests of systems in the same complex (installed at the same time) reveal 70-30
Antifreeze Incidents

- Herriman, UT (June 2010) – apartment
  - Fire starts on a couch, sprinkler opens
  - Apparently, some kind of flash fire occurred
  - Design of system was reported to be 60-40 (Glycerin)

Antifreeze Tests

- UL (Spring 2010) – tries to duplicate Truckee flash fire (high pressure and small orifice sprinkler)
  - 70% glycerin can cause a flash fire
  - 60% propylene glycol can cause a flash fire
  - 50% (propylene glycol and glycerin) does NOT cause a flash fire and reacts similar to water
- These tests are known as the “Phase 1 Tests”
Antifreeze Tests

- FPRF (CCI) – Performed tests in July 2010
  - A variety of antifreeze solutions
  - A variety of orifice residential sprinklers
  - A variety of pressures
  - A variety of fire sources
- Preliminary report finished early August 2010
- These tests are known as the “Phase 2 Tests”

FPRF (CCI) Phase 2 Tests

- 1.4 MW burner fire was considered best
- Propylene glycol at 50% can (in some circumstances) contribute to the heat release rate of a fire
- Propylene glycol at 40% acts much like water
- Glycerine at 55% can (in some circumstances) contribute to the heat release rate of a fire
- Glycerine at 50% acts much like water

FPRF (CCI) Phase 2 Tests

- Test report is available for download off the NFPA website
- Antifreeze Solutions in Home Fire Sprinkler Systems-Phase II Final Report

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Scope A Comparison of Sprinklers at 8' Above Floor
50% Propylene Glycol

<table>
<thead>
<tr>
<th>k3.1</th>
<th>k4.9</th>
<th>k4.9 Concealed</th>
<th>k7.4</th>
<th>k4.2 Sidewall</th>
<th>k5.5 Sidewall</th>
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- Increase in Heat Release Rate (kW)
- Sprinkler Flow Rate (gpm)
Phase 3 Antifreeze Tests

- Sponsored by NFPA
- 50% glycerine
- Standard spray sprinklers (k-2.8 to k-8)
- 8 ft, 15 ft and 20 ft high ceiling areas
- 1.4 and 3 MW fires

Results

- No increase in heat release in 1.4 MW fires
- Increase in heat release in 3.0 MW fires in certain conditions (up to 700%)
Phase 3 Tests

Latest Position of the NFPA

• Third Round of TIA’s acted on by NFPA Standards Council on August 8, 2012
  – NFPA 13 (new systems only)
  – NFPA 13R (new systems only)
  – NFPA 13D (new and existing systems)
  – NFPA 25 (existing systems designed per NFPA 13 and NFPA 13R)

• These TIA’s have been upheld by committees in processing the next edition of these standards
NFPA 13 and NFPA 13R

- No propylene glycol unless a sprinkler is specifically listed with it (Viking ESFR)
- No glycerine
- Antifreeze product must be listed (at this time there are no listed products)

Listed Antifreeze

- UL has developed a testing protocol
  - Combustibility of product
  - Compatibility of product with materials typically found in sprinkler systems

NFPA 13D

- New Systems
  - 48% glycerine
  - 38% propylene glycol
  - Allowed in specific areas of the dwelling unit, but only where the AHJ approves
  - Documentation will need to be provided to the AHJ to justify the use of the antifreeze.
- Existing Systems
  - 50% glycerine
  - 40% propylene glycol
- Must use premixed solution
- Listed products when they become available

48% gives you freeze protection to about -8°F
**NFPA 25**

- Assumes that systems installed after September 30, 2012 will be in accordance with the antifreeze rules of NFPA 13 as discussed previously
- Propylene glycol (premixed) will still be permitted to be used with ESFR sprinklers when the ESFR sprinklers are listed for use with the antifreeze

**NFPA 25 Systems installed prior to 9/30/12 can remain if all of the following are met**

- Replaced by September 30, 2022
  - A listed antifreeze solution
  - Another kind of sprinkler system
- Glycerine
  - Limited to 50%
  - Solutions over 38% need to be justified with “approved deterministic risk assessment”
- Propylene glycol
  - Limited to 40%
  - Solutions over 30% need to be justified with “approved deterministic risk assessment”
- All newly introduced solutions that are not listed will be required to be premixed

**Additional TIA Issued 10/30/12**

- NFPA 25 – Clarify the “Deterministic Risk Assessment”
  - Prepared by individual(s)
    - Demonstrate an ability to prepare a risk assessment by education and experience
    - Demonstrate an understanding of the issues associated with antifreeze sprinkler systems
  - AHJ’s
    - NFPA 551, Guide for the Evaluation of Fire Risk Assessments
    - SFPE Engineering Guide: Fire Risk Assessment

**Risk assessment should consider:**

1. Occupancy use group per NFPA 13 and size of structure
2. Ceiling height
3. Antifreeze solution concentration and type
4. Maximum system pressure (normal static pressures)
5. Sprinkler type, including k-Factor
6. Potential and actual fuel load (Christmas trees)
**Risk assessment should consider:**

7. Type of structure (construction types)
8. Ability of the sprinkler system to control the fire
9. Occupied spaces - vs - unoccupied space
   a) Adjacent occupancies and Separation
   b) Ventilation of areas protected with an antifreeze
   c) Duration of antifreeze discharge

**Additional TIA Issued 10/30/12**

- Large-scale ignition of the sprinkler spray did not occur in tests with 50% glycerine and 40% propylene glycol antifreeze solutions discharging onto a fire having a nominal Heat Release Rate of 1.4 MW
- An assessment that shows that the heat release rate for reasonable fire scenarios will be less than 1.4 MW at the time of sprinkler activation should be acceptable

**Additional TIA Issued 10/30/12**

- Assessment should address management of change
  – Change in occupancy
  – Temporary fuel loads (Christmas tree can cause a fire over 1.4 MW at the time of sprinkler activation)
- Assessment should include the overall impact on life safety and potential increase in heat release rate

**Alternatives to Antifreeze**

- Heating the space with water-filled pipe
- Using dry-type sprinklers from a heated space
- Tenting insulation over pipe (where there is a heated space below)
- Heat tracing
  – Permitted on mains and risers if listed
  – Permitted on branch lines if specially listed for branch lines
- Dry or preaction systems
Thank You!