SFPE Austin/San Antonio Chapter Meeting

14 May 2014

Kerry M. Bell, P.E.
Principal Engineer
UL LLC
Overview of Discussion

- Updates on the following areas
  - Dry sprinkler performance
  - Antifreeze for use in sprinkler systems
  - Sprinkler protection criteria for exposed, expanded Group A plastics
  - Fire resistive cables
  - Low frequency alarms
Dry Sprinklers

Historical Perspective

• First UL Listed Dry Sprinkler – 1937
• Oldest Dry Sprinkler Tested – 1949
• Initial use of O-ring seals in dry sprinklers – Late 1950’s
• Majority of dry sprinklers produced with O-ring seals – Late 1960’s to early 2000’s
• Limited dry sprinklers from the field submitted to UL for testing prior to 1999
Historical Perspective

Typical Applications

• Wet and dry systems
• Freezers and coolers
• Parking garages
• Loading docks
• Outdoor walkways
• Balconies
• Attic areas
**Inhibited Dry Sprinkler Operation**

**UL Investigation Initiated in late 1990’s based upon:**

1. Reports dry sprinklers not operating in a fire

2. Elevated operating pressures measured in limited number of samples submitted to UL
   - Approximately 100 samples submitted from 20 different installation locations
   - 60 percent required pressures greater than 0.5 bar (7 psig) to discharge water
   - Some samples did not discharge water when 6.8 bar (100 psig) was applied to the inlet
   - Several locations with 10 to 15 year old dry sprinklers required pressures greater than 0.5 bar (7 psig) to operate.

Revisions to Standards to Enhance Field Performance

Revision To NFPA 25

• In early 1999, UL proposed a Tentative Interim Amendment (TIA) to the Standard for Inspection, Testing and Maintenance of Water Based Sprinkler Systems, NFPA 25 to require replacement or testing of dry sprinklers after 10 years in service rather than the previously referenced 50 years.

• TIA failed to achieve the required 75% consensus of the TC with only 15 in favor and 14 opposed.

• Based upon an appeal by UL, the TIA was issued by NFPA Standards Council in the later part of 1999.
Inhibited Dry Sprinkler Operation

Data on Tested Dry Sprinkler Samples (1999 to 2004)

• More 1000 samples tested from approximately 150 locations

• Dry sprinklers experiencing elevated operating pressures included more than 25 different models produced by 10 different manufacturers

• Approximately 50 percent samples did not discharge water at 0.5 bar (7 psig)

• Approximately 25 percent did not discharge water at 2.7 bar (40 psig).
Inhibited Dry Sprinkler Operation

Key UL Findings Regarding Elevated Operating Pressure

• Collection of corrosion and other products in the small annular clearances provided between the operating components inhibited the required movement of the water seal assembly in O-ring seal sprinklers.

• Transfer (sticking) of O-ring material to the mating sealing surface

• UL sprinkler standards were revised to ban use of O-ring water seals and include a new deposit loading test for dry sprinklers with an effective date of January 9, 2003.
Impact of Standard Revisions
Timeline of Dry Sprinkler Samples Submittals

Quantity of Dry Sprinkler Field Samples Received by Year

- Dark Ages
- Years of Discovery and Action
- NFPA 25 Enforcement

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Analysis of Dry Sprinklers Received from 2006-2013
(19,623 Samples Submitted, 19,078 Samples Tested)

<table>
<thead>
<tr>
<th>Nominal Years of Service</th>
<th>&lt;10 years</th>
<th>≥10-15 years</th>
<th>≥15-20 years</th>
<th>≥20-25 years</th>
<th>≥25-30 years</th>
<th>≥30 years</th>
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</thead>
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<tr>
<td>Samples Tested</td>
<td>2186</td>
<td>427</td>
<td>3337</td>
<td>4635</td>
<td>940</td>
<td>3928</td>
</tr>
<tr>
<td>Samples with Abnormal Operation</td>
<td>14</td>
<td>78</td>
<td>31</td>
<td>1576</td>
<td>17</td>
<td>1644</td>
</tr>
</tbody>
</table>

Percent Tested - Abnormal Operation

- Percent Abnormal Operation - Tested Samples without O-rings
- Percent Abnormal Operation - Tested Samples with O-rings
2006-2013 Dry Sprinkler Samples with O-ring Seals Vs. Total Dry Sprinkler Samples Submitted

<table>
<thead>
<tr>
<th>Year Tested</th>
<th>Samples with O-ring Seals, Percent of Total</th>
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<tbody>
<tr>
<td>2006</td>
<td>87.4%</td>
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<tr>
<td>2007</td>
<td>81.8%</td>
</tr>
<tr>
<td>2008</td>
<td>73.3%</td>
</tr>
<tr>
<td>2009</td>
<td>77.2%</td>
</tr>
<tr>
<td>2010</td>
<td>63.8%</td>
</tr>
<tr>
<td>2011</td>
<td>62.8%</td>
</tr>
<tr>
<td>2012</td>
<td>59.7%</td>
</tr>
<tr>
<td>2013</td>
<td>49.1%</td>
</tr>
</tbody>
</table>
Antifreeze in Sprinkler Systems

Background on the Use of Antifreeze in Sprinkler Systems

➢ The use of antifreeze solutions including glycerin have been referenced in NFPA 13 since at least the 1952 edition of the standard.
➢ Most common antifreeze solutions historically used were propylene glycol and glycerin.
➢ Maximum concentration of glycerin solution permitted was a 70/30 mixture 60/40 for propylene glycol.
Fire and Explosion in an Apartment Complex Protected by a NFPA 13 Sprinkler System

General Details of Fire Occurrence

- Fire and explosion occurred in the first floor apartment of a 12-unit complex on August 2009.
- Sprinkler system was supplied with glycerin antifreeze.
- Fire involving a skillet containing cooking oil and onions originated on the range top.
Antifreeze in Sprinkler Systems

Initiatives to Address Concern

➢ The NFPA Sprinkler Correlating Committee (CC) discussed this issue during a meeting held on February 18, 2010.
➢ The CC formed a Task Group to develop and gather some information on antifreeze systems for the CC to consider by June 1, 2010.
➢ UL initiated research followed by research sponsored by the Fire Protection Research Foundation.
Antifreeze in Sprinkler Systems

Fire Test Parameters

- **Test Configuration:** Residential Sprinkler Discharging onto Fire Source
- **Liquid Discharged:** 60% PG/40% Water Mixture
- **Fire Source:** 12 in. Wide by 8 ft. Long Pan of Heptane
- **Sprinkler Type:** Nominal K=3.1 Residential
- **Sprinkler Pressure:** 10 - 80 psig
- **Nominal HRR of Fire:** 500 kW
- **Sprinkler to Pan Distance:** 5 ft.
Antifreeze in Sprinkler Systems

Fire Protection Research Foundation
Antifreeze Solutions in Home Fire Sprinkler Systems Phase II

Test A1 - 6" Wide Heptane Pan
K3.1 Sprinkler
60% Propylene Glycol
Antifreeze Solution
May 2010: UL issues Research Report

June 2010: UL sponsored research initiated

July 2010: FPRF initiates Research on residential sprinklers

Aug 2010: Interim FPRF Report Issued

Herriman, Utah fire

TIAs for NFPA 13, 13D, 13R and 25 permitting limited antifreeze concentrations become effective Aug 25, 2010

NFPA issues 1st public notice

FPRF research testing on residential sprinklers conducted at UL

Final FPRF I Report on Residential Sprinklers Issued

Interim FPRF Report Issued

TIAs for NFPA 13, 13D, 13R and 25 permitting limited antifreeze concentrations become effective March 21, 2011

FPRF research on spray sprinklers conducted at UL

New TIAs for NFPA 13, 13D, 13R and 25

New TIAs banning glycerin & PG in new NFPA 13/13R installations and phasing out glycerin and PG by 2022 in NFPA 25.


Status of Requirements in NFPA Standards

**NFPA 13**

- New systems are required to use listed antifreeze solutions.
- Exception for ESFR sprinklers for use a premixed propylene glycol solution or a specific application

**NFPA 13R**

- New systems are required to use listed antifreeze solutions.

**NFPA 13D**

- New systems are generally required to use listed antifreeze solutions except as noted below.
- New systems are permitted to use up to 38% premixed propylene glycol or 48% premixed glycerin in a limited portion of the building if the AHJ determines that no other option can be used (See 9.2.2.2).
- Existing systems are limited to 40% propylene glycol and 50% glycerin.
Status of Requirements in NFPA Standards

NFPA 25 (Existing Systems for NFPA 13 & 13R Installations)

1. Systems installed prior to September 12, 2012 are limited to 40% propylene glycol and 50% glycerin.

2. Systems having greater than 30% propylene glycol and 38% glycerin are required to have a deterministic risk assessment prepared by a qualified person approved by the AHJ to justify the use at the higher concentrations.

3. Listed antifreeze solutions are required after September 30, 2022.
Antifreeze in Sprinkler Systems

UL 2901, Standard for Antifreeze Solutions for Use in Sprinkler Systems

1. Solution Characterization (viscosity, specific gravity, freeze point, etc.)
2. Stability of Solutions (temperature extremes)
3. Exposure Tests (corrosion, material compatibility)
4. Health Effects (dermal contact, ingestion, inhalation)
5. Fire Performance (contribution and fire attack characteristics)
6. Conductivity (electrical shock risk is not to be greater than water)
7. Installation Instructions described proper use
Exposed Expanded Group A Plastics Fire Protection Research Foundation Project Team

Sponsors

• IKEA
• Viking Sprinkler
• Reliable Sprinkler
• Tyco Fire and Building Products
• XL Insurance
• Property Insurance Research Group
• Procter & Gamble
• Target
• Aon Insurance

Technical Panel

• Ken Linder, Swiss Re
• Jason Huczek, Southwest Research Institute
• John Denhardt, Strickland Fire Protection
• Steve Wolin, Code Consultants, Inc.
• Matt Klaus, NFPA Staff Liaison

Project Contractor

• UL LLC
## NFPA 13 Commodity Classification Information

<table>
<thead>
<tr>
<th>Class or Group</th>
<th>Class or Group Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Noncombustible products in single-layer corrugated cartons with or without pallets.</td>
</tr>
<tr>
<td>Class II</td>
<td>Noncombustible products in slatted wooden crates, solid wooden boxes or multiple thickness paperboard cartons with or without pallets</td>
</tr>
<tr>
<td>Class III</td>
<td>Wood, paper, natural fiber cloth or Group C plastics with or without pallets. May contain a limited amount (5% by weight or volume or less) of Group A or Group B plastics</td>
</tr>
<tr>
<td>Class IV</td>
<td>Commodities in corrugated cartons constructed of Group B plastics or with appreciable amounts (5-15% by weight, or 5-25% by volume) of Group A plastics</td>
</tr>
</tbody>
</table>

Plastics
- Cartoned Unexpanded Group A Plastic
- Exposed Unexpanded Group A Plastic
- Cartoned Expanded Group A Plastic
- Exposed Expanded Group A Plastic
Heat Release Rate Growth Curve of Standardized Commodities
Protection of Exposed Expanded Plastics Stored in Racks

Figure 17.1.2.1
<table>
<thead>
<tr>
<th>FIRE TEST NUMBER</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 5</th>
<th>Test 6</th>
<th>Test 7</th>
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<tr>
<td><strong>Test Parameters</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Storage Type</td>
<td>Double Row Rack</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Commodity Type</td>
<td>Exposed Expanded Group A Plastic (Bagged Meat Trays on Hardwood Pallets)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical Barriers</td>
<td>16 ft. on center - Main Array (Non-combustible)</td>
<td>16 ft. on center - Main Array (Non-combustible)</td>
<td>16 ft. on center - Main Array (Non-combustible)</td>
<td>24 ft. on center - Main Array (3/8 in. plywood)</td>
<td>16 ft. on center - Main Array (3/8 in. plywood)</td>
<td>16 ft. on center - Main Array (3/8 in. plywood)</td>
</tr>
<tr>
<td>Number of Blocked Traverse Flue Spaces</td>
<td>18</td>
<td>12</td>
<td>72</td>
<td>98</td>
<td>60</td>
<td>None</td>
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<tr>
<td>Length of Main Storage Array, ft.</td>
<td>32</td>
<td>32</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
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<tr>
<td>Nominal Storage Height, ft.</td>
<td>20</td>
<td>20</td>
<td>35</td>
<td>40</td>
<td>30</td>
<td>30</td>
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<tr>
<td>Ceiling Height, ft.</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>45</td>
<td>40</td>
<td>40</td>
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<tr>
<td>Aisle Width, ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td></td>
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<tr>
<td>Ignition Location</td>
<td>Between 2 Sprinklers (offset)</td>
<td>Under 1 Sprinkler (offset)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sprinkler Type</td>
<td>ESFR</td>
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<td></td>
<td></td>
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<tr>
<td>Sprinkler Orientation</td>
<td>Pendent</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Deflector to Ceiling, in.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td></td>
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<tr>
<td>Sprinkler Spacing, sprinkler by branchline ft. by ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 by 10</td>
<td></td>
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<tr>
<td>Temperature Rating, F</td>
<td>212</td>
<td>214</td>
<td>214</td>
<td>214</td>
<td>214</td>
<td>214</td>
</tr>
<tr>
<td>Nominal Sprinkler Discharge Coefficient K, gpm/psig $^{0.5}$</td>
<td>22.4</td>
<td>25.2</td>
<td>25.2</td>
<td>25.2</td>
<td>25.2</td>
<td>25.2</td>
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<tr>
<td>Nominal Discharge Pressure, psig</td>
<td>50</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
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<tr>
<td>----------------</td>
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<td>--------------</td>
<td>--------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Length of Test, minutes</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
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<tr>
<td>First Sprinkler Operation Time, min:sec</td>
<td>0:39</td>
<td>0:44</td>
<td>0:52</td>
<td>0:47</td>
<td>0:48</td>
<td>0.47</td>
</tr>
<tr>
<td>Number of Operated Sprinklers</td>
<td>12</td>
<td>6</td>
<td>10</td>
<td>18</td>
<td>11</td>
<td>7</td>
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<tr>
<td>Peak Gas Temperature at Ceiling Above Ignition, °F</td>
<td>564</td>
<td>558</td>
<td>1138</td>
<td>1002</td>
<td>241</td>
<td>414</td>
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<tr>
<td>Maximum 1 minute Average Gas Temperature at Ceiling Above Ignition, °F</td>
<td>255</td>
<td>220</td>
<td>353</td>
<td>489</td>
<td>151</td>
<td>190</td>
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<tr>
<td>Peak Steel Temperature at Ceiling Above Ignition, °F</td>
<td>126</td>
<td>119</td>
<td>145</td>
<td>160</td>
<td>129</td>
<td>131</td>
</tr>
<tr>
<td>Maximum 1 minute Average Steel Temperature at Ceiling Above Ignition, °F</td>
<td>124</td>
<td>117</td>
<td>141</td>
<td>156</td>
<td>127</td>
<td>127</td>
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<tr>
<td>Ignition Time of Target Array, minutes:seconds</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1:01</td>
<td>1:27</td>
<td>None</td>
</tr>
<tr>
<td>Fire Travel to Extremities of Test Array</td>
<td>Yes (East and West end of Main)</td>
<td>Yes (West end of Main)</td>
<td>No</td>
<td>Yes (North Target Array Burned Through to Extremities)</td>
<td>Yes (South Target Array Burned Through to Extremities)</td>
<td>No</td>
</tr>
</tbody>
</table>
Test 6 Arrangement

Plan View

Elevation View

- 3/8 inch plywood vertical barrier, 16 ft. on center
- Ignition - 2 half standard igniters
- Exposed Expanded Group A Plastic (typical)
- 8 ft. aisle

- 14 inches
- 1 ft. 6 in.

- Horizontal barrier, placed on top of pallets to span transverse flues (typical - 60 positions)
- Ignition location
- Vertical barrier, 4 inches off of lab floor (typical)
Test 6 – Sprinkler Operations (11)
Test 6 – Main North Array Damage
Test 6 – Main South Array Damage
Test 6 – South Target Array Damage
View from Outside Arrangement
Test 6 – Camera Locations

Ignition location: Centered under one sprinkler, offset in transverse flue space.

Infrared Camera View

North East Corner Balcony Camera View

Initial Ignition Location of South Target Array

South Wall View
Test 6 View from NE Balcony
Test 6 – View from South Target Array
Test 6 – View from South East Corner - Infrared

Test 6
November 8, 2012
Infrared View of South
Proposed Revisions to NFPA 13 in First Draft for 2016 Edition

Key Criteria in a New Section in Chapter 17 for the Protection of Rack Stored Exposed, Expanded Plastics

• Maximum storage height = 35 ft.
• Maximum ceiling height = 40 ft
• Minimum aisle width = 8 ft.
• Nominal K=25.2 Pendent ESFR intermediate temperature rated sprinklers
• Minimum design pressure = 60 psi
• Design area = 15 sprinklers (5 sprinklers on each of 3 branch lines)
• Minimum water duration = 60 minutes
• Minimum hose allowance = 250 gpm
• Maximum vertical barrier distance = 16.5 ft.
• Vertical barrier material = 3/8 in plywood, 22 gauge steel or equivalent
• Maximum area between vertical barriers and aisles = 124 ft²
• Vertical barrier to extend across longitudinal aisle to top of storage
• Commodity permitted to extend 4 inches beyond vertical barrier at aisle
Update on UL’s Certification Program for Fire Resistive Cables and Circuit Integrity (CI) Cable

Background

• First UL certified in 2000

• UL withdrew all certifications in September 2012 based upon UL’s research which indicated that a broad array of products did not consistently achieve a two-hour fire resistive rating

• To date, no known field issues
Certification Program Re-instatement

UL’s new certification program focuses on three key factors:

1) Larger sampling size to demonstrate repetition.

2) Test configurations take into consideration potential failure mode.

3) An enhanced surveillance program process designed to demonstrate continued compliance.
Products – Circuit Integrity Systems using Fire-resistive Cable

Characterized by either installation within a raceway or armored cable. Either power, control, or data cable.

System includes limitations such as supports, connectors, fittings, pull boxes, splice boxes, lubricants, etc.

Examples:
Mineral Insulated (MI)
Metal Clad (MC)
RHH, RHW, RHW-2, XHH, XHHW, XHHW-2
CL2R, CL3R; CMR; FPL, FPLP, FPLR; NPLF, NPLFP, NPLFR
Products – Circuit Integrity Cable

Characterized by installation in ‘free air’ (not within a raceway) and carries a low voltage or data transmission.

Examples (type followed by ‘-CI’):
CL2R-CI, CL3R-CI; CMR-CI; FPL-CI, FPLP-CI, FPLR-CI; NPLF-CI, NPLFP-CI, NPLFR-CI;
Certification program update
Current Certifications by UL

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Category Name</th>
<th>Link to File</th>
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<tbody>
<tr>
<td>COMTRAN CABLE L L C</td>
<td>Fire-resistive Cable</td>
<td>FHJR.R27557</td>
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<tr>
<td>DRAKA CABLETEQ USA INC</td>
<td>Fire-resistive Cable</td>
<td>FHJR.R19359</td>
</tr>
<tr>
<td>PENTAIR THERMAL MANAGEMENT CANADA LTD</td>
<td>Fire-resistive Cable</td>
<td>FHJR.R11251</td>
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<tr>
<td>RADIX WIRE CO</td>
<td>Fire-resistive Cable</td>
<td>FHJR.R21213</td>
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<tr>
<td>RSCT WIRE &amp; CABLE L L C</td>
<td>Fire-resistive Cable</td>
<td>FHJR.R15365</td>
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Model number information is not published for all product categories. If you require information about a specific model number, please contact Customer Service for further assistance.

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Certification program update
Mineral Insulated Fire-resistive Power Cable

<table>
<thead>
<tr>
<th>Circuit Integrity Rating, h</th>
<th>Fire Exposure Condition</th>
<th>No. of Conductors</th>
<th>AWG Size</th>
<th>Max Voltage, V AC</th>
<th>Line to Line</th>
<th>Line to Ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Normal (ANSI/UL 2196)</td>
<td>1</td>
<td>6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0, 250, 350, 500</td>
<td>600</td>
<td>347</td>
<td></td>
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<tr>
<td>2</td>
<td>Normal (ANSI/UL 2196)</td>
<td>2</td>
<td>16, 14, 12, 10, 8, 6, 4, 3, 2, 1</td>
<td>600</td>
<td>347</td>
<td></td>
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</tbody>
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Pyrotenax Brand Model System 1850 for use in System No. FHIT. 1850 when installed in accordance with manufacturer’s installation instructions dated December 2012.
Certification program update
Metal Clad Fire-resistive Power Cable

RSCC WIRE & CABLE LLC
20 BRADLEY PARK RD
EAST GRANBY, CT 06026-9789 USA

<table>
<thead>
<tr>
<th>Circuit Integrity Rating, h</th>
<th>Fire Exposure Condition</th>
<th>No. of Conductors</th>
<th>AWG/kcmil Size</th>
<th>Max Voltage, V AC</th>
<th>Line to Line</th>
<th>Line to Ground</th>
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</thead>
<tbody>
<tr>
<td>1 or 2</td>
<td>Normal (ANSI/UL 2196)</td>
<td>12</td>
<td>14, 12, 10</td>
<td>480</td>
<td>277</td>
<td></td>
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<tr>
<td>1 or 2</td>
<td>Normal (ANSI/UL 2196)</td>
<td>10</td>
<td>14, 12, 10</td>
<td>480</td>
<td>277</td>
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VITALink MC Brand Type MC (metal clad) for use in System No. PHIT.120 when installed in accordance with manufacturer’s installation guide dated February 2014 and installation instructions revised February 2014.
Certification program update
RHW-2 Fire-resistive Power Cable

<table>
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<tr>
<th>Circuit Integrity Rating, h</th>
<th>Fire Exposure Condition</th>
<th>No. of Conductors</th>
<th>AWG/kcmil Size</th>
<th>Max Voltage, V AC</th>
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</thead>
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<tr>
<td></td>
<td>Normal (ANSI/UL 2196)</td>
<td>1</td>
<td>8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0, 250, 300, 350, 400, 500, 600, 750</td>
<td>480</td>
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Lifeline Brand Type RHW-2 for use in System No. FHIT.25A when installed in accordance with the manufacturer’s installation instructions dated November 26, 2013.
Certification program update
FPL Fire-resistive Control Cable

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<th>Circuit Integrity Rating, h</th>
<th>Fire Exposure Condition</th>
<th>No. of Conductors</th>
<th>AWG/kcmil Size</th>
<th>Max Voltage, V AC</th>
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<tbody>
<tr>
<td>2</td>
<td>Normal (ANSI/UL 2196)</td>
<td>2</td>
<td>16, 14</td>
<td>72, 42</td>
</tr>
</tbody>
</table>

See Electrical Circuit Integrity Systems (FHIT) for description of System Numbers.
Certification program update
FPLR Fire-resistive Control Cable

<table>
<thead>
<tr>
<th>Circuit Integrity Rating, h</th>
<th>Fire Exposure Condition</th>
<th>No. of Conductors</th>
<th>AWG/kcmil Size</th>
<th>Max Voltage, V AC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal (ANSI/UL 2196)</td>
<td>2</td>
<td>14</td>
<td>50</td>
</tr>
</tbody>
</table>

VitaLink Brand Type FPLR/CL3R/CMR for use in System No. FHIT.40 when installed in accordance with the manufacturer’s installation instructions dated May 2014.

See Electrical Circuit Integrity Systems (FHIT) for description of System Numbers.
Future certification program & Standard update

**UL.com/FireRatedCable**

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**Fire-resistive and Circuit Integrity Cables**

**UPDATE AS OF MAY 2014:**

This supplements the previous update provided below:

1. Interim certifications.

UL continues its research and offers an interim program to which are certified fire-resistant cables including metal sheathed cable and cable in conduit. See System No. 1650, System No. 120, System No. 25A and FPL in EMT System No. 28A under product category FHIT for additional details. The fire-resistant cable manufacturers that have achieved certification under the interim program Current certifications can be viewed by clicking on the links below and then selecting “View Listings.” Within the individual certifications, please note important information directing the user to the manufacturer’s installation instructions and a link to the Electric Circuit Integrity System associated with the certified fire-resistant cable.

**UL Electrical Circuit Integrity Systems (FHIT)**

**ULC Electrical Circuit Integrity Systems (FHITC)**

**UL Fire-resistive Cable (FHIC)**

**ULC Fire-resistive Cable - Canada (FHCRC)**

Those interested in further program details for fire-resistant cable or circuit integrity cable (-CI suffix cable per the NEC) should contact UL's Principal Engineer, Blake Shugarman at +1.647 694-2022, or at Blake.M.Shugarman@UL.com.
UL Contact for Fire Resistive Cable

Blake Shugarman
Principal Engineer
Special Hazard Fire Suppression

UL LLC
333 Pfingsten Rd.
Northbrook, IL 60062
Tel: 847.664.2022
Email: blake.m.shugarman@ul.com
18.4.5.3* Effective January 1, 2014, audible appliances provided for the sleeping areas to awaken occupants shall produce a low frequency alarm signal that complies with the following:

1. The alarm signal shall be a square wave or provide equivalent awakening ability.

2. The wave shall have a fundamental frequency of 520 Hz ± 10 percent.
What Prompted the Change?

Research Studies

- University of Victoria/FPRF - May 2006
- University of Victoria/FPRF - June 2007 Alcohol Impairment
- University of Victoria/FPRF - June 2007 Hearing Impairment
Percentage of Adults 65-83 who slept through the alarms

![Bar chart showing percentage of adults who slept through different types of alarms.]

- High pitched current alarm: 18%
- 520 Hz square wave: 4.5%
- Actor's voice: 14%
- 500 Hz pure tone: 15.5%
Percentage of Young Adults with 0.05% Blood Alcohol who slept through the audible alarms

- 38.5% slept through 75 dBA high pitched current alarm
- 0% slept through 520 Hz square wave
- 7% slept through 400 Hz square wave
- 14% slept through 500 Hz pure tone
What do 3K and 520Hz Tone Sound Like?

3K Hz tone from a smoke alarm

520 Hz tone
Currently Listed 520Hz sounders

• Cooper Wheelock Inc.
• Lifetone Technology Inc.
• System Sensor
• Edwards, A Div. of UTC
UL Contact for Notification Appliances

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Senior Engineering Associate

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THANK YOU!

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