Alternative approach to fire suppression – Class A, B, & C fires in gloveboxes

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Los Alamos NATIONAL LABORATORY EST.1943

Operated by the Los Alamos National Security, LLC for the DOE/NNSA

NNSA

Industry Standard Glovebox Fire Suppression Systems

Fire suppression, and fire mitigation systems.

- Water-based Fire Suppression
  - Inexpensive to procure and install
  - Reliable
  - Generate large volume of water that may be difficult to dispose of.
  - Loss of containment
  - Criticality issues
  - Expansion of confinement boundary

Industry Standard Glovebox Fire Suppression Systems

- Dry Chemical Fire Suppression
  - Expensive to procure and install
  - Reliable
  - Expansion of confinement boundary
- Inertion Fire Mitigation
  - Expensive to procure and install
  - Reliable

Automatic Fire Extinguisher

Researching alternative means of fire suppression led us to an automatic clean agent fire extinguisher.

- U.L. Listed (U.L. 2166) for Class B and C fires

Automatic Fire Extinguisher

Features that attracted our attention:

- Self contained and compact
- Activated by temperature
- Bolt-on simplicity
- No mechanical, electrical, or battery systems required
- Rugged construction and maintenance free
- Vibration and Corrosion resistant

Envirogel® Extinguishing Agent

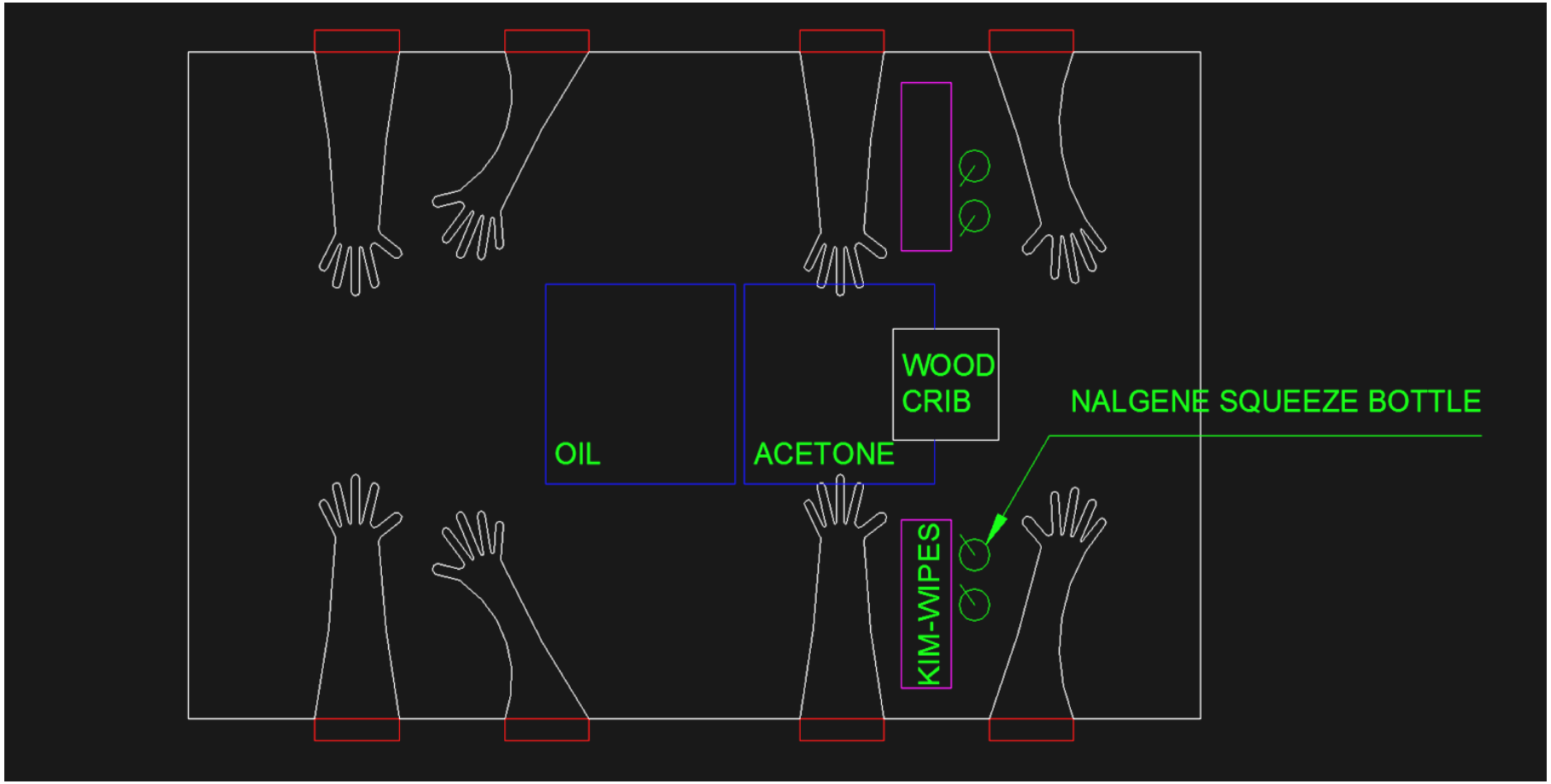
Contents of fire extinguisher:

- FE-25 Clean Agent Fire Suppressant
- FE-36 Clean Agent Fire Suppressant
- Sodium bicarbonate powder
- Charged with nitrogen gas to 100 psi

Automatic Fire Extinguisher

Fire Foe™ Tube has been NRTL Qualified by LANL for Class A, B, and C fires in enclosures up to 250 cu.ft. at and air flow rate of 1 air change per minute.

NRTL Qualification Fire Test



Proof-of-Concept Testing

- Summary of fire test results

Fire Test No.	Type of Combustibles	Time from ignition to activation of Extinguisher (minutes:seconds)	Pressure Profile Static, Fire, Activation	Approximate ceiling temperature at extinguisher activation
1	Class B	2:03	-3/4", 3", -8"	370°F
2	Class B	0:56	-3/4", 4", -6"	465°F
3	Class B	1:29	-3/4",2", -5"	430°F
4	Class A and B	1:25	-3/4", 3", -6"	340°F
5	Class A and B	2:31	-3/4", 3", -8"	355°F
6	Class A and B	1:16	-3/4", 3", -6"	255°F
7	Class A, B and C	2:33	-3/4", 2", -5"	305°F
8	Class A, B and C	1:07	-3/4", 1", -7"	390°F
9	Class A, B and C	2:06	-3/4", 2", -6"	325°F
10	Class A, B and C	2:18	-3/4", 2", -8"	340°F
11	Class A, B and C	1:58	-3/4", 3", -4"	315°F
12	Class B and C	3:05	-3/4", 2", -5"	322°F
13	Class B and C	5:59	-3/4", 2", -6"	270°F
14	Class A, B and C	3:45	-3/4", 3", -7"	545°F*

Class A Wood crib, and crumpled newspaper and Tygon tubing
Class B Liquid pool fires - Acetone and preheated cutting oil
Class C Coaxial cable, 16 AWG bundle of wires

* - 130 ft^3 extinguisher installed in 250 ft^3 enclosure

NRTL Certification Testing

- NRTL Certification

- Summary of fire test results

Fire Test No.	Type of Combustibles	Time from ignition to activation of extinguisher (minutes:seconds)	Pressure Profile Static, Fire, Activation	Temperature Average at extinguisher activation
1	Class A, B and C	4:21	-1/4", 1.5", -8"	245.2
2	Class A, B and C	N/A	-1/4", 2.5", N/A	N/A
3	Class A, B and C	6:11	-3/4",12", -3"	175.8
4	Class A, B and C	2:52	-3/4", 18", -7.5"	296.5
5	Class A, B and C	3:13	-3/4", 3", -15"	325.5
6	Class A, B and C	3:42	-3/4", 3", -11"	383

Class A	Wood crib, and crumpled newspaper and Tygon tubing
Class B	Liquid pool fires - Acetone and preheated cutting oil
Class C	Coaxial cable, 16 AWG bundle of wires

Seismic Reliability

- Water-based
  - Water supply may be affected by a seismic event.
- Dry Chemical
  - Storage cylinder and distribution piping may be compromised by a seismic event
  - Response time of the initiating device may be adversely affected by a seismic event.
- Inertion
  - Inerting may be compromised or lost in by a seismic event

Seismic Reliability

Automatic Fire Extinguisher

- Extinguisher not affected by a seismic event.
- Redundancy of extinguishers required by specifications we are developing would yield an extinguisher near the top of the glovebox in a toppling seismic event.

Reference LA-UR 12-20121 – Glovebox Issues: Controlling Fire Hazards after an Earthquake

Summary

- The extinguisher has been independently qualified to successfully extinguish Class A, B, and C fires in enclosures, based on LANL test protocol.
- The extinguisher presents the most reliable means of suppression in a post seismic event, when compared to other suppression systems.
- Installation of the extinguisher will satisfy DOE and NFPA requirements for automatic fire suppression in gloveboxes.
- Are any questions before we present an actual fire test video?