

# Compressed Air Foam.

## Terminology

### A

Absorption - The act of absorbing or being absorbed.

Adherence - The act of binding together substances of unlike compositions.

Aeration - The introduction of air into a foam solution to create bubbles that result in finished foam.

AFFF - Aqueous film forming foam

Anchor Point - A safe, secure area where a wildfire attack begins. The anchor point prevents the fire from outflanking the crew members and dangerously surrounding them.

Application Rate - The minimum amount of foam solution that must be applied to a fire, per minute, per square foot (square meter) of fire.

ARFF - Aircraft rescue and firefighting.

Aspirate - To draw in air; nozzle aspirating systems draw air into the nozzle to mix with the agent solution.

Automatic - Readily adjusts to changes in water flow and or pressure to maintain a desired mix ratio.

### B

Backdraft - Instantaneous explosion or rapid burning of superheated gases that occur when oxygen is introduced into an oxygen-depleted confined space. It may occur because of inadequate or improper ventilation procedures.

Backfire - Technique used in the indirect attack method for natural cover fires; intentionally setting a fire between the control line and the advancing fire. The intent is for the backfire to meet the advancing fire some distance from the control line.

Back Pressure - Pressure loss or gain created by changes in elevation between the nozzle and pump.

Bank-Down Method - This method of foam application may be employed when an elevated object is near or within the area

Batch Mix - Manual addition of foam concentrate to a water storage container or tank to make foam solution.

Batch-Mixing - The making of foam solution by pouring an appropriate amount of foam concentrate into a water tank.

Biodegradable - Capable of being broken down into innocuous products by the action of living things, such as microorganisms.

Biodegradation - Decomposition by microbial action, as with some detergents.

Blanket - A layer of foam

BLEVE - Acronym for Boiling Liquid Expanding Vapor Explosion.

Boil over - Overflow of crude oil from its container when the heat wave reaches the water level in the tank the water flashes to steam causing a violent expulsion of the material as a froth.

British Thermal Unit (Btu) - The amount of heat needed to raise the temperature of one pound of water one degree Fahrenheit.

Bubble - The building block of foam; bubble characteristics of water's content and durability influence foam performance.

Burn back Resistance - The ability of a foam blanket to resist direct flame impingement such as would be evident in a partially extinguished petroleum fire.

## C

CAFS - Abbreviation for Compressed-Air Foam System

Chemical Foams - Foams produced as a result of a reaction between two chemicals.

Class A Fire - 1. Fire in "ordinary" combustible solids. (However, if a plastic readily melts in a fire, it might be Class B rather than Class A.) 2. Fires involving ordinary combustibles such as wood, paper, cloth, and so on.

Class B Fire - Fires of flammable and combustible liquids and gases such as gasoline, kerosene, and propane.

Class C Fire - Fires involving energized electrical equipment.

Class D Fire - Fires of combustible metals such as magnesium, sodium, and titanium.

Class A Foam - Foam intended for use on Class A or woody fuel; made from hydrocarbon-based surfactant, therefore lacking the strong filming properties of Class B foam, but possessing excellent wetting properties. Class A foams are essentially wetting agents that reduce the surface tension of water and allow it to soak into combustible materials easier than plain water.

Class B Foam - Foam designed for use on Class B or flammable liquid fires; made from fluorocarbon-based surfactants, therefore capable of strong filming action but incapable of efficient wetting of Class A fuels. Foams designed to be used on fires or spills of flammable and combustible liquids.

Cohesion - The act of binding together substances of like composition.

Combination Nozzle - Also called an "adjustable fog nozzle." This nozzle is designed to provide either a solid stream or, fixed spray pattern suitable for water or wet water application.

Combustible Liquid - Liquid having a flash point at or above 100°F (37.8°C) and below 200°F (93.3°C).

Compressed Air Foam Systems (CAFS) - A generic term used to describe foam system; consisting of an air compressor (or air source), a water pump, and foam solution.

Concentrate - A substance that has been concentrated; specifically a liquid that has been made denser, as by the removal of some of its water.

Conduction - Transfer of heat energy from one body to another through a solid medium.

Conductivity - The ability of a substance to conduct an electrical current.

Confinement - (1) The process of controlling the flow of a spill and capturing it at some specified location. (2) Firefighting operations required to prevent fire from extending to uninvolved areas or structures.

Consistency - Uniformity and size of bubbles.

Containment - The act of stopping the further release of a material from its container.

Convection - Transfer of heat by the movement of fluids or gases; usually in an upward direction.

Cooling - The act of lowering the temperature of the fuel and adjacent surfaces.

Corrosives - Those materials that cause harm to living organisms by destroying body tissue.

## D

Degradation - The act of degrading or being degraded in rank, status, or condition.

Density - Weight per unit of volume of a substance. The density of any substance is obtained by dividing the weight by the volume. The amount of foam solution in the foam (note difference from "expansion").

Diked Areas - Areas that are bounded by either natural or manmade barriers intended to keep spilled fuel within these boundaries.

Direct Attack - (1) To attack a natural cover fire directly at or close to the burning edge. (2) Application of a fire stream directly onto a burning fuel.

Drainage Dropout Rate - See Drain Time.

Drainage Rate - See Drain Time.

Drain Time - The amount of time it takes foam to break down. Also called Drainage Rate and Drainage Dropout Rate. The time (minutes) it takes for foam solution to drop out from the foam mass for a specified percent of the total solution contained in the foam to revert to liquid and drain out of the bubble structure

Dry Foam - Foam that has a very high air-to-foam solution ratio. This foam will cling to horizontal surfaces.

Durability - The effective life span of foam bubbles.

## E

Eductor - A mixing system that uses water pressure to draw the fire chemical into the water stream for mixing; enables a pump to draw foam concentrate, as well as water, into the hose line. Portable proportioning device that injects a liquid, such as foam concentrate, into the water flowing through a hose line.

Ejector - Occasionally an injector is used to proportion mixes; this type of equipment is frequently referred to as an "ejector," though sometimes as an "injector."

Envelopment - Attacking key or critical segments around the entire fire perimeter at the same time.

Expansion - See Aeration.

Expansion Ratio - The ratio of the volume of the foam in its aerated state to the original volume of the non-aerated foam solution.

Explosive Limit - See Flammable Limit.

Explosive Range - See Flammable Range.

Exposure Protection - Covering any object in the immediate vicinity of the fire with water or foam.

## **F**

Fire Flow - (1) Quantity of water available for firefighting in a given area. It is calculated in addition to the normal water consumption in the area. (2) The amount of water required to extinguish a fire in a timely manner.

Fire Point - Temperature at which a liquid fuel produces sufficient vapors to support combustion once the fuel is ignited. The fire point is usually a few degrees above the flash point. Also called Burning Point.

Fire Retardant - Any substance that by chemical or physical action reduces the flammability of combustibles.

Fire Tetrahedron - Model of the four elements required to have a fire. The four sides represent fuel, heat, oxygen, and chemical chain reaction.

Fire Triangle - Plane geometric figure in which the three sides of an equilateral triangle represent oxygen, heat and fuel — the elements necessary to sustain combustion.

Flammable Limit - Percentage of a substance in air that will burn once it is ignited. Most substances have an upper (too rich) and lower (too lean) flammable limit also called Explosive Limit.

Flammable Liquid - Any liquid having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psi absolute (276 kPa).

Flammable Range - The range between the upper flammable limit and lower flammable limit in which a substance can be ignited. Also called Explosive Range.

Flank - Sides of a natural cover fire.

Flanking - Attacking the sides of the fire from a less active area or from an anchor point; the intent being to have the two crews attacking the flanks meet at the head of the fire.

Flashover - Stage of a fire at which all surfaces and object within a space have been heated to their ignition temperature and flame breaks out almost at once over the surface of all objects in the space.

Flash Point - Minimum temperature at which a liquid gives off enough vapors to form an ignitable mixture with air near the liquid's surface.

Fluid Foam - A shaving cream like foam that will hold peaks and cling to vertical surfaces. Used for protection of fuels.

Foam - (1) The aerated solution created by forcing air into, or entraining air in, a water solution containing a foam concentrate by means of suitably designed equipment or by cascading it through the air at a high velocity. (2) Extinguishing agent formed by mixing a foam concentrate with water and aerating the solution for expansion; for use on Class A and Class B fires. Foam may be protein, synthetic, aqueous film forming, high expansion, or alcohol type. Also known as finished foam.

Foam Concentrate - (1) The raw foam liquid as it rests in its storage container prior to the introduction of water and air. (2) The fire chemical product as received from the supplier that, when diluted with water, becomes foam solution.

Foam Expansion - See Aeration.

Foam Generation - The foam production process of solution agitation in a hose, mix chamber, or nozzle.

Foam Line - A body of foam placed along areas to be protected from fire; also used as an anchor for indirect attack in place of hand-made fire trail.

Foam Monitor - A foam master stream nozzle.

Foam Proportioner - Device that injects the correct amount of foam concentrate into the water stream to make the foam solution

Foam Solution - (1) A homogeneous mixture of water and foam concentrate in a proportion that meets the needs of the user. The dilute working-form of foam concentrate to which air is added to produce foam. (2) Mixture of foam concentrate and water after it leaves the proportioner but before it is discharged from the nozzle and air is added to it.

Foam Stability - The relative ability of a foam to withstand spontaneous collapse or breakdown from external causes.

Foam Systems - The apparatus and techniques used to mix concentrate with water to make solution, pump and mix air and solution to make foam, and transport and eject foam. (Systems defined here include compressed air foam and nozzle aspirated.)

Foam Tetrahedron - Model of the four elements required to create foam. The four sides represent water, foam concentrate, air and agitation.

Foam Type - A combined measure of drain time and expansion to describe durability, consistency, viscosity, and density.

Frontal Attack - Where the crew begins the attack from an anchor point at or near the head of the fire and then proceeds to the flanks.

## H

Heat Resistance - Foam's ability to resist the actual heat of the liquid or surface on which it is applied.

Homogeneous - A substance having uniform structure or composition throughout.

Hot-Smoldering Phase - Phase of combustion when the level of oxygen in a confined space is below that needed for flaming combustion. The hot smoldering phase is characterized by glowing embers, high heat at all levels of the room, and heavy smoke and fire gas production.

Hydrocarbon - Organic compound containing only hydrogen and carbon and found primarily in petroleum products and coal.

Hydrolyze - A chemical process of decomposition involving splitting of a bond and the addition of the elements of water.

Hand line Nozzle - Any nozzle that can be safely handled by one to three firefighters and flows less than 350 gpm

## I

Incipient Phase - First phase of the burning process where the substance being oxidized is producing some heat, but the heat has not spread to other substances nearby. During this phase, the oxygen content of the air has not been significantly reduced.

Indirect Attack - (1) Directing the fire stream at the ceiling level to generate steam. The steam helps darken the fire and cool the area enough so that firefighters may safely enter and make a direct attack to extinguish the fire. (2) A method of controlling a wildfire where a control line is constructed or located some distance from the edge of the main fire.

Inductor - A control mechanism that allows a regulated quantity of foam concentrate to be introduced into the main hose line.

Ingestion - To take things into the body (food, drugs, etc.) by swallowing.

Ingredient - Each chemical component used in the formulation of a product.

## L

LEL - Abbreviation for Lower Explosive Limit.

## M

Manual Regulation - A proportioning method or device that requires a manual adjustment to maintain a desired mix ratio over a changing range of water flows and pressures.

Mechanical Foams - Foams produced by a physical agitation of a mixture of water, air, and a foaming agent.

MIL-SPEC Foams - Foams that meet military specifications.

Mix Ratio - The ratio of liquid foam concentrate to water, usually expressed as a percent.

Mixed Solution - The combination of water and foam concentrate used to produce the foam used for fire suppression.

Mixing Chamber - A tube drilled, with deflectors or baffles, that produce tiny, uniform bubbles in a short distance (1 to 2 ft).

Monitor - A turret-type nozzle usually mounted on an engine.

MSDS - Acronym for Material Safety Data Sheet.

## N

Nozzle Aspirated Foam System (NAFS) - A foam generating device that mixes air at atmospheric pressure with foam solution in a nozzle chamber.

## O

Oxidation - Chemical reaction in which oxygen combine with other substances. Fire, explosions, and rusting are examples of oxidation.

Oxidizer - Substance that yields oxygen readily and may stimulate the combustion of organic and inorganic matter.

## P

Polar Solvents - Flammable liquids that have an attraction for water, much like a positive magnetic pole attracts a negative pole; examples include alcohols, ketones, and lacquers.

Positive Heat Balance - When heat is fed back to the fuel. A positive heat balance is required to maintain combustion.

Premixing - Mixing pre measured portions of water and foam concentrate in a container. Typically, the premix method is used with portable extinguishers

Proportioner - Pumps foam concentrate, as demanded into the hose line.

Proportioning - The mixing of water with an appropriate amount of foam concentrate to form a foam solution.

Pyrolysis - Chemical decomposition caused by heat that generally results in the lowered ignition temperature of the material.

## Q

Quarter Drain Time - See Quarter-Life.

Quarter-Life - The time required in minutes for one-fourth of the total liquid solution to drain from a foam blanket. Also called 25 Percent Drain Time and Quarter Drain Time.

## R

Retention - The characteristic of Class A foam and foam solution to remain on and in the fuel, reduce the fuel temperature, and increase the fuel moisture content.

Roll-On Method - This method of foam application directs the foam stream on the ground near the front edge of the liquid pool on fire. The foam then rolls across the surface of the fuel.

Rollover - Unburned combustible gases released during the incipient or early steady-state phase accumulate at the ceiling level. These superheated gases are pushed, under pressure, away from the fire area and into uninvolved areas where they mix with oxygen. When their flammable range is reached, they ignite and a fire front develops, expanding very rapidly and rolling over the ceiling.

Radiation - transfer of heat energy through light by electromagnetic waves. Also called Radiated Heat.

Radiative Feedback - Radiant heat providing energy for continued vaporization.

Rain-Down Method - This method of foam application directs the stream into the air above the fire and allows the foam to float gently down onto the surface of the fuel.

Rate Of Vaporization - The speed at which a liquid evaporates or vaporizes.

Refractometer - A device used to measure the amount of foam concentrate in the solution. This device operates in the principle of measuring the velocity of light that travels through the foam solution.

Resistance to Freezing - A foam concentrate's usefulness after it has frozen and thawed. Some concentrates freeze at lower temperatures than others; most can be used after freezing and thawing.

## S

Scrubbing - The process of agitating foam solution and air within a confined space (usually a hose) that produces tiny, uniform bubbles - the length and type of hose determine the amount of scrubbing and, therefore, foam quality.

Semi subsurface Injection - A system that discharges the foam through a flexible hose that rises from the bottom of the tank, up through the fuel, to the surface.

Separating - The act of creating a barrier between the fuel and the fire.

Short-Term Retardant - A viscous, water-based substance wherein water is the fire suppressing agent.

Size-Up - Mental evaluation made by the operational officer in charge that enables him or her to determine a course of action to accomplish the mission; a mental process of evaluating all influencing factors before committing personnel and equipment to a course of action. Size-up includes such factors as time, location, nature of occupancy, life hazard, exposures, property involved, nature and extent of fire, weather, and firefighting facilities.

Slug Flow - In CAFS only, when foam solution is not rich enough to mix with air, inadequate mixing occurs; this sends pockets (or plugs) of water and air to the nozzle.

Solubility - Degree to which a solid, liquid, or gas dissolves in a solvent (usually water).

Specific Gravity - Weight of a substance compared to the weight of water

Stability - See Viscosity.

Static Source - Body of water that is not under pressure or in a supply piping system and must be drafted from in order to be used. Static sources include ponds, lakes, rivers, wells, and so on.

Steady-State Burning Phase - Generally considered the phase of the fire where sufficient oxygen and fuel are available for fire growth and open burning to a point where total involvement is possible.

Structure Fire - Fire that involves a building, enclosed structure, or like property.

Subsurface Injection - A process by which foam is pumped into the bottom of a burning petroleum tank and allowed to float to the top to form a fire extinguishing blanket.

Suppressing - Sometimes referred to as smothering. The act of preventing the release of flammable vapors and therefore reducing the possibility of ignition or reignition.

Surface Tension - 1. The effect of a surfactant on the water/concentrate solution. It allows the water to spread more rapidly over the surface of Class A fuels and penetrate organic fuels. 2. The elastic-like force in the surface of a liquid, tending to minimize the surface area and causing drops to form. (Expressed as Newtons per meter or dynes per centimeter; there are 1,000,000 dynes per Newton.)

Surface-To-Mass Ratio - The ratio of the surface area of the fuel to the mass of the fuel.

Surfactant - 1. A chemical that lowers the surface tension of a liquid. 2. A surface active agent; any wetting agent.

Suppressant - An agent used to extinguish the flaming and flowing phases of combustion by direct application to the burning fuel.

## T

Training Concentrates - Foam concentrates that are designed especially for training. They are specifically formulated for hydrocarbon fuel fire training. Training concentrates generally reproduce the white color, appearance, expansion ratio, and drain time of Class B foam

Tube Seal - A type of seal used on a floating roof fuel storage tank. The seal is constructed of urethane foam that is contained within an envelope. The seal connected to the edge of the roof around the entire circumference of the tank. A secondary weather shield is usually installed above this main seal.

Turret - Large master stream appliance mounted on a pumper or trailer and connected directly to a pump. Also called Deck Gun or Deck Pipe.

Twenty Five (25) Percent Drain Time - See Quarter-Life.

## U

UEL - Abbreviation for Upper Explosive Limit.

Use Level - The appropriate ratio of liquid foam concentrate to water recommended by the chemical manufacturer for each class of fire.

## V

Vapor Density - Weight of a given volume of pure vapor or gas compared to the weight of an equal volume of air at the same temperature and pressure. Vapor density less than 1 indicates a vapor lighter than air; a vapor density greater than 1 indicates a vapor heavier than air.

Vaporization - Passage from a liquid to a gaseous state. Rate of vaporization depends on the substance involved heat, and pressure.

Vapor Suppression - The action taken to reduce the emission of vapor at a fuel spill.

Variable - See Automatic.

Venturi - When a fluid is forced under pressure through a restricted orifice, there is a decrease in the pressure exerted against the side of the constriction. Because the surrounding air is under greater pressure, it rushes into the area of lower pressure.

Viscosity - 1. A liquid's thickness or ability to flow. 2. An indication in the ability of the foam to spread and cling, as well as to cling to itself, upon delivery.

Volatility - The ability of a substance to vaporize easily at a relatively low temperature.

## W

Water Retention - A foam's ability to retain its water content.

Wet Water - Water with added chemicals, called wetting agents, which increase water's spreading and penetrating properties due to a reduction in surface tension.

Wetting Agent - A chemical that, when added to water, reduces the surface tension of the solution and causes it to spread and penetrate exposed objects more effectively.

Wildfire - An unplanned, unwanted, and uncontrolled fire involving vegetative fuels that often threatens structures.

Wildfire Mop-Up - See Wildfire Overhaul.

Wildfire Overhaul - Operations involving extinguishing hot spots and hidden fires after the main body of fire has been knocked down. Also known as Mop-Up.



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