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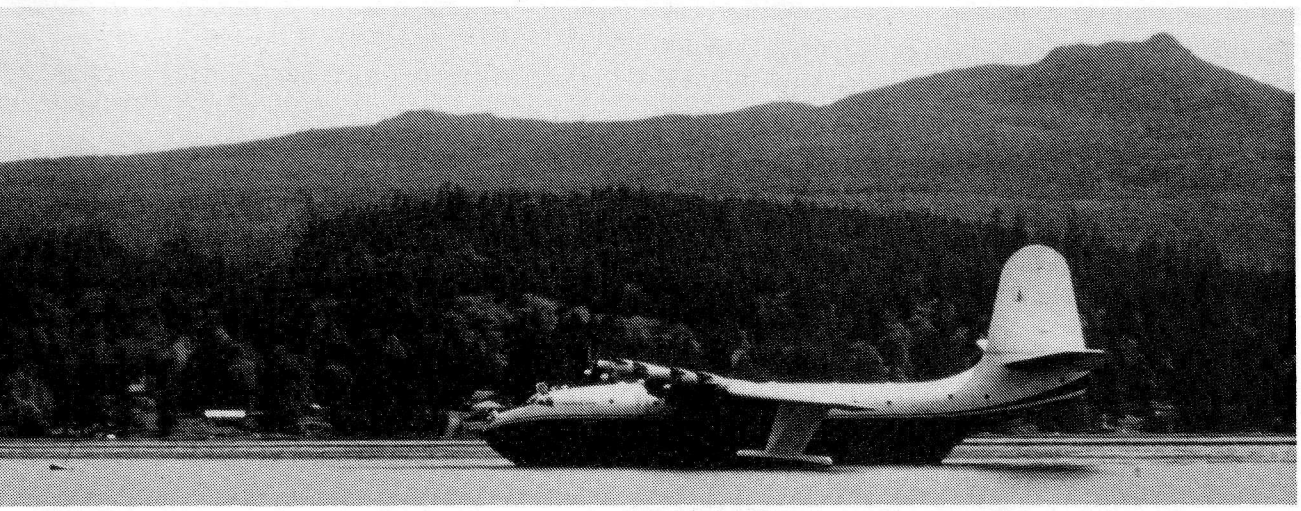
FOAM APPLICATIONS FOR WILDLAND & URBAN FIRE MANAGEMENT

Prepared by: **NWCG Fire Equipment Working Team's Task Group for International/Interagency Foams and Applications Systems**



MARTIN MARS WATER BOMBERS CARRY FOAM

by Tom E. Irving, Forest Industries Flying Tankers (FIFT) Ltd., Port Alberni, B.C., Canada

[NOTE: This is a followup article to Tom's "Waterbombers Use Foam in British Columbia," which appeared in the Vol. 1, No. 3 1988 issue.]

A forest fire is the most deadly kind of enemy. It can attack and grow deep in wilderness woods and on steep mountainsides inaccessible by fire trucks and far from water sources. It can travel with lighting speed, laying waste to acres of trees in no time, scorching the earth so deeply that no plant will dare to grow there; no animal will venture onto it for years. When you're fighting a forest fire, you can almost hear the ticking of the clock.

The cost of losing a battle against fire can be measured in terms of lost wildlife, lost millions of dollars, lost jobs from lost timber, lost years in the regeneration of a natural resource. To a forest products company—like any farmer whose year's crop is wiped out—it can mean all of these.

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Fire can be caused by lighting, a cigarette butt, a friction spark from a logging machine, or even by sunlight magnified through a bit of broken bottle. Convincing people not to litter and to take proper campfire and equipment precautions can reduce the occurrence of forest fires. But lighting can't be persuaded not to strike nor a summer to be wet, so you have to stay ready for the enemy, with the strongest weapons and fastest methods available. One of the best is guerrilla tactic: fight a fire as Nature would, by dropping water on it.

Some tanker aircraft were used for this in the United States by the 1950's: DC-7's able to drop 5,910 litres (1,300 gallons) of water. But these were land-based at specially-equipped airports. British Columbia's (B.C.) coastal forests with their many lakes and inlets seemed more suited to some sort of flying boat.

In 1959, after several disastrous fire seasons in a row, a group of B.C. fire control experts heard that the biggest flying boats ever flown operationally were about to go under the wrecker's hammer. MacMillan Bloedel took the initiative and formed Forest Industries Flying Tankers, which today represents the combined firefighting forces of five major B.C. forest products companies operating on Vancouver Island and the southwest mainland of the Province. The new company then purchased all four of the world's only fleet of mighty Martin Mars aircraft.

The Martin Mars is still the world largest operational flying boat in existence. Even the FIFT pilots admit that their first reaction to the aircraft was one of awe at its enormous size. The tip of the plane's tail is almost 15 metres (50 feet) above ground, about as high as a four or five-story building. The wing span is 61 metres (200 feet), the length of a city block. The two-story interior is as big as a 15-room house. The flight deck alone could be a studio apartment: it's connected to the lower deck by a long circular staircase.

Originally, five of them were produced and used for troop and cargo transporters by the U.S. Navy (USN). In 10 years of service, they established the world flying boat lift record of 30, 992 kilograms (68,327 pounds) and logged some 87,000 accident-free hours. With the proliferation of faster jet aircraft, the propeller-driven Mars were declared obsolete in 1956. But the type was ideally suited to water bombers, so FIFT purchased the four surviving aircraft—ironically, the USN had lost one in a fire—and turned them over to Fairey Aircraft of Canada for modification.

A fiberglassed Douglas-fir plywood tank able to carry a water load of 27,276 litres (6,000 gallons) was installed in the cargo area. (In a later conversion, some of the fuel tanks were replaced with water tanks.) Pickup probes or scoops were designed to withstand the tremendous strain of taking 27.21 tonnes (30 tons) of water into the tanks within 22 seconds, so the plane could load simply by skimming a lake surface at 112.6 kilomtetres an hour (70 mph). A foaming agent is added to the water to provide deep soaking and cooling of the fire fuels, as well as insulating the trees covering 4 acres when dropped from 150 to 200 feet.

To the end of the 1988, the bombers had dropped nearly 163 million litres (36 million gallons) of water on B.C. forest, quelling up to 40 fires each year. During a crisis, the Mars Can be in the air within 10 minutes and can make 6,000 gallon drops every 15 minutes; like dropping more than 27,000 one-litre milk cartons at once! The acreage destroyed by fires each years has been dramatically reduced—or to put it in another way, the flora and fauna preserved have been dramatically increased. A recent study demonstrated that one fire successfully quelled with the bomber's help would have taken a ground crew of 100 firefighters alone at least 5 more days to put out, losing an additional 7,787 cubic decametres (275,000 cu. ft.) of timber if the aircraft had not been available.

FIFT has lost one plane which struck tree tops during a fire in 1960; another was irreparably damaged on the ground during Typhoon Freida in 1962. The antifire flying force operating out of Sproat Lake, near Port Alberni, includes the Hawaii Mars, the Philippine Mars, a small amphibian plane and a helicopter.

EVERYTHING YOU WANTED TO KNOW ABOUT CLASS A FOAM—BUT DIDN'T KNOW WHO TO ASK

by Rod Carringer, General Manager, KK Products, Valparaiso, Indiana

1. Are Class A foams the same products wildlife agencies have been using for years under the name "wildland foam"?

The current generation of U.S. Department of Agriculture approved Class A foaming agents are highly developed versions of foaming agents used for years in helicopter and ground attack applications. NFPA places these foams under their Standard 298, Foam Chemicals for Wildland Control.

2. Are Class A foams the same as wetting agents, like the old "Fire-Out"?

No, Class A foams, though similar to wetting agents, are true foaming concentrates. They may be proportioned and applied in aspirated form to create a thick, white, long•lasting protective blanket or—in unaspirated form—as a water-wetting, penetrating agent. By the choice of concentrate proportion ratio and nozzle model, a wide variety of foam consistencies may be achieved for different applications.

3. Can Class A foams be applied on flammable liquid fires?

No, AFFF and protein-base foams are designed specifically for use on different types of flammable "Class B" fires and vapor suppression, and have received approval from Underwriters Laboratories for these applications. Class A foams, on the other hand, are designed to work on materials of Class A composition that exhibit deep-seated burning characteristics. Class A foam applications have been proven to be extremely effective not only in the suppression of wood, paper, fabric, tire, and plastic fires, but also in exposure protection for wildland control.

4. With renewed environmental awareness of materials we use, can Class A foams be routinely applied?

Definitely. When using Class A foam, demand *only one that has received final approval from* the U.S. Department of Agriculture through environmental testing submitted to their Forest Service Intermountain Fire Science Laboratory in Missoula, MT, and the San Dimas Technology Center in San Dimas, CA. Copies of Interim Requirements for Foam for Wildland Fires, Aircraft, and Ground Application, testing procedures, and documentation of qualified foaming agents are available through the laboratory.

5. Since Class A foams are true foaming concentrates and have received environmental approvals, could we use these foams as training foams for our firefighters instead of the expensive Class B foams we now use?

As long as no live fire training is involved, when mixed in ratios of 1 percent or less, the Class A concentrates offer a very cost-effective, environmentally tested product to familiarize firefighters with foam injection systems, application equipment, and vapor-suppression extinguishment techniques.

6. Our department has no water supply problems. Why would we want to use Class A foam agents on our everyday structural attacks?

Use of Class A foam concentrate allows you one more tool to accomplish your job more safely and quickly. Determined by the National Institute of Standards and Technology, Center for Fire Research in Maryland, and the Bureau of Land Management Foam Projects, Class A foaming agents, by modifying the surface tension of the water, increase the solution's ability to penetrate and suppress fire by 3 to 5 times. Aerated foam will cling to and blanket Class A fuels, insulate exposures from radiant heat, and provide water penetration on hard to reach, deep-seated fires.

7. Is the injection ratio the same for Class A foams as for AFFF and protein-type foams of 3 and 6 percent?

No, mixing ratios with Class A foams may be varied depending on the method of application or specific need, but typically the Class A foam concentrates mix at a rate of 0.3 to 0.6 percent. It is quickly noted that this is about 1/10 the rate at which Class B type foams must be applied. This fact shows that the logistics and economics of applying these concentrates is a very cost and manpower effective tool. Unlike the AFFF and protein-type foams, which have a specific application injection ratio, the Class A foam may be varied depending on the rate desired. (Concentrate injection examples: 0.1 to 0.3

percent as a wetting agent and penetrating agent; 0.4 to 0.6 percent as a moderate foaming agent; and 0.7 to 1.0 percent as a highly foaming agent.)

8. How will we mix this foaming agent for use at our next fire?

There are three commonly used methods of getting the foaming agent into the hoseline for application. Tank or batch mixing is one method that is simple, but tends to be messy and expensive and, because of the foam's base as a detergent, may increase maintenance of pump seals and packings due to the cleansing activity of the foam solution. Common eductors will also work, but have drawbacks as well. Most eductors require high engine pressures, allow only a limited length of hoselay, and cannot proportion much below 1.0 percent, thus causing a great deal of concentrate waste. The third, and by far most efficient, is the new generation of discharge-side foam injection systems. Tested extensively by the Forest Service and the California Department of Forestry and Fire Protection, these injection systems will be addressed in new NFPA standards. Used as portable units or as fixed units mounted directly on trucks, these systems allow unlimited hoselays, variable engine pressures, a wide range of flows and nozzles, and accurate concentrate injection metering from 0.1 to 1.0 percent.

9. Must specialty or aspirating nozzles be used with Class A foams to be effective?

No, standard initial attack nozzles, hoselines, and procedures need not be modified in any way to take advantage of the new properties of water that the foam concentrate provides. Ideally, for specific applications of wildland and exposure protection, an aspirating nozzle is a great asset as it provides expansion ratios up to 12:1 and a much dryer foam blanket. An even better possible choice is a new, unique series of combination fog/foam nozzles. These nozzles offer the nozzleperson the ability to choose the consistency of foam needed, yet provide a wide protective fog pattern for firefighter protection. The California Department of Forestry and Fire Protection has been instrumental in the research and development of nozzles of this type to fill their needs for both structural and wildland firefighting.

10. Should we be concerned about corrosion in tanks, pumps, nozzles, or couplings?

There are many Class A foams and wetting agents on the market today. Though most act as detergents in water systems by cleaning metal and breaking down lubricants, remember to use only Class A concentrates that have received final approval from the USDA Forest Service. These approvals not only address environmental and safety concerns, but determine the acceptable levels of corrosivity. ***The Forest Service approves only those concentrates which have acceptably low corrosion rates on mild steel, brass, and aluminum.***

11. The names CAFS and WEPS are used occasionally in discussion of Class A foaming agents. What do these terms refer to?

CAFS (compressed air foam systems) and WEPS (water expansion pumping systems) are terms used to describe high-energy systems of producing greatly aerated foam. A typical system includes not only a foam injection system and water pumping system, but also an air compressor. When mixed in common ratios of 1 cfm of air to 1 gpm of water, these systems can offer increased reach from lower water flows, and a more "shaving cream" type of consistency foam for extended exposure protection and moisture holding ability on Class A fuels. The Bureau of Land Management, National Interagency Fire Center (NIFC), Boise, ID, continues to do extensive research of CAFS units for both wildland and structural attack applications, and can offer a wealth of information on design and implementation of a CAFS.

12. What are the possible benefits from the regular use of Class A foams?

In the wildland, burning brush and grass not only are more quickly contained, but the overhaul and mop-up time is dramatically reduced. Structurally, faster knockdown times and less water damage are continually being documented by departments all over North America. Tire fires, once potential environmental disasters, can now be contained more easily and more quickly smothered with less hazardous waste-water runoff. Other deep-seated fires dreaded by fire agencies (such as peat moss, dump, and hay/barn fires) are being quickly and

safely brought under control. The use and application of Class A foam is an extremely cost-effective tool to help fire suppression professionals deal with ever-increasing fire loads and related hazards.

Questions? Give us a call at KK Products, 800/537-7553; FAX (219) 464-7155. Or write to 1004 Silhavy Road, Valparaiso, IN 46383.

MINUTES FROM FEWT, FOAM TASK GROUP MEETING
Victoria, British Columbia; May 12-14,1992
[NOTE: Many of these items are updated and/or presented in greater detail elsewhere in this publication.]

Meeting called to order by Doc Smith at 0840 hours.

Doc briefly discussed the agenda and asked the Group for any additional topics. A few topics were interjected for later discussion.

Steve Grimaldi of the British Columbia Forest Service welcomed the group to Victoria. Around the table introductions:

Ron Rochna, USDI Bureau of Land Management, Boise, Idaho

Chuck Ogilvie, Forestry Canada, Edmonton, Alberta

Paul Schlobohm, USDI Bureau of Land Management, Boise, Idaho
Mark Stanford, Texas Forest Service

Bill Weaver, California Dept. of Forestry and Fire Protection

Steve Raybould, SDTDC, USDA Forest Service, San Dimas, California

Paul Hill, SDTDC, USDA Forest Service, San Dimas, California

Steve Grimaldi, British Columbia Forest Service

Kerry Brewer, British Columbia Forest Service

Gordon Ramsey, Forestry Canada, Petawawa, Ontario

Chuck George, IFSL, USDA Forest Service, Missoula, Montana

Doc Smith, Chairman, USDA Forest Service, Kaibab NF, William, Arizona

Bob Joens, Washington Office, USDA Forest Service, Washington, D.C.

Roger Spalding, USDI Fish and Wildlife Service, Boise, Idaho

Lee Young, USDI Bureau of Indian Affairs, Boise, Idaho

International Foam Specification

- History and progress of present draft specification discussed by Chuck George.

- Comments indicate significant concern over the accuracy of the freeze and temperature-range tests.

- Paul Schlobohm will continue working with NFPA until specification is complete.

- USDA Forest Service will be responsible for maintaining this specification.

Rick Clevette Manager, Fire Management, British Columbia Forest Service.

- Welcomed the Group to Victoria.

- Shared some experiences from his recent field trip to Australia regarding foam.

Foam Training Videos (Paul Schlobohm)

- Comment for the *"Foam Proportioners"* video were used to make final changes, should be available June 1, 1992.

- "Aspirating Nozzles" and "CAFS/Tactics" are in progress.

- Film footage associated with the tactics is difficult to obtain, anyone who can

acquire suitable film footage should send it to Paul.

• Paul Schlobohm will send out a list of requirements to define what suitable film footage is.

• All changes should be finalized at the storyboard phase to avoid costly audio/ video changes.

Forward Looking Infra Red Scanner (FLIR)

• Slide and video presentation of FLIR by Chuck Ogilvie.

• Four of the eight tanker groups operating in the Northern Division are equipped with FLIR; the remainder should be so equipped in 1993.

• The Air Attack Officers claim FLIR is a very valuable tool which allows them to accurately access the drops.

Helicopter Safety Video

• Presented by Steve Grimaldi.

• Video produced by the British Columbia Forest Service; for information on purchasing copies contact Steve.

Foam Toxicity

• At present it is not a problem, but problems are anticipated by some Group members.

• Some formulations contain chemicals classified as hazardous.

• Discussion on how health and environmental effects of foam are being dealt with and what we may expect in the future.

Foam Information Retrieval System

• Chuck George is building a library and bibliography; please send copies of pamphlets and publications.

"Foam Vs. Fire" Publication

• Draft is ready to print; the Group agreed to the following:

• Change guidelines for Class A Foam to Class A Foam for Wildland Fire; keep the fire triangle as the cover logo; change foam terms from Fluid, Dripping and Dry to Wet, Fluid and Dry; format will be 8-1/2 x 11, saddle•stitched, with three-hole punch.

"Foam Applications for Wildland & Urban Fire Management" Publication

• Two issues per year; one issue per year will be produced by FEWT.

• CDF and CCFFM have agreed to alternately produce the second issue per year.

• Continue printing the minutes from the Foam Task Group Meeting in this publication

• Steve Raybould urges members to produce articles for the publication.

Field Trips

Duncan Forest District

• Pat Hayes, Resource Officer-Protection, welcomed the Group to Duncan; he described the climate, fuels, topography etc. in the Duncan Fire District.

• Described district fire operations, and how firefighting foam is used; demonstration of district CAFS unit.

Sproat Lake—Forest Industries Flying Tankers (FIFT)

• Tom Irving of FIFT welcomed the Group; he described FIFT operations.

• Tour of a Martin Mars water bomber with foam system; demo drop of water.

"Foam Vs. Fire Primer" Publication

• Discussion of first draft resulted in the following decisions:

• Format will be 8-1/2 x 11 as per companion Class A publication; change foam texture descriptions to "Wet," "Fluid," and "Dry;" no change to layout; no change to writing style (informal); use descriptive adjectives rather than hard

numbers; use fractions for mix ratios rather than decimals; drop the term "NAFS" and use aspirating nozzles; change electronically controlled system to direct injection; add CCFFM on second page under "prepared by;" the term "vapor suppression" should be defined in the glossary; add more graphics where possible (Paul Schlobohm); correct Material Safety Data Sheet (MSDS); "Primer" should make reference to "Foam vs. Fire" more often; indirect attack should indicate the type of foam to use; copies required initially is 5,000 of each; Paul Hill suggests that they be different colors for easy identification.

Next Meeting

- Location—San Dimas, California; Dates—December 3-5, 1992 (Thursday-Saturday); field trip on Saturday; Host—Steve Raybould, USDA Forest Service, Technology and Development Center.

Helicopter Workshop

- May 28 & 29, 1992, at Salt Lake City, Utah.

- Open invitation; please contact Chuck George if you are planning to attend; Chuck George will report on the workshop and write an article for this publication.

Accompanying Documents to Foam Videos

- Purpose is to help explain the information in the videos.

- Paul Schlobohm & Ron Rochna will write outline for the next meeting.

Foam Qualified Products List (QPL)

- Chuck George will include in next "Foam Applications" issue.

- Tests performed by Chuck George indicate that dual exposure of retardant/foam will cause corrosion to tankers; discussion on why this occurs.

- Preventative measure should be developed, suggestions are protective coatings, alternate materials, flushing.

Long-Term Foam

- Ron Rochna has done trials with Terra Foam (reformulated).

- Objective of the long-term foam is to hold water for 24 hours.

- At 1% formulation the foam has held water for up to 5 days.

- More trials are required to determine its operational effectiveness; results will be presented in this publication.

Proportioner Study Update

- Ron Rochna has tested 11 foam proportioners.

- Greatest concern is the dangers from the compounding pressure created on two models.

- The "around the pump" produced by Mulligan and Associates builds compound pressure over 500 psi and burst the bypass line.

- The Co-son Blizzard Wizard blew the foot valve.

- Most manual proportioners were very inaccurate.

- Trial focused on automatics, none were accurate over all flow conditions.

- The Flow Mix 500 has had the best results.

- A report is to be completed by the end of the fiscal year.

Aviation

- Need to know direction, training, tools.

- 3rd edition of "Foam vs. Fire" will focus on aviation.

- Group has identified a need to form an aviation subgroup.

- Discussion on who will form the new subgroup and what their mandate should be thought expressed that

should involve two aviation-type persons—maybe from the Helicopter Workshop.

Budget Outlook

1993 $40,000 for foam characteristics

1994 $20,000 for videos
$7,000 for this publication
$6,000 State travel
$33,000 Total

1995 $10,000 for video
$10,000 for "Foam vs. Fire"
$6,000 State travel
$26,000 Total

FOUR NEW REPORTS ON FOAM, FOAM USE, AND FOAM EQUIPMENT

by Dan W. McKenzie, USDA Forest Service, San Dimas, California

Four new reports are now available on foam, foam use, and foam equipment; they are:

- *Foam vs Fire—Primer*
- *Foam vs Fire—Class A Foam for Wildland Fires*
- *Proportioners for Use in Wildland Fire Applications*
- *Compressed Air Foam Systems for Use in Wildland Fire Applications*

Foam vs Fire—Primer is available from the National Interagency Fire Center, Boise, ID: ATTN: Supply, for $0.44 per copy: order No. NFES 2270.

Foam vs Fire—Class A Foam for Wildland Fires is also available from the National Interagency Fire Center, Boise, ID: ATTN: Supply, for $0.33 per copy; order No. NFES 2246.

Proportioners for the Use in Wildland Fire Applications and Compressed Air Foam Systems for the Use in Wildland Fire Applications are available from the USDA Forest Service, Technology and Development Center, 444 E. Bonita Ave., San Dimas, CA 91773-3198; (909) 599-1267; FAX (909) 592-2309.

Foam vs Fire—Primer is a 9-page publication; the first in a series on Class A foam. It covers the basics of using Class A foams and discusses their adaptability to present application equipment.

Foam vs Fire—Class A Foam for Wildland Fires is the second in a series of three publications on the use of Class A foam. The Foam Task Group, Fire Equipment Working Team of the National Wildfire Coordinating Group (NWCG), in cooperation with the Canadian Committee on Forest Fire Management and Forest Fire Equipment Working Group, sponsored preparation and publishing of this 28-page report. It contains results of work accomplished by units within many government agencies in both the United States and Canada. The report presents discussions of the background of Class A foams, the characteristics and properties of foam, foam and personal safety and the environment, foam proportioners (manual and automatic), foam nozzles (conventional and aspirating), compressed air foam systems (CAFS), foam application, initial attack, backpack pumps, etc.

Proportioners for Use in Wildland Fire Applications (No. 9251 1204-SDTDC) covers methods of proportioning foam concentrate into water to make foam solution that can be used with standard nozzles, aspirating nozzles, or in a compressed air foam system (CAFS) for use in fighting wildland fires. There are two basic types of foam concentrate proportioning systems:

1. Manually regulated proportioning systems.
2. Automatic regulating proportioning systems.

Manually regulated proportioning systems include:

Batch mixing
Suction-side proportioner
In-line eductor
Bypass eductor
Around-the-pump proportioner
Direct injection manually regulated.

Automatic regulating proportioning systems include:

Balanced pressure venturi systems
Pump systems
Bladder tank systems
Water-motor meter proportioner
Direct injection automatic regulating proportioner.

All manually regulated proportioning systems have significant disadvantages when used in wildland fire applications. In general, manually regulated proportioning systems do have one desirable advantage—low initial cost. However, manually regulated proportioning systems (other than batch mixing) have the potential of using much more foam concentrate than necessary, negating their low-cost advantage. In reality, they could become the most costly proportioning system. Thus, manually regulated proportioning systems should be avoided or, when used, utilized with caution in wildfire suppression operations.

Because of the many shortcomings of the manually regulated proportioning systems, automatic regulating proportioning systems have been designed to reduce these limitations. Specifically, the automatic regulating proportioning systems are designed to remain proportional over a wide range of flows. They are not affected by changes in engine pressure, changes in hose length and size, or changes in nozzle adjustments, size, or elevation and generally inject the foam concentrate into the discharge side of the pump.

The use of automatic regulating proportioning systems injection into the discharge side of the pump should be encouraged. To accomplish this, automatic regulating proportioning systems should be formally tested and test results appropriately disseminated.

Compressed Air Foam Systems for Use in Wildland Fire Applications (No. 9251 1203-SDTDC) covers equipment arrangements for compressed air foam systems (CAFS) for use in fighting wildland fires. Guidelines which should be used when acquiring CAFS units are:

- With the CAFS in place, there should be no deterioration of the water handling capability or reliability of the engine.

- With CAFS, the engine should be able to make a moving attack.

- Operation of the engine equipped with CAFS should be easy and simple.

There are three general arrangements of CAFS equipment now commonly being use:

1. Fire truck engine driving a centrifugal water pump and an air compressor through a load sense hydraulic drive system

2. Single auxiliary engine mechanically driving both the centrifugal water pump and the air compressor

3. Fire truck engine driving a centrifugal water pump and an air compressor through a mechanical drive.

The fire truck engine driving the CAFS equipment through a load sense hydraulic drive system and an auxiliary engine mechanically driving the CAFS equipment will allow the fire truck to meet all three guidelines. The fire truck engine driving the CAFS equipment mechanically (by transmission pto's, split-shaft pto's and/or front engine drives) will allow the equipment to meet the first and third, but not the second, guideline (moving back). If moving attack is not required or not important, mechanically driving the water pump and air compressor by the fire truck engine is a very good way to drive the CAFS equipment and is mechanically equivalent to a single auxiliary engine CAFS drive system. A moving attack cannot be made with CAFS when the CAFS equipment is mechanically driven by the fire truck engine.

Each of the components of a CAFS (centrifugal water pump, air compressor, foam concentrate proportioning system, drive system, and control and instrument system) must be sized, driven, and controlled to produce a well-operating and reliable CAFS unit. In recent years, as the use

of CAFS has progressed, several good "rules of thumb" have been identified. They are:

1. A centrifugal pump should be used in a CAFS unit with water pressure controlled by pump rpm and, if possible, stand alone in operation.

2. Air compressor used in CAFS units should be modulating-type with pressure adjustment at the panel and, if possible, stand alone in operation.

3. As a general rule and as a place to start, the centrifugal pump selected should have a rating in gpm of at least twice the air compressor rating in cfm.

4. In the operation of a CAFS unit, static water pressure and static air pressure should be equal, and air pressure automatically controlled by water pressure.

5. Water flow and air flow should be adjustable and controlled by variable orifices (ball valves) or other equal controls.

6. At a minimum; water, air, and mix point pressure, plus water air flows should be available to the operator. Also desirable is an indication that foam concentrate is flowing.

7. An automatic regulating proportioning system injecting into the discharge side of the pump should be used.

8. Open CAFS nozzles very slowly. If they are opened quickly, the nozzle reaction can be quite intense for a short time.

By following the guidelines and "rules-of-thumb" listed in this report on the design, manufacture, and operation of CAFS units, satisfactory results are currently being obtained. When procuring CAFS equipment, a person knowledgeable in CAFS equipment should be used in the development of the specifications and should assist in contract administration and inspection. Crew leaders and crew members should also receive special training in CAFS operation.

FOAM TRAINING PROGRAM IN NORTHEASTERN AREA

by E. Sven Carlson, Northeastern Area Foam Cadre Task Group Leader

Northeastern Area Foam Cadre Mission Statement

It is the mission of the Northeastern Area Foam Cadre to provide high quality level of Class A foam training and technical assistance. These services are provided through a highly trained and adaptable force of personnel who utilize modern educational and technical knowledge.

Accomplishments

The 20 northeastern States have taken an aggressive approach to Class A Foam training in the following ways:

June 1992: Development of the Northeastern Area Foam Cadre, with representatives from New Jersey, Maryland, Ohio, Minnesota, and New Hampshire.

July 1992: A 3-hour program for the Northeastern Area State Foresters at their annual meeting in New Hampshire with lecture and table-top demonstrations on" What is Class A Foam ". Outside presentation with helicopter drops, manual and automatic proportioners, low, medium and high expansion foams, and working with a compressed air foam system.

June through December 1992: Development of mission statement, three levels of Class A Foam Workshops, and instructor qualifications (see below).

September & October 1992: The Northeastern Compact (New England, New York, Quebec, and New Brunswick) sponsored five 16-hour Operational Level Classes in Connecticut, Vermont, and three in New York. A total of 205 personnel where trained at the five locations. It also provided the Northeastern Area Foam Cadre an opportunity to train its primary instructions.

January 1993: The 2- to 4-hour Awareness Level Program was completed and distributed to qualified instructors.

FY 1993: Program updating and continued development of the instructor cadre. Operation

Level classes planned for Minnesota in April, and possibility of Mid-Atlantic Compact.

Class A Foam Training Programs
Class A foam training programs are set up in three levels:

1. Awareness Level, which is designed as an introduction into properties of water and how Class A foam makes water work for us through lecture and table-top demonstrations, foam generating and delivering systems, and a outdoor demonstration. It is designed to cover 2 to 4 hours of instruction.

2. Operation Level, which is designed for the students to understand the properties of water and Class A foam, then to familiarize students with lecture and hands-on operation of foam generating and delivery systems—with an introduction into compressed air foam systems. This class will get more involved with the tactics and strategies with the use of Class A foam. This program covers 12 to 16 hours.

3. Technician Level, which is designed to give the student an even better understanding of the overall concepts of Class A foam—with extended lecture and hands-on use of all the foam generating and delivery systems, including an in-depth look into the use of compressed air foam systems. This program covers 24 hours.

These programs were developed as workshops for the students to integrate their new-found knowledge in their everyday work lives, and be more familiar with the abilities of Class A foam and also with the abilities and limitations of foam generating and delivery systems. It is also a basic level of training which students need if they wish to develop into a Class A foam instructor.

I would like to thank Ron Rochna and Paul Schlobohm at BLM-NIFC for their continued effort in developing Class A foam training material and information. The basics for these training levels where all designed after the 3-day BLM Class A foam training program.

Instructor Qualification
The following are the instructor qualifications to teach Class A foam training programs.

TRAINING PROGRAM	INSTRUCTOR QUALIFICATIONS
Awareness Level	Trained to Operation Level (16 hr) and teamteach two classes with primary instructor.
Operation Level	Trained to Technician (24 hr) or Operation (16 hr) Level and team teach 3 to 4 classes with primary instructor.
Technician Level	Trained to Technician Level (24 hr) and possess a great desire to learn as well as devote time and energy to learning Class A foam technology.

CLASS A FOAM IS ON THE SHELF
by Paul Schlobohm, USDI Bureau of Land Management, Boise, Idaho

If you have a need for practical information, equipment, or training in Class A foam use, you may be able to find it on the shelf of your nearest fire cache. A videotape series introduces the basic principles of foam chemicals, explains the function of mixing and foam generating equipment, and demonstrates suppressive and protective applications. Videotapes and publications listed here are now available through the National Wildfire Coordinating Group (NWCG) Publications Management System (PMS).

Ordering
Copies of each of these items may be ordered from the National Interagency Fire Center (NIFC). To order, mail or fax a purchase order or requisition to:

National Interagency Fire Center
ATTN: Supply
3905 Vista Avenue
Boise, Idaho 83705
FAX 208-389-2573

Orders must be from agencies or organizations, not private individuals. Use the "NFES" number for the item(s) you are ordering. Do not send money, checks, or money orders with the order. Phone orders are not accepted. You will be billed the cost of the item(s) after the items are sent. Orders from other than Federal wildland fire agencies or State land protection agencies will receive an 18% surcharge on the bill. Transportation charge, other than mail, will also appear on the bill. Questions regarding ordering procedures can be addressed to the NIFC Supply Office, (208) 389-2542. Questions regarding billing procedures can be addressed to NIFC Finance Office, 208-389-2533. The estimated price (when exact price not given) for each videotape is $3.00; each user guide, $0.75.

Video Tapes

Introduction To Class A Foam, a brief introduction to Class A foam technology discussing chemistry, generating equipment, and examples of application. 1989, 13:00, VHS only, NFES #2073, $2.34.

The Properties Of Foam, explains how Class A foam enhances the abilities of water to extinguish fire and to prevent fuel ignition. Basic foam concepts including drain time, expansion, and foam type are presented. 1992, 15:00, VHS only, NFES #2219, $2.36.

Class A Foam Proportioners, explains how common mixing systems—including eductors and direct injection devices—add a measured amount of foam concentrate into a known volume of water. Advantages and disadvantages are also discussed. 1992, 23:10, VHS only, NFES #2245, $2.41.

Aspirating Nozzles, explains how aspirating nozzles work and introduces the variety of nozzles available. 1992, 10:13, VHS only, NFES #2272.

Videotapes that will be available in the near future include:

Compressed Air Foam Systems, explains the basics of compressed air foam systems; discusses options for water pumps, air compressors, and power sources; demonstrates safe operation. Available Spring 1993.

Tactics I: Indirect Attack, discusses the primary objective of raising fuel moisture; demonstrates applications for protection of vegetation and structures, and for constructing line from which to burn. Available Fall 1993.

Tactics II: Direct Attack, discusses the primary objective of achieving the critical flow rate; demonstrates applications of suppression—including flame knockdown, extinguishment, and mop-up. Available Fall 1993.

Publications

A basic user guide series presents introductory and comprehensive explanations of foam properties, equipment, ground applications, and aerial applications. User guides that are now available through the Publications Management System are:

Foam Vs Fire, Class A Foam For Wildland Fires. This 28-page publication explains how to get the most firefighting punch from water by converting water to class A foam. Discusses how and why foam works. Explains drain time, expansion ratio, foam type, proportioning, aspirating nozzles, and compressed air foam systems. Also discusses application for direct attack, indirect attack, mop-up, structure protection, and safety considerations. NFES #2246, $0.33.

Foam Vs Fire, Primer. This 9-page publication covers the basics of using Class A foams and discusses their adaptability to present application equipment. NFES #2270, $0.44.

A third user guide will address aerial delivery of class A foam including foam properties, and equipment for helicopter and fixed•wing applications. This publication is under development.

Equipment

Foam concentrate, proportioners, and aspirating nozzles are available through Regional fire caches. To order foam concentrate:

1) NFES #3400 concentrate, liquid/dry 4 oz. For use with backpack pump NFES #1149. $1.25 per bottle R3, R6, NIFC.

2) NFES #1554 Chemonics Fire-Trol, 5 gal/pail, R1, R2, R3, R9, NIFC.

3) NFES #1145 Monsanto Phos-Chek WD 861, 5 gal/pail, R1, R3, R6, R8, NIFC.

4) NFES #1360 Silv-Ex, 5 gal/pail, R1, R6, R9, NIFC.

5) NFES #0360 Silv-Ex, 30 gal/drum, NIFC.

To order proportioner kits and aspirating nozzles:

6) NFES #0626 Foam Proportioner Kit, R1, R6, R9.

7) NFES #0627 Fire Foam Nozzle (Aspirated) 3/4-in NH, 8 gpm, plastic, $10.24 ea., R3, R6, R9, NIFC.

8) NFES #0628 Fire Foam Nozzle (Aspirated) 1-1/2-in NH, 16 gpm, plastic, $30.19 ea., R1, R3, R9, NIFC.

9) NFES #0629 Fire Foam Nozzle (Aspirated) 1-1/2-in NH, 32 gpm, plastic, $36.07 ea., R3, R6, NIFC.

Training

The Bureau of Land Management is presenting a workshop on class A foam entitled "Class A foams, Generating Systems, and Tactics." The workshop demonstrates the properties of water and foam for fire suppression, examines proportioning and foam generating devices, and describes applications and tactics. Case studies from actual fires are used to suggest tactics for direct and indirect attack, mop-up/overhaul, and structure and resource protection. Instruction is a combination of lecture, hands on demonstration, and live fire exercises.

The course is scheduled as follows:

April 20-22, 1993
July 13-15, 1993
October 19-21, 1993

All sessions will be held at the National Interagency Fire Center, Boise, Idaho. To place nominations please contact Ron Rochna, course coordinator, at (208) 389-2432, or write to: National Interagency Fire Center, 3905 Vista Avenue, Boise, ID 83705.

A 16-hour Class A foam S-course is also under development for training. The course is expected to combine material from the videos, publications, and workshop exercises to enable students to successfully use foam for fire management.

CLASS A FOAM EXTINGUISHES COAL FIRE

by Russ Cox, Decker Coal Co., Decker, Montana

On Wednesday, Oct. 21, 1992, the Decker Coal Co. had a large coal fire in a highwall in their exterior pit. The fire was not accessible by any means except by boat, because of the large amount of water that had collected at the base of the fire. The area covered by water was approximately 300-ft long by 100-ft wide and had a depth of 0-20 ft. The fire located in a vertical highwall was 150-ft long by 60-ft high.

The normal procedure for extinguishing a coal fire at the mine is to bury the fire with dirt or dig the fire out and then burying it. The cost associated with burying a fire includes workhours plus dozer, backhoe, or the use of other equipment used in mining. At any rate, this procedure for extinguishing coal fires is very costly and time consuming.

This particular fire at Decker Coal normally would require a considerable amount of time to extinguish. It would have taken approximately 30 hr of dozer time to get enough dirt at the base of the fire to allow a backhoe to sit and be able to reach up and dig the fire out of the highwall, which would take approximately another 4 hr. Dozer time costs $65 per hr; backhoe time costs $90 per hr. Because of the amount of smoke being given off by this fire, extinguishing it as quickly as possible was the main concern.

Decker Coal's safety supervisor, Don Reynolds, and I talked about using Class A foam to put out coal fires. Because of the

amount of smoke being given off by this fire, we decided this was a good time to try foam. With the cooperation of Big Horn Fire Department, Big Horn, Wyoming, a foam proportioner and 20 gall of Class A (Silv-Ex) foam concentrate was made available for use. By utilizing Decker Coals' firefighting equipment, along with the foam proportioner and foam concentrate, we set up across from the fire. The Flow-Mix, Model 500, by Robwen Inc. was used

With the temperature reaching up in the 80's and an adequate water supply, we set up the pump and laid out 300 ft of 1-1/2-in hose. Connecting the proportioner differential valve to the pump and the hoses to the proportioner and discharge line, we began to spray the fire with foam using a straight-bore nozzle. The pump was running at 150 psi, with the proportioner set at 0.5 percent. After using 5 gal of foam concentrate, we stopped because we were not close enough to do an adequate job. To get closer, a boat was necessary. With the assistance of the Decker Coal Mine Rescue Team, a boat was used to get to the base of the fire. The entire fire area, once again, was covered with 5 gal of 0.5 percent concentrate foam mixed with 1,000 gal of water. The fire was extinguished in less than 4 hr, from setup to putting equipment away.

In extinguishing this fire, 10 gal of Silv-Ex Class A foam concentrate was used, costing $140. A total of 4 workhours was necessary to fight this fire, costing $100 In comparison, the normal procedure used at Decker Coal to extinguish this coal fire, an estimated cost of $2,310. The use of Class A foam is considerably less expensive.

FIELD SURVEY OF HELICOPTER FOAM INJECTION SYSTEMS

by Melinda R. Seevers, B.S.M.E
and John A. Seevers, Ph.D., P.E.,
Phoenix Design Engineering

Introduction

The use of helicopter on-board foam injection systems has increased dramatically in recent fire seasons. To document the effectiveness of field equipment and discover areas for improvements, the San Dimas Technology and Development Center (SDTDC) conducted a survey of operators' experience with the helicopter foam injection systems. (Be sure to see John Seever's article "Foam Dispensing Equipment Requirements for Contract Helicopters" in Vol. 3, No. 1 1990.) Also, be aware that foam residue might be a problem when dipping from rivers or lakes because of threatened and endangered species—especially if the system fails at that point.

Helicopter Foam Injection Systems

The three units most widely used by survey respondents were the various systems from Chemonics Industries and the California Department of Forestry and Fire Protection (CDF), plus the SEI Industries "Sacksafoam." A brief description of each of these can be found in Project Report 9257 1201-SDTDC. In the responses, Chemonics systems (various models, U.S. and Canadian made) were cited 26 times, CDF systems (three different models) 13 times, and SEI systems 8 times. In addition to the three primary systems mentioned, many other systems exist in the field.

Helicopters used with the various systems included the Bell 205, 206-L3 & -B3, 212, and 412, Hughes 500, Sikorski S-58T, Aerospatiale SA315B Lama and SA316B Aloutte III, and Boeing Vertol BV-107-II.

Foam concentrates used by the respondents are listed in the table below in order of frequency cited in the survey. Seventeen respondents listed the Chemonics concentrate among the foams they used, making it the most frequent.

Type of foam	Number of respondents using foam type
Chemonics Fire-Trol Fire Foam	17
Ansul Silv-Ex	12
Monsanto Phos-Chek WD 881	5
Monsanto Phos-Chek WD 861	3
Texas Correctional Institute Fire Quench	1

Buckets vs Fixed Tanks
When asked if they use buckets, 93 percent of the respondents said that they use buckets for their firefighting operations; 5 percent have not used buckets. Due to the widespread use of buckets, the majority of the foam injection systems are used in conjunction with buckets. Some foam injection systems are employed with fixed tanks. Although not directly related to the subject of helicopter foam injection systems, the respondent were asked for their thoughts regarding the use of fixed tanks versus buckets.

The breakdown of responses was that 38 percent preferred buckets, 17 percent preferred tanks, 26 percent had not preference. Preferences depend upon forest fuel, topography, ground crews and equipment available, water availability, and other helicopter uses (such as sling load work). A primary reason cited for preferring buckets was the versatility offered by buckets; this is particularly attractive to operators who are doing sling work. Those who preferred fixed tanks were typically located in more metropolitan areas with limited water access and plentiful support equipment.

Foam Concentrate Storage
Of those surveyed, 64 percent stated that they preferred the foam concentrate storage container to be located outside of the helicopter; 17 percent preferred it to be located on board the helicopter. Of those who preferred the storage tank exterior to the aircraft, 37 percent specifically explained that this was due to concerns over possible spillage and resulting corrosion.

Systems Problems—42.5 percent of the respondents stated that they had encountered some problems with the systems they had used. Of the problems 5 percent were operational in nature, the remaining 37.5 percent entailed either a mechanical or electrical component malfunction.

Foam Mixing—Everyone indicated that sufficient mixing of the foam concentrate and water occurred from either the drop alone and/or from the flight vibration, if foam was injected to the water at least a couple minutes before the drop.

Concentrate Carrying Capacity and Number of Drops—The general response was that refueling is usually necessary before the foam concentrate supply is completely used.

Concentrate Tank-Filling Methods—The majority of the respondents who explained how they presently refill the concentrate tank stated that they simply pour to refill (usually using a funnel). The next most common method was to change out the empty concentrate container, stored inside the helicopter, and replace it with a full container. Others use a pump system. Although some users are satisfied with their current method of refilling, many stated that spillage does occur. Several of the respondents admitted that the present method is less than desirable but know of no better way. One respondent summed up the most important consideration by simply responding, "Neatly!"

General Comments
The responses were very positive toward the use of helicopter foam injection systems. However, three points were brought up repeatedly that merit concern and consideration. Many commended that the potential for corrosion of helicopter components and equipment due to exposure to foam was significant concern. Others stated that foam injection systems need to meet established standards and be inspected. And finally, many pointed out there is a need for guidelines regarding the use of foam injection systems.

Of the many positive comments, this one was particularly notable: "I'm a strong believer in foam. It really helps when you are on the ground. If we're going to use helicopter time to drop water on a fire, we might as well invest in a good foam unit and do the best job we can for our money. Any person that has worked on a fire with foam would rather see foam that just plain water."

UPDATE—APPROVED, AVAILABLE FIRE CHEMICALS

by Steve Raybould, USDA Forest Service, San Dimas, California

A wildland chemical qualification, testing, and approval program is carried out for the agency by its National Wildfire Suppression Technology (NWST) Group, Missoula, Montana, and the Technology and Development Center, San Dimas, California (SDTDC). The program covers all fire chemicals—including long- and short-term retardants, as well as foam concentrates.

Table 1.

FIRE CHEMICALS

(Qualified or Approved and commercially available)

Chemical	Mix Ratio	Status	Qualified/Approved Applications			
			Fixed-wing Airtanker	Fixed-Tank Helicopter	Helicopter Bucket	Ground Engine
WILDLAND FIRE FOAM (Administrative approval using Interim Requirements for Wildland Fire Foam)						
Phos-Chek WD 861	.1-1%	Adm. Approval			•	•
Ansul Silv-Ex	.1-1%	Adm. Approval			•	•
Fire-Trol FireFoam 103	.1-1%	Adm. Approval[2]		°	•	•
Phos-Chek WD 881	.1-1%	Adm. Approval[2]		°	•	•
Fire-Trol FireFoam 104	.1-1%	Adm. Approval			•	•
Angus For Expan S	.1-1%	Adm. Approval			•	•
Pyrocap B-136	.1-1%	Adm. Approval			•	•

[1] Administrative approval given when interim requirements are met.
- • Administratively approved
- ° Temporary administrative approval

[2] Temporary administrative approval for use from fixed-tank helicopters until a new or modified formulation meets magnesium corrosion requirements.

Table 1 is the very latest Qualified Product List (QPL) of approved wildland fire foams and their status. (This replaces table 1 on p. 9, Vol. 3, No. 1 of Foam Applications ... .)

IMPORTANT SAFETY NOTE

by Paul Schlobohm, USDI Bureau of Land Management, NIFC

The use of the **Mulligan APM-20**, around-the-pump foam concentrate proportioning system, poses a threat to personal safety. It is recommended that this device ***not*** be used in the following manner:

1. Engines plumbed with a check valve installed between the water tank and water pump suction, and operating with the relief valve setting at 300 psi or greater.

2. Water pumps having a foot or check valve, but no pressure relief on the discharge side of the pump.

When the device is used as above and the nozzle is shut off, discharge pressure will build up by compounding. During testing we had a discharge pressure go from 150 psi to over 500 psi within 4 seconds. Pressure reached 350 psi on the SUCTION SIDE of the pump. This resulted in (1) the pressure lines of the APM-20 breaking away from the fittings, and (2) the foot seat blowing open on the draft hose. The loose pressure lines and the highly pressurized foam solution escaping from the lines can cause serious injury to the operator.

If you have any questions about around-the-pump proportioners call the BLM Branch of Technical Support, Foam Section (208) 389-2432, or read "Proportioners," the Foam Section's operational evaluation of this and other concentrate metering devices.

OBTAINING COPIES OF THIS PUBLICATION SERIES

Are you reading your own copy of this document, or a hand-me-down copy? Do you wish to obtain back issues and get on the mailing list for future issues? Do you even know who put this together and what the objectives are? Read on!

The National Wildfire Coordinating Group (NWCG)—which is sponsored by the United States Departments of Agriculture and Interior and the National Association of State Foresters—in cooperation with the Petawawa National Forestry Institute of the Canadian Forestry Service, has been issuing documents jam-packed with information on *"Foam Applications for Wildland & Urban Fire Management."*

This publication series contains articles presenting background, historical, health and safety, use, equipment, and suggested reading data on foams and applications systems. The series of publications represents a complete compendium on everything you ever wanted to know about foam but perhaps didn't know enough about to ask.

Authors from numerous agencies, worldwide, have been contributing to the issues in the series. Publications group personnel at the USDA Forest Service San Dimas Technology and Development Center (SDTDC) have been taking the original inputs and performing editorial and graphic functions to produce each issue in the series. So far, the following have been published: Vol. 1, No's 1 to 3 (1988); Vol. 2, No's 1 to 3 (1989); Vol. 3, No's 1 and 2 (1990); Vol. 4, No 1 (1991) and 2 (1992); and now this present issue: Vol. 5, No. 1 (1993).

For your free copies, contact:

Program Leader, Fire
USDA Forest Service
Technology & Development Center
444 East Bonita Avenue
San Dimas, CA 91773-3198
909/599-1267; FAX 592-2309
DG, SDTDC: W07A

FOAM TASK GROUP QUESTIONNAIRE

The Foam Task Force Group needs information for future planning and direction. If you use foam, please fill out the attached survey form and return it to the Group:

H.B. "Doc" Smith, Chairperson
800 South 6th Street
Williams, AZ 86046

NWCG (FEWT)
FOAM TASK GROUP QUESTIONNAIRE

Date _____
Agency _____
Position _____
Specific Location
(District/Station;City/State) _____
_____
_____
_____

WHAT IS YOUR PRESENT FOAM USE?:

Type of foam _____
Hardware:
Ground type _____
Air type _____

HOW ARE YOU USING FOAM?:

Ground:
Initial Attack _____
Mop-Up _____
Prescribed Fire _____
Air:
Direct Attack _____
Indirect Attack _____

LEVEL OF SATISIFACTION:

Products _____
Hardware _____
Training _____
Information _____

WHAT'S MISSING—

Want to see, but do ***NOT*** have?: _____
_____
_____
_____
Sources of Frustration: _____
_____
_____
_____

How effective is Foam vs Water only: _____
_____
_____
_____
What are your environmental concerns?: _____
_____
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What are your health & safety concerns?: _____
_____
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FACTORS LIMITING APPLICATIONS:

Chemicals _____
_____
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Hardware _____
_____
_____

RECOMMENDATIONS, REMARKS, COMMENTS

(Serviceability, weight, portability, storage, aesthetics, materials, housekeeping, etc.):

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Signature: _____

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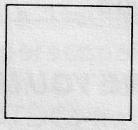

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