UPDATE ON THE EVALUATION OF SELECTED NFPA 2001 AGENTS FOR SUPPRESSING CLASS "C" ENERGIZED FIRES

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ABSTRACT

The paper entitled "Evaluation of Selected NFPA 2001 Agents for Suppressing Class "C" Energized Fires" published in the Halon Options Technical Working Conference Proceedings, May 7-9, 1996 has been updated to include the clean agents: FC-2-1-8 (CEA-308) and HFC-236fa (FE-36). Test results indicated that these agents required concentrations higher that the heptane cup-burner extinguishing concentrations to extinguish and prevent reignition of Class "C" energized fires. These tests also indicated that higher agent concentrations were required to extinguish and prevent reflash/reigntion on higher energy Class " C energized fires.

INTRODUCTION

A number of groups have been conducting studies concerning Class " C" energized fires. Among them are the following:

- NFPA 2001 established a Task Group on Energized Electrical Equipment in March 1997 to determine the special considerations necessary for using clean agent fire extinguishing systems to protect energized electrical equipment including: (a) impact of the discharge on energized components, (b) post fire suppression reignition, and (c) the role of the energy input. The Task Group is presently evaluating the results of Class "C" energized fire tests that have been conducted by various groups prior to making recommendations to the full NFPA 2001 Technical Committee.
- Tests conducted by Driscoll et al. [1] found that higher clean agent concentrations (above cup-burner value) were required to suppress and prevent reignition of Class "C" energized fires. These tests were conducted using polymethylmethacryate (PMMA) as the fuel ignited by a nickel-chromium (nichrome) wire energized by a direct current (DC) power supply.
- Hughes Associates has conducted a series of Class "C" fire tests (Ohmic Heating, Circuit Board and Overhead Connection) on the agent, HFC-227ea. These tests were designed to replicate limited low energy fire scenarios found in telecommunications facilities. Their preliminary findings indicated that HFC-227ea does not require an increase in concentration above the cup-burner value for extinguishing low energy Class "C" energized fires.

OBJECTIVE

The objective of the tests was to investigate the effectiveness of new clean agents to extinguish Class "C" energized fires of polymeric materials ignited by nickel-chromium resistance wire energized by a Direct Current (DC) power source. Specific tests were conducted to determine the following: (1) minimum agent concentration required to extinguish Class "C" energized **fires,** and (2) minimum agent concentration required to prevent reflashheignition.

AGENT SELECTION CRITERIA

The criteria considered for selecting the new clean agents to be tested were that they must (1) have zero Ozone Depletion Potential (ODP), and (2) be approved as a total flooding agent for use in occupied areas by EPA/SNAP and '' P A2001. The agents initially selected for testing were FC-3-1-10, HFC-227ea, and HFC-23. Subsequent tests have been conducted on the agents FC-2-1-8 and HFC-236fa.

TEST PROCEDURES

The criteria used for testing halocarbons are listed below:

Pre-burn	60 sec
Discharge time	≤ 10 sec
Flame extinguishment	≤ 30 sec
No reflashheignition	≥ 10 min

AGENT TESTS

Each agent was tested for (a) minimum concentration required for flame extinguishment, and (b) minimum concentration required to prevent reflashheignition for a period up to 10 min after flame extinguishment. The test protocol used to conduct tests on the various agents at energy levels of 48 W and 192 W is displayed in Table 1.

TEST RESULTS

A comparison of the various agent concentrations required to extinguish and prevent reflashheignition at 48 W and 192 W energy levels is presented in Table 2. The results of the tests indicated that:

- While all of the agents were effective in suppressing Class "C" energized fires at energy levels of 48 W and 192 W, the concentrations required for flame extinguishment were higher than the heptane cup-burner extinguishing concentrations listed in NFPA 2001.
- Reflash/reignition occurred with all agents at minimum extinguishing concentrations at both 48 W and 192 W.
- Higher agent concentrations (above the extinguishing levels) were required to prevent reflashheignition at both 48 W and 192 W.
- Higher agent concentrations were required to extinguish and prevent reflashheignition on higher energy fires (48 W compared to 192 W).

RECOMMENDATIONS

Based on a review of the test results the following recommendations are made:

- Additional Class " C energized fires tests be conducted on the clean agents at low energy levels (below 48 W) to determine if reflashheignition after flame extinguishment is a factor in **low** energy electrical fires.
- Additional Class "C" energized fire tests be conducted on the clean agents at high energy levels (above 192 W) to determine if there is an upper limit for clean agents to be effective in suppressing and preventing reflashheignition of high energy Class "C" fires
- An acceptable Class " C energized fire test standard be developed for NFPA-2001 total-flooding agents and included in appropriate test standards.

TABLE 1. TEST PROTOCOL.

Test Protocol	Fuel Sample/Wire Configuration	Energy (W)	Agent	Test Conducted
1	4-in long, 24-gauge,	48	FC-2-1-8	10
	nichrorne wire inserted in		FC-3-1-10	8
	center of PMMA block		HFC-23	7
	(3 in x 1 in x 5/8 in)		HFC-227ea	7
			HFC-236fa	13
2	12-in long, 20-gauge,	192	FC-2-1-8	6
	nichrorne wire wrapped		FC-3-1-10	12
	around PMMA block		HFC-23	5
	(3 in x 2 in x ¼ in)		HFC-227ea	7
			HFC-236fa	8

TABLE 2. AGENT TEST SUMMARY.

Agent	Energy Level (W)	Extinguish (min. conc., % by vol.)	Prevent Reflash/Reignition (min. conc., % by vol.)
FC-2-1-8	48	7.0	7.5
	192	9.0	12.0
FC-3-1-10	48	5.5	8.0
	192	6.5	9.5
HFC-23	48	13.0	16.0
	192	14.0	20.0
HFC-227ea	48	6.5	8.0
	192	8.0	9.0
HFC-236fa	48	6.3	6.5

REFERENCE

1. M. Driscoll, P. Rivers, 3M, "Clean Extinguishing Agents and Continuously Energized Circuits: Recent Findings," *Proceedings, Halon* ***Options*** *Technical Working Conference* Proceedings, May 6-8, 1997, pp. 129-140.