Advanced Technologies in Clean Agent and Special Hazard Systems

SFPE
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“You can’t expect to meet the challenges of today with yesterday’s tools and expect to be in business tomorrow” (unknown author)
• Clean Agent Systems
• Advancements in Clean Agent Delivery
• Argon Inert Gas Systems
• Individual Data Rack Extinguishing Systems
• Air Aspirating Smoke Systems
What are Clean Agents

NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems:
• 1.4.1.1 (2008) The fire extinguishing agents addressed in this standard shall be electrically nonconducting and leave no residue upon evaporation.

Two types of clean agents
• Chemical Agents
• Inert Gas
Clean Agent Systems

Chemical agents

- FK-5-1-12 - 3M™ Novec 1230™ Fire Fighting Fluid
- HFC 227ea - DuPont™ FM- 200™
- HFC 125 - DuPont™ FE-25™ Fike ECARO
- HFC -23 - DuPont™ FE-13

Inert gas

- IG-01 – Argon
- IG-100 – Nitrogen
- IG-55 – Argonite - Argon Nitrogen mix
- IG-541 – Nitrogen (52%) Argon (40%) CO2 (8%) - Inergen
Chemical agents
80% Absorb Heat
20% Interrupt the chain reaction

Inert gas
Deplete O2 level below 15%
Inhibit combustion

Fire Tetrahedron
Why use Clean Agents:

- Minimize downtime from a fire event
- When the contents as well as the building require protection
- When water can do more damage than the incident
- Three dimensional shielded objects
Clean Agent Systems

Applications
• Data Centers
• Cell Sites
• Telecommunications
• Museums / Art Galleries
• Hospitals
• Power Generation
Conceptual Design: Architects need to know….

Space planning
• How many Cylinders?
• How large are the Cylinders?

How do we determine the amount of Agent Required?
• NFPA 2001 has all the tools you need!
## Clean Agent Systems

### Minimum Design Concentrations Per NFPA 2001 Standard Have Changed

<table>
<thead>
<tr>
<th>Class</th>
<th>FK 5-1-12 (Novec 1230)</th>
<th>HFC-227ea (FM200)</th>
<th>HFC-125 (Ecaro FE25)</th>
<th>IG-541 (Inergen)</th>
<th>IG-55 (Argonite)</th>
<th>IG-100 (Nitrogen)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class A/C</strong></td>
<td>4.2%</td>
<td>6.25%</td>
<td>8.0%</td>
<td>34.2%</td>
<td>37.9%</td>
<td>36.0%</td>
</tr>
<tr>
<td><strong>Class A</strong></td>
<td>4.5%</td>
<td>6.7%</td>
<td>8.7%</td>
<td>34.2%</td>
<td>37.9%</td>
<td>36.0%</td>
</tr>
<tr>
<td><strong>Class C</strong></td>
<td>4.7%</td>
<td>7.0%</td>
<td>9.0%</td>
<td>38.5%</td>
<td>42.7%</td>
<td>40.5%</td>
</tr>
<tr>
<td><strong>Class B</strong></td>
<td>5.85%</td>
<td>8.7%</td>
<td>11.3%</td>
<td>40.3%</td>
<td>45.5%</td>
<td>40.3%</td>
</tr>
</tbody>
</table>

* In August of 2011 these percentages were approved by NFPA to be part of the 2012 standard. Minimum concentrations listed, some applications will require higher concentrations, verify final percentages prior to pricing and/or installation.

Image: 3M
### Clean Agent Systems

**Table A.5.5.1(a) FK-5-1-12 Total Flooding Quantity (U.S. Units)**

<table>
<thead>
<tr>
<th>Temp (°F)</th>
<th>Specific Vapor Volume (ft³/lb)</th>
<th>Weight Requirements of Hazard Volume, W/V (lb/ft³)</th>
<th>Design Concentration (% by Volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>-20</td>
<td>0.93678</td>
<td>0.0330</td>
<td>0.0445</td>
</tr>
<tr>
<td>-10</td>
<td>0.96119</td>
<td>0.0322</td>
<td>0.0433</td>
</tr>
<tr>
<td>0</td>
<td>0.9856</td>
<td>0.0314</td>
<td>0.0423</td>
</tr>
<tr>
<td>10</td>
<td>1.01001</td>
<td>0.0306</td>
<td>0.0413</td>
</tr>
<tr>
<td>20</td>
<td>1.03442</td>
<td>0.0299</td>
<td>0.0403</td>
</tr>
<tr>
<td>30</td>
<td>1.05883</td>
<td>0.0292</td>
<td>0.0394</td>
</tr>
<tr>
<td>40</td>
<td>1.08324</td>
<td>0.0286</td>
<td>0.0385</td>
</tr>
<tr>
<td>50</td>
<td>1.10765</td>
<td>0.0279</td>
<td>0.0376</td>
</tr>
<tr>
<td>60</td>
<td>1.13206</td>
<td>0.0273</td>
<td>0.0368</td>
</tr>
</tbody>
</table>

**4.5% = 0.04075**

Table: NFPA 2001
Clean Agent Systems

Calculations:

\[ W = \frac{V}{s} \left[ \frac{C}{100 - C} \right] \]

\[ C = \frac{100 \times s \times W}{s \times W + V} \]

\[ FF = \frac{1}{s} \left[ \frac{C}{100 - C} \right] \]

- \( W \) = Weight of Agent
- \( V \) = Volume of Protected space (ft\(^3\))
- \( s \) = Specific Vapor Volume (ft\(^3\)/lb)
  \( s = .9856 + .002441 \times t \)
- \( C \) = Concentration %
- \( FF \) = Flooding Factor

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### Safety Margins Halocarbon Agents

<table>
<thead>
<tr>
<th>Agent</th>
<th>Design</th>
<th>NOAEL</th>
<th>LOAEL</th>
<th>Safety Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>FK-5-1-12</td>
<td>4.5% - 6%</td>
<td>10%</td>
<td>&gt;10%</td>
<td>67% -120%</td>
</tr>
<tr>
<td>(Novec 1230)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HFC-227ea</td>
<td>6.7% - 9%</td>
<td>9%</td>
<td>10.5%</td>
<td>35%</td>
</tr>
<tr>
<td>(FM-200)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HFC-125</td>
<td>8.7% – 11.3%</td>
<td>7.5%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>(Ecaro 25)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Maximum exposure to any agent is 5 min.
### Global Warming is the current environmental challenge

In the current environmental challenge, Clean Agent Systems offer a sustainable solution through their properties.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Novec 1230 (FK-5-1-12)</th>
<th>Halon 1301 (HFC-227ea)</th>
<th>FM-200 (HFC-125)</th>
<th>Ecaro (HFC-125)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone Depletion Potential (ODP)</td>
<td>0.0</td>
<td>12</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Global Warming Potential (GWP)</td>
<td>1</td>
<td>6900</td>
<td>3500</td>
<td>3400</td>
</tr>
<tr>
<td>Atmospheric Lifetime (years)</td>
<td>0.014</td>
<td>65</td>
<td>33</td>
<td>29</td>
</tr>
</tbody>
</table>
Clean Agent Systems

System Design Considerations

Room Requirements

- Length, width, and height
- Sub-floor
- Preferred tank location
- Room integrity
- Room must be tight enough to maintain concentration
- HVAC must be shut down unless it is self-contained
- Identify any enclosable openings
- Pressure relief venting may be required
System Design Considerations

Electrical Requirements

- Detection
- Manual pull station
- Abort stations
- Alarm bell inside area (first warning)
- Pre-discharge horn strobe inside area (pre-discharge)
- Flashing strobes above each entrance into protected area
- Warning signs by alarms inside and outside of the room
Agent Selection

Chemical agents
• Less cylinders
• Typically less expensive
• More expensive to recharge

Inert gas
• More cylinder space requirements
• 20% more expensive initially
• Less expensive to recharge
• Best environmental solution
Advancements in Clean Agent Delivery

- Novec-1230 & FM200, 360 PSI
- Novec-1230 & FM200, 500 PSI
- Novec-1230 & FM200, 725 PSI
Advancements in Clean Agent Delivery

Initial Agent Fill Station
725 PSI Advantages

Optimized Usage of Container Volume

- When Comparing 360 PSI and 725 PSI you cannot compare the cylinder size
- What we have to compare is the required volume of agent and nitrogen
- This comparison can typically lead to at least one size smaller cylinder, depending on the piping network.
### Much Greater Pressure To Work With in Piping Network

<table>
<thead>
<tr>
<th>Working Pressure</th>
<th>Pressure loss at valve after release</th>
<th>Min. Nozzle pressure</th>
<th>Pressure for agent transport through pipes</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>360 psi</td>
<td>-116 psi</td>
<td>-111 psi</td>
<td>171 psi</td>
<td>100%</td>
</tr>
<tr>
<td>725 psi</td>
<td>-116 psi</td>
<td>-111 psi</td>
<td>498 psi</td>
<td>291%</td>
</tr>
</tbody>
</table>

Location, Location, Location!!!
**725 PSI Advantages**

- Pipe Diameter will decrease with 725 PSI system design
- Single pipe runs compared to two pipe runs in 360 PSI design

<table>
<thead>
<tr>
<th>Delivering agent in lbs. in 10sec</th>
<th>Pipe Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>360psi</td>
<td>610psi</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
</tr>
<tr>
<td>37</td>
<td>55</td>
</tr>
<tr>
<td>61</td>
<td>88</td>
</tr>
<tr>
<td>92</td>
<td>132</td>
</tr>
<tr>
<td>145</td>
<td>209</td>
</tr>
<tr>
<td>246</td>
<td>352</td>
</tr>
<tr>
<td>370</td>
<td>529</td>
</tr>
<tr>
<td>617</td>
<td>881</td>
</tr>
<tr>
<td>925</td>
<td>1322</td>
</tr>
<tr>
<td>1388</td>
<td>1984</td>
</tr>
</tbody>
</table>
725 PSI Advantages

725 PSI components

Pipe Requirements same as 360 PSI
- Schedule 40 (i.e. A-53B ERW, A-106B Seamless)
- 300 lb. class fittings
- Valves and components

Cylinder Requirements
- 3AA910 DOT Spun Steel Cylinder
725 PSI Advantages

Multizone/Selector Valve Systems
725 PSI Advantages

- Selector Valve Option for Multi Zone Systems
- Maximum Protection Using Connected Reserve
- Less Expensive than Single Zone for each Hazard

- Single System = 5,064 lbs.
- Multi Zone 1,731 + 1,731 = 3,462 lbs.
Argon Extinguishing Systems
Argon Extinguishing

- Inert Gas (IG-01)
- Single Molecule Gas (Ar)
- Extinguishment by lowering $O_2$
- (0) ODP, (0) GPW
- 2900 psi (200 bar) Systems
- Readily Available (No Blends)
- NFPA 484
- Class D
  - Lithium Ion
  - Magnesium
  - Titanium
OneU Active Extinguishing System
Self Contained Units

- 42U 19” Racks
- Energy Efficient
- Perfect for Small Number of Racks
OneU product family

Active Fire Suppression System, OneU ED and OneU DD

- Sensitive smoke aspirating system with 2 optical smoke detectors for two alarm thresholds, Two alarm thresholds 0.76%/ft - 1.06%/ft
- Emergency power for 4 hours
- Suppression module with 7.05 lbs. 3M™ Novec 1230™ Fire Suppression Fluid for 106ft³ protected volume.
- Suppression module includes agent loss monitoring supervision.
- Accessories: door switch monitoring, sampling pipe, and auxiliary relays for shut down, alarm and trouble.
The main components

- 1) Extinguishing agent container with level monitoring
- 2) Propellant gas cartridge
- 3) Discharge nozzle
- 4) Smoke sensors
- 5) Aspiration fan
- 6) Adapter bar with all necessary connections
- 7) Emergency power supply
- 8) Control unit
- 9) Power supply unit
- 10) Front panel with LCD display
OneU - Active Fire Detection and Suppression

Typical use
- Installation in upper third of rack
- Single or master/slave design for multi cabinet applications
- Maximum of 4 slave units connected to one master unit for a total of 5 units
OneU - Active Fire Detection and Suppression
OneU - Active Fire Detection and Suppression
Air Sampling Smoke Detection
Air Sampling Smoke Detection

- Early detection by monitoring the airflow
- Detector sensitivity options
- Use for extinguishing systems
- Suited to almost all object sizes
- Limitations of pipe length
How does Air Sampling work?

Unit includes Detector, Fan, Airflow Monitor, Alarm Contacts

max. transport time [sec]

Need to consider pressure drop (pipe length, equipment, elbows etc.)

Sampling hole spacing based on NFPA 72, size per manufacture criteria
Functional overview

- **Air output**
- **Cable entry**
- **Fan behind Main Board**
- **Main Board**
- **Detector Housing**
  - Programmable Sensitivity
  - Ranges Per Manufacture
    - (0.006 – 3.048 %/ft sensitivity)

**Extra Modules**
- Contacts
- Memory
- Networks

**Air Flow Sensor**
**Sampling Holes**
Room protection
- High rack stock facility
- Suspended ceiling and raised floor
- IT rooms
- Clean rooms
- Atriums

Special protection
- IT racks
- Local applications
- Cold Storage Facilities
Predefined symmetric systems – No software needed

* For design details refer to the Operating Instructions, chapter 5.4.4.3 (order no. 906146, Rev. 0.0, Ver. 0.2)
Air Sampling Smoke Detection

Calculation Software
• Unique piping configurations
• Further pipe lengths
• More sampling holes
• Additional accessories options
Cold Storage Applications

Problem:
• Regularly icing of sampling points caused by frost (mainly in entrance section) blocks the sampling tube

Solution:
• Heating on demand only if risk of pipe blocking by ice threats
• Control by air flow monitoring
• Wiring through sampling pipes
Air Sampling Smoke Detection
Thank You

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