

**FIRE-FIGHTING FOAM
TEST REPORT
CONDUCTED BY:**

THE DOW CHEMICAL COMPANY

On September 23 through September 25, 2002

**Report Date
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TABLE OF CONTENTS

Purpose of Testing 4

Objective of Testing 4

Fire Test Facility 4

Third Party Contractor 4

Preparation For Test.....4

Personnel in Attendance 5

Equipment to be Utilized 5

Test Conditions 6

Data Collection 6

Test Program and Procedures7

Clarifications and Definitions 8

Nozzle Application Methods 9

 Type II Application 9

 Type III Application 9

Foam Concentrate Procurement and Handling10

Foam Solution Premixing10

Fire Test Pan11

Fuel11

Nozzle Configurations11

Nozzle Calibration.....12

Foam Quality Testing12

Foam Test Results.....12

Summary.....13

TABLE OF CHARTS - FIGURES

Figure 1 - Foam Testing Criteria 8

Figure 2 – Foam Concentrate Premix Matrix.....11

Figure 3 - Nozzle Configurations 12

Figure 4 - Nozzle Calibration 12

TEST RESULTS SECTION

Figure 5 – Toluene 2 GPM Plunge Nozzle Fire Test Summary.....14

Figure 6 – Toluene 2 GPM Spreader Nozzle Fire Test Summary.....16

Figure 7 – Toluene 1.5 GPM Fire Test Summary17

Figure 8 - Isopropanol Anhydrous Fire Test Summary18

Figure 9 - Fire Test Summary by Mfg’r – Buckeye Platinum 3x319

Figure 9a - Fire Test Summary by Mfg’r – Buckeye Platinum 3x620

Figure 10 - Fire Test Summary by Mfg’r – Chemguard UltraGuard 3x3.....21

Figure 10a - Fire Test Summary by Mfg’r – Chemguard 3x622

Figure 11 - Fire Test Summary by Mfg’r – National Foam Universal Gold 3x323

Figure 11a - Fire Test Summary by Mfg’r – National Foam Universal Plus 3x624

Figure 12 - Fire Test Summary by Mfg’r – Williams ThunderStorm 1x325

APPENDIX

Appendix A – Fuel MSDS – Toluene.....A-1 – A-10

Appendix B – Fuel MSDS – Isopropanol Anhydrous..... B-1 – B-8

PURPOSE OF TESTING

The Dow Foam Concentrate Team, conducted a series of fire-fighting foam tests, to provide updated data on Class B fire-fighting foam concentrates that are suitable for use by Dow to extinguish large in-depth flammable liquid fires in both hydrocarbon and polar solvent fuels.

These tests were conducted using the Underwriters Laboratories Inc. Standard for Safety for Foam Equipment and Liquid Concentrates, (UL 162), as a guide. The tests were conducted using Toluene and Isopropanol Anhydrous. Fuel specifications indicating composition and purity are provided for each fuel used in the test. See Appendix A & B for fuel specifications.

OBJECTIVE OF TESTING

This testing was conducted to determine the optimum foam concentrate on the market for these type fires. Typical foam tests use heptane as the standard fuel. The objective of the testing was to provide Dow with an updated list of foam concentrates that have passed the UL protocol with fuels commonly found at Dow sites.

FIRE TEST FACILITY

Buckeye Fire Equipment Co. located in Kings Mountain, NC provided the fire test facility. The Dow Foam Concentrate Team and Vector Fire Technology personnel staffed the building for the duration of testing. The building is approximately 50 ft square and 55 feet in height with an observation room overlooking the test area. The observation room is equipped with scales and measuring equipment required to perform foam quality testing and premix preparation. A high capacity smoke removal system installed in the building was used during the preburn and selectively thereafter.

THIRD PARTY CONTRACTOR

Vector Fire Technology, Inc. was selected as an independent third party contractor to conduct the Dow Fire Test Series and Training Specialties Inc., another third party independent, was also contracted as a third party witness. Vector and Training Specialties was chosen because of their experience and reputation in the foam industry and familiarity with the UL-162 standard testing requirements.

PREPARATION FOR TEST

The fire testing began on Monday September 23, 2002, at 0800 hours and continued through Wednesday September 25.

PERSONNEL IN ATTENDANCE

The following is a list of personnel in attendance for the Dow Fire Test series.

- J. G. “Shane” Tullier Jr. (Dow) Louisiana Operations Fire Protection Technologist
- Mike Quisenberry (Dow) Freeport Texas, Delivery Leader
- Terry Williams (Dow) Texas City, Texas, Delivery Leader

- Steve DiLuigi Training Specialties Inc.

- Steve Kiernan (independent contractor) Vector Fire Technology, Inc.

- Jim Devonshire (Manager, Foam Business Div.) Buckeye Fire Equipment

EQUIPMENT TO BE UTILIZED

The test utilized the following equipment:

- UL 50 sq. ft. pan (reference Underwriters Laboratory, Inc. Standard UL-162)
- UL test nozzles
- One 1-1/2 fire safety line with nozzle
- Two 20 lb. Class B fire extinguishers
- Two different fuels (Toluene, Isopropanol Anhydrous)
- Seven different foam concentrates.

Foam Tested:

National Foam	Universal Plus 3x6 AR AFFF
National Foam	Universal Gold 1x3 AR AFFF
Chemguard	3% UltraGuard 3x3 AR AFFF
Chemguard	3x6 AR AFFF
Williams Fire & Hazard Control	Thunderstorm ATC 1x3
Buckeye Fire Equipment Co.	Platinum 3x3 AR AFFF
Buckeye Fire Equipment Co.	Platinum 3x6 AR AFFF

TEST CONDITIONS

The tests were conducted at the Buckeye Fire Equipment facility in Kings Mountain NC, following the UL 162 protocol. The facility is 50 ft x 50 ft x 55 ft high indoor fire test laboratory with suitable fuel and air handling capabilities to handle UL 162 topside fire testing.

- All tests were conducted using fresh water premix.
- The temperature of each foam concentrate premix solution was approximately the same.
- Fuel was added to the pan immediately prior to the start of each test.
- Each test fire was allowed to pre-burn for 60 seconds.
- The foam blanket was allowed to spread over and completely cover the test fuel surface.
- Extinguishment was required during or at the end of the foam discharge period.
- A lighted torch was moved over all areas of the foam surface twice during the period from the end of foam application and ignition of the burnback stove pipe.
- The burnback stove pipe was planted vertically in the foam and the foam blanket was removed from the interior area of the pipe. The stove pipe was ignited and the blanket observed to either:
 1. Restrict for five minutes the spread of fire to an area not larger than ten square feet (20%) or;
 2. Flow over and self extinguish the burning area.

DATA COLLECTION

All instrumentation used for the program was calibrated within the past 30 days in accordance with Buckeye ISO-9000 certification requirements.

The following data was collected for each test:

- Fuel type
- Type of foam concentrate
- Weight of foam concentrate added for premix
- Premix solution amount
- Type of water used
- Type of application (i.e. Type II or Type III)
- Rate of application (gpm / sq. ft.)
- Nozzle configuration
- Test nozzle flow rate
- Foam expansion ratio
- Foam 25% drainage time
- Pre-burn times

- Foam application time
- 90 percent reduction in fire intensity – defined as “control”
- Total extinguishment times
- Torch Time and results
- 20% burn back time (if applicable)

TEST PROGRAM AND PROCEDURES

The program involved testing seven different foam concentrates on two different fuels with four different test applications. Fresh water was used to make the foam solution premix for each test fire. Foam was pre-mixed with fresh water by weight measurement using a calibrated 6000 gram electronic scale capable of measuring one gram units. Fresh fuel (55 gals.) was used for each test and the fuel temperature was measured. The tests on Toluene was conducted using a Type III (moveable nozzle) application method. The tests on the Isopropanol Anhydrous were conducted using a Type II (fixed) discharge outlet.

The tests were intended to determine:

- How quickly each individual foam was able to extinguish the fires,
- The effect of torching the blanket to test for sealability,
- The ability of the foam concentrates to resist burn back,
- The 25% drainage time of each foam (the time it takes for 25% of the expanded foam to drain back into solution), and
- The expansion ratio (air volume to solution) of each foam produced by the test nozzle.

Foam quality measurement was done in accordance with procedures as stated in NFPA-11, Appendix C, Section C-1. The criteria shown in Figure 1 were used for testing.

Parameter	Type III			Type II
	Toluene	Toluene	Toluene	Isopropanol Anhydrous
<i>Fuel Group</i>	<i>Toluene</i>	<i>Toluene</i>	<i>Toluene</i>	<i>Isopropanol Anhydrous</i>
<i>Application Rate (gpm/ sq. ft.)</i>	<i>0.04</i>	<i>0.04</i>	<i>0.03</i>	<i>0.09</i>
<i>Application Flow Rate</i>	<i>2.0 gpm</i>	<i>2.0 gpm</i>	<i>1.5 gpm</i>	<i>4.5 gpm</i>
<i>Nozzle Tip</i>	<i>3/8 x 2 straight</i>	<i>3/8 x 2 spreader</i>	<i>3/8 x 2 straight</i>	<i>1/2 x 4 straight</i>
Water Bottom	2 inches			None
Start Preburn (min)	0:00			0:00
Start Foam Application (min)	1:00			1:00
Stop Foam Application (min)	4:00			6:00
Start First Torch (min)	4:30 - 5:00			7:00 – 7:30
Stove Pipe In (min)	10:30			18:30
Start Second Torch (min)	11:00 - 11:50			18:30 – 19:30
Light Stove Pipe (min)	13:00			21:00
Remove Stove Pipe (min)	14:00			22:00
Record Burnback (min)	19:00			27:00

**Foam Testing Criteria
Figure 1**

CLARIFICATIONS AND DEFINITIONS.

All times recorded from start of preburn.

Preburn – After ignition the fire was allowed to burn freely for 60 seconds.

Application time – The application time started after 60 second preburn. Application times are defined in the chart above. Type III tests on hydrocarbon utilized a 3 minute foam discharge duration. Type II tests on Isopropanol Anhydrous utilized a 5 minute foam discharge duration.

Control Time – Control of the test fire was called when the fire has reduced in intensity by approximately 90%. Flame height was not higher than 4 feet and involve only the “lead edge” and corners.

Extinguishment – This term is self-explanatory.

Torch tests – Torch tests were conducted at the times prescribed in the table above. Torch testing was conducted by passing a lit torch 1 inch above the foam blanket, along all 4 sides of the pan and in an “X”

pattern over the center of the pan from corner to corner. Candling, flaming, or flash over was considered acceptable providing it did not remain in one area for more than 30 seconds and flame height did not exceed 2 feet.

Burnback test – The burnback test was conducted by placing a 12 inch diameter stovepipe approximately 30 inches from two adjacent sides of the pan. The stovepipe was placed near the corner last to extinguish during foam application. The foam blanket was cleared from the inside of the stovepipe. The stovepipe was ignited and allowed to burn for 1 minute. After 1 minute the stovepipe was removed and the blanket observed for 5 minutes. The burnback test was considered acceptable if the foam blanket restricted the burning area to no more than 20% (10 sq ft) of the foam surface area. Candling, flaming, or flash over were considered acceptable providing the total burning area was less than 20% of the total pan area.

Walkover – Small flames that move over the foam blanket surface.

Undercut – Burning that occurs just below the top of the foam blanket causing a horizontal separation in the foam blanket.

NOZZLE APPLICATION METHODS

The terms Type II and Type III Application are terms derived from Underwriters Laboratories Inc, Standard 162 – Standard for “Foam Equipment and Liquid Concentrates”. These terms relate to the relative position of the nozzle in relation to the fire test pan and the manner in which the expanded foam solution is applied to the fuel surface. The method of application used for this test series are described as follows:

For Type II application the nozzle was positioned in front of the pan and fixed into a clamp down device for the duration of testing. The nozzle was centered on the pan as measured from side to side and the foam stream directed onto a backboard that was affixed to the opposite side of the pan. Backboard dimensions were approximately 2 feet high by 4 feet wide. The stream was directed at a point approximately 18 to 24 inches above the fuel surface. The nozzle was not moved at any time during discharge application. The nozzle operator was Steve Kiernan, from Vector Fire Technology, Inc.

For Type III application the nozzle was positioned in front of the pan and held by a nozzle operator. The nozzle operator remained stationary, but was allowed to move the nozzle in an oscillatory fashion while directing the expanded foam solution onto the fuel surface. The foam stream was not permitted to contact the sides of the test pan during this portion of the test. Upon control of the fire the nozzle operator was permitted to move along the front edge and one adjacent side of the test pan while applying foam to the fuel surface and sides of the pan. At no time was the nozzle allowed to extend over the edge of the test pan or beyond a line created by the two adjacent side extensions of the pan. “Control” was called when a 90% reduction in fire intensity occurred and flame height did not exceed 4 feet. For consistency, all Type III tests were done by the same nozzle operator and person who determined “control”. The nozzle operator was Steve Kiernan, from Vector Fire Technology, Inc.

Type III application method was selected since it simulates some of the problems encountered in actual full - scale over-the-top foam application methods using portable nozzles and monitors.

FOAM CONCENTRATE PROCUREMENT AND HANDLING

Foam concentrates were Purchased by Dow through Training Specialties, marked and seals checked, then shipped to the test site and rechecked by Dow. The Buckeye shipment did not make it to the test site in time so Dow personnel hand picked concentrate from the Buckeye warehouse. All foam concentrates were premixed by weight into water for testing. Sample weighing and premixing were performed by Vector Fire Technology personnel.

FOAM SOLUTION PREMIXING

Foam solution premix was made using foam samples prepared by weight. A certified scale capable of measuring to within one gram, was used to weigh each foam concentrate sample to obtain the volume required for the premix. The specific gravity of each sample was determined by Buckeye's Technical Service Laboratory. See Figure 2 for specific gravity results. Foam concentrate volume used for premixing foam solution was calculated as follows:

Independent laboratory results are shown in Appendix

$$\text{Wt (grams)} = \text{Premix Volume (gal)} \times \text{Premix \%} \times 3785 \times 454 \times \text{SG}$$

Where:	Premix %	=	
	0.01	=	for 1% Foam concentrates.
	0.03	=	for 3% Foam concentrates.
	0.06	=	for 6% Foam concentrates.
	3785	=	grams per gallon of water.
	SG	=	Specific Gravity as determined by lab analysis.

	FOAM CONCENTRATE WEIGHT (grams)					Specific Gravity
	Fire Type	Toluene	Toluene	IPA	IPA	
	Gallons	30	50	40	40	
Product	Percent	1%	3%	3%	6%	
Buckeye Platinum 3x3 AR AFFF		N/A	5830	4664	N/A	1.0269
Buckeye Platinum 3x6 AR AFFF		N/A	5811	N/A	9297	1.0235
Chemguard UltraGuard 3x3 AR AFFF		N/A	5827	4661	N/A	1.0263
Chemguard 3x6 AR AFFF		N/A	5822	N/A	9316	1.0255
National Foam Universal Gold 1x3 AR AFFF		N/A	5843	4675	N/A	1.0292
National Foam Universal Plus 3x6 AR AFFF		N/A	5799	N/A	9278	1.0214
Williams Fire & Hazard Control Thunderstorm 1x3 AR AFFF		1178	N/A	4712	N/A	1.0374

**Foam Concentrate Premix Matrix
Figure 2**

FIRE TEST PAN

The fire test pan used was a UL-162 defined square, straight-sided steel pan 50 square feet in surface area. The top edge of the pan was reinforced with 2 x 2 x 3/8 angle. The test pan was 12 inches deep and supported on 6 inch channel. The area under the tank bottom is closed on 3 sides. When required for Type II testing a steel backboard was clamped to the angel flange on one side of the tank. The backboard was approximately 2 feet high by 4 feet wide.

FUEL

The fuels selected for test were provided with MSDS sheets. Fifty five gallons of fresh fuel was used for each test. Hydrocarbon fuels (Toluene) was placed on a 2” layer of water in the bottom of the test pan. Water miscible fuels (Isopropanol Anhydrous) was placed directly on the bottom of the test pan.

NOZZLE CONFIGURATIONS:

The fire test nozzles used for this program were brass construction and typical of the design used for MIL-F-24385 and UL-162 fire testing. The nozzle has changeable jet and receiver sections as well as a selection of discharge pipes which are defined as “Tip Size” and “Tip Configuration” in the chart below. The configurations shown in the chart were determined by the Dow Foam Committee and selected to provide reasonable foam quality that is representative of foam produced by full scale aspirating type nozzles.

Application Rate (gpm/sq-ft)	Flow Rate (gpm)	Jet Size (in)	Rec. Size (in)	Tip Size (in)	Tip Configuration	Inlet Pressure (PSI)
0.04	2.0	0.082	0.109	3/8 x 2	Straight	106
0.04	2.0	0.082	0.109	Flare	Spreader	106
0.03	1.5	0.079	0.109	3/8 x 2	Straight	86
0.09	4.5	0.147	0.166	1/2 x 4	Straight	106

**Nozzle Configuration
Figure 3**

NOZZLE CALIBRATION

All nozzle configurations were calibrated prior to testing. A certified scale was used to measure the weight of water flowed during a fixed time. The nozzle inlet pressure was set to deliver the flow rate required to provide the desired application rate. Flow rate was calculated by:

$$\text{Flow Rate (gpm)} = \frac{\text{Measured wt. (lbs.)} \times 1 \text{ (min)}}{8.325 \times \text{Flow Time (min)}}$$

Nozzle Calibration Test

Nominal Flow Rate (gpm)	Inlet Pressure (psi)	Run Time (min)	Weight of Discharged Water (lbs.)	Actual Flow Rate (gpm)
2	106	2	34.55	2.08
1.5	86	2	25.55	1.53
4.5	106	40 sec	25.00	4.50

**Nozzle Calibration Test
Figure 4**

FOAM QUALITY TESTING

Foam Quality testing was performed with each foam concentrate. Two samples were taken simultaneously to assure consistent results. Foam Quality testing was performed using the practice outlined in UL-162 and the Appendix of NFPA-11.

FOAM TEST RESULTS

The performance of the foams tested, listed by fuel and in order of testing, is included in Figures 5 through 12. A pass / fail determination is indicated in the far right column. This determination is dependent on two

factors, as stated in UL-162, Section 10, with the information specifically effecting pass / fail shown in the columns labeled “Ext. (min:sec)” and “10 sq.ft. Burnback Test, Area (sq.ft.). As stated in Section 10, the foam shall be “completely extinguished during or at the end of the foam discharge”, or upon removal of the stovepipe shall either “restrict the spread of fire for 5 minutes to an area not larger than 10 sq ft or flow over and close the burning area.

FOAM CONCENTRATE TEST ORDER

The foam concentrate was randomly selected by the Foam Concentrate Committee, there was no particular order to the testing.

TEST SITE CONDITIONS

Ambient air temperature, premix temperature and fuel temperatures were recorded for the purpose of standardized testing. Ambient air temperature was between 68 °F and 77 °F for all tests. Premix temperature was between 74 °F and 77 °F for all tests. Fuel temperature was between 68 °F and 82 °F for all tests.

SUMMARY

The results of the Fire Fighting Foam Test Conducted by THE DOW CHEMICAL COMPANY on September 23 through September 25, 2002 are as follows:

1. Buckeye Platinum 3 x 3 and 3 x 6 outperformed the other foams tested. Also Buckeye is the only foam concentrate on the market today that has been tested and found to be compatible with other similar Foam Concentrates.
2. Chemguard 3 x 6 AR – AFFF did not fail a test, even though it had a walkover in the all of the hydrocarbon test, the foam blanket was destroyed and therefore more foam concentrate would be needed to reapply a new blanket. .
3. The Foam Concentrate Committee, based upon their testing recommends that all Dow foam users should consider Buckeye Foam.

Type III – Toluene

0.04 gpm/sq ft Application Rate

3/8 x 2” Plunge Nozzle

Test	Concentrate	Premix Percentage	Application Rate	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	10 SQ. FT. BURNBACK TEST		Foam Quality		Pass/Fail
								Area (sq. ft.)	Notes	Exp.	1/4 DT (min:sec)	
1	Williams ThunderStorm 1x3	1	0.04	2:20	2:57	5:00	11:00	12.5 @ 19:00	Walkover @ 16:30, Failed Burnback	6.85	2.25	Fail
4	National Foam Universal Plus 3x6	3	0.04	1:37	2:07	5:00	11:00	7.5 @ 19:00	Burning spread to 15% of pan at 19:00	8.26	5.48	Pass
7	Buckeye Platinum 3x6	3	0.04	1:57	2:24	4:30	11:00	4 @ 19:00	Small amount of walkover @ 14:20	7.55	3.41	Pass
10	Chemguard 3x6	3	0.04	1:47	2:47	4:06	11:00	SE	14:29 Complete walkover 15:03 Self Extinguished	9.44	6.17	Pass
13	Chemguard UltraGuard 3x3	3	0.04	1:57	2:33	4:20	11:00	20 @ 14:17	14:17 walkover started, 40% continuous burn, flames over 4 ft high for over 30 seconds, then self extinguished @ 16:37	8.81	10.01	Fail
16	Buckeye Platinum 3x3	3	0.04	1:37	2:13	4:20	11:00	1.5 @ 19:00	Burning restricted to stovepipe burnback area only	8.35	7.19	Pass
19	National Foam Universal Gold 3x3	3	0.04	1:47	2:20	4:20	11:00	2 @ 19:00	Burning restricted to stovepipe burnback area only	8.81	9.13	Pass

Notes: 1. First torch was conducted between 4:05 and 5:00 for all Hydrocarbon test.
 2. Second torch was conducted between 11:00 and 11:50 for all Hydrocarbon test

Figure 5

Type III – Toluene

0.04 gpm/sq ft Application Rate

Spreader Nozzle

Test	Concentrate	Premix	Air	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	Area (sq. ft.)	10 SQ. FT. BURNBACK TEST		Pass/Fail	
									Notes	Foam Quality		
									Exp.	1/4 DT (min:sec)		
2	Williams ThunderStorm 1x3	1	0.04	2:05	3:00	4:30	10:30	18@ 19:00	36% walkover at 4:30, Failed Burnback	6.77	1:25	Fail
5	National Foam Universal Plus 3x6	3	0.04	2:27	3:26	4:30	11:00	11@ 19:00	Burnback area was 22% of total area, Failed Burnback	6.84	4:46	Fail
8	Buckeye Platinum 3x6	3	0.04	1:57	2:36	4:10	11:00	5@ 19:00	Burning restricted to stovepipe burnback area only	13.50	3:41	Pass
11	Chemguard 3x6	3	0.04	1:57	2:23	4:15	11:25	SE	14:30 Walkover Began, 14:40 stovepipe area self extinguished, 14:55 walkover self extinguished	9.93	5:45	Pass
14	Chemguard UltraGuard 3x3	3	0.04	1:57	2:24	4:10	11:00	SE	Self Extinguished at 15:50	8.80	7:16	Pass
17	Buckeye Platinum 3x3	3	0.04	1:39	2:06	4:10	11:00	SE	Self Extinguished at 14:12	15.40	5:16	Pass
20	National Foam Universal Gold 3x3	3	0.04	1:57	2:43	4:20	11:00	5@ 19:00	Burnback area was 10% of total area	8.89	8:55	Pass

Figure 6

Type III – Toluene

0.03 gpm/sq ft Application Rate

3/8” x 2” Plunge Nozzle

Test	Concentrate	Premix	Air	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	Area (sq. ft.)	10 SQ. FT. BURNBACK TEST		Pass/Fail	
									Notes	Exp.		1/4 DT (min:sec)
3	Williams ThunderStorm 1x3	1	0.03	2:10	3:55	5:00	10:00	20@ 17:30	Walkover on second torch, Called test at 17:30, Failed Burnback	7.72	1:44	Fail
6	National Foam Universal Plus 3x6	3	0.03	1:37	2:47	4:30	Failed	None	Flashover on second torch and blanket burned away, Continued to burn over 30 seconds in one place, Called test	9.35	4:46	Fail
9	Buckeye Platinum 3x6	3	0.03	2:05	2:35	4:30	Failed	None	Walkover started near the end of second torch and covered entire pan, Pan stayed lit in one area over 30 seconds, Called test	8:33	4:10	Fail
12	Chemguard 3x6	3	0.03	1:57	3:21	4:20	11:00	SE	14:15 walkover entire pan, 14:20 stovepipe area self extinguished, 14:56 walkover self extinguished	8.76	5:23	Pass
15	Chemguard UltraGuard 3x3	3	0.03	2:09	2:51	4:10	Failed	None	11:03 Walkover and blanket burned off and fire continued to burn in one place over 30 seconds, Test called on second torch	8.79	7:59	Fail
18	Buckeye Platinum 3x3	3	0.03	1:42	2:42	4:20	11:08	7.5@ 19:00	Touched corner of blanket with torch and caused walkover, No walkover during burnback even though blanket was reduced earlier	8.81	5:08	Pass
21	National Foam Universal Gold 3x3	3	0.03	2:09	2:56	4:10	11:00	11@ 19:00	15:00 walkover lasted for 3 seconds, Did not hold during burnback, Failed	9.98	8:09	Fail

Figure 7

Type II – IPA

0.09 gpm/sq ft Application Rate

½” x 4” Nozzle

Test	Concentrate	Premix	Air	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	10 SQ. FT. BURNBACK TEST		Foam Quality		Pass/Fail
								Area (sq. ft.)	Notes	Exp.	1/4 DT (min:sec)	
22	National Foam Universal Gold 3x3	3	0.09	3:03	4:37	7:00	20:40	20@ 22:10	20:00 Blanket started to collapse and broke down, 25% lit off when stovepipe was removed and then area started getting larger	5.21	10:22	Fail
23	Williams ThunderStorm 1x3	3	0.09	1:44	3:16	6:30	19:52	0.5@ 27:00	Burning restricted to stovepipe burnback area only	4.95	10:41	Pass
24	Buckeye Platinum 3x3	3	0.09	1:51	3:29	6:30	19:30	0.5@ 27:00	Burning restricted to stovepipe burnback area only	5.25	8:40	Pass
25	Chemguard UltraGuard 3x3	3	0.09	None	None	None	None	None	No foam blanket, foam broke up less than 6" from lead wall. Test called. Tested w/conductivity meter foam was 3%. Poured foam into small pan of IPA and showed no alcohol resistance.	5.42	10:39	Fail
26	Chemguard 3x6	6	0.09	2:39	4:45	6:10	19:30	SE@ 22:56	Self extinguished at 22:56 in burnback	5.61	16:14	Pass
27	National Foam Universal Plus 3x6	6	0.09	3:15	None	None	None	None	Did not extinguish fire, two corners left burning at 6:00	6.33	18:38	Fail
28	Buckeye Platinum 3x6	6	0.09	1:46	3:06	6:30	19:30	0.3@ 27:00	Burning restricted to stovepipe burnback area only	5.57	10:47	Pass

Note: 1. First torch was conducted between 6:10 and 7:00 on all alcohol test.
 2. Second torch was conducted between 19:30 and 20:40 on all alcohol test.

Figure 8

Buckeye Fire Equipment Co.

3 x 3 Platinum

Test	Concentrate & Nozzle	Premix Rate (%)	Fuel	Appl. Type	Appl. Rate (gpm/sq.ft.)	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	Area (sq.ft.)	10 Sq. Ft. Burnback Test		Foam Quality		Pass/Fail
											Notes	Exp.	1/4 DT (min:sec)		
16	Buckeye Platinum 3x3 / 3/8 x 2" straight	3	Toluene	III	0.04	1:37	2:13	4:20	11:00	1.5	Burning restricted to stovepipe burnback area only	8.35	7:19	Pass	
17	Buckeye Platinum 3x3 / 3/8" x Spreader	3	Toluene	III	0.04	1:39	2:06	4:10	11:00	SE	Self extinguished at 14:12	15:40	5:16	Pass	
18	Buckeye Platinum 3x3 / 3/8 x 2" straight	3	Toluene	III	0.03	1:42	2:42	4:20	11:08	7.5	Touched corner of blanket with torch and caused walkover, No walkover during burnback even though blanket was reduced earlier	8.81	5:08	Pass	
24	Buckeye Platinum 3x3 / 1/2 x 4" straight	3	IPA	II	0.09	1:51	3:29	6:30	19:30	0.5	Burning restricted to stovepipe burnback area only	5.25	8:40	Pass	

Figure 9

Buckeye Fire Equipment Co.

3 x 6 Platinum

Test	Concentrate & Nozzle	Premix Rate (%)	Fuel	Appl. Type	Appl. Rate (gpm/sq.ft.)	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	10 Sq. Ft. Burnback Test		Foam Quality		Pass/Fail
										Area (sq.ft.)	Notes	Exp.	1/4 DT (min:sec)	
7	Buckeye Platinum 3x6 / 3/8 x 2" straight	3	Toluene	III	0.04	1:57	2:24	4:20	11:00	4	Small amount of walkover @ 14:20	7.55	3:41	Pass
8	Buckeye Platinum 3x6 / 3/8 x Spreader	3	Toluene	III	0.04	1:57	2:36	4:10	11:00	5	Burning restricted to stovepipe burnback area only	13.50	3:41	Pass
9	Buckeye Platinum 3x6 / 3/8 x 2" straight	3	Toluene	III	0.03	2:05	2:35	4:30	None	None	Walkover started near the end of first torch and covered entire pan, Pan stayed lit in one area over 30 seconds, Called test	8.33	4:10	Fail
28	Buckeye Platinum 3x6 / 1/2 x 4" straight	6	IPA	II	0.09	1:46	3:06	6:30	19:30	0.3	Burning restricted to stovepipe burnback area only	5.57	10:47	Pass

Figure 9a

Chemguard

3 x 3 UltraGuard

Test	Concentrate & Nozzle	Premix Rate (%)	Fuel	Appl. Type	Appl. Rate (gpm/sq.ft.)	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	10 Sq. Ft. Burnback Test		Foam Quality		
										Area (sq.ft.)	Notes	Exp.	1/4 DT (min:sec)	Pass/Fail
13	Chemguard UltraGuard 3x3 / 3/8 x 2" Straight	3	Toluene	III	0.04	1:57	2:33	4:20	11:00	20@ 14:17	14:17 walkover started, 40% continuous burn for over 30 seconds, then self extinguished @ 16:37	8.81	10:01	Fail
14	Chemguard UltraGuard 3x3 / 3/8 x Spreader	3	Toluene	III	0.04	1:57	2:24	4:10	11:00	SE	Self Extinguished at 15:50	8.80	7:16	Pass
15	Chemguard UltraGuard 3x3 / 3/8 x 2" Straight	3	Toluene	III	0.03	2:09	2:51	4:10	11:00	None	11:03 Walkover, blanket burned off and fire continued to burn in one place over 30 seconds, Test called	8.79	7:59	Fail
25	Chemguard UltraGuard 3x3 / 1/2 x 4" Straight	3	IPA	II	0.09	None	None	None	None	None	No foam blanket, foam broke up less than 6" from lead wall. Test called. Tested w/conductivity meter foam was 3%. Poured foam into small pan of IPA and showed no alcohol resistance.	5.42	10:39	Fail

Figure 10

Chemguard

3 x 6 AR/AFFF

Test	Concentrate & Nozzle	Premix Rate (%)	Fuel	Appl. Type	Appl. Rate (gpm/sq.ft.)	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	Area (sq.ft.)	10 Sq. Ft. Burnback Test		Foam Quality	
											Notes	Exp.	1/4 DT (min:sec)	Pass/Fail
10	Chemguard UltraGuard 3x6 / 3/8 x 2" Straight	3	Toluene	III	0.04	1:47	2:47	4:00	11:00	SE	14:29 Complete walkover 15:03 Self Extinguished	9.44	6:17	Pass
11	Chemguard UltraGuard 3x6 / 3/8 x Spreader	3	Toluene	III	0.04	1:57	2:23	4:15	11:25	SE	14:30 Walkover Began, 14:40 stovepipe area self extinguished, 14:55 walkover self extinguished	9.93	5:45	Pass
12	Chemguard UltraGuard 3x6 / 3/8 x 2" Straight	3	Toluene	III	0.03	1:57	3:21	4:20	11:00	SE	14:15 walkover entire pan, 14:20 stovepipe area self extinguished, 14:56 walkover self extinguished	8.76	5:23	Pass
26	Chemguard UltraGuard 3x6 / 1/2 x 4" Straight	6	IPA	II	0.09	2:39	4:45	6:10	19:30	SE	Self extinguished at 22:56 in burnback	5.61	16:14	Pass

Figure 10a

National Foam

1 x 3 Universal Gold

Test	Concentrate & Nozzle	Premix Rate (%)	Fuel	Appl. Type	Appl. Rate (gpm/sq.ft.)	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	Area (sq.ft.)	10 Sq. Ft. Burnback Test		Foam Quality	
											Notes	Exp.	1/4 DT (min:sec)	Pass/Fail
19	National Foam Universal Gold 3x3 / 3/8 x 2" Straight	3	Toluene	III	0.04	1:47	2:20	4:20	11:00	2	Burning restricted to stovepipe burnback area only	8.81	9:13	Pass
20	National Foam Universal Gold 3x3 / 3/8 x Spreader	3	Toluene	III	0.04	1:57	2:43	4:20	11:00	5	Burnback area was 10% of total area	8.89	8:55	Pass
21	National Foam Universal Gold 3x3 / 3/8 x 2" Straight	3	Toluene	III	0.03	2:09	2:56	4:10	11:00	11	15:00 walkover lasted for 3 seconds, Did not hold during burnback, Failed Burnback	9.98	8:09	Fail
22	National Foam Universal Gold 3x3 / 1/2 x 4" Straight	3	IPA	II	0.09	3:03	4:37	7:00	20:40	20	20:00 Blanket started to collapse and broke down, 25% lit off when stovepipe was removed and then area started getting larger	5.21	10:22	Fail

Figure 11

National Foam

3 x 6 Universal Plus

Test	Concentrate & Nozzle	Premix Rate (%)	Fuel	Appl. Type	Appl. Rate (gpm/sq.ft.)	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	10 Sq. Ft. Burnback Test		Foam Quality		
										Area (sq.ft.)	Notes	Exp.	1/4 DT (min:sec)	Pass/Fail
4	National Foam Universal Plus 3x6 / 3/8 x 2" Straight	3	Toluene	III	0.04	1:37	2:07	5:00	11:00	7.5	Burning spread to 15% of pan at 19:00	8.26	5:48	Pass
5	National Foam Universal Plus 3x6 / 3/8 x Spreader	3	Toluene	III	0.04	2:27	3:26	4:30	11:00	11	Burnback area was 22% of total area, Failed Burnback	6.84	4:46	Fail
6	National Foam Universal Plus 3x6 / 3/8 x 2" Straight	3	Toluene	III	0.03	1:37	2:47	4:30	11:00	None	Flashover on second torch and blanket burned away, Continued to burn over 30 seconds in one place, Called test	9.35	4:46	Fail
27	National Foam Universal Plus 3x6 / 1/2 x 4" Straight	6	IPA	II	0.09	3:15	None	None	None	None	Did not extinguish fire, two corners left burning at 6:00	6.33	18:38	Fail

Figure 11a

Williams Fire and Hazard Control

1 x 3 ThunderStorm

Test	Concentrate & Nozzle	Premix Rate (%)	Fuel	Appl. Type	Appl. Rate (gpm/sq.ft.)	Control (min:sec)	Ext. (min:sec)	First Torch	Second Torch	Area (sq.ft.)	10 Sq. Ft. Burnback Test	Foam Quality		
											Notes	Exp.	1/4 DT (min:sec)	Pass/Fail
1	Williams ThunderStorm 1x3 / 3/8x2" Straight	1	Toluene	III	0.04	2:20	2:57	5:00	11:00	12.5	Walkover @ 16:30	6.85	2:25	Fail
2	Williams ThunderStorm 1x3 / 3/8xSpreader	1	Toluene	III	0.04	2:05	3:00	5:00	10:30	18	35% walkover at 4:30	6.77	1:25	Fail
3	Williams ThunderStorm 1x3 / 3/8x2" Straight	1	Toluene	III	0.03	2:10	3:55	5:00	10:00	20	Flashover on second torch, Called test at 17:30	7.72	1:44	Fail
23	Williams ThunderStorm 1x3 / 1/2x4" Straight	3	IPA	II	0.09	1:44	3:16	6:30	19:52	0.5	Burning restricted to stovepipe burnback area only	4.95	10:41	Pass

Figure 12