There is very little information on the service procedure, and use of Foam fire extinguishers. Understand the following terms:

- Foam concentrate is the liquid substance purchased from a manufacturer in a containers.
- Foam solution is the mixture obtained when foam concentrate is proportioned (mixed) with water prior to the addition of air.
- Finished foam is obtained by adding air to foam solution through either entrainment or mechanical agitation.

Foam Proportioning and Delivery Systems

The effectiveness of foam depends on proper proportioning and the ability to deliver finished foam to the spill or fire.

Concentration Levels

Foams are applied at various concentration levels depending on the fuel involved and the concentrate being used.

Typically for hydrocarbons, foam is proportioned at 3 percent: that is three parts foam concentrate to ninety-seven parts water.

For polar solvents, foam is usually proportioned at 6 percent: that is six parts foam concentrate to ninety-four parts water.

Some concentrates allow for proportioning at 1 percent on hydrocarbons.

Foam Delivery Method

A number of ways exist to proportion foam. These include: line inductors, self-inducting nozzles (Portable Fire Extinguishers), pressure systems, and pump proportioning systems.

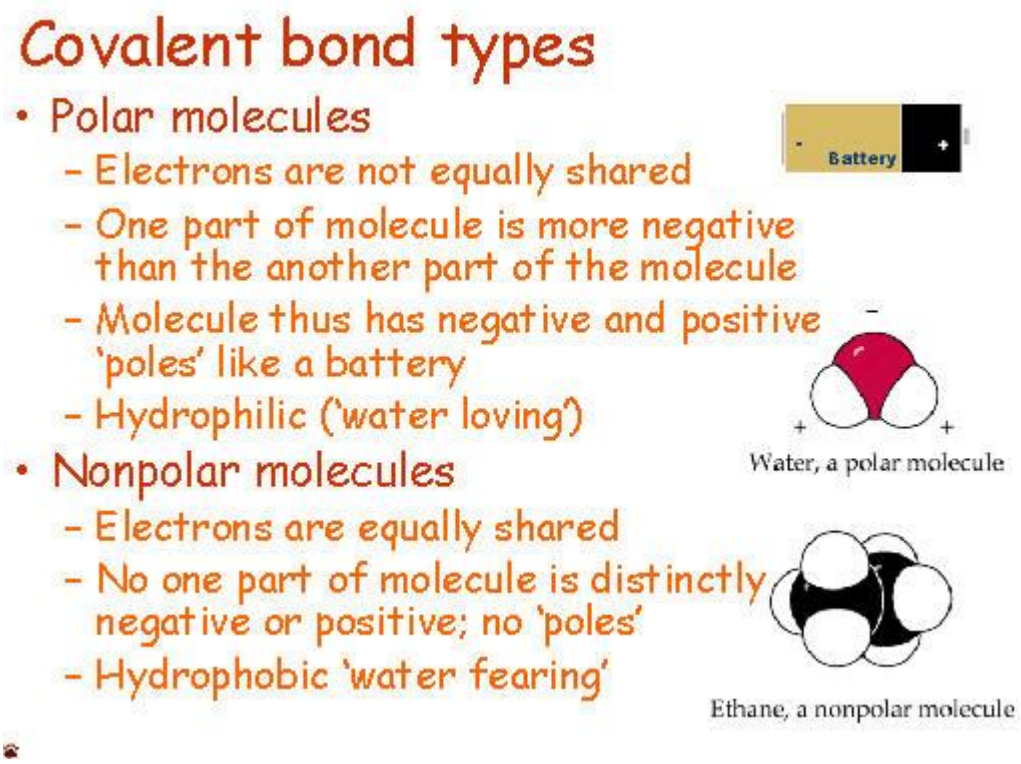
Foams we will concentrate on AFFF and AR-AFFF

Other Types of Foam.

- ✓ Protein foam, one of the earliest foams, is produced by the hydrolysis of protein material such as animal hoof and horn. Stabilizers and inhibitors are added to prevent corrosion, resist bacterial decomposition, and control viscosity.
- ✓ Fluorprotein foams are formed by the addition to protein foam of special fluorochemical surfactants that reduce the surface tension of the protein-based concentrate and allow more fluid movement.
- ✓ Film-Forming Fluoroprotein Foam (FFFP) is a protein-based foam with the more

advanced fluorochemical surfactants of AFFF. FFFPs combine the burn-back resistance of fluoroprotein foam with the knockdown power of AFFF.

Polar and Non-Polar Foams



http://www.thinglink.com

Class B liquid fires / Polar solvents

Chemical fires are polar liquid fires. Polar solvents are usually carriers of O or N atoms, or also halogens: Cl, Br, F or I.

They are characterised by their affinity for water (Love It).

There are 7 main families:

- The **alcohols**: methanol, ethanol, isopropanol…
- The **ketones and aldehydes**: acetone, acetaldehyde, methylethycathinone, MIBK…
- The **esthers**: ethyl acetate…
- The **ethers** : diethylether, MTBE, THF…
- The **glycols** : a combination of 'alcohol + ether': MEG, MPG, Butoxyethanol, butylcarbitol…
- The **amines** : trimethylamine…
- The **acids** : acetic acid, propionic acid…

As they have a great affinity for water they can be only be put out using specific so-called "versatile" or AR "Alcohol Resistant" foam concentrates.

Alcohol Resistant-Aqueous Film Forming Foam (AR-AFFF)

AR-AFFF's are available in a 3%/6% type or 3%/3% type concentrate. Flammable liquids that readily mix with water are a more difficult fire to extinguish as opposed to a hydrocarbon fire. Polar solvent/alcohol liquids destroy any foam blanket that has been generated using standard AFFF or fluoroprotein type concentrates. Water in the generated foam blanket mixes with alcohol causing the foam blanket to collapse and disappear until the fuel surface is completely exposed again. To overcome this problem, AR-AFFF type concentrates were developed. Using plain AFFF concentrate as a base material, a high molecular weight polymer is added during the manufacturing process. When AR-AFFF is used on a polar solvent fuel fire, the polar solvent fuel tries to absorb water from the foam blanket. A polymer precipitates out forming a physical membrane/barrier between the fuel surface and foam blanket. This barrier now protects the generated foam blanket from destruction by the alcohol fuel.

AR-AFFF concentrates are very viscous. Initial impression of this type of foam concentrate my lead one to believe that the concentrate has "gelled" and somehow gone bad. However, a thick, gel-like appearance is normal. This appearance is caused by the presence of polymers, which are the main components required for polar solvent applications. Modern AR-AFFF concentrates are designed to work through proportioning equipment such as in-line inductors, bladder tanks, and balanced pressure pump systems.

AR-AFFF 3%/6% type of concentrate is designed to be used at the 3% application rate when used on a standard hydrocarbon fuel fire and 6% when used on a polar solvent/alcohol fuel. Current 3% AR-AFFF type concentrate is designed for 3% application on either type group, i.e. 3% on hydrocarbons and 3% on polar solvent fuels.

When AR-AFFF is used at the correct proportioning rate on hydrocarbon fuel, firefighting performance and application rate are the same as for standard AFFF agents. An "invisible" film is formed, the speed of covering a fuel spill with the foam blanket is similar and the application technique using either air-aspirating or non-air-aspirating nozzles can be used. When used on an alcohol fire, an air-aspirating nozzle will give a better performance over the non-air-aspirating nozzle. The increased expanded foam mass generated by the air-aspirating nozzle will give a more gentle application onto the surface of the alcohol liquid fire than will the non-aspirating nozzle. The intensity of the fire, distance the foam must be thrown, and the application rate also play an important part in determining the type of nozzle and method of extinguishment. The application technique and performance factors are the same for both the 3% and the 3%-6% types of AR-AFFF concentrates.

Class B liquid fires / Hydrocarbons – Non Polar (Hates Water)

Hydrocarbon fires are **combustible liquid fires**.

Hydrocarbons are composed of **carbon** and **hydrogen**.

They are combustibles that have no affinity for water.

There are 3 main families:

- Light hydrocarbons: petrol, heptane, cyclohexane, terpenes...
- Heavy hydrocarbons: fuel, diesel, kerosene...
- Aromatic hydrocarbons: benzene, toluene...

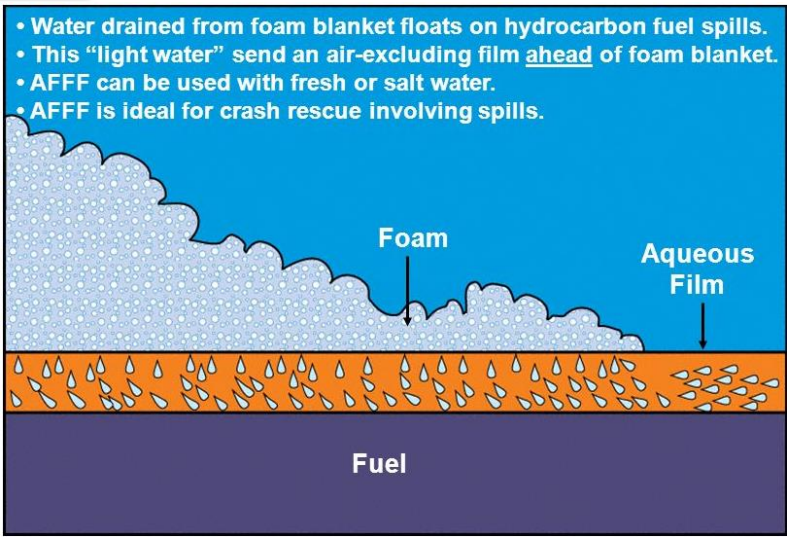
Aqueous Film Forming Concentrate (AFFF)
Available in either a 1%, 3%, or 6% type concentrate. These concentrates are manufactured from synthetic type materials such as: Synthetic foaming agents (hydrocarbon surfactants); Solvents (i.e., viscosity leveller, freezing point depressant, foam booster); Fluoro Chemical surfactants; Small amounts of salts; Foam stabilizers (slow drainage, increases fire resistance).

AFFF generated foams extinguish hydrocarbon flammable liquid fires the same way as the protein or fluoroprotein foams; however, there is an additional feature. An aqueous film is formed on the surface of the flammable liquid by the foam solution as it drains from the foam blanket. This film is very fluid and floats on the surface of most hydrocarbon fuels. This gives the AFFF un-equalled speed in fire control and knockdown when used on a typical hydrocarbon spill fire. In certain circumstances, it is possible to notice the fire being extinguished by the "invisible" film before there is complete foam blanket coverage over the surface of the fuel.

AFFF foam solutions can be applied to a flammable liquid fire using either aspirating or non-aspirating discharge devices. The difference between the two is that the air-aspirating device entrains air and causes it to mix with the foam solution within the device. The non-air-aspirating device is incapable of this process.

- The AFFF/Water solution requires relatively low energy input to expand the foam solution into an expanded foam mass.
- AFFF foam solutions are unique in that in addition to forming an expanded foam mass, the liquid that drains from the blanket has a low surface tension, which gives it the ability to form the aqueous film that floats on the fuel surface.

When flow rates and pressures are similar, AFFF solutions used with a non-air-aspirating discharge device will generally discharge/throw the foam a greater distance than the foam that is discharged from the air-aspirating discharge device. A non-aspirating AFFF will generally extinguish a low vapour pressure fuel spill fire slightly faster than the foam discharged from an air-aspirating device. This is because the non-aspirated nozzle generated foam has a lower expansion and will be more fluid; therefore, it will move faster across the fuel surface.



EXPANSION RATE: Volume of finished foam divided by the volume of foam solution used to create the finished forma; i.e., a ratio of 5 to 1 would mean that one gallon of foam solution after aeration would fill an empty 5-gallon container with the expanded foam mass.

LOW EXPANSION FOAM: Foam aerated to an expansion ratio of between 2 to 1 and 20 to 1.

MEDIUM EXPANSION FOAM: Expansion ratio between 20 to 1 and 200 to 1.

HIGH EXPANSION FOAM: Expansion ratio above 200 to 1.

DILUTION RATE, MIXING RATE, OR PROPORTIONING RATE (Correct amount of foam concentrate to be mixed with water): The amount is normally shown on the drum of concentrate. If the container of foam concentrate has 3% shown, it means that for every 100 litres of foam solution required, 3 litres of the foam concentrate must be used in the solution with the balance being 97litres of water.

SEAWATER COMPATIBLE: Some foam concentrates can be used successfully with either sea, fresh or brackish water.

Fire departments generally equip themselves with a type of foam that will handle multiple flammable liquid types that are commonly encountered. Generally that would be AR-AFFF (Alcohol Resistant, Aqueous Film Forming Foam.) AR-AFFF is a multi-use, multi-purpose foam concentrate. This type of foam can be used in low concentrations (3%) to fight a common petrol or diesel fire at an accident scene. At higher percentages (6%) the same foam can be used to fight fires that contain polar solvents such as

alcohol. (Polar solvents are compounds that readily mix with water which will cause a foam blanket to dissolve rapidly.)

www.davidsfire.com/foam_basics.htm

Ansul

Class B Hydrocarbons (AFFF)

Class B Foam Agents are ideal for suppressing fires involving petroleum-based products, LNG, rubber, and flammable and combustible liquids; such as diesel fuel, crude oil gasoline and ethanol.

ANSULITE Aqueous Film-Forming Foam (AFFF) can be applied through a wide variety of delivery systems which provides extreme versatility. The foam is an ideal fire suppression choice for airports, refineries, manufacturing plants, municipal fire departments, and other operations involving the transportation, processing, or handling of flammable liquids. It is available as 1%, 3%, and 6% concentrates or as 1% and 3% freeze-protected concentrates.

As with other Class B Foam Agents, ANSULITE AFFF extinguishes fires of flammable gases, liquids, greases, and similar materials by excluding oxygen and inhibiting the release of combustible vapours... The combustion of these liquids and gases involves rapid vapour-phase oxidation of the fuel and subsequent involvement of more fuel due to radiant heat feedback.

Class B Polar Solvents (AR-AFFF)

Class B Foam Agents are ideal for suppressing fires involving petroleum-based products, LNG, rubber, and flammable and combustible liquids; such as diesel fuel, crude oil gasoline and ethanol.

ANSULITE Alcohol-Resistant Aqueous Film-Forming Foam (AR-AFFF) Concentrates produce a foam that is effective on hydrocarbon fuels as well as fuels such as methanol, ethanol and acetone which have appreciable water solubility or miscibility. AR-AFFF exhibits the best cross-functional performance for flame knock-down, burn-back resistance, extended vapour suppression, manufacturing and proportioning consistency, and the longest potential shelf life.

While early alcohol-resistant foams were based on mixtures of protein foams and chemicals called metal soaps, the most current alcohol-resistant concentrates are based on AFFF concentrates to which a water soluble polymer (polysaccharide) has been added. When these foam agents are applied to a water soluble fuel such as methyl alcohol, a polymeric membrane is formed between the foam and the water soluble fuel. When these foam agents are used on a conventional (water insoluble) hydrocarbon fuel, they function as an

AFFF foam by forming an aqueous film at the fuel/air interface.

Property	*Protein*	*Fluoroprotein*	*AFFF*	*FFFP*	*AR-AFFF*
Knockdown	*Fair*	*Good*	*Excellent*	*Good*	*Excellent*
Heat Resistance	*Excellent*	*Excellent*	*Fair*	*Good*	*Good*
Fuel Tolerance	*Fair*	*Excellent*	*Moderate*	*Good*	*Good*
Vapour Suppression	*Excellent*	*Excellent*	*Good*	*Good*	*Good*
Alcohol Tolerance	***None***	***None***	***None***	***None***	***Excellent***
Source: National Foam					

Inspection and Servicing:

General Maintenance or Extended Maintenance is per the requirements of SANS1475 Part 1, and the manufacturers requirements.

Sadly manufacturer's specification, and parts lists are simply lacking in South Africa at the stage.

This type of extinguisher is dependent on it components and mix ratio. Name the Nozzle and the Foam concentrate.

Any changes to the nozzle design or the strength will effect the performance of the extinguisher.

Example: You cannot put a Chubb nozzle on a Safequip Extinguisher, and so on. (Not that you are allowed to do it anyway – SANS1475 Part1)

You cannot change the Foam Type or the strength of the Foam mix.

Foam:

Foam Strength increased over the percentage requirement will effect the flow rate and the throw distance.

Foam Mixture too weak will not aerate properly, and will be more water than foam mix. This would not assist in putting a fire out, and could in-fact exasperate the problem.

If the Nozzle is not the correct one for that particular extinguisher it will effect the overall performance of the extinguisher, and again it could end up exasperating the problem.

Finally: Part of your tasks is to is to indicate whether the extinguisher is covering the risk it has been designed for – So is it the correct equipment for the risk "Polar or Non-Polar"?

PORTABLE FOAM FIRE EXTINGUISHERS DO NOT WORK ON THREE DIMENSIONAL FIRES

Three-dimensional Class B Fires. A three-dimensional Class B fire involves Class B materials in motion such as pouring, running or dripping flammable liquids and generally includes vertical as well as one or more horizontal surfaces. Fires of this nature are considered to be a special hazard. Class B fires are those involving flammable (gasoline, alcohol) and combustible (diesel, oil, tar, grease) liquids

NFPA 11 – Low, Medium and High Expansion Foam Standard – Annex A.1.1 specifically states, "Foam is not suitable for three-dimensional flowing liquid fuel fires or for gas fires." F-500 Encapsulator Agent has proven itself to be very effective on three-dimensional fires around the world. When municipal fire departments arrive on the scene of a fire, they may encounter flowing fuel fires or flat spill fires. Having a single product that has a multitude of capabilities is desirable over having to choose between various foams required for different types of fires.

Check MSDS for whether the substance is Polar or Non-Polar – and if in doubt use AR Type foam which works on both.

Presented By: Name:_____	Date _____	Signature _____

NAME	SIGNATURE	NAME	SIGNATURE