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Foam Definitions For Use With Ansul Foam Concentrates

Adhesive Qualities:
The ability to bind together substances of unlike composition. When a foam blanket clings to a vertical surface, it is said to have adhesive qualities. This is required to prevent vapor release at a tank shell, for example.

Air Foam:
Foam produced by a physical agitation of a mixture of water, air and a foaming agent.

Application Rate:
The total flow of liquid per unit of time and is expressed in gallons per minute (L/min).

Aspirated Foam:
A general term to indicate expanded foam which has an expansion ratio typically 4:1 or more.

Balanced Pressure Proportioning:
A system designed to inject automatically the proper amount of foam liquid into a water stream over wide flow ranges and pressures.

Base Injection:
A system used for the protection of fixed roof hydrocarbon fuel storage tanks where fuel-resistant aspirated foam is injected into the base of the tank and rises through the fuel to the surface to effect extinguishment. Also known as Subsurface Injection.

Boiling Liquid Expanding Vapor Explosion (B.L.E.V.E.):
Explosive fire balls caused by the rapid escape of flammable gas, discharging from sealed pressurized containers, which have ruptured/failed due to adverse heat exposure.

Boilover:
Violent ejection of flammable liquid from its container caused by the vaporization of water beneath the body of liquid. It will not occur to any significant extent with water-soluble liquids or light products such as gasoline.

Bund Area:
A diked area surrounding a storage tank, that is designed to contain the liquid product in the event of a tank rupture.

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

Closed-Head Foam-Water Sprinkler System:
A system that utilizes fusible link or frangible bulb style standard sprinklers that discharge foam or water directly onto the fire after the fusible links or frangible bulbs are activated.

Cohesive Qualities:
The ability to bind together substances of like composition. A good foam blanket is held together by its cohesive qualities.

Combustible Liquids:
Any liquid having a flash point at or above 100°F (37.8°C). They are subdivided as follows:

- **Class II** liquids include those having flash points at or above 100°F (37.8°C) and below 140°F (60°C).
- **Class IIIA** liquids include those having flash points at or above 140°F (60°C) and below 200°F (93.3°C).
- **Class IIIB** liquids include those having flash points at or above 200°F (93.3°C).

Concentrate Controller:
See Proportioner.

Concentration:
Percent of foam concentrate contained in a foam solution. The type of foam concentrate being used determines the percentage of concentration required. A 3 percent foam concentrate is mixed in the ratio of 97 parts water to 3 parts foam concentrate to make foam solution. A 6 percent concentrate is mixed with 94 parts water to 6 parts foam concentrate.

Critical Application Rate:
Minimum rate at which foam solution can be applied to a given fire in order to achieve extinguishment.

Deflector:
The device attached to most Type II fixed foam chamber discharge outlets` which directs the flow of foam down and over a large area of the inside of the tank wall.

Density/Application Rate:
The unit rate of liquid application to an area, expressed in gallons per minute per sq. ft. (mm/min). The term “density” is used with reference to application of water in some cases, and in others to the application of foam solution.

Discharge Devices:
There are four principal types of discharge devices that are installed at the discharge locations of the systems covered by these definitions.

- **Foam-Water Sprinklers:**
  Discharge devices specially designed, open-type, air-aspirating sprinklers consisting of an open barrel body foam maker that terminates in a deflector to shape the pattern of the foam or water issuing from the assembly. These devices produce water discharge patterns closely comparable to those of standard sprinklers (see NFPA 13, Standard for the Installation of Sprinkler Systems) when discharging at the same rates of flow.
- **Foam-Water Spray Nozzles:**
  Air-aspirating discharge devices, but they differ in design from foam-water sprinklers. When supplied with an approved foam solution such as AFFF, they discharge foam in a pattern particular to the discharge device. See NFPA 11, Standard for Low Expansion Foam and Combined Agent Systems, for specifics on application rates.
- **Non-Aspirating Spray Nozzles:**
  These discharge devices are open, directional spray nozzles. When supplied with an approved foam solution such as AFFF, they discharge foam in a pattern particular to the discharge device. See NFPA 11, Standard for Low Expansion Foam and Combined Agent Systems, for specifics on application rates.

- **Standard Sprinklers:**

  These discharge devices are standard sprinklers, with or without heat responsive elements, referred to in NFPA 13, Standard for the Installation of Sprinkler Systems. They are non-air-aspirating. When they are supplied with aqueous film forming foam (AFFF) air foam solution, or film forming fluoroprotein (FFFP) air foam solution, a foam discharge pattern is produced, closely conforming to the water discharge pattern of these sprinklers.

Downstream:

In the direction to which the water is flowing.

Drainage Rate:

The rate at which solution drains from a foam blanket or foam bubble structure.

Eductor (Inductor):

A device that uses the Venturi principle to introduce a proportionate quantity of foam concentrate into a water stream. The pressure at the foam concentrate inlet is below atmospheric pressure and will draw in liquid from atmospheric storage.

Expansion Ratio:

The ratio of final foam volume to original foam solution volume before adding air.

Film Forming:

A foam that can produce a spreading, vapor securing, thin aqueous film on the surface of certain hydrocarbon fuels.

Finished Foam:

The homogeneous blanket obtained by mixing water, foam concentrate and air.

Fire Classifications:

- **Class A Fires:**

  Fires in ordinary combustible materials such as wood, cloth, paper, rubber, and many plastics.

- **Class B Fires:**

  Fires in flammable liquids, oils, greases, tars, oil base paints, lacquers, and flammable gases.

- **Class C Fires:**

  A fire in “live” electrical equipment where use of a non-conducting fire extinguishant is of first importance.

- **Class D Fires:**

  Fires in metals such as magnesium, zirconium, lithium and potassium, etc.

Flammable Liquids:

- **Class I** liquids have flash points below 100°F (37.8°C) and may be subdivided as follows:
- **Class IA** liquids have flash points below 73°F (22.8°C) and having a boiling point below 100°F (37.8°C).
- **Class IB** liquids have flash points below 73°F (22.8°C) and having a boiling point above 100°F (37.8°C).
- **Class IC** liquids have flash points at or above 73°F (22.8°C) and below 100°F (37.8°C).

Flashback:
Re-ignition of flammable liquid caused by exposure of its vapors to a source of ignition such as a hot metal surface or a spark.

Foam:
Fire fighting foam is a stable aggregation of small bubbles of lower density than oil or water, and shows tenacious qualities for covering horizontal surfaces. Air foam is made by mixing air into a water solution containing a foam concentrate by means of suitably designed equipment. It flows freely over a burning liquid surface and forms a tough, air-excluding continuous blanket to seal volatile combustible vapors from air. It resists disruption from wind and draft, or heat and flame attack, and is capable of resealing in case of mechanical rupture. Fire fighting foams retain these properties for relatively long periods of time. Foams are also defined by expansion and are arbitrarily subdivided into three ranges of expansion. These ranges correspond broadly to certain types of usage described below. The three ranges are: Low Expansion Foam- expansion up to 20; Medium Expansion Foam- expansion 20-200; and High Expansion Foam- expansion 200-1000.

Foam Concentrate:
Foam concentrate is a concentrated liquid foaming agent as received from the manufacturer.

A. **Protein-Foam Concentrates:**
   Consist primarily of products from a protein hydrolysate, plus stabilizing additives and inhibitors to protect against freezing, to prevent corrosion of equipment and containers, to resist bacterial decomposition, to control viscosity, and to otherwise assure readiness for use under emergency conditions. They are diluted with water to form 3 percent to 6 percent solutions depending on the type. These concentrates are compatible with certain dry chemicals.

B. **Fluoroprotein-Foam Concentrates:**
   Similar to protein-foam concentrates as described above, but with a synthetic fluorinated surfactant additive. In addition to an air-excluding foam blanket, they may also deposit a vaporization-preventing film on the surface of a liquid fuel. They are diluted with water to form 3 percent to 6 percent solutions depending on the type. The concentrates are compatible with certain dry chemicals.

C. **Synthetic Foam Concentrates:**
   Based on foaming agents other than hydrolyzed proteins. They include:

   Aqueous Film-Forming Foam (AFFF) Concentrates:
   Based on fluorinated surfactants plus foam stabilizers and are usually diluted with water to a 3 percent or 6 percent solution. The foam formed acts both as a barrier to exclude air or oxygen and to develop an aqueous film on the fuel surface capable of suppressing the evolution of fuel vapors. The foam produced with AFFF concentrate is dry chemical compatible and thus is suitable for combined use with dry chemicals.

   Low, Medium and High Expansion Foam Concentrates:
   (usually derived from hydrocarbon surfactant) are used in specially designed equipment to produce foams of foam-to-solution volume ratios of 20:1 to approximately 1000:1. This equipment may be air-aspirating or blower-fan type. Guidance for the use of these materials is given in NFPA 11, Standard for Low, Medium and High Expansion Foam Systems.

   Other Synthetic Concentrates:
   Based on hydrocarbon surface active agents and are listed as wetting agents or as foaming agents, or both. In general, their use is limited to portable nozzle foam application to spill fire within the scope of their listings. The appropriate listings shall be consulted to determine proper application rates and methods. (See NFPA 18, Standard on Wetting Agents.)

D. **Film-Forming Fluoroprotein (FFFP) Foam Concentrates:**
   Use fluorinated surfactants to produce a fluid aqueous film for suppressing hydrocarbon fuel vapors. This type of foam also utilizes a protein base plus stabilizing additives and inhibitors to protect against freezing, corrosion, and bacterial decomposition and it also resists fuel pickup. The foam is usually diluted with water to 3 or 6 percent solution and is dry chemical compatible.

E. Alcohol-Resistant Foam Concentrates:
Used for fighting fires on water-soluble materials and other fuels destructive to regular, AFFF, or FFFP foams, as well as fires involving hydrocarbons. There are three general types. One is based on water-soluble natural polymers, such as protein or fluoroprotein concentrates, and also contains alcohol insoluble materials that precipitate as an insoluble barrier in the bubble structure. Another is based on synthetic concentrates and contains a gelling agent that surrounds the foam bubbles and forms a protective raft on the surface of water-soluble fuels; these foams may also have film-forming characteristics on hydrocarbon fuels. The third is based on both water-soluble natural polymers, such as fluoroprotein, and contain a gelling agent that protects the foam from water soluble fuels. This foam may also have film-forming and fluoroprotein characteristics on hydrocarbon fuels. Alcohol-resistant foam concentrates are generally used in concentrations of 3 to 10 percent solutions, depending on the nature of the hazard to be protected and the type of concentrate.

F. Compatibility of Concentrates and Their Foams:
Different types and brands of concentrates may be incompatible and shall not be mixed in storage. Foams generated separately from protein, fluoroprotein, FFFP, and AFFF concentrates may be applied to a fire in sequence or simultaneously.

G. Chemical Foam:
Made by the reaction of an alkaline salt solution (usually bicarbonate of soda) and an acid salt solution (usually aluminum sulfate) to form a gas (carbon dioxide) in the presence of a foaming agent that causes the gas to be trapped in bubbles to form a tough, fire-resistant foam. Note: This type of foam is considered obsolete and has generally been replaced by air foam.

Foam Generating Methods:
The methods of generation of air foam include:

- **Pressure Foam Maker (High Back-Pressure or Forcing Type):**
  A foam maker utilizing the Venturi principle for aspirating air into a stream of foam solution forms foam under pressure. Sufficient velocity energy is conserved in this device so that the resulting foam may be conducted through piping or hosed to the hazard being protected.
- **Foam Maker:**
  A device designed to introduce air into a pressurized foam solution flow.
- **Foam Pourer:**
  A device designed to deliver expanded foam gently onto a burning liquid.

Foam Solution:
Foam solution is a homogeneous mixture of water and foam concentrate in the proper proportions.

Foam Stability:
The relative ability of a foam to withstand spontaneous collapse or breakdown from external causes, such as heat or chemical reaction.

Foam-Water Sprinkler System:
A fire sprinkler system that is designed to discharge foam solution in lieu of plain water. The design should include a device to proportion foam concentrate into the water stream once water begins to flow through the sprinkler system.

Foam-Water Spray System:
A foam-water spray system is a special system pipe-connected to a source of foam concentrate and to a water supply, and equipped with foam-water spray nozzles for extinguishing agent discharge (foam or water sequentially in that order or in reverse order) and distribution over the area to be protected. System operation arrangements parallel those for foam-water sprinkler systems as described in the preceding paragraph.

Friction Loss:
The loss of pressure in a flowing stream resulting from resistance to flow imposed by the inside of the pipe or hose, and by changes in flow direction such as elbows and tees.

Head Loss:
Pressure necessary to force water up a pipe or hose to a given vertical height above the source of water pressure. To convert feet of water head to pounds per square inch, multiply 0.433 psi/Ft. times the elevation (in feet).

Heat Resistance:
The ability of a foam to withstand exposure to heat.

High Back Pressure Generator:
HBPGs introduce air into the foam solution to produce expanded foam in a base injection system.

Hydrocarbon Fuel:
Fuels based exclusively on chains or rings of linked hydrogen and carbon atoms. Hydrocarbon fuels are not miscible in water.

Hydrophobic:
Having the property of not mixing with water.

Hydrophilic:
Mixes readily with water.

Labeled:
Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization acceptable to the "Authority Having Jurisdiction". Such organization is involved with product evaluation and maintains periodic inspection of the production of labeled equipment or materials. By such labeling the manufacturer indicates compliance with appropriate standard or performance in a specified manner.

Listed:
Equipment or materials included in a list published by an organization acceptable to the "Authority Having Jurisdiction". Such organization is involved with product evaluation and maintains periodic inspection of the production of listed equipment or materials. By such listing the manufacturer states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in specified manner.

Mechanical Foam:
Foam produced by a physical agitation of a mixture of water, air and a foaming agent.

Minimum Operating Temperature:
The lowest temperature at which a foam liquid will proportion with venturi devices.

NFPA Requirements or Recommendations:
Standards established for Foam Extinguishing Systems are set forth in the National Fire Protection Association Standard Nos. 11, 13, 16, 30, 403, 409, 412 & 418.

Oleophobic:
Having the ability to shed gasoline, oil and similar products.

Pickup:
The induction of foam liquid into a water stream by a venturi.

Polar Solvent:
A liquid whose molecules possess a permanent electric moment. Examples are amines, ethers, alcohols, esters, aldehydes, and ketones. In fire fighting, any flammable liquid that destroys regular foam is generally referred to as a polar solvent.

Pour Point:
The lowest temperature at which a foam liquid is fluid enough to pour, generally about 5°F above the freezing point.

Premixed Foam Solution:
Premixed solution is produced by introducing a measured amount of foam concentrate into a given amount of water in a storage tank.

Pressure Drop:
The net loss in flowing water pressure between any two points in a hydraulic system. It is the sum of friction loss, head loss, or other losses due to the insertion of an orifice plate, venturi, or other restriction into a section of pipe or hose.

Pressurized Bladder:
This is a bladder tank, which has continuous system water pressure being applied to the tank water supply piping. The tank water supply piping is connected to the system water supply so that it provides continuous water pressure to the bladder tank.

Proportioner:
The device in which foam liquid and water are mixed to form foam solution.

Proportioning:
The continuous introduction of foam concentrate at the recommended ratio into the water stream to form foam solution.

Proportioning Methods for Air Foam Systems:
The methods of proportioning to give the proper solution of water and foam liquid concentrate include:

- **Coupled Water-Motor Pump:**
  A suitably designed positive displacement pump in the water supply line is coupled to a second, smaller, positive displacement foam concentrate pump to provide proportioning.
- **Foam Nozzle Eductor:**
  A suitable designed Venturi with "pickup tube" is included in the foam nozzle construction so that foam liquid concentrate is drawn up through a short length of pipe or flexible tubing connecting the foam nozzle with the container of foam concentrate. The concentrate is automatically mixed with the water in recommended proportion.
- **In-Line Eductor:**
  A Venturi eductor is located in the water supply line to the foam maker. This is connected by single or multiple lines to the source of foam concentrate. It is pre-calibrated, and it may be adjustable.
- **Metered Proportioning:**
  A separate foam concentrate pump is used to inject foam concentrate into the water stream. Orifices or Venturis, or both, control or measure the proportion of water to foam concentrate. Either manual or automatic adjustment of foam concentrate injection by pressure or flow control may be utilized. Another type of proportioning uses a pump or diaphragm tank to balance the pressure of the water and the concentrate. Variable orifices proportion automatically through a wide range of solution requirements.

Pump Proportioner (Around-the-pump Proportioner):
The pressure drop between the discharge and suction side of the water pump of the system is used to induct foam concentrate into water by suitable variable or fixed orifices connected to a Venturi inductor in a bypass between the pump suction and the pump discharge.

Un-pressurized Bladder:
This is a bladder tank whose tank water supply is connected to the system piping in a manner that does not pressurize the bladder until the system trips. (i.e. deluge systems, flow control systems)

Unstable (Reactive) Liquid:
A liquid that will vigorously polymerize, decompose, condense, or will become self-reactive under certain conditions of shock, pressure, or temperature.

Residual Pressure:
The pressure existing in a line at a specific flow. (As opposed to static pressure)

Rheology:
Study of deformation and flow characteristics of foam.

Skins Fire:
A flammable liquid fire, such as a spill on a solid surface in which the liquid is not present in a depth exceeding one inch.

Solution:
See Foam Solution

Specific Gravity:
The specific gravity of a material is a measure of the density of the material in relationship to the density of water. The specific gravity is calculated as:

$$\text{Specific Gravity} = \frac{\text{Material Density}}{\text{Water Denity}}$$

Spray Pattern:
The pattern produced by a widely divergent flow of fully formed sub-divided foam. The pattern varies with the nozzle pressure and the adjustment of the spray-creating device.

Static Pressure:
The pressure existing in a line at no-flow. This can be considerably higher than the residual pressure at flow conditions.

Submergence:
Plunging of foam beneath the surface of burning liquid resulting in a partial breakdown of the foam structure and coating of the foam with the burning liquid.

Subsurface (Base) Injection:
The introduction of foam beneath the surface of certain flammable hydrocarbons to effect fire extinguishment. See also Base Injection.

Surfactant or Surface Active Agent:
A chemical that lowers the surface tension of a liquid.

Transmit (Premix) Time:
The time required for foam solution to pass from the point of its formation (where the foam liquid is introduced into the water supply) to the foam maker where air is introduced.

Type I Applicator:
The NFPA term for a discharge outlet which under severe service conditions will conduct and deliver foam directly onto the surface of the burning liquid without undue submergence of agitation of the liquid.

Type II Applicator:
The NFPA term for a discharge outlet not supplemented with means for delivering foam on the surface of the burning liquid without undue submergence of agitation of the liquid.

Upstream:
In the direction from which the water is flowing.

Venturi:
A constricted portion of a pipe or tube which increases water velocity, thus momentarily reducing its pressure. It is in this reduced pressure area that the foam liquid is introduced in many types of proportioning equipment.