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# CONTRACT TEST REPORT

## INTEGRATED COMPRESSED AIR FOAM FIRE EXTINGUISHING SYSTEM FOR FIXED PIPING NETWORKS EFFECT OF SPRINKLER DISCHARGE

**Prepared for:**

**FireFlex Systems, Inc.**
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**Boisbriand QC J7H 1N8**
**Canada**

**Project:** 3030128
**Class:** 5136
**Date of Report:** October 11, 2007

**Authorized by:**

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**INTEGRATED COMPRESSED AIR FOAM
FIRE EXTINGUISHING SYSTEM
FOR FIXED PIPING NETWORKS
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**from**

**FIREFLEX SYSTEMS, INC.
1935 LIONEL BERTRAND BLVD
BOISBRIAND QC J7H 1N8
CANADA**

## I INTRODUCTION

1.1 FireFlex Systems, Inc. requested contract test witnessing of the performance of their compressed air foam (CAF) system when installed under a fire protection sprinkler system.

1.2 This system is currently Approved. The reports listed in Table 1.2 document its prior examinations:

| Project | Description | Date Issued |
|---|---|---|
| 3019601 | Integrated Compressed Air Foam Fire Extinguishing System for Fixed Piping Networks | 28 October 2004 |
| 3021612 | Model ARC-1 Fire Alarm Control for Automatic Release of Extinguishing Systems | 06 December 2004 |
| 3025398 | Integrated Compressed Air Foam Fire Extinguishing System for Fixed Piping Networks (MODIFICATIONS) New valve and cylinder. | 13 March 2006 |
| 3025049 | (For Ansul, Inc.) FlowMax CL Wide Range Proportioner for Low Expansion Foam Fire Extinguishing Systems using Ansulite 3% AFFF and 3X3 LV Alcohol Resistant 3% Foam Concentrates | 25 May 2006 |
| 3026593 | Integrated Compressed Air Foam Fire Extinguishing System for Fixed Piping Networks (MODIFICATION) [Alcohol Resistant Concentrate and Higher Installation Heights] | 09 November 2006 |

1.3 This Report may be freely reproduced only in its entirety and without modification.

1.4 **Standards**
The following standard was referenced in designing this test program.

| Title | Class Number | Date |
|---|---|---|
| FM Approvals Standard for Foam Extinguishing Systems | 5130 | April 2007 |

## II DESCRIPTION

2.1 FM Approvals issued a new Approval Standard for Foam Extinguishing Systems, Class 5130 in April 2007. This new Approval Standard requires CAF systems to retain their effectiveness when installed under fire protection sprinkler systems.

2.2 The FireFlex ICAF system was examined prior to the addition of this requirement. Since all foam extinguishing systems Approved prior to the issuance of this standard will be required to conform to all of its requirements to maintain their Approvals. FireFlex decided to take a proactive stance and not wait for a formal reexamination program to demonstrate their system's ability to meet this requirement. Instead, they requested FM Approvals witnessing of testing to demonstrate compliance with the new requirement.

2.3 No changes to this system were required to meet the new requirement. It was tested as currently Approved.

## III EXAMINATIONS AND TESTS

3.1 Samples as detailed below were submitted for examination and testing. The submitted samples were considered to be representative of the product line and were examined, tested, and compared to the manufacturer's drawings. Fire extinguishment, reignition resistance, and burnback resistance tests were conducted at the National Research Council of Canada Institute for Research in Construction (NRC-IRC) fire test laboratory in Ottawa, Ontario and were witnessed by FM Approvals engineer Armand V. Brandao. All data is on file at FM Approvals along with other documents and correspondence applicable to this testing.

3.2 Firefighting effectiveness tests were conducted using both the National Foam Aer-O-Lite AFFF (aqueous film-forming foam) and the Ansul 3X3 LV alcohol resistant foam concentrates. The National Foam Aer-O-Water AFFF concentrate was not tested, as it has consistently demonstrated better performance than the similar Aer-O-Lite concentrate, which differs mainly in a lower use of fluorosurfactants. The test protocol used was derived from the FM Approval Standard 5130, Section 4.22.1, CAF Fire Extinguishment, with the following clarifications.

3.2.1 The sprinkler piping grid was located 38.5 (11.75 m) ft above the floor. Viking VK100 upright k=5.6 sprinklers were installed on a 10x10 ft (3.05x3.5 m) spacing, centered above the fire test pan. Water flow was adjusted to provide a 0.25 gal/min/$ft^2$ (10.2 mm/min) density.

3.2.2 The ICAF system's TAR 225C nozzles were spaced to produce the manufacturer's specified maximum area of coverage, 150 $ft^2$ (13.9 $m^2$) for the Aer-O-Lite concentrate and 100 $ft^2$ (9.29 $m^2$) for the 3X3 LV. Square arrays for these areas of coverage were used, as prior Approvals testing showed inconsequential differences in performance between square and the manufacturer's specified most asymmetrical rectangular arrays. The ICAF grid was located 36 ft (11.0 m) above the floor. This height was chosen as well representative of the system's performance, based upon tests in the Approval examinations at various heights.

3.2.3 The application rate was the manufacturer's specified minimum, 0.04 gal/min/$ft^2$ (1.6 mm/min) for the currently Approved concentrates and 0.06 gal/min/$ft^2$ (2.45 mm/min) for the 3X3 LV.

3.2.4 The five minute water discharge was turned on immediately subsequent to the five-minute foam discharge.

3.2.5 The Aer-O-Lite concentrate was proportioned at 2 percent and the 3X3 LV at 6 percent, their Approved concentrations for the ICAF system.

3.2.6 The torch passes were at approximately 11:15 and 17:15 min:s after ignition for all tests.

3.2.7 The stovepipe insertion, ignition, and withdrawal times were approximately 18:15, 19:15, and 20:15 min:s, after ignition, respectively, for both tests.

Table 3.2.7
Firefighting Effectiveness Tests

| Concentrate | Fuel | Grid | Extinguishment Time s | Reflash From Torch Passes | Burnback Resistance Time m:s |
|---|---|---|---|---|---|
| Aer-O-Lite | Heptane | 12.25 x 12.25 (3.73 x 3.73) | 54 | None | 26:00+ |
| 3X3 LV | Heptane | 16 x 6.62 (4.88 x 2.02) | 36 | None | Rift fire self-extinguished after removal of stovepipe |

3.2.8 In all cases, there was a 15 second minimum delay after ignition before foam application was begun. This is called the preburn time.

3.2.9 All criteria for success in these tests were met. These included:

Creation of a uniform foam blanket throughout the surface of the pan.
Complete extinguishment of the fire prior to completion of foam discharge.
No reignition when a lighted torch was passed over all areas of the blanket.
Either self-extinguishment or no increase in fire area beyond 10 $ft^2$ (0.9 $m^2$) in less than 5 minutes after removal of the stovepipe.

3.2.10 The 1-1/2 in. mixing chamber was used for all fire tests. Foam samples were taken at floor level for each test and expansion ratio and 25 percent drainage time were measured for each. These were compared to those from foam generated by different combinations of equipment, as described in Paragraph 3.3, to verify that fire tests with other combinations would not be necessary. The quality measurements corresponding to the two firefighting effectiveness tests described in Table 3.2.7 are listed in Table 3.2.10, in the same order.

Table 3.2.10
Fire Test Concentrations and Foam Quality Measurements

| Concentrate | Sample | Concentration Percent | Expansion Ratio :1 | 25 Percent Drainage Time m:s |
|---|---|---|---|---|
| Aer-O-Lite | Fire Test 1-1/2 in. Mixer | 2.1 | 9.9 | 05:09 |
| 3X3 LV | Fire Test 1-1/2 in. Mixer | 6.3 | 11.1 | 33.25 |

3.3 During testing of accuracy of concentrate metering for various combinations of equipment and flow rates in the prior Approval examinations, foam quality (expansion ratio and 25 percent drainage time) measurements were also made. These data were used for comparison to similar measurements taken during the fire tests and shown in Table 3.2.10. The test protocol was as described in FM Approvals Standard 5130, Section 4.2, Low Expansion Foam Quality Measurements. Table 3.3 summarizes the results.

Table 3.3
Average Foam Quality Measurements from Proportioning Accuracy Tests

| **Concentrate** | **Expansion Ratio :1** | **25 Percent Drainage Time min:s** |
|---|---|---|
| Aer-O-Lite | 10.8 | 03:42 |
| Ansulite 3X3 LV | 10.7 | 29:26 |

3.3.1 Foam quality measurements from Tables 3.2.10 and 3.3 were compared, as shown in Table 3.3.1.

Table 3.3.1
Comparison of Fire Test and Proportioning Test Foam Qualities

| **Concentrate** | **Difference In Expansion Ratio From Fire Test Average :1** | **Difference In 25 Percent Drainage Time From Fire Test Average min:s** |
|---|---|---|
| Aer-O-Lite | 0.9 | -01:27 |
| Ansulite 3X3 LV | -0.4 | -03:59 |

3.3.2 These results were deemed acceptable, falling within the allowable ranges of Table 4.22.4 of Approval Standard 5130, which limits CAF proportioning expansion ratios to within -1/+2 expansion ratio units (or -10/+20 percent) and drainage times to -5/+10 minutes (or -10/+20 percent) of the fire test values.

3.4 The manufacturer also conducted additional testing to explore the limits of effective performance of his system under sprinkler discharge. These tests included varying sprinkler piping grid orientation between parallel to that of the CAF piping grid and 90° rotation (in the horizontal plane), varying the sprinkler discharge density and CAF concentration and application rate, running sprinkler discharge throughout the CAF discharge in addition to the subsequent 5 minutes, running longer than five minute subsequent water discharges, and testing with both acetone and heptane fuels. These tests are summarized in Institute for Research in Construction, National Research Council of Canada (NRC-CNRC) Research Report IRC-RR-237, Fire Extinguishing Performance of the ICAF System with Synchronous Operation of Sprinklers, dated August 2007, authored by George Crampton. FM Approvals witnessed a significant portion of these tests and agrees with the conclusions of the NRC-CNRC report, although the additional testing would not be a requirement as a part of an examination for possible for FM Approval. A copy of this report is on file at FM Approvals as a part of this project's documentation.

## IX CONCLUSION

The information obtained in this project will be used to address the applicable requirements when a reexamination to the new Approval Standard is conducted for this manufacturer.

**TESTING WITNESSED BY:** **Armand V. Brandao**

**PROJECT DATA RECORD:** **Project 3030128**

**ORIGINAL TEST DATA:** **PDRs 3019601, 3026593, & 3030128**

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