Firefighting Foam Updates

for the Swannanoa FD

10/13/2007

Contains:
Information on switch from 3%-6% AR-AFFF to 3%-3% AR-AFFF
Information on switch from Class A Foam to Class A/B for Brush 6/Engine 62 and stock
Information and direction for:

- **Part 1 Class B Firefighting review (basic)**
- **Part 2 Class A Firefighting review & CAFS**

Note
Information from this collection will divided into separate manuals. The main purpose of the information is for immediate flow of information on changes and refresher info for operations

Use the "Fill-in the blank" study guide to receive training credit

Index

Removal of 3M 3%-6% AFFF from service

Considering a combination of age for some AFFF stock and research labeling PFOS (found in our 3M 3%-6% AFFF), as a Persistent Bioaccumulative Toxic Pollutant (PBT), we have voluntarily removed the product from service out of concern for employee health and environmental impact.
(Only available in .pdf version for links)
EPA & 3M announce phase out of PFOS (May 16,2000) www.epa.gov
Quote from another 2007 EPA document - "long term potential adverse effects in people and wildlife over time if PFOS should continue to be produced, released, and built up in the environment."
The Ecologist Online (Bunsfield Oil Deopt Fire, England)
RSC Chemical World

Replacement foam information and operational changes for Engineers/Firefighters

About our new Class B Foam

Our old AFFF was an AR (Alcohol resistant) foam that required a setting of 3% from the eductor for hydrocarbon fires and 6% for polar solvent fires (see review of fighting flammable liquid fires). The new foam can be set at 3% for either hydrocarbon or polar solvent fires. You will not have to change the eductor setting from 3% for any flammable liquid fire.

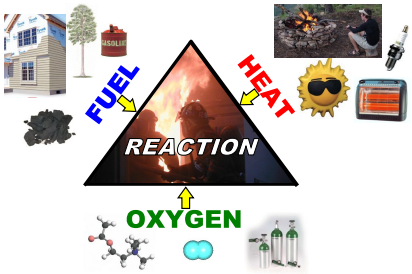
During polar solvent fires, our stock carried on apparatus will last twice as long and provide twice the coverage as a 3%-6% AR AFFF. Switching to 6% doubles consumption.

It is important to note that only the 3%-3% AR AFFF foam (Engine 6 & 63) can be used on polar solvent fires and the <u>Class A/B type on Engine 62 cannot</u>.

Detailed information can be reviewed by accessing the manufacturer's website with this link to the 3%-3% product page http://www.usfoam.com/html/3-3.html.

Quick review of fighting flammable liquid fires

Flammable liquids produce vapors which flash or ignite at a given temperature. When considering how we suppress a flammable liquid fire we still look at fire behavior basics of the fire tetrahedron.



Fuel - the vapors
Heat - the original ignition source, ambient temperature, flames or other hostile fires.
Oxygen - Already in the air and the chemical chain reaction.

As in any type of suppression, sides of the tetrahedron must be changed such as taking the fuel away or diminishing it, cooling or depleting oxygen or smothering.

How plain water affects the fuel, heat and oxygen side

Flammable liquids such as gasoline, diesel and several other products have a lower specific gravity than water (less dense than water). These products will float on top of water so they can continue to release vapors given the correct temperature. Even if a small spill fire was "knocked down" with plain water, fuel vapors can continue to release and reignite or "flashback."

While a plain water fog application may cool the flammable liquid and disrupt vapor (from a small fire), such as when a spill spreads the liquid over a small area, a flammable liquid with greater size or much depth creates a major problem.

1. Water application will not effectively cool the flammable liquid for a positive effect.
2. Water boils at 212°F. If the water reaches 212°F, the boiling will cause major disturbance to the fuel surface allowing more surface to release vapor, thereby increasing fire activity.
3. Any disruption of the fuel's surface increases surface area available to release vapors. While any water stream can increase fire activity, solid streams plunging into the liquid will cause a dramatic increase.
4. Once the flammable liquid fire is of any size, water application could not cover the entire area without flashback.

What is the difference between normal Hydrocarbon fires and Polar Solvent fires?

Hydrocarbons are constituted with carbon and hydrogen. Their characteristic is their lack of affinity (doesn't mix) with water. We can identify 3 families :
Light hydrocarbons : gasoline, heptane, cyclohexane, terpene
Heavy hydrocarbons : fuel-oil, diesel, kerosene
Aromatic hydrocarbons : benzene, toluene
Being not miscibles with water, they can be extinguished with "ordinary" foams, even if it is recommended to apply film forming foams to get a fast extinction. Our 3%-3% AFFF works effectively with these products.

Polar solvents include O (*Oxygen*) or N (*Nitrogen*) atoms or halogenes : Cl, Br, F or I. Their characteristic is their affinity for water (*They mix easily with it*). These materials typically break down foam quicker than foam or foam settings not intended for polar solvents. Foam is still made up of a lot of water so polar solvents can "blend" with the water in foam and break down its structure.
Common groups of Polar Solvents:
Alcohols : méthanol, éthanol, isopropanol…
Ketones and aldehydes : acetone, acetaldehyde, methylethylKetone MEK, MIBK…
Esters : Ethyl acetate…
Ethers : diethylether, MTBE, THF…
Glycols : combination 'alcohol + ether' : MEG, MPG, Butoxyethanol, butylcarbitol…
Amines : trimethylamine…
Acids : acetic acid, propionic acid…

Without our 3%-3% AFFF, a 3%-6% AFFF or 6%AFFF foam concentrate would be required. The 2 latter concentrates require a heavier application to overcome the breakdown. The 3%-3% works with Hydrocarbon or Polar Solvent fires.

What about new fuels coming out today?

The first clue is... Ethanol... look back under Polar Solvents... Alcohols/Ethanol. You guessed it, our future may depend on predominately fighting polar solvent fires. At least in any respect, the possibility has already greatly increased. Switching into "6%" *(not required with our new foam)* mode as required in past decades as an extremely rare occurrence may become the norm.

Ethanol is produced by fermenting corn, sugar cane or other organic materials. The product is an alcohol. Fuels such as E-85 contain 85% ethanol/ 15% hydrocarbon fuel such as gasoline. Flex-fuel vehicles can use ethanol or gasoline. E-10 is 10%ethanol/90% gasoline, also referred to as Gasohol. Some Ethanol vehicles use gasoline to warm up the motor on cold mornings and then switch to Ethanol for normal operations because of the flash point differences. Information on Ethanol fuels can be found at www.ethanol.org.

There are some commonalities for whichever liquid fuel sources come on the market and how we deal with them:
1. They will produce vapors
2. Vapors must be suppressed to extinguish their fire
3. They will require firefighting foams

	Basic information on common flammable liquids								
	Biodeisel	**B20 20% biodiesel 80% diesel**	**Diesel**	**Gasoline**	**JetA**	**K1 Kerosene**	**Gasohol**	**Ethanol**	**E-85 85% Gasoline 15% Ethanol**
Specific Gravity	.886	.860	.780-.955	.650-.750	.700-.800	.810	.750	.816	.794
Flashpoint	321	149	125	-45	<100	100	-50	55	-40 to -50
Autoignition	unk	1131	494	545	410	410	495-850	793	495
Mixes W/ water	Insoluble	Negligible	Negligible	Negligible	Negligible	Insoluble	Partially	Complete	Gas- Negligible Eth-Complete
FL range	NA	0.6% to 7.5%	0.3%-10%	1.3% - 7.6%	0.7% - 5.0%	0.6% - 8.0%	1.4% - 7.6%	3.3%-19.0%	1.4-19.0%

Various classes of fuels will pose a variety of MSDS (Material Safety Data Sheets) and product information because each manufacturer has a different process and/or additive for their product. If you search for product information, you will find a variety of temperatures for flashpoints, specific gravities and so on. Biodeisel may have the widest set of available numbers due to home manufacture by individuals. Even gasoline used in everyday vehicles can have different numbers.
Gasoline consists of a complex blend of paraffinic, olefinic, napthenic, and aromatic hydrocarbons which may contain up to 5% benzene and dosages of multi-functional additives. May contain 0-10% ethanol.

"Currently, 10% ethanol is added to approximately one third of all the gasoline used in the United States."
US Department of Energy

Biodiesel

Biodiesel is defined as the mono alkyl esters of long-chain fatty acids derived from renewable lipid feedstocks, such as vegetable oils or animal fats, and was developed for use in compression-ignition engines. Biodeisel blend (B20) is a blend of 20% biodiesel fuel, and 80% No. 2 diesel.

One concern of biodiesel is when "home kitchens" and small scale production in garages may yield storage in drums or other larger tanks along with waste products. During production a byproduct of glycerin is produced. While glycerin does not have any specific flammability concerns and is used in several safe products, burning of glycerin produces "Acrolein."

Acrolein is a severe pulmonary irritant and has been used as a chemical weapon during World War I. It is, however, not outlawed by the Chemical Weapons Convention. Skin exposure to acrolein causes serious damage. Acrolein concentrations of 2 ppm are immediately harmful and a suspected human carcinogen. *"Where is the waste glycerin stored?"*

"One pound of glycerin is produced for every 10 pounds of biodiesel,"
said Gonzalez, Rice's William Akers Assistant Professor in Chemical and Biomolecular Engineering.

Homebrew Biodiesel Fire

Posted December 9th, 2006 by Kai Curry

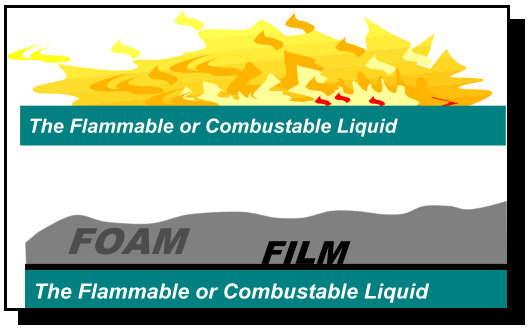
On May 7, 2006, a hazardous materials (HazMat) release occurred in a residential area of Colorado when a homeowner who was processing a tank of homemade biodiesel fuel forgot to turn off the tank's heating element and left for the weekend. The heating element overheated and caused a fire that burned the surrounding shed and equipment. The shed had contained >600 gallons of biodiesel and recycled restaurant cooking oil, smaller amounts of glycerin and sodium hydroxide, and 1-gallon containers of sulfuric and phosphoric acid; a mixture of these ingredients seeped into the ground during the fire. A certified HazMat team and the local fire department responded. Investigators found seven 55-gallon barrels of methanol and other hazardous materials outside the shed. No injuries or evacuations occurred. To prevent potential injuries, biodiesel should be purchased from a licensed commercial source.

How AFFF works

Aqueous Film Forming Foam	
Aqueous	*Refers to a solution in water*
Film Forming	*Creates a film or layer helping suppress vapor release from the fuel surface*
Foam	*Thick frothy substance: a thick but light mixture that contains a lot of tiny bubbles*

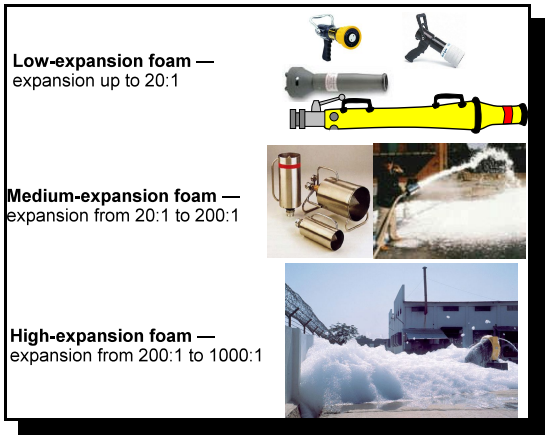
AFFF works by creating a film that stays on top of the flammable liquid to suppress vapors and a foam substance that helps cooling, insulates and separates other ignition sources or hostile fire from reigniting the vapors. All these qualities combine to produce a "finished foam product."

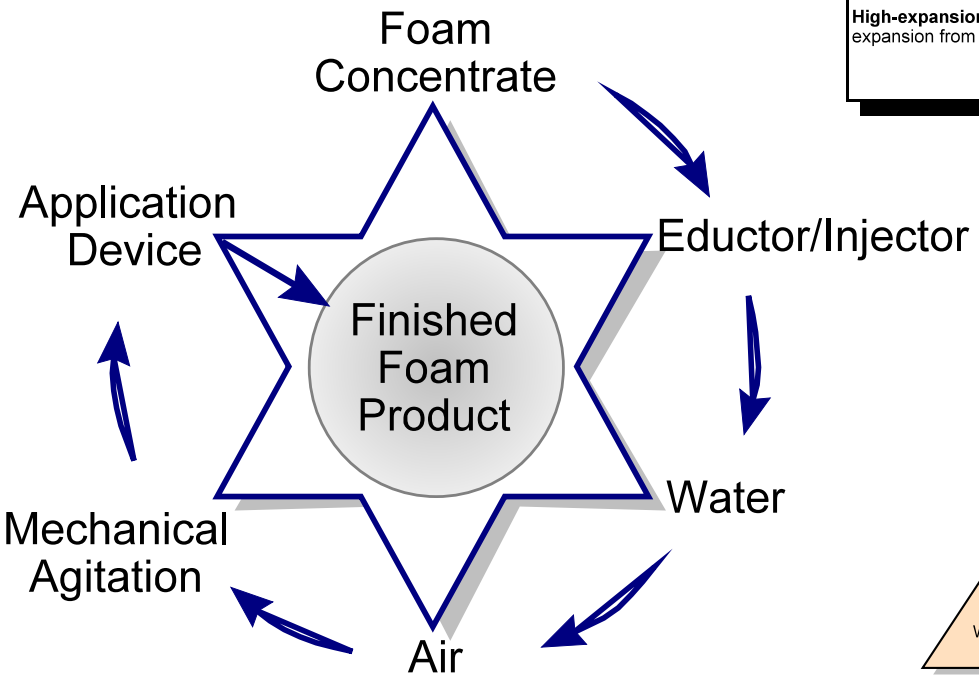
AFFF also has a "self healing" capability. If the foam & film layer is disturbed, vapors can come through and be ignited again but AFFF moves back into position to do its job. This "self healing" can only occur if enough foam product is still available, the surface of the fuel is not being disturbed and is not on a vertical surface. If the flammable liquid is boiling, suppression will be far more difficult and fire volume may increase dramatically due to available fuel surface area.

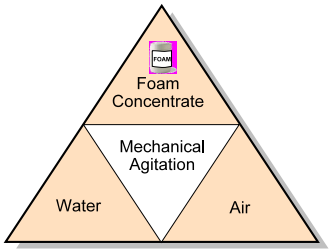


How Foam Solution is created

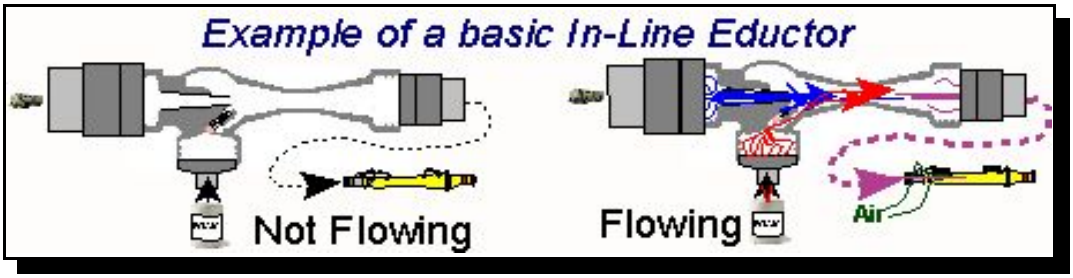
Pressure/flow from a water source creates a venturi effect to draw foam concentrate into a chamber which mixes with water. The foam/water solution travels through a hose and enters a nozzle which also uses the venturi effect. However, in the nozzle the foam/water mixture draws air to complete a foam/water/air mixture.



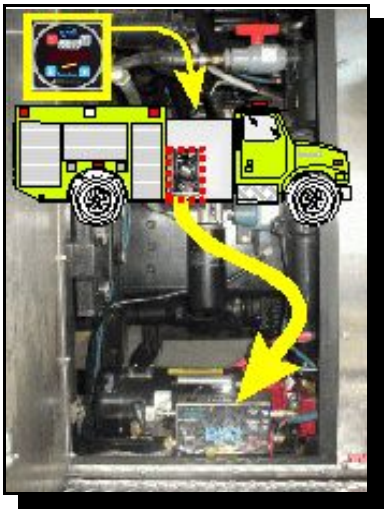




Eductor Basics



In-Line Eductor (On Engine 63)	By-Pass Eductor (On Engine 6)
 ***Akron 3072*** ***200psi*** ***125gpm*** ***1½" - 1½"***	 ***Akron 2958*** *(newer model in graphic)* ***200psi*** ***95gpm*** ***2½" - 1½"***
In-Line eductors are placed between hose lengths or connections. Connecting to a 2½" discharge or to place on an extended hoselay away from the truck, a 2½"-1½" reducer must be used.	By-Pass eductors also allow a water only flow which can be used to flush hose and nozzles of foam solution without removing the foam supply.



Creating foam solution with Engine 62

On-board foam proportioners (such as Engine 62) inject foam into a discharge and is controlled by a control head on the pump panel. The control head can be set to inject various percentage rates such as the 3% required for flammable liquid fires or other settings such as .2% as needed for Class A use. ***Engine 62's foam tank and system can only be used <u>on flammable liquid fires</u> if the Class A/B foam concentrate product is used.***

The onboard air compressor also provides the air component to produce a "finished foam product" leaving the discharge and use of a solid bore nozzle directs and applies the product to the fire. If the compressor is not used, an air aspirating nozzle or other type will have to be used to complete the finished foam product at the end of the line.

If Engine 62 engages in flammable liquid firefighting, the 30 gallon foam tank can be used and refilled with 4 extra buckets stored in the pump well or by more Class A/B during operations.

<u>It is important to remember 2 points:</u>

1. DO NOT ADD THE 3%-3% OR ANY 3%-6% AFFF TO ENGINE 62's TANK!

2. DO NOT ADD REGULAR CLASS A FOAM TO THE TANK UNLESS REQUIRED FOR AN IMMEDIATE OPERATION!

Adding normal Class A foam will not hurt anything, only take the capability of Class B firefighting away. If E62 operates in a wildland/urban scenario and the Class A/B supply runs out, use other Class A if you have to. Engine 6 & 63 will take over all suppression of flammable liquid fires until 62's tank has been flushed and refilled with Class A/B.

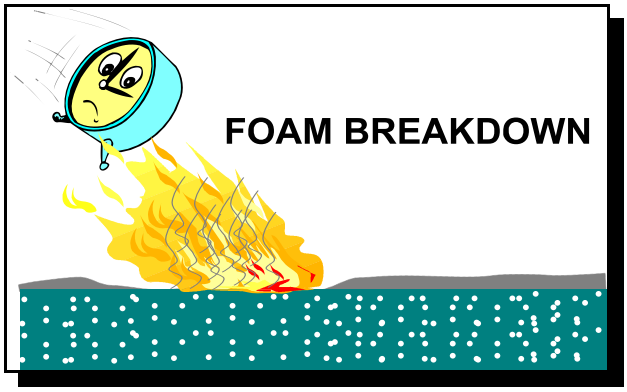
If the Class A/B foam product will run out during flammable liquid fire operations, an eductor can be connected to a discharge and 3%-3% AFFF (or other 3%-6%) can be used on the ground in 5 gallon buckets the same as with Engine 6 or 63 with addition or change out of an appropriate nozzle.

Foam breakdown

The film and foam layer applied to a fuel or fire will begin to breakdown and lose the original qualities. Normal bubble structure degradation, heat, wind, disturbance, flow and other factors such as the type of fuel can all contribute to the breakdown. Foam solution may have to be continuously applied or reapplied until danger of a flashback is eliminated.

Anything that disturbs or diminishes the film layer, even though it is "self-healing" with AFFF, may cause enough surface area to release vapors and if the ignition factors are favorable:

FIRE MAY REOCCUR!

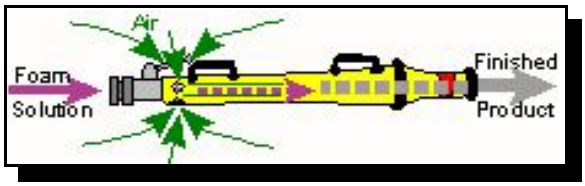


Foam Nozzles

Any nozzle will let a foam solution pass through. The nozzle selection will determine what kind of finished foam product is provided and the stream reach. No one nozzle that can be the best at every incident.

Foam Tube/Branchpipe

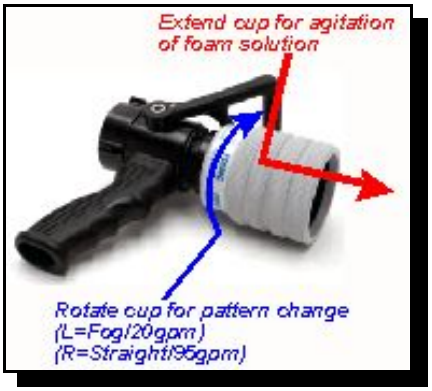
When using an eductor system, an air aspirating nozzle uses the venturi effect to draw air into the tube. The nozzle is designed to agitate the foam solution by some type of constriction or screen, mix with air and produce the finished foam product before it exits the nozzle. The firefighter operating the nozzle should take care not to block air intakes or the finished product will be of lower quality *(less bubbles)*. This type of nozzle is typically best for application on flammable liquids. The model we have is an ***Angus F-450 - Foam Branchpipe*** *(Engine 63)* which produces a variety of foam application rates as described in the foam/eductor matching table. The only downfall is that if not preconnected, setup time will be slightly increased. This nozzle should not be used with CAFS, it will destroy bubble structure.

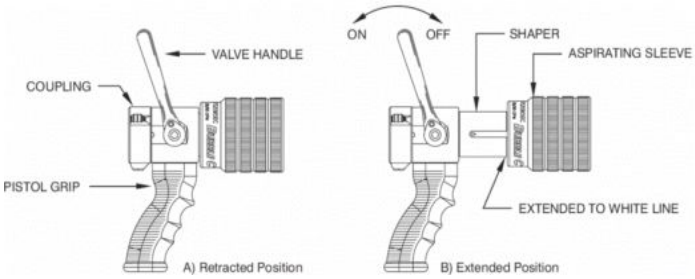


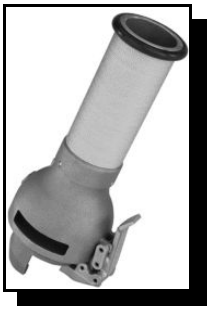
Bubble Cup

A bubble cup nozzle has no internal air entrainment, only turbulence/agitation by small teeth inside the extended tube. The Bubblecup *(TFT)* relies on mixing foam solution with air while the stream is on its way the target. It provides a slightly better finished foam product than a fog nozzle with diminished reach. The model we have is a ***TFT FS2095BC*** *(20-95gpm).*

It is very important to note that this model does not operate like our Elkhart SM-20 or SM-30 nozzles which can maintain gpm through fog or straight stream. Turning the cup all the way left will change the flow from 95gpm to 20gpm. While this nozzle can deliver AFFF and produce the needed film layer in straight stream mode, turning the cup left will improve foam bubbles but reduce the application rate *(down to 20gpm!)* And reduce stream reach. Another downfall is that if not preconnected, setup time will be slightly increased. ***This nozzle should not be used for structural firefighting!***







Foam Tube/Aeration Attachments

Attachment foam tubes can be clamped/fixed onto fog nozzles if the tube is specifically designed for the nozzle. The process uses teeth from the fog nozzle, air entrainment from the intakes and the foam tube to produce the finished foam product. Such a device is the next best to a branchpipe in finished foam product quality. Two more advantage are that the device can be quickly attached to existing fog nozzles and they are generally only limited to the capability of application rate of the nozzle.

We do not possess these type attachments.

Fog Nozzles

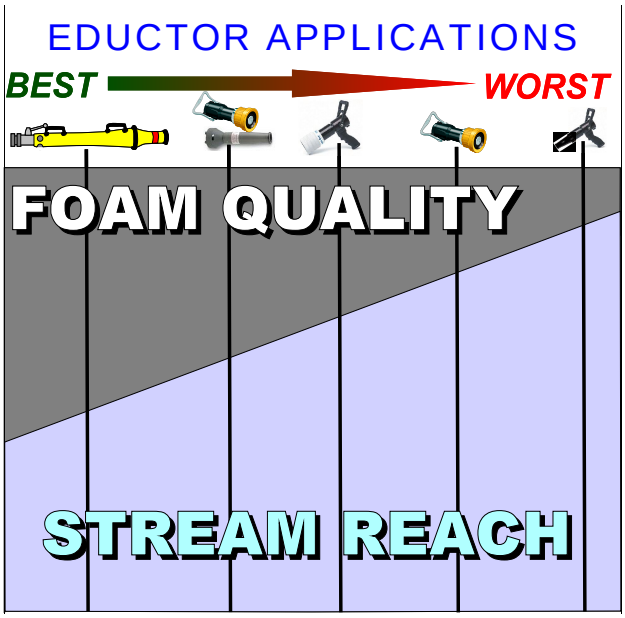
Fog nozzles can use foam solution and produce moderate finished foam product by agitation from spinning teeth but just like a bubblecup but must rely on air entrainment while enroute to the target. The finished foam with AFFF will still produce a film layer but without the higher quality insulation/bubble structure of foam tube attachments or branchpipes. Fog nozzles will already be attached to crosslays and would not require a time delay in setup or can have a foam tube or aeration attachment placed on them.

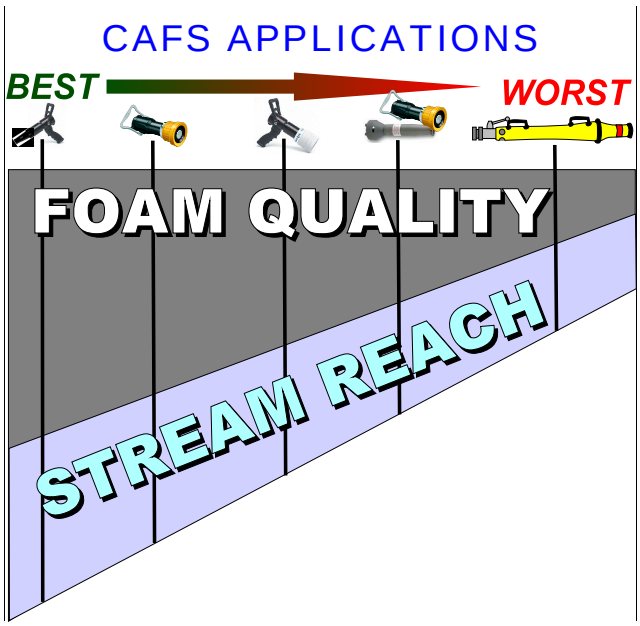
Solid Bore Nozzles

When using an eductor system, solid bore nozzles do not have the capability to create hardly any type of foam production although they can still deliver AFFF for a film layer. The only way a solid bore nozzle can create any kind of low quality finished foam is to bounce the stream off of the ground or other objects for agitation. “Bouncing” a stream off of a flammable liquids surface is not an option since it will disturb the film layer or splash the flammable material creating more available surface area and creating larger fire volume. This weakness eductor systems is offset when using CAFS.

With a CAFS *(E62)*, air is entrained with solution before leaving the discharge and mechanical agitation occurs in the hoseline. Finished foam is delivered to the nozzle and the solid bore maintains bubble structure and will be the best selection *(with CAFS)*.

Nozzle selection should be based on the system used & tactical objective.





Matching the Eductor and Nozzle

Any nozzle used with an eductor must be able to flow the rated gpm of the eductor. If it is a 95gpm eductor, the nozzle must be capable of flowing 95gpm. If the eductor is rated at 125gpm, the nozzle must be capable of flowing 125gpm....Why?.....

Consider using a 95gpm nozzle with a 125gpm eductor. If the nozzle can only flow 95gpm, then only 95gpm is flowing through the eductor even when set at 200psi. This creates back pressure affecting foam pickup ability and changes the % of foam being applied. Lower % concentration may not effectively suppress/protect.

DO NOT USE A NOZZLE WITH LOWER GPM FLOW THAN THE EDUCTOR'S RATED GPM!

If any mismatch was to be made it would be better to have a higher gpm flowing nozzle than the eductor. Stream reach would be negatively affected but the finished foam product would most likely be OK but with an increased concentrate of foam solution. Higher percent concentration uses up foam supply faster without the need. Flowing more or less through the eductor has effects similar to what a mismatched nozzle can create and giving more psi to the eductor can actually decrease you foam percentage.

Example using a 6% eductor setting,

Table provided by Elkhart Brass with addition of the 2nd & 4th column

(we will not have to use 6% setting with our 3%-3% foam, just for demonstration of effect),

@ Eductor Intake	Dial Setting	Percent foam actually applied	What's happening?
250psi	6%	5.5%	Backpressure created from nozzle, diminishing foam pickup
200psi	6%	6%	Correct, 6% of the total flow is foam concentrate
150psi	6%	6.9%	Not enough back pressure, higher concentration
100psi	6%	8.4%	Not enough back pressure, far higher concentration

	Eductor Match		PSI at Nozzle	GPM	Stream Reach
	 200psi 125gpm	 *200psi 95gpm*			
Angus F-450 - Foam Branchpipe  *This model and flow rates are designated by the red band on the front of the nozzle.*	✘	✘	50psi	85gpm	50'
	✘	✔	75psi	100gpm	60'
	✔	✔	100psi	120gpm	70'
 **TFT Bubblecup FS95BCP** *Single gallonage, not for use with the 125gpm eductor on E63*	✘	✔	100psi	95gpm	
 **Solid Bore 15/16 tip**	✘	✘			
	 *Requires CAFS*				

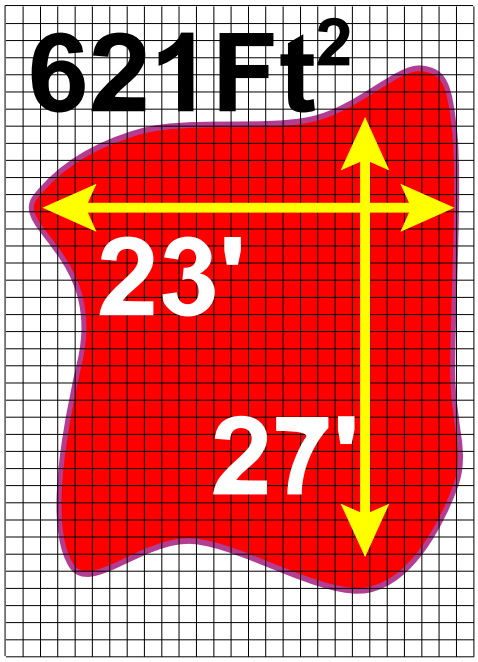
Having to match eductors & nozzles does not rule out more foam lines used off of one apparatus. Two foam lines *(or more)* may be needed for a proper application rate. The 2nd-in pumper may distribute their foam equipment to the 1st-in attack pumper. As long as both foam lines have matched equipment, 200psi at the eductor and appropriate line lengths the system will work. If the attack pumper is in proper position for the given incident, using one pumper will only require water supply operations to one pumper.

Foam Application Rates & Water Supply

Just as a structure fire needs a minimum flow rate to suppress a fire, so does a flammable liquid fire.
It is important to remember that application rates that are below recommendations may simply be a waste of foam concentrate and effort... you may need to delay attack until sufficient concentrate and all needed resources are on scene and ready.
There is a difference between percent rates for a given fuel and their needed application rate. The percent rate such as 3% or 6% if the percentage of foam concentrate needed in the foam solution. Application rate is how much of that solution is applied in a specified time.

There are five basic considerations that will dictate the application rate/time:
1. Surface Size (Square Footage of surface)
2. Fuel Type (Hydrocarbon/Polar Solvent *and what type polar solvent*)
3. Fuel Depth (Surface only spill fire Vs. 1"-2" or greater)
4. Application time needed
5. Foam coverage disturbance (Wind, hostile flame damage, rapid convection columns and others) While not part of the application rate calculations, these factors may necessitate more foam or more frequent application.

1. Surface size
Surface size is calculated by square footage of the fuel's surface LxW=FT^2. It is rare that a surface area will have an actual square shape except for containment areas underneath storage tanks. Square footage is a best guess with no measuring tape.
Use something familiar to judge size such as .....
Attic ladder x an attic ladder (10'L x 10'W=100 FT^2)
1 hose length by 1 hose length (50'L x 50'W=2,500 FT^2.)
Crosslay by Crosslay (200'L x 200'W=40,000 FT^2)
Crosslay by a yardstick (200'L x 3'W=600 FT^2)



2. Fuel Type

Application rates will remain the same for hydrocarbon fuels (*at 0.10 gpm foam solution per square foot*). Polar solvents generally require a minimum .16gpm foam solution per square foot and certain polar solvents may require applications rates up to .24 gpm per square foot. One issue which may remain mysterious until after the call is over: *what was the truck actually hauling?* Flames & smoke obscuring placards, burning shipping papers and an injured driver..... what fuel are we really dealing with? If efforts are not effective given an anticipated fuel, consider higher application rates.

The following table provides a view of fuel differences/needed application rates on a 25'x25' fire (625 Ft2) and demonstrate the benefit of a 3%-3% foam concentrate Vs. 3%-6%.

L	W	Ft^2	Type Fuel?	New Foam / Old Foam	App Rate	GPM solution	Concentrate gal. Per/Min	Gall of foam for 15 min	5 gallon Buckets		
25'	25'	$625Ft^2$	Hydrocarbon	**3%**-3% AFFF	.10	62.5	1.88	28.13	**5.60**	✔	**SVFD new**
				3%-6% AFFF	.10	62.5	1.88	28.13	5.60	✔	Vs Traditional
25'	25'	$625Ft^2$	Lower Polar Solvent	3%-**3%** AFFF	.16	100	3	45	**9.00**	✔	**SVFD new**
				3%-**6%** AFFF	.16	100	6	90	18.00	✘	Vs Traditional
25'	25'	$625Ft^2$	Medium Polar Solvent	3%-**3%** AFFF	.20	125	3.75	56.25	**11.25**	✔	**SVFD new**
				3%-**6%** AFFF	.20	125	7.5	112.50	22.50	✘	Vs Traditional
25'	25'	$625Ft^2$	High polar Solvent	3%-**3%** AFFF	.24	150	4.5	67.5	**13.50**	✘	**SVFD new**
				3%-**6%** AFFF	.24	150	9	135.00	27.00	✘	Vs Traditional

6 Buckets on E6, 6 Buckets on E63 = 12 buckets (60 gallons) AR-AFFF 3%-3% ✔Current capability ✘Do not have the capability

There is not a classification system such as Lower, Medium or Higher polar solvents, only on this table to designate application rate categories.

3-4. Fuel Depth & time required

A "spill fire" would be considered a depth less than 1". If the spill is not being fed fuel by a leak, such fires will consume fuel and lessen the potential duration. Application of an appropriately rated Class B extinguisher (50B=$50Ft^2$, *Appx a 7' x 7' fire*) may be all that is needed or a foam application rate may not need the full 15 minutes for control.

The overall volume of fuel for spill fires can cool quicker than deeper fuels lessening flashback potential but not eliminating it for most fuels. Be prepared for a leak adding fuel, expanding Ft^2 and runoff.

Deeper spills, standing liquids and containers pose different requirements. If the fuel in deeper amounts has been ignited and has been heated, it may take some time before temperatures cool and the foam blanket controls vapor emissions. Continuous or repeated foam blanket application may be required. If the fuel is present, vapor release will continue to pose a hazard until conditions change. A minimum 15 minute application time is used per NFPA11.

Capability Tables - Hydrocarbon fire (3% at a .10 application rate for 15 minutes)

(Square Feet X .10 per minute) X 15 minutes = Total Foam solution GPM needed

(Total Foam solution GPM needed X .03 (3%) = gallons of foam concentrate used)

Perspectives when considering fire size:

It will be best to humble yourself ..... a 1 or 2 engine capability is VERY LIMITED!

In general, Mutual Aid for foam and an established water supply is essential for fires beyond 625 Ft^2

Perspectives on size of fire/spill (Calculated for 1" depth or greater)		
The concrete area at the diesel pumps at Exxon are 30' x 60' = 1,800Ft^2	The containment area for Davidson's Oil Storage facility (behind Exxon) is appx 2,710Ft^2. The entire fenced in compound is 6,955Ft^2	The surface area of a fuel tanker which has burned to mid-level: 450Ft^2 (53' x 8.5')... plus whatever spilled area is involved.
		
.10 app rate for 15 minutes? **81 gallons of foam** ***just over*** **16 Five gallon buckets** ***More than supply on E6 & 63 comhbined!***	.10 app rate for 15 minutes? **122 gallons of foam** ***just over*** **24.5 Five gallon buckets** .10 app rate for 15 minutes? **313 gallons of foam** **63 Five gallon buckets**	10 app rate for 15 minutes? **Minimum 20.25 gallons of foam** **just over 4 Five gallon buckets**
Personnel will be needed. Water Supply must be established, especially on the interstate **THE MAJOR MUTUAL AID REQUEST WILL BE FOR FOAM BUCKETS!**		

Simple math for water supply needs

This is only based on the application rate needs.

Whatever foam eductor/nozzle combinations are used - water supply must be maintained for the duration

Application rate needed	water supply needs		Application rate needed	water supply needs
95gpm	95gpm		220gpm	220gpm
125gpm	125gpm			
200gpm	200gpm			

Engine 6, or Engine 62, or Engine 63 - Lone Ranger attack. No backup, no water supply

Apparatus	Onboard foam	Water onboard	Eductor rate Foam solution	**Fire Area (Max)**	Booster tank Status	Foam supply Status
Engine 6	30gal	1000	95gpm	**665Ft^2**	Empty	Gone
Engine 62	30gal + 20	500	1-167gpm max	**330Ft^2**	Empty	> 35 gallons left
Engine 63	30gal	1000	125gpm	**665Ft^2**	Empty	Gone

In the "Lone Ranger" scenarios, Engine 6 or 63 only have appx a 22' x 30' fire area to control by themself. Each foam eductor has the capability for this range. Engine 62 will be mostly limited by onboard water although CAFS may produce better finished foam product, there will be a balance between:

Better bubble structure for insulation & lower film layer formed.

The benefit of CAFS is its ability to adapt for the need.

Engine 6, & Engine 62, & Engine 63 - Combined/Individual attack. No backup, no water supply

Apparatus	Onboard foam	Water onboard	Eductor rate Foam solution	Fire Area (Max)	Booster tank Status	Foam supply Status	Combined Square Footage Capable
Engine 6	30gal	1000	95gpm	665Ft^2	Empty	Gone	**1,660Ft^2**
Engine 62	30gal+20	500	1-167gpm max	330Ft^2	Empty	> 35 gallons left	
Engine 63	30gal	1000	125gpm	665Ft^2	Empty	Gone	

Engine 6 with extra needed water supply & foam
(15 minute application @ .10) (If current Akron model eductor at 95gpm)

Apparatus	Onboard foam	Water onboard	Eductor rate Foam solution	**Fire Area (Max)**	Booster tank used	Extra water used	Foam supply used	Extra foam used
Engine 6	30gal	1000	95gpm	**950Ft^2**	1,000	425	30 gallons	12.75

Engine 63 with extra needed water supply & foam
(15 minute application @ .10) (If current Akron model eductor at 125gpm)

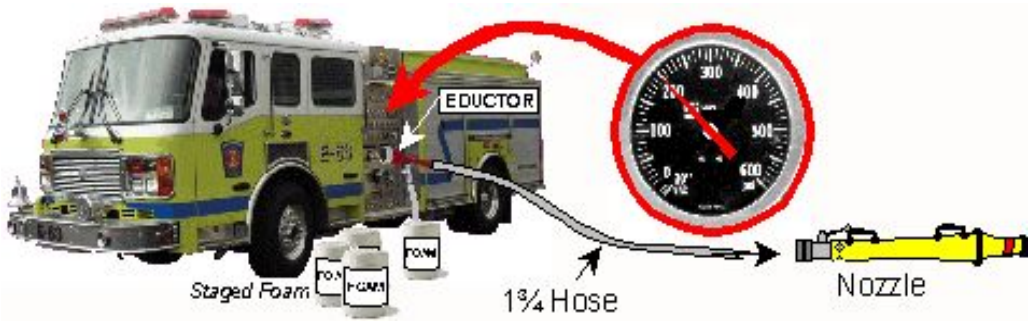
Apparatus	Onboard foam	Water onboard	Eductor rate Foam solution	**Fire Area (Max)**	Booster tank used	Extra water used	Foam supply used	Extra foam used
Engine 6	30gal	1000	125gpm	**1,250Ft^2**	1,000	875	30 gallons	26.25

Engine 62 with extra needed water supply & foam
(15 minute application @ .10) (If current Akron model eductor at 125gpm)

Apparatus	Onboard foam	Water onboard	Eductor rate Foam solution	**Fire Area (Max)**	Booster tank used	Extra water used	Foam supply used	Extra foam used
Engine 6	30gal	1000	167gpm max	**1,670Ft^2**	500	1,975	50 gallons	24.25

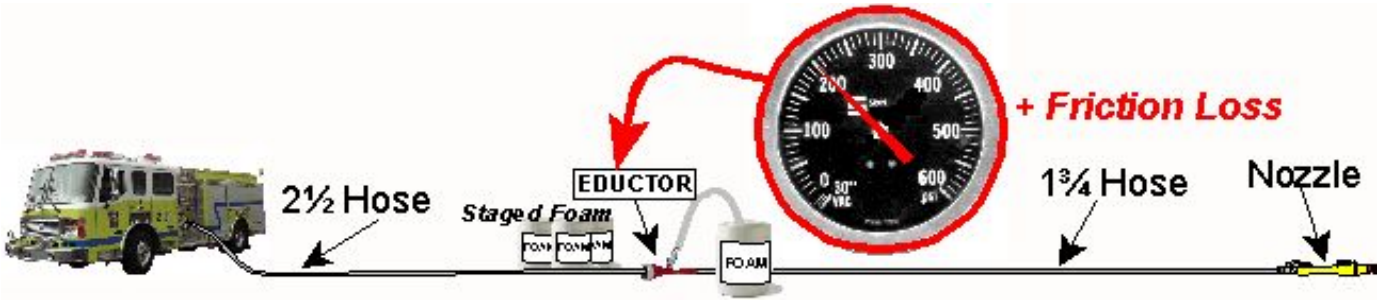
Pump and equipment setup, Hose layouts

The intake of the eductor is a 2½”connection, the discharge side is a 1½” connection *(Either apparatus)*. A foam eductor should be provided 200psi at the eductor’s intake as per manufacturer’s specifications. If the eductor is attached to a discharge on the pumper, the discharge pressure will be 200psi as shown below with a maximum of 300' of 1¾” or 150' of 1½” hose after the eductor. All preconnects/crosslays on our apparatus are 1¾” hose so the general maximum will be 300' however, some specifications may only allow a max of 250' and combinations of eductors/nozzles may produce various limitations. For simplicity and practicality, most maximum handline lays after the eductor will be 200' of 1¾” because that is what will be pulled from the crosslay.



Rule of Thumb: 200' preconnect pulled and placed after the eductor

There can certainly be circumstances, such as a large tanker fire, when the apparatus does not need to be within 200' of the fire. In such cases 2½” is laid to the eductor, foam buckets are deployed away from the apparatus and foam handlines are extended from that point. The eductor still needs to receive 200psi so friction loss must be accounted for in the 2½”. Engine 63's Akron Model 3072 will require a 2½"-1½" reducer to connect the hose.



Rule of Thumb: (Max1,000' of 2½"/3") - (Eductor) - (200' 1¾) after the eductor

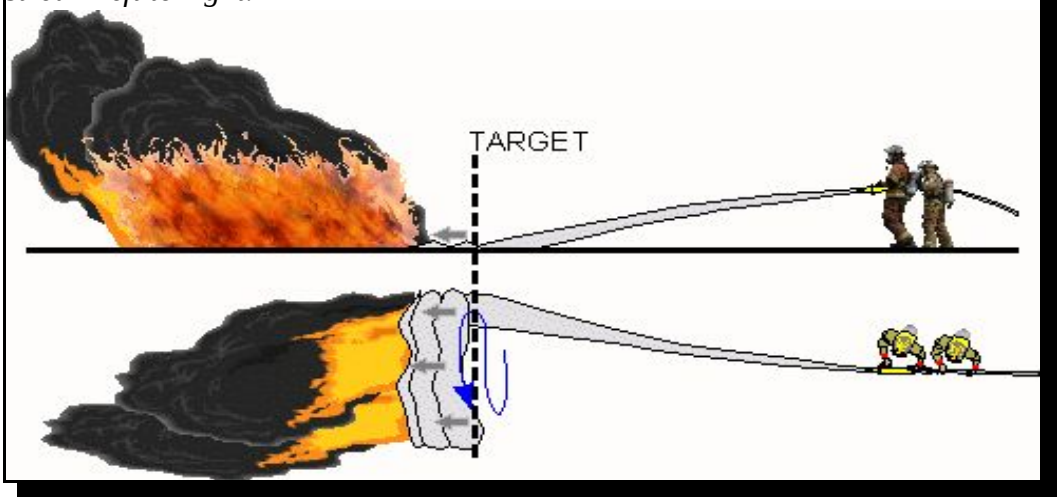
	2½" FL-100' Friction Loss	Eductor GPM/PSI required
Engine 6's eductor	2psi	95gpm/200psi
Engine 63's eductor	3psi	125gpm/200psi
Engine 62's eductor (Foam Logix 5.0)		1,000gpm @ .5%
		500gpm @ 1%
		167gpm @ 3%

Application Techniques

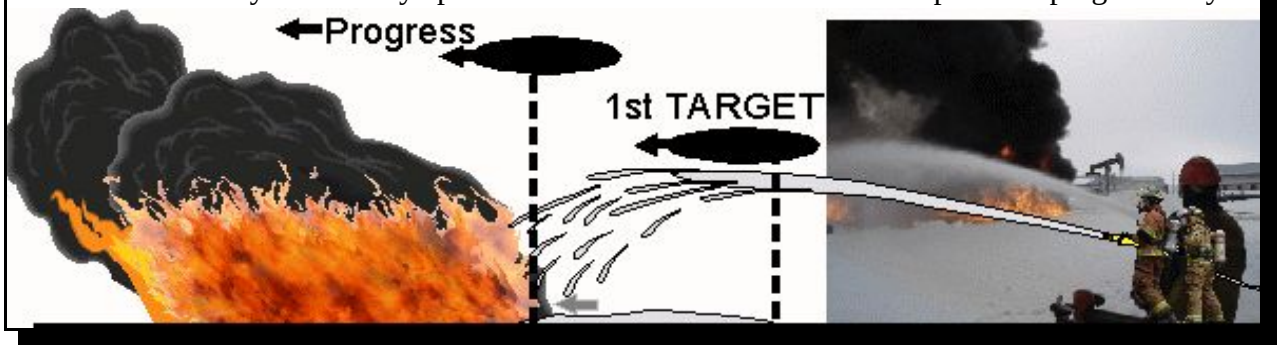
Quote from the NFPA Fire Protection Handbook, 18th edition, 6-352

"The more gently the foam is applied, the more rapid the extinguishment and the lower the total amount of agent required."

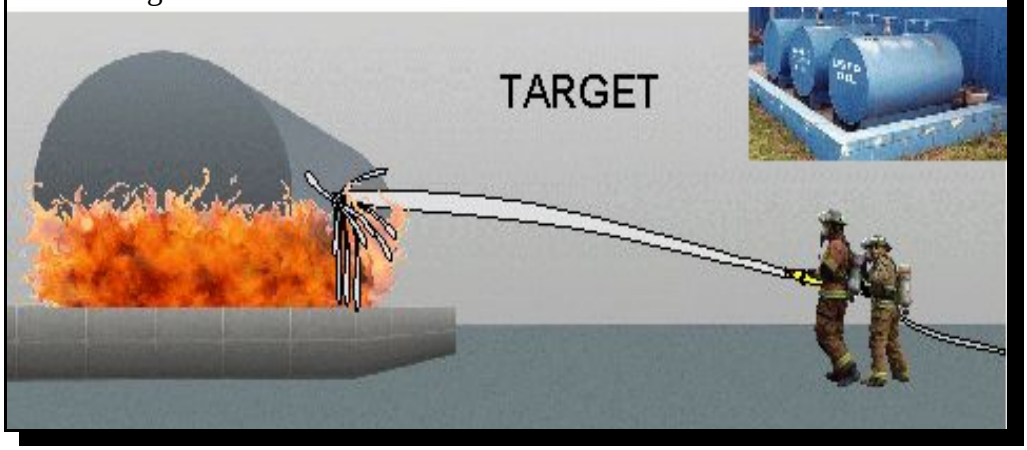
Rolling *is conducted by targeting the foam stream before the flame/fuel front and using the stream to push a "wave" of foam over the area by sweeping the stream left to right.*

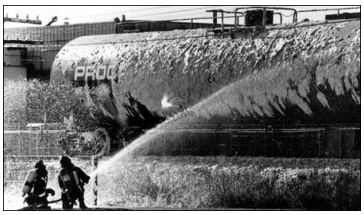


Lobbing may be required when objects block rolling techniques or when debris clutters an area. Lobbing decreases the effectiveness of a foam fire stream, may contribute to fuel surface disturbance but may be the only options in some situations. The area is "painted" progressively.



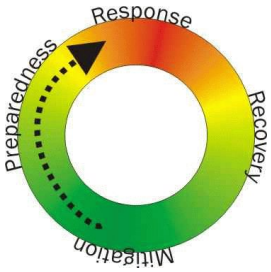
Banking uses deflection from another object such as a tank or wall to allow foam to flow downward and spread out over the intended area. Can be useful when storage tanks have a containment area.





Banking/lobbing may be used to insulate other surfaces.

RESPONSE - Scene Sizeup/Apparatus Placement & Applying foam for Class B Fires.



The Emergency Management cycle starts with mitigation through prevention, code enforcement and other efforts. Preparedness comes through training, preplanning facilities and other locations and acquiring appropriate equipment. While the cycle ends with recovery, most of our focus here will be on the response phase.

Many acronyms have been developed over the years to organize the strategy and tactical decision making process. Here are two suggestions: REVAS has been around for a while and with a slight modification of the Ventilation portion, can be applied to Flammable Liquid Firefighting. The FOAM acronym was created for this article and can work just as well. In either case life safety comes first and priorities remain the same.

FOAM	REVAS
Free people Passenger vehicles, tractor trailers, bus occupants Civilians needing a path out, trapped in building exposures Civilians near gas pumps Helicopters (How many on MAMA?), Aircraft passengers	**Rescues** Passenger vehicles, tractor trailers, bus occupants Civilians needing a path out, trapped in building exposures Civilians near gas pumps Helicopters (How many on MAMA?), Aircraft passengers
Objects needing exposure protection Your own apparatus? Other flammable liquids/gasses/other materials Structures & Vehicles Bridges Electrical or other utilities Environment (where will run off go?)	**Exposures** Your own apparatus? Other flammable liquids/gasses/other materials Structures & Vehicles Bridges Electrical or other utilities Environment (where will run off go?)
Attack & Anticipate Which direction is wind blowing? Temperature (Effect on fuel, water, foam concentrate & personnel) What equipment selection What direction to attack from What technique of foam application will work best How much of an application rate is required, how long? How many foam lines are needed? How much foam will be needed? (Mutual Aid for foam product) Are other lines needed to extinguish non-Class B areas?	**Ventilation (Wind & Weather)** Which direction is wind blowing? Temperature (Effect on fuel, water, foam concentrate & personnel) **Attack** What equipment selection What direction to attack from What technique of foam application will work best How much of an application rate is required, how long? How much foam will be needed? (Mutual Aid for foam product)
Mitigate Normal salvage & overhaul required if structure is involved? Mop-up of vehicles/aircraft Continue containment methods/lessen environmental impact Debriefing/improvement adjustments to planning	**Salvage** Normal salvage & overhaul required if structure is involved? Mop-up of vehicles/aircraft May continue foam operations during salvage (flashback) Continue containment methods/lessen environmental impact

Neither acronym can be employed without a scene size-up.

Answer the following questions during response and on arrival:

! Response

What resources are responding?

What route should I take? (consider pre knowledge of drainage areas, uphill/downhill)

What type facility or vehicle? At the gas pumps? Truck on fire I-40... what kind of truck? Tractor Trailer on fire US70.... what kind of tractor trailer.... gasoline tanker? If little information is provided during dispatch, ask for more but beware the original callers may not have provided the info.

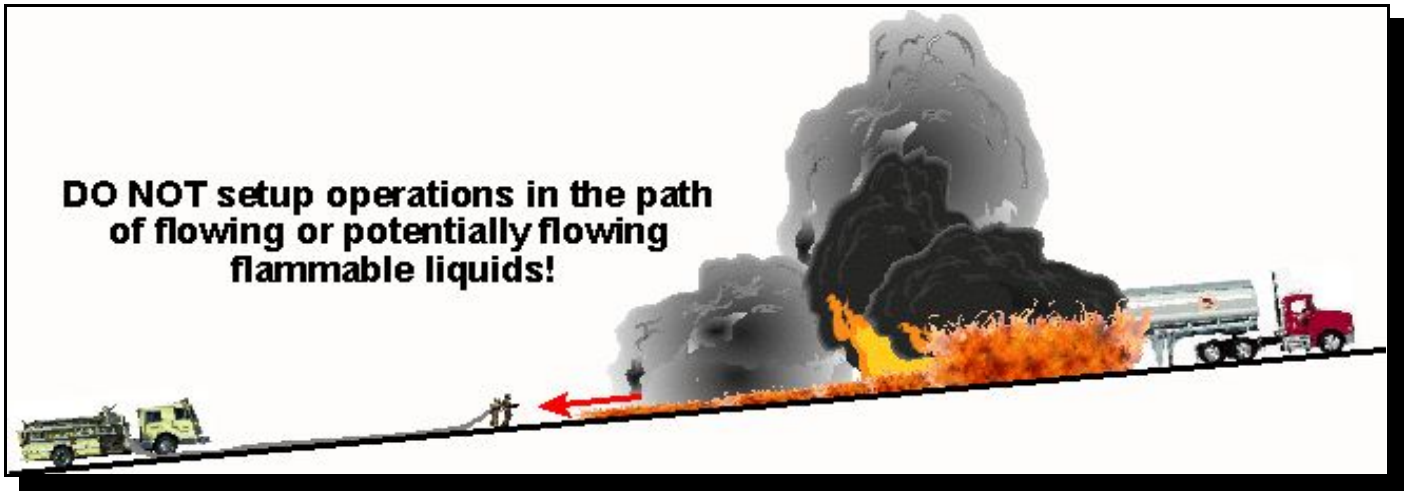
Do I have a preplan for a facility?

Should other/mutual aid units stage at a certain location until size-up is completed? Most likely

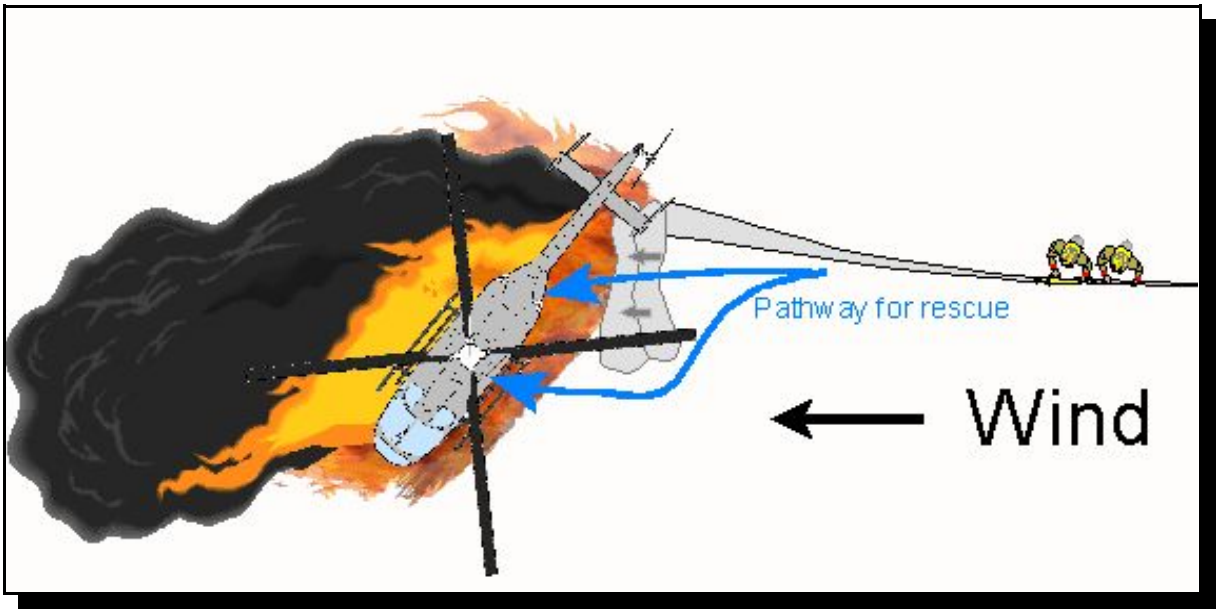
! Arrival

What size is the fire? So it is 4' x 5' Class B fire.... grab a Class B extinguisher rated for at least 20B and put it out. Remember.... a class B extinguisher is rated for the square footage that a non-expert (as judged by UL) can put out. 5B-5ft^2..... 10B-10Ft^2..... 40B-40Ft^2.

Regardless of the situation found on arrival the fireground commander or first arriving engineer must anticipate current & future needs. Where is the fuel now?... where is it going? Placing apparatus or personnel downhill of a flammable liquid fire may likely result in a wee bit a drama, need to move the setup and a serious life safety hazard to personnel.



Although some containment efforts may be employed well ahead of the flow, a sudden and massive release of fuel from the container may occur. Anything downhill is in danger!



Consider the wind direction when approaching. Foam application does not always have to cover the entire fire area. Coverage may only be needed to create a pathway for rescue. MAMA 1 may carry appx 185 gallons of Jet A.

Recognize when the scene is bigger than you. There can be cases where the best option is to let the fire burn. Either the fire can consume the fuel and cause a lot of air pollution .... or...
we can expend millions of gallons of water in which the runoff will carry all sorts of products into drainage ditches, creeks and then the river.... which we will be worse?
Consider the overall impact.....

Mutual Aid Foam

Though each flammable liquid incident may need a variety or resources, one very important difference may be the consideration for calling mutual for foam concentrate. Requests to EOC should be specific as to quantity & type. If we are working a scene involving polar solvents, we need to include that information during the request.

The Asheville Airport Fire Rescue states they will respond mutual aid with foam up to 20 miles from the airport. The majority of the Swannanoa district is within that range including CD Owen, lytle cove, the interstate etc. If foam concentrate is provided by the airport, it will be delivered in 55 gallon drums.

Personal Protective Equipment & Exposure safety

Class B firefighting requires all personal protective equipment (including SCBA) the same as structural firefighting. Wind may quickly turn flames, heat and byproducts of combustion towards firefighters. Even during spills, in which foam is applied as a preventative measure, ignition may occur posing serious danger to life & health. Firefighters should anticipate the possibility of rescue situations or rapidly changing conditions that would create a risk.

Swannanoa Firefighters attending training sessions in other jurisdictions are required to wear <u>full PPE</u> when using foam or other type streams during flammable liquid live fire evolutions and should evaluate fire potential during basic fire extinguisher training. Students may call a Chief officer for clarification based on conditions at a school.

When using or handling Class A or B foams, limit exposure to skin or clothing and wear eye protection when there is a potential for splashing. Foam products will cause some form of eye and skin irritation to varying degrees.