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Aspirated Versus Nonaspirated AFFF

Aqueous film forming foam concentrates (AFFF) can be applied to flammable liquid fires using either aspirating or nonaspirating discharge devices. The difference between the two is simply that the aspirating device mixes or entrains air in the AFFF/water solution within the nozzle or foam maker, whereas nonaspirating devices do not. Typical examples of nonaspirating devices are water/fog nozzles, water spray heads and conventional sprinkler heads. The reason that AFFF can be used in this way relates to two unique characteristics of AFFF. First, the AFFF solution requires relatively low energy to expand it into a foam. Second, and more important, the liquid which drains from the foam has the unique ability to form an aqueous film on most hydrocarbon fuel surfaces.

In deciding whether to use aspirated or nonaspirated AFFF, it is important to realize that fire performance will be affected by the quality of foam produced by the discharge device and the configuration and type of fuel encountered. The quality of any foam is measured in terms of expansion ratio, 25% drainage time, foam viscosity, and burnback resistance. These properties are described below.

- Expansion ratio is the ratio of the volume of foam formed to the volume of solution used.
- The 25% draintime is the time required for 25% of the total liquid solution to drain from the foam.
- Foam viscosity is a measure of the resistance of the expanded foam to flow over a fuel surface.
- Burnback resistance is a measurement of the ability of the foam blanket to resist destruction when subjected to radiant heat from an open flame. This parameter is usually determined in the context of a standardized test (see MIL-F-24385 and UL 162).

The following generalization may be applied with respect to these properties.

- Aspirated AFFF results in higher expansion ratios than nonaspirated. The exact values depend on the properties of the discharge device, i.e.; nozzle pressure, solution flow and solution velocity.
- Aspirated AFFF results in longer 25% drain times than nonaspirated. Generally, the lower the expansion ratio the shorter the 25% drain time.
- Aspirated AFFF results in 25% burnback times which are longer than those from nonaspirated. The exact burnback resistance will depend largely on foam quality plus the intensity of the burnback source and the amount of time which has elapsed from the end of foam discharge to the start of the burnback sequence.

The typical expansion ratio values for AFFF using aspirating devices would involve a range of 6 to 12:1 as compared to nonaspirating devices where the range would be 2 to 4:1. It should be noted that high flow rate nonaspirated discharge devices of 500 gallons per minute or higher may generate AFFF foams with expansions of 6:1 or higher. This is a result of the entrainment or mixing of air with liquid droplets due to the high velocity. The 25% drain time also increases under these conditions. For further information one should consult CEEDO-TR-78-22 “Comparative Nozzle Study for Applying Aqueous Film Forming Foam on Large-Scale Fires” by Jablonski et. al. April 1978.

As is the case in most fire protection situations, things are very seldom simple. While it is generally desirable to apply AFFF with aspirating devices, it should be noted that most commercially available foam nozzles were designed for use with protein type foams and are not optimized for use with AFFF foams. Also, the use of aspirated foam is particularly important when dealing with situations where safety of life is a factor or where high vapor pressure fuel are involved. Any time operations are to be conducted in the foam blanket, aspirated foam should be used and should be replenished at intervals which will allow maximum burnback and flashover resistance.

Non-aspirated AFFF does have several advantages over the use of aspirated AFFF in certain circumstances. When considering handline nozzles, two advantages become apparent with the use of water fog type nozzles instead of foam nozzles. First, the straight stream pattern allows a longer range than that attainable with a foam nozzle of the same flow rate. Second, the fog pattern provides a very effective heat shield for the operator. These two advantages provide an extra margin of safety for the firefighter as long as he does not advance into the fuel. Another consideration is the use of conventional sprinkler heads instead of foam/water heads in fixed pipe systems. Often times these systems are installed in locations where thermal updrafts from a fire and wind may cause much of the foam produced by aspirating type heads to be blown away from the fire area. Conventional sprinkler heads produce a foam with a lower expansion ratio and will therefore allow more of the foam to fall into the fire area. In addition, conventional sprinkler heads cost less to purchase and require lower water pressure to operate than do foam/water heads. These factors may substantially reduce the cost of the fixed system.

These are a number of factors which must be carefully weighed when deciding to use aspirated or nonaspirated AFFF. Generally it is acceptable to use a nonaspirated AFFF in situations where life, safety and rescue operations are not factors or in situations which involve low vapor pressure fuels. The reduced expansion ratio and faster 25% drain times must be considered with respect to a lower resistance to flashover and burnback before one actually decides to use nonaspirated AFFF.

