Foam System Proportioning And Testing

Apparatus Specification & Vehicle Maintenance Symposium 2006

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National Foam

The Foam Rule Books

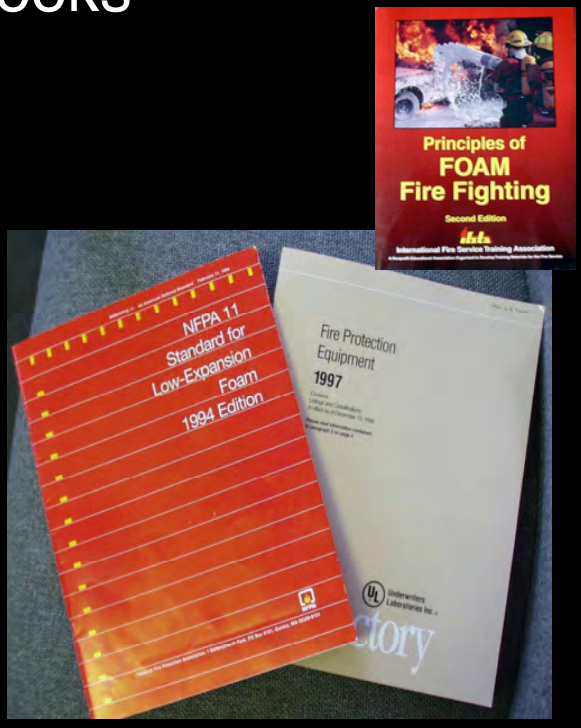
NFPA 11, 1901, 1911, 1145, 1150, 414, 412, etc.

Wetting agents are treated in NFPA 18

U.L. Fire Protection Equipment Directory

FAA regulations

IFSTA Principles Of Foam Fire Fighting (training)



Underwriters Laboratory Listings…

The industry's assurance that the product will perform as advertised.

Gasoline:

MTBE Methanol And Ethanol Blends

Diesel Fuel

Jet Fuel

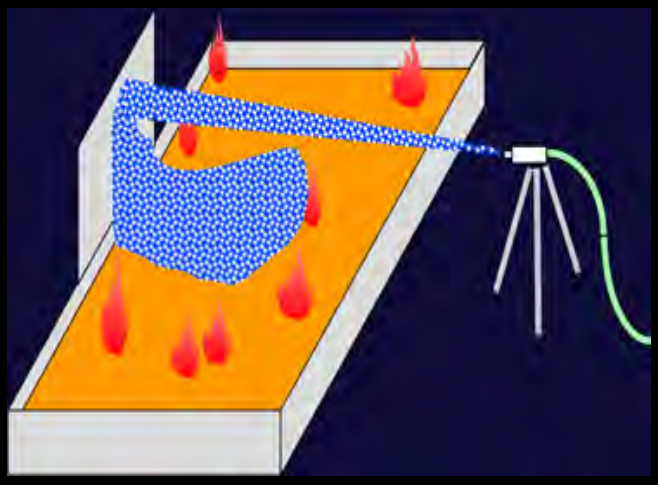
Ethanol (denatured alcohol)

Isopropyl Alcohol

Acetone

Underwriters Laboratory Fire Tests

The BASIC UL162 (NFPA 11) fire test for simple hydrocarbon fuels requires air-foam to extinguish a 50 sq. ft. heptane fire at 2 gpm, in five minutes or less; prevent burn back and hold vapors secure against a torch for fifteen minutes. Similar tests are conducted on high performance gasolines and polar solvent fuels such as ethanol.



A similar test is conducted using NFPA 18, wetting agents, which generally use more water and agent to extinguish the heptane fire than conventional AFFFs.

Note: There are no UL tests for polar solvents (ethanol) using NFPA 18, wetting agents.

In the class B world, everything depends on proportioning accuracy.

At crash scenes, lives depend on proportioning accuracy.

Proportioning accuracy is mission critical in terms of extinguishing liquid fires.

Proportioning accuracy is mission critical in terms of protecting crash scene spills.

Proportioning accuracy is critical to foam use economics $$$

Class A Proportioning Accuracy

Nobody dies if your class A system proportions lean…

For most municipal customers, if it makes bubbles, you're good to go… Not so!

1/2% - 3% or 6%?

Systems Make Foam Solution

Definition

Concentrate added to water makes *Foam Solution*

Foam systems do this on the fly

Adding 3 ml. of foam concentrate to 97 ml. water, makes 100 ml of 3% foam / water solution.

Making 3% Foam Solution

Draw up 3 ml. foam concentrate using a graduated eye dropper or a plastic, medication syringe.

Add concentrate to 97 ml. water.

Green food dye was added to the water for visibility.

Shake To Expanded Foam

Aerate the solution sample by vigorously shaking for about fifteen seconds. This sample has expanded to the 750 ml. line, in a 1000 ml. bottle, which is a 7.5:1 expansion ratio.

NFPA 1911

Foam System Solution Testing

20.1.1 At minimum, the foam proportioning system shall be tested annually.

20.2.1 The system output shall be measured to determine calibration accuracy.

NFPA 1911

(Annual System Testing)

20.3 Testing Methods.

One of the following four methods for testing a foam proportioning system for calibration accuracy shall be used:

(1) Substituting water for foam concentrate

(2) Measuring foam concentrate pump output directly

(3) Determining foam percentage by use of a refractometer

(4) Determining foam percentage by use of a conductivity meter

NFPA 1901- Current

Less than 1%

19-9-4* Foam Proportioning System Accuracy. (Paraphrased)

Foam proportioning shall be accurate throughout the manufacturer's stated range of flows and pressure(s). Systems designed to produce foam at less than one percent (class A for example) shall proportion foam concentrate to an accuracy of +/-20%.

Therefore, if your system is set at 1/2% (0.05) it's ok if it proportions at 0.04 or 0.06%.

There's no life safety down-side to lean proportioning with Class A systems.

NFPA 1901- Current

Greater than 1%

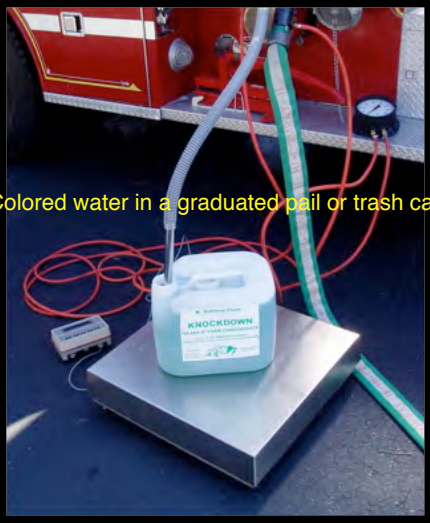
19-9-4* Foam Proportioning System Accuracy. (Paraphrased)

Foam proportioning shall be accurate throughout the manufacturer's stated range of flows and pressure(s). Systems designed to produce foam greater than 1 percent (class B for example) shall proportion foam concentrate to an accuracy of -0 to +30%, or 1 percentage point, whichever is less.

Therefore, if your system is set at 3% (0.3) it's ok if it proportions at 0.39 (4%). If at 6%, it is OK at 7%.

Solution can be rich - but no lean…

NFPA 1911
Water Substitution Method



Colored water in a graduated pail or trash can

This method relies on substituting water for foam concentrate. Where measuring how much water (by weight or volume) is drawn into the proportioning system over time.

I would add foam concentrate equivalency factors here. As foam viscosity can be cause for lean proportioning.

NFPA 1911
Water Substitution Method

A 500 GPM system, set at 3% will drink fifteen-gallons of water or more in sixty-seconds. If it drinks fifteen-gallons of water in a minute, it will drink about 99% of that using AFFF or Class A foam.

If using fluoroprotien foam or Alcohol Resistant, AFFF (AR-AFFF) the same system will consume about 15% less, or 85% of water's value.

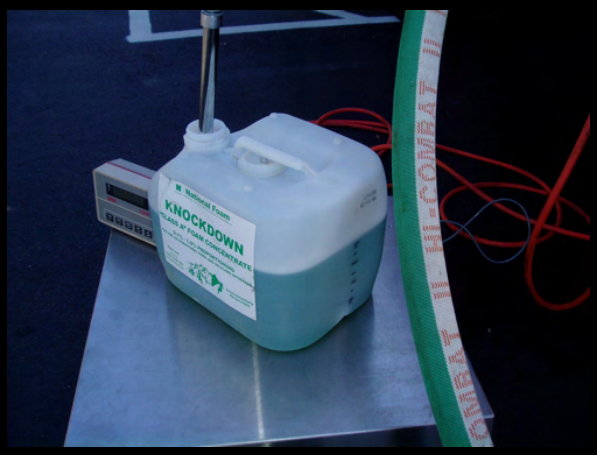
NFPA 1911
Foam Pump Outlet Flow Measurement

Suitable For Direct Injection Systems

A 3%, 100 GPM solution setting should discharge three gallons of concentrate in sixty-seconds. If water were in the foam tank, it might discharge slightly more than 3 GPM. I recommend viscosity equivalents be considered for fluoroprotein and AR-AFFF foam concentrate.

If using a scale to determine exact foam concentrate output, consult foam manufacturer's data sheet for your foam's weight (specific gravity) compared to water.

NFPA 1911
Foam Pump Outlet Flow Measurement



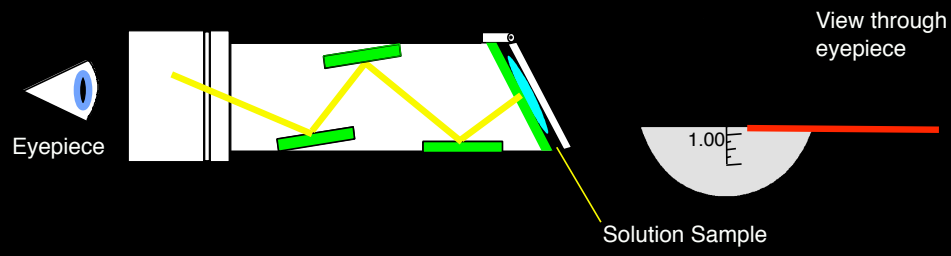
Cause for inaccuracy using this method may be due to lack of back pressure against the foam pump's discharge hose.

A foam concentrate pump in good or new condition may well perform to specification. If the pump is worn or slipping, back pressure may be a cause for lean proportioning.

A restrictor valve and pressure gauge fit on the pump's discharge hose can be helpful where tests against the water pump's discharge pressure is desired.

Refractive Index Method

A system sample compared to a bench-mark sample



The refractometer works fine for protein based foam solutions

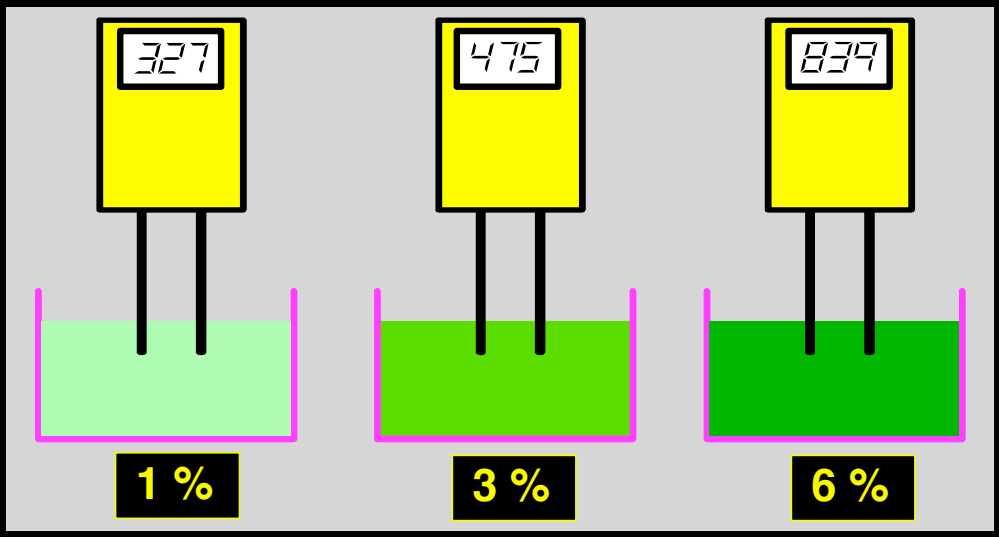
Readings should be done with solution at 50 degrees (10 C) or higher.

OK for mil spec. AFFF (mil. F24385) Butylcarbitol is the refractive chemical.

Not recommended for class A, civilian AFFF and AR-AFFF's, as refractive chemicals may not be present in enough quantity to produce accurate readings.

Accurate readings are difficult achieve in solutions of 1% or less.

ELECTRICAL CONDUCTIVITY



As concentrate is added to water, solution becomes increasingly conductive.

A properly proportioned sample is compared to system discharge.

Not appropriate for solutions produced with sea water.

Down and dirty - In the field

Need:

Stop watch

Two empty, 1000 ml plastic bottles

Cylinder graduate

Marking pen

Using water measured in a graduate, mark the two bottles (as shown) at 100 - 500 - 750 and 25 mil. The 25 ml line should be at the capped end of the bottle.

Down and dirty test… Step 1

Sample from foam pail or foam tank

Add 3 ml of foam concentrate the system will be using for the test to 97 ml test water.

Booster tank or hydrant water.

Note:

Regular AFFF concentrate does not gell-up.

Alcohol resistant (AR-AFFF) foam is normally gell-like in appearance; and is easily lifted with an eye-dropper or medication syringe.

Down and dirty test… Step 2

Vigorously shake the bottle for fifteen seconds or longer. Make sure all the concentrate and water has fully expanded.

Turn it on its cap and start the watch…

Down and dirty test… Step 3

25 ml drainage line

When 25 ml have drained to the line, stop the watch. This is the quarter drain time of the bench-mark sample. You're going to compare this to a system discharge sample in the next step.

Down and dirty test…. Step 4

Run the foam system (make foam) for at least thirty seconds at a setting that compares with the bench-sample.

Down and dirty test… Step 5

Throttle down.

Bleed pressure.

Shut the discharge nozzle.

Capture a solution sample from a discharge hose coupling.

Down and dirty test… Step 6

Put 100 ml of the system discharge sample into the other test bottle.

Shake till its fully expanded. Compare the system sample's quarter drain time to your bench-mark sample.

Down and dirty test… Step 7

If the quarter life is near the same (+/- 5%) as the bench sample, you're good to go.

Five-minutes is 300 seconds. Five % would be +/- fifteen seconds.

If it's less, you're lean

If it's more you're rich.

A little rich is OK

Lean is not good

Note: Although this test method is not as scientific as the tests described in the NFPA standard, it's close enough to determine if something is very wrong.

Down and dirty test… Alcohol Resistant?

In terms of your foam's ability to resist polar solvents, (alcohols) shake it again and apply the sample to dish of isopropyl-alcohol (UL's test fuel)

Isopropyl alcohol can be found as dry gas. Be sure it is isopropyl. Methyl alcohol is not as aggressive.

If the foam is destroyed as you apply it, it is either not alcohol resistant or your system is proportioning too lean.

This (sugar) membrane (polymer) will form on alcohol if the foam is alcohol resistant.

Alcohol Resistant Wetting Agents. No such thing.

To test an NFPA 18 - UL wetting agent, prepare a 500 ml. batch, proportioned at 6% (470 ml water and 30 ml agent).

Ignite 100 ml. isopropyl-alcohol and apply the solution.

Be sure to use a metal loaf pan under your test cell, as overflow may cause an unexpected fire emergency.

Have a proper fire extinguisher on hand, just in case.

Causes for test failure:

- Contaminated concentrate
- Debris in the foam concentrate plumbing.
- Concentrate plumbing too small
- System strainer too small for AR-AFFF
- Too much system back pressure
- System not installed to specification.
- Foam tank not properly vented
- Low budget, non-listed foam concentrate

Storing Fire Fighting Foam Concentrate

Store between 35 and 120 degrees

Keep containers closed. Do not store foam concentrate in boiler rooms, outdoor sheds or attics. Storage temp. range should be between 120 f and 35 f. Freezing and thawing will not harm foam. Per NFPA 11:
Do not mixing unlike foam brands. Never mix class A foam with Class B foam. Not even trace amounts

Shelf life is indefinite as long as foam is stored in original packaging or in approved tanks.

NFPA 11 says:
Do not mixing unlike foam brands. Never mix class A foam with Class B foam. Not even trace amounts

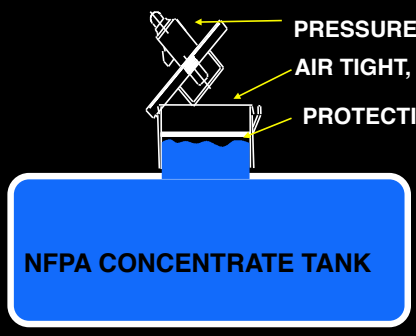
Accidental A or B mixing can be system fatal...

Half cup alcohol based class A foam or regular AFFF and a shot glass of AR-AFFF will do this in minutes.

The AR-AFFF's xanthan is doing what it should… in your tank, rather than on a spill...

Apparatus Foam Tanks

Store foam as if it were latex paint.

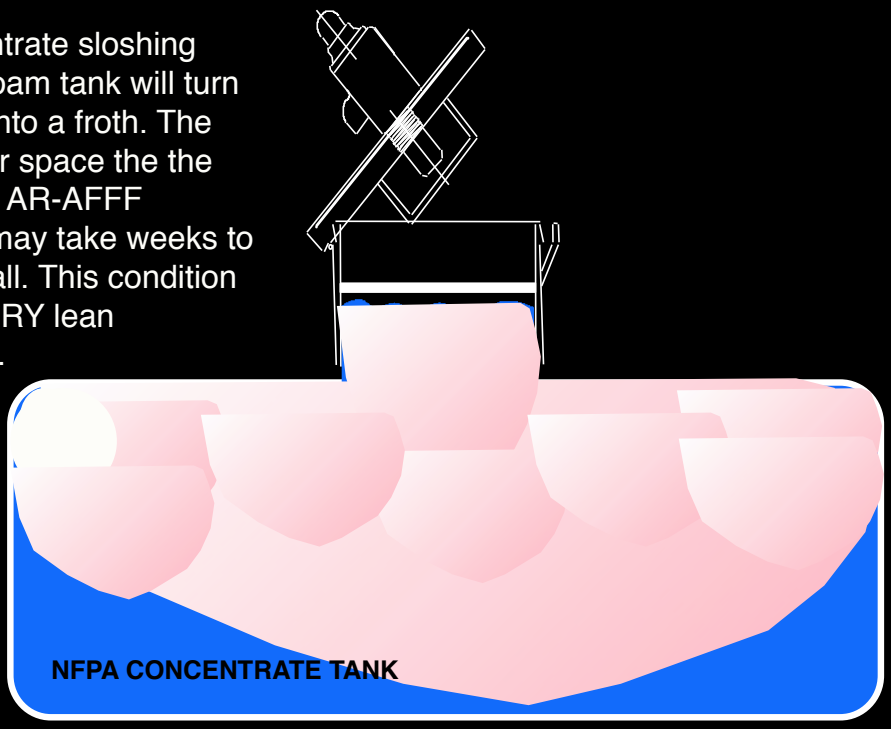


MINIMISE AIR TO CONCENTRATE INTERFACE

Keeping the tank full prevents sloshing.
This tends to stop aeration of the foam in your tank which will result in lean proportioning.

Keep Apparatus Foam Tanks Full!

- Foam concentrate sloshing around in a foam tank will turn concentrate into a froth. The greater the air space the the worse it gets. AR-AFFF concentrate may take weeks to unfroth, if at all. This condition will cause VERY lean proportioning.



Concentrate supply plumbing

AR-AFFF foam users:

Supply plumbing from foam concentrate tank to foam pump or foam eductor must be at least 3/4” for 1/2 to 3 GPM.

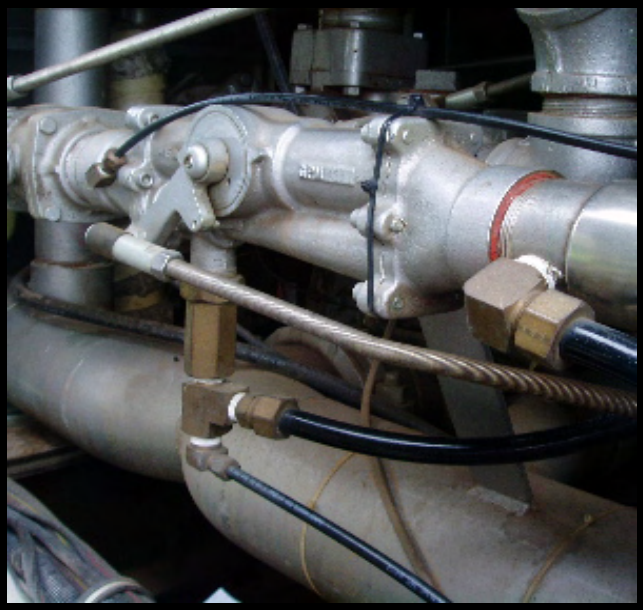
3 to 8 gpm - One inch hose

10 to 15 GPM 1.25” hose

20 GPM to 30 GPM 1.5” hose

30 gpm + 2” hose

AVOID AIR BRAKE HOSE!



Pet peeves:

System failures caused by back pressure and plumbing mistakes.

Your Foam Is Jelled-up!

NO WAY! That’s how it’s made. The thicker it is the more alcohol resistant polymer it contains.