Testing of TF 1122 Class A Wetting Agent:

Four Fire Tests Associated with NFPA 18 (2017 ed.)

Prepared for:

Alan Snipes
Cross Plains Solutions

Prepared by:

Chippewa Valley Technical College
Fire Safety Center

3617 Campus Road
Eau Claire, WI 54703

Principal contact:
Christopher J. Turner
Ph.: 715-829-3737
Email: cturner@cvtc.edu

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1 Abstract

TF 1122 Class A wetting agent was tested using protocols contained within the National Fire Protection Association (NFPA) 18: Standard on Wetting Agents (2017 edition). Four tests associated with extinguishment of Class A and B fires were performed:

1. Wood crib fire test;
2. Deep-seated fire test;
3. Wood fiberboard penetration; and
4. 50 square foot heptane fire test.

Each test was performed following the procedures detailed in NFPA 18. The TF 1122 Class A wetting agent passed each of the four tests.

2 Introduction

To test the ability of TF 1122 Class A wetting agent to pass three Class A fire related tests and one Class B fire related test of NFPA 18, staff from Chippewa Valley Technical College's (CVTC) Fire Safety Center (FSC) performed the tests as specified in the standard. Tests were performed at the FSC in Eau Claire, WI and were performed in January, 2023. This report details each of the test methods and the results of each test performed.

3 Methods

This section describes the methods used for each of the four fire-related tests performed. Each test is described in its own sub-section and the results/discussions of each test are contained within the following section.

3.1 Wood crib fire test

The first of the Class A fire tests in NFPA 18 Chapter 8 tests the ability of a wetting agent solution to extinguish wood crib fires with the solution prepared at the minimum concentration specified for use by the manufacturer (0.1% in this case).

Tests are conducted according to the procedures detailed in this section and ANSI/UL 711 CAN/ULC S508 for Class A fires utilizing a 3-A wood crib. The solution is applied with a nominal 9.5 L (2.5 gal) listed 2-A rated water extinguisher. As per UL 711, two consecutive crib extinguishments are required, and the steps listed below are performed for each of the trials. Figure 1 depicts each of the key steps of this test.

1. Crib constructed of 18 layers of 8 wood members each 38 mm by 38 mm by 735 mm
2. Members are constructed of kiln dried spruce or fir having a moisture content of 9 to 15 percent.
3. Crib is placed on an angle iron frame above a burn pan.
4. The net mass of the crib is determined prior to commencing the test
5. Ignition of the crib is accomplished by burning 2.8 liters of heptane in the pan.
6. The crib fire is to be attacked when its mass has been reduced to 55 ±1 percent of its original mass
7. Discharge is to be continuous until the extinguisher is completely discharged.
8. After 15 minutes, the crib is examined for any hot spots or re-ignition.

A) Crib is placed on frame on top of scale and weighed.

B) Charge pan under crib is lit to ignite crib.

C) Application of wetting agent commences when crib weight has been reduced to 55% of starting weight.

D) Crib is inspected for hot spots or re-ignition after a 15 minute waiting period.

Figure 1. NFPA 18 Wood Crib Fire Test

3.2 Deep-seated fire test

The second of the Class A fire tests in NFPA 18 Chapter 8 tests whether the wetting agent solution can extinguish deep-seated cotton fires and exhibit less runoff than water. Tests are conducted three times with plain water and three times with the wetting agent solution prepared at the manufacturer's recommended concentrations. This test was performed with 0.1% solution.

The tests are conducted using a cylindrical basket of perforated sheet steel, 114 mm (4.5 in.) in diameter and 178 mm (7 in.) high, and ginned cotton weighing 100 g (3.5 oz). The steps listed below are performed for each of the six trials. Figure 2 depicts each of the key steps of this test.

1. Stuff 50 g (1.75 oz) of cotton into the bottom half of the basket.
2. Heat a steel rod 35 mm (1.38 in.) in diameter and 33 mm (1.3 in.) long to 593°C (1100°F).
3. Place the rod on the cotton in the basket.
4. Immediately insert 50 g (1.75 oz) of cotton into the basket on top of the rod.
5. Pour 250 mL (8.5 fl oz) of test liquid (water or wetting agent solution) onto the cotton and catch the runoff in a pan placed below the basket.
6. Measure and record the volume of runoff.

A) 50 g of ginned cotton in bottom half of perforated steel cylinder.

B) Heated steel rod (1100 F) placed on top of cotton.

C) Second 50 g of cotton stuffed into cylinder on top of heated rod.

D) Pouring 250 mL of test solution into the cylinder with catch pan placed below to collect runoff.

Figure 2. NFPA 18 Deep-seated Fire Test

3.3 Wood fiberboard penetration

The third of the Class A fire test in NFPA 18 Chapter 8 tests the wetting agent solution's ability to extinguish wood fiberboard fires and exhibit less runoff and weight loss than water. Tests are conducted three times with plain water and three times with the wetting agent solution prepared at the manufacturer's recommended concentrations. This test was again performed with 0.1% solution.

The tests are conducted with fiber insulation board squares measuring 305 mm × 305 mm × 13 mm (12 in. × 12 in. × 1⁄2 in.) and are performed by following the steps listed below. Figure 3 depicts each of the key steps of this test.

1. Weigh the test board and place it on a wire grid.
2. Expose the test board to an alcohol flame from a burning pan that is placed immediately below the test board for 105 seconds.
3. Remove the fuel pan and place a clean, dry pan under the test board to collect the water or agent runoff.
4. Spray 250 mL (8.5 fl oz) of test liquid (water or wetting agent solution) on the upper surface of the test board using a small sprinkler bottle.
5. Measure and record the volume of runoff.
6. Dry and weigh the boards and calculate the weight loss.

A) Fiberboard test board placed on wire grid above pan of alcohol.

B) Test board being exposed to alcohol flame.

C) Applying 250 mL of test solution with sprinkler bottle. Catch pan in place to collect runoff.

D) Test panel after application of 250 mL of test solution.

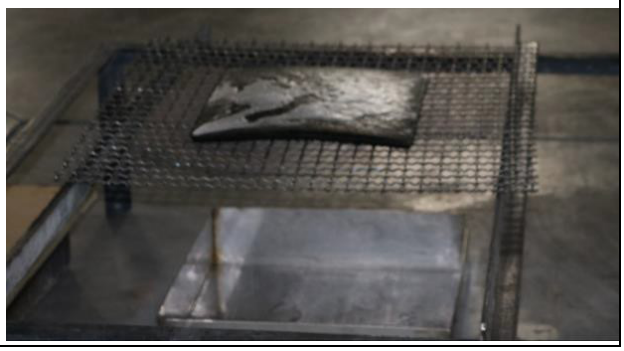

Figure 3. NFPA 18 Wood Fiberboard Penetration Test

3.4 Heptane fire

Chapter 7 of NFPA 18 specifies that products listed for use on Class B fires shall pass the single Class B fire extinguishment test detailed in this chapter. Wetting agent solutions at the concentrations specified by the manufacturer (3.0% in this case) are evaluated to determine their ability to extinguish a Class B heptane fire as follows:

1. A 4.65 m2 (50 ft^2) 20 B pan constructed as described in UL 711 is fitted with a backboard that is the width of the pan and 0.9 m (3 ft) high.
2. A 51 mm (2 in.) layer of heptane fuel is floated on a 102 mm (4 in.) depth of water.
3. The fuel in the pan is ignited and allowed to free burn for 60 seconds.
4. A 37.9 L/min (10 gpm) nozzle is used to apply the wetting agent solution to the fire using one, or a combination, of the following methods:
   a. The nozzle shall be fixed in position at an angle above the horizontal in order to direct the discharge across the pan onto the backboard for the entire duration of the test; or
   b. The nozzle shall be permitted to be moved as necessary for control and extinguishment.
5. In no case shall the nozzle extend over any part of the test pan.
6. In order for the test to be successful, the fire shall be extinguished within 5 minutes of the start of application of the wetting agent solution.

A wetting agent is considered to have passed this test if successfully extinguishes the 20B heptane fire on two consecutive attempts. Figure 4 depicts the key steps of this test.

A) 20B (50 sq ft.) Test pan fitted with 3 ft high backboard, filled with 4 inches of water and 2 inches of heptane.

B) Heptane free burning during 60 second preburn.

C) Applying 3.0% Class A wetting solution at 10 gpm (37.9 L/min).

D) Test pan after extinguishment.

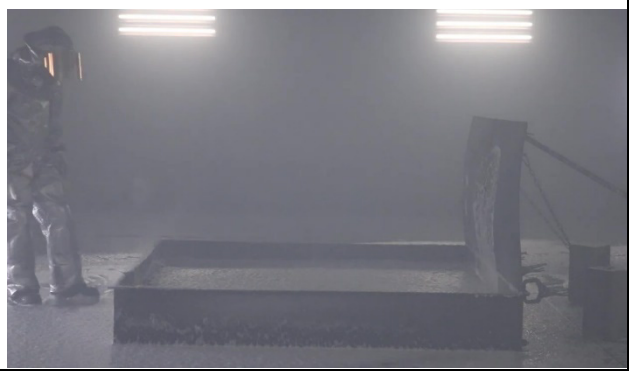

Figure 4. NFPA 18 Class B Fire Test

4 Results/Discussion

This section describes the results of each of the fire tests performed. Each sub-section also discusses the results as details the pass/fail criteria used to evaluate the results.

4.1 Wood crib fire test

Key data associated with the wood crib fire tests are contained in Table 1. The 0.1% solution of TF 1122 wetting agent successfully extinguished two 3-A cribs and no re-ignition or hot spots were found after the 15 minute waiting periods. The consecutive extinguishment of two cribs with the 9.5 L extinguisher filled with the wetting agent solution constitutes a passing test.

Table 1. Pertinent Details of NFPA 18 Wood Crib Tests

Crib #1	**TF 1122 @ 0.1%**					
	Starting weight:	164.5	pounds		Ignition Time:	0:00
	Hit weight:	90.5	pounds	(55% of original)	Heptane consumed:	3:09
% moisture	Top	14.1			Start of Extinguishment:	8:14
	Side 1	14.2			End of Extinguishment:	9:23
	Side 2	13.8			*Duration of Extinguishment:*	*1:09*
	Side 3	14.9			End of waiting period:	24:23
	Side 4	14.6			**Result = Full extinguishment**	
	Average	**14.32**	*Criteria is between 9 and 15 percent*			
Crib #2	**TF 1122 @ 0.1%**					
	Starting weight:	168.0	pounds		Ignition Time:	0:00
	Hit weight:	92.5	pounds	(55% of original)	Heptane consumed:	3:02
% moisture	Top	15.3			Start of Extinguishment:	8:34
	Side 1	10.9			End of Extinguishment:	9:41
	Side 2	11.1			*Duration of Extinguishment:*	*1:07*
	Side 3	10.7			End of waiting period:	24:41
	Side 4	10.3			**Result = Full extinguishment**	
	Average	**11.66**	*Criteria is between 9 and 15 percent*			

4.2 Deep-seated fire test

Results of the deep-seated fire trials are detailed in Table 2. The passing criteria of this test (extinguish the fire and exhibit less runoff than water) were surpassed with the 0.1% solution of TF 1122 Class A wetting agent. The cotton fire was extinguished in each of the trials with wetting agent solution, and the mean runoff of each test solution was less when compared with plain water. The technicians also noted more complete extinguishment of the cotton in each of the tests with wetting agent solution, while some hot spots remined after several of the water-only tests.

Table 2. Results of TF 1122 Class A solution: Deep-seated fire tests

Test ID#	Extinguishing Solution used	Volume of Solution used (mL)	Volume of Runoff (mL)	Mean Runoff Volume (mL)	St Dev
W1	Water	250.0	181.2	154.3	31.1308529
W2	Water	250.0	161.5		
W3	Water	250.0	120.2		
S1	0.1% Wetting Agent	250.0	97.8	108.7	39.5917921
S2	0.1% Wetting Agent	250.0	75.7		
S3	0.1% Wetting Agent	250.0	152.6		

4.3 Wood fiberboard penetration

Results of the wood fiberboard fire test trials are detailed in Table 3 and Table 4. The passing criteria of this test (extinguish the fire, exhibit less runoff than water, and exhibit less weight loss than boards extinguished with water) were met with the 0.1% solution of TF 1122 Class A wetting agent. The test boards were extinguished in each of the three trials with wetting agent solution, and the mean runoff was less than the volume when compared with plain water (Table 3).

Table 3. Results of TF 1122 Class A solution: Wood fiberboard runoff tests

Test Board	Extinguishing Solution used	Volume of Solution used (mL)	Volume of Runoff (mL)	Mean Runoff Volume (mL)	St Dev
W1	Water	250.0	134.9	137.0	2.1007935
W2	Water	250.0	139.1		
W3	Water	250.0	137.1		
S1	0.1% Wetting Agent	250.0	131.0	130.1	0.8544004
S2	0.1% Wetting Agent	250.0	130.0		
S3	0.1% Wetting Agent	250.0	129.3		

While the difference in percent weight loss was less dramatic with wetting agent solution when compared to water (Table 4), there is a clear reduction in weight loss of those panels treated with TF 1122 solution than those treated with water only. NFPA 18 does not state to what degree the panel weight loss difference must be, just that the boards treated with solution should "exhibit less runoff and weight loss than water". Additionally, the technicians noted that the extinguishment of the panels was faster and more complete with the wetting agent solutions than with plain water.

Given the reduction in runoff and the decrease in panel weight loss of the wetting agent solution treatments when compared to plain water, it is our professional opinion that the 0.1% solution of TF 1122 Class A wetting agent passed this test.

Table 4. Results of TF 1122 Class A solution: Wood fiberboard weight loss tests

Test Board	Extinguishing Solution used	Panel Starting Weight (g)	Panel Ending Weight (g)	Weight Loss (g)	Percent Weight Loss	Mean Weight Loss (%)	St Dev
W1	Water	305.0	234.4	70.6	23.1%	22.92%	0.002956
W2	Water	306.6	236.0	70.6	23.0%		
W3	Water	305.5	236.5	69.0	22.6%		
S1	0.1% Wetting Agent	306.5	242.5	64.0	20.9%	20.68%	0.008056
S2	0.1% Wetting Agent	308.2	247.2	61.0	19.8%		
S3	0.1% Wetting Agent	304.7	239.6	65.1	21.4%		

4.4 Heptane fire

The 3.0% solution of TF 1122 Class A wetting agent successfully and fully extinguished the 20B (50 square foot) heptane fire within 5 minutes of application in two consecutive attempts, which is the passing criteria for this test. No reignition occurred after full extinguishment.

5 Summary

TF 1122 Class A wetting agent was found to be capable of successfully passing all four fire-related tests contained within NFPA 18 (2017 ed.). This includes extinguishment of wood crib fires, deep-seated fires, wood fiberboard penetration, and heptane fire.

6 References

National Fire Protection Association. (2016). NFPA 18, *Standard on Wetting Agents,* 2017 Edition.

Underwriters Laboratories, Inc. (2009). UL 711, *Standard for Safety for Rating and Fire Testing of Fire Extinguishers*, 7th Edition, dated December 17, 2004 and revised April 28, 2009.