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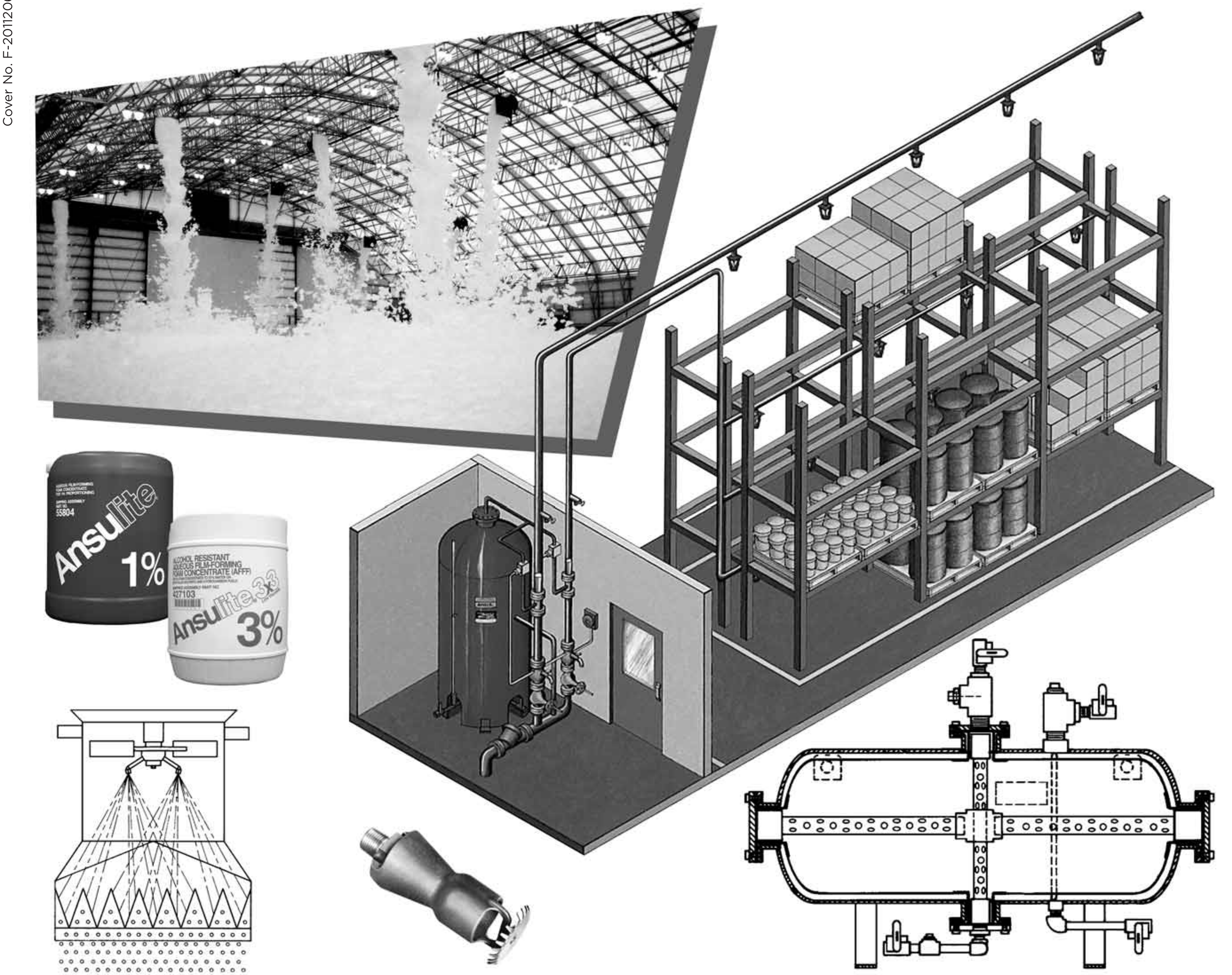

FOAM SYSTEMS

Design and Applications Manual

ANSUL®

A Tyco International Company

ANSUL®

FOAM SYSTEMS DESIGN AND APPLICATIONS MANUAL

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Note: The converted metric values in this document are provided for dimensional reference only and do not reflect an actual measurement.

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Foam System Design and Application

Foam System Design and Application

Foam Agents

FOAM VS. COMBUSTION

In order to understand how foam suppresses fire, it is first necessary to understand the process of combustion.

Combustion is a process where fuel undergoes a rapid exothermic chemical reaction (release of heat) with an oxidizing agent, usually air, resulting in the formation of products of combustion and energy (fire).

FUEL		PRODUCTS OF COMBUSTION
+	=	+
OXIDIZER		ENERGY

A fuel is any material that can be oxidized; it can be a solid, liquid, or gas and is generally organic in nature, i.e., composed mostly of carbon, hydrogen, or oxygen. The products of combustion of an organic fuel (assuming complete combustion) are carbon dioxide and water. The energy released may be in the form of heat or light, or the combination of heat and light (fire).

The chemical reaction is not a simple one-step reaction, but is a chain reaction resulting in a number of interdependent chemical reactions. Figure 1-1 depicts the four requirements for combustion using the “fire tetrahedron.”

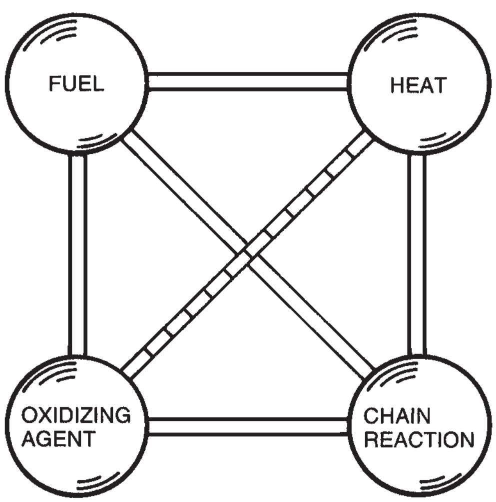

FIGURE 1-1
001141

It follows that any method for extinguishing fire must involve one or more of the following techniques:

1. Remove heat at a faster rate than it is released.
2. Separate the fuel from the oxidizing agent.
3. Dilute the vapor-phase concentration of the fuel and/or oxidizing agent below that necessary for combustion.
4. Terminate the chemical chain-reaction sequence.

Fire fighting foam is an aggregate of gas-filled bubbles (Figure 1-2) formed from aqueous solutions of specially formulated, liquid agent concentrates. The gas used is usually air, but certain applications use an inert gas.

Since foam is lighter than flammable and combustible liquids, it floats on the fuel surface producing a continuous blanket that suppresses fire by separating flammable vapors and oxygen as shown in Figure 1-2. Because foam is a water-bearing material, it also cools the fuel surface.

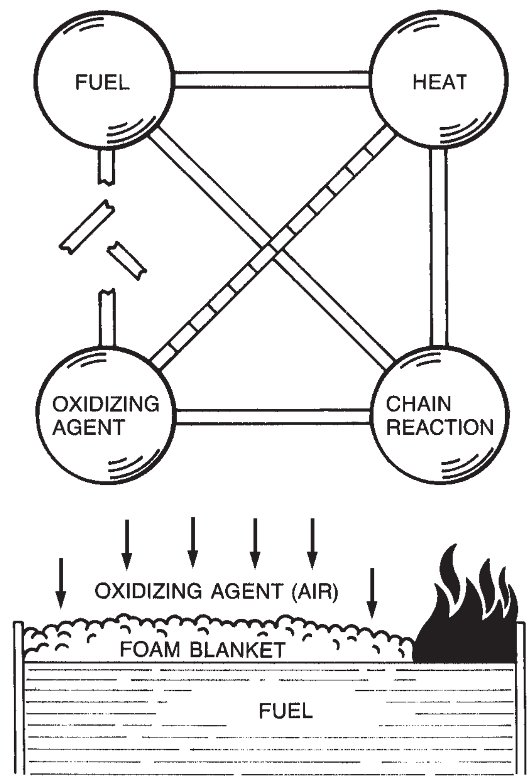

FIGURE 1-2
001142

Foam Agents

CLASSES OF FIRE

There are four broad classes of fire as defined by the National Fire Protection Association (NFPA). Three of these represent the fuel involved, while one, Class C, reflects the source of ignition. In fact, all Class C fires involve Class A, Class B, or Class D combustibles. Each of these classes involves somewhat different modes of combustion.

Class A Fires

A TRASH • WOOD • PAPER

FIGURE 1-3
001143

Class A fires involve ordinary combustible materials (such as wood, cloth, paper, rubber, and many plastics) requiring the heat-absorbing (cooling) effects of water and water solutions or the coating effects of certain dry chemicals which retard combustion.

Class A fires can be further divided into two categories. **Flaming combustion** involves the volatile gases which result from the thermal decomposition of the fuel; it produces rapid vapor-phase oxidation of the fuel and heat transfer back to the fuel. **Glowing or deep-seated fires** represent combustion within the mass of the fuel and are characterized by a slow rate of heat loss and a slow rate of reaction between oxygen and fuel. While the two modes of Class A fires usually occur concurrently, either type can precede the other depending on the fuel type and configuration.

Class B Fires

B LIQUIDS • GREASE

FIGURE 1-4
001144

Class B fires involve flammable or combustible gases, liquids, greases, and similar materials where extinguishment is most readily accomplished by excluding oxygen, inhibiting the release of combustible vapors, or interrupting the combustion of chain reaction. The combustion of these liquids and gases involves rapid vapor-phase oxidation of the fuel and subsequent involvement of more fuel due to radiant heat feedback.

Class B materials are either water soluble (mix with water) or water insoluble (will not mix with water). Water soluble fuels require special alcohol-resistant foam agents that will resist breakdown by the fuel when applied correctly.

Class C Fires

C ELECTRICAL EQUIP

FIGURE 1-5
001145

Class C fires involve energized electrical equipment where operator safety requires the use of electrically non-conductive extinguishing agents. Foam agents are not recommended for Class C fires due to the conductivity of the agent resulting from the high water content. However, when electrical equipment is de-energized, foam agents may be used.

Classes of Fire (Continued)

Class D Fires

FIGURE 1-6
007914

Class D fires involve certain combustible metals such as magnesium, titanium, zirconium, sodium, potassium, etc., and require a heat-absorbing extinguishing agent that does not react with the burning metal.

The combustion of metals involves a rapid oxidation that depends upon the chemical and physical properties of the metal involved. Generally, metals burn at higher temperatures, but with relatively low flame intensity. In certain configurations, metal fires can become deep-seated (i.e., magnesium dust) or if dispersed in the oxidizer, can be explosive. However, the nature of the combustion process depends on the properties of the metal (i.e., zirconium burns explosively when dry, but when wetted with oil, burns more quietly).

Foam agents are not recommended for Class D fires due to the reactivity of some combustible metals with water.

TYPES OF FOAM

There are numerous types of foams that are selected for specific applications according to their properties and performance. Some foams are thick, viscous, and form tough, heat-resistant blankets over burning liquid surfaces; other foams are thinner and spread more rapidly. Some foams are capable of producing a vapor sealing film of surface active water solution on a liquid surface. Others, such as medium and high expansion foams, are used as large volumes to flood surfaces and fill cavities.

Chemical Foams

Foams have been classified in different ways over the years. The earliest foams were based upon a chemical reaction occurring between aluminum sulfate ($Al_2 (SO_4)_3$) and sodium bicarbonate ($NaHCO_3$). The energy used to create the foam bubbles came from the chemical reaction. This type of foam is now largely obsolete.

Mechanical Foams

Mechanical foam is produced by mixing a foam concentrate with water at the appropriate concentration, and then aerating and agitating the solution to form a bubble structure. Therefore, unlike chemical foams, the energy used to create the foam bubbles of a mechanical foam comes from an outside source.

There are several types of mechanical foams:

– Protein
– Fluoroprotein
– Film-Forming Fluoroprotein (FFFP)
– Aqueous Film-Forming Foam (AFFF)
– Alcohol-Resistant Concentrate (ARC)
– Synthetic Detergent (High/Medium Expansion)

The differences between these foam concentrates depend on:

– whether the concentrate is based upon naturally-occurring materials or synthetic chemicals.
– whether the synthetic chemicals are fluoronated or nonfluoronated.
– the type of fuel being protected.
– the expansion ratio (see Page 1-5).
– whether they will form an aqueous film on certain fuels.

Protein Foam is derived from naturally-occurring sources of protein such as hoof and horn meal or feather meal. The protein meal is hydrolyzed in the presence of lime and converted to a protein hydrolysate which is neutralized and to which other components are added such as foam stabilizers, corrosion inhibitors, antimicrobial agents, and freezing point depressants. Foams derived from protein foam concentrates generally have very good heat stability and resist burnback, but are not as mobile or fluid on the fuel surface as other types of low expansion foams. Protein foams are susceptible to fuel pickup; consequently, care should be taken to minimize submergence.

Fluoroprotein Foam is derived from protein foam concentrates to which small amounts of fluorochemical surfactants are added. The fluorochemical surfactants are similar to those developed for AFFF foam agents but used in much lower concentrations. The addition of these chemicals produces an easier flowing foam. Because of these chemicals, fluoroprotein foams are said to be oleophobic (oil shedding) and are well suited for sub-surface injection.

Foam Agents

TYPES OF FOAM (Continued)

Film-Forming Fluoroprotein (FFFP) is a protein base foam concentrate to which quantities of fluorochemical surfactants (similar to those used in AFFF foam agents) are added. This improves the mobility of the foam to the point where it begins to approach the quick extinguishment that is characteristic of AFFF foam agents. On some fuels, it also forms an aqueous film like the AFFF foam agents. However, this reduces the burnback resistance that is characteristic of protein-based foams. Film-forming fluoroprotein foams tend to be a compromise between AFFF and fluoroprotein foam agents.

Aqueous Film-Forming Foam (AFFF) is a completely synthetic foam. It consists of combinations of fluorochemical and hydrocarbon surfactants combined with high boiling point solvents and water. Surfactants are chemicals that have the ability to alter the surface properties of water. Fluorochemical surfactants alter these properties in such a way that a thin film (Figure 1-7) can spread on a hydrocarbon fuel (such as gasoline) even though the aqueous film is more dense than the fuel.

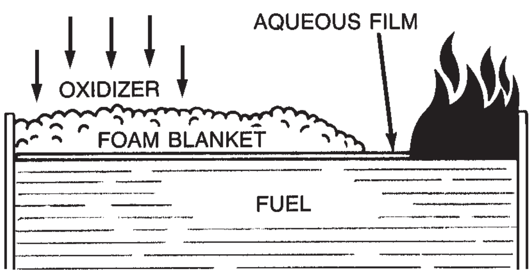

FIGURE 1-7
001147

Alcohol-Resistant Concentrate (ARC) produces a foam that is effective on fuels such as methyl alcohol, ethyl alcohol, and acetone which have appreciable water solubility or miscibility.

Standard foam agents are mixtures of chemicals (natural or synthetic) whose bubbles collapse when applied to water soluble fuels. These fuels are said to be foam destructive. The early alcohol-resistant foams were based on mixtures of protein foams and chemicals called metal soaps. These chemicals are hydrophobic or water repellent.

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 (Figure 1-8) is formed between the foam and the water soluble fuel.

When this foam agent is used on a conventional (water insoluble) hydrocarbon fuel, it functions as an AFFF foam by forming an aqueous film at the fuel/air interface. AR-AFFF exhibits the best cross-functional performance for flame knock-down, burnback resistance, extended vapor suppression, manufacturing and proportioning consistency, and the longest potential shelf life.

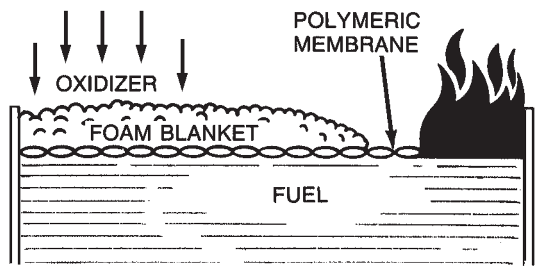

FIGURE 1-8
001148

Synthetic Detergent type foam agents are based on mixtures of non-fluorochemical, hydrocarbon type surfactants along with solvents and water. These foam agents do not form aqueous films or polymeric membranes. Instead, they function by forming an aggregate of foam bubbles on the surface of the fuel. They are most frequently used with high expansion foam generators yielding expansion ratios of 200 to 1000:1 (see Figure 1-9). The reduced water content of high expansion foams makes them suitable for use in total flooding applications and on cyrogenic type fuels such as liquefied natural gas (LNG). Some of these foam agents are specially formulated to be used with low, medium, and high expansion foam hardware at different proportioning ratios and are referred to as multiple expansion foam agents.

FIGURE 1-9
007629

Foam Agents

FOAM QUALITY AND TESTING

Depending on the authority having jurisdiction, varying agencies require different qualification testing for foam concentrates. Standard manufacturing tests for concentrates include pH, density (or specific gravity), and viscosity. These are performed as quality control measures.

Foam quality is a measure of the physical properties of foam expressed as expansion ratio and quarter drain time (or 25% drain time).

Expansion Ratio

Expansion ratio is the comparison of final foam volume to the original foam solution before air is added.

$$\text{EXPANSION RATIO} = \frac{\text{Volume of Container}}{\text{Mass}_{\text{Full}} - \text{Mass}_{\text{Empty}}}$$

Example: A 1000 ml graduated cylinder is filled with expanded foam. The weight of the filled cylinder is 450 g while the tare weight of the cylinder is 250 g. The expansion ratio is calculated as follows:

$$\text{EXPANSION RATIO} = \frac{1000 \text{ ml}}{450 \text{ g} - 250 \text{ g}} = 5.0$$

NFPA classifies foam concentrates by expansion ratio as follows:

Low Expansion – Expansion ratio up to 20:1

Medium Expansion – Expansion ratio from 20:1 to 200:1

High Expansion – Expansion ratio above 200:1

Typical values for expansion ratios are as follows:

Low Expansion – 8:1

Medium Expansion – 100:1

High Expansion – 500:1

Quarter Drain Time

Quarter drain time is a test measure of the time required to drain the volume of liquid having a weight equal to 25% of the foam sample.

Example: Continuing from the previous example, the quarter drain time is derived by timing from when the cylinder was first filled until 25% by weight volume of liquid is measured as in the following calculation:

$$25\% \ (450 \text{ g} - 250 \text{ g}) = 50 \text{ ml}$$

Note that 1 ml of foam solution is equal to 1 gram of weight. It is therefore simpler to use these units as compared to units requiring conversion.

Burnback Resistance

Burnback resistance is the ability of the foam blanket to resist radiant heat after a fire is extinguished and to help prevent reignition of the fuel. This test varies with specifications and agents used.

Compatibility

The question of compatibility of different types and brands of foams is important because there are a number of foam agent manufacturers throughout the world. “Compatibility” is a term which defines a situation where different manufacturer’s foam concentrates are mixed in the same storage vessel. Concentrates are found to be compatible when, after mixing, the physical and chemical characteristics of the resulting mixture perform at least equal to that of each individual concentrate in the mixture.

NFPA 11, Standard for Low, Medium, and High Expansion Foam states that “different types and brands of concentrates may be incompatible and shall not be mixed in storage.”

United States Military Specifications O-F-555 for protein foam concentrate and MIL-F-24385 for AFFF concentrate compatibility require that: “concentrates of one manufacturer shall be compatible in all proportions with the concentrates furnished by other manufacturers listed on the Qualified Products List (QPL).” This also includes compatibility with concentrates from previous versions of the respective specification. Products which are on the Qualified Products List for these specifications have been tested for compatibility.

There are also non-qualified protein and AFFF concentrates along with fluoroprotein and alcohol-resistant AFFF (AR-AFFF) for which there are no specifications or standards which address compatibility. These concentrates should only be mixed in an emergency or if the manufacturer has supporting data to substantiate that the mixture meets the same requirements as the individual component concentrates.

Foam Agents

FOAM QUALITY AND TESTING (Continued)

Compatibility (Continued)

Presently, all major U.S. manufacturers of polar solvent AFFF concentrates are using the same type of polymer. Therefore, if the regular AFFF concentrates are compatible, then their polar solvent AFFF concentrates will be chemically compatible. Physically, there may be a difference in the density and static viscosity of any two manufacturer's products which may lead to layering of the two products. The fact that they don't intermix is not a concern. The products may be left layered or, if desired, they may be mechanically mixed.

Although compatibility is of concern in storage, NFPA 11 states that "foams generated separately from protein, fluoroprotein and AFFF concentrates may be applied to a fire in sequence or simultaneously."

The only requirement still in effect for dry chemical compatibility is for those protein and AFFF concentrates that are on the Qualified Products List for the respective military specifications O-F-555 and MIL-F-24385. The U.S. Coast Guard and Underwriters Laboratories no longer test or require dry chemical agents to be foam compatible. Current ANSUL dry chemical agents that may be applied with foam include: Purple-K, PLUS-FIFTY® C, and FORAY®.

STORING, HANDLING, AND INSPECTING ANSUL FOAM AGENTS

ANSUL foam concentrates will provide years of service if proper handling and storage guidelines are followed. In general, all ANSUL synthetic concentrates have minimum shelf lives of 20 to 25 years. ANSUL protein base concentrates have minimum shelf lives of 7 to 10 years. The shelf life of ANSUL foam concentrates is valid only when the agents are stored in accordance with the following recommendations.

ANSUL Shipping/Storage Containers

FIGURE 1-10
001150

Storage of ANSUL foam concentrates in their shipping containers is acceptable as long as certain precautions are taken. Whenever possible, they should be stored within the temperature limits specified on the container or container label (see specific product data sheet or Technical Bulletin No. 54).

ANSUL packages its concentrates in 5 gal. (19 L) pails and 55 gal. (208 L) drums and 265 gal. (1000 L) intermediate bulk containers (totes). These containers are constructed of molded polyethylene and meet the requirements of the U.S. Department of Transportation. At present, only UL Listed agents supplied in pails or drums can include the UL logo on the conainer label.

STORING, HANDLING, AND INSPECTING ANSUL FOAM AGENTS

Temperature Considerations

If the minimum or maximum usable temperature is exceeded, inspection of the concentrate should be performed. See Technical Bulletin No. 54 for details.

If the product is frozen, it should be thawed and agitated by rolling on a level surface before inspection. In the case of ANSULITE alcohol-resistant concentrate, vigorous mechanical agitation may be necessary. It is important to note that the minimum usable temperature is not the freezing point of the product. It is the minimum temperature that the product was tested for correct proportioning ability. Most ANSUL foam concentrates are not adversely affected by freeze/thaw cycling; however, freezing of ANSULITE alcohol-resistant concentrates should be avoided.

STORING, HANDLING, AND INSPECTING ANSUL FOAM AGENTS (Continued)

Temperature Considerations (Continued)

Special freeze protected or low temperature ANSUL foam concentrates are available with minimum use temperatures. Consult specific Agent Data Sheets for details.

Inspection

At least annually, an inspection shall be made of foam concentrates and their tanks or storage containers for evidence of excessive sludging or deterioration. Samples of concentrates shall be sent to the manufacturer or a qualified laboratory for quality condition testing.

Atmospheric Storage Tanks

Atmospheric storage tanks, generally used with fixed or mobile equipment, should only be constructed of material specified by ANSUL. Materials of construction for the tank are normally polyethylene plastic, fiberglass reinforced polyester, fiberglass reinforced epoxy resin, mild steel, or stainless steel. These tanks should be closed to atmosphere except for a pressure/vacuum vent mounted on top of the tank.

Mild steel tanks should be designed with an expansion dome constructed of a heavier gauge material as compared to the tank shell to allow for internal corrosion. These tanks should always be filled half way into the expansion dome. In extremely corrosive environments, it may be desirable to fabricate these tanks from stainless steel or another synthetic material recommended by ANSUL.

Alcohol-resistant concentrates are susceptible to polymer collapse due to dehydration. In order to protect from dehydration, it is desirable to always cap concentrates stored in atmospheric tanks with 1/4 in. mineral oil as a sealer.

Under no circumstances should the interior of the tank be painted or lined. The tank and lining have different coefficients of thermal expansion; as the ambient temperature cycles, separation of the tank and lining will occur. Foam concentrates have good wetting characteristics, and if a crack develops, concentrate will quickly seep between the tank wall and lining resulting in lining failure, corrosion problems, and possible tank failure. In addition, small pieces of the lining may break away resulting in clogged strainers or blocked proportioner orifices.

TESTING AND APPROVAL OF ANSUL FOAM AGENTS

The ANSUL Fire Technology Center has the research, development and testing facilities to provide for all facets of testing foam agents. These facilities include laboratories for formulation development, physiochemical property determination, and complete fire test capabilities.

ANSUL maintains a vigorous quality assurance program through complete quality control testing of all production batches. This includes physiochemical property testing of both incoming raw materials and finished production batches; and performance fire testing of all production batches to nationally recognized testing standards such as those described in the latest Amendment of U.S. Military Specification MIL-F-24385 and Underwriters Laboratories Standard 162.

The qualification or listing of ANSUL foam concentrates as detailed by product specific data sheets show that products have met the rigid requirements of those standards and specifications as tested by independent, third-party, testing authorities. Most of the standards or specifications cited reflect end-user requirements as defined by a government agency, or independent laboratory requirements as accepted by insurance underwriters. Government specifications frequently detail the acceptable performance requirements for the foam agent. Underwriters Laboratories specifications reflects a combination of acceptable performance requirements for the agent in selected types of foam hardware.

The United States Coast Guard (USCG) is the agency that represents regulatory authority for commercial shipping as well as offshore exploration and production facilities. USCG approval is granted only on the basis of an approved foam system design for a defined hazard such as petroleum or chemical tanker involving a foam agent, a proportioning device, and a discharge device designed to produce foam at a given rate of application for a minimum period of time. It is for this reason that USCG approval only applies to a complete system and never to individual components such as the foam agent.

Since specifications and standards cannot cover all possible hazard characteristics, especially fuel type and configuration, it is necessary to have the facilities conduct tests and determine minimum rates of application as defined by the National Fire Protection Association (NFPA) and in various international standards. This then constitutes a manufacturer's approval or recommendation regarding the conditions under which the foam agent may be used. It is very important that this recommendation be based upon documented test data which supports the recommendation.

3% REGULAR PROTEIN FOAM CONCENTRATE EXTINGUISHING AGENT

Data/Specifications

ANSUL

DESCRIPTION

ANSUL® 3% Protein Foam Concentrate is formulated from hydrolyzed protein, foam stabilizers (metal salts), bactericide, corrosion inhibitors, freezing point depressants and solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and space.

It is intended for use as a 3% proportioned solution either in fresh, salt or hard water. The correct proportioning ratio is 3 parts of concentrate to 97 parts of water.

Two fire extinguishing mechanisms are in effect when using ANSUL 3% Protein Foam. First, a foam blanket is formed which works to prevent the release of fuel vapor. Second, the water content of the foam provides a cooling effect.

APPLICATION

ANSUL 3% Protein Foam Concentrate is intended for use on Class B hydrocarbon fuels having low water solubility such as various crude oils, gasolines, diesel fuels, aviation fuels, etc. It is not suitable for use on fuels having appreciable water solubility (polar solvents), i.e., methyl and ethyl alcohol, acetone and methyl ethyl ketone. This concentrate can be used only with air aspirating type discharge devices.

Its wetting characteristics make it useful in combating Class A fires as well. It can also be used with foam compatible dry chemical extinguishing agents without regard to the order of application, to provide even greater fire protection capability.

PERFORMANCE

Fire Performance – The fire performance of ANSUL 3% Protein Foam Concentrate is measured against specifications and standards such as Underwriters Laboratories Standard UL 162, latest edition.

Foaming Properties – When used with fresh or salt water or water of any hardness at the correct dilution and with most conventional foam making equipment, the expansion ratio will vary depending on the performance characteristics of the equipment. Air aspirating discharge devices produce expansion ratios from 8 to 1 to 12 to 1 depending primarily on type and flow rate. In general, the higher the flow rate the higher the expansion ratio. Thus, monitors and foam chambers normally produce higher expansion ratios than foam water sprinkler heads and hand held type nozzles.

Typical expansion ratios for foam chambers are in the range of 5 to 1 to 7 to 1, and for foam water sprinkler heads in the range of 3 to 1 to 6 to 1.

Typical Physiochemical Properties at 77 °F (25 °C)

Type	3%
Appearance	Dark brown liquid
Density	1.15 g/ml ± 0.03
pH	6.0 – 8.0
Viscosity	12 ± 4 centistokes
Freezing Point	5 °F (–15 °C)
Sediment Volume	0.20% maximum

Proportioning – 3% Protein Foam Concentrate can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pump proportioning equipment
2. Balanced pressure bladder tank type proportioners
3. Around the pump type proportioners
4. Fixed or portable in-line venturi type proportioners
5. Hand line nozzles with fixed induction/pick up tubes

The minimum and maximum usable temperatures for ANSUL 3% Protein Foam Concentrate with this equipment is: 20 °F (–6.7 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) within the temperature limits specified, or in equipment recommended by the manufacturer as part of the foam system, the shelf life of ANSUL 3% Protein Foam Concentrate is generally in excess of 10 years. If the product is frozen during storage or transportation, thawing will render the product completely usable.

Compatibility – There are no specifications or standards which address the subject of compatibility of different manufacturer brands of protein foam concentrates. In an emergency or if the manufacturer has supporting test data to substantiate that the mixture meets the same requirements as the individual component concentrates, they may be mixed together in the same storage vessel.

Different types of foam concentrates, i.e., AFFF and protein base should not be mixed under any circumstances.

Inspection – As with any fire extinguishing agent, ANSUL 3% Protein Foam Concentrate should be inspected periodically.

Please refer to the Field Inspection Manual for detailed procedures how to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur. In the latter case, ANSUL recommendation should be sought.

APPROVALS AND LISTINGS

ANSUL 3% Protein Foam Concentrate is approved, qualified under, listed or meets the requirements of the following specifications and standards:

- Underwriters Laboratories, Inc. – UL Standard 162

1. Foam Quality Test
2. Class B Hydrocarbon Fuel Fire Tests
3. Foam Identification Tests
4. Test of shipping containers
5. Class B Hydrocarbon fuel fire tests using foam water sprinkler (both upright and pendent approvals)

It is impractical for ANSUL to list its 3% Protein Foam Concentrate with every piece of UL listed hardware. Moreover there are numerous foam hardware components without UL listings that cannot be listed for use with any protein foam agent.

Many unlisted pieces of foam hardware should be similar to those listed. However, on installations where ANSUL 3% foam concentrate may be used with hardware components of significantly different types than those tested, contact ANSUL for recommendations.

ORDERING INFORMATION

Part No.	Description
73971	3% Protein Foam – 5 gallon
73970	3% Protein Foam – 55 gallon

Shipping Weight:
5 gal (19 L) pail – 51 lb (23.1 kg)
55 gal (208 L) drum – 555 lb (251.7 kg)

Cube:
5 gal (19 L) pail – 1.08 ft^3 (0.0305 m^3)
55 gal (208 L) drum – 11.33 ft^3 (0.3208 m^3)

3% FLUOROPROTEIN FOAM CONCENTRATE EXTINGUISHING AGENT

Data/Specifications

ANSUL

DESCRIPTION

ANSUL® 3% Fluoroprotein Foam Concentrate is formulated from hydrolyzed protein, fluorochemical surfactants, foam stabilizers (metal salts), bactericide, corrosion inhibitors, freezing point depressants and solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and space.

It is intended for use as a 3% proportioned solution either in fresh, salt or hard water. The correct proportioning ratio is 3 parts of concentrate to 97 parts of water.

Two fire extinguishing mechanisms are in effect when using ANSUL 3% Fluoroprotein Foam. First, a foam blanket is formed which works to prevent the release of fuel vapor. Second, the water content of the foam provides a cooling effect.

APPLICATION

ANSUL 3% Fluoroprotein Foam Concentrate is intended for use on Class B hydrocarbon fuels having low water solubility such as various crude oils, gasolines, diesel fuels, aviation fuels, etc. It is not suitable for use on fuels having appreciable water solubility (polar solvents), i.e., methyl and ethyl alcohol, acetone and methyl ethyl ketone. This concentrate can be used only with air aspirating type discharge devices.

Its wetting characteristics make it useful in combating Class A fires as well. It can also be used with foam compatible dry chemical extinguishing agents without regard to the order of application, to provide even greater fire protection capability.

PERFORMANCE

Fire Performance – The fire performance of ANSUL 3% Fluoroprotein Foam Concentrate is measured against specifications and standards such as Underwriters Laboratories Standard UL 162, latest edition.

Foaming Properties – When used with fresh or salt water or water of any hardness at the correct dilution and with most conventional foam making equipment, the expansion ratio will vary depending on the performance characteristics of the equipment. Air aspirating discharge devices produce expansion ratios from 6 to 1 to 12 to 1 depending primarily on type and flow rate. In general, the higher the flow rate the higher the expansion ratio. Thus, monitors and foam chambers normally produce higher expansion ratios than foam water sprinkler heads and hand held type nozzles.

Typical expansion ratios for foam chambers are in the range of 5 to 1 to 7 to 1, and for foam water sprinkler heads in the range of 3 to 1 to 6 to 1. Subsurface injection is a special case where generally speaking, expansion ratios of 2 to 1 to 3 to 1 are preferred but up to 4 to 1 is also effective.

Typical Physiochemical Properties at 77 °F (25 °C)

Type	3%
Appearance	Dark brown liquid
Density	1.15 g/ml ± 0.03
pH	6.0 – 8.0
Viscosity	10 ± 4 centistokes
Freezing Point	5 °F (–15 °C)
Sediment Volume	0.20% maximum

Proportioning – 3% Fluoroprotein Foam Concentrate can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pump proportioning equipment
2. Balanced pressure bladder tank type proportioners
3. Around the pump type proportioners
4. Fixed or portable in-line venturi type proportioners
5. Hand line nozzles with fixed induction/pick up tubes

The minimum and maximum usable temperatures for ANSUL 3% Fluoroprotein Foam Concentrate with this equipment is: 20 °F (–6.7 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) within the temperature limits specified, or in equipment recommended by the manufacturer as part of the foam system, the shelf life of ANSUL 3% Fluoroprotein Foam Concentrate is generally in excess of 10 years. If the product is frozen during storage or transportation, thawing will render the product completely usable.

Compatibility – There are no specifications or standards which address the subject of compatibility of different manufacturer’s brands of fluoroprotein foam concentrates. In an emergency or if the manufacturer has supporting test data to substantiate that the mixture meets the same requirements as the individual component concentrates, they may be mixed together in the same storage vessel.

Different types of foam concentrates, i.e., AFFF and fluoroprotein base should not be mixed under any circumstances.

Inspection – As with any fire extinguishing agent, ANSUL 3% Fluoroprotein Foam Concentrate should be inspected periodically. Please refer to the Field Inspection Manual for detailed procedures how to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur. In the latter case, ANSUL’s recommendation should be sought.

APPROVALS AND LISTINGS

ANSUL 3% Fluoroprotein Foam Concentrate is approved, qualified under, listed or meets the requirements of the following specifications and standards:

Underwriters Laboratories, Inc. – UL Standard 162

1. Foam Quality Test
2. Class B Hydrocarbon Fuel Fire Tests
3. Foam Identification Tests
4. Test of shipping containers
5. Class B Hydrocarbon fuel fire tests using foam water sprinkler (both upright and pendent approvals)
6. Subsurface Injection

It is impractical for ANSUL to list its 3% Fluoroprotein Foam Concentrate with every piece of UL listed hardware. Moreover there are numerous foam hardware components without UL listings that cannot be listed for use with any fluoroprotein foam agent.

Many unlisted pieces of foam hardware should be similar to those listed. However, on installations where ANSUL 3% foam concentrate may be used with hardware components of significantly different types than those tested, contact ANSUL for recommendations.

ORDERING INFORMATION

Part No.	Description
73973	3% Fluoroprotein Foam – 5 gallon
73972	3% Fluoroprotein Foam – 55 gallon

Shipping Weight:
5 gal (19 L) pail – 51 lb (23.1 kg)
55 gal (208 L) drum – 555 lb (262.6 kg)

Cube:
5 gal (19 L) pail – 1.08 ft^3 (0.0305 m^3)
55 gal (208 L) drum – 11.33 ft^3 (0.3208 m^3)

Ansul Incorporated
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www.ansul.com

ANSULITE 1% AFFF CONCENTRATE

Data/Specifications

ANSUL

A Tyco International Company

DESCRIPTION

ANSULITE 1% AFFF (Aqueous Film-Forming Foam) Concentrate is formulated from specialty fluorochemical and hydrocarbon surfactants along with solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume.

It is intended for use as a 1% proportioned solution in fresh, salt or hard water. It may also be used and stored as a 1% premixed solution in fresh or potable water only. The correct proportioning or mixture ratio is 1 part concentrate to 99 parts of water.

Three fire extinguishment mechanisms are in effect when using ANSULITE 1% AFFF Concentrate. First, an aqueous film is formed which works to help prevent the release of fuel vapor. Second, the foam blanket from which the film-forming liquid drains effectively excludes oxygen from the fuel surface. Third, the water content of the foam provides a cooling effect.

TYPICAL PHYSIOCHEMICAL PROPERTIES AT 77 °F (25 °C)

Appearance	Colorless to Pale Yellow Liquid
Density	1.036 g/ml ± 0.01
pH	7.0 – 8.5
Refractive Index	1.3884 ± 0.0020
Surface Tension (1% Solution)	18 ± 1 dynes/cm
Viscosity	7.5 ± 1 centistokes

APPLICATION

ANSULITE 1% AFFF Concentrate is intended for use on Class B hydrocarbon fuel fires having low water solubility such as various crude oils, gasolines, diesel fuels, aviation fuels, etc. **It is not suitable for use on fuels having appreciable water solubility (polar solvents), i.e., methyl and ethyl alcohol, acetone, and methyl ethyl ketone.** It can be used with both aspirating and non-aspirating discharge devices because of the low energy required to make it foam.

Its excellent wetting characteristics make it useful in combating Class A fires as well. It can be used with dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability.

FIRE PERFORMANCE

The fire performance of ANSULITE 1% AFFF Concentrate is measured against specifications and standards such as U.S. Military Specification MIL-F-24385 and Underwriters Laboratories Standard UL 162. Reports covering this fire performance are available on request since standards and specifications such as those cited are continuously being upgraded and changed.

FOAMING PROPERTIES

When used with fresh or salt water or water of any hardness, at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of from 6:1 to 10:1 depending primarily on type of aspirating device and flow rate. Subsurface injection generally produces expansion ratios of 2:1 to 3:1. Non-aspirating devices such as handline water fog/stream nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1.

PROPORTIONING

ANSULITE 1% AFFF Concentrate can be proportioned (at the correct dilution) using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pumped proportioning equipment
2. Balanced pressure bladder tank proportioner
3. Fixed or portable (in-line) venturi type proportioners
4. Handline nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperature for ANSULITE 1% AFFF Concentrate in this equipment is 35 °F (2 °C) to 120 °F (49 °C) respectively.

STORAGE/SHELF LIFE

When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system and within the temperature limits specified, the shelf life of ANSULITE AFFF 1% AFFF Concentrate is about 20-25 years. The factors affecting shelf life and stability for ANSULITE AFFF Agents are discussed in detail in ANSUL Technical Bulletin No. 54. If the product is frozen during storage or transportation, thawing will render the product completely usable.

COMPATIBILITY

Tyco Fire Protection Products has conducted testing with admixtures of different manufacturers' AFFF products in varying proportions and is satisfied that the ANSULITE 1% AFFF is compatible with these products. Refer to ANSUL Technical Bulletin No. 48 for a more detailed discussion of compatibility.

Different types of foam concentrates, i.e., AFFF, protein base, etc., should not be mixed under any circumstances.

MATERIALS OF CONSTRUCTION COMPATIBILITY

Tests have been performed with ANSULITE 1% AFFF Concentrate verifying its compatibility with standard carbon steel ''black'' pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to ANSUL Technical Bulletin No. 59 addressing acceptable materials of construction for use with ANSUL foam concentrates.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Please **first** consult Tyco Fire Protection Products for specific guidelines concerning materials of construction.

INSPECTION

As with any fire extinguishing agent, ANSULITE 1% AFFF Concentrate, whether in the concentrate or pre-mixed form should be inspected periodically. Please refer to the Field Inspection Manual, Part No. 31274, for the detailed procedures to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur such as are described in ANSUL Technical Bulletin No. 54. In such cases, Tyco Fire Protection Products' recommendation should be sought.

APPROVALS AND LISTINGS

ANSULITE 1% AFFF Concentrate is approved, qualified under, listed or meets the requirements of the following specifications and standards:

Underwriters Laboratories Inc.

UL Standard 162 (latest edition)

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Foam Identification Tests
4. Tests of Shipping Containers
5. Class B Hydrocarbon Fuel Sprinkler Tests (foam water and standard type both upright and pendent approvals)
6. Subsurface Injection at 1% Proportioning

It is impractical for Tyco Fire Protection Products to list its ANSULITE 1% agents with every piece of UL listed hardware. Moreover, there are numerous foam hardware components without UL listings that cannot be listed for use with any AFFF agent.

Many unlisted pieces of foam hardware should be similar to those listed. However, on installations where ANSULITE 1% may be used with hardware components of significantly different types than those tested, contact Tyco Fire Protection Products for recommendations.

ORDERING INFORMATION

ANSULITE 1% AFFF is available in pails, drums, totes, or bulk shipment.

Part No.	Description	Shipping Weight	Cube
55804	5 gal (19 L) Pail	45 lb (20.4 kg)	1.25 ft^3 (0.0353 m^3)
55811	55 gal (208 L) Drum	495 lb (224.5 kg)	11.83 ft^3 (0.335 m^3)
432160	265 gal (1000 L) Tote	2465 lb (1118 kg)	50.05 ft^3 (1.42 m^3)
73595	Bulk Order	Contact Technical Services	

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ANSULITE® 1% FREEZE-PROTECTED AFFF CONCENTRATE EXTINGUISHING AGENT –20 °F (–29 °C)

Data/Specifications

ANSUL®

DESCRIPTION

ANSULITE® 1% Freeze-Protected AFFF (Aqueous Film-Forming) Foam Concentrate is formulated from specialty fluorochemical and hydrocarbon surfactants along with solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume.

It is intended for use as a 1% proportioned solution in fresh, salt or hard water. It may also be used and stored as a 1% premixed solution in fresh or potable water only. The correct proportioning or mixture ratio is 1 part concentrate to 99 parts of water.

Three fire extinguishment mechanisms are in effect when using ANSULITE 1% Freeze-Protected AFFF Concentrate. First, an aqueous film is formed which works to help prevent the release of fuel vapor. Second, the foam blanket from which the film-forming liquid drains effectively excludes oxygen from the fuel surface. Third, the water content of the foam provides a cooling effect.

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Colorless to Pale Yellow Liquid
Density	1.059 g/ml ± 0.020
pH	7.0 – 8.5
Refractive Index	1.4000 ± 0.0020
Surface Tension (1% Solution)	18 ± 1 dynes/cm
Viscosity	10.5 ± 1 centistokes

APPLICATION

ANSULITE 1% Freeze-Protected AFFF Concentrate is intended for use on Class B hydrocarbon fuel fires having low water solubility such as various crude oils, gasolines, diesel fuels, aviation fuels, etc. **It is not suitable for use on fuels having appreciable water solubility (polar solvents), i.e., methyl and ethyl alcohol, acetone, and methyl ethyl ketone.** It can be used with both aspirating and non-aspirating discharge devices because of the low energy required to make it foam.

Its excellent wetting characteristics make it useful in combating Class A fires as well. It can be used with dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability.

PERFORMANCE

Fire Performance – The fire performance of ANSULITE 1% Freeze-Protected AFFF Concentrate is measured primarily against Underwriters Laboratories Standard UL 162.

Foaming Properties – When used with fresh or salt water or water of any hardness, at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of from 6:1 to 10:1 depending primarily on type of aspirating device and flow rate. Subsurface injection is a special case where generally expansion ratios of 2:1 to 3:1 are preferred but up to 4:1 is allowed. Non-aspirating devices such as handline water fog/stream nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1.

Proportioning – ANSULITE 1% Freeze-Protected AFFF Concentrate can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pumped proportioning equipment
2. Balanced pressure bladder tank proportioner
3. Around the pump type proportioners
4. Fixed or portable (in-line) venturi type proportioners
5. Handline nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperature for ANSULITE 1% Freeze-Protected AFFF Concentrate in this equipment is –20 °F (–29 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system and within the temperature limits specified, the shelf life of ANSULITE 1% Freeze-Protected AFFF Concentrate is about 20-25 years. The factors affecting shelf life and stability for ANSULITE AFFF concentrates are discussed in detail in Ansul Technical Bulletin No. 54. If the product is frozen during storage or transportation, thawing will render the product completely usable. Mixing after freeze thaw cycle is recommended.

Compatability – ANSUL has conducted testing with admixtures of different manufacturers' AFFF products in varying proportions and is satisfied that the ANSULITE 1% Freeze-Protected AFFF Concentrate is compatible with these products. Refer to Ansul Technical Bulletin No. 48 for a more detailed discussion of compatibility.

Different types of foam concentrates, i.e., AFFF, protein base, etc., should not be mixed under any circumstances.

Materials of Construction Compatibility – Tests have been performed with ANSULITE AFFF concentrates verifying compatibility with standard carbon steel "black" pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to Ansul Technical Bulletin No. 59 addressing acceptable materials of construction for use with ANSUL foam concentrates.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Please **first** consult ANSUL Fire Protection for specific guidelines concerning materials of constructions.

Inspection – As with any fire extinguishing agent, ANSULITE AFFF concentrates, whether in the concentrate or pre-mixed form, should be inspected periodically. NFPA 11 "Standard for Low Expansion Foam and Combined Agent Systems" requires that foam concentrate samples be submitted to the manufacturer or other qualified laboratory for quality condition testing at least annually. Contact ANSUL for further information on annual inspection.

APPROVALS AND LISTINGS

ANSULITE 1% Freeze Protected AFFF Concentrate is approved, qualified under, listed or meets the requirements of the following specifications and standards:

- Underwriters Laboratories Inc. – UL Standard 162

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Foam Identification Tests
4. Tests of Shipping Containers

It is impractical for ANSUL to list its ANSULITE 1% Freeze-Protected AFFF Concentrate with every piece of UL listed hardware. Moreover, there are numerous foam hardware components without UL listings that cannot be listed for use with any AFFF concentrate.

Many unlisted pieces of foam hardware should be similar to those listed. However, on installations where ANSULITE 1% Freeze-Protected AFFF Concentrate may be used with hardware components of significantly different types than those tested, contact ANSUL for recommendations.

ORDERING INFORMATION

ANSULITE 1% Freeze-Protected AFFF Concentrate is available in pails, drums, totes, or bulk shipment.

Part No. 415301	5 gallon pail
Part No. 415303	55 gallon drum
Part No. 432156	265 gallon tote
Part No. 415305	Bulk (contact ANSUL about domestic truck-load delivery)

Shipping Weight:

5 gal (19 L) pail – 45 lb (20.4 kg)

55 gal (208.1 L) drum – 495 lb (224.5 kg)

265 gal (1000 L) tote – 2465 lb (1118 kg)

Cube:

5 gal (19 L) pail – 1.25 ft^3 (0.0353 m^3)

55 gal (208.1 L) drum – 11.83 ft^3 (0.3350 m^3)

265 gal (1000 L) tote – 50.05 ft^3 (1.42 m^3)

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ANSUL

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ANSULITE 3% (AFC-3A) AFFF CONCENTRATE

Data/Specifications

DESCRIPTION

ANSULITE 3% (AFC-3A) AFFF (Aqueous Film-Forming Foam) Concentrate is formulated from specialty fluorochemical and hydrocarbon type surfactants along with solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume.

It is intended for use as a 3% proportioned solution in fresh, salt or hard water. It may also be used and stored as a 3% premixed solution in fresh or potable water only. The correct proportioning or mixture ratio is 3 parts of concentrate to 97 parts of water.

Three fire extinguishment mechanisms are in effect when using ANSULITE 3% (AFC-3A) AFFF Concentrate. First, an aqueous film is formed which works to help prevent the release of fuel vapor. Second, the foam blanket from which the film-forming liquid drains effectively excludes oxygen from the fuel surface. Third, the water content of the foam provides a cooling effect.

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Colorless to Pale Yellow Liquid
Density	1.026 g/ml ± 0.020
pH	7.0 – 8.5
Refractive Index	1.3490 ± 0.0025
Surface Tension (3% Solution)	18 ± 1 dynes/cm
Viscosity	2.9 ± 1 centistokes

APPLICATION

ANSULITE 3% (AFC-3A) AFFF Concentrate is intended for use on Class B hydrocarbon fuel fires having low water solubility such as various crude oils, gasolines, diesel fuels, aviation fuels, etc. **It is not suitable for use on fuels having appreciable water solubility (polar solvents), i.e., methyl and ethyl alcohol, acetone, and methyl ethyl ketone.** It can be used with both aspirating and non-aspirating discharge devices because of the low energy required to make it foam.

Its excellent wetting characteristics make it useful in combating Class A fires as well. It can be used with dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability.

PERFORMANCE

Fire Performance – The fire performance of ANSULITE 3% (AFC-3A) AFFF Concentrate is measured against specifications and standards such as U.S. Military Specification MIL-F-24385 **but is not on the Qualified Product List (QPL).** ANSULITE 3% (AFC-3A) AFFF Concentrate has also been tested to Underwriters Laboratories Standard 162. Reports covering this fire performance are available on request since standards and specifications such as those cited are continuously being upgraded and changed.

Foaming Properties – When used with fresh or salt water or water of any hardness, at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of from 6:1 to 10:1 depending primarily on type of aspirating nozzle and flow rate. Subsurface injection is a special case where generally expansion ratios of 2:1 to 3:1 are preferred but up to 4:1 is allowed. Non-aspirating devices such as handline water fog/stream nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1.

Proportioning – ANSULITE 3% (AFC-3A) AFFF Concentrate can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pumped proportioning equipment
2. Balanced pressure bladder tank type proportioners
3. Around the pump type proportioners
4. Fixed or portable (in-line) venturi type proportioners
5. Handline nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperatures for ANSULITE 3% (AFC-3A) AFFF Concentrate in this equipment is 35 °F (2 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system within the temperature limits specified, the shelf life of ANSULITE 3% (AFC-3A) AFFF Concentrate is about 20-25 years. The factors affecting shelf life and stability for ANSULITE AFFF Concentrates are discussed in detail in ANSUL Technical Bulletin No. 54. If the product is frozen during storage or transportation, thawing will render the product completely usable. Mixing after freeze thaw cycling is recommended.

Compatibility – Certain specifications such as U.S. Military Specification MIL-F-24385 require that products placed on the Qualified Products List (QPL) for that specification demonstrate performance compatibility in all mixture proportions.

With regard to non-qualified (QPL) AFFF type concentrates, they should only be mixed in an emergency, or if the manufacturer has supporting test data to substantiate that the mixture meets the same requirements as the individual component concentrates. Refer to ANSUL Technical Bulletin No. 48 for a more detailed discussion of compatibility.

Different types of foam concentrates, i.e., AFFF, protein base, etc., should not be mixed under any circumstances.

Materials of Construction Compatibility – Tests have been performed with ANSULITE 3% (AFC-3A) AFFF Concentrate verifying its compatibility with standard carbon steel "black" pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, plastic fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to ANSUL Technical Bulletin No. 59, Form No. F-90109, addressing acceptable materials of construction for use with ANSUL foam concentrates.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Please **first** consult Tyco Fire Protection Products for specific guidelines concerning materials of construction.

Inspection – As with any fire extinguishing agent, ANSULITE 3% (AFC-3A) AFFF Concentrate, whether in the concentrate or pre-mixed form should be inspected periodically. NFPA 11 "Standard for Low Expansion Foam and Combined Agent Systems" requires that foam concentrate samples be submitted to the manufacturer or other qualified laboratory for quality condition testing at least annually. Contact Tyco Fire Protection Products for further information on annual inspection.

APPROVALS AND LISTING

ANSULITE 3% (AFC-3A) AFFF Concentrate is approved, qualified under, listed or meets the requirements of the following specifications and standards:

Underwriters Laboratories Inc. – UL Standard 162

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Foam Identification Tests
4. Tests of Shipping Containers
5. Class B Hydrocarbon Fuel Sprinkler Tests (Foam water and standard type both upright and pendent approvals)

Factory Mutual Research Corporation – Approval Guide

It is impractical for Tyco Fire Protection Products to list its ANSULITE 3% AFFF Concentrate with every piece of UL listed hardware. Moreover, there are numerous foam hardware components without UL listings that cannot be listed for use with any AFFF concentrate.

Many unlisted pieces of foam hardware should be similar to those listed. However, on installations where ANSULITE 3% AFFF Concentrate may be used with hardware components of significantly different types than those tested, contact Tyco Fire Protection Products for recommendations.

ORDERING INFORMATION

ANSULITE 3% (AFC-3A) is available in pails, drums, totes, or bulk shipment.

Part No.	Description	Shipping Weight	Cube
55800	5 gal (19 L) Pail	45 lb (20.4 kg)	1.25 ft^3 (0.0353 m^3)
55809	55 gal (208 L) Drum	495 lb (224.5 kg)	11.83 ft^3 (0.335 m^3)
431499	265 gal (1000 L) Tote	2465 lb (1118 kg)	50.05 ft^3 (1.42 m^3)
26700	Bulk Order	Contact Technical Services	

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ANSULITE® PREMIUM 3% (AFC-5A) AFFF CONCENTRATE

Data/Specifications

ANSUL®

DESCRIPTION

ANSULITE® Premium 3% (AFC-5A) AFFF (Aqueous Film-Forming Foam) Concentrate is formulated from specialty fluorochemical and hydrocarbon type surfactants along with solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and space.

It is intended for use as a 3% proportioned solution in fresh, salt, or hard water. Water hardness should not exceed 500 ppm expressed as calcium and magnesium. It may also be used and stored as a 3% premixed solution in fresh or potable water only. The correct proportioning or mixture ratio is 3 parts of concentrate to 97 parts of water.

Three fire extinguishment mechanisms are in effect when using ANSULITE Premium 3% (AFC-5A) AFFF Concentrate. First, an aqueous film is formed which works to help prevent the release of fuel vapor. Second, the foam blanket from which the film-forming liquid drains effectively excludes oxygen from the fuel surface. Third, the water content of the foam provides a cooling effect.

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Colorless to Pale Yellow Liquid
Density	1.023 g/ml ± 0.020
pH	7.0 – 8.5
Refractive Index	1.3640 ± 0.0020
Surface Tension (3% Solution)	18 ±1 dynes/cm
Viscosity	4.5 ± 1 centistokes

APPLICATION

ANSULITE Premium 3% (AFC-5A) AFFF Concentrate is intended for use on Class B hydrocarbon fuel fires having low water solubility such as various crude oils, gasolines, diesel fuels, aviation fuels, etc. It is not suitable for use on fuels having appreciable water solubility (polar solvents), i.e., methyl and ethyl alcohol, acetone, and methyl ethyl ketone. It can be used with both aspirating and non-aspirating discharge devices because of the low energy required to make it foam.

Its excellent wetting characteristics make it useful in combating Class A fires as well. It can be used with dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability.

PERFORMANCE

Fire Performance – The fire performance of ANSULITE Premium 3% (AFC-5A) AFFF Concentrate is measured against specifications and standards such as U.S. Military Specification MIL-F-24385 and Underwriters Laboratories Standard UL 162. Reports covering this fire performance are available on request since standards and specifications such as those cited are continuously being upgraded and changed.

Foaming Properties – When used with fresh, salt or hard water at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of from 6:1 to 10:1 depending primarily on type of aspirating nozzle and flow rate. In general the higher the flow rate the higher the expansion ratio. Thus monitors and foam chambers normally produce higher expansion ratios than foam water sprinkler heads and hand held type nozzles. Subsurface injection is a special case where generally expansion ratios of 2:1 to 3:1 are preferred but up to 4:1 is allowed. Non-aspirating devices such as handline water fog/stream nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1.

Proportioning – ANSULITE Premium 3% (AFC-5A) AFFF Concentrate can be proportioned easily at the correct dilution using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pumped proportioning equipment
2. Balanced pressure bladder tank type proportioners
3. Around-the-pump type proportioners
4. Fixed or portable (in-line) venturi type proportioners
5. Handline nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperatures for ANSULITE Premium 3% (AFC-5A) AFFF Concentrate in this equipment is 35 °F (2 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system and within the temperature limits specified, the shelf life of ANSULITE Premium 3% (AFC-5A) AFFF Concentrate is about 20-25 years. The factors affecting shelf life and stability for ANSULITE AFFF Agents are discussed in detail in Ansul Technical Bulletin No. 54. If the product is frozen during storage or transportation, thawing will render the product completely usable. Upon thawing, gentle mixing to ensure a homogeneous solution is recommended.

Compatibility – Certain specifications such as U.S. Military Specification MIL-F-24385 require that products placed on the Qualified Products List (QPL) for that specification demonstrate performance compatibility in all mixture proportions. ANSULITE Premium 3% (AFC-5A) AFFF Concentrate which is on the QPL for this specification is therefore compatible with any other product qualified under that specification or preceding versions of this specification.

With regard to other non-qualified (QPL) AFFF type concentrates, they should only be mixed in an emergency, or if the manufacturer has supporting test data to substantiate that the mixture meets the same requirements as the individual component concentrates. Refer to Ansul Technical Bulletin No. 48 for a more detailed discussion of compatibility.

Different types of foam concentrates, i.e., AFFF, protein base, etc., should not be mixed under any circumstances.

Materials of Constructions Compatibility – Tests have been performed with ANSULITE Premium 3% (AFC-5A) AFFF Concentrate verifying its compatibility with standard carbon steel "black" pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to Ansul Technical Bulletin No. 59, Form No. F-90109, addressing acceptable materials of construction for use with ANSUL foam concentrates.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Please **first** consult Ansul Incorporated for specific guidelines concerning materials of construction.

Inspection – As with any fire extinguishing agent, ANSULITE Premium 3% (AFC-5A) AFFF Concentrate, whether in the concentrate or premixed form should be inspected periodically. Please refer to the Field Inspection Manual, Ansul Part No. 31274, for the detailed procedures to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur, such as are described in Ansul Technical Bulletin No. 54. In such cases, ANSUL's recommendation should be sought.

APPROVALS AND LISTING

- ANSULITE Premium 3% (AFC-5A) AFFF Concentrate is approved, qualified under, listed or meets the requirements of the following specifications and standards:
- U.S. Military Specification – MIL-F-24385 with latest amendments and listed on QPL 24385 issued by U.S. Navy (NAVSEA).
- Underwriters Laboratories Inc. – UL Standard 162

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Foam Identification Tests
4. Tests of Shipping Containers
5. Class B Hydrocarbon Fuel Sprinkler Tests (Standard type both upright and pendant approvals only).
6. Subsurface Injection

It is impractical for ANSUL to list its ANSULITE 3% agents with every piece of UL listed hardware. Moreover, there are numerous foam hardware components without UL listings that can not be listed for use with any AFFF agent.

Unlisted pieces of foam hardware should be similar to those listed. However, on installations where ANSULITE 3% may be used with hardware components of significantly different types than those tested, contact ANSUL for recommendations.

ORDERING INFORMATION

ANSULITE Premium 3% (AFC-5A) AFFF Concentrate is available in pails, drums, totes, or bulk shipment.

Part No. 68122	5 gallon pail
Part No. 68123	55 gallon drum
Part No. 432336	265 gallon tote
Part No. 68119	Bulk (contact ANSUL about domestic truckload delivery)

Shipping Weight:
5 gal (19 L) pail – 45 lb (20.4 kg)
55 gal (208.1 L) drum – 495 lb (224.5 kg)
265 gal (1000 L) tote – 2465 lb (1118 kg)

Cube:
5 gal (19 L) pail – 1.25 ft^3 (0.0353 m^3)
55 gal (208.1 L) drum – 11.83 ft^3 (0.3350 m^3)
265 gal (1000 L) tote – 50.05 ft^3 (1.42 m^3)

ANSULITE® 3% FREEZE-PROTECTED AFFF CONCENTRATE –20 °F (–29 °C)

Data/Specifications

ANSUL®

DESCRIPTION

ANSULITE® 3% Freeze-Protected AFFF (Aqueous Film-Forming Foam) Concentrate is formulated from specialty fluorochemical and hydrocarbon type surfactants along with solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume.

It is intended for use as a 3% proportioned solution in fresh, salt or hard water. It may also be used and stored as a 3% premixed solution in fresh or potable water only. However, the diluted solution will freeze at 32 °F (0 °C). The correct proportioner mixture ratio is 3 parts concentrate to 97 parts water.

Three fire extinguishment mechanisms are in effect when using ANSULITE 3% Freeze-Protected AFFF Concentrate. First, an aqueous film is formed which works to help prevent the release of fuel vapor. Second, the foam blanket from which the film-forming liquid drains effectively excludes oxygen from the fuel surface. Third, the water content of the foam provides a cooling effect.

Typical Physiochemical Properties at 77 °F (25 °C) of ANSULITE 3% Freeze-Protected AFFF Concentrate

Appearance	Colorless to Pale Yellow Liquid
Density	1.050 g/ml ± 0.025
pH	7.0 – 8.5
Refractive Index	1.3910 ± 0.0030
Surface Tension (3% Solution)	18 ± 1 dynes/cm
Viscosity	7 ± 2 centistokes

APPLICATION

ANSULITE 3% Freeze-Protected AFFF Concentrate is intended for use on Class B hydrocarbon fuel fires having low water solubility such as various crude oils, gasolines, diesel fuels, aviation fuels, etc. It is not suitable for use on fuels having appreciable water solubility (polar solvents), i.e., methyl and ethyl alcohol, acetone, and methyl ethyl ketone. It can be used with both aspirating and non-aspirating discharge devices because of the low energy required to make it foam.

Its excellent wetting characteristics make it useful in combating Class A fires as well. It can be used with dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability.

PERFORMANCE

Fire Performance – The fire performance of ANSULITE 3% Freeze-Protected AFFF Concentrate is measured against specifications and standards such as U.S. Military Specification MIL-F-24385 and Underwriters Laboratories Standard UL 162. Reports covering this fire performance are available on request since standards and specifications such as those cited are continuously being upgraded and changed.

Foaming Properties – When used with fresh salt water or hard water at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of from 6:1 to 10:1 depending primarily on type of aspirating device and flow rate. In general, the higher the flow rate the higher the expansion ratio. Subsurface injection is a special case where generally expansion ratios of 2:1 to 3:1 are preferred but up to 4:1 is allowed. Non-aspirating devices such as handline water fog/stream nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1.

Proportioning – ANSULITE 3% Freeze-Protected AFFF Concentrate can be proportioned easily at the correct dilution using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pumped proportioning equipment
2. Balanced pressure bladder tank type proportioner
3. Around-the-pump type proportioners
4. Fixed or portable (in-line) venturi type proportioners
5. Handline nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperatures for ANSULITE 3% Freeze-Protected AFFF Concentrate in this equipment is –20 °F (–29 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system and within the temperature limits specified, the shelf life of ANSULITE 3% Freeze-Protected AFFF Concentrate is about 20-25 years. The factors affecting shelf life and stability for ANSULITE AFFF Agents are discussed in detail in Ansul® Technical Bulletin No. 54. If the product is frozen during storage or transportation, thawing will render the product completely usable. Mixing after thawing is desirable so as to assure a homogenous solution.

Compatibility – Although ANSULITE 3% Freeze-Protected AFFF Concentrate does not appear on the QPL for MIL-F-24385, ANSUL has conducted testing with admixtures of different manufacturers products in varying proportions and is satisfied that the ANSULITE 3% Freeze-Protected AFFF Concentrate is compatible with these products. Refer to Ansul Technical Bulletin No. 48 for a more detailed discussion of compatibility.

Different types of foam concentrates, i.e., AFFF, protein base etc., should not be mixed under any circumstances. Refer to Ansul Technical Bulletin No. 59 addressing acceptable materials of construction for use with ANSUL foam concentrates.

Inspection – As with any fire extinguishing agent, ANSULITE 3% Freeze-Protected AFFF Concentrate, whether in the concentrate or premixed form, should be inspected periodically. Please refer to the Field Inspection Manual, Ansul Part No. 31274, for the detailed procedures to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur, such as are described in Ansul Technical Bulletin No. 54. In such cases, ANSUL's recommendation should be sought.

APPROVALS AND LISTINGS

ANSULITE 3% Freeze-Protected AFFF Concentrate is approved, qualified under, listed or meets the requirements of the following specifications and standards:

- Underwriters Laboratories Inc. – UL Standard 162

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Foam Identification Tests
4. Tests of Shipping Containers
5. Class B Hydrocarbon Fuel Sprinkler Tests (Standard type both upright and pendent approvals only)

It is impractical for ANSUL to list its ANSULITE 3% agent with every piece of UL listed hardware. Moreover, there are numerous foam hardware components without UL listings that cannot be listed for use with any AFFF agent.

Many unlisted pieces of foam hardware should be similar to those listed. However, on installations where ANSULITE 3% may be used with significantly different hardware components than those tested, contact ANSUL for recommendations.

ORDERING INFORMATION

- ANSULITE 3% Freeze-Protected AFFF Concentrate is available in pails, drums, totes, or bulk shipment.

Part No. 54783	5 gallon pail
Part No. 54892	55 gallon drum
Part No. 432161	265 gallon tote
Part No. 54660	Bulk (contact ANSUL about domestic truck-load delivery)

Shipping Weight:

5 gal (19 L) pail – 45 lb (20.4 kg)
55 gal (208.1 L) drum – 495 lb (224.5 kg)
265 gal (1000 L) tote – 2465 lb (1118 kg)

Cube:

5 gal (19 L) pail – 1.25 ft^3 (0.0353 m^3)
55 gal (208.1 L) drum – 11.83 ft^3 (0.3350 m^3)
265 gal (1000 L) tote – 50.05 ft^3 (1.42 m^3)

Ansul Incorporated
Marinette, WI 54143-2542
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Form No. F-8125-3

ANSUL

A Tyco International Company

ANSULITE 6% (AFC-3) AFFF CONCENTRATE

Data/Specifications

DESCRIPTION

ANSULITE 6% (AFC-3) AFFF (Aqueous Film-Forming Foam) Concentrate is formulated from specialty fluorochemical and hydrocarbon surfactants along with solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and space.

It is intended for use as a 6% proportioned solution in fresh, salt or hard water. It may also be used and stored as a 6% premixed solution in fresh or potable water only. The correct proportioning or mixture ratio is 6 parts of concentrate to 94 parts of water.

Three fire extinguishment mechanisms are in effect when using ANSULITE 6% (AFC-3) AFFF Concentrate. First, an aqueous film is formed which works to help prevent the release of fuel vapor. Second, the foam blanket from which the film-forming liquid drains effectively excludes oxygen from the fuel surface. Third, the water content of the foam provides a cooling effect.

Physiochemical Properties at 77 °F (25 °C)

Appearance	Colorless to Pale Yellow Liquid
Density	1.013 g/ml ± 0.020
pH	7.0 – 8.5
Refractive Index	1.3390 ± 0.0030
Surface Tension (6% Solution)	18 ± 1 dynes/cm
Viscosity	2 ± 1 centistokes

APPLICATION

ANSULITE 6% (AFC-3) AFFF Concentrate is intended for use on Class B hydrocarbon fuel fires having low water solubility such as various crude oils, gasolines, diesel fuels, aviation fuels, etc. **It is not suitable for use on fuels having appreciable water solubility (polar solvents), i.e., methyl and ethyl alcohol, acetone, and methyl ethyl ketone.** It can be used with both aspirating and non-aspirating discharge devices because of the low energy required to make it foam.

Its excellent wetting characteristics make it useful in combating Class A fires as well. It can be used with dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability.

PERFORMANCE

Fire Performance – The fire performance of ANSULITE 6% (AFC-3) AFFF Concentrate is measured against specifications and standards such as U.S. Military Specification MIL-F-24385 **but is not on the Qualified Product List (QPL).** ANSULITE 6% (AFC-3) AFFF Concentrate has been tested to Underwriters Laboratories Standard 162. Reports covering this fire performance are available on request since standards and specifications such as those cited are continuously being upgraded and changed.

Foaming Properties – When used with fresh, salt, or hard water at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of from 6:1 to 10:1 depending primarily on type and flow rate. Subsurface injection generally produces expansion ratios of 2:1 to 3:1. Non-aspirating devices such as handline water fog/stream nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1.

Proportioning – ANSULITE 6% (AFC-3) AFFF Concentrate can be proportioned easily at the correct dilution using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pumped proportioning equipment
2. Balanced pressure bladder tank type proportioner
3. Around-the-pump type proportioners
4. Fixed or portable (in-line) venturi type proportioners
5. Handline nozzles with fixed induction/ pickup tubes

The minimum and maximum usable temperatures for ANSULITE 6% (AFC-3) AFFF Concentrate in this equipment is 35 °F (2 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system and within the temperature limits specified the shelf life of ANSULITE 6% (AFC-3) AFFF Concentrate is about 20-25 years.

The factors affecting shelf life and stability for ANSULITE AFFF Agents are discussed in detail in ANSUL Technical Bulletin No. 54. If the product is frozen during storage or transportation, thawing will render the product completely usable.

Compatibility – Tyco Fire Protection Products has conducted testing with admixtures of different manufacturers 6% AFFF products in varying proportions and is satisfied that the ANSULITE 6% AFFF is compatible with these products. Refer to ANSUL Technical Bulletin No. 48 for a more detailed discussion of compatibility.

Different types of foam concentrates, i.e., AFFF, protein base, etc., should not be mixed under any circumstances.

Materials of Construction Compatibility – Tests have been performed with ANSULITE 6% (AFC-3) AFFF Concentrate verifying its compatibility with standard carbon steel black pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Refer to ANSUL Technical Bulletin No. 59 addressing acceptable materials of construction for use with ANSUL foam concentrates.

Inspection – As with any fire extinguishing agent, ANSULITE 6% (AFC-3) AFFF Concentrate, whether in the concentrate or pre-mixed form should be inspected periodically. Please refer to the Field Inspection Manual, Part No. 31274, for the detailed procedures to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur, such as are described in ANSUL Technical Bulletin No. 54. In such cases, Tyco Fire Protection Products' recommendation should be sought.

APPROVALS AND LISTINGS

ANSULITE 6% (AFC-3) AFFF Concentrate is approved, qualified under, listed or meets the requirements of the following specifications and standards:

Underwriters Laboratories Inc. – UL Standard 162

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Foam Identification Tests
4. Tests of Shipping Containers
5. Class B Hydrocarbon Fuel Sprinkler Test (Foam water type both upright and pendent approvals only)

It is impractical for Tyco Fire Protection Products to list its ANSULITE 6% agents with every piece of UL listed hardware. Moreover, there are numerous foam hardware components without UL listings that cannot be listed for use with any AFFF agent.

Many unlisted pieces of foam hardware should be similar to those listed. However, on installations where ANSULITE 6% may be used with hardware components of significantly different types than those tested, contact Tyco Fire Protection Products for recommendations.

ORDERING INFORMATION

ANSULITE 6% (AFC-3) is available in pails, drums, totes, or bulk shipment.

Part No.	Description	Shipping Weight	Cube
54391	5 gal (19 L) Pail	45 lb (20.4 kg)	1.25 ft^3 (0.0353 m^3)
54392	55 gal (208 L) Drum	495 lb (224.5 kg)	11.83 ft^3 (0.335 m^3)
432155	265 gal (1000 L) Tote	2465 lb (1118 kg)	50.05 ft^3 (1.42 m^3)
30915	Bulk Order	Contact Technical Services	

tyco
Fire Protection Products

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www.ansul.com

ANSULITE® PREMIUM 6% (AFC-5) AFFF CONCENTRATE

Data/Specifications

ANSUL®

DESCRIPTION

ANSULITE® Premium 6% (AFC-5) AFFF (Aqueous Film-Forming Foam) Concentrate is formulated from specialty fluorochemical and hydrocarbon surfactants along with solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and space.

It is intended for use as a 6% proportioned solution in fresh, salt, or hard water. It may also be used and stored as a 6% premixed solution in fresh or potable water only. The correct proportioning or mixture ratio is 6 parts of concentrate to 94 parts of water.

Three fire extinguishment mechanisms are in effect when using ANSULITE Premium 6% (AFC-5) AFFF Concentrate. First, an aqueous film is formed which works to help prevent the release of fuel vapor. Second, the foam blanket from which the film-forming liquid drains effectively excludes oxygen from the fuel surface. Third, the water content of the foam provides a cooling effect.

Physiochemical Properties at 77 °F (25 °C)

Appearance	Colorless to Pale Yellow Liquid
Density	1.015 g/ml ± 0.020
pH	7.0 – 8.5
Refractive Index	1.3600 ± 0.0020
Surface Tension (6% Solution)	18 ± 1 dynes/cm
Viscosity	2.5 ± 1 centistokes

APPLICATION

ANSULITE Premium 6% (AFC-5) AFFF Concentrate is intended for use on Class B hydrocarbon fuel fires having low water solubility such as various crude oils, gasolines, diesel fuels, aviation fuels, etc. **It is not suitable for use on fuels having appreciable water solubility (polar solvents), i.e., methyl and ethyl alcohol, acetone, methyl ethyl ketone.** It can be used with both aspirating and non-aspirating discharge devices because of the low energy required to make it foam.

Its excellent wetting characteristics make it useful in combating Class A fires as well. It can be used with dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability.

PERFORMANCE

Fire Performance – The fire performance of ANSULITE Premium 6% (AFC-5) AFFF Concentrate is measured against specifications and standards such as U.S. Military Specification MIL-F-24385 and Underwriters Laboratories Standard UL 162. Reports covering this fire performance are available on request since standards and specifications such as those cited are continuously being upgraded and changed.

Foaming Properties – When used with fresh, salt or hard water, at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of from 6:1 to 10:1 depending primarily on type of aspirating device and flow rate. Subsurface injection generally produces expansion ratios of 2:1 to 3:1. Non-aspirating devices such as handline water fog nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1.

Proportioning – ANSULITE Premium 6% (AFC-5) AFFF Concentrate can be proportioned easily at the correct dilution using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pumped proportioning equipment
2. Balanced pressure bladder tank type proportioner
3. Around-the-pump type proportioners
4. Fixed or portable (in-line) venturi type proportioners
5. Handline nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperature for ANSULITE Premium 6% (AFC-5) AFFF Concentrate in this equipment is 35 °F (2 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system and within the temperature limits specified, the shelf life of ANSULITE Premium 6% (AFC-5) AFFF Concentrate is about 20-25 years. The factors affecting shelf life and stability for ANSULITE AFFF Agents are discussed in detail in Ansul Technical Bulletin No. 54. If the product is frozen during storage or transportation, thawing will render the product completely usable. Mixing after freeze thaw cycling is recommended.

Compatibility – Certain specifications such as U.S. Military Specification MIL-F-24385 require that products placed on the Qualified Products List (QPL) for that specification demonstrate performance compatability in all mixture proportions. ANSULITE Premium 6% (AFC-5) AFFF Concentrate which is on the QPL for this specification is therefore compatible with any other product qualified under that specification or preceding versions of this specification.

With regard to other non-qualified (QPL) AFFF type concentrates, they should only be mixed in an emergency, or if the manufacturer has supporting test data to substantiate that the mixture meets the same requirements as the individual component concentrates. Refer to Ansul Technical Bulletin No. 48 for a more detailed discussion of compatibility.

Different types of foam concentrates, i.e., AFFF, protein base, etc., should not be mixed under any circumstances.

Materials of Constructions Compatibility – Tests have been performed with ANSULITE Premium 6% (AFC-5) AFFF Concentrate verifying its compatibility with standard carbon steel "black" pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to Ansul Technical Bulletin No. 59, Form No. 90109, addressing acceptable materials of construction for use with Ansul foam concentrates.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Please **first** consult Ansul Incorporated for specific guidelines concerning materials of construction.

Inspection – As with any fire extinguishing agent, ANSULITE Premium 6% (AFC-5) AFFF Concentrate, whether in the concentrate or pre-mixed form should be inspected periodically. Please refer to the Field Inspection Manual, Ansul Part No. 31274, for the detailed procedures to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur such as are described in Ansul Technical Bulletin No. 54. In such cases, ANSUL's recommendation should be sought.

APPROVALS AND LISTING

ANSULITE Premium 6% (AFC-5) AFFF Concentrate is approved, qualified under, listed or meets the requirements of the following specifications and standards:

U.S. Military Specification – MIL-F-24385 with latest amendments and listed on QPL 24385 issued by U.S. Navy (NAVSEA).

Underwriters Laboratories, Inc. – UL Standard 162

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Foam Identification Tests
4. Tests of Shipping Containers

It is impractical for ANSUL to list its ANSULITE 6% agents with every piece of UL listed hardware. Moreover, there are numerous foam hardware components without UL listings that cannot be listed for use with any foam agent.

Many unlisted pieces of foam hardware should be similar to those listed. However, on installations where ANSULITE 6% Foam Concentrate may be used with hardware components of significantly different design than those tested, contact ANSUL for recommendations.

ORDERING INFORMATION

ANSULITE Premium 6% (AFC-5) AFFF Concentrate is available in pails, drums, totes, or bulk shipment.

Part No. 68120	5 gallon pail
Part No. 68121	55 gallon drum
Part No. 432159	265 gallon tote
Part No. 68118	Bulk (contact ANSUL about domestic truckload delivery)

Shipping Weight:
5 gal (19 L) pail – 45 lb (20.4 kg)
55 gal (208.1 L) drum – 495 lb (224.5 kg)
265 gal (1000 L) tote – 2465 lb (1118 kg)

Cube:
5 gal (19 L) pail – 1.25 ft^3 (0.0353 m^3)
55 gal (208.1 L) drum – 11.83 ft^3 (0.3350 m^3)
265 gal (1000 L) tote – 50.05 ft^3 (1.42 m^3)

ANSUL

A Tyco International Company

ANSULITE 1x1 AR-AFFF CONCENTRATE

Data/Specifications

FEATURES

- 1% proportioning for both hydrocarbon and polar solvent fuels
- UL-162 listed, EN 1568 approved, EPA 2015 compliant, and LASTFIRE tested
- Use with aspirating and non-aspirating discharge devices
- Low “water-like” viscosity
- Suitable for use with fresh, salt, or hard water
- Freeze protected down to 0 °F (–18 °C)

APPLICATION

ANSULITE 1x1 Alcohol-Resistant Aqueous Film-Forming Foam (AR-AFFF) Concentrate is formulated for use in a 1% foam solution on all Class B fuels, hydrocarbon or polar solvent, wherever life safety and asset protection is essential. When diluted with fresh, salt, or hard water; ANSULITE 1x1 AR-AFFF can be discharged through aspirating or non-aspirating branch pipes and nozzles, fixed foam making devices, and sprinklers to suppress Class A and B fuel fires. Typical applications include oil and gas facilities, chemical plants, refineries and tank farms, alternative fuel facilities, warehouses, municipal fire service, and many others.

DESCRIPTION

ANSULITE 1x1 AR-AFFF Concentrate is manufactured using C-6 fluoro-chemistry in compliance with the U.S. Environmental Protection Agency 2015 Stewardship Program. This proprietary formulation is the first AR-AFFF that does not rely on biopolymer precipitation to suppress polar solvent fires. Therefore, the concentrate does not possess a thixotropic property, but rather has the appearance and viscosity of an AFFF.

Unlike conventional AR-AFFF products, the physical properties of ANSULITE 1x1 concentrate are similar to traditional AFFF products. Benefits to the end user include a reduction in the required storage space for the foam concentrate because of its ability to work as a 1% solution on both hydrocarbon and polar solvent fuels. ANSULITE 1X1 AR-AFFF is approved for use in salt, fresh, or hard water. Proportioning properties are very similar to AFFF and its water-like viscosity enhances performance in all types of foam proportioning equipment.

There are three fire extinguishing mechanisms in effect when using ANSULITE 1x1 foam solution on either a conventional Class B hydrocarbon fuel such as gasoline, diesel fuel, etc.; or a Class B polar solvent (water miscible fuel) such as methyl alcohol, acetone, etc.

1. An aqueous film is formed in the case of a conventional hydrocarbon fuel, or a polymeric membrane in the case of a polar solvent fuel. This film or membrane forms a barrier to help prevent the release of fuel vapor.
2. Regardless of the fuel type, a foam blanket is formed which excludes oxygen. The liquids that form the film or the polymeric membrane are drained from the foam blanket.
3. The water content of the foam produces a cooling effect.

008649

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Amber Liquid
Density	1.09 ± 0.01 g/ml
pH	7.0 – 8.0
Refractive Index	1.3980 ± 0.0015
Viscosity	50 cSt
Spreading Coefficient	4.0 – 6.0

PERFORMANCE

Fire Performance

The fire performance of ANSULITE 1x1 AR-AFFF is measured against Underwriters Laboratories Standard 162 (Latest Revision) fire tests. The UL testing focuses on fuels such as heptane and isopropyl alcohol.

Foaming Properties

When used with fresh, salt or hard water at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios from 5:1 to 10:1 depending primarily on the type of aspirating device and the flow rate. Non-aspirating devices, such as hand-line water fog/stream nozzles or standard sprinkler heads, give expansion ratios of 2:1 to 4:1. Medium-expansion discharge devices produce typical expansion ratios between 20:1 and 60:1 depending primarily on the type of device and operating conditions.

Proportioning

ANSULITE 1x1 AR-AFFF can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

- Balanced pressure and in-line balanced pressure pump proportioning equipment
- Balanced pressure bladder tank proportioners
- Around-the-pump and through-the-pump proportioners
- Fixed or portable (in-line) Venturi-type proportioners
- Hand-line nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperature for ANSULITE 1x1 AR-AFFF in this equipment is 0 °F (–18 °C) to 120 °F (49 °C).

PERFORMANCE (Continued)

Storage/Shelf Life

When stored in the packaging supplied (polyethylene totes, drums, or pails) or in equipment recommended by the manufacturer and within the temperature limits specified, the shelf life of ANSULITE 1x1 AR-AFFF is about 20-25 years. The factors affecting shelf life and stability for AFFF agents are discussed in detail in ANSUL Technical Bulletin No. 54 (Form No. F-83114). Freezing of the product should be avoided. If the product is frozen during transport or storage, it must be thawed and inspected for signs of separation. If separation has occurred, the product must be mechanically mixed until homogeneous.

When the concentrate is to be stored in an atmospheric storage tank, a 1/8 to 1/4 in. (3–6 mm) layer of mineral oil should be added to seal the concentrate and minimize the effects of evaporation.

Compatibility

Since it is a unique blend of surfactants, high molecular weight polymers, and solvents; it is recommended that ANSULITE 1x1 AR-AFFF not be mixed with any other foam concentrates. Consult Technical Services with any questions of compatibility.

Materials of Construction Compatibility

Tests have been performed with ANSULITE 1x1 AR-AFFF verifying its compatibility with standard carbon steel ''black'' pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, plastic fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to ANSUL Technical Bulletin No. 59 (Form No. F-90109) addressing acceptable materials of construction for use with ANSUL foam concentrates.

To help prevent corrosion, galvanized pipe and fittings must not be used in areas where they will contact the undiluted concentrate.

Please consult Technical Services for specific guidelines concerning materials of construction.

Inspection

As with any fire extinguishing agent, ANSULITE 1x1 AR-AFFF, whether in the concentrate or pre-mixed form, should be inspected periodically. NFPA 11 ''Standard for Low Expansion Foam and Combined Agent Systems'' requires that foam concentrate samples be submitted to the manufacturer or other qualified laboratory for quality condition testing at least annually. Please refer to the Field Inspection Manual (Part No. 31274) for the detailed procedures necessary to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur, as described in ANSUL Technical Bulletin No. 54. In such cases, contact Technical Services.

APPROVALS AND LISTINGS

Underwriters Laboratories successfully tested ANSULITE 1x1 AR-AFFF to the requirements contained in UL 162 "Standard for Air-Foam Equipment and Liquid Concentrates." To receive a UL listing, the following tests must be performed successfully:

- Foam Quality Tests
- Class B Hydrocarbon Fuel Fire Tests
- Class B Polar Solvent Fuel Fire Tests
- Foam Identification Tests
- Tests of Shipping Containers

In addition to determining agent characteristics, Underwriters Laboratories lists ANSULITE 1x1 AR-AFFF for use with specific hardware components that also carry the UL listing.

ANSULITE 1x1 AR-AFFF is approved to EN 1568 Parts 3 and 4. It has also been successfully tested to LASTFIRE test protocol by Resource Protection International.

ORDERING INFORMATION

ANSULITE 1x1 AR-AFFF is available in pails, drums, totes or bulk shipment.

Part No.	Description	Shipping Weight	Cube
437681	5 gal (19 L) Pail	46 lb (20.9 kg)	1.25 ft^3 (0.0353 m^3)
437682	55 gal (208 L) Drum	495 lb (224.5 kg)	11.83 ft^3 (0.3350 m^3)
437683	265 gal (1000 L) Tote	2463 lb (1117 kg)	50.05 ft^3 (1.42 m^3)
437680	Bulk Order	Contact ANSUL Technical Services	

ANSUL

by Tyco Fire Suppression & Building Products

ANSULITE 1x3 F-601A AR-AFFF CONCENTRATE

Data/Specifications

DESCRIPTION

ANSULITE 1x3 F-601A AR-AFFF is formulated from special fluorochemical and hydrocarbon surfactants, a high molecular weight polymer, and solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume. It contains no PFOS or PFOA. It is intended for use as a 1% proportioned solution on hydrocarbon fuels and as a 3% proportioned solution on polar solvent fuels in fresh, salt, or hard water. Water hardness should not exceed 500 ppm expressed as calcium and magnesium. It may also be used and stored as a pre-mixed solution in only fresh, potable water.

There are three fire extinguishing mechanisms in effect when using ANSULITE 1x3 F-601A foam solution on either a conventional Class B hydrocarbon fuel such as gasoline, diesel fuel, etc.; or a Class B polar solvent (water miscible fuel) such as methyl alcohol, acetone, etc.

1. An aqueous film is formed in the case of a conventional hydrocarbon fuel, or a polymeric membrane in the case of a polar solvent fuel. This film or membrane forms a barrier to help prevent the release of fuel vapor.
2. Regardless of the fuel type, a foam blanket is formed which excludes oxygen. The liquids that form the film or the polymeric membrane are drained from the foam blanket.
3. The water content of the foam produces a cooling effect.

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Purple Gelled Liquid
Density	1.02 ± 0.01 g/ml
pH	7.5 – 8.5
Refractive Index	1.3600 ± 0.0015
Viscosity	2700 ± 500 cps*
Spreading Coefficient	4.0 – 6.0

*Brookfield Viscometer Spindle #4, Speed 30 rpm

ANSULITE 1x3 F-601A AR-AFFF Concentrate is a non-Newtonian fluid that is both pseudoplastic and thixotropic. Because of these properties, dynamic viscosity will decrease as shear increases.

APPLICATION

ANSULITE 1x3 F-601A AR-AFFF can be used on either conventional Class B fuels or polar solvent-type Class B fuels. Its excellent wetting characteristics make it useful in combating Class A fires as well. Because of the low energy required to make foam, it can be used with both aspirating and non aspirating discharge devices.

To provide even greater fire protection capability, it may be used with Purple-K dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability. Due to the velocity of the dry chemical discharge, care must be taken not to submerge the polymeric membrane below the fuel surface when using the twin agent method on polar solvent fuels.

008492

PERFORMANCE

Fire Performance

The fire performance of ANSULITE 1x3 F-601A AR-AFFF is measured against Underwriters Laboratories Standard 162 (Latest Revision) fire tests. The UL testing focuses on fuels such as heptane and isopropyl alcohol. ANSULITE 1x3 F-601A AR-AFFF was formulated to provide superior performance on all fire tests, especially high octane gasoline.

Foaming Properties

When used with fresh, salt or hard water at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios from 5:1 to 10:1 depending primarily on the type of aspirating device and the flow rate. Non-aspirating devices, such as hand-line water fog/stream nozzles or standard sprinkler heads, give expansion ratios of 2:1 to 4:1. Medium-expansion discharge devices produce typical expansion ratios between 20:1 and 60:1 depending primarily on the type of device and operating conditions.

Proportioning

ANSULITE 1x3 F-601A AR-AFFF can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

- Balanced pressure and in-line balanced pressure pump proportioning equipment.
- Balanced pressure bladder tank proportioners
- Around-the-pump and through-the-pump proportioners
- Fixed or portable (in-line) Venturi-type proportioners
- Hand-line nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperature for ANSULITE 1x3 F-601A AR-AFFF in this equipment is 35 °F (2 °C) to 120 °F (49 °C).

PERFORMANCE (Continued)

Storage/Shelf Life

When stored in the packaging supplied (polyethylene totes, drums, or pails) or in equipment recommended by the manufacturer and within the temperature limits specified, the shelf life of ANSULITE 1x3 F-601A AR-AFFF is about 20-25 years. The factors affecting shelf life and stability for AFFF agents are discussed in detail in ANSUL Technical Bulletin No. 54. Freezing of the product should be avoided. If the product is frozen during transport or storage, it must be thawed and inspected for signs of separation. If separation has occurred, the product must be mechanically mixed until homogeneous.

When the concentrate is to be stored in an atmospheric storage tank, a 1/8 to 1/4 in. (3–6 mm) layer of mineral oil should be added to seal the concentrate and minimize the effects of evaporation.

Compatibility

Since it is a unique blend of surfactants, high molecular weight polymers, and solvents; it is recommended that ANSULITE 1x3 F-601A AR-AFFF not be mixed with any other foam concentrates. Consult ANSUL Technical Services with any questions of compatibility.

Materials of Construction Compatibility

Tests have been performed with ANSULITE 1x3 F-601A AR-AFFF verifying its compatibility with standard carbon steel ‘‘black’’ pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, plastic fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to ANSUL Technical Bulletin No. 59 (Form No. F-90109) addressing acceptable materials of construction for use with ANSUL foam concentrates.

To help prevent corrosion, galvanized pipe and fittings must not be used in areas where they will contact the undiluted concentrate.

Please consult ANSUL Technical Services for specific guidelines concerning materials of construction.

Inspection

As with any fire extinguishing agent, ANSULITE 1x3 F-601A AR-AFFF, whether in the concentrate or pre-mixed form, should be inspected periodically. NFPA 11 ‘‘Standard for Low Expansion Foam and Combined Agent Systems’’ requires that foam concentrate samples be submitted to the manufacturer or other qualified laboratory for quality condition testing at least annually. Please refer to the Field Inspection Manual, Part No. 31274, for the detailed procedures necessary to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occurs, as described in ANSUL Technical Bulletin No. 54. In such cases, contact ANSUL Technical Services.

APPROVALS AND LISTINGS

Underwriters Laboratories successfully tested ANSULITE 1x3 F-601A AR-AFFF to the requirements contained in UL 162 “Standard for Air-Foam Equipment and Liquid Concentrates.” To receive a UL listing, the following tests must be performed successfully:

- Foam Quality Tests
- Class B Hydrocarbon Fuel Fire Tests
- Class B Polar Solvent Fuel Fire Tests
- Foam Identification Tests
- Tests of Shipping Containers

In addition to determining agent characteristics, Underwriters Laboratories lists ANSULITE 1x3 F-601A AR-AFFF for use with specific hardware components that also carry the UL listing.

ORDERING INFORMATION

ANSULITE 1x3 F-601A AR-AFFF is available in pails, drums, totes or bulk shipment.

Part No.	Description	Shipping Weight	Cube
437187	5 gal (19 L) Pail	45 lb (20.4 kg)	1.25 ft (0.0353 m^3)
437188	55 gal (208 L) Drum	495 lb (224.5 kg)	11.83 ft^3 (0.3350 m^3)
437189	265 gal (1000 L) Tote	2463 lb (1117 kg)	50.05 ft^3 (1.42 m^3)
429962	Bulk Order	Contact ANSUL Technical Services	

One Stanton Street
Marinette, WI 54143-2542
+1-715-735-7411
www.ansul.com

Form No. F-2009161-01

ANSULITE® 3x6 F-600A AR-AFFF CONCENTRATE

Data/Specifications

by Tyco Fire Suppression & Building Products

DESCRIPTION

ANSULITE® 3x6 F-600A AR-AFFF is formulated from special fluorochemical and hydrocarbon surfactants, a high molecular weight polymer, and solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume. It contains no PFOS or PFOA. It is intended for use as a 3% proportioned solution on hydrocarbon fuels and as a 6% proportioned solution on polar solvent fuels in fresh, salt, or hard water. Water hardness should not exceed 500 ppm expressed as calcium and magnesium. It may also be used and stored as a pre-mixed solution in only fresh, potable water.

There are three fire extinguishing mechanisms in effect when using ANSULITE 3x6 F-600A foam solution on either a conventional Class B hydrocarbon fuel such as gasoline, diesel fuel, etc.; or a Class B polar solvent (water-miscible fuel) such as methyl alcohol, acetone, etc.

1. An aqueous film is formed in the case of a conventional hydrocarbon fuel, or a polymeric membrane in the case of a polar solvent fuel. This film or membrane forms a barrier to help prevent the release of fuel vapor.
2. Regardless of the fuel type, a foam blanket is formed which excludes oxygen. The liquids that form the film or the polymeric membrane are drained from the foam blanket.
3. The water content of the foam produces a cooling effect.

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Orange Gelled Liquid
Density	0.985 ± 0.050 gm/ml
pH	7.0 – 8.5
Refractive Index	1.3475 ± 0.025
Viscosity	2500 ± 500 centipoise*
Spreading Coefficient	5.7 ± 1.5

*Brookfield Viscometer Spindle #4, Speed 30

ANSULITE 3x6 F-600A AR-AFFF Concentrate is a non-Newtonian fluid that is both pseudoplastic and thixotropic. Because of these properties, dynamic viscosity will decrease as shear increases.

APPLICATION

ANSULITE 3x6 F-600A AR-AFFF can be used on either conventional Class B fuels or polar solvent-type Class B fuels. Its excellent wetting characteristics make it useful in combating Class A Fires as well. Because of the low energy required to make foam, it can be used with both aspirating and non-aspirating discharge devices.

To provide even greater fire protection capability, it may be used with Purple-K dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability. Due to the velocity of the dry chemical discharge, care must be taken not to submerge the polymeric membrane below the fuel surface when using the twin agent method on polar solvent fuels.

008493

PERFORMANCE

Fire Performance

The fire performance of ANSULITE 3x6 F-600A AR-AFFF is measured against Underwriters Laboratories Standard 162 (Latest Revision) fire tests. The UL testing focuses on fuels such as heptane and isopropyl alcohol.

Foaming Properties

When used with fresh, salt, or hard water at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios from 5:1 to 10:1 depending primarily on the type of aspirating device and the flow rate. Non-aspirating devices, such as hand-line water fog/stream nozzles or standard sprinkler heads, give expansion ratios of 2:1 to 4:1. Medium-expansion discharge devices produce typical expansion ratios between 20:1 and 60:1 depending primarily on the type of device and operating conditions.

Proportioning

ANSULITE 3x6 F-600A AR-AFFF can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

- HYDRO-FOAM™ and HYDRO-CHEM™ Nozzles
- Balanced pressure and in-line balanced pressure pump proportioning equipment
- Balanced pressure bladder tank proportioners
- Around-the-pump and through-the-pump proportioners
- Fixed or portable (in-line) Venturi-type proportioners
- Hand-line nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperature for ANSULITE 3x6 F-600A AR-AFFF in this equipment is 35 °F to 120 °F (2 °C to 49 °C).

PERFORMANCE (Continued)

Storage/Shelf Life

When stored in the packaging supplied (polyethylene totes, drums, or pails) or in equipment recommended by the manufacturer and within the temperature limits specified, the shelf life of ANSULITE 3x6 F-600A AR-AFFF is about 20-25 years. The factors affecting shelf life and stability for AFFF Agents are discussed in detail in ANSUL Technical Bulletin No. 54. Freezing of the product should be avoided. If the product is frozen during transport or storage, it must be thawed and inspected for signs of separation. If separation has occurred, the product must be mechanically mixed until homogeneous.

When the concentrate is to be stored in an atmospheric storage tank, a 1/8 to 1/4 in. (3–6 mm) layer of mineral oil should be added to seal the concentrate and minimize the effects of evaporation.

Compatibility

Since it is a unique blend of surfactants, high molecular weight polymers, and solvents; it is recommended that ANSULITE 3x6 F-600A AR-AFFF not be mixed with any other foam concentrates. Consult ANSUL Technical Services with any questions of compatibility.

Materials of Construction Compatibility

Tests have been performed with ANSULITE 3x6 F-600A AR-AFFF verifying its compatibility with standard carbon steel ''black'' pipe, and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, plastic fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to ANSUL Technical Bulletin No. 59 (Form No. F-90109) addressing acceptable materials of construction for use with ANSUL foam concentrates.

To help prevent corrosion, galvanized pipe and fittings must not be used in areas where they will contact the undiluted concentrate.

Please consult ANSUL Technical Services for specific guidelines concerning materials of construction.

Inspection

As with any fire extinguishing agent, ANSULITE 3x6 F-600A AR-AFFF, whether in the concentrate or pre-mixed form, should be inspected periodically. NFPA 11 ''Standard for Low Expansion Foam and Combined Agent Systems'' requires that foam concentrate samples be submitted to the manufacturer or other qualified laboratory for quality condition testing at least annually. Please refer to the Field Inspection Manual, Part No. 31274, for the detailed procedures necessary to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur, as described in ANSUL Technical Bulletin No. 54. In such cases, contact ANSUL Technical Services.

APPROVALS AND LISTINGS

Underwriters Laboratories successfully tested ANSULITE 3x6 F-600A AR-AFFF to the requirements contained in UL 162 “Standard for Air-Foam Equipment and Liquid Concentrates.” To receive a UL listing, the following tests had to be performed successfully:

- Foam Quality Tests
- Class B Hydrocarbon Fuel Fire Tests
- Class B Polar Solvent Fuel Fire Tests
- Foam Identification Tests
- Tests of Shipping Containers

In addition to determining agent characteristics, Underwriters Laboratories lists ANSULITE 3x6 F-600A AR-AFFF for use with specific hardware components that also carry the UL listing.

ORDERING INFORMATION

ANSULITE 3x6 F-600A AR-AFFF is available in pails, drums, totes, or bulk shipment.

Part No.	Description	Shipping Weight	Cube
437197	5 gal (19 L) Pail	45 lb (20.4 kg)	1.25 ft (0.0353 m^3)
437198	55 gal (208 L) Drum	495 lb (224.5 kg)	11.83 ft^3 (0.335 m^3)
437199	265 gal (1000 L) Tote	2463 lb (1117 kg)	31.50 ft^3 (0.892 m^3)
432037	Bulk Order	Contact ANSUL Technical Services	

ANSULITE® 3x3 LOW-VISCOSITY AR-AFFF CONCENTRATE

Data/Specifications

ANSUL®

DESCRIPTION

ANSULITE® 3x3 Low-Viscosity AR-AFFF (Alcohol-Resistant Aqueous Film-Forming Foam) Concentrate is formulated using a newly patented and proprietary technology. The foam concentrate has a dramatically reduced viscosity as compared to other listed polar-solvent type AR-AFFF concentrates on the market. This reduced viscosity enhances performance in all types of foam proportioning equipment including in-line eductors, balanced pressure systems, and built-in systems aboard CFR vehicles.

Additionally, the fire fighting performance of ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate is superior to other 3% foam concentrates. This includes the blended gasoline additive Methyl Tertiary Butyl Ether (MTBE) which is being used worldwide as an oxygenate to make gasoline cleaner burning.

ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate offers many distinct advantages for ease of use and represents a continued commitment to quality by improving the first agent listed by Underwriters Laboratories for use as a 3% concentrate on both polar solvent and hydrocarbon fuels.

ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate is formulated from special fluorochemical and hydrocarbon surfactants, a high molecular weight polymer, and solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume.

It is intended for use as a 3% proportioned solution on both polar solvent and hydrocarbon fuels in fresh, salt or hard water. It may also be stored and used as a premixed solution in fresh water only.

There are three fire extinguishing mechanisms in effect when using ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate on either a conventional Class B hydrocarbon fuel such as gasoline, diesel fuel, etc., or a Class B polar solvent (water miscible fuel) such as methyl alcohol, acetone, etc. First, an aqueous film is formed in the case of a conventional hydrocarbon fuel, or a polymeric membrane in the case of a polar solvent fuel. This film or membrane forms a barrier to help prevent the release of fuel vapor. Second, regardless of the fuel type, a foam blanket is formed which excludes oxygen and from which drains the liquids that form the film or the polymeric membrane. Third, the water content of the foam produces a cooling effect.

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Colorless to Pale Yellow Gelled Liquid
Density	1.020 g/ml ± 0.020
pH	7.0 – 8.5
Refractive Index	1.3565 ± 0.0020
Surface Tension (3% Solution)	18 ± 1 dynes/cm
Viscosity	1500 ± 500 cps*

*Brookfield Viscometer Spindle #4, Speed 30

ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate is a non-Newtonian fluid that is both pseudoplastic and thixotropic. Because of these properties, dynamic viscosity will decrease as shear increases.

APPLICATION

ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate is unique among the ANSULITE AFFF agents in that it can be used on either conventional Class B fuel or the polar solvent type Class B fuels. Its excellent wetting characteristics make it useful in combating Class A fires as well.

Because of the low energy required to make foam, it can be used with both aspirating and nonaspirating discharge devices.

To provide even greater fire protection capability, it may be used with dry chemical extinguishing agents without regard to the order of application. Due to the velocity of the dry chemical discharge, care must be taken not to submerge the polymeric membrane below the fuel surface.

A unique application for ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate is vapor mitigation for hazardous fuming compounds including fuming acids. Recent tests on oleum and chlorosulfonic acids conducted in conjunction with DuPont at a DOE testing facility in Nevada found the foam to be very effective when applied through medium expansion nozzles such as the ANSUL® Model KR-M2 and KR-M4. In addition, the concentrate is ideally suited for situations involving flammable liquid spills where prolonged vapor suppression is desirable in advance of the spill clean up.

APPLICATION RATES

Application Rates using UL 162 Standard 50 ft^2 Fire Test on representative hydrocarbon and polar solvent fuels are listed below.

U.L. Type II Application(1) – Polar Solvents

Fuel Group	Concentration	Minimum Recommended Application Rate gpm/ft^2	(Lpm /m^2)
Alcohols			
Methanol (MeOH)	3%	0.10	(4.1)
Ethanol (EtOH)	3%	0.10	(4.1)
Isopropanol (IPA)	3%	0.15	(6.1)
Tertiary Butyl Alcohol (TBA)	3%	0.19	(7.7)
Ketones			
Methyl Ethyl Ketone (MEK)	3%	0.10	(4.1)
Acetone	3%	0.15	(6.1)
Methyl Isobutyl Ketone (MIBK)	3%	0.15	(6.1)
Amines			
Ethylene Diamene	3%	0.10	(4.1)
Ethers			
Methyl Tertiary Butyl Ether (MTBE)	3%	0.13	(5.3)
MTBE Blended Gasoline(2)	3%	0.10	(4.1)
Ethyl Tertiary Butyl Ether	3%	0.14	(5.7)
Tetrahydrofuran (THF)	3%	0.20	(8.2)

U.L. Type III Application(3) – Hydrocarbons

Heptane	3%	0.10	(4.1)

(1) TYPE II DISCHARGE OUTLET – A device that delivers foam onto the burning liquid and partially submerges the foam or procedures restricted agitation of the surface as described in UL 162.

(2) MTBE (17.8%)/Regular Unleaded Gasoline (82.2%) Blend

(3) TYPE III DISCHARGE OUTLET – A device that delivers the foam directly onto the burning liquid as described in UL 162.

PERFORMANCE

Fire Performance – The fire performance of ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate is measured primarily against Underwriters Laboratories Standard 162.

Foaming Properties – When used with fresh, salt or hard water at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of 5:1 to 10:1 depending primarily on type of aspirating device and flow rate. Nonaspirating devices such as handline water fog/stream nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1. Medium expansion discharge devices produce typical expansion ratios between 20:1 to 60:1 depending primarily upon type of device and operating conditions.

Proportioning – ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pump proportioning equipment
2. Balanced pressure bladder tank proportioner
3. Around-the-pump proportioners
4. Fixed or portable (in-line) venturi proportioners
5. Handline nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperature for ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate in this equipment is 35 °F (2 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer and within the temperature limits specified, the shelf life of ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate is about 20-25 years. The factors affecting shelf life and stability for ANSULITE AFFF agents are discussed in detail in Ansul Technical Bulletin No. 54. Freezing of the product should be avoided. If, however, the product is frozen during transport or storage, it must be thawed and inspected for signs of separation. If separation has occurred, the product must be mechanically mixed until homogeneous.

When the concentrate is to be stored in an atmospheric storage tank, a 1/4 in. (6 mm) layer of mineral oil should be added to seal the concentrate and minimize the effects of evaporation.

Compatibility – Since ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate is a unique blend of surfactants, high molecular weight polymers, and solvents; it is recommended that ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate should not be mixed with any other foam concentrates. Consult Ansul Incorporated with any questions of compatibility.

Materials of Construction Compatibility – Tests have been performed with ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate verifying its compatibility with standard carbon steel "black" pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, plastic fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to Ansul Technical Bulletin No. 59, Form No. F-90109, addressing acceptable materials of construction for use with ANSUL foam concentrates.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Please **first** consult Ansul Incorporated for specific guidelines concerning materials of construction.

Inspection – As with any fire extinguishing agent, ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate, whether in the concentrate or premixed form, should be inspected periodically. NFPA 11 "Standard for Low Expansion Foam and Combined Agent Systems" requires that foam concentrate samples be submitted to the manufacturer or other qualified laboratory for quality condition testing at least annually. Contact ANSUL for further information on annual inspection.

APPROVALS AND LISTINGS

Underwriters Laboratories successfully tested ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate to the requirements contained in UL Standard 162, "Standard for Air-Foam Equipment and Liquid Concentrates." To receive the UL listing, the following tests had to be performed successfully:

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Class B Polar Solvent Fuel Fire Tests
4. Foam Identification Tests
5. Tests of Shipping Containers
6. Class B Hydrocarbon and Polar Solvent Fuel Sprinkler Tests (Standard type both upright and pendent)

Besides determining agent characteristics, Underwriters Laboratories lists ANSULITE 3x3 Low-Viscosity Concentrate for use with specific hardware components that also carry the UL listing. To obtain these listings, ANSUL selected various hardware components from the major U.S. manufacturers of foam hardware.

ORDERING INFORMATION

ANSULITE 3x3 Low-Viscosity AR-AFFF Concentrate is available in pails, drums, totes, or bulk shipment.

Part No. 416493	5 gallon pail
Part No. 416495	55 gallon drum
Part No. 429741	265 gallon tote
Part No. 416607	Bulk (contact ANSUL about domestic truckload delivery)

Shipping Weight:

5 gal (19 L) pail – 45 lb (20.4 kg)
55 gal (208.2 L) drum – 495 lb (224.5 kg)
265 gal (1000 L) tote – 2465 lb (1118 kg)

Cube:

5 gal (19 L) pail – 1.25 ft^3 (0.0354 m^3)
55 gal (208.2 L) drum – 11.83 ft^3 (0.3350 m^3)
265 gal (1000 L) tote – 50.05 ft^3 (1.42 m^3)

ANSULITE® ARC 3% or 6% AR-AFFF CONCENTRATE

Data/Specifications

ANSUL®

DESCRIPTION

ANSULITE® ARC (Alcohol-Resistant Concentrate) 3% or 6% AR-AFFF (Aqueous Film-Forming Foam) Concentrate is formulated from special fluorochemical and hydrocarbon surfactants, a high molecular weight polymer, and solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume.

It is intended for use as a 3% or 6% proportioned solution (depending on the type of fuel) in fresh, salt or hard water. It may also be used and stored as a premixed solution in fresh or potable water for use with the ANSUL® Model AR-33-D wheeled fire extinguisher.

There are three fire extinguishing mechanisms in effect when using ANSULITE ARC 3% or 6% AR-AFFF Concentrate on either a conventional Class B hydrocarbon fuel such as gasoline, diesel fuel, etc., or a Class B polar solvent (water miscible fuel) such as methyl alcohol, acetone, etc. First, an aqueous film is formed in the case of a conventional hydrocarbon fuel, or a polymeric membrane in the case of a polar solvent fuel. This film or membrane forms a barrier to help prevent the release of fuel vapor. Second, regardless of the fuel type, a foam blanket is formed which excludes oxygen and from which drains the liquids that form the film or the polymeric membrane. Third, the water content of the foam produces a cooling effect.

Physiochemical Properties at 77 °F (25 °C)

Appearance	Pale Yellow Gelled Liquid
Density	1.000 g/ml ± 0.02
pH	7.0 – .8.5
Refractive Index	1.3480 ± 0.0020
Surface Tension (3% Solution)	18 ± 1 dynes/cm
Viscosity	2525 ± 700 centipoise*

*Brookfield Viscometer Spindle #4, Speed 30

ANSULITE ARC 3% or 6% AFFF Concentrate is a non-Newtonian fluid that is both pseudoplastic and thixotropic. Because of these properties, dynamic viscosity will decrease as shear increases.

APPLICATION

ANSULITE ARC 3% or 6% AR-AFFF Concentrate is unique among AFFF agents in that it can be used on either conventional Class B fuels or the polar solvent type Class B fuels. Its excellent wetting characteristics make it useful in combating Class A Fires as well. Because of the low energy to make foam, it can be used with both aspirating and non-aspirating discharge devices.

To provide even greater fire protection capability, it can be used with dry chemical extinguishing agents without regard to the order of application to provide even greater fire protection capability. Due to the velocity of the dry chemical discharge, care must be taken **not** to submerge the polymeric membrane below the fuel surface.

APPLICATION RATES

Application Rates using UL 162 Standard 50 ft^2 Fire Test on representative hydrocarbon and polar solvent fuels are listed below.

UL Type II Application(1) – Polar Solvents

Fuel Group	Concentration	UL(2) Recommended Application Rate gpm/ft^2	(Lpm/m^2)
Alcohol			
Methanol (MeOH)	6%	**0.10**	(4.1)
Ethanol (EtOH)	6%	**0.10**	(4.1)
Isopropanol (IPA)	6%	**0.15**	(6.1)
Ketone			
Acetone	6%	**0.15**	(6.1)
Methyl Ethyl Ketone (MEK)	6%	**0.15**	(6.1)
Carboxylic Acid			
Acetic Acid	6%	**0.17**	(6.9)
Aldehyde			
Propionaldehyde	6%	**0.17**	(6.9)
Ester			
Ethyl Acetate	6%	**0.10**	(4.1)
Butyl Acetate	6%	**0.10**	(4.1)
U.L. Type III Application(3) – Hydrocarbons			
Heptane	3%	**0.10**	(4.1)
Toluene	3%	**0.10**	(4.1)
Gasoline	3%	**0.10**	(4.1)
10% Gasohol (EtOH)	3%	**0.10**	(4.1)

(1) TYPE II DISCHARGE OUTLET – A device that delivers foam onto the burning liquid and partially submerges the foam or produces restricted agitation of the surface as described in UL 162.

(2) UL builds in a 5/3 safety factor from its test rate to its recommended rate of application.

(3) TYPE III DISCHARGE OUTLET – A device that delivers the foam directly onto the burning liquid as described in UL 162.

PERFORMANCE

Fire Performance – The fire performance of ANSULITE ARC 3% or 6% AR-AFFF Concentrate is measured primarily against Underwriters Laboratories Standard 162.

Foaming Properties – When used with fresh, salt or hard water, at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of from 5:1 to 10:1 depending primarily on type of aspirating device and flow rate. Non-aspirating devices such as handline water fog/stream nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1.

Proportioning – ANSULITE ARC 3% or 6% AR-AFFF Concentrate can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pumped proportioning equipment
2. Balanced pressure bladder tank type proportioner
3. Around-the-pump proportioners
4. Fixed or portable (in-line) venturi type proportioners
5. Handline nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperature for ANSULITE ARC 3% or 6% AR-AFFF Concentrate in this equipment is 35 °F (2 °C) to 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer and within the temperature limits specified, the shelf life of ANSULITE ARC 3% or 6% AR-AFFF Concentrate is about 20-25 years. The factors affecting shelf life and stability for ANSULITE AFFF Agents are discussed in detail in Ansul Technical Bulletin No. 54. Freezing of the product should be avoided. If, however, the product is frozen during transport or storage, it must be thawed and inspected for signs of separation. If separation has occurred, the product must be mechanically mixed until homogeneous.

When the concentrate is to be stored in an atmospheric storage tank, a 1/4 in. layer of mineral oil should be added to seal the concentrate and minimize the effects of evaporation.

Compatibility – Since ANSULITE ARC 3% or 6% AR-AFFF Concentrate is a unique blend of surfactants, high molecular weight polymers, and solvents; it is recommended that ANSUL be consulted before ANSULITE ARC concentrate is mixed with any other concentrates.

Materials of Construction Compatibility – Tests have been performed with ANSULITE ARC Concentrate verifying its compatibility with standard carbon steel "black" pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, plastic fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to Ansul Technical Bulletin No. 59, Form No. F-90109, addressing acceptable materials of construction for use with ANSUL foam concentrates.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Please **first** consult Ansul Fire Protection for specific guidelines concerning materials of construction.

Inspection – As with any fire extinguishing agent, ANSULITE ARC 3% or 6% AR-AFFF Concentrate, whether in the concentrate or pre-mixed form, should be inspected periodically. Please refer to the Field Inspection Manual, (Part No. 31274), for the detailed procedures to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur such as are described in Ansul Technical Bulletin No. 54. In such cases, ANSUL's recommendation should be sought.

APPROVALS AND LISTINGS

There are no military or federal specifications covering products such as ANSULITE ARC 3% or 6% AR-AFFF Concentrate.

Underwriters Laboratories successfully tested ANSULITE ARC 3% or 6% AR-AFFF Concentrate to the requirements contained in the UL Standard 162, "Standard for Air-Foam Equipment and Liquid Concentrates." To receive the UL listing, the following tests had to be performed successfully:

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Class B Polar Solvent Fuel Fire Tests
4. Foam Identification Tests
5. Tests of Shipping Containers
6. Class B Hydrocarbon and Polar Solvent Fuel Sprinkler Tests (Standard type both upright and pendent)
7. Subsurface Injection

Besides determining agent characteristics, Underwriters Laboratories lists ANSULITE ARC foam concentrate for use with specific hardware components that also carry the UL listing. To obtain these listings, ANSUL selected various hardware components from the major U.S. manufacturers of foam hardware.

ORDERING INFORMATION

ANSULITE ARC 3% or 6% AR-AFFF Concentrate is available in pails, drums, totes, or bulk shipment.

Part No. 55797	5 gallon pail
Part No. 55808	55 gallon drum
Part No. 432157	265 gallon tote
Part No. 56084	Bulk (contact ANSUL about domestic truckload delivery)

Shipping Weight:

5 gal (19 L) pail – 45 lb (20.4 kg)
55 gal (208.1 L) drum – 495 lb (224.5 kg)
265 gal (1000 L) tote – 2465 lb (1118 kg)

Cube:

5 gal (19 L) pail – 1.25 ft^3 (0.0353 m^3)
55 gal (208.1 L) drum – 11.83 ft^3 (0.3350 m^3)
265 gal (1000 L) tote – 50.05 ft^3 (1.42 m^3)

ANSULITE® ARC 3% or 6% FREEZE-PROTECTED AR-AFFF CONCENTRATE

Data/Specifications

ANSUL®

DESCRIPTION

ANSULITE® ARC (Alcohol-Resistant Concentrate) 3% or 6% Freeze-Protected AR-AFFF (Alcohol-Resistant – Aqueous Film-Forming Foam) Concentrate is formulated from special fluorochemical and hydrocarbon surfactants, a high molecular weight polymer, and solvents. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume.

It is intended for use as a 3% or 6% proportioned solution (depending on the type of fuel) in fresh, salt, or hard water.

The foam concentrate may be stored at temperatures to 0 °F (–18 °C) without freezing. If stored below the minimum use temperature, freezing may occur. If frozen, the concentrate can be thawed and remixed before use.

There are three fire extinguishing mechanisms in effect when using ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate on either a conventional Class B hydrocarbon fuel such as gasoline, diesel fuel, etc., or a Class B polar solvent (water miscible fuel) such as methyl alcohol, acetone, etc. First, an aqueous film is formed in the case of a conventional hydrocarbon fuel, or a polymeric membrane in the case of a polar solvent fuel. This film or membrane forms a barrier to help prevent the release of fuel vapor. Second, regardless of the fuel type, a foam blanket is formed which excludes oxygen and from which drains the liquids that form the film or the polymeric membrane. Third, the water content of the foam produces a cooling effect.

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Light Yellow to Amber Gelled Liquid
Density	1.065 g/ml ± 0.020
pH	7.0 – .8.5
Refractive Index	1.3925 ± 0.0075
Surface Tension (3% Solution)	18 ± 1 dynes/cm
Viscosity	1450 ± 550 centipoise*

*Brookfield Viscometer Spindle #4, Speed 30

ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate is a non-Newtonian fluid that is both pseudoplastic and thixotropic. Because of these properties, dynamic viscosity will decrease as shear increases.

APPLICATION

ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate is unique among the ANSULITE AFFF agents in that the minimum use temperature is the lowest of all conventional AR-AFFF products on the market. This product can be used on either conventional Class B fuels or the polar solvent type Class B fuels. Its excellent wetting characteristics make it useful in combating Class A Fires as well. Because of the low energy to make foam, it can be used with both aspirating and non-aspirating discharge devices.

To provide even greater fire protection capability, it can be used with dry chemical extinguishing agents without regard to the order of application. Due to the velocity of the dry chemical discharge, care must be taken not to submerge the polymeric membrane below the fuel surface.

006964

PERFORMANCE

Fire Performance – The fire performance of ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate is measured primarily against Underwriters Laboratories Standard 162. There are no U.S. or foreign government specifications on this type of product.

Foaming Properties – When used with fresh, salt or hard water, at the correct dilution with most conventional foam making equipment, the expansion will vary depending on the performance characteristics of the equipment. Aspirating discharge devices produce expansion ratios of from 5:1 to 10:1 depending primarily on type of aspirating device and flow rate. Non-aspirating devices such as handline water fog/stream nozzles or standard sprinkler heads give expansion ratios of 2:1 to 4:1.

Proportioning – ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pumped proportioning equipment
2. Balanced pressure bladder tank type proportioner
3. Around-the-pump proportioners
4. Fixed or portable (in-line) venturi type proportioners
5. Handline nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperature for ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate in this equipment is 0 °F (–18 °C) to 120 °F (49 °C) respectively.

PERFORMANCE (Continued)

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer and within the temperature limits specified, the shelf life of ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate is about 15 years. The factors affecting shelf life and stability for ANSULITE AFFF Agents are discussed in detail in Ansul Technical Bulletin No. 54. Freezing of the product should be avoided. If, however, the product is frozen during transport or storage, it must be thawed and inspected for signs of separation. If separation has occurred, the product must be mechanically mixed until homogeneous.

When the concentrate is to be stored in an atmospheric storage tank, a 1/4 in. (6 mm) layer of mineral oil should be added to seal the concentrate and minimize the effects of evaporation.

Compatibility – Since ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate is a unique blend of surfactants, high molecular weight polymers, and solvents; it is recommended that Ansul Fire Protection be consulted before concentrate is mixed with any other concentrates.

Materials of Construction Compatibility – Tests have been performed with ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate verifying its compatibility with standard carbon steel "black" pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, plastic fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction. Refer to Ansul Technical Bulletin No. 59, Form No. F-90109, addressing acceptable materials of construction for use with ANSUL foam concentrates.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Please **first** consult ANSUL for specific guidelines concerning materials of construction.

Inspection – NFPA 11, "Standard for Low, Medium, and High Expansion Foam," states, "At least annually, all foam systems shall be thoroughly inspected and checked for proper operation. The inspection shall include performance evaluation of the foam concentrate or premix solution quality or both. At least annually, an inspection shall be made of foam concentrates and their tanks or storage containers for evidence of excessive sludging or deterioration." Please refer to the Field Inspection Manual, Part No. 31274, for the detailed procedures to perform this inspection. An annual inspection is recommended unless unusual conditions of exposure occur such as are described in Ansul Technical Bulletin No. 54. In such cases, ANSUL's recommendation should be sought.

APPROVALS AND LISTINGS

Underwriters Laboratories successfully tested ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate to the requirements contained in the UL Standard 162, "Standard for Air-Foam Equipment and Liquid Concentrates." To receive the UL listing, the following tests had to be performed successfully:

1. Foam Quality Tests
2. Class B Hydrocarbon Fuel Fire Tests
3. Class B Polar Solvent Fuel Fire Tests
4. Foam Identification Tests
5. Tests of Shipping Containers

Besides determining agent characteristics, Underwriters Laboratories lists ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate for use with specific hardware components that also carry the UL listing. To obtain these listings, ANSUL selected various hardware components from the major U.S. manufacturers of foam hardware.

ORDERING INFORMATION

ANSULITE ARC 3% or 6% Freeze-Protected AR-AFFF Concentrate is available in pails, drums, totes, or bulk shipment.

Part No. 415245	5 Gallon Pail
Part No. 415246	55 Gallon Drum
Part No. 432852	265 Gallon Tote
Part No. 73758	Bulk (contact ANSUL about domestic truckload delivery)

Shipping Weight:
5 gal (19 L) pail – 45 lb (20.4 kg)
55 gal (208.1 L) drum – 495 lb (224.5 kg)
265 gal (1000 L) tote – 2465 lb (1118 kg)

Cube:
5 gal (19 L) pail – 1.25 ft^3 (0.0353 m^3)
55 gal (208.1 L) drum – 11.83 ft^3 (0.3350 m^3)
265 gal (1000 L) tote – 50.05 ft^3 (1.42 m^3)

JET-X® 2% HIGH-EXPANSION FOAM CONCENTRATE

Data/Specifications

ANSUL®

DESCRIPTION

JET-X® 2% High-Expansion Foam Concentrate is a synthetic based formulation comprised of hydrocarbon surfactants, solvents, and stabilizers for use with medium- and high-expansion foam generators. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume.

JET-X 2% High-Expansion Foam Concentrate can be used to produce foam with expansion ratios ranging from 50:1 to 1000:1 depending upon the type of generator and its operating pressure. It must only be proportioned with fresh water. When used with High-Expansion Generators, recommended proportioning is at 2% (2 gallons JET-X concentrate with 98 gallons water). When used with medium-expansion foam nozzles, it is typically proportioned at a 2% concentration.

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Blue
Density	1.020 g/ml ± 0.010
pH	6.0 – 7.0
Refractive Index	1.350 ± 0.015
Viscosity	8 ± 2 centistokes 186 ± 10 centipoise

008444

APPLICATION

JET-X 2% High-Expansion Foam Concentrate is a tremendously flexible firefighting agent, used in fighting Class A, Class B, and LNG fires both indoors and outdoors. It is used only with air aspirating foam discharge devices except when used as a wetting agent on Class A fuels.

JET-X 2% High-Expansion Foam Concentrate, when used with high-expansion generators, is capable of totally flooding large rooms and enclosures allowing it to effectively extinguish horizontal and vertical (three-dimensional) fires. High-expansion foam is also effective in reducing vapor concentrations downwind from unignited LNG and other hazardous low boiling point gaseous products such as ammonia spills.

When used with medium-expansion foam equipment, JET-X 2% High-Expansion Foam Concentrate forms a foam blanket which prevents the release of fuel vapor and also provides additional cooling due to the higher water content. Medium-expansion foam has benefits in outdoor applications because the foam is less affected by wind conditions.

PERFORMANCE

Foaming Properties – The performance of JET-X 2% High-Expansion Foam Concentrate will vary depending upon the performance characteristics of the equipment. Expansion ratios through high-expansion generators typically are between 200:1 and 1000:1. For this reason, it is important for the proper design of a high-expansion system that the JET-X 2% High-Expansion Foam Concentrate be specifically listed with the foam generators. Refer to the performance table listing expansion ratios of JET-X high-expansion generators used in conjunction with JET-X 2% Foam Concentrate (See JET-X Generator Data Sheet, Form F-93137). Medium-expansion foam generators typically deliver expansion ratios between 50:1 and 200:1.

Proportioning – JET-X 2% High-Expansion Foam Concentrate can be proportioned easily at the correct dilution using most conventional proportioning equipment such as:

– Balanced pressure bladder tank type proportioners

– Balanced pressure and in-line balanced pressure pump proportioning equipment

– Fixed or portable in-line venturi (eductor) type proportioners

– Around the pump type proportioners

The minimum and maximum usable temperatures for JET-X 2% High-Expansion Foam Concentrate in this equipment is 35 °F to 120 °F (1.7 °C to 49.0 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums, pails, or totes) and within the temperature limits specified, or in equipment recommended by the manufacturer as part of the foam system, the shelf life of JET-X 2% High-Expansion Foam Concentrate is about 20 – 25 years. If the product is frozen during storage or transportation, thawing will render the product completely usable. Mixing after freeze thaw cycling is recommended.

PERFORMANCE (Continued)

Compatibility – There are no specifications or standards which address the subject of compatibility of different manufacturers brands of multiple expansion foam concentrates. In an emergency or if the manufacturer has supporting test data to substantiate that the mixture meets the same requirements as the individual component concentrates, they may be mixed together in the same storage vessel.

Different types of foam concentrates, i.e., multiple expansion and protein base, should not be mixed under any circumstances. JET-X 2% High-Expansion Foam Concentrate should not be mixed for use with JET-X 2 3/4% concentrate.

Refer to Ansul Technical Bulletin No. 49 addressing acceptable materials of construction for use with ANSUL® foam concentrates.

Inspection – As with any fire extinguishing agent, JET-X 2% High-Expansion Foam Concentrate, whether in the concentrate or pre-mixed form, should be inspected periodically. NFPA 11, "Standard for Low-, Medium-, and High-Expansion Foam Systems," requires that foam concentrate samples be submitted to the manufacturer or other qualified laboratory for quality condition testing at least annually. Contact ANSUL for further information on annual inspection.

APPROVALS AND LISTINGS

JET-X 2% High-Expansion Foam Concentrate is Underwriters Laboratories (UL) Listed with various foam hardware devices.

ORDERING INFORMATION

JET-X 2% High-Expansion Foam Concentrate is available in pails, drums, totes, or bulk shipment.

Part No.	Size	Shipping Weight	Cube
436879	5 gallon (19 L) Pail	51 lb (23.1 kg)	1.08 ft^3 (0.0305 cu m)
436881	55 gallon (208 L) Drum	577 lb (261.7 kg)	11.33 ft^3 (0.3208 cu m)
436883	265 gallon (1003 L) Tote Container	2465 lb (1118 kg)	50.05 ft^3 (1.42 m^3)
436131	Bulk	Contact ANSUL about domestic truckload delivery	

Form No. F-2009121

ANSUL

by Tyco Fire Suppression & Building Products

JET-X 2 3/4% HIGH-EXPANSION FOAM CONCENTRATE

Data/Specifications

DESCRIPTION

JET-X 2 3/4% High-Expansion Foam Concentrate is a synthetic-based formulation comprised of hydrocarbon surfactants, solvents, and stabilizers for use with medium and high expansion foam generators. It is transported and stored as a concentrate to provide ease of use and considerable savings in weight and volume.

JET-X 2 3/4% High-Expansion Foam Concentrate can be used to produce foam with expansion ratios ranging from 50:1 to 1000:1 depending upon the type of generator and its operating pressure. It can be proportioned with fresh, salt or hard water. When used with high-expansion generators, recommended proportioning is at 2.75% (2.75 gallons JET-X concentrate with 97.25 gallons water). When used with medium-expansion foam nozzles, it is typically proportioned at a 2% concentration.

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Green Liquid
Density	1.020 g/ml ± 0.020
pH	7.0 – 8.5
Refractive Index	1.365 ± 0.010
Viscosity	8 ± 2 centistokes

008445

APPLICATION

JET-X High-Expansion Foam Concentrate is a tremendously flexible fire-fighting agent, used in fighting Class A, Class B, and LNG fires both indoors and outdoors. It is used only with air aspirating foam discharge devices except when used as a wetting agent on Class A fuels.

JET-X High-Expansion Foam Concentrate, when used with high-expansion generators, is capable of totally flooding large rooms and enclosures allowing it to effectively extinguish horizontal and vertical (three-dimensional) fires. High-expansion foam is also effective in reducing vapor concentrations downwind from unignited LNG and other hazardous low boiling point gaseous products such as ammonia spills.

When used with medium expansion foam equipment, JET-X High-Expansion Foam Concentrate forms a foam blanket which prevents the release of fuel vapor and also provides additional cooling due to the higher water content. Medium-expansion foam has benefits in outdoor applications because the foam is less affected by wind conditions.

PERFORMANCE

Foaming Properties – The performance of JET-X High-Expansion Foam Concentrate will vary depending upon the performance characteristics of the equipment. Expansion ratios through high-expansion generators are typically between 200:1 and 1000:1. For this reason, it is important for the proper design of a high-expansion system that the JET-X High-Expansion Foam Concentrate be specifically listed with the foam generators. Refer to the performance table listing expansion ratios of JET-X high-expansion generators used in conjunction with JET-X foam concentrate (See JET-X Generator Data Sheet, Form F-93137). Medium-expansion foam generators typically deliver expansion ratios between 50:1 and 200:1.

Proportioning – JET-X High-Expansion Foam Concentrate can be proportioned easily at the correct dilution using most conventional proportioning equipment such as:

- Balanced pressure bladder tank type proportioners
- Balanced pressure and in-line balanced pressure pump proportioning equipment
- Fixed or portable in-line venturi (eductor) type proportioners
- Around the pump type proportioners

The minimum and maximum usable temperatures for JET-X High-Expansion Foam Concentrate in this equipment is 35 °F to 120 °F (1.7 °C to 49.0 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums, pails, or totes) and within the temperature limits specified, or in equipment recommended by the manufacturer as part of the foam system, the shelf life of JET-X High-Expansion Foam Concentrate is about 20 – 25 years. If the product is frozen during storage or transportation, thawing will render the product completely usable. Mixing after freeze thaw cycling is recommended.

PERFORMANCE (Continued)

Compatibility – There are no specifications or standards which address the subject of compatibility of different manufacturers brands of multiple expansion foam concentrates. In an emergency or if the manufacturer has supporting test data to substantiate that the mixture meets the same requirements as the individual component concentrates, they may be mixed together in the same storage vessel.

Different types of foam concentrates, i.e., multiple expansion and protein base, should not be mixed under any circumstances. JET-X 2 3/4% should not be mixed for use with JET-X 2% concentrate.

Refer to Ansul Technical Bulletin No. 49 addressing acceptable materials of construction for use with ANSUL foam concentrates.

Inspection – As with any fire extinguishing agent, JET-X High-Expansion Foam Concentrate, whether in the concentrate or pre-mixed form, should be inspected periodically. NFPA 11, “Standard for Low-, Medium-, and High-Expansion Foam Systems,” requires that foam concentrate samples be submitted to the manufacturer or other qualified laboratory for quality condition testing at least annually. Contact ANSUL for further information on annual inspection.

APPROVALS AND LISTINGS

JET-X High-Expansion Foam Concentrate is Underwriters Laboratories (UL) Listed and Factory Mutual (FM) Approved with various foam hardware devices.

ORDERING INFORMATION

JET-X High-Expansion Foam Concentrate is available in pails, drums, totes, or bulk shipment.

Part No.	Size	Shipping Weight	Cube
420008	5 gallon (19 L) Pail	51 lb (23.1 kg)	1.08 ft^3 (0.0305 cu m)
420009	55 gallon (208 L) Drum	577 lb (261.7 kg)	11.33 ft^3 (0.3208 cu m)
431175	265 gallon (1003 L) Tote Container	2465 lb (1118 kg)	50.05 ft^3 (1.42 m^3)
420208	Bulk (contact ANSUL about domestic truckload delivery)		

ANSUL

by Tyco Fire Suppression & Building Products

SILV-EX PLUS "CLASS A" FIRE CONTROL CONCENTRATE

Data/Specifications

FEATURES

SILV-EX PLUS is a low, medium, and high expansion, Class A foam concentrate formulated from specialty hydrocarbon surfactants, stabilizers, corrosion inhibitors and solvents. This formulation provides superior cold weather performance. The latest development in the *original* forest fire control concentrate, SILV-EX PLUS has been proven effective on many deep-seated Class A fires such as tire fires, paper fires, coal fires, structure fires, and wild fires.

SILV-EX PLUS foam concentrate can be proportioned from 0.1% to 1.0% in fresh, brackish or sea water. When used as a pre-mixed solution, only fresh or potable water should be used if the premix is to be stored over long time periods. Due to its extremely low proportioning rate, SILV-EX PLUS foam concentrate offers outstanding economy in concentrate storage space, cost (compared to conventional 3% and 6% foaming agents) and water hauling requirements.

Example:

How much SILV-EX PLUS concentrate is required to make 500 gallons (1893 L) of foam solution?

Final solution volume X concentration percentage = foam concentrate required

At 0.1% concentration:
500 gal (1893 L) X 0.001 = 0.5 gal (1.9 L) of concentrate

At 0.6% concentration:
500 gal (1893 L) X 0.006 = 3 gal (11.4 L) of concentrate

At 1.0% concentration:
500 gal (1893 L) X 0.01 = 5 gal (19 L) of concentrate

Fire extinguishment mechanisms in effect when using SILV-EX PLUS "Class A" Fire Control Concentrate include:

- Reduction of the surface tension of water, which provides the SILV-EX PLUS solution with superior wetting and penetrating characteristics. This renders Class A fuels less combustible and allows the solution to penetrate past the char to control deep seated fires.
- Extended drain time provides longer surface wetting, reducing the risk of ignition/reignition.
- SILV-EX PLUS agent creates a foam blanket which provides an insulating barrier between the fuel and air.
- SILV-EX PLUS foam suppresses combustible vapors while cooling the fuel.

In addition, SILV-EX PLUS concentrate offers fire fighting characteristics:

- The brilliant white foam reflects heat.
- SILV-EX PLUS solution creates a dense foam blanket with excellent insulating properties.
- SILV-EX PLUS foam clings to vertical surfaces for structure protection.
- The wetting and penetrating characteristics of the SILV-EX PLUS solution reduce the combustibility of Class A fuels and makes water five times more effective.

Applicable extinguishment mechanisms and some properties of SILV-EX PLUS foam depend on the type of foam delivery device used. SILV-EX PLUS has a reduced environmental signature and does not have any EPA reportable contents. The solution does not destroy or retard new forest growth, and will not harm fish or wildlife; it is biodegradable in soils, aquatic ecosystems, and sewage treatment facilities.

008318

Typical Physiochemical Properties at 77 °F (25 °C)

Appearance	Light Amber Clear Liquid
Density	1.010 g/ml ± 0.010
pH	7.0 – 8.5
Refractive Index	1.3660 ± 0.0035
Viscosity	12 ± 3 centistokes

For comparison purposes, the viscosity of 10W40 motor oil is 160 centistokes at 77 °F (25 °C) and 800 centistokes at 12 °F (–11.1 °C).

Surface Tension

Water	66 to 76 dynes/cm
0.1% SILV-EX PLUS solution	27.20 dynes/cm
0.6% SILV-EX PLUS solution	26.80 dynes/cm
1.0% SILV-EX PLUS solution	26.60 dynes/cm
Flash Point	> 200 °F (93.3 °C)
Pour Point	22 °F (–5.5 °C)

APPLICATION

SILV-EX PLUS concentrate is designed specifically for use on Class A fuel fires including wood, paper, coal, and rubber. SILV-EX PLUS foam gives the fire fighter extinguishment capabilities, exposure protection, and increased safety.

Although designed for Class A fires, SILV-EX PLUS foam can be effective on some Class B flammable liquid fires when applied by medium and high expansion devices.

SILV-EX PLUS solution can be used with aspirating and non-aspirating discharge devices, compressed air foam systems (CAFS), or dropped from fixed or rotary wing aircraft.

ENVIRONMENTAL AND HEALTH INFORMATION

1. Biodegradability Test – the concentrate is readily biodegradable
2. Mammalian Toxicity Tests
   a. Acute Oral Toxicity in Rats
      i. Concentrate: LD_{50} > 5050 mg/Kg
      ii. 1.0% Dilution: LD_{50} > 5050 mg/Kg
   b. Acute Dermal Toxicity in Rabbits
      i. Concentrate: LD_{50} > 2020 mg/Kg
      ii. 1.0% Dilution: LD_{50} > 2020 mg/Kg

ENVIRONMENTAL AND HEALTH INFORMATION (Continued)

3. Mammalian Irritation Tests
   a. Primary Eye Irritation in Rabbits
      i. Single-Wash Eyes
         1. Concentrate: mildly irritating
         2. 1.0% Dilution: minimally irritating
      ii. Double-Wash Eyes
         1. Concentrate: minimally irritating
         2. 1.0% Dilution: practically non-irritating
   b. Primary Dermal Irritation in Rabbits
      i. Concentrate: non-irritating
      ii. 1.0% Dilution: non-irritating
4. Aquatic Toxicity Tests
   a. Fish:
      i. Rainbow Trout: Concentrate: 96 hour LC_{50} = 56.6 mg/L
      ii. Threespined Stickleback: Concentrate: 96 hour LC_{50} = 7.31 mg/L
   b. Daphnids, Daphnia Magna: Concentrate: 48 hour LC_{50} = 62.7 mg/L

PERFORMANCE

Standards/Specifications – The performance of SILV-EX PLUS concentrate is measured against and/or is on the approved list of the following:

- NFPA 1150 – Foam Chemicals for Fire in Class A Fuels
- Canadair Corporation – Approved for use in the CL-215 and CL-415 Aircraft and foam metering systems
- USDA Forest Service Specification 307a – Fire Suppressant Foam for Wildland Firefighting

Foaming Properties – When used with fresh, sea or brackish water at the correct proportioning rate, the expansion will vary depending on the performance characteristics of the foam making equipment.

Proportioning – SILV-EX PLUS concentrate can be proportioned using most conventional proportioning equipment such as:

- Flow-Mix™ Model 500 foam proportioner
- Hypro FoamPro™ injection system
- Balanced pressure pump or bladder tank fixed sprinkler system
- In-line fixed or portable venturi type proportioners (eductors)

TYPICAL PROPORTIONING RATES FOR COMMON APPLICATIONS:

Fixed Wing Aircraft	0.6% to 0.7%
Rotary Wing Aircraft	0.2% to 0.5%
Air Aspirating Devices	0.2% to 1.0%
Non-Air Aspirating Devices	0.5% to 1.0%
Compressed Air Foam Systems (CAFS)	0.1% to 0.3%

ANSUL Handline Nozzles

HL-60 Low Expansion	0.3% to 1.0%
HL-95 Low Expansion	0.3% to 1.0%
KR-S2 Low Expansion	0.3% to 1.0%
KR-M2 Medium Expansion	0.3% to 1.0%
KR-S/M2 Dual Expansion	0.3% to 1.0%

Flow-Mix is a registered trademark of Robwen Inc., Los Angeles, CA.

Hypro and FoamPro are registered trademarks of the HyPro Corporation, New Brighton, MN.

Storage/Shelf Life – When stored in the original packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system and within the temperature limits specified, the shelf life of SILV-EX PLUS concentrate is normally about 20-25 years. The recommended storage temperature for SILV-EX PLUS concentrate is 30 °F (–1 °C) to 120 °F (49 °C).

If the product is frozen during storage or transportation, thawing will render the concentrate completely usable and ready for proportioning.

Compatibility – Because of the many products available, consult with ANSUL before mixing SILV-EX PLUS concentrate with other manufacturer's products.

Materials of Construction Compatibility – Tests have been performed with SILV-EX PLUS concentrate verifying its compatibility with the steel, stainless steel, yellow brass, magnesium and aluminum alloys found in aerial and ground-based fire fighting equipment. SILV-EX PLUS is also compatible with standard fire fighter turn out gear and hose material.

Packaging – SILV-EX PLUS concentrate is packaged in opaque white 5 gallon (19 L) plastic (polyethylene) containers with 2 3/4 in. (6.9 cm) capped openings. 55 gallon (208 L) drum size is blue polyethylene with sealed 2 1/4 in. (5.7 cm) closures. All containers are marked "SILV-EX PLUS Class A Fire Control Concentrate."

Equipment Clean-up – The standard procedure of flushing with fresh water should be used with all equipment used with SILV-EX PLUS concentrate or foam solution.

Additional Information – Request the following ANSUL Forms:

- MSDS Sheet – F-2009065

ORDERING INFORMATION

SILV-EX PLUS concentrate is available in the following sizes:

Part No.	Size	Shipping Weight	Cube
434467	5 gallon (19 L)	45 lb (20.4 kg)	1.25 ft^3 (0.0353 m^3)
434469	55 gallon (208 L)	495 lb (224.5 kg)	11.83 ft^3 (0.3350 m^3)
► 434471	265 gallon (1003 L)	2465 lb (1118 kg)	50.05 ft^3 (1.42 m^3)
434463	Bulk (contact ANSUL about domestic truckload delivery)		

ANSUL-A™ MUNICIPAL "CLASS A" FIRE CONTROL CONCENTRATE 30 °F (–1.1 °C) to 120 °F (49 °C)

Data/Specifications

ANSUL

DESCRIPTION

ANSUL-A™ Municipal "Class A" Fire Control Concentrate is formulated using fluorine-free hydrocarbon surfactants to perform on Class A combustible materials typical in municipal applications. The ANSUL-A concentrate is designed for use between 0.1% and 1.0% in standard proportioning equipment.

TYPICAL PHYSIOCHEMICAL PROPERTIES AT 77 °F (25 °C)

Appearance	Clear Light Yellow Liquid
Density	1.01 g/ml ± 0.01
pH	7.0 – 8.5
Refractive Index	1.3486 ± 0.0025
Viscosity @ 25 °C	1.7 ± 0.5 centistokes
Slush Point	28 °F (–2.2 °C)
Surface Tension	
0.1% ANSUL-A solution	39.5 ± 0.8 dynes/cm
0.6% ANSUL-A solution	30.2 ± 0.8 dynes/cm
1.0% ANSUL-A solution	28.9 ± 0.8 dynes/cm

APPLICATION

ANSUL-A Municipal "Class A" Fire Control Concentrate is intended for use on Class A combustible fires. Its low surface tension demonstrates the excellent wetting characteristics needed to efficiently combat Class A fires. The ANSUL-A concentrate is not suitable for use on any fuel with an appreciable water solubility (polar solvents) such as methyl and ethyl alcohol, acetone, and methyl ethyl ketone; it is not intended for use on Class B hydrocarbons. This Compressed Air Foam System (CAFS) compatible concentrate can be used with both aspirating and non-aspirating discharge devices because of the low energy required to make it foam. ANSUL-A concentrate can also be used with dry chemical extinguishing agents without any regard to the order of application.

PERFORMANCE

As with most conventional foam making equipment, the expansion of ANSUL-A Municipal "Class A" Fire Control Concentrate will vary depending on the performance characteristics of the equipment and the type of water (i.e., fresh, salt, or hard) at the correct dilution. Aspirating discharge devices produce expansion ratios from 6:1 to 10:1 depending primarily on the type of aspirating device and flow rate. In general, the higher the flow rate, the higher the expansion ratio. Non-aspirating devices such as hand line water fog/stream nozzles will give expansion ratios of 2:1 to 4:1.

ANSUL-A concentrate can be proportioned easily at the correct dilution using most conventional equipment such as:

1. Compressed Air Foam Systems (CAFS)
2. Balanced pressure and in-line balanced pressure pumped proportioning equipment
3. Balanced pressure bladder tank type proportioners
4. Around-the-pump type proportioners
5. Fixed or portable (in-line) venturi type proportioners
6. Hand line nozzles with fixed induction/pickup tubes

The minimum and maximum usable temperatures for the ANSUL-A concentrate in this equipment is 30 °F (–1.1 °C) to 120 °F (49 °C).

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STORAGE/SHELF LIFE

When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system and within the temperature limits specified, the shelf life of ANSUL-A Municipal "Class A" Fire Control Concentrate is about 20-25 years. The factors affecting shelf life and stability for ANSUL-A concentrate are discussed in detail in ANSUL® Technical Bulletin No. 54. If the product is frozen during storage or transportation, thawing will return the product to a usable state. Mixing after thawing is desirable so as to assure a homogenous solution.

COMPATIBILITY

Refer to Ansul Technical Bulletin No. 48 for a more detailed discussion of compatibility.

Different types of foam concentrates (i.e., AFFF, protein base, etc.) should not be mixed under any circumstances.

INSPECTION

As with any fire extinguishing agent, ANSUL-A Municipal "Class A" Fire Control Concentrate should be inspected periodically, either in the concentrate or pre-mixed form. Please refer to the Field Inspection Manual (Ansul Part No. 31274) for detailed instructions on how to perform an inspection. An annual inspection is recommended unless unusual conditions of exposure occur, as described in Ansul Technical Bulletin No. 54. In such cases, ANSUL's recommendation should be sought.

ORDERING INFORMATION

ANSUL-A Municipal "Class A" Fire Control Concentrate is available in:

Part No. 433442	5 gallon pail
Part No. 433443	55 gallon drum
Part No. 433558	265 gallon tote
Part No. 433441	Bulk (contact ANSUL about domestic truck-load delivery)

Shipping Weight:

5 gal (19 L) pail – 45 lb (20.4 kg)
55 gal (208 L) drum – 495 lb (224.5 kg)
265 gal (1000 L) tote – 2465 lb (1118 kg)

Cube:

5 gal (19 L) pail – 1.25 ft^3 (0.04 m^3)
55 gal (208 L) drum – 11.83 ft^3 (0.34 m^3)
265 gal (1000 L) tote – 50.05 ft^3 (1.42 m^3)

TARGET-7® VAPOR MITIGATION AND NEUTRALIZING AGENT

Data/Specifications

ANSUL®

DESCRIPTION

TARGET-7® Vapor Mitigation and Neutralizing Agent will mitigate dangerous vapor releases and simultaneously neutralize the spilled material without causing additional vapor release. The TARGET-7 technology allows for a one-step application to both mitigate vapor release from a spill and neutralize the spilled material. This has traditionally been accomplished in a two-step process with two different products and two different methods of application. The ability to perform this task in one step is critical when there is a dangerous spill of fuming acid or other hazardous chemicals – time is of the essence. Once TARGET-7 agent is applied and has formed its cover on the spill, there is no need to apply another neutralizing agent which would break the foam blanket thus requiring re-application of the foam agent; also complicated subsurface application of a neutralizing agent would not be required. The outcome is a stable foam blanket to suppress vapor release along with the drop-out of a neutralizing agent that will neutralize the spill as close as possible to a pH of 7.

TARGET-7 agent is a foam concentrate formulation that can be mixed with either an acid or alkaline water-based solution and discharged through an air-aspirated foam discharge device to produce an expanded foam. The foam produced is extremely stable, meaning that it will slowly release its solution from the bubble walls and neutralize the spill. For an acidic spill (such as CLO_2), the foam will be created from an alkaline water solution. For an alkaline spill (such as NH_3), the foam will be created from an acidic water solution.

The foam blanket serves three distinct purposes:

1. It will serve as the source for the neutralizing solution.
2. It will act to suppress vapor release from the spill.
3. It will act as a natural gas/vapor scrubber.

In addition, by choosing the type of acid or alkali used to make the foam solution, and by controlling the rate at which the foam releases its solution from the bubble walls, the TARGET-7 agent process will then control the acid/base neutralization reaction. This in turn will help prevent too much heat from being generated due to the heat of neutralization.

APPLICATION

TARGET-7 agent is a unique product in which application rates are defined case by case dependent on the hazard and its vapor pressure. Other variables that are required to determine the application rate include the type and concentration of the spill material, temperature of the spill material, as well as the surface area and total volume of the hazard that is being protected. When looking at a particular hazard, be sure to consult with ANSUL® Applications Engineering for design of the equipment and the use rates of TARGET-7 agent.

The types of hazardous products TARGET-7 agent is suited for include chlorine dioxide, oleum, chlorosulfonic acids, sulfur trioxide, liquid ammonia, and a variety of other fuming acids. Once again, consult with ANSUL for the hazard you wish to protect.

Foaming Properties – When used with fresh, salt, or hard water at the correct dilution with most conventional foam-making equipment, the expansion will vary depending on the performance characteristics of the equipment. Typical aspirating discharge devices produce expansion ratios of 5:1 to 10:1 depending primarily on the type of aspirating device and flow rate. For vapor mitigation where prolonged vapor suppression is desirable, a higher expansion ratio (20:1 and greater) is recommended for two reasons: 1) the thicker blanket will last longer thus allowing TARGET-7 agent time to both hold the vapors down and neutralize the spill, and 2) if a course hose stream is applied to this type of hazard, the vapor will be readily liberated, thus a gentle application is recommended to minimize turbulent action. A very effective device is a medium-expansion nozzle such as the ANSUL Model KR-M2 and KR-M4.

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Proportioning – TARGET-7 agent can be easily proportioned (at the correct dilution) using most conventional proportioning equipment such as:

1. Balanced pressure and in-line balanced pressure pump proportioning.
2. Balanced pressure bladder tank proportioner.
3. Around-the-pump proportioner.
4. Fixed or portable (in-line) venturi proportioners.
5. Handline nozzles with fixed induction/pickup tubes.

TARGET-7 agent will typically be proportioned at 6%; occasionally a 3% ratio will be recommended by ANSUL Applications Engineering. It will be specific to the hazard to be protected.

Mobile units such as pre-piped bladder tanks on a single/double-axle cart or a 36-gallon foam cart with medium expansion nozzle are viable and flexible options to a fixed TARGET-7 system. The TARGET-7 agent can also be pre-mixed and stored with the neutralizing acid/caustic.

The minimum and maximum usable temperatures for TARGET-7 agent in this equipment are 35 °F (2 °C) and 120 °F (49 °C) respectively.

Storage/Shelf Life – When stored in the packaging supplied (polyethylene drums or pails) or in equipment recommended by the manufacturer as part of the foam system and within the temperature limits specified, the shelf life of TARGET-7 agent is about 20-25 years.

Compatibility – It is recommended that TARGET-7 agent not be mixed or stored with AFFFs or other firefighting agents. **TARGET-7 agent is not a fire fighting or suppressing agent.** Consult ANSUL Applications Engineering for acids/caustics that are compatible.

Material of Construction Compatibility – Tests have been performed with TARGET-7 Agent verifying its compatibility with standard carbon steel black pipe and pipe manufactured from various stainless steel or brass compounds. Alternative pipe, fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction.

Galvanized pipe and fittings must not be used in areas where undiluted concentrate will contact them since corrosion will result.

Please **first** consult Ansul Incorporated for specific guidelines concerning materials of construction.

ORDERING INFORMATION

TARGET-7 Vapor Mitigation and Neutralizing Agent is available in pails, drums, totes or bulk shipment.

Part No. 428500	5 gallon pail
Part No. 428499	55 gallon drums
Part No. 428550	265 gallon totes
Part No. 428498	Bulk (contact ANSUL about domestic truckload delivery)

Shipping Weights:

5 gal pail – 45 lb (20.4 kg)

55 gal drum – 495 lb (224.5 kg)

265 gal tote – 2465 lb (1118 kg)

Ansul Incorporated
Marinette, WI 54143-2542

715-735-7411
www.ansul.com

Form No. F-2001072-2

TRAINING FOAM CONCENTRATE

Data/Specifications

ANSUL

FEATURES

- Designed to be proportioned at either 3% or 6%
- Economical fire training alternative
- For use during TRAINING to SIMULATE AFFF
- Provides expanded foam blanket with air aspirating devices
- Can be used to calibrate proportioning equipment
- Biodegradable; this product is considered to be readily biodegradable. It does not contain any fluorochemicals or polymers that are used in firefighting foam agents.
- Suitable for use with fresh or salt water
- Shelf life of 10-15 years
- Temperature range of 35 – 120 °F (1.6 – 48.8 °C)
- ► Supplied ready to use in 5 gallon pail, 55 gallon drums or 265 gallon totes

DESCRIPTION

ANSUL® Training Foam has been carefully formulated to allow firefighters the ability to conduct training with their own foam proportioning and generating equipment, while minimizing the effects of such training on the environment. It has foam expansion and drainage characteristics very similar to conventional 3% or 6% AFFF products. This is in contrast to other training foams on the market that simulate the expansion but have drain times far quicker than real firefighting foam. Using ANSUL Training Foam allows the user to determine both how much foam will be generated and how long the foam blanket will likely remain.

The product has been formulated with surfactants and other chemicals commonly found in household products such as shampoo and dish washing detergents. It is safe to handle, is readily biodegradable and has low orders of aquatic toxicity. ANSUL Training Foam contains no fluorochemicals or fluorosurfactants. None of the components are reportable under current federal regulations. Please check with local and state regulations regarding use of this product and discharge to the environment.

Typical Physiochemical Properties at 77 °F (25 °C) unless otherwise noted

► Appearance	Light Yellow to Amber Liquid
► Density	1.015 g/ml ± 0.015
pH	7.0 – 8.5
Viscosity	1.40 cs
Total Dissolved Solids (TDS)	6 – 9% by weight
Refractive Index	1.3433 ± 0.0020
Surface Tension @ 6%	27 dynes/cm
Surface Tension @ 3%	28 dynes/cm

APPLICATION

ANSUL Training Foam is not intended for live fire training or for actual firefighting operations. See your ANSUL professional if you require live fire training. It may be used with all conventional proportioning and discharge devices as well as specialized products such as Compressed Air Foam generating equipment or systems (CAFS). As stated earlier, the foam characteristics, in terms of expansion ratio and foam drainage rates, will be very similar to conventional 3% or 6% AFFF products. This allows users to conduct operational training with regard to equipment set up, application techniques, and foam containment. It also allows users to determine the foam quality and range of different types of discharge devices at different operating pressures.

Compatibility – ANSUL Training Foam SHOULD NOT be mixed, stored, or used with any other type of foam concentrate. Proportioning and application equipment should be flushed clean after use and before using different foam concentrate types.

Storage/Shelf Life – ANSUL Training Foam Concentrate should be stored and used within a temperature range of 35 °F (2 °C) to 120 °F (49 °C). Storage in the original polyethylene shipping containers or other containers approved by ANSUL that minimize evaporation should result in a shelf life of 10 or more years. Containers should be kept tightly closed until use to both prevent evaporation and to minimize any contamination that might promote natural biodegradation of the product (ANSUL Training Foam is readily biodegradable). If the product is frozen during storage or transportation, thawing will render the product completely useable. Mixing after freeze/thaw cycling is recommended. For more information on shelf life and materials of construction when using or storing training foam concentrate, ask your ANSUL supplier for Technical Bulletins Number 54 and 59.

Safe Handling – When handling the concentrate, ANSUL recommends the use of chemical goggles or splash proof safety glasses to prevent eye irritation. One should avoid direct contact of the concentrate with exposed skin to prevent possible mild irritation or drying of the skin. Use of rubber or plastic gloves and clean protective clothing is recommended. If exposed to the concentrate, washing and flushing with water should provide immediate relief. Exposure to the end use working solutions (either 3% or 6%) is not expected to cause any discomfort.

ENVIRONMENTAL INFORMATION

Aquatic Toxicity – ANSUL Training Foam has been formulated to minimize the impact of AFFF discharges to an aquatic ecosystem. The levels of toxicity to both fish and lower organisms on the aquatic food chain are very low. Evaluations were conducted on the concentrate on both fingerling Rainbow Trout (a very sensitive fish species) and Daphnia magna (a water flea low on the aquatic food chain). Results of these tests are given as LC50 values (lethal concentration to 50% of the test population over a given time frame). It is common practice to conduct fish toxicity tests over a 96 hour exposure period and to conduct Daphnia tests over a 48 hour exposure period. The results of the testing are given below:

96 Hour LC_{50} Value for Fingerling Rainbow Trout	1.78 g/L (1,780 ppm)
48 Hour LC_{50} Value for Daphnia magna	1.9 g/L (1,900 ppm)

The above data are for the concentrate. Since it is rare for the concentrate to be released directly to the environment, we can estimate the aquatic toxicity of the three percent or six percent working solution by using a dilution factor of 33 for 3% and 16.7 for 6%.

3% WORKING SOLUTION

96 Hour LC_{50} Value for Fingerling Rainbow Trout	58.7 g/L (58,700 ppm)
48 Hour LC_{50} Value for Daphnia magna	62.7 g/L (62,700 ppm)

6% WORKING SOLUTION

96 Hour LC_{50} Value for Fingerling Rainbow Trout	29.7 g/L (29,700 ppm)
48 Hour LC_{50} Value for Daphnia magna	31.7 g/L (31,700 ppm)

The end result is that the working solutions of ANSUL Training Foam can be considered practically non-toxic in aquatic ecosystems.

Biodegradability – Biodegradability of a chemical is a measure of how readily that chemical is broken down in the environment (typically by bacteria and fungi) into carbon dioxide and water or other components that are "generally regarded as safe" (GRAS). In determining the biodegradability potential of a chemical or mixture of chemicals, industries often times look at and compare two related analytical tests.

The first test, Chemical Oxygen Demand (COD), is a measure of how much oxygen would be required to convert the chemicals to their most oxidized state. The second test, Biochemical Oxygen Demand (BOD), is a measure of how much oxygen will be used up by bacteria and other microorganisms over a given time period (usually 5 to 30 days). The bacteria and other microorganisms use the chemicals as a food source, which also consumes dissolved oxygen in the water as part of their metabolic process.

The ratio of BOD to COD determines the theoretical biodegradability of a chemical or chemical mixture. If the BOD/COD ratio is greater than 0.50 (50%), the chemical or chemical mixture is considered to be readily biodegradable. ANSUL Training Foam has BOD/COD ratios well above the 50% value. BOD and COD values for the concentrate and 3% and 6% working solutions are listed below. The subscript after the BOD represents the time frame in number of days over which the test was conducted. Longer times give the bacteria and other microorganisms more time to breakdown the chemicals and result in higher uses of the dissolved oxygen.

ANSUL TRAINING FOAM CONCENTRATE

Test	Results	Ratio (BOD/COD)
COD	146,400 ppm	
BOD_5	64,971 ppm	0.444
BOD_{10}	108,039 ppm	0.738
BOD_{20}	155,416 ppm	1.062

6% WORKING SOLUTION

Test	Results	Ratio (BOD/COD)
COD	8,300 ppm	
BOD_5	4,611 ppm	0.555
BOD_{10}	5,623 ppm	0.677
BOD_{20}	11,756 ppm	1.416

3% WORKING SOLUTION

Test	Results	Ratio (BOD/COD)
COD	3,900 ppm	
BOD_5	2,507 ppm	0.643
BOD_{10}	2,632 ppm	0.675
BOD_{20}	3,331 ppm	0.854

Nutrient Loading – ANSUL Training Foam contains no nitrogen or phosphorous compounds. As such, it will not contribute to nutrient loading in either an aquatic or terrestrial ecosystem.

Disposal – ANSUL Training Foam contains no ingredients that are reportable under federal regulations. Care should be taken to prevent discharges of foam solutions or the concentrate into waterways wherever possible. After checking with the proper authorities at the treatment plant, it is often permissible to discharge to a waste treatment works. It may be necessary to meter the discharge at a rate that is acceptable to the plant operators in order to prevent excessive foaming that could upset the normal operation of the plant.

ORDERING INFORMATION

ANSUL Training Foam Concentrate is available in pails, drums, totes or bulk shipment.

Part No. 428704	5 gallon pail
Part No. 428706	55 gallon drum
Part No. 428707	265 gallon tote container
Part No. 428703	Bulk (contact ANSUL about domestic truckload delivery)

Shipping Weight:

5 gal (19 L) pail – 45 lb (20.4 kg)
55 gal (208 L) drum – 495 lb (225 kg)
265 gal (1000 L) tote – 2453 lb (1118 kg)

Cube:

5 gal (19 L) pail – 1.25 ft^3 (0.0354 m^3)
55 gal (208 L) drum – 11.83 ft^3 (0.3350 m^3)
265 gal (1000 L) tote – 50.05 ft^3 (1.42 m^3)

FOAM TESTING/FOAM TEST KIT

Data/Specifications

FEATURES

- Capable of testing any brand of foam products
- Three levels of foam testing available – Standard Quality, Proportioning, or Coast Guard Requirements
- Standard Quality and Coast Guard testing include a lab-scale fire test
- Test kit includes 2 leak-resistant, wide-mouth bottles

APPLICATION

Foam concentrates are exposed to a variety of conditions that could compromise the quality and firefighting ability of the foam. These conditions include contamination, dilution, evaporation, and temperature extremes.

Annual testing of foam concentrates is the only way to ensure foam quality. NFPA 11, Standard for Low-, Medium-, and High-Expansion Foam, and NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, require that samples of foam concentrate be sent for analyses to a qualified lab at least annually for quality condition testing.

A fire test, the only true measure of foam concentrate performance, is the cornerstone of the ANSUL® Foam Testing Service. It has been designed to ensure that the quality and performance of foam concentrates in the field remain within acceptable specifications. The fire test, combined with physical properties and foam quality analyses, fulfills the annual testing requirement for foam concentrates under NFPA 11 and 25. Foam concentrates are evaluated using the same equipment and rigorous test methods applied to production material. The ANSUL Agents Laboratory is capable of analyzing any manufacturer's foam product.

DESCRIPTION

Three levels of foam testing are available – standard quality, proportioning, and Coast Guard requirements.

Standard Quality

- Includes analysis of physical properties as required: pH, refractive index, density, and/or viscosity, as well as sedimentation for protein foams.
- Includes foam quality testing for expansion and 50% drain time.
- Includes lab-scale fire test including extinguishment and burn-back time.
- Pass/fail report issued upon completion of analyses.

Proportioning

- Used to verify system-proportioning capability.
- Refractive index comparison curve issued upon completion of analyses.

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Coast Guard Requirements

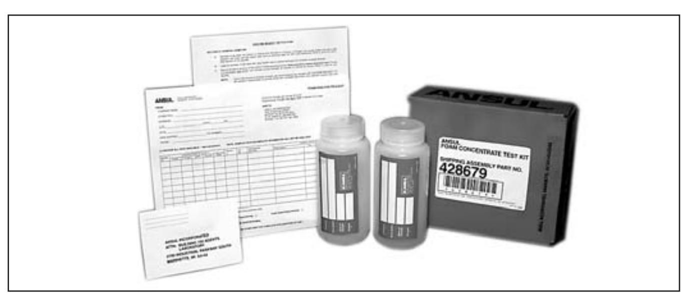
- Includes all analyses listed under Standard Quality with the addition of a sedimentation test.
- Used for port entry/exit of ships.
- Pass/fail report issued upon completion of analyses.

All instrumentation used for testing is calibrated and maintained using strict ISO regulations. For convenience, a foam test sample kit, Part No. 428679, is available. This kit is shipped in a convenient, reusable box and includes 2 leak-resistant, wide-mouth bottles, a return shipping label, a permanent marker, and the required foam analysis request form. Simply take the kit to the job site – no more searching for bottles, boxes, forms, markers, or the shipping address!

TESTING GUIDELINES

Physical properties and foam quality analyses give an indication of performance. Contamination or degradation of foam may be seen in changes of physical properties over time. Expansion and drain time are indicators of foam quality and are analyzed as a premix prepared to the specified percent dilution. The fire test is performed on a lab-scale fire. Parameters of this fire have been carefully correlated to the 50 ft^2 (4.6 m^2) fire that is used for approval under UL Standard 162.

In addition to testing the foam concentrate for quality and performance, the ANSUL Agents Laboratory can test the proportioning of a system; that is, the concentration of the solution after mixing prior to foam generation. A refractometer is used to generate data required to plot a curve of known concentration. This concentration must be prepared using the foam concentrate and the water used in the system. A proportioned field sample's refractive index is then compared to this curve to determine acceptance of the proportioning system.



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ORDERING INFORMATION

Foam Test Sample Kits, Part No. 428679, can be ordered through your local authorized ANSUL distributor or by calling Customer Service at 800-862-6785 or 715-735-7411.

To obtain only a foam analysis request form to submit using in-house sample bottles, ask for Form No. F-88195 or retrieve on-line at www.ansul.com.

PROPORTIONING TEST INSTRUMENTS

Data/Specifications

DESCRIPTION

As defined by NFPA 11 (the Standard for Low-, Medium-, and High-Expansion Foam), proportioning is the continuous introduction of foam concentrate at the recommended ratio into a water stream to form a foam solution. If the level of foam concentrate varies widely from that of the design, it can negatively influence the foam's fire fighting performance.

Acceptable ranges of proportioning systems are not less than the rated concentration, and not more than 30% above the rated concentration or one percentage point above the rated concentration, whichever is less. For example, the acceptable proportioning range for a 3% concentrate is from 3.0 to 3.9%. Unless manually pre-mixing a known amount of concentrate with a known amount of water, all foam systems will use some type of proportioning system. Illustrations and descriptions of common systems can be found in ANSUL®'s Foam Systems Design Manual or NFPA 11.

APPLICATION

There are two acceptable methods for measuring foam concentrate percentage in water: the Refractive Index Method or Conductivity Method. Both methods are based on comparing foam solution test samples to premeasured solutions that are plotted on a baseline graph of percent concentration versus instrument reading.

Test procedures for conducting proportioning testing can be found in the supplement manual (Part No. 31274) Field Inspection Manual for Foam Concentrates and Foam Pre-mixed Solutions. This supplement is included with the Foam Systems Design Manual and many other ANSUL Foam System Manuals. These procedures are also outlined in NFPA 11.

PROPORTIONING SYSTEM TEST INTERVAL

NFPA Standards vary on the frequency and method of test relative to the type of hazard application and the requirements of the Authority Having Jurisdiction (AHJ). Most AHJs will require a proportioning test at the commissioning of a system and at some regular interval thereafter in accordance with NFPA Standards such as NFPA 11, 25, 409, or other AHJ specific requirements. In the absence of AHJ direction on this subject, ANSUL would recommend that a proportioning test be conducted at a minimum three year interval after commissioning.

FIELD TEST INSTRUMENT RECOMMENDATIONS

The highest degree of accuracy may be achieved using the Conductivity Meter Model 1500-32 (Part No. 434435), but results can be skewed when water of varying quality such as salty, brackish, or fluctuating temperatures is used for making foam solution. ANSUL recommends the Handheld Refractometer Model 10419 (Part No. 405713) with accuracy approaching that of the conductivity meter (but less prone to problems with varying water qualities) as the best option for most real-world proportioning tests. Some customers prefer the ease of use with the Handheld Digital Refractometer Model PA202 (Part No. 434434). This instrument may be slightly less accurate than the Model 10419 with some foam solutions as a result of digital rounding for displayed values.

FEATURES

Hand-held Refractometer, Model 10419 (Part No. 405713)

- Refractive Index Scale: 1.3330 – 1.3730
- Scale Division: 0.0002 readily estimated to 0.0001
- Accuracy: ± 0.0001
- Salinity Scale: 0 – 160
- Scale Division: 2 ppt.
- Accuracy: ± 1 ppt.

007523

Digital Hand-held Refractometer, Model PA202 (Part No. 434434)

- Refractive Index Scale: 1.3330 – 1.5040
- Scale Division: 0.0001
- Accuracy: ± 0.0001
- Brix Scale: 0 – 85
- Scale Division: 0.1
- Accuracy: ± 0.1
- Power: 2 AAA Batteries

007524

Conductivity Meter, Model 1500-32 (Part No. 434435)

- Range of Instrument: 0 – 20000 uS, Range on Foam Setting (x100): 0 – 2000 uS
- Accuracy: ± 40 uS
- Resolution: 2 uS
- Power: 8 Rechargeable AA NICAD Batteries

007525

ORDERING INFORMATION

Contact ANSUL Customer Service for ordering information.

ANSUL | tyco

Ansul Incorporated
Marinette, WI 54143-2542

715-735-7411
www.ansul.com

Form No. F-2007003

ANSUL® A Tyco International Company

ANSUL® FOAM CONCENTRATE TRANSFER PUMP

Data/Specifications

FEATURES

- Bronze construction
- Self-priming
- 316 Stainless Steel impeller sleeve over steel motor shaft
- Direct drive
- 1 in. NPT internal ports
- 3/4 HP electric motor
- 115 VAC operation
- 20 amp fuse
- 23 gpm (87 Lpm) capacity at 4.3 psi (0.3 bar)

008928

APPLICATION

The ANSUL® Foam Concentrate Transfer Pump is useful for transferring foam concentrates from pails, drums, totes, or bulk shipments into ANSUL bladder tanks or atmospheric tanks. The impeller design reduces foaming of the concentrate during transfer.

DESCRIPTION

Assembly consists of self-priming impeller pump rated for 23 gpm at 4.3 psi (87 Lpm at 0.3 bar) head-flow and is well suited for transfer of ALL ANSUL Foam Concentrates from the agent shipping container to the foam systems storage tank. Higher operating pressures will reduce flow rate. Lower operating pressure will reduce wear and tear on equipment.

The pump is driven by a 3/4 hp, single phase, 60 Hz, 115 VAC, O.D.P. electric motor provided with a 20 amp fuse, ON/OFF switch, and 5 ft (1.5 m) power cord with plug. The assembly will also include a 1 in. NPT flow control ball valve, 8 ft (2.4 m) length of non-collapsible suction hose, and 10 ft (3 m) length of clear discharge hose.

Other fittings, hose clamps, or a drum pick-up tube that may be required are not provided as the items may be unique per individual set-up.

SYSTEM OPERATION

The rotation of the motor shaft determines the location of the pump intake and discharge ports. Intake is on the right when looking at pump end cover. Attach the non-collapsible suction hose to the right and clear discharge hose connects to the 1 in. flow control ball valve on the left.

Pump will produce a suction lift of approximately 9 ft (2.7 m) when dry and a lift up to 20 ft (6 m) when primed depending on the viscosity of the liquid. Suction lines must be airtight or pump will not self-prime. Do not run dry for more than 30 seconds as pumping of liquid provides lubrication for the impeller. Lack of liquid will damage the impeller.

Use only with ANSUL foam concentrates. Other liquids may cause impeller and pump damage. To prolong pump life, flush with water after use. To protect from freezing temperatures, drain unit by loosening the end cover.

When operating the pump, liquid temperatures should be between 50 °F to 180 °F (10 °C to 83 °C).

For continuous operation, discharge pressure should not exceed 20 psi (1.3 bar). Intermittent stopping and starting of pump indicates the unit is operating against excessive discharge pressure.

⚠ WARNING

Do not use where flammable vapors are present. Motor is not explosion proof and can spark. Explosion and death can occur.

Use a standard pump part if replacing the gasket. A thicker gasket will reduce priming ability. A thinner gasket will cause impeller to bind. The standard gasket is 0.010 in. (0.2 mm) thick.

ORDERING INFORMATION

Part No.	Description	Shipping Weight
72724	Foam Concentrate Transfer Pump	36 lb (16.3 kg)

Contact Tyco, Technical Services for other available options if above specification does not meet your requirements. Phone: +1-800-862-6785

Note: The converted metric values in this document are provided for dimensional reference only and do not reflect an actual measurement.

Proportioning Equipment

PROPORTIONING

Proportioning refers to the introduction of a foam concentrate into a volume or flowing stream of water. Proper foam proportioning is essential to ensure the optimum performance from the foam liquid concentrate.

Per NFPA 11, "Standard for Low-, Medium-, and High-Expansion Foam," acceptable ranges of proportioning systems are not less than the rated concentration and not more than 30% above the rated concentration, whichever is less. For example, the acceptable range for a 3% concentrate is from 3 to 3.9%. Proportioning too rich also diminishes the discharge duration of foam as the consumption rate is increased.

Various types of proportioning systems are available, each with advantages and disadvantages depending on the specific application and site conditions. Usually one type of system will stand out as best for the application; the required foam solution flow rate and available water pressure are the foremost deciding factors.

PREMIX/DUMP-IN METHOD

The simplest means of proportioning is accomplished by premixing. With this method, pre-measured portions of water and foam concentrate are mixed in a container. Typically the premix method is used with hand portable extinguishers, wheeled extinguishers, twin-agent skids, and vehicle-mounted systems.

In most cases, premixed solutions are discharged from a pressure-rated tank using an inert gas such as carbon dioxide or nitrogen. An alternate method of discharge uses a pump and non-pressure-rated, atmospheric storage tank. The pump transfers the foam solution (under pressure) through piping or hose to the discharge devices.

Fire departments can use the dump-in method in their pumper trucks. An operator simply "dumps in" a pre-determined amount of foam concentrate into the booster tank and uses the on-board pump to supply discharge devices. For example, a truck with a 500 gal (1893 L) capacity booster tank requires 5 gal (19 L) of 1% AFFF concentrate, 15 gal (57 L) of 3% AFFF concentrate, or 30 gal (114 L) of 6% AFFF concentrate to produce 500 gal (1893 L) of premixed foam solution.

FIGURE 2-1
001151

Only AFFF concentrates can be used with the premix or dump-in methods. Protein base foams do not mix as readily as AFFF and will gradually settle out of the premixed solution. Specially diluted alcohol-resistant concentrates are used in specific pre-mix units. In dump-in applications, ANSULITE alcohol-resistant AFFF concentrate should only be used when the booster tank is equipped with a circulation pump and complete mixing can be accomplished through the recycle line.

A disadvantage with premix systems is that all the water is converted to foam solution. Other types of proportioning systems store the foam concentrate separately from the water supply so that either foam or water discharge is possible.

BALANCED PRESSURE PROPORTIONING SYSTEMS

Balanced pressure proportioning is the most common method used for system applications. There are two basic types: bladder tanks and pump systems.

All balanced pressure systems use a modified venturi device called a proportioner or ratio controller (Figure 2-2). The proportioners are available in a variety of sizes and styles to match required flow ranges and pipe sizes.

FIGURE 2-2
001152

Proportioning Equipment

BALANCED PRESSURE PROPORTIONING SYSTEMS (Continued)

As water flows through the proportioner nozzle, a low pressure area is created. (See Figure 2-3.) It is in this low pressure area that the pressurized concentrate mixes with the water stream. A metering orifice, at the concentrate inlet, regulates the rate of concentrate flow and thus determines the percentage of concentrate in the foam solution.

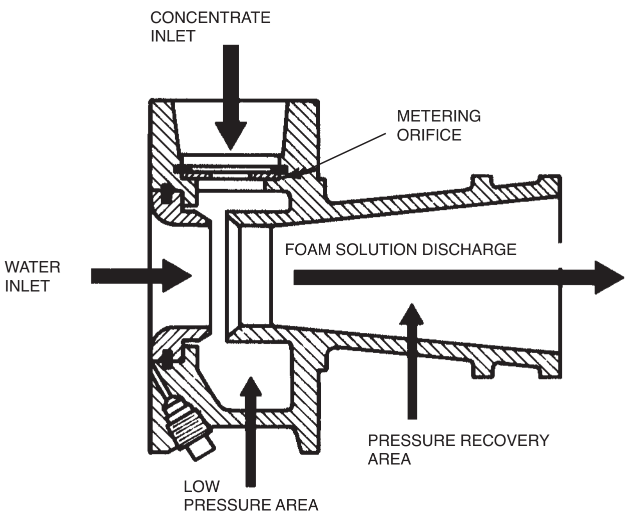


FIGURE 2-3
001153

Balanced pressure proportioning systems require the foam concentrate pressure to be balanced with the water pressure at the proportioner inlets. This balance meters the proper amount of foam concentrate into the water stream.

Bladder Tanks

Balanced pressure bladder tank systems (Figure 2-4) use a pressure-rated tank with an internal elastomeric bladder. System water pressure is used to squeeze the bladder containing the foam concentrate providing pressurized concentrate to the proportioner. The resulting foam solution is piped to discharge devices protecting the hazard area.

FIGURE 2-4
001154

A distinct advantage of bladder tanks is that no external power supply is required other than a pressurized water source. However, because the bladder tank is pressurized during operation, it cannot be conveniently recharged during discharge. Because of their simple design, bladder tanks require very little maintenance.

BALANCED PRESSURE PROPORTIONING SYSTEMS (Continued)

Balanced Pressure Pump Proportioning Systems (Pump Skid)

Balance pressure pump proportioning systems (Figure 2-5) use atmospheric foam concentrate storage tanks (Figure 2-6). The tank is not pressure-rated and may be constructed of mild steel, fiberglass-reinforced plastic, or polyethylene plastic. Instead of using pressurized water as with bladder tanks, the foam liquid is pumped to the proportioner.

An automatic pressure balancing valve regulates the foam concentrate pressure to match the water pressure. A duplex pressure gauge provides continuous monitoring of both water and concentrate pressures. The system can also be operated manually to control the pressures and isolate the automatic balancing valve.

Positive displacement pumps are used with these systems to allow maximum efficiency for liquids of varying viscosity. The size of pumps and drivers will vary depending on the application and the type of foam concentrate used. (Contact Ansul Incorporated, Technical Services, for assistance in selecting the proper pump system.)

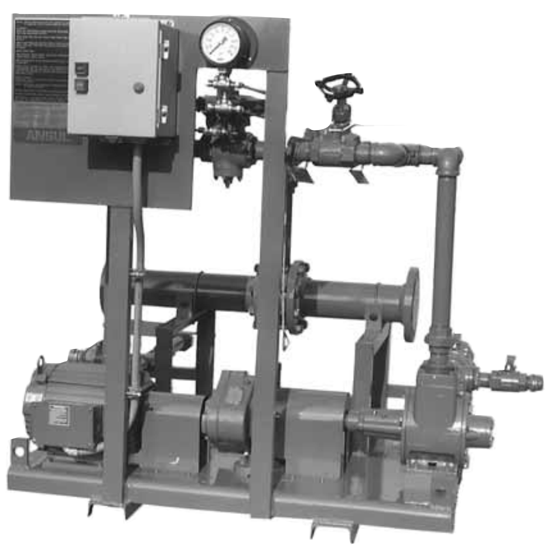


FIGURE 2-5
001155

FIGURE 2-6
001156

In-Line Balanced Pressure Proportioner

The in-line balanced pressure proportioner (Figure 2-7) is similar to the pump skid previously described except that it is a separate assembly that offers the advantage of proportioning the foam concentrate at a location remote from the tank and pump.

Like the pump skid, the proportioner assembly incorporates an automatic pressure balancing valve, duplex gauge, and hand-operated valves for optional manual pressure regulation. A pressure control valve, located in the return line to the foam concentrate storage tank, maintains constant pressure in the supply manifold that is 15-20 psi (1.03-1.38 bar) higher than the water pressure to the proportioner.

Multiple in-line balanced pressure proportioners can be supplied from a single foam pump to protect several hazard areas. By adding an automated valve to each proportioner, either foam discharge or water-only discharge can be selected.

FIGURE 2-7
001157

Proportioning Equipment

LINE PROPORTIONING SYSTEMS

Line proportioning systems also use atmospheric storage tanks. Pressurized water, flowing through the line proportioner (eductor), creates a negative pressure area where suction draws the foam concentrate from the storage tank. Typically, these systems will require residual water pressure in excess of 100 psi (6.9 bar).

Line proportioners (Figure 2-8) are rated for specific flow rates depending on the available water pressure. In comparison, standard proportioners have wide flow range capabilities. Limitations exist in piping and/or hose lengths between the line proportioners and discharge devices. (The maximum back-pressure allowed is generally expressed as a percentage of the operating inlet pressure.) A line proportioner must control the system flow. The discharge device controls discharge pressure as long as the allowable back-pressure is not exceeded. Thus, when the required flow rates and pressures can be met, line proportioning systems can be very economical.

The use of line proportioning systems for protection of fixed hazards (i.e. loading racks and aircraft hangars) is rare. This is usually due to the lack of sufficient water pressure and the need for variable foam solution flow rates.

FIGURE 2-8
001158

Proportioning Equipment

AROUND-THE-PUMP PROPORTIONING SYSTEMS

Figure 2-9 illustrates a typical around-the-pump proportioning system. With this system, a portion of the fire pump discharge outlet, commonly 10 to 40 gpm (38 to 151 Lpm), is diverted through a line proportioner (eductor). The line proportioner outlet is piped to the suction side of the pump to form a loop around the fire pump. The line proportioner is producing a very rich foam solution with the incoming water in the loop piping. The rich foam solution is in such a ratio that, when it is proportioned with the fire pump intake water, the desired 3% or 6% foam solution is produced. Once the initial cycle occurs, the proportioning percentage stabilizes and remains fixed.

The proper setting of a metering orifice, relative to a specific discharge output, is critical for proper proportioning with the type of foam concentrate used. With some around-the-pump systems, flow measuring devices control the operation of an automated metering valve to adjust for variances in discharge outputs.

Typical applications for around-the-pump proportioners include crash rescue trucks, foam trucks, and fixed industrial complexes.

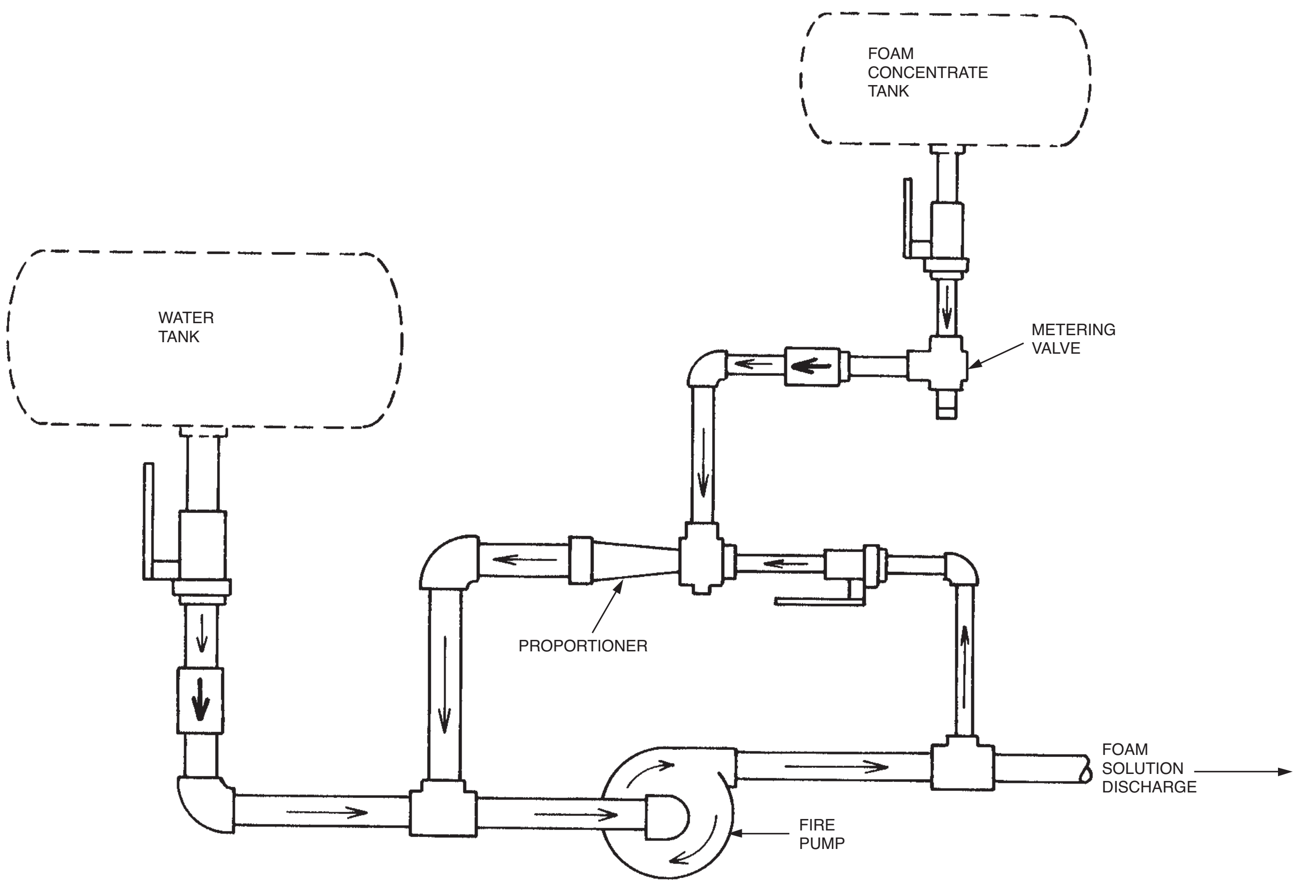


FIGURE 2-9
001159

Proportioning Equipment

PROPORTIONING EQUIPMENT SELECTION CRITERIA

Type	Advantages	Disadvantages
Premix	• Simplicity • Independent of piped water supply • Accuracy of proportioning	• Limited foam generating capability • Entire water supply becomes foam solution • Cannot use with protein and fluoroproteins
Balanced Pressure (Bladder Tank)	• Low cost (2000 gal or less) • Wide flow range (proportioner) • Variable pressure range • Simple operation • Auxiliary power not required	• Cannot refill during system discharge • Limited capacities
Balanced Pressure (Pump Skid)	• Low cost (2000 gal or more) • Wide flow range (proportioner) • Can refill during system discharge • Variable pressure range	• Auxiliary power required • Additional maintenance (pump)
Balanced Pressure (In-Line Proportioner)	• Low cost (2000 gal or more) • Wide flow range (proportioner) • Can refill during system discharge • Variable pressure range • Proportioner(s) remotely located	• Auxiliary power required • Additional maintenance (pump)
Line Proportioner	• Low cost • Can refill during system discharge	• Fixed flow range • High water pressure needed
Around-The-Pump	• Simple operation • Can refill during system discharge	• A portion of pump discharge is by-passed • Changes to discharge rates require metering valve adjustment • Auxiliary power required • Typical range limit of 100 – 1000 gpm (379 – 3785 Lpm) • Pump suction inlet pressure must be zero to slight vacuum

A Tyco International Company

VERTICAL AND HORIZONTAL BLADDER TANKS

Data/Specifications

APPLICATION

The ANSUL bladder tank is one component in a balanced pressure proportioning system. Its operation requires no external power other than a pressurized water system. The bladder tank may be used with any ANSUL foam agent. It can be used in a proportioning system incorporating single or multiple proportioners and any suitable discharge device.

ANSUL bladder tanks have numerous applications including truck loading racks, aircraft hangers, dip tanks, pump rooms, helipads, etc.

DESCRIPTION

The ANSUL bladder tank is a steel pressure vessel which stores a foam concentrate contained within an elastomeric bladder. The concentrate is discharged from the tank by incoming water applying pressure to the bladder. This applied energy is transferred to the concentrate, supplying pressurized concentrate to the proportioner. (Proportioners are separate items described on a separate data sheet.)

ANSUL bladder tanks are available in both vertical and horizontal tank models and a variety of nominal capacities as listed in the tank information tables. Both tank models feature perforated center tubes which allow improved agent discharge.

Features incorporated into the ANSUL bladder tanks include the following:

- Water pressurized bladder construction, alleviating the requirement for foam pumps or other energy sources
- Valves that are pinned in the normal operative positions and are supplied with nameplates identifying their functions and operating instructions
- Bladder tanks supplied with corrosion-resistant piping
- Exterior tank surfaces finished in red standard system paint or coated with an epoxy "CR" red finish for use in marine or corrosive environments
- Tanks with a high build epoxy coated interior for use with both fresh and salt water

APPROVALS

The ANSUL vertical and horizontal tank assemblies are both Underwriters Laboratories listed and Factory Mutual approved with various ANSUL proportioners and foam concentrates and bear the (UL) label along with an American Society of Mechanical Engineers (ASME) code stamp.

Bladder tanks 200 gallons (757 L) and larger are CE marked in conformance with the 97/23/EC Pressure Equipment Directive. Tanks less than 200 gallons (757 L) are acceptable based on sound engineering practices of ASME code.

SPECIFICATIONS

The ANSUL vertical and horizontal bladder tanks shall be designed and constructed in accordance with the latest revisions to ASME code, Section VIII, Division I, for unfired pressure vessels with a maximum working pressure of 175 psi (12.1 bar) and tested to at least 255 psi (17.6 bar). The tank shall be of (specify) gallon nominal capacity and overall dimensions as indicated in the appropriate diagram and corresponding information table. The tank shall be constructed of steel complying to ASME specifications possessing a tensile strength of not less than 70,000 psi (482.6 MPa). The circumferential, as well as the longitudinal body seam, shall be machine welded and radiographed when applicable by ASME codes.

The tank heads shall be 2 to 1 elliptical to ensure strength while reducing overall tank weight.

All 1 in. (25 mm) diameter and larger tank openings on the outside of the bladder shall be divided to prevent bladder blow-out. There shall be a water channel between the water inlet opening and water drain opening to establish a water path between the tank shell interior and the bladder.

The tank interior shall have all welds and edges ground smooth. It shall be cleaned, grit blasted to a near white surface, and immediately coated with a high build epoxy coating. The tank data plate shall be of a material compatible with the tank shell and shall be seal welded with appropriate procedure and material to the tank. (This ensures that the data plate will reflect the overall condition of the tank and that no corrosion occurs undetected behind the data plate.) The data plate shall contain as a minimum ASME code stamp: year of manufacture, working pressure, board number, material thickness, temperature, and type of head. The tank shall also have a label specifying the type of foam concentrate the system was designed to use, the quantity of concentrate, and any other pertinent warnings.

The vertical tank assembly shall be supported by a continuous skirt of a diameter equal to the tank with four feet drilled for anchoring. The horizontal tank assembly shall be supported by two saddles permanently welded to the tank and drilled for anchoring. These supports provide maximum stability and a maximum amount of bearing area which protects against horizontal and vertical forces such as vibration and shifting.

Lifting lugs shall be substantial welded tank attachments with a clear hole not less than 2 in. (51 mm) in diameter.

The tank shall contain a flexible bladder of material tested by Underwriters Laboratories for compatibility with the agent to be used. The bladder material shall be constructed to conform with the inside tank dimensions.

Both the vertical and horizontal tank assemblies shall contain porous center tubes of P.V.C. or other material compatible with the agent, with holes of no more than 3/4 in. (19 mm) diameter. The vertical tank assembly shall contain a single perforated center tube. The horizontal tank assembly shall contain both vertical and horizontal perforated center tubes connected with a cross fitting of compatible material.

The following shall be assembled to each tank: a bladder drain/fill valve, bladder vent/fill valve, tank shell drain valve, and tank shell vent valve. These valves shall be 1 in., 1/4-turn ball valves with bronze bodies, hard chromium-plated bronze ball, bronze stem, stainless steel locking nut and handle, and high performance Teflon seats and stuffing box ring. Each valve shall have a nameplate secured to it depicting the valve name and operating position. Also, the valve shall have a ring pin and chain attached for securing the valve in the operating position. The valve names shall coincide exactly with those in the tank instruction manual. All valves shall be piped out from under the tank for easy access. All pipe shall be Schedule 40 ASTM-B-43 and all fittings shall be ASTM B-62 or B-584 bronze. The bladder drain/fill piping shall include a tee with 1/2 in. plug for future sight gauge connection.

The tank exterior shall be prepared and finished in accordance with the appropriate red paint system standard or "CR" red per ANSUL specification or equivalent.

A printed filling and maintenance manual shall be supplied with each tank. The manual shall contain a system schematic, installation instructions, initial fill procedures, major and minor refill procedures, inspection and maintenance procedures, sight gauge use instructions, service and repair procedures, and field inspection manual.

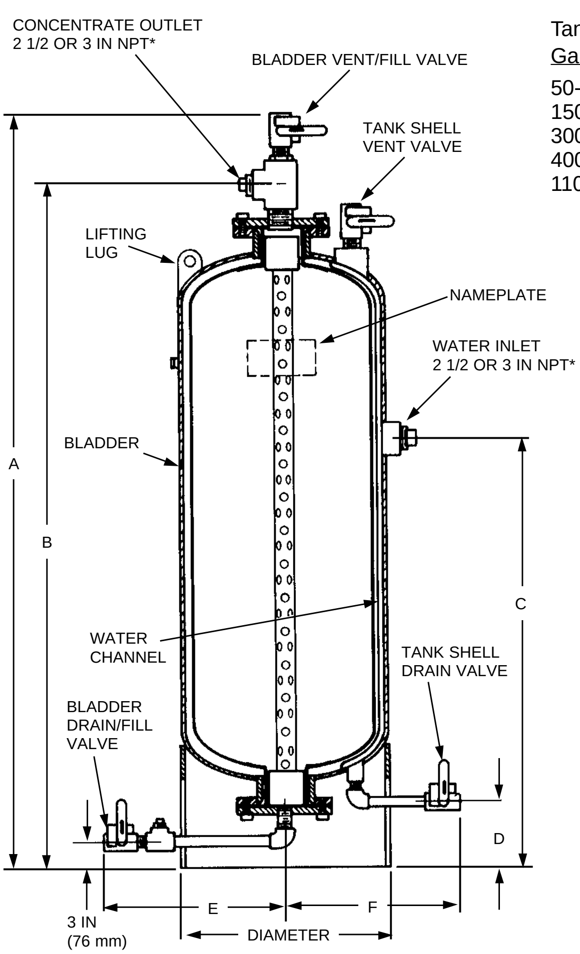
ORDERING INFORMATION

The ANSUL bladder tank shipping assembly part numbers and approximate shipping weights are identified in the following tables. Part numbers vary according to tank requirements.

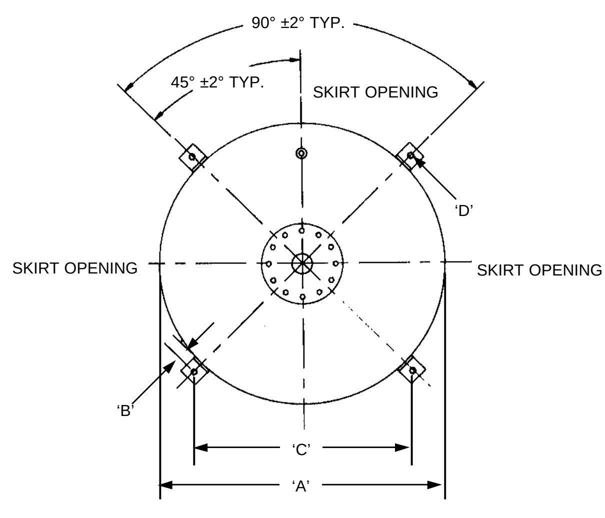
For tanks with special engineered options, such as special pressure ratings, seismic ratings, or trim and finish options, contact the Technical Services Department.

VERTICAL BLADDER TANK

Nominal Capacity		Bladder Tank Part No.	Dimensions														Approximate Shipping Weight	
			Diameter		A		B		C		D		E		F			
Gal	(L)	Epoxy/Enamel	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	lb	(kg)
50	(189)	70501/70502	24	(610)	64.0	(1626)	57.0	(1448)	24	(610)	7.5	(191)	20	(508)	19	(483)	470	(213)
100	(379)	69000/69001	24	(610)	90.0	(2286)	82.0	(2083)	52	(1321)	8.5	(216)	19	(483)	19	(483)	700	(318)
150	(568)	70516/70517	30	(762)	90.0	(2286)	82.0	(2083)	49	(1245)	10.5	(267)	21	(533)	21	(533)	980	(445)
200	(757)	69002/69003	30	(762)	108.0	(2743)	100.0	(2540)	68	(1727)	10.5	(267)	22	(559)	21	(533)	1290	(585)
300	(1136)	69004/69005	36	(914)	112.0	(2845)	104.0	(2642)	70	(1778)	10.5	(267)	25	(635)	24	(610)	1550	(703)
400	(1514)	419153/419154	48	(1219)	92.5	(2350)	84.5	(2146)	55	(1397)	10.5	(267)	32	(813)	30	(762)	2250	(1021)
500	(1893)	419155/419156	48	(1219)	105.5	(2680)	97.5	(2477)	73	(1854)	10.5	(267)	32	(813)	30	(762)	2500	(1134)
600	(2271)	69010/69011	48	(1219)	118.0	(2997)	110.0	(2794)	87	(2210)	10.5	(267)	32	(813)	30	(762)	2570	(1166)
700	(2650)	69012/69013	48	(1219)	132.0	(3353)	124.0	(3150)	88	(2235)	10.5	(267)	32	(813)	30	(762)	2840	(1288)
800	(3028)	419157/419158	48	(1219)	146.5	(3721)	138.5	(3518)	95	(2413)	10.5	(267)	32	(813)	30	(762)	3200	(1452)
900	(3407)	419159/419160	48	(1219)	160.5	(4077)	152.5	(3874)	106	(2692)	10.5	(267)	32	(813)	30	(762)	3400	(1542)
1000	(3785)	419161/419162	48	(1219)	174.5	(4432)	166.5	(4229)	116	(2946)	10.5	(267)	32	(813)	30	(762)	3600	(1633)
1100	(4164)	71118/71119	60	(1524)	144.0	(3658)	136.0	(3454)	90	(2286)	18.5	(470)	37	(940)	36	(914)	3750	(1701)
1200	(4542)	71120/71121	60	(1524)	153.0	(3886)	145.0	(3683)	96	(2438)	18.5	(470)	37	(940)	36	(914)	3950	(1792)
1300	(4921)	71122/71123	60	(1524)	162.0	(4115)	154.0	(3912)	104	(2642)	18.5	(470)	37	(940)	36	(914)	4140	(1878)
1400	(5300)	71124/71125	60	(1524)	171.0	(4343)	163.0	(4140)	110	(2794)	18.5	(470)	37	(940)	36	(914)	4350	(1973)
1500	(5678)	71126/71127	60	(1524)	180.0	(4572)	171.0	(4343)	117	(2972)	18.5	(470)	37	(940)	36	(914)	4530	(2055)



Tank Capacity		Dim. 'A' Tank Dia.		Dim. 'B'		Dim. 'C'		Dim. 'D' Hole Dia.	
Gal	(L)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
50-100	(189-379)	24	(610)	1.7	(43)	19.5	(495)	1	(25)
150-200	(568-757)	30	(762)	1.7	(43)	23.7	(602)	1	(25)
300	(1136)	36	(914)	1.7	(43)	27.9	(709)	1	(25)
400-1000	(1514-3785)	48	(1219)	2.2	(56)	37.1	(942)	1	(25)
1100-1500	(4164-5678)	60	(1524)	2.2	(56)	45.6	(1158)	1	(25)



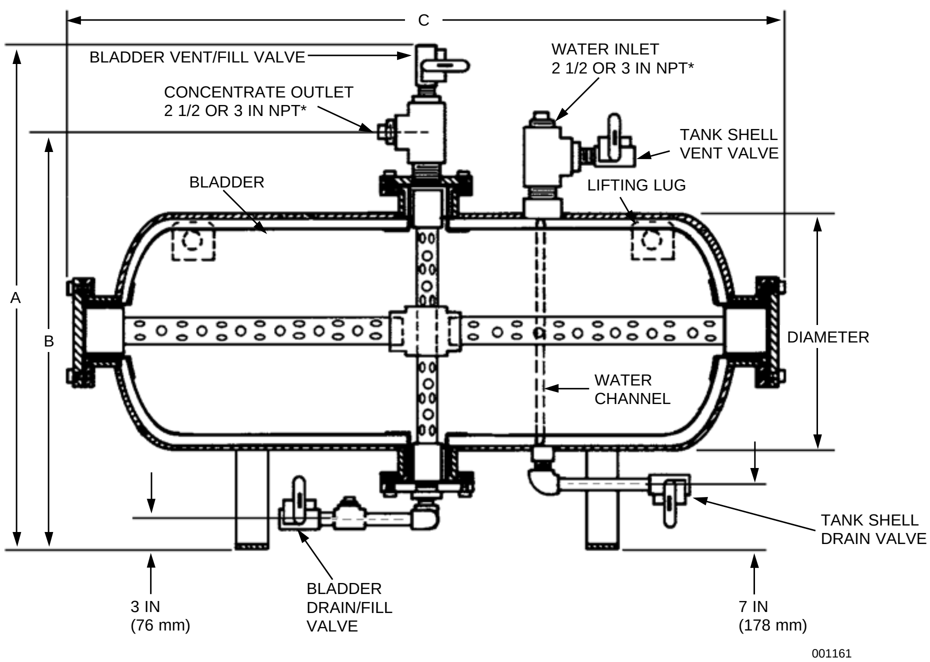
001160

* 2 1/2 in. NPT on tanks 1000 gallons (3785 L) or less

* 3 in. NPT on tanks over 1000 gallons (3785 L)

HORIZONTAL BLADDER TANK

Nominal Capacity Gal.	(L)	Bladder Tank Part No. Epoxy/Enamel	Diameter in.	(cm)	A in.	(cm)	B in.	(cm)	C in.	(cm)	Approximate Shipping Weight lb	(kg)
100	(379)	69090/69091	24	(610)	52	(1321)	44	(1118)	74	(1880)	720	(327)
150	(568)	70521/70522	30	(762)	58	(1473)	50	(1270)	74	(1880)	1050	(476)
200	(757)	69092/69093	30	(762)	58	(1473)	50	(1270)	91	(2311)	1320	(599)
300	(1136)	69094/69095	36	(914)	64	(1626)	56	(1422)	96	(2438)	1600	(726)
400	(1514)	419178/419179	48	(1219)	76	(1930)	68	(1727)	77	(1956)	2300	(1043)
500	(1893)	419180/419181	48	(1219)	76	(1930)	68	(1727)	90	(2286)	2550	(1157)
600	(2271)	69100/69101	48	(1219)	76	(1930)	68	(1727)	103	(2616)	2800	(1270)
700	(2650)	69102/69103	48	(1219)	76	(1930)	68	(1727)	117	(2972)	3050	(1383)
800	(3028)	419182/419183	48	(1219)	76	(1930)	68	(1727)	131	(3327)	3250	(1474)
900	(3407)	419184/419185	48	(1219)	76	(1930)	68	(1727)	145	(3683)	3420	(1551)
1000	(3785)	419186/419187	48	(1219)	76	(1930)	68	(1727)	159	(4037)	3600	(1633)
1100	(4164)	71100/71101	60	(1524)	88	(2235)	80	(2032)	123	(3124)	4150	(1882)
1200	(4542)	71102/71103	60	(1524)	88	(2235)	80	(2032)	132	(3353)	4370	(1982)
1300	(4921)	71104/71105	60	(1524)	88	(2235)	80	(2032)	141	(3581)	4550	(2064)
1400	(5300)	71106/71107	60	(1524)	88	(2235)	80	(2032)	150	(3810)	4760	(2159)
1500	(5678)	71108/71109	60	(1524)	88	(2235)	80	(2032)	159	(4039)	4940	(2441)
1600	(6057)	71110/71111	60	(1524)	88	(2235)	80	(2032)	169	(4293)	5130	(2327)
1700	(6435)	71112/71113	60	(1524)	88	(2235)	80	(2032)	178	(4521)	5330	(2418)
1800	(6814)	71114/71115	60	(1524)	88	(2235)	80	(2032)	187	(4750)	5510	(2499)
1900	(7192)	71116/71117	60	(1524)	88	(2235)	80	(2032)	196	(4978)	5690	(2581)
2000	(7571)	71150/71151	72	(1829)	100	(2540)	93	(2362)	154	(3912)	6030	(2735)
2200	(8328)	71152/71153	72	(1829)	100	(2540)	93	(2362)	166	(4216)	6390	(2898)
2400	(9085)	71154/71155	72	(1829)	100	(2540)	93	(2362)	180	(4572)	6770	(3071)
2600	(9842)	71156/71157	72	(1829)	100	(2540)	93	(2362)	193	(4902)	7190	(3261)
2800	(10599)	71158/71159	72	(1829)	100	(2540)	93	(2362)	205	(5207)	7480	(3393)
3000	(11356)	71160/71161	72	(1829)	100	(2540)	93	(2362)	218	(5537)	7870	(3570)

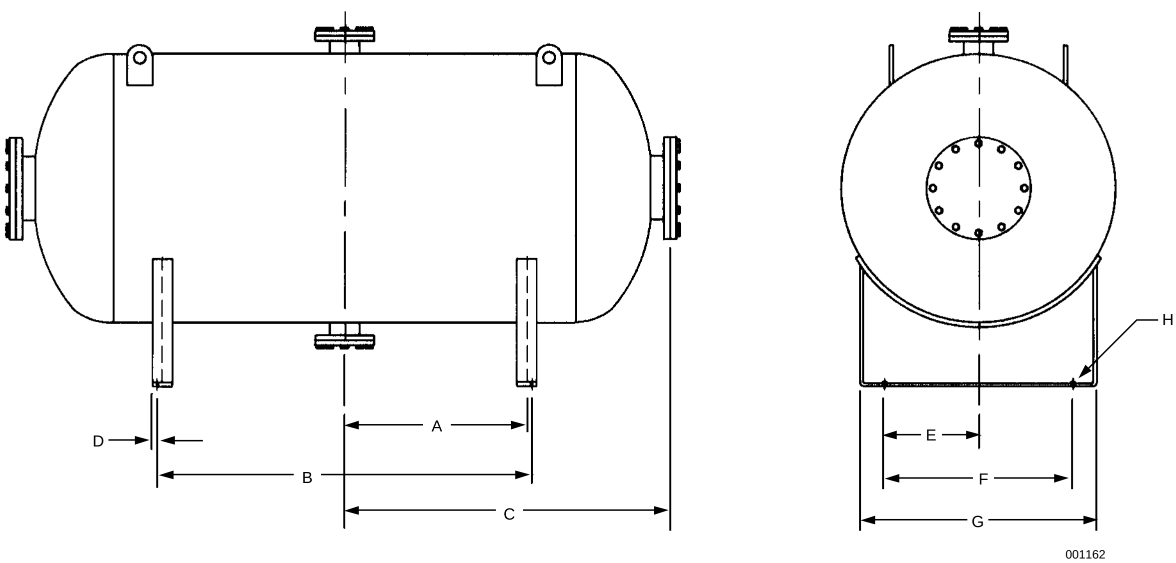


* 2 1/2 in. NPT on tanks 1000 gallons (3785 L) or less

* 3 in. NPT on tanks over 1000 gallons (3785 L)

HORIZONTAL BLADDER TANK

Tank Size Gal	(L)	A in.	A (mm)	B in.	B (mm)	C in.	C (mm)	D in.	D (mm)	E in.	E (mm)	F in.	F (mm)	G in.	G (mm)	H in.	H (mm)	Saddle Width in.	Saddle Width (mm)
100	(379)	16.0	(406)	33.75	(857)	35.5	(902)	0.63	(16)	5	(127)	10	(254)	18	(457)	0.63	(16)	3	(76)
150	(568)	18.0	(457)	37.75	(959)	35.0	(889)	0.63	(16)	8	(203)	16	(406)	24	(610)	0.63	(16)	3	(76)
200	(757)	20.0	(508)	41.75	(1061)	44.0	(1118)	0.63	(16)	8	(203)	16	(406)	24	(610)	0.63	(16)	3	(76)
300	(1136)	20.0	(508)	41.75	(1061)	46.0	(1168)	0.63	(16)	11	(279)	22	(559)	30	(762)	0.63	(16)	3	(76)
400	(1514)	15.8	(400)	33.75	(857)	36.5	(927)	0.88	(22)	17	(432)	34	(864)	42	(1067)	0.88	(22)	4	(102)
500	(1893)	19.5	(495)	41.25	(1048)	43.0	(1092)	0.88	(22)	17	(432)	34	(864)	42	(1067)	0.88	(22)	4	(102)
600	(2271)	22.5	(572)	47.25	(1200)	49.5	(1257)	0.88	(22)	17	(432)	34	(864)	42	(1067)	0.88	(22)	4	(102)
700	(2650)	26.0	(660)	54.25	(1378)	56.5	(1435)	0.88	(22)	17	(432)	34	(864)	42	(1067)	0.88	(22)	4	(102)
800	(3028)	29.5	(749)	61.25	(1556)	63.5	(1613)	0.88	(22)	17	(432)	34	(864)	42	(1067)	0.88	(22)	4	(102)
900	(3407)	33.0	(838)	68.25	(1734)	70.5	(1791)	0.88	(22)	17	(432)	34	(864)	42	(1067)	0.88	(22)	4	(102)
1000	(3785)	36.5	(927)	75.25	(1911)	77.5	(1969)	0.88	(22)	17	(432)	34	(864)	42	(1067)	0.88	(22)	4	(102)
1100	(4164)	28.0	(711)	58.25	(1480)	60.0	(1524)	0.88	(22)	23	(584)	46	(1168)	54	(1372)	1.00	(25)	4	(102)
1200	(4542)	30.5	(775)	63.25	(1607)	64.5	(1638)	0.88	(22)	23	(584)	46	(1168)	54	(1372)	1.00	(25)	4	(102)
1300	(4921)	32.5	(826)	67.25	(1708)	69.0	(1753)	0.88	(22)	23	(584)	46	(1168)	54	(1372)	1.00	(25)	4	(102)
1400	(5299)	35.0	(889)	72.25	(1835)	73.5	(1867)	0.88	(22)	23	(584)	46	(1168)	54	(1372)	1.00	(25)	4	(102)
1500	(5678)	37.0	(940)	76.25	(1937)	78.0	(1981)	0.88	(22)	23	(584)	46	(1168)	54	(1372)	1.00	(25)	4	(102)
1600	(6057)	39.5	(1003)	81.25	(2064)	88.0	(2235)	0.88	(22)	23	(584)	46	(1168)	54	(1372)	1.00	(25)	4	(102)
1700	(6435)	42.0	(1067)	86.25	(2191)	87.5	(2223)	0.88	(22)	23	(584)	46	(1168)	54	(1372)	1.00	(25)	4	(102)
1800	(6814)	44.0	(1118)	90.25	(2292)	92.0	(2337)	0.88	(22)	23	(584)	46	(1168)	54	(1372)	1.00	(25)	4	(102)
1900	(7192)	46.5	(1181)	95.25	(2419)	96.5	(2451)	0.88	(22)	23	(584)	46	(1168)	54	(1372)	1.00	(25)	4	(102)
2000	(7571)	36.0	(914)	74.25	(1886)	72.2	(1834)	0.88	(22)	29	(737)	58	(1473)	66	(1676)	1.00	(25)	4	(102)
2200	(8328)	39.0	(991)	80.25	(2038)	81.7	(2075)	0.88	(22)	29	(737)	58	(1473)	66	(1676)	1.00	(25)	4	(102)
2400	(9085)	42.5	(1080)	87.25	(2216)	88.2	(2240)	0.88	(22)	29	(737)	58	(1473)	66	(1676)	1.00	(25)	4	(102)
2600	(9842)	45.5	(1156)	93.25	(2369)	94.7	(2405)	0.88	(22)	29	(737)	58	(1473)	66	(1676)	1.00	(25)	4	(102)
2800	(10599)	48.5	(1232)	99.25	(2521)	100.7	(2558)	0.88	(22)	29	(737)	58	(1473)	66	(1676)	1.00	(25)	4	(102)
3000	(11356)	52.0	(1321)	106.25	(2699)	107.2	(2723)	0.88	(22)	29	(737)	58	(1473)	66	(1676)	1.00	(25)	4	(102)



NOTE: The converted metric values in this document are provided for dimensional reference only and do not reflect an actual measurement.

BLADDER TANK SIGHT GAUGE

Data/Specifications

APPLICATION

The sight gauge, for ANSUL® bladder tanks, is a device designed as a convenient visual method of estimating the level of foam concentrate in the tank.

Bladder tank construction does not allow pressurized, continuous, or direct gauge readings. The ANSUL sight gauge is a non-pressure-rated device. It normally shows empty avoiding a false “full reading” and an erroneous sense of security.

Because ANSUL bladder tanks are pressurized when operated, the pressure must be relieved before a sight gauge reading can be taken. After the water is drained, and the pressure is vented, the full port ball valve can be opened to the “READ” position. This allows the concentrate in the tank to seek its own level in the sight gauge tube enabling a visual estimation of the bladder tank concentrate level.

As an integral part, the gauge has easy-to-follow instructions with a ring pin to secure the valve handle in the proper position.

SPECIFICATIONS

The sight gauge shall be a device for estimating the quantity of foam concentrate in a bladder tank, and shall be self-draining.

The gauge tube shall be 1/2 in. polycarbonate and tested for compatibility with the agent used. It shall be fastened to the tank near the tube top and the tube bottom shall terminate in a 1/2 in. full port bronze body ball valve.

The valve shall have a chromium-plated bronze ball, bronze stem, stainless steel handle and locking nut, and high performance reinforced teflon seats and stuffing box ring with a 600 psi (4136 kPa) W.O.G. rating. The valve shall have a clearly legible nameplate including the necessary steps to safely use the sight gauge.

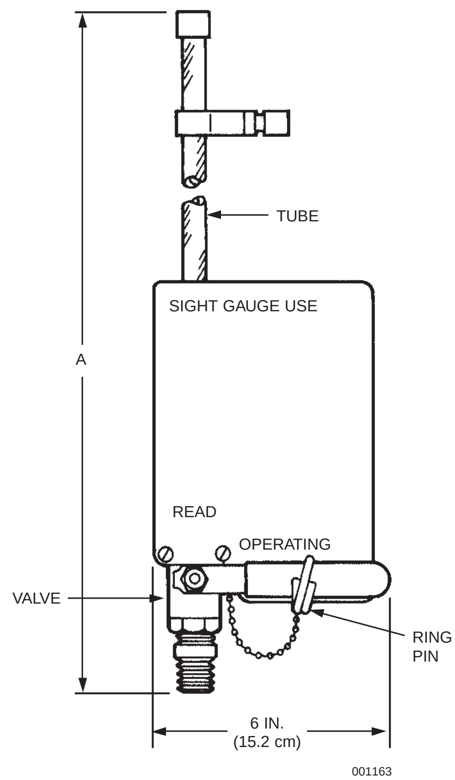
The valve handle shall be drilled so that it may be pinned in the position that allows operation of the bladder tank. The pin shall be attached to the valve by a chain to avoid loss.

The gauge assembly shall be designed for connection to a 1/2 in. F.N.P.T.

ORDERING INFORMATION

The ANSUL sight gauge shipping assembly is an option shipped as a separate component, Part No. 68427 for 50-400 gallon (189.3-1514 L) vertical bladder tanks (VBT) and all horizontal bladder tanks, or Part No. 422863 for 500-1500 gallon (1892.7-5678.1 L) VBT. The approximate shipping weight is 3 lb (1.4 kg).

Bladder Tank Sight Gauge



Nominal Capacity Gallons	Dimension A* (Vertical Tank) in.	(cm)	Dimension A* (Horizontal Tank) in.	(cm)
50	52	(132)	–	–
100	78	(198)	40	(102
150	78	(198)	46	(117)
200	96	(244)	46	(117)
300	100	(254)	52	(132)
400	96	(244)	58	(147)
500	114	(290)	58	(147)
600	102	(259)	64	(163)
700	120	(305)	64	(163)
800	112	(284)	70	(178)
900	124	(315)	70	(178)
1000	134	(340)	70	(178)
1100	127	(323)	76	(193)
1200	136	(345)	76	(193)
1300	145	(368)	76	(193)
1400	154	(391)	76	(193)
1500	163	(414)	76	(193)
1600 – 1900	–	–	76	(193)
2000 – 3000	–	–	88	(224)

* Dimensions are approximate.

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ANSUL

by Tyco Fire Suppression & Building Products

THREADED PROPORTIONERS (2 AND 2 1/2 IN.)

Data/Specifications

APPLICATION

ANSUL proportioners are specifically designed to accurately proportion and control the mixing of pressurized ANSUL foam concentrates into a water stream with minimum pressure loss. ANSUL proportioners are UL listed and FM approved with certain ANSUL foam concentrates and are used in conjunction with bladder tanks and pump proportioning skids. Typical applications include flammable liquid storage tanks, loading racks, aircraft hangars, heliports, and anywhere flammable liquids are used, stored, processed, or transported.

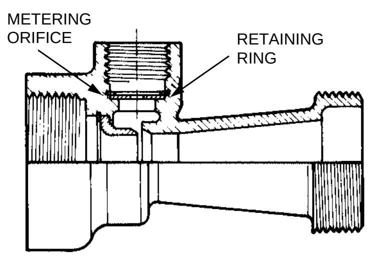
DESCRIPTION

Each ANSUL proportioner consists of a body, inlet nozzle, and metering orifice, all of which are corrosion-resistant brass.

The proportioner body is designed with a female NPT threaded inlet and a male NPT threaded outlet in sizes of 2 or 2 1/2 inches. Clearly marked on the proportioner body are the flow direction arrow, as well as the type and percentage of concentrate for which the proportioner was designed.

The inlet nozzle is secured by a stainless steel retaining ring.

The metering orifice is sized according to the type and percentage of concentrate used and is also secured with a stainless steel retaining ring.



001191

SPECIFICATIONS

The proportioner body and inlet nozzle shall be of low zinc (less than 15%) brass. The nozzle and foam orifice retaining rings shall be of stainless steel.

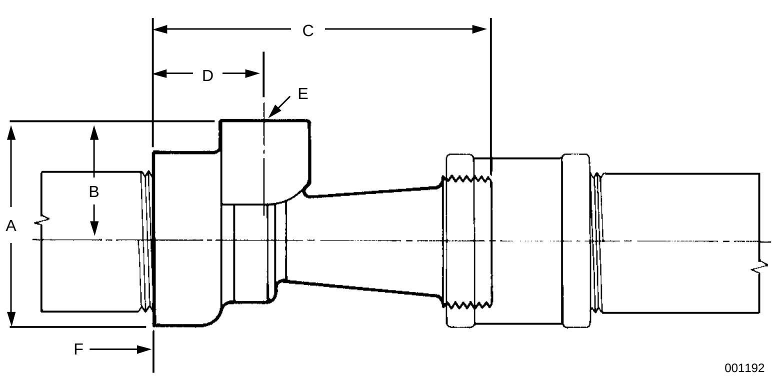
The proportioner body shall be designed with a female NPT inlet and a male NPT outlet. The body shall be clearly marked with a flow direction arrow, and the type and percent of foam concentrate that it was designed to proportion.

The convergent inlet nozzle shall have a rounded inlet and a smooth machined finish to ensure minimum stream constriction and maximum velocity. It shall be retained by a stainless steel retaining ring. The inlet nozzle shall terminate in the foam concentrate annulus chamber and be concentric with and set back from the proportioner recovery section.

The foam concentrate metering orifice shall be machined to the proper diameter for the agent. It shall rest on a machined surface to prevent leakage and shall be secured by a removable stainless steel retaining ring.

PROPORTIONER DIMENSION TABLE

Proportioner Size	Dimensions A in.	A (cm)	B in.	B (cm)	C in.	C (cm)	D in.	D (cm)	E in.	F in.	F (cm)
2 in.	3.94	(10.0)	2.44	(6.2)	9.1	(23.1)	2.25	(5.7)	1 NPT	10	(25)
2 1/2 in.	4.25	(10.8)	2.47	(6.3)	6.9	(17.5)	2.28	(5.8)	1 NPT	12	(30)



001192

STRAIGHT PIPE LENGTH UPSTREAM

ORDERING INFORMATION

Concentrate Used	Proportioner Part No. 2 in.	2 1/2 in.
1% AFFF	71877*	71897*
3% AFFF	71878*	71898**
3% AFFF @ 2% (Sub-surface)	–	71914*
3% AFFF (Freeze Protected)	71879	71899
3% AR-AFFF	71880*	71900**
6% AFFF	71881*	71901*
6% AR-AFFF	71883*	71903**
3% Protein Foam	71884	71904
3% Fluoroprotein Foam	71888	71908
2% JET-X Foam	71896*	71915*
2 3/4% JET-X Foam	71894*	71913*
	8 lb (3.6 kg)	8 lb (3.6 kg)

* UL Listed with Bladder Tanks
** UL Listed and FM Approved with Bladder Tanks

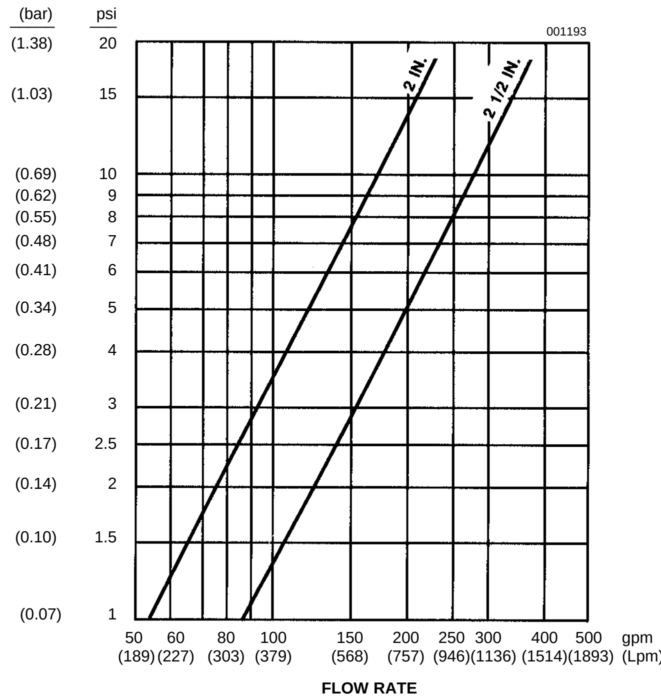
NOMINAL FLOW RANGES

The following table lists the nominal flow range for each proportioner size. For flow ranges using specific concentrations, consult ANSUL Technical Services.

Proportioner Size	Nominal Flow Range gal/min	(L/min)
2 in	30 – 300	(114 – 1136)
2 1/2 in	35 – 400	(132 – 1514)

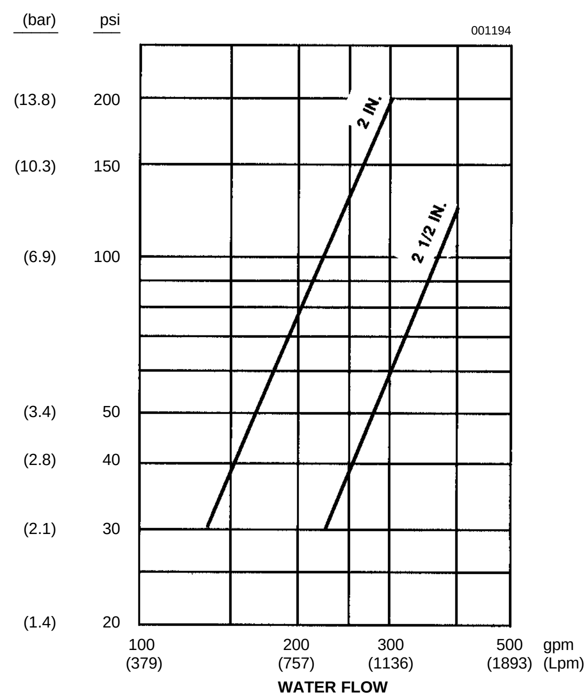
NOTICE: Listed nominal flow ranges do not apply for Alcohol Resistant Concentrates.

FRICTION LOSS CURVES



NOTICE: Consult ANSUL Technical Services to determine proportioner size and maximum pipe run between foam tank and proportioner when using Alcohol Resistant Concentrate AFFF.

MINIMUM INLET PRESSURE VERSUS WATER FLOW



BETWEEN FLANGE PROPORTIONERS (3, 4, 6, AND 8 IN.)

Data/Specifications

by Tyco Fire Suppression & Building Products

APPLICATION

- ANSUL proportioners are specifically designed to accurately proportion and control the mixing of pressurized ANSUL foam concentrates into a water stream with minimum pressure loss. ANSUL proportioners are UL listed with certain ANSUL foam concentrates and are used in conjunction with bladder tanks and pump proportioning skids. Typical applications include flammable liquid storage tanks, loading racks, aircraft hangars, heliports, and anywhere flammable liquids are used, stored, processed, or transported.

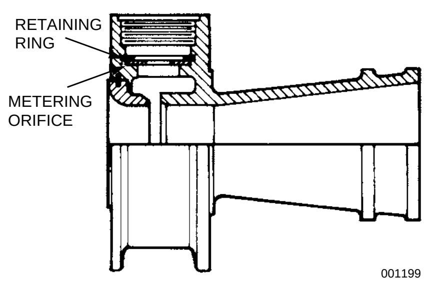
DESCRIPTION

Each ANSUL proportioner consists of a body, inlet nozzle, and metering orifice, all of which are corrosion-resistant brass.

The proportioner body is designed in four sizes to fit between 3 in., 4 in., 6 in., or 8 in. pipe flanges. Clearly marked on the proportioner body are the flow direction arrow, as well as the type and percentage of concentrate for which the proportioner was designed.

The inlet nozzle is secured by a stainless steel retaining ring that is internally concealed to prevent removal after installation.

The metering orifice is sized according to the type and percentage of concentrate used and is also secured with a stainless steel retaining ring.



SPECIFICATIONS

The proportioner body and inlet nozzle shall be of low zinc (less than 15%) brass. The nozzle and foam orifice retaining rings shall be of stainless steel.

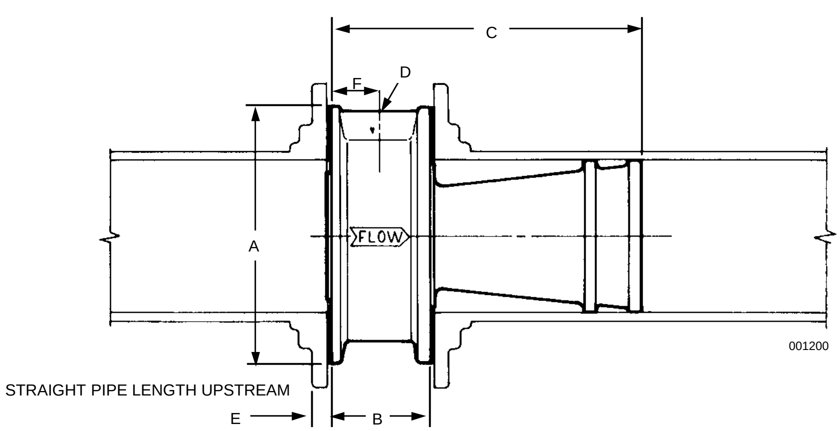
The proportioner body shall be designed so that it fits between two 150 lb pipe flanges. Only the recovery section of the proportioner shall protrude into the system water piping. To capture and seal against the flange gaskets, the mating face shall be machined with 32 grooves per inch (2.5 cm) for the 4, 6, and 8 in. models, and 64 grooves per inch (2.5 in.) for the 3 in. model. The body shall be clearly marked with a flow direction arrow, and the type and percent of foam concentrate that it was designed to proportion.

The convergent inlet nozzle shall have a rounded inlet and a smooth machined finish to ensure minimum stream constriction and maximum velocity. It shall be retained by an internally concealed retaining ring that prevents removal after installation. The inlet nozzle shall terminate in the foam concentrate annulus chamber and be concentric with and set back from the proportioner recovery section.

The foam concentrate metering orifice shall be machined to the proper diameter for the agent. It shall rest on a machined surface to prevent leakage and shall be secured by a removable stainless steel retaining ring.

PROPORTIONER DIMENSION TABLE

	Dimensions										
Proportioner	A		B		C		D	E		F	
Size	in.	(cm)	in.	(cm)	in.	(cm)	in.	in.	(cm)	in.	(cm)
3 in.	5.3	(13.5)	2.50	(6.35)	6	(15.2)	1 1/4 NPT	15	(38)	1.19	(3.02)
4 in.	6.8	(17.3)	2.54	(6.45)	8	(20.3)	1 1/2 NPT	20	(51)	1.27	(3.23)
6 in.	8.6	(21.8)	3.25	(8.26)	12	(30.5)	2 NPT	30	(76)	1.63	(4.14)
8 in.	11.0	(27.9)	3.56	(9.04)	12	(30.5)	2 1/2 NPT	40	(102)	1.78	(4.52)



ORDERING INFORMATION

Concentrate Used	3 in.	4 in.	6 in.	8 in.
	Proportioner Part No.			
1% AFFF	70800*	69350*	69370*	69390
3% AFFF	70801**	69351**	69371**	69391**
3% AFFF @ 2% (Sub-surface)	70817*	69367*	–	–
3% AFFF (Freeze Protected)	70802	69352	69372	69392
3% AR-AFFF	70803**	69353**	69373**	69393**
6% AFFF	70804*	69354*	69374*	69394*
6% AR-AFFF	70806*	69356*	69376**	69396**
3% Protein Foam	70807	69357	69377	69397
3% Fluoroprotein Foam	70811	69361	69381	69401
▸ 2% JET-X Foam	70817*	69369*	69387*	69407*
2 3/4% JET-X Foam	70816*	69366*	69386*	69406*
▸ 0.5% SILV-EX Foam	70818	—	—	—
Shipping Weight	10 lb (4.5 kg)	20 lb (9.1 kg)	40 lb (18.1 kg)	70 lb (31.8 kg)

* UL Listed with Bladder Tanks
** UL Listed and FM Approved with Bladder Tanks

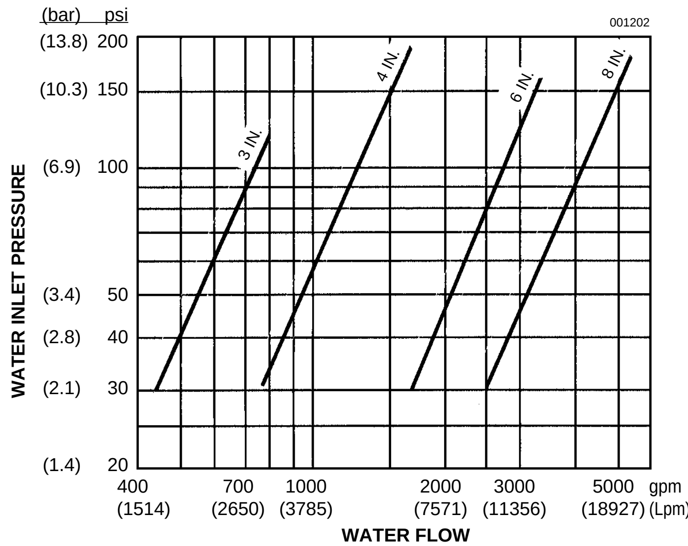
NOMINAL FLOW RANGES

The following table lists the nominal flow range for each proportioner size. For flow ranges using specific concentrates, consult ANSUL Technical Services.

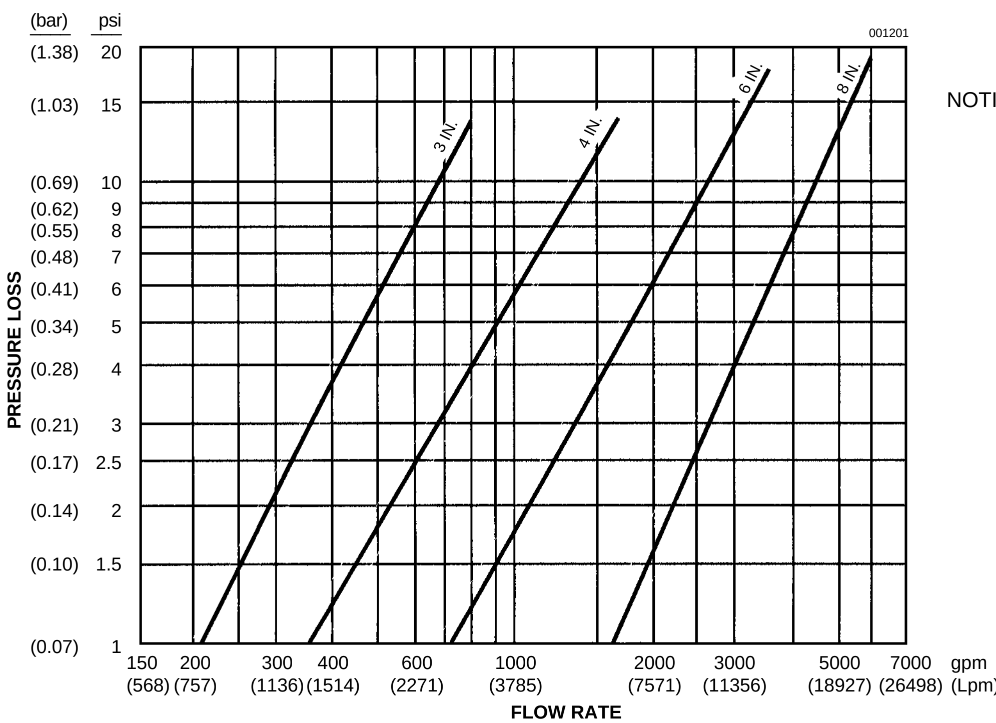
Proportioner Size	Nominal Flow Range gpm	(Lpm)
3 in.	70 – 800	(265 – 3028)
4 in.	200 – 1600	(757 – 6057)
6 in.	300 – 3400	(1136 – 12870)
8 in.	500 – 5500	(1892 – 20819)

NOTICE: Listed Nominal Flow Ranges do not apply for Alcohol Resistant Concentrate.

MINIMUM INLET PRESSURE VERSUS WATER FLOW



FRICTION LOSS CURVES



NOTICE: Consult ANSUL Technical Services to determine proportioner size and maximum pipe run between foam tank and proportioner when using Alcohol Resistant Concentrate AFFF.

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Form No. F-8452-07

FLANGED PROPORTIONERS (3, 4, 6, AND 8 IN.)

Data/Specifications

ANSUL

by Tyco Fire Suppression & Building Products

APPLICATION

- ANSUL proportioners are specifically designed to accurately proportion and control the mixing of pressurized ANSUL foam concentrates into a water stream with minimum pressure loss. ANSUL proportioners are UL Listed and FM approved with certain ANSUL foam concentrates and are used in conjunction with bladder tanks and pump proportioning skids. Typical applications include flammable liquid storage tanks, loading racks, aircraft hangars, heliports, and anywhere flammable liquids are used, stored, processed, or transported.

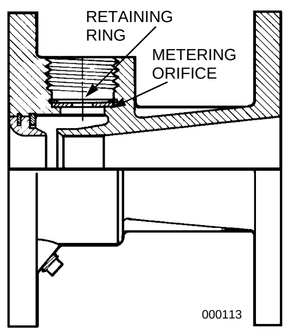
DESCRIPTION

Each ANSUL proportioner consists of a body, inlet nozzle, and metering orifice, all of which are corrosion-resistant brass.

The proportioner body is designed with flat-faced flanges to match ANSI 150 lb flanges of the same nominal size. Clearly marked on the proportioner body are the flow direction arrow, as well as the type and percentage of concentrate for which the proportioner was designed.

The inlet nozzle is secured by a stainless steel retaining ring that is internally concealed to prevent removal after installation.

The metering orifice is sized according to the type and percentage of concentrate used and is also secured with a stainless steel retaining ring.



SPECIFICATIONS

The proportioner body and inlet nozzle shall be of low zinc (less than 15%) brass. The nozzle and foam orifice retaining rings shall be of stainless steel.

The proportioner body shall be designed to connect to ANSI 150 lb flat-faced flanges; removal shall be possible without disassembly of additional pipe sections. The two proportioner flange mating faces shall be machined with 64 grooves per inch (2.5 cm) to capture and seal against the flange gaskets. The body shall be clearly marked with a flow direction arrow, and the type and percent of foam concentrate that it was designed to proportion.

The convergent inlet nozzle shall have a rounded inlet and a smooth machined finish to ensure minimum stream constriction and maximum velocity. It shall be retained by an internally concealed retaining ring that prevents removal after installation. The inlet nozzle shall terminate in the foam concentrate annulus chamber and be concentric with and set back from the proportioner recovery section.

The foam concentrate metering orifice shall be machined to the proper diameter for the agent. It shall rest on a machined surface to prevent leakage and shall be secured by a removable stainless steel retaining ring.

NOMINAL FLOW RANGES

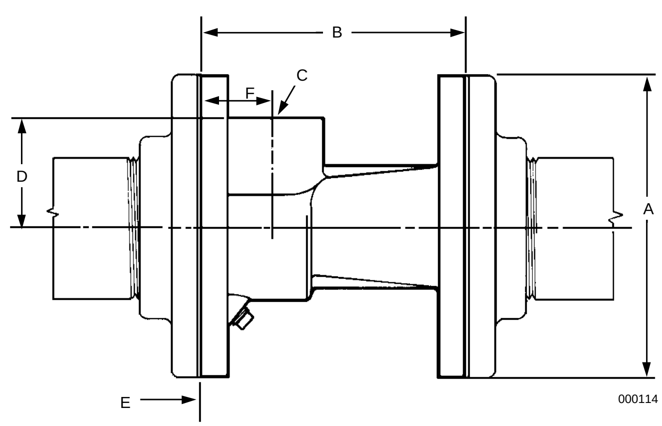
The following table lists the nominal flow range for each proportioner size. For flow ranges using specific concentrates, consult ANSUL Technical Services.

Proportioner Size	Nominal Flow Range gpm	(Lpm)
3 in.	70 – 800	(265 – 3028)
4 in.	200 – 1600	(757 – 6057)
6 in.	300 – 3400	(1136 – 12870)
8 in.	500 – 5500	(1892 – 20819)

NOTICE: Listed nominal flow ranges do not apply for Alcohol Resistant Concentrate.

PROPORTIONER DIMENSION TABLE

Proportioner Size	A in.	A (cm)	B in.	B (cm)	C in.	D in.	D (cm)	E in.	E (cm)	F in.	F (cm)
3 in.	7.5	(19.1)	6.50	(16.5)	1 1/4 NPT	2.66	(6.8)	15	(38.1)	1.75	(4.43)
4 in.	9.0	(22.9)	10.00	(25.4)	1 1/2 NPT	4.00	(10.2)	20	(50.8)	3.00	(7.62)
6 in.	11.0	(27.9)	12.75	(32.4)	2 NPT	4.63	(11.8)	30	(76.2)	3.06	(7.77)
8 in.	13.5	(34.3)	13.50	(34.3)	2 1/2 NPT	6.38	(16.2)	40	(101.6)	3.50	(8.89)



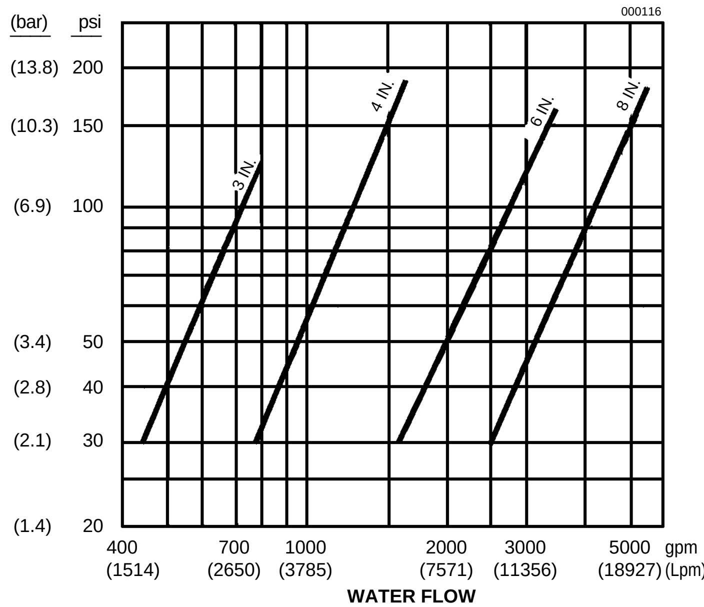
STRAIGHT PIPE LENGTH UPSTREAM

ORDERING INFORMATION

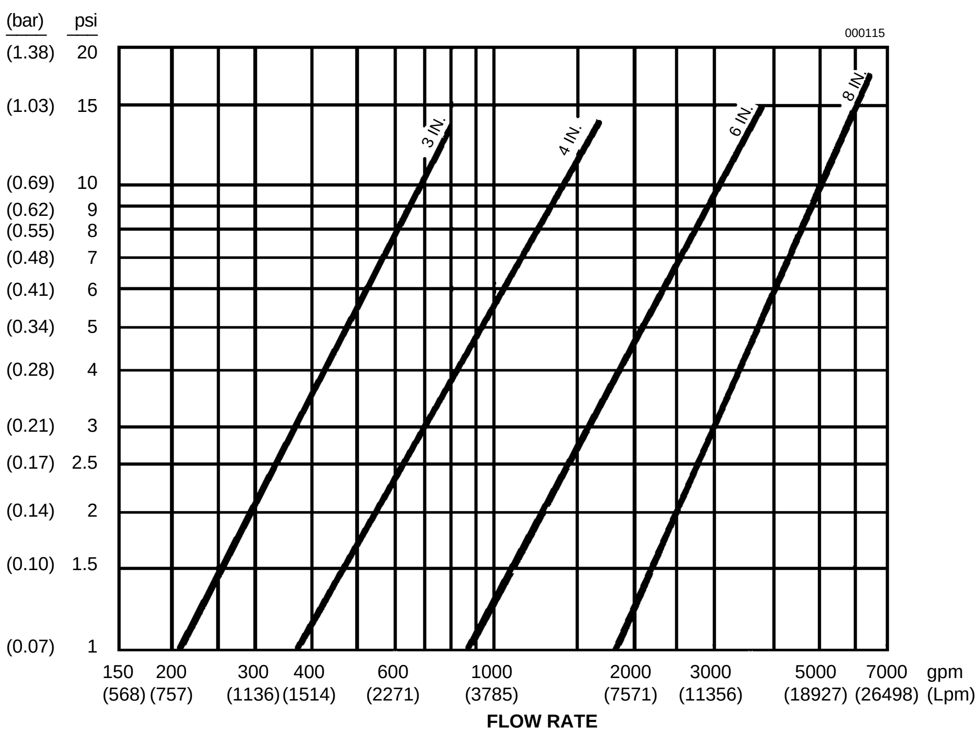
Concentrate Used	3 in.	4 in.	6 in.	8 in.
	Proportioner Part No.			
1% AFFF	74544*	74889*	74909*	74929*
3% AFFF	74545**	74890**	74910**	74930**
3% AFFF (Freeze-Protected)	74546	74891	74911	74931
3% AR-AFFF	74547**	74892**	74912**	74932**
3% AFFF @ 2% (Sub-surface)	74561*	74906*	—	—
6% AFFF	74548*	74893*	74913*	74933*
6% AR-AFFF	74550*	74895*	74915**	74935**
3% Protein Foam	74551	74896	74916	74936
3% Fluoroprotein Foam	74555	74900	74920	74940
▸ 2% JET-X Foam	74561*	74907*	74926*	74946*
2 3/4% JET-X Foam	74560*	74905*	74925*	74945*
Shipping Weight	22 lb (54 kg)	50 lb (10 kg)	75 lb (23 kg)	120 lb (34 kg)

* UL Listed with Bladder Tanks
** UL Listed and FM Approved with Bladder Tanks

MINIMUM INLET PRESSURE VERSUS WATER FLOW



FRICTION LOSS CURVES



NOTICE: Consult ANSUL Technical Services to determine proportioner size and maximum pipe run between foam tank and proportioner when using Alcohol Resistant Concentrate AFFF.

One Stanton Street
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www.ansul.com

FLOWMAX® CL VARIABLE RANGE PROPORTIONER

Data/Specifications

ANSUL®

FEATURES

- Designed to meet the requirements of NFPA 16, Chapter 4 for Closed Head Foam-Water Sprinkler Systems and NFPA 30, Flammable and Combustible Liquids Code
- Fast response
- Foam proportioning as low as 25 gpm (95 Lpm)
- Maximum/minimum flow rate ratio of 120:1
- Allows the use of lower cost bladder tank systems
- Less total system hardware required
- Less total system maintenance required
- Easy installation – can be pre-piped to bladder tank
- Minimal moving parts
- No electrical hook-up required
- Fits between two flanges without spool piece

APPLICATION

The FLOWMAX® CL Variable Range Proportioner, Part No. 433907, is listed for use with ANSULITE® 3x3 Low Viscosity AR-AFFF, and Part No. 433906 is listed for use with ANSULITE 3% AFFF. They are designed to proportion and control the mixing of the foam concentrate into a water stream over a wide range of water flow rates and pressures.

The FLOWMAX CL proportioner is to be used with bladder tank systems only. The proportioner can be located up to 35 equivalent ft (10.7 m) from the bladder tank outlet. The normal swing check, concentrate isolation, and hydraulic valve(s) do not have to be included in this equivalent length calculation.

Note: 2 in. pipe size is minimum for water supply to tank and foam concentrate supply to proportioner.

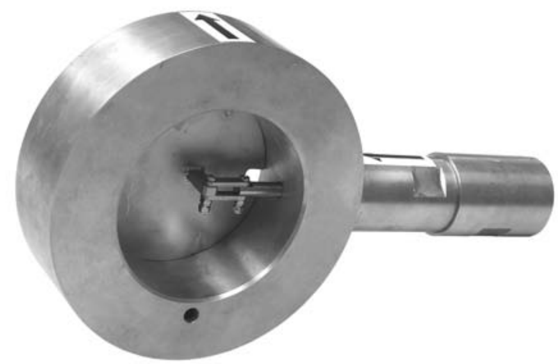
The proportioner has the capability to proportion foam concentrate at flow rates between 25 to 3000 gpm (95 to 11356 Lpm) at a maximum working pressure of 250 psi (17.2 bar).

With their low flow capability, these proportioners are especially suited for closed head foam-water sprinkler applications where the system flow starts out low and if the fire intensifies, more sprinklers will open, increasing the flow rate.

Historical data on closed head sprinkler systems has proven that, on an average, only four or five sprinklers operate during a fire. As a result, NFPA 30 Standard requires properly proportioned foam solution be generated with as few as four sprinklers flowing, otherwise control of the fire might not be established. Such a flow condition would produce flows considerably less than the minimum design flow of conventional proportioning equipment. With the flow capacity of the FLOWMAX CL Variable Range Proportioner, foam would be proportioned properly with even fewer sprinklers operating.

Other common applications include:

- Aircraft hangar protection per NFPA 409 involving closed head foam-water sprinkler systems utilizing ANSULITE 3% AFFF whereby the foam handline nozzles can be fed from the same proportioner used for the overhead sprinklers.
- Tank farm protection systems per NFPA 11 using foam chamber, or other means of foam delivery where varied flow rates are encountered in conjunction with requirements for supplementary foam handline(s).
- Typical applications, in conjunction with a closed head foam-water sprinkler system for warehouse storage, chemical processing, loading racks, and anywhere flammable liquids are used, stored, processed, or transported.



007330

DESCRIPTION

The FLOWMAX CL Variable Range Proportioner consists of a brass body, stainless steel deflector, stainless steel spring, and stainless steel foam metering cone and orifice.

The proportioner body is designed to fit between 6 in. pipe flanges. **Note:** A minimum of 30 in. (762 mm) of straight pipe is required in the water line before entering the proportioner.

The body is marked with an arrow to indicate the direction of flow.

The foam concentrate inlet is female 2 in. NPT.

When installed in a closed head, wet sprinkler system, the proportioner operates as follows:

With the proportioner properly installed in the sprinkler riser, the water pressure is equal on both sides of the proportioner. As sprinkler heads open in a fire situation, foam concentrate is metered into the water stream through a precisely machined cone and orifice. As more sprinkler heads open, the increase in water flow causes the deflector to open more, thus opening the cone versus the orifice, allowing more foam concentrate into the water stream. This feature gives the proportioner the ability to properly proportion at extremely low flow rates and also at extremely high flow rates.

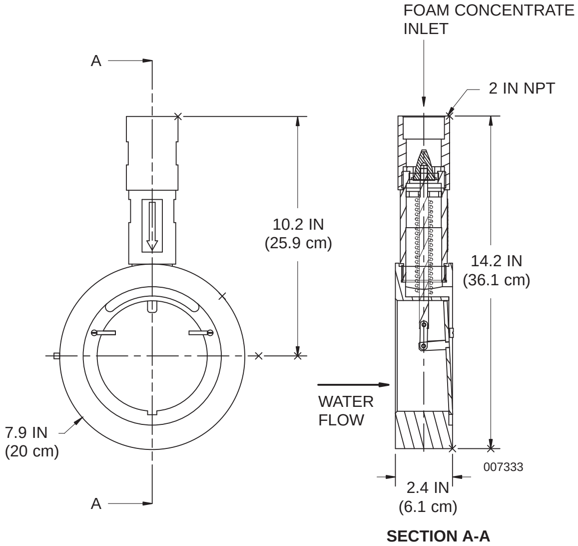
APPROVALS

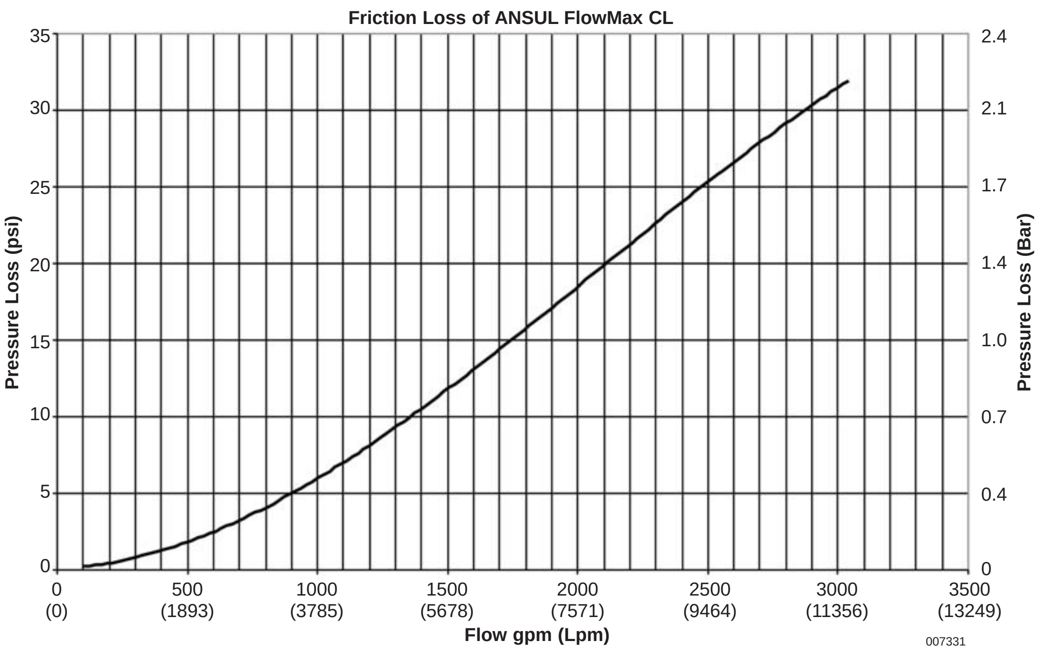
The FLOWMAX CL Variable Range Proportioners are both UL listed and FM approved for use with ANSULITE 3x3 Low Viscosity AR-AFFF and ANSULITE 3% AFFF.

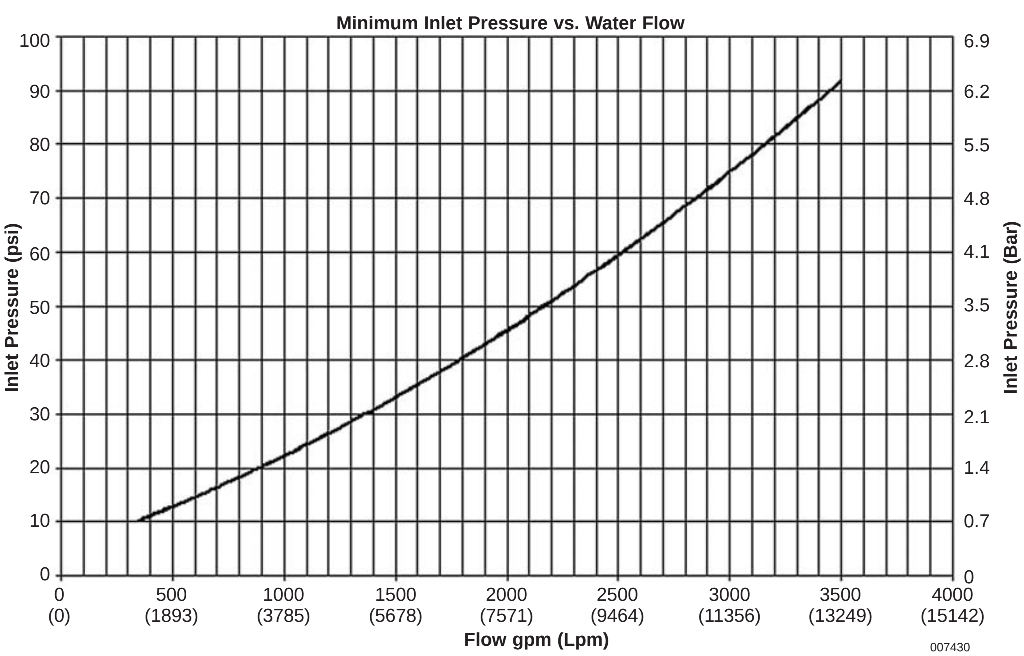
ORDERING INFORMATION

Ansul Part No.	Description	Shipping Weight lb	(kg)
433907	FLOWMAX CL Variable Range Proportioner for ANSULITE 3x3 Low Viscosity AR-AFFF	30 lb	(13.6 kg)
433906	FLOWMAX CL Variable Range Proportioner for ANSULITE 3% AFFF	30 lb	(13.6 kg)

Note: Weight of proportioner without shipping packaging is 27.1 lb (12.3 kg).







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HYDRAULIC CONCENTRATE CONTROL VALVE

Data/Specifications

ANSUL

by Tyco Fire Suppression & Building Products

APPLICATION

The hydraulic concentrate control valve is FM Approved and designed for use in either an ANSUL bladder tank system or an in-line balanced pressure proportioning system. The valve is used to automatically open the line supplying concentrate to the foam proportioner. The valve requires no electrical power. It operates solely by the pressure of the inlet water supply.

DESCRIPTION

Standard valve sizes are available from 1 in. to 2 1/2 in. to match the concentrate inlet thread size on the full range of ANSUL proportioners and in-line balanced pressure proportioner (IBP) assemblies. Each hydraulic concentrate control valve assembly consists of a factory assembled and tested ball valve, hydraulic actuator, and mounting kit attaching the actuator to the ball valve. The actuator has a position indicator and manual override capability. The internal components of the actuator are designed to be compatible for use with pressurized water which is used as the means of actuation. The actuator is a double-acting type: the pressurized water supplied to the actuator can be used to either close or open the valve. However, for foam concentrate lines, the valve is normally closed and is hydraulically opened for system use. Care should be taken to ensure that the proper pressure sensing port is utilized on the actuator to drive the valve to the position (closed or open) desired.

The hydraulic concentrate control valve can be used in conjunction with any type of closed-head sprinkler system (wet pipe, dry pipe, and preaction). It can also be used in open-type deluge systems. To pressurize the valve, the water line is commonly run from the alarm trim of the sprinkler valve (see ''Typical Piping Arrangement''). The pressure sensing line to the actuator should be a minimum of 1/4 in. pipe or alternate 3/8 in. tubing (the actual connection to the actuator is 1/8 in. NPT). The actuators are sized to operate with a minimum pressure of 30 psi (2.1 bar). Technical Services should be consulted for applications where the water pressure potentially could be lower. The maximum recommended water pressure to the actuator is 160 psi (11 bar). If potentially higher pressures could be encountered, an available 1/4 in. FM Approved Pressure Reducing Valve (PRV), (Part No. 415020), should be installed in the line to the actuator.

Hydraulic Concentrate Control Valve

006740

SPECIFICATIONS

The FM Approved hydraulic concentrate control valve shall consist of items that have been factory assembled and tested, including:

- Threaded bronze body ball valve, with mounting pad, designed for a minimum 400 psi (27.6 bar) WOG. Valve shall be fitted with a stainless steel ball, stem, and packing nut. Valve seats shall be of glass reinforced Teflon™ material.
- Hydraulic actuator is approved by the manufacturer for using water as the medium to operate. The actuator shall have a position indicator and have the capability for manual override. The actuator shall be designed to operate the valve with a minimum of 30 psi (2.1 bar) water pressure and shall contain no external moving parts which could cause fouling of adjacent equipment, injury to personnel, misalignment problems common to external linkage systems, or potential for disengagement caused by tampering.
- Mounting kit for securely attaching hydraulic actuator to ball valve.

Refer to the following chart to determine the size of hydraulic control valve required when the size of proportioner has been determined.

VALVE SIZE REQUIRED

Proportioner Size	Bladder Tank System	Pump System (In-Line Balance Pressure)
2 in.	1 in.	1 in.
2 1/2 in.	1 in.	1 in.
3 in.	1 1/4 in.	1 in.
4 in.	1 1/2 in.	1 1/2 in.
6 in.	2 in.	1 1/2 in.
8 in.	2 1/2 in.	2 in.

BALL VALVES AND SWING CHECK VALVES

For your convenience, ANSUL ball valves and swing check valves are available for use with most bladder tank foam systems. All valves are of bronze construction and have NPT connections. The water inlet and concentrate isolation ball valves feature nameplates with their respective name, a ring pin, and tamper seal to allow valve to be visually monitored as to its correct position.

Water Inlet Ball Valve

006739

BALL VALVES AND SWING CHECK VALVES (Continued)

Concentrate Isolation Ball Valve

006738

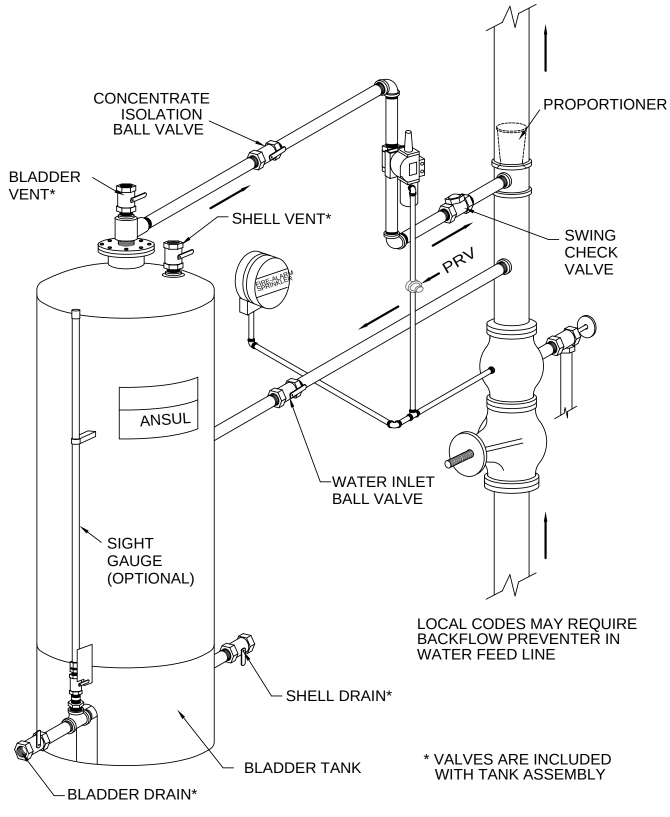
Swing Check Valve

006742

Pressure Reducing Valve (PRV)

006741

TYPICAL PIPING ARRANGEMENT



001204

ORDERING INFORMATION

Part No.	Description	Valve Length** in.	(cm)	Approximate Shipping Weight lb	(kg)	Approvals
68787	Water Inlet Ball Valve/Nameplate, 1 in.	3.50	(9)	1	(0.5)	
68822	Water Inlet Ball Valve/Nameplate, 1 1/4 in.	4.00	(10)	1	(0.5)	
68788	Water Inlet Ball Valve/Nameplate, 1 1/2 in.	4.50	(11)	1	(0.5)	
68789	Water Inlet Ball Valve/Nameplate, 2 in.	4.75	(12)	2	(1.0)	
74202	Water Inlet Ball Valve/Nameplate, 2 1/2 in.	6.50	(17)	2	(1.0)	
404669	Water Inlet Ball Valve/Nameplate, 3 in.	6.75	(17)	2	(1.0)	
74188	Concentrate Isolation Ball Valve/Nameplate, 1 in.	3.50	(9)	1	(0.5)	
74192	Concentrate Isolation Ball Valve/Nameplate, 1 1/4 in.	4.00	(10)	1	(0.5)	
74196	Concentrate Isolation Ball Valve/Nameplate, 1 1/2 in.	4.50	(11)	1	(0.5)	
74200	Concentrate Isolation Ball Valve/Nameplate, 2 in.	4.75	(12)	2	(1.0)	
74203	Concentrate Isolation Ball Valve/Nameplate, 2 1/2 in.	6.50	(17)	2	(1.0)	
404670	Concentrate Isolation Ball Valve/Nameplate, 3 in.	6.75	(17)	2	(1.0)	
403155	Swing Check Valve (Brass), 1 in.	3.25	(8)	2	(1.0)	
403780	Swing Check Valve (Brass), 1 1/4 in.	4.00	(10)	2	(1.0)	
403781	Swing Check Valve (Brass), 1 1/2 in.	4.50	(11)	2	(1.0)	
403782	Swing Check Valve (Brass), 2 in.	5.25	(13)	3	(1.4)	
403080	Swing Check Valve (Brass), 2 1/2 in.	6.25	(16)	3	(1.4)	
65987	Hydraulic Concentrate Control Valve, 1 in.	3.25	(8)	10	(4.5)	FM
65988	Hydraulic Concentrate Control Valve, 1 1/4 in.	3.75	(9)	15	(6.8)	FM
403490	Hydraulic Concentrate Control Valve, 1 1/2 in.	4.25	(10)	20	(9.0)	FM
403491	Hydraulic Concentrate Control Valve, 2 in.	4.75	(12)	20	(9.0)	FM
403827	Hydraulic Concentrate Control Valve, 2 1/2 in.	6.50	(17)	30	(13.6)	FM
415020	Pressure Reducing Valve, 1/4 in.	1.50	(4)	2	(1.0)	FM
431763	Hydraulic Concentrate Control Valve, Flanged, Stainless Steel, 1 in.*	5.00	(13)	14	(6.6)	FM
431764	Hydraulic Concentrate Control Valve, Flanged, Stainless Steel, 1.5 in.*	6.50	(17)	26	(12.0)	FM
431765	Hydraulic Concentrate Control Valve, Flanged, Stainless Steel, 2.0 in.*	7.00	(18)	37	(16.8)	FM

*Contact Technical Services for details. ** Nominal length dimension is from thread inlet to thread outlet.

► Indicates revised information.

ANSUL

by Tyco Fire Suppression & Building Products

PRE-PIPED BLADDER TANKS WITH PROPORTIONER

Data/Specifications

APPLICATION

The ANSUL Pre-piped Bladder Tank is a complete balanced pressure proportioning system. A Pre-piped Bladder Tank offers the foam system designer fixed dimensions inclusive of the proportioner/ratio controller. This takes away some of the uncertainty when sizing the foam equipment room and piping layout. Plus, the installer has the advantage of a pre-fabricated foam system, eliminating loose components and simplifying the installation. Its operation requires no external power other than a pressurized water system. The bladder tank may be used with any ANSUL foam agent and with any suitable discharge device.

ANSUL bladder tanks have numerous applications including truck loading racks, aircraft hangers, dip tanks, pump rooms, helipads, etc.

DESCRIPTION

The ANSUL pre-piped bladder tank is a steel pressure vessel which stores a foam concentrate contained within an elastomeric bladder. The concentrate is discharged from the tank by incoming water applying pressure to the bladder. This applied energy is transferred to the concentrate, supplying pressurized concentrate to the proportioner.

ANSUL bladder tanks are available in a variety of nominal capacities as listed in the tank information tables. All tank models feature perforated center tubes which allow improved agent discharge.

Features incorporated into the ANSUL pre-piped bladder tanks include the following:

- Water pressurized bladder construction, alleviating the requirement for foam pumps or other energy sources
- Valves that are pinned in the normal operative positions and are supplied with nameplates identifying their functions and operating instructions
- Proportioner and piping attached to side of tank
- Complete bill of materials with fixed dimensions
- Corrosion-resistant piping
- Exterior tank surfaces finished with a red “CR” epoxy finish for use in marine or corrosive environments
- Tanks with a high build epoxy coated interior for use with both fresh and salt water

APPROVALS

ANSUL bladder tanks and proportioners are both Underwriters Laboratories listed and Factory Mutual approved with various ANSUL foam concentrates and bear the (UL) label along with an American Society of Mechanical Engineers (ASME) code stamp.

Bladder tanks 200 gallons (757 L) and larger are CE marked in conformance with the 97/23/EC Pressure Equipment Directive. Tanks less than 200 gallons (757 L) are acceptable based on sound engineering practices of ASME code.

SPECIFICATIONS

The ANSUL vertical and horizontal bladder tanks shall be designed and constructed in accordance with the latest revisions to ASME code, Section VIII for unfired pressure vessels with a working pressure of 175 psi (12.1 bar) and tested to at least 255 psi (17.6 bar). The tank shall be of (specify) gallon nominal capacity and overall dimensions as indicated in the appropriate diagram and corresponding information table. The tank shall be constructed of steel complying to ASME specifications possessing a tensile strength of not less than 70,000 psi (4827 bar). The circumferential, as well as the longitudinal body seam, shall be machine welded and radiographed to ensure 85% efficiency when applicable by ASME code.

The tank heads shall be 2 to 1 ellipsoid to ensure strength while reducing overall tank weight.

► All tank openings larger than 1 in. (25 mm) diameter shall be divided to prevent bladder blow-out. There shall be a water channel between the water inlet opening and water drain opening to establish a water path between the tank shell interior and the bladder.

The tank interior shall have all welds and edges ground smooth. It shall be cleaned, sand blasted to a near white surface, and immediately coated with a high build epoxy coating. The tank data plate shall be of a material compatible with the tank shell and must be seal welded with appropriate procedure and material to the tank. (This ensures that the data plate will reflect the overall condition of the tank and that no corrosion occurs undetected behind the data plate.) The data plate shall contain as a minimum ASME code stamp: year of manufacture, working pressure, board number, material thickness, temperature, and type of head. The tank shall also have a label specifying the type of foam concentrate the system was designed to use, the quantity of concentrate, and any other pertinent warnings.

The vertical tank assembly shall be supported by a continuous skirt of a diameter equal to the tank, with four brackets (feet) drilled for anchoring.

The horizontal tank assembly shall be supported by two saddles permanently welded to the tank and drilled for anchoring. These supports provide maximum stability and a maximum amount of bearing area which protects against horizontal and vertical forces such as vibration and shifting. Lifting lugs shall be substantial welded tank attachments
► with a clear hole not less than 2 in. (50 mm) in diameter.

The tank shall contain a flexible bladder of a material tested by Underwriters Laboratories for compatibility with the agent to be used. The bladder material shall be constructed to conform with the inside tank dimensions.

Both vertical and horizontal tank assemblies shall contain porous center tubes of PVC or other material compatible with the agent, with holes of no more than 3/4 in. (19 mm) diameter. The horizontal tank assembly shall contain both vertical and horizontal perforated center tubes connected with a cross fitting of compatible material.

The following 1 in. valves shall be assembled to each tank: a bladder drain/fill valve, bladder vent/fill valve, tank shell drain valve, and tank shell vent valve. An appropriately sized concentrate isolation valve and water inlet valve shall be assembled with the proportioner piping. All six valves shall be 1/4-turn ball valves with bronze bodies, hard chromium-plated bronze ball, bronze stem, stainless steel locking nut and handle, and high performance Teflon seats and stuffing box ring. Each valve shall have a nameplate secured to it depicting the valve name and operating position. Also, the valve shall have a ring pin and chain attached for securing the valve in the operating position. The valve names shall coincide exactly with those in the tank instruction manual. Bottom valves shall be piped out from under the tank for easy access. All pipe shall be Schedule 40 ASTM-B-43 and all fittings shall be ASTM B-62 or B-584 bronze. The bladder drain/fill piping shall include a tee with 1/2 in. plug for future sight gauge connection.

The tank exterior shall be prepared and finished in accordance with the ANSUL red “CR” epoxy specification or equivalent.

An ANSUL proportioner shall be mounted on the bladder tank with appropriate inlet and outlet piping and water and foam concentrate piping and valving. Reference ANSUL Proportioner data sheets for proportioner specifications and flow data.

A printed filling and maintenance manual shall be supplied with each tank. The manual shall contain a system schematic, installation instructions, initial fill procedures, major and minor refill procedures, inspection and maintenance procedures, sight gauge use instructions, service and
► repair procedures, and field inspection manual.

ORDERING INFORMATION

The ANSUL bladder tank shipping assembly part numbers and approximate shipping weights are identified in the following tables. Part numbers vary according to tank requirements. **Note:** For tanks with special engineered options, such as special pressure ratings, seismic ratings, or trim and finish options, contact Technical Services Department.

Specify type and percent of foam concentrate to be used in the bladder tank and proportioner. The proportioner metering orifice is sized according to type and percentage of concentrate used. **Note:** Dimensions rounded to nearest inch – see Page 4 for drawing.

HORIZONTAL PRE-PIPED BLADDER TANKS

Part No.	Tank Size Gal.	(L)	Proportioner Size in	Diameter in	(cm)	Dimension A in	(cm)	Dimension B in	(cm)	Dimension C in	(cm)	Dimension D in	(cm)	Weight lb	(kg)
419800	100	(379)	2	24	(61)	54	(136)	11	(28)	74	(188)	34	(86)	760	(345)
419801	100	(379)	2 1/2	24	(61)	53	(135)	11	(28)	74	(188)	34	(86)	765	(347)
419802	100	(379)	3	24	(61)	53	(135)	11	(28)	74	(188)	34	(86)	770	(349)
419803	150	(568)	3	30	(76)	53	(134)	13	(33)	73	(186)	38	(96)	1100	(499)
419804	200	(757)	3	30	(76)	67	(170)	15	(38)	91	(232)	42	(106)	1370	(621)
419805	300	(1136)	3	36	(91)	69	(175)	16	(41)	95	(242)	42	(106)	1650	(748)
419806	150	(568)	4	30	(76)	58	(147)	13	(33)	73	(186)	38	(96)	1120	(508)
419807	200	(757)	4	30	(76)	67	(170)	15	(38)	91	(232)	42	(106)	1400	(635)
419808	300	(1136)	4	36	(91)	69	(175)	16	(41)	95	(242)	42	(106)	1685	(764)
419809	200	(757)	6	30	(76)	77	(196)	15	(38)	91	(232)	42	(106)	1430	(649)
419810	300	(1136)	6	36	(91)	79	(201)	16	(41)	95	(242)	42	(106)	1700	(771)
419811	400	(1514)	4	48	(122)	60	(152)	11	(28)	77	(195)	34	(87)	2425	(1100)
419812	500	(1893)	4	48	(122)	66	(168)	15	(37)	90	(228)	41	(105)	2675	(1213)
419813	600	(2271)	4	48	(122)	73	(185)	18	(44)	103	(261)	47	(120)	2725	(1236)
419814	700	(2650)	4	48	(122)	80	(203)	21	(53)	117	(297)	54	(137)	3075	(1395)
419815	800	(3028)	4	48	(122)	87	(221)	25	(62)	131	(333)	61	(156)	3275	(1486)
419816	900	(3407)	4	48	(122)	94	(238)	28	(71)	145	(368)	68	(173)	3545	(1608)
419817	1000	(3785)	4	48	(122)	101	(256)	32	(80)	159	(404)	75	(191)	3725	(1690)
419818	400	(1514)	6	48	(122)	70	(178)	11	(28)	77	(195)	34	(87)	2475	(1123)
419819	500	(1893)	6	48	(122)	77	(195)	15	(37)	90	(228)	41	(105)	2725	(1236)
419820	600	(2271)	6	48	(122)	83	(211)	18	(44)	103	(261)	47	(120)	2775	(1259)
419821	700	(2650)	6	48	(122)	90	(229)	21	(53)	117	(297)	54	(137)	3125	(1418)
419822	800	(3028)	6	48	(122)	97	(247)	25	(62)	131	(333)	61	(156)	3325	(1508)
419823	900	(3407)	6	48	(122)	104	(265)	28	(71)	145	(368)	68	(173)	3595	(1631)
419824	1000	(3785)	6	48	(122)	111	(282)	32	(80)	159	(404)	75	(191)	3775	(1712)
419825	400	(1514)	8	48	(122)	80	(204)	11	(28)	77	(195)	34	(87)	2525	(1145)
419826	500	(1893)	8	48	(122)	87	(221)	15	(37)	90	(228)	41	(105)	2775	(1259)
419827	600	(2271)	8	48	(122)	93	(237)	18	(44)	103	(261)	47	(120)	2825	(1281)
419828	700	(2650)	8	48	(122)	100	(255)	21	(53)	117	(297)	54	(137)	3175	(1440)
419829	800	(3028)	8	48	(122)	107	(273)	25	(62)	131	(333)	61	(156)	3375	(1531)
419830	900	(3407)	8	48	(122)	114	(290)	28	(71)	145	(368)	68	(173)	3645	(1653)
419831	1000	(3785)	8	48	(122)	121	(308)	32	(80)	159	(404)	75	(191)	3825	(1735)
419832	1100	(4164)	4	60	(153)	106	(270)	22	(56)	124	(315)	58	(148)	4300	(1950)
419833	1200	(4542)	4	60	(153)	110	(279)	25	(62)	131	(333)	63	(161)	4520	(2050)
419834	1300	(4921)	4	60	(153)	114	(290)	27	(67)	140	(356)	67	(171)	4700	(2132)
419835	1400	(5300)	4	60	(153)	119	(302)	29	(74)	149	(378)	72	(184)	4910	(2227)
419836	1500	(5678)	4	60	(153)	123	(313)	31	(79)	158	(401)	76	(194)	5090	(2309)
419837	1600	(6057)	4	60	(153)	128	(325)	34	(85)	167	(424)	81	(206)	5280	(2395)
419838	1700	(6435)	4	60	(153)	132	(336)	36	(91)	176	(447)	86	(219)	5480	(2486)
419839	1800	(6814)	4	60	(153)	137	(348)	38	(97)	185	(470)	90	(229)	5660	(2567)
419840	1900	(7192)	4	60	(153)	141	(359)	41	(103)	194	(493)	95	(242)	5840	(2649)
419841	1100	(4164)	6	60	(153)	107	(271)	22	(56)	124	(315)	58	(148)	4375	(1985)
419842	1200	(4542)	6	60	(153)	110	(280)	25	(62)	131	(333)	63	(161)	4595	(2084)
419843	1300	(4921)	6	60	(153)	115	(291)	27	(67)	140	(356)	67	(171)	4775	(2166)
419844	1400	(5300)	6	60	(153)	119	(303)	29	(74)	149	(378)	72	(184)	4985	(2261)
419845	1500	(5678)	6	60	(153)	124	(314)	31	(79)	158	(401)	76	(194)	5165	(2343)
419846	1600	(6057)	6	60	(153)	128	(326)	34	(85)	167	(424)	81	(206)	5355	(2429)
419847	1700	(6435)	6	60	(153)	133	(337)	36	(91)	176	(447)	86	(219)	5555	(2520)
419848	1800	(6814)	6	60	(153)	137	(348)	38	(97)	185	(470)	90	(229)	5735	(2601)
419849	1900	(7192)	6	60	(153)	142	(360)	41	(103)	194	(493)	95	(242)	5915	(2683)
419850	1100	(4164)	8	60	(153)	108	(274)	22	(56)	124	(315)	58	(148)	4420	(2005)
419851	1200	(4542)	8	60	(153)	112	(285)	25	(62)	133	(338)	63	(161)	4640	(2105)
419852	1300	(4921)	8	60	(153)	117	(297)	27	(67)	142	(361)	67	(171)	4820	(2186)
419853	1400	(5300)	8	60	(153)	121	(308)	29	(74)	151	(383)	72	(184)	5030	(2282)
419854	1500	(5678)	8	60	(153)	126	(320)	31	(79)	160	(406)	76	(194)	5210	(2363)
419855	1600	(6057)	8	60	(153)	131	(332)	34	(85)	170	(432)	81	(206)	5300	(2404)
419856	1700	(6435)	8	60	(153)	136	(345)	36	(91)	179	(455)	86	(219)	5600	(2540)
419857	1800	(6814)	8	60	(153)	140	(355)	38	(97)	188	(477)	90	(229)	5780	(2622)
419858	1900	(7192)	8	60	(153)	144	(367)	41	(103)	197	(500)	95	(242)	5960	(2703)
419859	2000	(7571)	8	72	(183)	129	(328)	30	(76)	154	(392)	74	(189)	6330	(2871)
419860	2200	(8328)	8	72	(183)	136	(344)	33	(84)	167	(425)	80	(204)	6690	(3035)
419861	2400	(9085)	8	72	(183)	142	(361)	37	(93)	180	(458)	87	(222)	7070	(3207)
419862	2600	(9842)	8	72	(183)	149	(377)	40	(100)	193	(491)	93	(237)	7490	(3397)
419863	2800	(10599)	8	72	(183)	155	(394)	43	(108)	206	(524)	99	(252)	7780	(3529)
419864	3000	(11356)	8	72	(183)	165	(419)	46	(117)	219	(557)	106	(269)	8170	(3706)

Proportioner Size – (in)	Proportioner Pipe Connection	Proportioner Size – (in)	Proportioner Pipe Connection
2	2 in NPT Thread (male)	4	4 in x 150 lb raised face flange
2 1/2	2 1/2 in NPT Thread (male)	6	6 in x 150 lb raised face flange
3	3 in x 150 lb raised face flange	8	8 in x 150 lb raised face flange

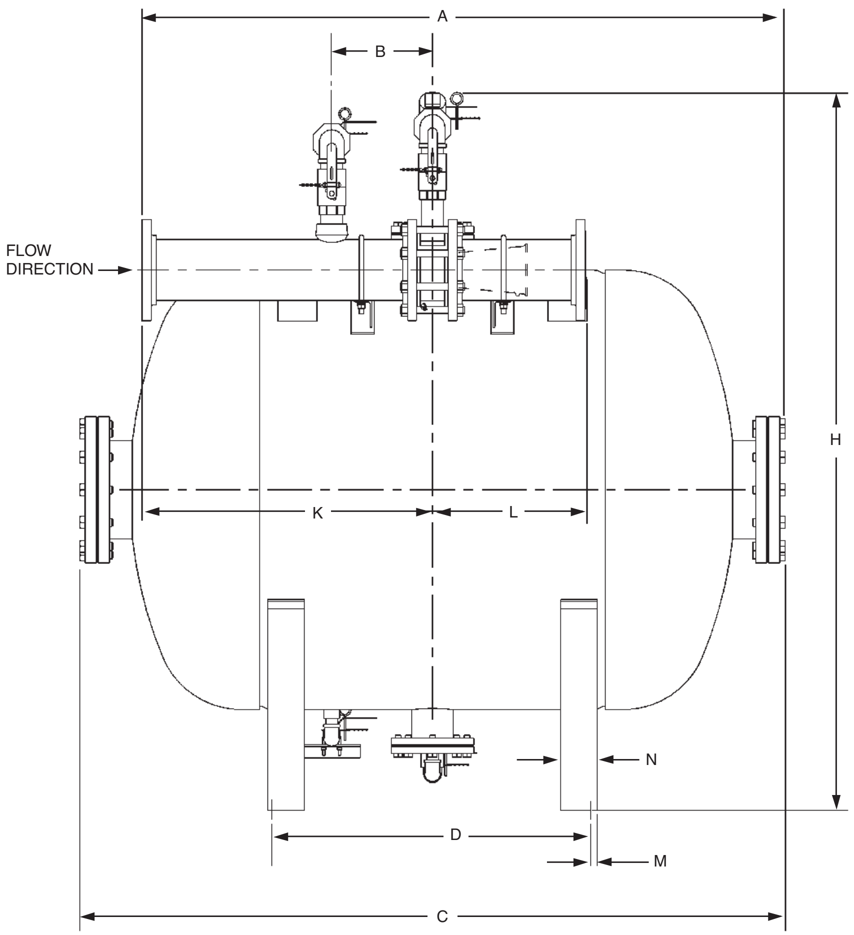
Note: Dimensions rounded to nearest inch – see Page 4 for drawing.

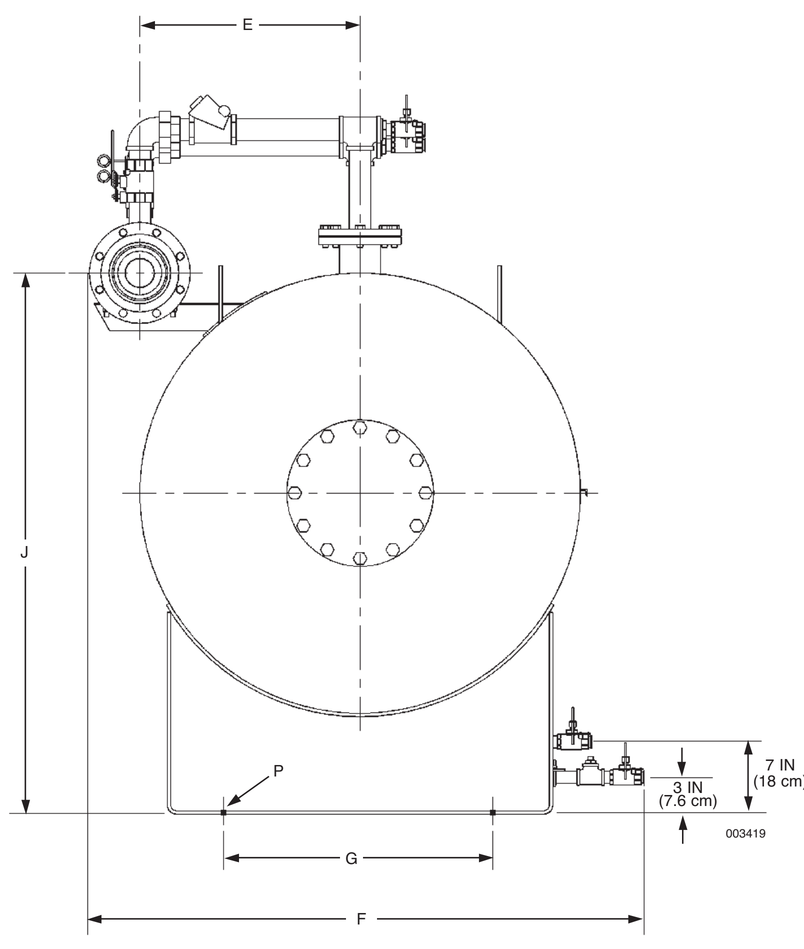
HORIZONTAL PRE-PIPED BLADDER TANKS (Continued)

Part No.	Dimension E in	(cm)	Dimension F in	(cm)	Dimension G in	(cm)	Dimension H in	(cm)	Dimension J in	(cm)	Dimension K in	(cm)	Dimension L in	(cm)
419800	12	(30)	34	(87)	10	(25)	47	(120)	35	(89)	17	(42)	20	(52)
419801	12	(30)	34	(87)	10	(25)	47	(120)	35	(89)	16	(42)	18	(46)
419802	14	(36)	36	(92)	10	(25)	49	(126)	35	(89)	16	(41)	11	(29)
419803	17	(43)	42	(108)	16	(41)	55	(141)	41	(104)	16	(41)	11	(29)
419804	17	(43)	42	(108)	16	(41)	55	(141)	41	(104)	16	(41)	11	(29)
419805	20	(51)	48	(123)	22	(56)	61	(156)	47	(119)	16	(41)	11	(29)
419806	17	(43)	43	(109)	16	(41)	58	(147)	41	(104)	21	(54)	11	(29)
419807	17	(43)	43	(109)	16	(41)	58	(147)	41	(104)	21	(54)	11	(29)
419808	20	(51)	49	(125)	22	(56)	64	(163)	47	(119)	21	(54)	11	(29)
419809	17	(43)	44	(112)	16	(41)	60	(153)	41	(104)	32	(80)	17	(42)
419810	20	(51)	50	(127)	22	(56)	69	(176)	47	(119)	32	(80)	17	(42)
419811	24	(61)	59	(150)	34	(86)	76	(193)	59	(150)	21	(54)	11	(29)
419812	24	(61)	59	(150)	34	(86)	76	(193)	59	(150)	25	(64)	11	(29)
419813	24	(61)	59	(150)	34	(86)	76	(193)	59	(150)	28	(70)	11	(29)
419814	24	(61)	59	(150)	34	(86)	76	(193)	59	(150)	31	(79)	11	(29)
419815	24	(61)	59	(150)	34	(86)	76	(193)	59	(150)	35	(89)	11	(29)
419816	24	(61)	59	(150)	34	(86)	76	(193)	59	(150)	38	(97)	11	(29)
419817	24	(61)	59	(150)	34	(86)	76	(193)	59	(150)	42	(107)	11	(29)
419818	24	(61)	60	(153)	34	(86)	78	(199)	59	(150)	32	(80)	17	(42)
419819	24	(61)	60	(153)	34	(86)	78	(199)	59	(150)	35	(89)	17	(42)
419820	24	(61)	60	(153)	34	(86)	78	(199)	59	(150)	38	(97)	17	(42)
419821	24	(61)	60	(153)	34	(86)	78	(199)	59	(150)	42	(107)	17	(42)
419822	24	(61)	60	(153)	34	(86)	78	(199)	59	(150)	45	(114)	17	(42)
419823	24	(61)	60	(153)	34	(86)	78	(199)	59	(150)	49	(125)	17	(42)
419824	24	(61)	60	(153)	34	(86)	78	(199)	59	(150)	52	(132)	17	(42)
419825	24	(61)	61	(156)	34	(86)	83	(211)	59	(150)	42	(106)	22	(56)
419826	24	(61)	61	(156)	34	(86)	83	(211)	59	(150)	42	(106)	22	(56)
419827	24	(61)	61	(156)	34	(86)	83	(211)	59	(150)	42	(106)	22	(56)
419828	24	(61)	61	(156)	34	(86)	83	(211)	59	(150)	42	(106)	22	(56)
419829	24	(61)	61	(156)	34	(86)	83	(211)	59	(150)	42	(106)	22	(56)
419830	24	(61)	61	(156)	34	(86)	83	(211)	59	(150)	42	(106)	22	(56)
419831	24	(61)	61	(156)	34	(86)	83	(211)	59	(150)	42	(106)	22	(56)
419832	30	(76)	71	(181)	46	(117)	88	(223)	71	(180)	44	(113)	11	(29)
419833	30	(76)	71	(181)	46	(117)	88	(223)	71	(180)	44	(113)	11	(29)
419834	30	(76)	71	(181)	46	(117)	88	(223)	71	(180)	44	(113)	11	(29)
419835	30	(76)	71	(181)	46	(117)	88	(223)	71	(180)	44	(113)	11	(29)
419836	30	(76)	71	(181)	46	(117)	88	(223)	71	(180)	44	(113)	11	(29)
419837	30	(76)	71	(181)	46	(117)	88	(223)	71	(180)	44	(113)	11	(29)
419838	30	(76)	71	(181)	46	(117)	88	(223)	71	(180)	44	(113)	11	(29)
419839	30	(76)	71	(181)	46	(117)	88	(223)	71	(180)	44	(113)	11	(29)
419840	30	(76)	71	(181)	46	(117)	88	(223)	71	(180)	44	(113)	11	(29)
419841	30	(76)	72	(183)	46	(117)	90	(230)	71	(180)	45	(114)	17	(42)
419842	30	(76)	72	(183)	46	(117)	90	(230)	71	(180)	45	(114)	17	(42)
419843	(30	(76)	72	(183)	46	(117)	90	(230)	71	(180)	45	(114)	17	(42)
419844	30	(76)	72	(183)	46	(117)	90	(230)	71	(180)	45	(114)	17	(42)
419845	30	(76)	72	(183)	46	(117)	90	(230)	71	(180)	45	(114)	17	(42)
419846	30	(76)	72	(183)	46	(117)	90	(230)	71	(180)	45	(114)	17	(42)
419847	30	(76)	72	(183)	46	(117)	90	(230)	71	(180)	45	(114)	17	(42)
419848	30	(76)	72	(183)	46	(117)	90	(230)	71	(180)	45	(114)	17	(42)
419849	30	(76)	72	(183)	46	(117)	90	(230)	71	(180)	45	(114)	17	(42)
419850	30	(76)	73	(186)	46	(117)	96	(245)	71	(180)	46	(116)	22	(55)
419851	30	(76)	73	(186)	46	(117)	96	(245)	71	(180)	46	(116)	22	(55)
419852	30	(76)	73	(186)	46	(117)	96	(245)	71	(180)	46	(116)	22	(55)
419853	30	(76)	73	(186)	46	(117)	96	(245)	71	(180)	46	(116)	22	(55)
419854	30	(76)	73	(186)	46	(117)	96	(245)	71	(180)	46	(116)	22	(55)
419855	30	(76)	73	(186)	46	(117)	96	(245)	71	(180)	46	(116)	22	(55)
419856	30	(76)	73	(186)	46	(117)	96	(245)	71	(180)	46	(116)	22	(55)
419857	30	(76)	73	(186)	46	(117)	96	(245)	71	(180)	46	(116)	22	(55)
419858	30	(76)	73	(186)	46	(117)	96	(245)	71	(180)	46	(116)	22	(55)
419859	37	(93)	86	(219)	58	(147)	109	(277)	84	(212)	52	(132)	22	(55)
419860	37	(93)	86	(219)	58	(147)	109	(277)	84	(212)	52	(132)	22	(55)
419861	37	(93)	86	(219)	58	(147)	109	(277)	84	(212)	52	(132)	22	(55)
419862	37	(93)	86	(219)	58	(147)	109	(277)	84	(212)	52	(132)	22	(55)
419863	37	(93)	86	(219)	58	(147)	109	(277)	84	(212)	52	(132)	22	(55)
419864	37	(93)	86	(219)	58	(147)	109	(277)	84	(212)	55	(140)	22	(55)

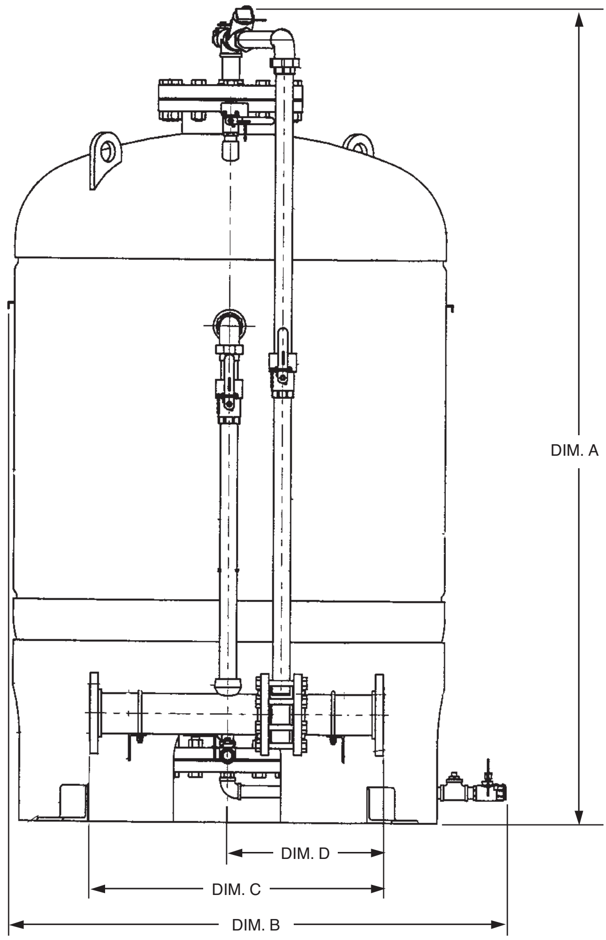
Tank Size Range Gal	(L)	Dimension M in	(cm)	Dimension N in	(cm)	Dimension P in	(cm)
100 - 300	(379 - 1136)	0.63	(1.6)	3	(7.6)	0.63	(1.6)
400 - 1000	(1514 - 3785)	0.88	(2.2)	4	(10.2)	0.88	(2.2)
1100 - 3000	(4164 - 11356)	0.88	(2.2)	4	(10.2)	1.00	(2.5)

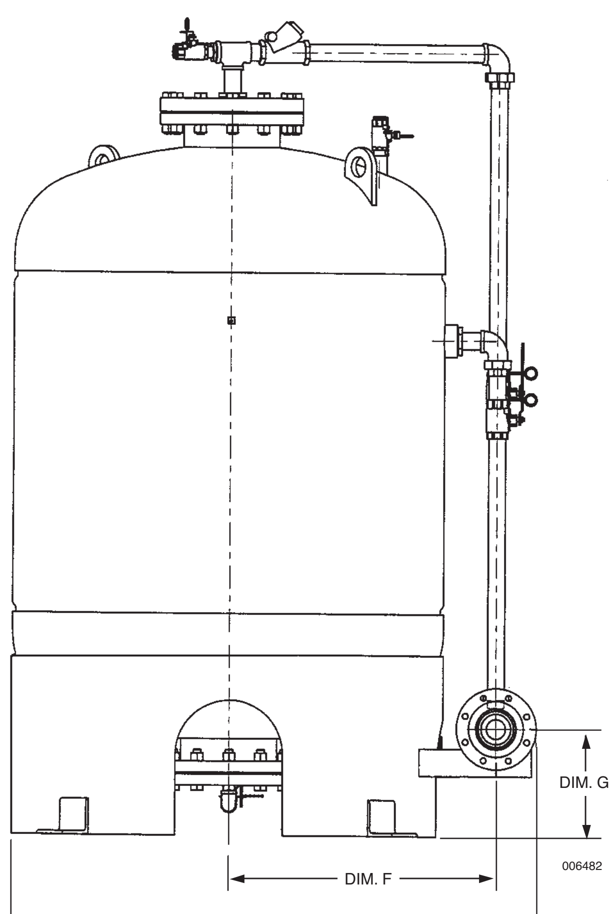
HORIZONTAL PRE-PIPED BLADDER TANKS





VERTICAL PRE-PIPED BLADDER TANKS





ORDERING INFORMATION

The ANSUL bladder tank shipping assembly part numbers and approximate shipping weights are identified in the following tables. Part numbers vary according to tank requirements. **Note:** For tanks with special engineered options, such as special pressure ratings, seismic ratings, or trim and finish options, contact the ANSUL Technical Services Department.

Specify type and percent of foam concentrate to be used in the bladder tank and proportioner. The proportioner metering orifice is sized according to type and percentage of concentrate used.

Note: Dimensions rounded to nearest inch – see Page 5 for drawing.

VERTICAL PRE-PIPED BLADDER TANKS

Part No.	Tank Size Gal.	(L)	Proportioner Size in	Tank Diameter in	(cm)	Dimension A in	(cm)	Dimension B in	(cm)	Dimension C in	(cm)	Dimension D in	(cm)	Dimension E in	(cm)	Dimension F in	(cm)	Dimension G in	(cm)	Weight lb	(kg)
419865	50	(189)	2	24	(57)	57	(145)	31	(79)	24	(61)	18	(46)	34	(86)	18	(46)	11	(28)	510	(231)
419866	100	(379)	2	24	(61)	84	(213)	31	(79)	24	(61)	18	(46)	34	(86)	18	(46)	11	(28)	740	(336)
419867	50	(189)	2 1/2	24	(61)	57	(145)	31	(79)	23	(58)	16	(41)	34	(86)	18	(46)	10	(25)	515	(234)
419868	100	(379)	2 1/2	24	(61)	84	(213)	31	(79)	23	(58)	16	(41)	34	(86)	18	(46)	10	(25)	745	(338)
419869	100	(379)	3	24	(61)	85	(216)	31	(79)	28	(71)	16	(41)	34	(86)	18	(46)	12	(30)	750	(340)
419870	150	(568)	3	30	(76)	85	(216)	37	(94)	28	(71)	16	(41)	40	(102)	21	(53)	12	(30)	1030	(467)
419871	200	(757)	3	30	(76)	103	(262)	37	(94)	28	(71)	16	(41)	40	(102)	21	(53)	12	(30)	1340	(608)
419872	150	(568)	4	30	(76)	87	(221)	37	(94)	33	(84)	17	(43)	42	(107)	22	(56)	12	(30)	1050	(476)
419873	200	(757)	4	30	(76)	105	(267)	37	(94)	33	(84)	17	(43)	42	(107)	22	(56)	12	(30)	1340	(608)
419874	200	(757)	6	30	(76)	104	(264)	37	(94)	48	(122)	24	(61)	45	(114)	24	(61)	15	(38)	1360	(617)
419875	300	(1136)	3	36	(91)	106	(269)	43	(109)	28	(71)	16	(41)	46	(117)	24	(61)	12	(30)	1600	(726)
419876	300	(1136)	4	36	(91)	109	(277)	43	(109)	33	(84)	17	(43)	47	(119)	24	(61)	12	(30)	1620	(735)
419877	300	(1136)	6	36	(91)	107	(272)	49	(124)	48	(122)	24	(61)	48	(122)	24	(61)	15	(38)	1660	(753)
419878	400	(1514)	4	48	(122)	90	(229)	55	(140)	33	(84)	17	(43)	59	(150)	30	(76)	12	(30)	1870	(848)
419879	500	(1893)	4	48	(122)	103	(262)	55	(140)	33	(84)	17	(43)	59	(150)	30	(76)	12	(30)	2220	(1007)
419880	600	(2271)	4	48	(122)	116	(295)	55	(140)	33	(84)	17	(43)	59	(150)	30	(76)	12	(30)	2640	(1198)
419881	700	(2650)	4	48	(122)	130	(330)	55	(140)	33	(84)	17	(43)	59	(150)	30	(76)	12	(30)	2905	(1318)
419882	800	(3028)	4	48	(122)	144	(366)	55	(140)	33	(84)	17	(43)	59	(150)	30	(76)	12	(30)	3170	(1438)
419883	900	(3407)	4	48	(122)	158	(401)	55	(140)	33	(84)	17	(43)	59	(150)	30	(76)	12	(30)	3470	(1574)
419884	1000	(3785)	4	48	(122)	172	(437)	55	(140)	33	(84)	17	(43)	59	(150)	30	(76)	12	(30)	3670	(1665)
419885	400	(1514)	6	48	(122)	89	(226)	55	(140)	48	(122)	24	(61)	62	(157)	32	(81)	12	(30)	1910	(866)
419886	500	(1893)	6	48	(122)	102	(259)	55	(140)	48	(122)	24	(61)	62	(157)	32	(81)	12	(30)	2260	(1025)
419887	600	(2271)	6	48	(122)	115	(292)	55	(140)	48	(122)	24	(61)	62	(157)	32	(81)	12	(30)	2680	(1216)
419888	700	(2650)	6	48	(122)	129	(328)	55	(140)	48	(122)	24	(61)	62	(157)	32	(81)	12	(30)	2945	(1336)
419889	800	(3028)	6	48	(122)	143	(363)	55	(140)	48	(122)	24	(61)	62	(157)	32	(81)	12	(30)	3210	(1456)
419890	900	(3407)	6	48	(122)	157	(399)	55	(140)	48	(122)	24	(61)	62	(157)	32	(81)	12	(30)	3510	(1592)
419891	1000	(3785)	6	48	(122)	171	(434)	55	(140)	48	(122)	24	(61)	62	(157)	32	(81)	12	(30)	3710	(1683)
419892	400	(1514)	8	48	(122)	89	(226)	55	(140)	64	(163)	31	(79)	63	(160)	32	(81)	15	(38)	1925	(873)
419893	500	(1893)	8	48	(122)	102	(259)	55	(140)	64	(163)	31	(79)	63	(160)	32	(81)	15	(38)	2275	(1032)
419894	600	(2271)	8	48	(122)	115	(292)	55	(140)	64	(163)	31	(79)	63	(160)	32	(81)	15	(38)	2695	(1223)
419895	700	(2650)	8	48	(122)	129	(328)	55	(140)	64	(163)	31	(79)	63	(160)	32	(81)	15	(38)	2960	(1343)
419896	800	(3028)	8	48	(122)	143	(363)	55	(140)	64	(163)	31	(79)	63	(160)	32	(81)	15	(38)	3225	(1463)
419897	900	(3407)	8	48	(122)	157	(399)	55	(140)	64	(163)	31	(79)	63	(160)	32	(81)	15	(38)	3525	(1599)
419898	1000	(3785)	8	48	(122)	171	(434)	55	(140)	64	(163)	31	(79)	63	(160)	32	(81)	15	(38)	3725	(1690)
419899	1100	(4164)	4	60	(152)	141	(358)	67	(170)	33	(84)	17	(43)	71	(180)	36	(91)	18	(46)	3820	(1733)
419900	1200	(4542)	4	60	(152)	150	(381)	67	(170)	33	(84)	17	(43)	71	(180)	36	(91)	18	(46)	4020	(1824)
419901	1300	(4921)	4	60	(152)	159	(404)	67	(170)	33	(84)	17	(43)	71	(180)	36	(91)	18	(46)	4210	(1910)
419902	1400	(6300)	4	60	(152)	168	(427)	67	(170)	33	(84)	17	(43)	71	(180)	36	(91)	18	(46)	4420	(2005)
419903	1500	(5678)	4	60	(152)	176	(447)	67	(170)	33	(84)	17	(43)	71	(180)	36	(91)	18	(46)	4600	(2087)
419904	1100	(4164)	6	60	(152)	140	(356)	67	(170)	48	(122)	24	(61)	74	(188)	38	(97)	18	(46)	3860	(1751)
419905	1200	(4542)	6	60	(152)	149	(378)	67	(170)	48	(122)	24	(61)	74	(188)	38	(97)	18	(46)	4060	(1842)
419906	1300	(4921)	6	60	(152)	158	(401)	67	(170)	48	(122)	24	(61)	74	(188)	38	(97)	18	(46)	4250	(1928)
419907	1400	(5300)	6	60	(152)	167	(424)	67	(170)	48	(122)	24	(61)	74	(188)	38	(97)	18	(46)	4460	(2023)
419908	1500	(5678)	6	60	(152)	175	(445)	67	(170)	48	(122)	24	(61)	74	(188)	38	(97)	18	(46)	4640	(2105)
419909	1100	(4164)	8	60	(152)	141	(358)	67	(170)	64	(163)	31	(79)	77	(196)	40	(102)	18	(46)	3875	(1758)
419910	1200	(4542)	8	60	(152)	150	(381)	67	(170)	64	(163)	31	(79)	77	(196)	40	(102)	18	(46)	4075	(1848)
419911	1300	(4921)	8	60	(152)	159	(404)	67	(170)	64	(163)	31	(79)	77	(196)	40	(102)	18	(46)	4265	(1935)
419912	1400	(5300)	8	60	(152)	168	(427)	67	(170)	64	(163)	31	(79)	77	(196)	40	(102)	18	(46)	4475	(2030)
419913	1500	(5678)	8	60	(152)	176	(447)	67	(170)	64	(163)	31	(79)	77	(196)	40	(102)	18	(46)	4655	(2112)

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Fire Suppression & Building Products

www.ansul.com
One Stanton Street
Marinette, WI 54143-2542

36 GALLON BLADDER TANK/FOAM STATION

Data/Specifications

ANSUL

FEATURES

Options

- 36 gallon bladder tank with fittings and valves only.
- 36 gallon bladder tank with fittings and valves pre-piped to a 2 in. proportioner.
- 36 gallon handline foam station.

Bladder Tank

- Fill cap opening provides ease of filling without the need for a funnel or fill pump. In addition, fill opening provides convenient access for checking agent fill level.
- Exterior surfaces finished in red standard paint system or coated with a red "CR" epoxy finish for use in marine, offshore or other corrosive environments.
- Tank interior coated with high build epoxy for use with both fresh and salt water.
- Internal tank perforated center tube allows unrestricted and maximum agent discharge.
- Can be used with all ANSUL® foam concentrates and proportioner sizes.
- Can be used for foam/water supply to any type discharge device suitable for use with selected foam concentrate.
- Operating, refilling and maintenance instruction plate provided.

With Proportioner

- 2 in. proportioner provides capability of variable flow range with minimum pressure loss.
- Minimum design restrictions on hose and/or piping lengths between proportioner and discharge device when compared to foam eductor-type systems.
- Can be used with all ANSUL foam concentrates.
- Concentrate shut-off valve provided to allow water-only operation.

Handline Foam Station

- Minimum design restrictions on hose and/or piping lengths between proportioner and discharge device when compared to nozzle and foam eductor combinations.
- Can be used with all ANSUL foam concentrates, depending on nozzle selection.
- Concentrate shut-off valve provided to allow water-only operation.

APPLICATION

The ANSUL 36 gallon bladder tank, when coupled with a standard proportioner, becomes a self-contained foam proportioning system which requires no external power supply other than pressurized water. Compact in size, these bladder tanks and foam stations are ideal for supplying foam solution to various handline nozzles. Other design applications include small fixed systems protecting flammable liquid storage areas. Fixed systems typically use sprinkler heads, foam makers or other types of foam discharge devices available from ANSUL to provide uniform foam blanketing over the hazard area.

The ANSUL 36 gallon foam station satisfies the guidelines of NFPA 409 for supplementary foam-water hand hose line system for aircraft hanger protection. Other applications include use in and around off-shore platforms, truck loading racks, chemical process/refining plants and heliports.

DESCRIPTION

Bladder Tank

The 36 gallon capacity bladder tank stores a foam liquid concentrate in an elastomeric bladder. The concentrate is discharged from the tank by incoming water applying pressure to the bladder. This applied energy is transferred to the concentrate, which is forced through the concentrate discharge line to any size ANSUL proportioner.

Bladder Tank With Proportioner/Foam Station

The bladder tank is available pre-piped to a 2 in. proportioner consisting of a body, inlet nozzle and metering orifice, all of which are corrosion-resistant brass. The metering orifice is sized according to the type and percentage of concentrate used and is secured with a stainless steel retaining ring. The proportioner is connected to the pressurized water line and concentrate discharge line. It properly regulates the amount of concentrate injected into the water stream over a wide flow range. The foam solution is then supplied to a handline nozzle or other appropriate foam discharge device.

APPROVALS

Bladder Tank

The ANSUL 36 gallon tank carries the American Society of Mechanical Engineers (ASME) code stamp, is U.L. listed and FM approved with various ANSUL proportioner and foam concentrate combinations as indicated in the proportioner foam systems data sheet.

Bladder Tank with Proportioner and Foam Station

The ANSUL 36 gallon tank with 2 in. proportioner is UL listed and carries the UL label when used with the following concentrates:

ANSULITE® 1%, 3%, 6% AFFF Concentrates

ANSULITE AR-AFFF Concentrates (3% and 6% proportioning)

ANSULITE 3% AFFF Freeze Protected Concentrate

ANSUL 3% Protein Foam Concentrate

ANSUL 3% Fluoroprotein Foam Concentrate

SPECIFICATIONS

Bladder Tank

The 36 gallon bladder tank shall be designed and constructed in accordance with the latest revisions to ASME code, Section VIII, Division 1 for unfired pressure vessels with a working pressure of 175 psi (12.07 bar) and hydrotested to at least 255 psi (17.6 bar). The tank shall be 36 gallons nominal capacity with overall dimensions as indicated in the drawing below. The tank shall be constructed of steel complying with ASME specifications possessing a tensile strength of not less than 70,000 psi (4827 bar). The circumferential, as well as the longitudinal body seam shall be machine welded and radiographed to ensure 85% efficiency.

The tank heads shall be 2 to 1 ellipsoid to ensure strength while reducing overall tank weight.

There shall be a water channel, permanent and non-movable, between the water inlet opening and water drain opening to establish a water path between the tank shell interior and the bladder.

The tank interior shall have all welds and edges ground smooth. It shall be cleaned, sand blasted to a near white surface, and immediately coated with a coal tar epoxy sealer.

The tank shall contain a flexible bladder of material tested by Underwriters Laboratories for compatibility with the agent used. The bladder shall comply with UL 162, "Foam Equipment and Liquid Concentrates." The bladder material shall be constructed to conform with the inside tank dimensions.

The tank assembly shall contain a perforated center tube of P.V.C. or other material compatible with the foam concentrate to assure that foam concentrate will be discharged without restriction to flow.

The tank assembly shall be fitted with a 4 in. inside diameter fill opening in the top head and provided with a fill cap. The cap shall consist of a cast brass body with two handles extending from opposite sides of the cap to permit hand tightening without the use of tools so that the cap is free from leakage under normal operating pressure. The cap shall be equipped with a 5/32 in. thick rubber gasket inserted in a machined recess. A safety vent hole shall be located in the fill cap so that the cap will vent while at least 3 1/2 threads are still engaged.

The following valves shall be assembled to each tank: a bladder drain/fill valve, tank shell drain valve and tank shell vent valve. These valves shall be 1 in. 1/4 – turn ball valves with bronze body, hard chromium plated bronze ball, bronze stem, stainless steel locking nut and handle, and high performance teflon seats and stuffing box ring. Each valve shall have a nameplate secured to it identifying the valve name and operating position. Each valve shall be provided with a ring pin and chain attached for securing the valve in the operating position. All pipe and fittings shall be Schedule 40 ASTM B-43 Brass and B-145 Bronze, respectively.

2-Inch Proportioner

The proportioner body, inlet nozzle and foam orifice shall be of ASTM 85-5-5-5 Brass. The nozzle and foam orifice retaining rings shall be of stainless steel.

The proportioner body shall be designed with a female NPT inlet and a male NPT outlet. The body shall be clearly marked with a flow direction arrow, and the type and percent of foam concentrate that it was designed to proportion.

The convergent inlet nozzle shall have a rounded inlet and a smooth machined finish to ensure minimum stream constriction and maximum velocity. It shall be retained by a stainless steel retaining ring. The inlet nozzle shall terminate in the foam concentrate annulus chamber and be concentric with and set back from the proportioner recovery section.

The foam concentrate metering orifice shall be machined to the proper diameter for the agent. It shall rest on a machined surface to prevent leakage and shall be secured by a removable stainless steel retaining ring.

A concentrate valve shall be installed in the foam concentrate line leading to the proportioner to allow water-only operation. This valve shall meet the valve specifications outlined above.

Foam Station Hose Reel

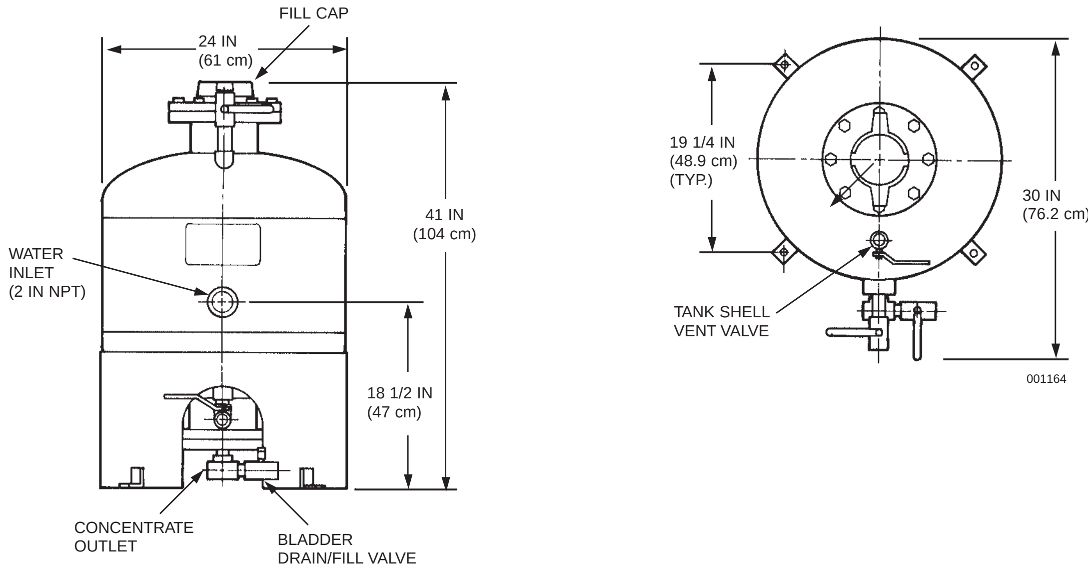
A metal hose reel with straight-through internal fittings, designed to provide a minimum pressure drop, shall be provided. The reel shall be capable of holding 75 ft (23 m) or 100 ft (33 m) of 1 1/2 in. hose with nozzle and shall be manual rim rewind. The reel shall be provided with a locking mechanism to prevent unwinding of the hose. The hose shall be continuous flow type, oil and chemical resistant, with a minimum working pressure of 175 psi (12.07 bar) and tested to 400 psi (27.6 bar). The nozzle shall be variable stream (water/AFFF), rated for a nominal flow of 95 gpm (379 Lpm) at 100 psi (6.9 bar).

ORDERING INFORMATION

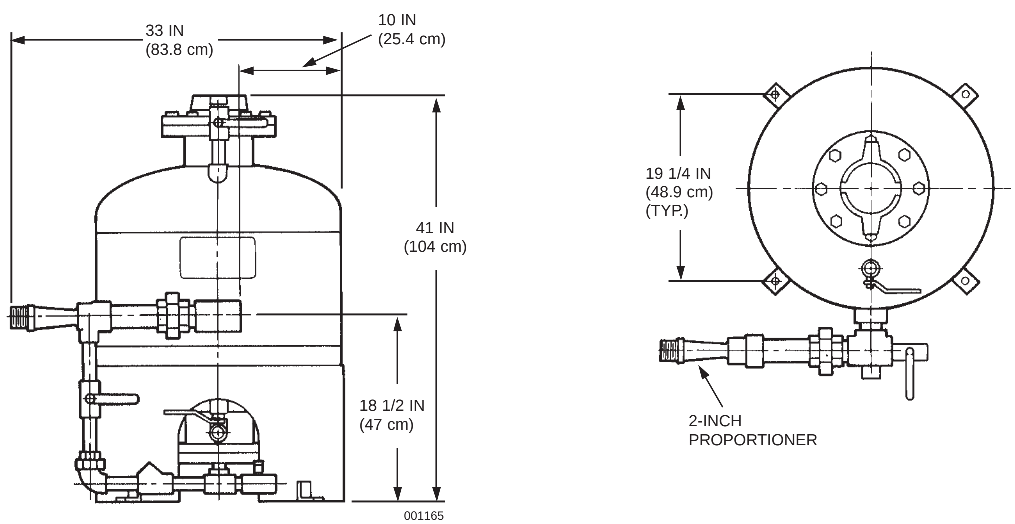
Part No.	Equipment Description	Approximate Shipping Weight lb	(kg)
404127	36 Gallon Bladder Tank, Standard Red Paint	300	136
404413	36 Gallon Bladder Tank, Red "CR" Epoxy Paint	300	136
403942	36 Gallon Bladder Tank, pre-piped to 2 in. Proportioner, Standard Red Paint	330	150
404414	36 Gallon Bladder Tank, pre-piped to 2 in. Proportioner, Epoxy Paint	330	150
76400	36 Gallon Foam Station with 75 ft (23 m) Hose Reel and Nozzle, Standard Red Paint	550	250
76401	36 Gallon Foam Station with 75 ft (23 m) Hose Reel and Nozzle, Epoxy Paint	550	250
404103	36 Gallon Foam Station with 100 ft (33 m) Hose Reel and Nozzle, Standard Red Paint	575	260
404197	36 Gallon Foam Station with 100 ft (33 m) Hose Reel and Nozzle, Red 'CR' Epoxy Paint	575	260

For other design options such as additional hose lengths, alternate nozzles, fixed systems other discharge devices and special applications, contact Ansul Incorporated, Technical Services, Marinette, WI 54143-2542.

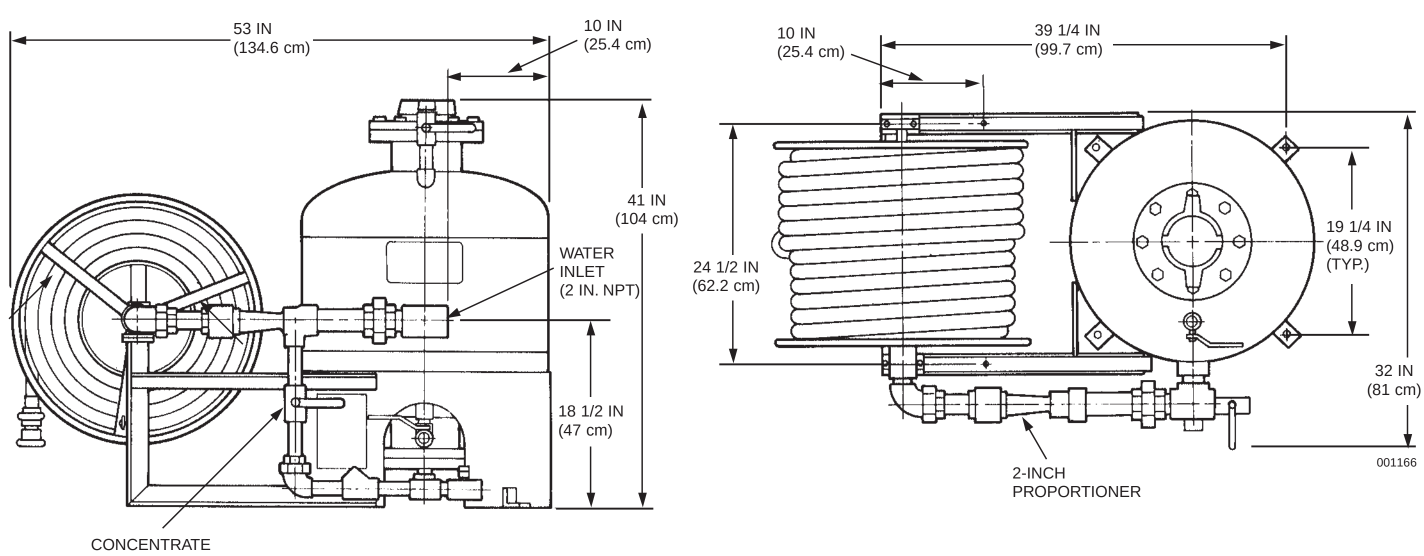
36 GALLON BLADDER TANK WITH FITTINGS AND VALVES ONLY



36 GALLON BLADDER TANK WITH FITTINGS AND VALVES PRE-PIPED TO A 2-INCH PROPORTIONER



36 GALLON HANDLINE FOAM STATION



Ansul Incorporated
Marinette, WI 54143-2542

715-735-7411
www.ansul.com

Form No. F-8649-4

BALANCED PRESSURE PUMP PROPORTIONING SYSTEM

Data/Specifications

FEATURES

- Six Proportioner Sizes to Handle Wide Range of Flows with Minimum Friction Loss
- Diaphragm Valve Design Ensures Accurate Pressure Regulation and Rapid Response to Changes in Flow Demand
- ► Choice of Standard Red or Corrosion-Resistant Polyamide Epoxy Finish
- Brass Foam Concentrate Piping Standard for Use in Marine Applications and Other Corrosive Environments
- Compatible with Ansul Foam Concentrates
- Stainless Steel Nameplates for Valve Identification and Instruction

APPLICATION

ANSUL® balanced pressure pump proportioning systems are designed to accurately control the flow of a foam liquid concentrate into a water stream over a wide range of flow rates and pressures. These pump proportioning systems are compatible with ANSUL foam concentrates by matching the required foam concentrate pump output to the proportioner maximum flow demand. For other special requirements, contact Ansul Incorporated, Technical Services, Marinette, WI 54143-2542.

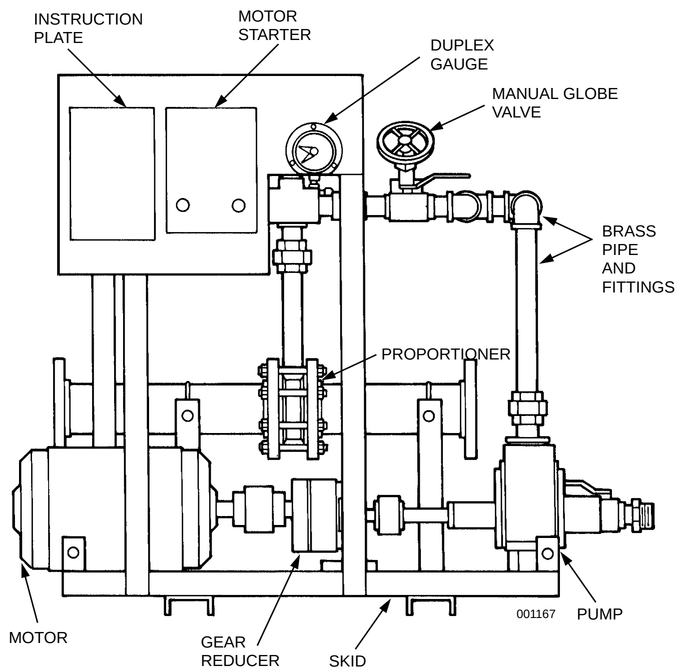
Because they are capable of continuously generating large volumes of foam solution, balanced pressure pump proportioning systems are typically used to protect tank farms, marine docks, chemical processing plants, offshore oil platforms, aircraft hangars, and loading racks.

DESCRIPTION

The balanced pressure proportioning system functions by maintaining an equal pressure in the foam concentrate and water inlets to the proportioner. This balancing ability allows the proportioner to be used over a wide range of flows and pressures. The system will also respond quickly and accurately to changes in the water inlet pressures and flow rates.

The system operates by passing the required portion of foam concentrate from a positive displacement pump to a venturi proportioner with the remaining portion recirculating through a diaphragm valve in the return line to the tank. The diaphragm valve senses and balances the pressures in the foam concentrate and water lines to the proportioner. (The pressures can also be balanced manually by using the manual regulating globe valve and the duplex gauge.) The foam concentrate then enters the proportioner where a built-in orifice regulates the flow of pressurized foam concentrate entering the water stream.

The skid units are available in six proportioner sizes ranging from 2 to 8 in. with flow rates from 30 to 5500 gpm (114 to 20816 Lpm) as listed under the Proportioner Flow Range Table. Each unit consists of a positive displacement foam pump with electric motor and starter; various control, drain, and check valves; pressure balancing diaphragm valve; duplex gauge; foam proportioner; interconnecting brass pipe; and stainless steel valve identification and system instruction nameplates. The entire assembly is mounted on a steel skid and available with either
► standard red or corrosion-resistant polyamide epoxy "CR" finish.



SPECIFICATIONS

The balanced pressure proportioning skid shall contain all necessary components including control valves, proportioner, interconnecting piping, water flush-out connections, positive displacement foam liquid pump, pump driver, and duplex pressure gauge.

Balancing shall be accomplished through the use of a diaphragm pressure balancing valve.

The skid shall have manual override capability through use of a manually-controlled globe valve and duplex pressure gauge. Interconnecting foam concentrate piping shall be of brass construction. Valve nameplates shall be of 304 stainless steel and shall specify valve function and stand-by position.

ORDERING INFORMATION

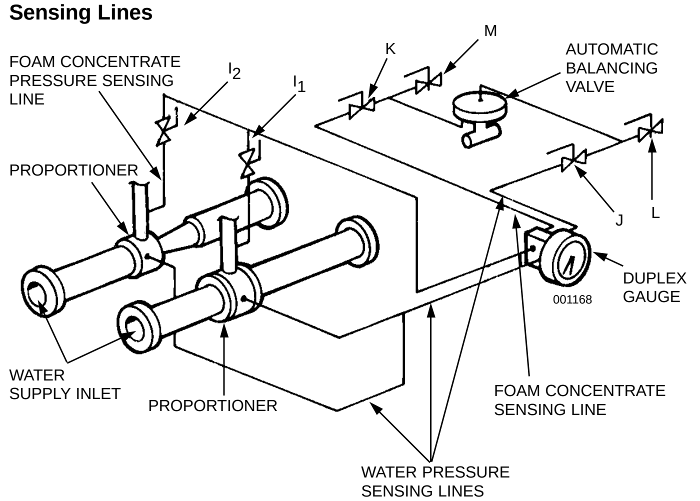
When ordering, the following information must be provided:

- Type and Percentage of Concentrate
- Minimum and Maximum Water Inlet Pressure Available to Proportioner
- Minimum and Maximum Foam Solution Flow Required
- Power Supply Available
- ► Desired Paint System (Standard or Epoxy "CR")

PROPORTIONER FLOW RANGES

Proportioner Size	Approximate Flow Range gpm	(Lpm)
2 in.	30 – 300	(114 – 1136)
2 1/2 in.	35 – 400	(132 – 1514)
3 in.	70 – 800	(265 – 3028)
4 in.	200 – 1600	(757 – 6057)
6 in.	300 – 3400	(1136 – 12870)
8 in.	500 – 5500	(1892 – 20819)

Sensing Lines

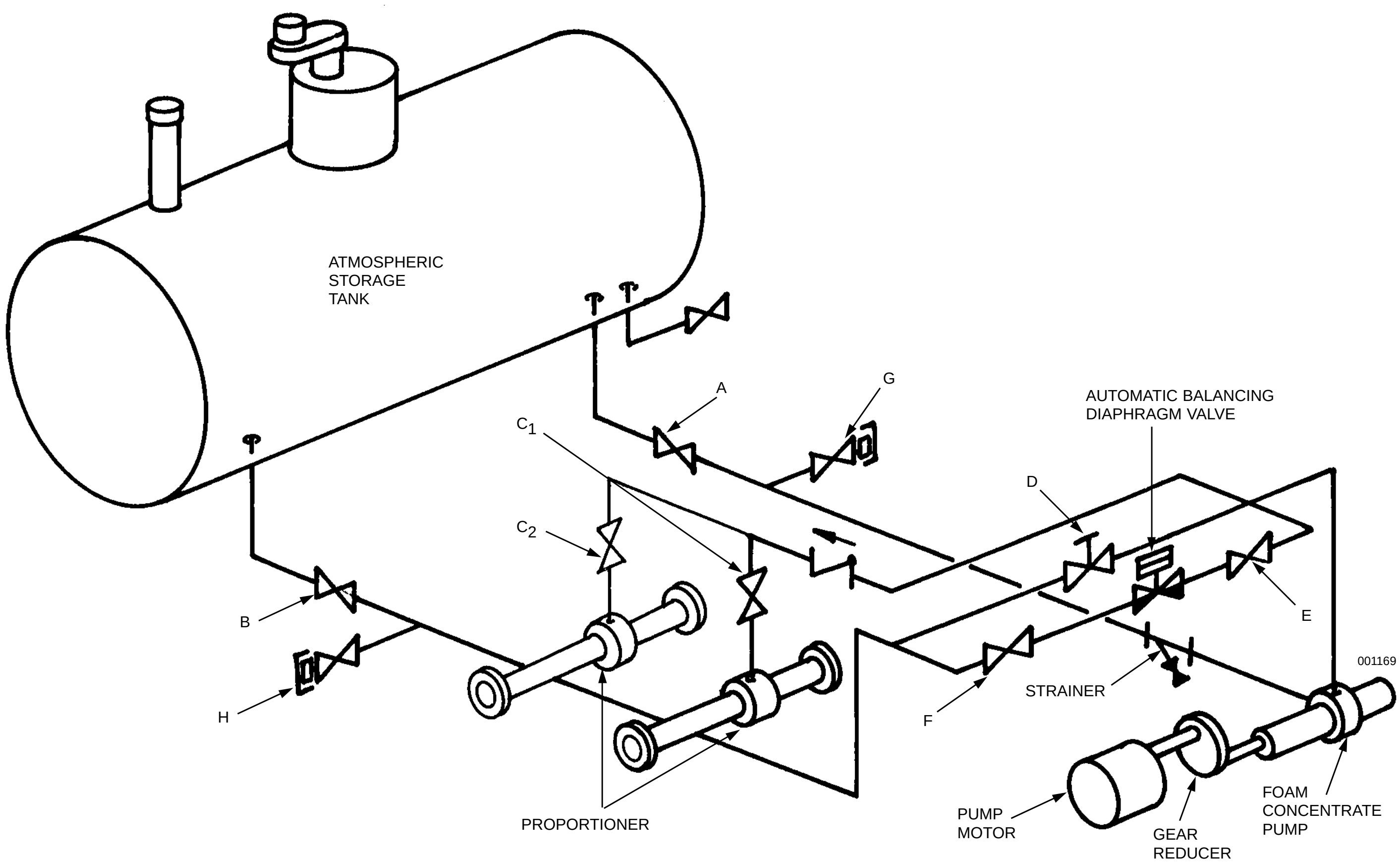


Depicted for manual operation. Refer to ANSUL Balanced Pressure Pump Proportioning System Manual, Part No. 77166, for installation and operation instructions.

VALVE IDENTIFICATION

Valve	Description
A	Foam Tank Suction
B	Foam Tank Return
C_1	Foam Proportioner Supply
C_2	Foam Proportioner Supply (If Required)
D	Manual Foam Balancing
E	Foam Supply to Automatic Balancing Valve
F	Foam Discharge from Automatic Balancing Valve
G	Flush Inlet
H	Flush Outlet
I_1	Foam Pressure Sensing (If Required)
I_2	Foam Pressure Sensing (If Required)
J	Water Sensing to Automatic Balancing Valve
K	Foam Sensing to Automatic Balancing Valve
L	Water Flush Out
M	Foam Flush Out

Typical Balanced Pressure Pump Proportioning System



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Marinette, WI 54143-2542

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Form No. F-85174-3

ANSUL

A Tyco International Company

IN-LINE BALANCED PRESSURE PROPORTIONERS MODELS IBP, IBP-M

Data/Specifications

FEATURES

- Six standard sizes to handle a wide range of flows with minimum friction loss
- Spool valve design ensures accurate pressure regulation and rapid response to changes in flow demand
- Brass foam concentrate piping with stainless steel trim accessories standard for use in marine applications and other corrosive environments
- Compatible with all ANSUL foam concentrates
- Choice of unpainted brass or standard red paint finish

APPLICATION

ANSUL in-line balanced pressure proportioners are used with an atmospheric foam concentrate tank and a positive displacement foam concentrate pump. In-line balanced pressure proportioners are designed to accurately control the flow of a foam liquid concentrate into a water stream over a wide range of flow rates and pressures. These devices can be used with all types of foam concentrates. Advantages of the in-line balanced pressure proportioner include the following:

- Multiple proportioning devices from a single pressurized foam concentrate supply.
- Foam concentrate can be proportioned near the discharge devices while the foam concentrate storage tank and pump are placed in a remote location.
- Water supply pressure may vary at proportioners under simultaneous operation without affecting foam solution concentration.
- Capable of combining various sizes of in-line balanced pressure proportioners to best suit the flow requirements of each hazard area.

DESCRIPTION

The in-line balanced pressure proportioning system functions by maintaining an equal pressure in the foam concentrate and water inlets to the proportioner. This balancing ability allows the proportioner to be used over a wide range of flows and pressures. The system will also respond quickly and accurately to changes in the water inlet pressures and flow rates.

The system utilizes a positive displacement foam pump to pressurize foam concentrate within the supply manifold. A pressure control valve, located in the return line to the foam concentrate storage tank, is set to maintain a regulated pressure in the supply manifold that is higher than the pressure in the water supply line. The foam concentrate that is not required by the proportioner is returned to the atmospheric storage tank through the pressure control valve. The spool valve senses the foam concentrate pressure and automatically adjusts to balance it with the water pressure. A duplex pressure gauge provides a reading of the foam concentrate and water pressures. The foam concentrate then enters the proportioner, where a built-in orifice regulates the flow of pressurized foam concentrate entering the water stream.

The units are available in six standard sizes to supply proportioners ranging from 2 to 8 inches with flow rates from 30 to 5,500 gpm (114 to 20820 Lpm) as listed under the System Information Table. Each unit consists of a foam proportioner; pressure balancing spool valve; duplex gauge; various control, drain and check valves; interconnecting brass pipe and fittings; stainless steel braid flexible pressure sensing hoses; and valve identification nameplates. The IBP-M models are also provided with a manual foam balancing valve. The in-line balanced pressure proportioner is factory pressure tested after being assembled.

APPROVALS

The ANSUL in-line balanced pressure proportioner assemblies are both Underwriters Laboratories listed and Factory Mutual approved with ANSULITE 3% AFFF, ANSULITE 3x3 Low-Viscosity AR-AFFF, and ANSULITE ARC 3% or 6% AR-AFFF Foam Concentrates. Models IBP-4/IBP-4M and IBP-6/IBP-6M are UL listed with JET-X 2% and JET-X 2 3/4% High-Expansion Foam Concentrates.

SPECIFICATIONS

The in-line balanced pressure proportioner assembly shall contain all necessary components including: foam proportioner; pressure balancing spool valve; duplex gauge; control, drain and check valves; interconnecting brass pipe; and valve identification nameplates.

Balancing shall be accomplished through the use of a spool-type pressure balancing valve. This valve shall sense foam concentrate and water inlet pressures at the outer ends of a dumbbell-shaped piston and shall react to pressure changes by covering or uncovering the foam supply port to the proportioner. The balancing valve shall be of UNS-83600 brass construction with a bronze piston and Buna-N rubber O-rings and seals. The in-line balanced pressure proportioner shall be completely pressure tested by the manufacturer.

Interconnecting foam concentrate piping shall be of brass construction. Pressure sensing hoses shall be Teflon® with stainless braid cover and permanently attached brass couplings. Valve nameplates shall be provided and shall specify valve function and normal operating position. The ‘‘foam concentrate’’ ball valve shall have a ring pin and chain for securing the ball valve in the operating position.

SYSTEM INFORMATION TABLE

The following table lists the nominal flow range for each proportioner size. For flow ranges using specific concentrates, consult ANSUL Technical Services.

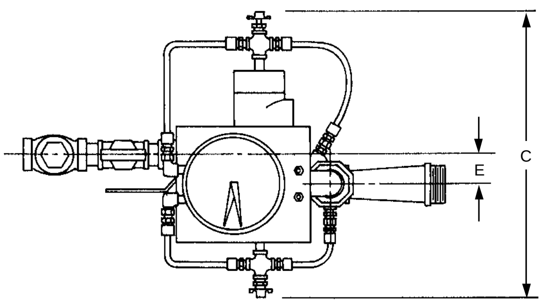
	Model IBP-2/IBP-2M	Model IBP-2 1/2/IBP-2 1/2M	Model IBP-3/IPB-3M	Model IBP-4/IBP-4M	Model IBP-6/IBP-6M	Model IBP-8/IBP-8M
Proportioner Size	2 in.	2 1/2 in.	3 in.	4 in.	6 in.	8 in.
Nominal Flow Range gpm	30-300	35-400	70-800	200-1600	300-3400	500-5500
Nominal Flow Range (Lpm)	(114-1136)	(132-1514)	(265-3028)	(757-6057)	(1136-12870)	(1892-20819)

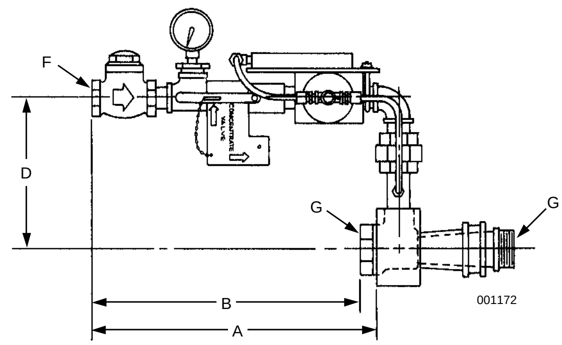
In-line balanced pressure proportioner systems will proportion slightly higher concentrations at the low end of the nominal flow range.

NOTICE: Listed Nominal Flow Ranges do not apply for Alcohol Resistant Concentrate.

IN-LINE BALANCED PRESSURE PROPORTIONERS (MODELS IBP-2 TO IBP-8)

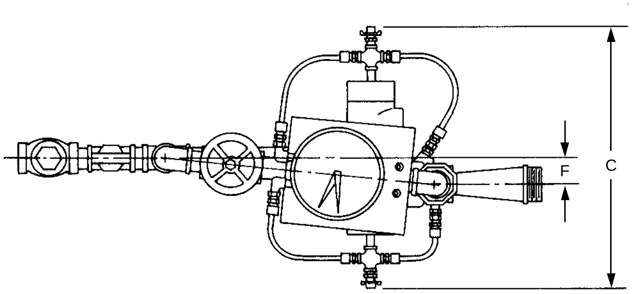
	Model IBP-2		Model IBP-2 1/2		Model IBP-3		Model IBP-4		Model IBP-6		Model IBP-8	
	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
Dimension A	–		–		17	(430)	18 1/2	(470)	18 1/4	(460)	22 1/2	(570)
Dimension B	16	(410)	16	(410)	–		–		–		–	
Dimension C	16 3/4	(430)	16 3/4	(430)	16 3/4	(430)	16 3/4	(430)	16 3/4	(430)	20	(510)
Dimension D	9	(230)	9	(230)	9 3/4	(250)	10 1/2	(270)	12	(310)	14	(360)
Dimension E	1 3/4	(45)	1 3/4	(45)	1 3/4	(45)	1 3/4	(45)	1 3/4	(45)	2 3/16	(55)
Dimension F	1 NPT		1 NPT		1 NPT		1 1/2 NPT		1 1/2 NPT		2 NPT	
Dimension G	2 NPT		2 1/2 NPT		3*		4*		6*		8*	

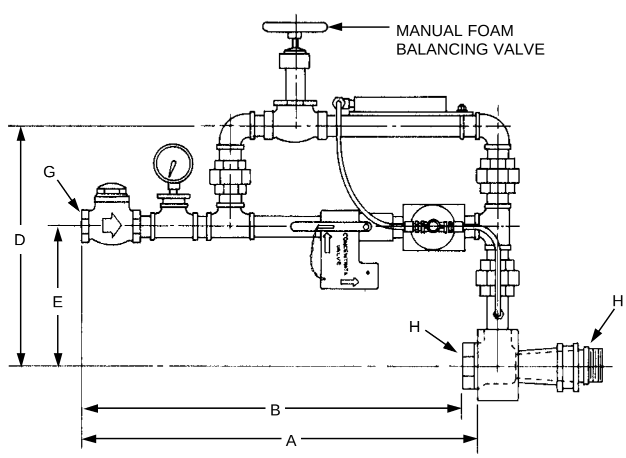




IN-LINE BALANCED PRESSURE PROPORTIONERS WITH MANUAL FOAM BALANCING VALVE (MODELS IBP-2M TO IBP-8M)

	Model IBP-2M		Model IBP-2 1/2M		Model IBP-3M		Model IBP-4M		Model IBP-6M		Model IBP-8M	
	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
Dimension A	–		–		25 1/2	(650)	28 1/2	(720)	28	(710)	32 3/8	(820)
Dimension B	24 1/2	(620)	24 1/2	(620)	–		–		–		–	
Dimension C	16 3/4	(430)	16 3/4	(430)	16 3/4	(430)	16 3/4	(430)	16 3/4	(430)	20	(510)
Dimension D	15 5/8	(400)	15 5/8	(400)	16 3/8	(420)	18	(460)	19 1/2	(500)	22 1/2	(570)
Dimension E	9	(230)	9	(230)	9 3/4	(250)	10 1/2	(270)	12	(310)	14	(360)
Dimension F	1 3/4	(45)	1 3/4	(45)	1 3/4	(45)	1 3/4	(45)	1 3/4	(45)	2 3/16	(55)
Dimension G	1 NPT		1 NPT		1 NPT		1 1/2 NPT		1 1/2 NPT		2 NPT	
Dimension H	2 NPT		2 1/2 NPT		3*		4*		6*		8*	





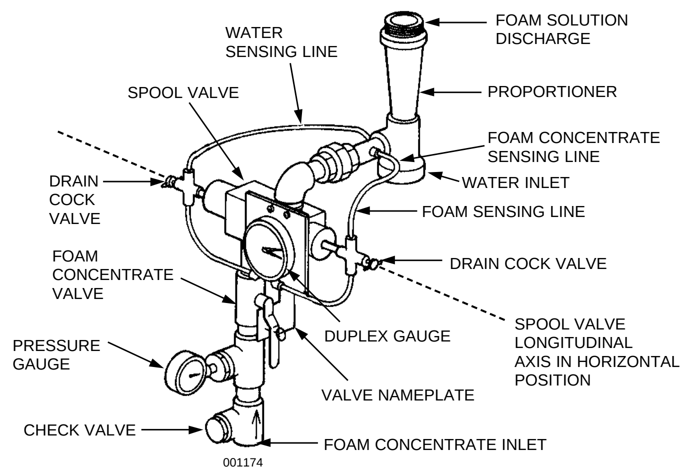
*Between flange proportioner is standard. Upon request, proportioners can also be supplied in flanged style.

Note: ANSUL in-line balanced pressure proportioners require a minimum of 5 pipe diameters of straight, unobstructed water inlet supply pipe.

ORDERING INFORMATION

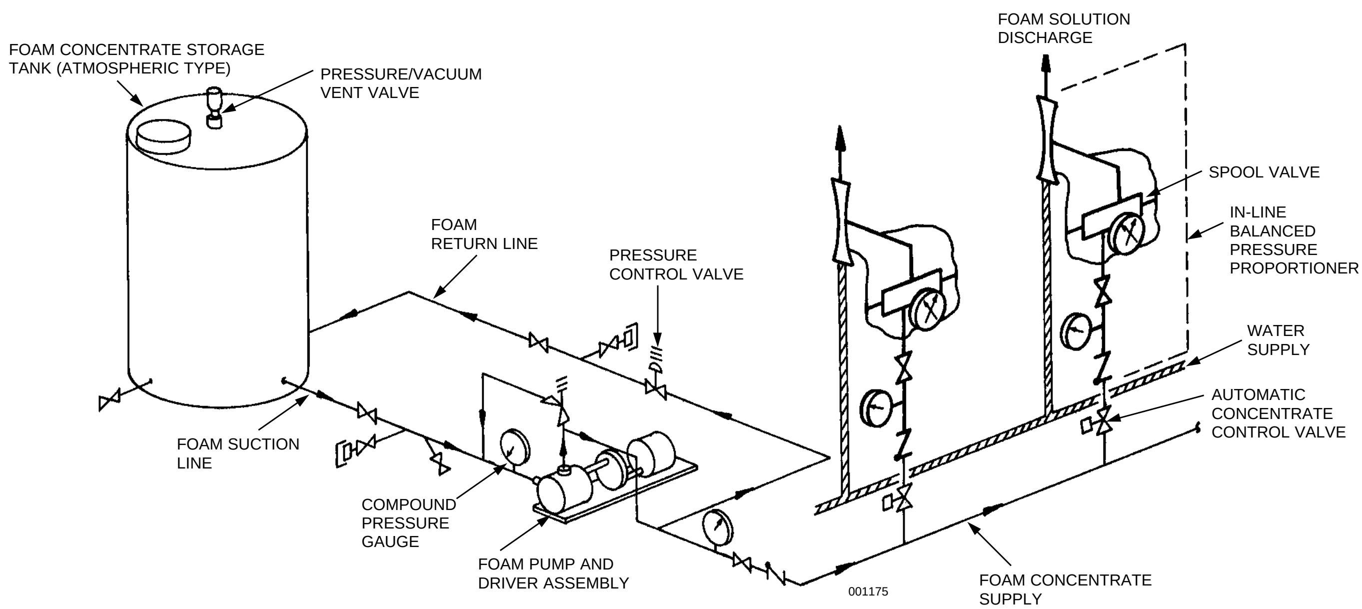
Part No. Unpainted	Part No. Standard Red Paint	Description	Approximate Shipping Weight lb	(kg)
73700	73701	Model IBP-2 In-line proportioner assembly	45	(20.4)
73702	73703	Model IBP-2 1/2 In-line proportioner assembly	45	(20.4)
73704	73705	Model IBP-3 In-line proportioner assembly	50	(22.7)
73706	73707	Model IBP-4 In-line proportioner assembly	65	(29.5)
73708	73709	Model IBP-6 In-line proportioner assembly	80	(36.3)
73710	73711	Model IBP-8 In-line proportioner assembly	135	(61.2)
73712	73713	Model IBP-2M In-line proportioner assembly	60	(27.2)
73714	73715	Model IBP-2 1/2M In-line proportioner assembly	60	(27.2)
73716	73717	Model IBP-3M In-line proportioner assembly	65	(29.5)
73718	73719	Model IBP-4M In-line proportioner assembly	90	(40.8)
73720	73721	Model IBP-6M In-line proportioner assembly	105	(47.6)
73722	73723	Model IBP-8M In-line proportioner assembly	170	(77.1)

IN-LINE BALANCED PRESSURE PROPORTIONER



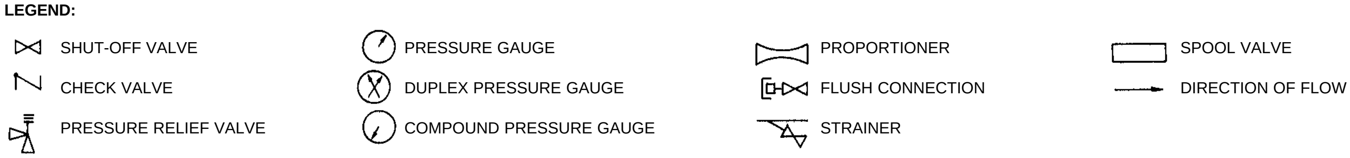
NOTE: Spool valve must be installed with the longitudinal axis in the horizontal (level) position.

TYPICAL IN-LINE BALANCED PRESSURE PROPORTIONING SYSTEM

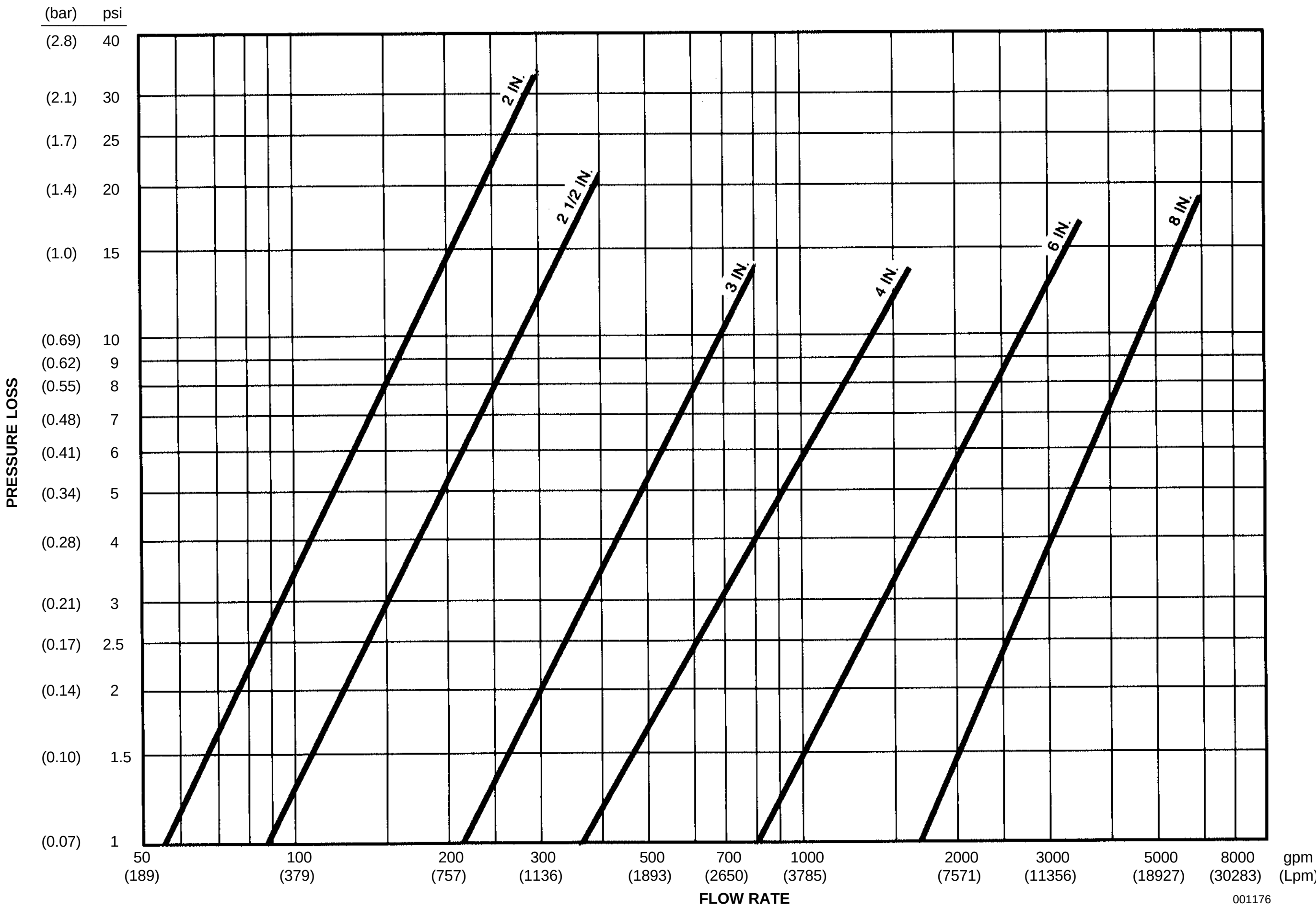


NOTE: Flush connections are only required with protein based foam concentrates.

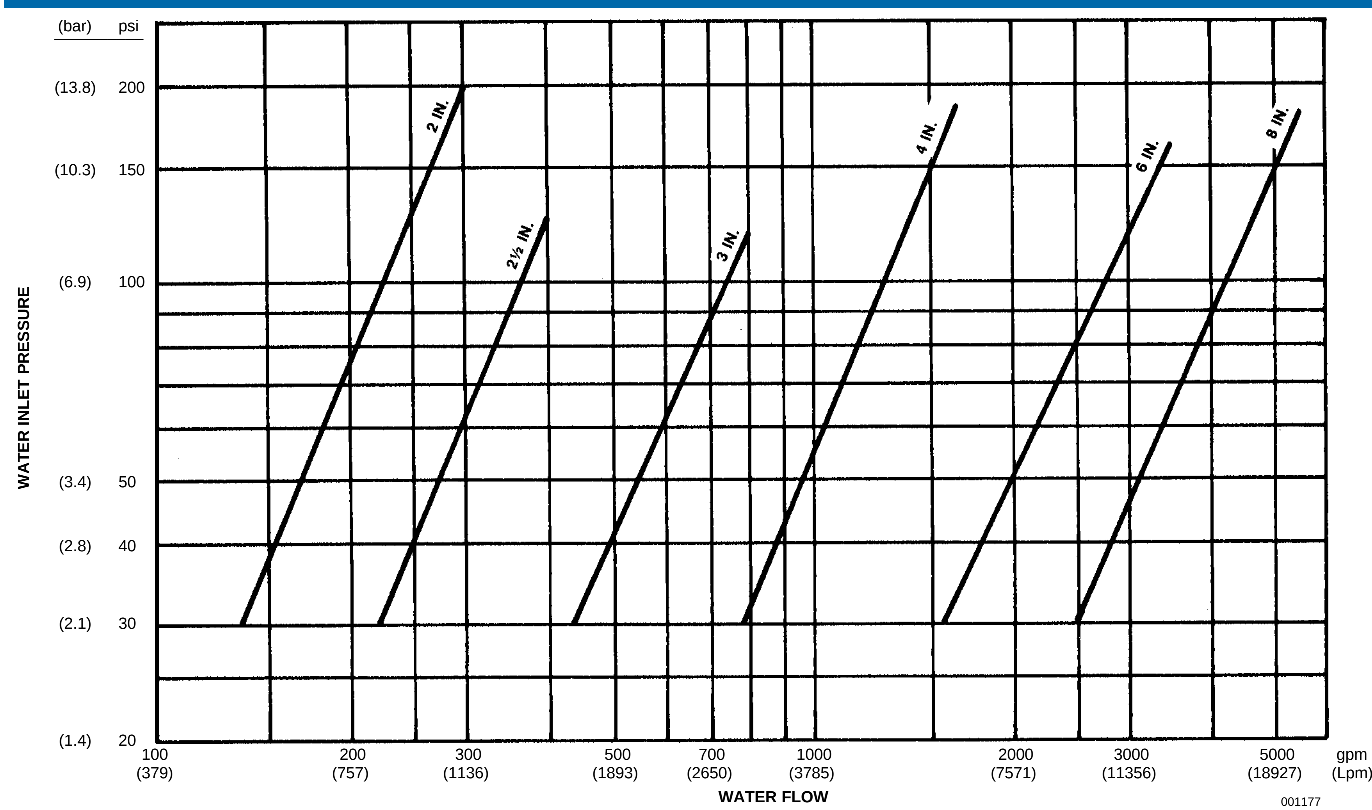
LEGEND:



FRICTION LOSS CURVES (THROUGH PROPORTIONER)



MINIMUM INLET PRESSURE VERSUS WATER FLOW



Note: The converted metric values in this document are provided for dimensional reference only and do not reflect an actual measurement.

ATMOSPHERIC POLY FOAM CONCENTRATE TANKS

Data/Specifications

ANSUL

APPLICATION

An atmospheric foam concentrate storage tank is one component of a foam proportioning system. The high density cross-linked polyethylene (XLPE) storage tanks supplied by ANSUL® are compatible with all ANSUL foam concentrates including ANSULITE® AFFF, ANSULITE Alcohol Resistant AFFF, JET-X® High Expansion, SILV-EX®, along with ANSUL 3% Protein and Fluoroprotein concentrates. Because of the excellent properties of XLPE relating to stress crack resistance, impact strength, light weight and overall toughness, poly tanks are an excellent choice for many foam system applications. An atmospheric concentrate tank is typically used in conjunction with an ANSUL "balanced pressure pump proportioning" skid unit or "in-line balanced pressure proportioning" system. Additionally, similar tanks could be used with an ANSUL "line proportioning" system.

DESCRIPTION

The atmospheric poly foam concentrate tanks are supplied with fittings as shown on drawings enclosed. There are two (2) return fittings provided on all tanks located 180 degrees apart to enable ease and flexibility for piping on site. Either connection can be used as the foam concentrate return with the other return connection having the provided pipe plug installed. The poly tanks are translucent and have a level gauge strip for approximating tank contents.

Optional tank trim components are also available including:

- Tank Trim Package (2 in. pressure/vacuum vent and 1 1/2 in. drain valve)
- Low Liquid Level Float Switch – normally open or normally closed contact
- Flex Connectors (1 1/2 in. – 6 in.)
- Seismic Restraints (Contact Ansul Technical Services for details.)

Poly tanks of alternate sizes and configurations are also available. ANSUL can also provide tanks in fiberglass, carbon steel, and stainless steel. Contact ANSUL Applications Engineering Department for additional information.

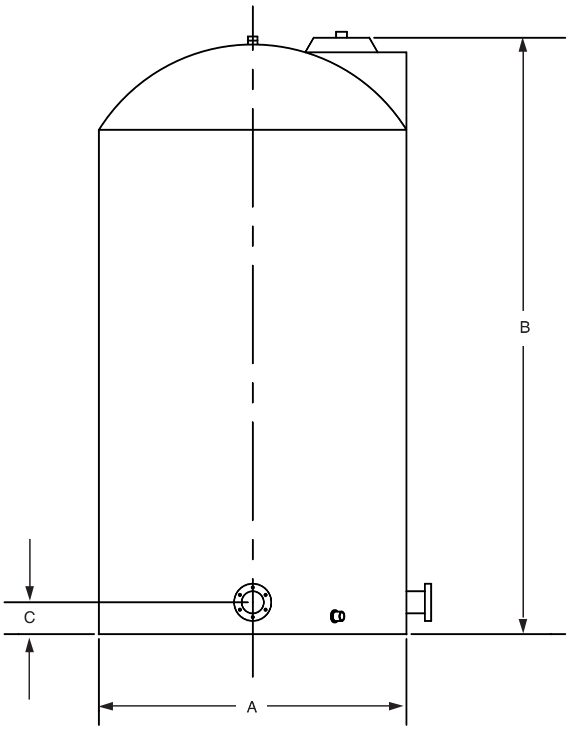
SPECIFICATIONS

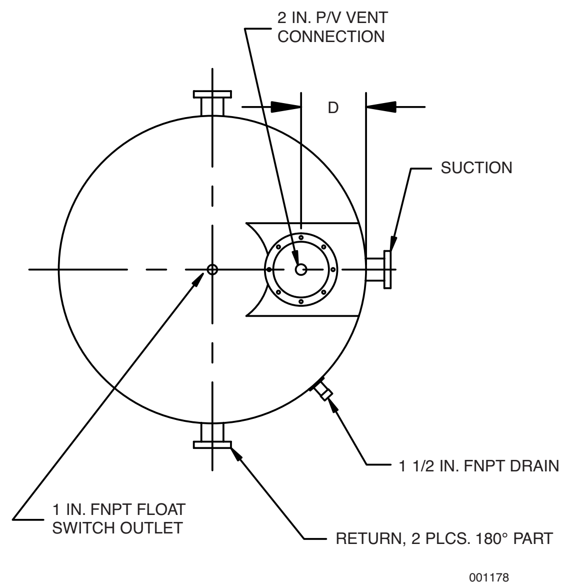
Storage tanks shall be designed for storage of foam concentrate at atmospheric pressure and shall be of vertical, cylindrical, high density cross-linked polyethylene construction. Tanks shall be equipped with the following: valved drain/fill connection, foam concentration pump suction and return connections, inspection hatch, pressure/vacuum vent valve, and gauge or unbreakable sight glass to permit visual determination of level of tank contents. The foam concentrate storage tank shall have a minimum capacity to provide sufficient foam concentrate for the time specified when the system is discharging foam solution at total maximum system flow.

ORDERING INFORMATION

Part No.	Description	Approximate Shipping Weight lb.	(kg)
416850	100 gal (379 L) Poly Foam Tank	75	(34)
416851	205 gal (776 L) Poly Foam Tank	100	(45)
416852	295 gal (1117 L) Poly Foam Tank	125	(57)
▸ 416853	475 gal (1798 L) Poly Foam Tank	130	(59)
416854	540 gal (2044 L) Poly Foam Tank	150	(68)
416855	805 gal (3047 L) Poly Foam Tank	220	(100)
416856	1000 gal (3785 L) Poly Foam Tank	250	(113)
416857	1150 gal (4353 L) Poly Foam Tank	300	(137)
416858	1450 gal (5489 L) Poly Foam Tank	350	(159)
416859	2250 gal (8517 L) Poly Foam Tank	350	(159)
416860	2550 gal (9653 L) Poly Foam Tank	450	(204)
416861	3000 gal (11356 L) Poly Foam Tank	550	(250)
416862	3900 gal (14763 L) Poly Foam Tank	800	(363)
416863	5050 gal (19116 L) Poly Foam Tank	1300	(590)
404377	Tank Trim Package (2 in. P/V Vent and 1 1/2 in. Drain Vent)	25	(11)
403508	Low Liquid Level Switch (Normally Closed Contact)	15	(7)
405777	Low Liquid Level Switch (Normally Open Contact)	15	(7)
405613	Flex Connector – 1 1/2 in.	3	(1.4)
404886	Flex Connector – 2 in.	4	(1.8)
404854	Flex Connector – 3 in.	7	(3.2)
404855	Flex Connector – 4 in.	9	(4.1)
405538	Flex Connector – 6 in.	14	(6.4)
404382	Mineral Oil Concentrate Sealer – 5 gal Pail	45	(20)

Seismic Zone Restraints are available.





Ansul Part No.	Nominal Tank Size* Gal	Nominal Tank Size* (L)	Liquid Full Capacity Gal	Liquid Full Capacity (L)	A in.	A (cm)	B in.	B (cm)	C in.	C (cm)	D in.	D (cm)	Suction Diameter	Return Diameter	Shipping Weight lb	Shipping Weight (kg)	Wall Thick. in.	Wall Thick. (cm)
416850	100	379	106	401	23.0	58.4	66.50	168.9	8.0	20.3	11.5	29.2	2 in. FNPT	1.5 in. FNPT	75	34	0.25	0.64
416851	205	776	214	810	31.0	78.7	73.50	186.7	8.0	20.3	15.5	39.4	2 in. FNPT	1.5 in. FNPT	95	43	0.25	0.64
416852	295	1117	319	1208	46.0	116.8	53.00	134.6	8.0	20.3	23.0	58.4	2 in. FNPT	1.5 in. FNPT	115	52	0.25	0.64
► 416853	475	1798	503	1904	48.0	121.9	75.00	190.5	8.0	20.3	24.0	60.9	2 in. FNPT	1.5 in. FNPT	125	57	0.25	0.64
416854	540	2044	565	2139	48.0	121.9	81.75	207.6	8.0	20.3	17.5	44.5	3 in. Flange	2 in. FNPT	165	75	0.25	0.64
416855	805	3047	834	3157	48.0	121.9	119.00	302.3	8.0	20.3	14.0	35.6	3 in. Flange	2 in. FNPT	215	98	0.25	0.64
416856	1000	3785	1164	4406	86.0	218.4	56.50	143.5	8.0	20.3	17.5	44.5	3 in. Flange	2 in. FNPT	230	104	0.31	0.79
416857	1150	4353	1229	4652	64.0	162.6	98.50	250.2	8.0	20.3	18.0	45.7	3 in. Flange	3 in. Flange	290	132	0.31	0.79
416858	1450	5489	1611	6098	86.0	218.4	75.00	190.5	8.0	20.3	16.0	40.6	3 in. Flange	3 in. Flange	310	141	0.31	0.79
416859	2250	8517	2492	9433	96.0	243.8	93.25	236.9	8.0	20.3	18.5	47.0	4 in. Flange	3 in. Flange	360	163	0.38	0.97
416860	2550	9653	2701	10224	85.0	215.9	123.50	313.7	8.0	20.3	19.0	48.3	4 in. Flange	3 in. Flange	455	206	0.38	0.97
416861	3000	11356	3173	12011	85.0	215.9	139.50	354.3	8.0	20.3	19.0	48.3	4 in. Flange	3 in. Flange	655	297	0.44	1.12
416862	3900	14763	4131	15637	94.0	238.8	152.75	388.0	10.0	25.4	23.5	59.7	6 in. Flange	4 in. Flange	880	399	0.56	1.42
416863	5050	19116	5244	19851	94.0	238.8	192.25	488.3	10.0	25.4	23.0	58.4	6 in. Flange	4 in. Flange	1550	703	0.75	1.91

* Nominal tank size is used for design purposes. Up to 1.3% of nominal tank size volume may not discharge from tank based on suction drop tube being 1" from tank bottom. (liquid pad)

Tank sizing should include room for required agent quantity + liquid pad + thermal expansion of agent (2.5% of fill volume) + required 1/4" mineral oil sealer.

Manufacturing tolerance for A and B dimensions are + / – 3% of number shown.

Notes for factory installed fittings:

1. 1.5 in. and 2 in. connections are PVC Bulk Head Type with FNPT, 3 in. and larger connections are PVC gusseted bolt on flange type which mate to Standard ANSI Flange Connection for Pipe Size shown.
2. All Flanged Connections extend 6.5 in. (17 cm) from tank wall to flange face
3. Suction connections supplied with drop tube.
4. (1) return connection supplied with appropriate plug or blind flange, float switch connection supplied with pipe plug.
5. ► ► 100-295 gallon (379-1117 L) tanks have 7 in. (18 cm) threaded inspection port; 540-1450 gallon (2044-5489 L) tanks have a 19 in. (48 cm) bolted manway with a 10 in. (25 cm) threaded inspection port. (Exception: 475 gallon (1798 L) and 1000 gallon (3785 L) tanks have 17 in. (43 cm) manway); 2250-5050 gallon (8517-19116 L) tanks have a 24 in. (61 cm) combination manway.

FOAM SYSTEMS LINE PROPORTIONERS

Data/Specifications

ANSUL

by Tyco Fire Suppression & Building Products

APPLICATION

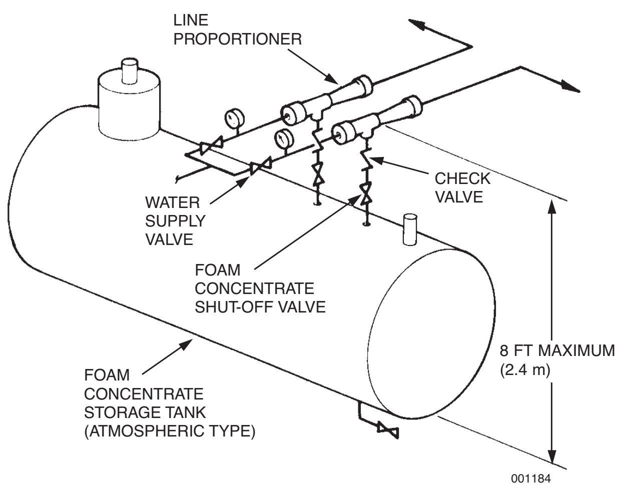
ANSUL line proportioners are designed to introduce a controlled flow of foam concentrate into a pressurized water stream. They provide an inexpensive foam proportioning means for systems requiring fixed flow rates and where available water supply pressures are adequate. Depending on specific foam systems design, line proportioners may operate with inlet pressures as low as 80 psi (552 kPa). However, in most systems a water pressure between 125 psi and 200 psi (862 and 1379 kPa) is required. The flow rate and operating pressure required at the foam making device are of primary importance in determining the required line proportioner inlet pressure. The line proportioner must match the flow rate of the foam making discharge device.

ANSUL model "PL" line proportioners can be used with all types of foam concentrates. The proportioners are available in a wide range of sizes for fixed foam system applications. These applications also require an atmospheric foam concentrate storage tank as shown in the Typical Line Proportioning System schematic.

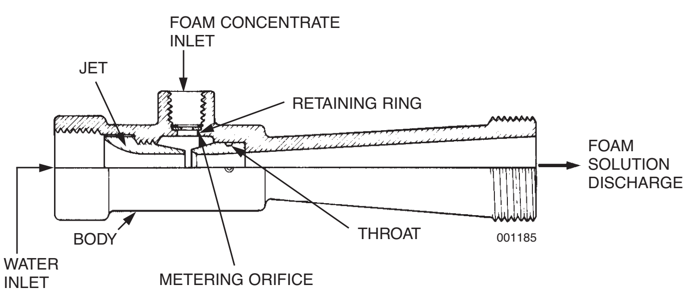
Portable line proportioners with fire hose thread connections (typically for use with matched handline nozzles) are also available for the PL-60 through PL-350 sizes.

Typical applications include use by municipal fire departments and CFR type vehicles, or with fixed systems for protecting flammable liquid storage tanks, loading racks, dike areas, and anywhere flammable liquids are used, stored, processed, or transported.

Typical Line Proportioning System



Line Proportioner Cross Section



DESCRIPTION

Each ANSUL line proportioner consists of a body, jet, throat, and metering orifice – all of which are corrosion-resistant brass.

The line proportioner body is designed with a female NPT threaded inlet and a male NPT threaded outlet (see Line Proportioner Dimensions). The proportioner body is clearly marked with a flow direction arrow and the designed concentration percentage.

The inlet jet is secured by a stainless steel retaining ring on models PL-60 through PL-350; the inlet jet is threaded in place on models PL-420 through PL-730. The metering orifice or adjustable metering valve is sized according to the type and percentage of foam concentrate used. The metering orifice is secured with a stainless steel retaining ring to enable ease of change-over to other concentrate percentages.

In fixed systems, the line proportioner may be mounted at a maximum distance of 8 ft (2.4 m) above the minimum foam liquid surface.

SPECIFICATIONS

The line proportioner body, jet, and throat shall be of brass construction. Retaining rings for both the inlet jet and the metering orifice shall be stainless steel.

The line proportioner body shall have a female NPT inlet and male NPT outlet (see Line Proportioner Dimensions). The body shall be clearly marked with a flow direction arrow and the percentage of foam concentrate that the proportioner was designed to provide.

The convergent inlet jet shall have a rounded inlet and a smooth machined finish to ensure minimum friction loss. It shall be retained by a stainless steel retaining ring or shall be threaded in place. The inlet jet shall terminate in the foam concentrate annulus chamber, and shall be concentric with and set back from the throat and pressure recovery section. Line proportioner outlet pressure recovery shall be 65% of the inlet pressure. The line proportioner shall be approved for mounting up to a maximum height of 8 ft (2.4 m) above the minimum foam liquid surface.

The foam concentrate metering orifice shall be machined to the proper diameter for the agent. It shall rest on a machined surface to prevent leakage and shall be secured by a removable stainless steel retaining ring.

ORDERING INFORMATION

Line Proportioner Model	Part No. with 3% Concentrate Orifice	Part No. with 6% Concentrate Orifice	Approximate Shipping Weight lb	(kg)
PL-60	75650	75656	7	(3.2)
PL-95	75662	75668	7	(3.2)
PL-120	75674	75679	12	(5.4)
PL-210	75684	75689	19	(8.6)
PL-240	76890	76895	19	(8.6)
PL-280	75694	75699	19	(8.6)
PL-350	75704	75709	19	(8.6)
PL-420	71508	71504	24	(10.9)
PL-480	71518	71514	24	(10.9)
PL-550	71528	71524	24	(10.9)
PL-600	71538	71534	29	(13.2)
PL-660	71548	71544	29	(13.2)
PL-730	71558	71554	29	(13.2)

Flow Rate at Given Pressure

Line Proportioner Model	K Factor Water (No Proportioning)	K Factor 3%	K Factor 6%
PL-60	4.3	4.5	4.6
PL-95	6.7	7.0	7.1
PL-120	8.5	8.8	9.0
PL-210	15.3	15.9	16.2
PL-240	16.8	17.4	17.8
PL-280	20.2	21.0	21.5
PL-350	26.3	27.2	27.9
PL-420	32.1	33.2	34.1
PL-480	35.5	36.8	37.7
PL-550	41.8	43.3	44.4
PL-600	44.2	45.8	46.9
PL-660	50.1	51.9	53.2
PL-730	56.3	58.4	59.8

Formula: $Q = (K\sqrt{P})$

Example: Find flow of PL-350 @ 180 psi (1241 kPa) when used with a 3% foam concentrate:

PL-350 3% K Factor		27.2
Square root of 180 psi	X	13.41
FLOW RATE		365 gpm @ 180 psi (1382 Lpm @ 1241 kPa)

INSTALLATION REQUIREMENTS

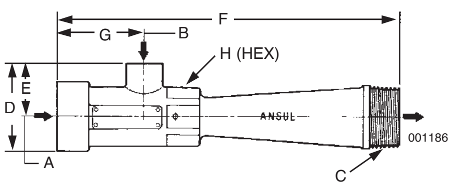
1. The line proportioner must not be mounted more than 8 ft (2.4 m) above the minimum foam concentrate liquid level as shown on Page 1.
2. Downstream pipe, fittings, elevation head, and discharge devices must not result in line proportioner outlet backpressure in excess of 65% of line proportioner inlet pressure. (Consult with the system designer to verify.)
3. A check valve must be installed in the foam concentrate line with the direction of flow from the foam concentrate storage tank to the line proportioner. (See Page 1.)
4. A shutoff valve in the foam concentrate line is recommended to enable flush out of foam solution piping or allow for water only discharge. (See Page 1.)
5. Piping to foam concentrate inlet must be sized to match the foam concentrate inlet piping size. (See Dimension B below.)
6. The foam concentrate inlet line should not exceed 11 ft (3.4 m) of pipe, two 90° elbows, one swing check valve, and one nonrestricting shutoff valve.

NOTICE

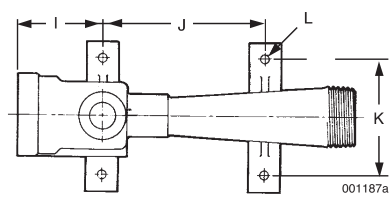
Exceeding foam concentrate line limitations or using pipe sizes smaller than the foam concentrate inlet of the line proportioner may reduce concentration percentages.

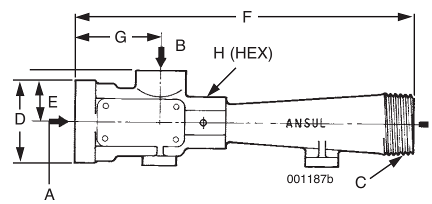
LINE PROPORTIONER DIMENSIONS

MODELS PL-420 THROUGH PL-730



MODELS PL-60 THROUGH PL-350





Dimensions – Inches (cm)

	A	B	C	D	E	F	G	H	I	J	K	L
PL-60	1 1/2 – 11 1/2 NPT	1/2 – 14 NPT	1 1/2 – 11/12 NPT	2.50 (6.35)	1.59 (4.04)	10.00 (25.40)	2.47 (6.27)	1.25 (3.18)	2.47 (6.25)	5.00 (12.70)	3.50 (8.89)	.281 (.714)
PL-95	1 1/2 – 11 1/2 NPT	1/2 – 14 NPT	1 1/2 – 11/12 NPT	2.50 (6.35)	1.59 (4.04)	10.25 (26.04)	2.63 (6.68)	1.38 (3.51)	2.63 (6.68)	5.00 (12.70)	3.50 (8.89)	.281 (.714)
PL-120	2 1/2 – 8 NPT	1/2 – 14 NPT	2 1/2 – 8 NPT	3.56 (9.04)	2.38 (10.80)	14.25 (36.20)	2.88 (7.32)	2.00 (5.08)	2.88 (7.32)	8.00 (20.32)	3.50 (8.89)	.281 (.714)
PL-210	2 1/2 – 8 NPT	1 – 11 1/2 NPT	2 1/2 – 8 NPT	3.75 (9.53)	2.69 (6.83)	16.00 (40.64)	4.25 (10.80)	2.63 (6.68)	4.25 (10.80)	8.50 (21.59)	4.00 (10.16)	.343 (.87)
PL-240	2 1/2 – 8 NPT	1 – 11 1/2 NPT	2 1/2 – 8 NPT	3.75 (9.53)	2.69 (6.83)	16.00 (40.64)	4.25 (10.80)	2.63 (6.68)	4.25 (10.80)	8.50 (21.59)	4.00 (10.16)	.343 (.87)
PL-280	2 1/2 – 8 NPT	1 – 11 1/2 NPT	2 1/2 – 8 NPT	3.75 (9.53)	2.69 (6.83)	16.00 (40.64)	4.25 (10.80)	2.63 (6.68)	4.25 (10.80)	8.50 (21.59)	4.00 (10.16)	.343 (.87)
PL-350	2 1/2 – 8 NPT	1 – 11 1/2 NPT	2 1/2 – 8 NPT	3.75 (9.53)	2.69 (6.83)	16.00 (40.64)	4.25 (10.80)	2.63 (6.68)	4.25 (10.80)	8.50 (21.59)	4.00 (10.16)	.343 (.87)
PL-420	2 1/2 – 8 NPT	1 – 11 1/2 NPT	3 – 8 NPT	4.03 (10.24)	2.97 (7.54)	18.38 (46.69)	4.75 (12.07)	3.00 (7.62)				
PL-480	2 1/2 – 8 NPT	1 – 11 1/2 NPT	3 – 8 NPT	4.03 (10.24)	2.97 (7.54)	18.38 (46.69)	4.75 (12.07)	3.00 (7.62)				
PL-550	2 1/2 – 8 NPT	1 – 11 1/2 NPT	3 – 8 NPT	4.03 (10.24)	2.97 (7.54)	18.38 (46.69)	4.75 (12.07)	3.00 (7.62)				
PL-600	3 – 8 NPT	1 1/4 – 11 1/2 NPT	4 – 8 NPT	4.38 (11.13)	3.21 (8.15)	20.19 (51.28)	5.06 (12.85)	3.25 (8.26)				
PL-660	3 – 8 NPT	1 1/4 – 11 1/2 NPT	4 – 8 NPT	4.38 (11.13)	3.21 (8.15)	20.19 (51.28)	5.06 (12.85)	3.25 (8.26)				
PL-730	3 – 8 NPT	1 1/4 – 11 1/2 NPT	4 – 8 NPT	4.38 (11.13)	3.21 (8.15)	20.19 (51.28)	5.06 (12.85)	3.25 (8.26)				

NOTICE

Mounting feet are not provided with models PL-420 through PL-730.

tyco
Fire Suppression
& Building Products

www.ansul.com
One Stanton Street
Marinette, WI 54143-2542

AROUND-THE-PUMP PROPORTIONING SYSTEMS

Data/Specifications

ANSUL

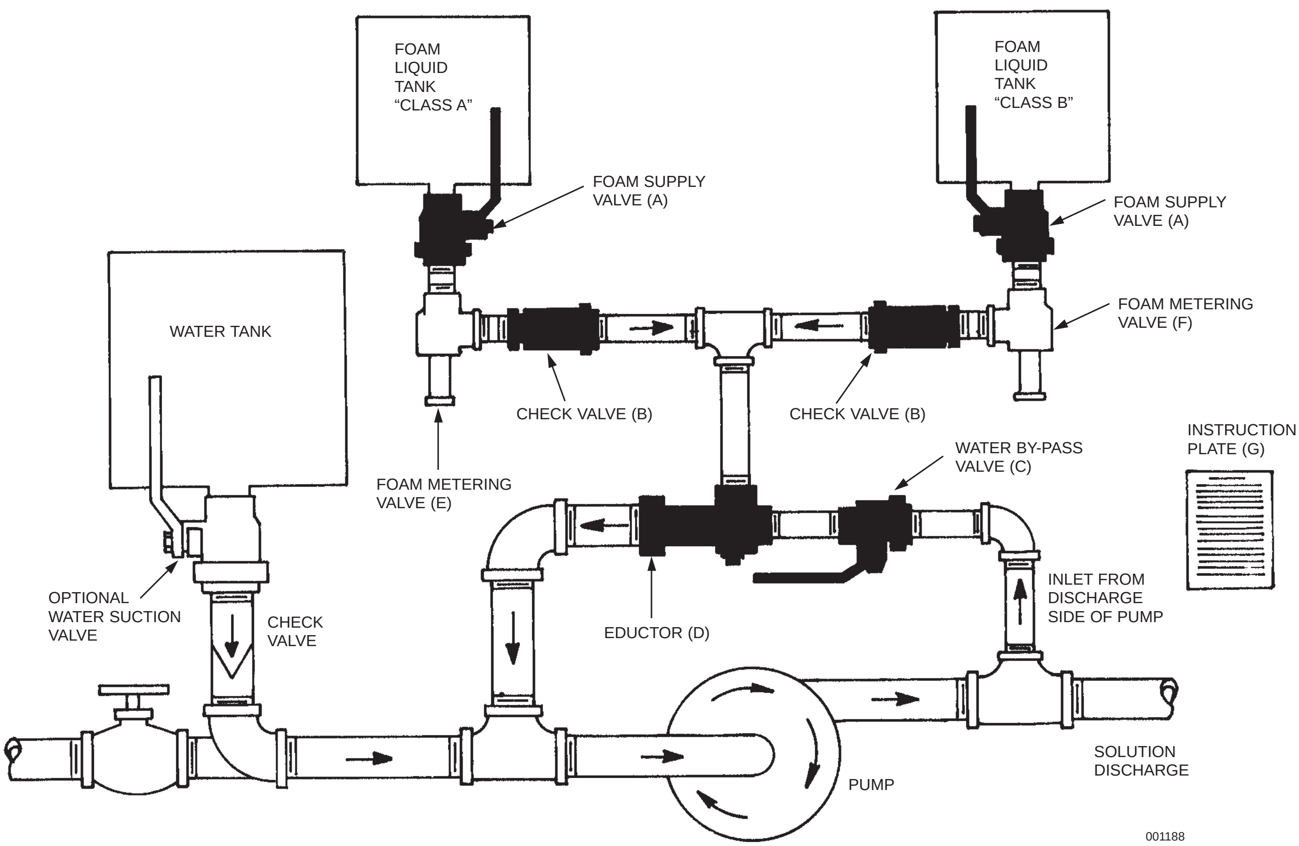
APPLICATION

The ANSUL® Around-The-Pump proportioning systems provide a simple and effective means to introduce a foam concentrate at the desired percentage to the water being discharged in a fire pump system. The number of different foam concentrates is only limited by available space as each foam concentrate would require its own separate tank. The types of foam concentrates might typically include ANSULITE® AFFF of either 1%, 3%, or 6%; ANSULITE AR-AFFF of either 3X3 LV or ARC types; or SILV-EX® Class A foam concentrate. A fire truck pumper system may therefore have a dual proportioning system with one tank having a Class B foam concentrate for flammable liquid fires and a second tank having Class A foam concentrate for structural fire attack or other ordinary combustible fire materials.

Besides applications for fire pumper trucks, an around-the-pump proportioning system can be used aboard various shipboard applications where the addition of foam to water is desired to enhance the fire fighting operations. Only a fire pump with the inlet pressure to the pump not exceeding 10 psi is required for proper operation. The sole limitations are that the flow rate is within the around-the-pump proportioning system range with the type of foam concentrate selected.

DESCRIPTION

With an ANSUL Around-The-Pump proportioning system a small portion of the discharge from the pressure side of the pump serves as a “drive motor” being recirculated through an eductor to the suction side of the pump. The eductor is a modified venturi device which creates a suction, drawing foam concentrate into it at a rich ratio. At the junction point of the piping from the eductor and the water suction line, the rich foam solution is mixed with the incoming water and is diluted to the proper foam solution concentration. After the initial cycle, the operation is continuous, with a portion of the foam solution utilized as the “drive motor.” Adjustment of a foam concentrate metering valve is initially required, but once properly set, the operation is continuous and automatic. In the event of a complete shutdown at the discharge nozzle(s), the system is check valved to prevent entry of water into the concentrate storage tank.



TECHNICAL INFORMATION

Dual B-2 Package – Part No. 420011

Flow Rate*	Type of Foam Concentrate	A	B	C	D	E	F	G
20-400 gpm (75-1514 lpm)	Class A and B	(2) 1 in Supply Valves Part No. 420081	(2) 1 in Check Valves Part No. 420783	3/4 in By-Pass Valve Part No. 420080	Eductor Part No. 420016 3/4 in water inlet 1 in foam concentrate inlet 1 1/2 in foam solution outlet	Class A 1 in Foam Metering Valve Part No. 420018	Class B 1 in Foam Metering Valve Part No. 420017	Instruction Plate Part No. 420792
B-2 Package – Part No. 420012								
20-400 gpm (75-1514 lpm)	Class B	1 in. Supply Valve Part No. 420081	1 in. Check Valve Part No. 420783	3/4 in. By-Pass Valve Part No. 420080	Eductor Part No. 420016 3/4 in. water inlet 1 in foam concentrate inlet 1 1/2 in foam solution outlet	——	Class B 1 in Foam Metering Valve Part No. 420017	Instruction Plate Part No. 420792
W-2 Package – Part No. 420013								
20-400 gpm (75-1514 lpm)	Class A	1 in Supply Valve Part No. 420081	1 in Check Valve Part No. 420783	3/4 in By-Pass Valve Part No. 420080	Eductor Part No. 420016 3/4 in water inlet 1 in foam concentrate inlet 1 1/2 in foam solution outlet	Class A 1 in Foam Metering Valve Part No. 420018	——	Instruction Plate Part No. 420792
1200 Package – Part No. 420014								
60-1200 gpm (227-4543 lpm)	Class B	1 in Supply Valve Part No. 420081	1 in Check Valve Part No. 420783	3/4 in By-Pass Valve Part No. 420080	Eductor Part No. 420795 3/4 in water inlet 1 in foam concentrate inlet 1 1/2 in foam solution outlet	——	Class B 1 in Foam Metering Valve Part No. 420019	Instruction Plate Part No. 420800
1600 Package – Part No. 420015								
150-1600 gpm (568-6057 lpm)	Class B	1 1/2 in Supply Valve Part No. 420083	1 1/2 in Check Valve Part No. 420831	1 1/2 in By-Pass Valve Part No. 420083	Eductor Part No. 420801 2 in water inlet 2 in water foam concentrate inlet 2 in foam solution outlet Valve	——	Class B 1 1/2 in Foam Metering Part No. 420808	Instruction Plate Part No. 420832

* Flow rates listed apply to 3% ANSUL foam concentrates.

ORDERING INFORMATION

Part No.	Description	Approximate Shipping Wt. lb	(kg)
420011	ATP, Model Dual B-2 Package (20-400 gpm) Class A and B (76-1515 lpm)	60	(27)
420012	ATP, Model B-2 Package (20-400 gpm) Class B (76-1515 lpm)	50	(23)
420013	ATP, Model W-2 Package (20-400 gpm) Class A (76-1515 lpm)	50	(23)
420014	ATP, Model 1200 Package (60-1200 gpm) Class B (227-4543 lpm)	75	(34)
420015	ATP, Model 1600 Package (150-1600 gpm) Class B (227-4543 lpm)	75	(34)

Bladder Tank Proportioning System

Modified Venturi Proportioners (Ratio Controllers)

1.0 The Foam Solution:

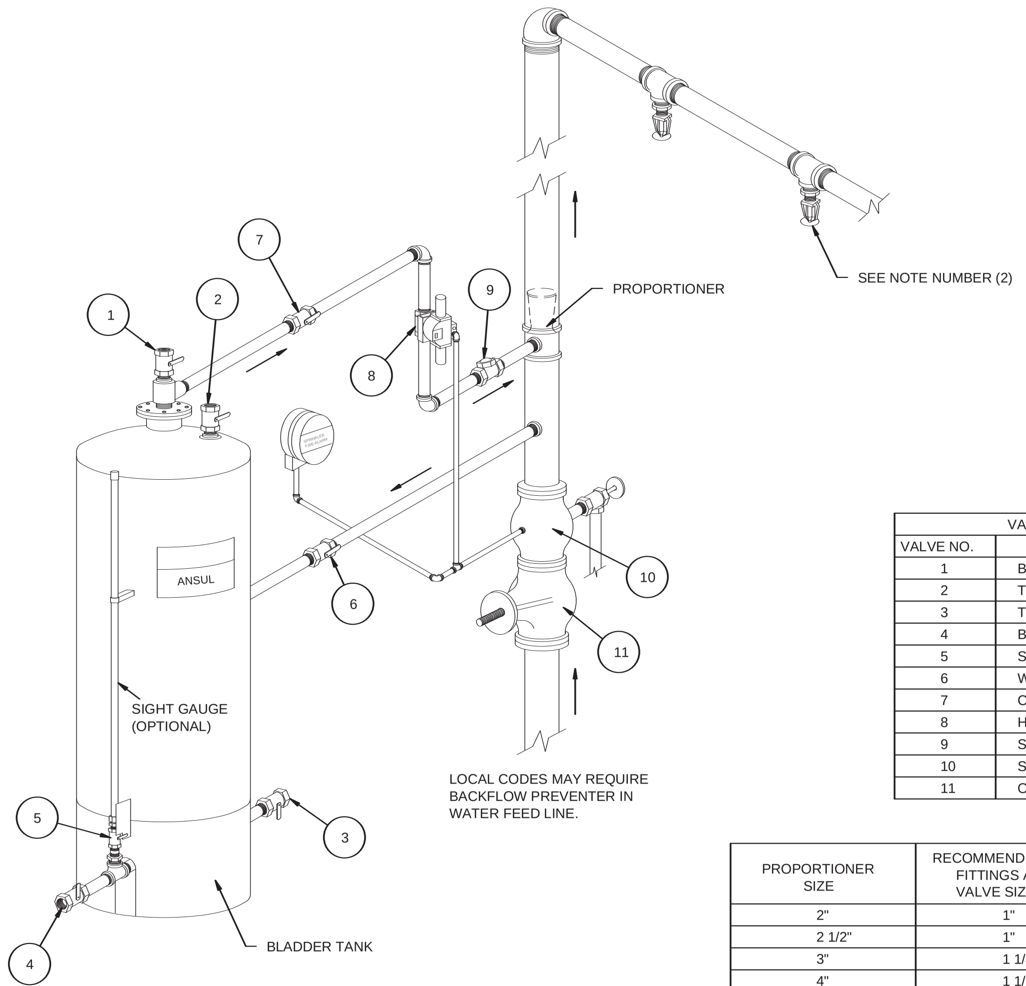
The foam solution shall be produced by introducing foam concentrate into the water stream by the balanced pressure proportioning method using a bladder (diaphragm) pressure tank and a modified venturi proportioner (ratio controller).

1.1 Bladder Tank:

Tank shall be a (vertical) (horizontal) cylindrical steel ASME coded pressure vessel with a UL Approved bladder shaped to conform to the inner pressure vessel configuration. Tank shall be designed for working pressure of 175 psi (12.1 Bar) and hydrostatically tested to at least 255 psi (17.6 Bar). The tank interior shall be coated with a high build epoxy sealer for additional corrosion resistance. The bladder tank shall be UL listed or FM approved together with the type of foam concentrate and proportioner(s) being used in the system. The bladder tank is to have a minimum __________________ gallon capacity to provide sufficient foam concentrate for the time specified when the system is discharging foam solution at total maximum system flow. The bladder tank is to be complete with all necessary outlets and supports such as a continuous welded skirt equal to tank diameter or two saddle supports as appropriate. Associated trim on the bladder tank shall include bronze pipe and fittings, four 1 in. bronze ball valves with secured nameplate depicting the valve name and operating position, and a break-resistant polycarbonate sight gauge. The tank exterior shall be primed and painted red (Standard Paint System) or (Corrosion Resistant "CR" Epoxy Paint System) for added corrosion protection. The bladder tank, proportioner, and foam concentrate shall all be the products of a single manufacturer. The bladder tank shall be an Ansul Part No. ________________ or equal.

1.2 Proportioner (Ratio Controller):

The foam proportioner(s) is to be a modified venturi type designed to accurately proportion and control the mixing of pressurized foam concentrate into the water stream. The proportioner shall have either NPT threads (2 in. and 2 1/2 in. sizes) or "between flange" or "flanged" type (3 in., 4 in., 6 in. and 8 in. sizes) designed to fit between two 150 lb. pipe flanges. Proportioner(s) shall be sized for the specified flow rate(s) and either be UL listed or FM approved with the type of foam concentrate and bladder tank being used together in the system. A fixed metering orifice, secured with a stainless steel retaining ring, shall be sized according to the type and percentage of foam concentrate used. The proportioner(s) shall be an Ansul Part No.________________or equal.



NOTES:

1. SPRINKLER VALVE MAY BE ALARM CHECK, DRY PIPE, PRE-ACTION, OR DELUGE TYPES AS REQUIRED BY SYSTEM DESIGN.

2. DISCHARGE DEVICE MAY BE SPRINKLER HEADS (AS SHOWN) OR OTHER TYPE DEVICE SUCH AS MONITOR NOZZLES, HANDLINE NOZZLES, OR FOAM CHAMBERS AS REQUIRED BY SYSTEM DESIGN.

3. ARROWS INDICATE DIRECTION OF FLOW.

4. RECOMMENDED INTERCONNECTING PIPE, FITTINGS, AND VALVE (SEE CHART, NUMBERS 6 THRU 9) SIZES TO BLADDER TANK ARE GIVEN CORRESPONDING TO PROPORTIONER SIZE.

5. PIPE, VALVES, AND FITTINGS MAY HAVE TO BE UPSIZED TO ENSURE MINIMAL FRICTION LOSS BASED ON THE MEDIAN FLOW OF THE PROPORTIONER SELECTED. 2 PSI IS CONSERVATIVELY THE MAXIMUM PRESSURE DIFFERENTIAL BETWEEN THE WATER INLET AND THE CONCENTRATE INLET AT THE PROPORTIONER.

6. THE HYDRAULIC CONCENTRATE VALVE (VALVE #8) MAY BE ELIMINATED ON AN AUTOMATIC SYSTEM HAVING ONE PROPORTIONER PROVIDED THE PROPORTIONER IS LOCATED AT AN ELEVATION AT OR ABOVE THE BLADDER TANK FOAM CONCENTRATE OUTLET CONNECTION LOCATED AT THE TOP OF THE TANK.

VALVE DESCRIPTION			NORMAL POSITION	
VALVE NO.	DESCRIPTION		MANUAL SYSTEM	AUTO SYSTEM
1	BLADDER VENT/FILL	- 1"	CLOSED	CLOSED
2	TANK SHELL VENT	- 1"	CLOSED	CLOSED
3	TANK SHELL DRAIN	- 1"	CLOSED	CLOSED
4	BLADDER DRAIN/FILL	- 1"	CLOSED	CLOSED
5	SIGHT GAUGE (OPTIONAL)	- 1/2"	CLOSED	CLOSED
6	WATER INLET		OPEN	OPEN
7	CONCENTRATE SUPPLY		CLOSED	OPEN
8	HYDRAULIC CONCENTRATE		---	CLOSED
9	SWING CHECK		---	---
10	SPRINKLER ACTUATION/ALARM		---	CLOSED OR OPEN
11	OS&Y		CLOSED	OPEN

PROPORTIONER SIZE	RECOMMENDED PIPE FITTINGS AND VALVE SIZES
2"	1"
2 1/2"	1"
3"	1 1/4"
4"	1 1/2"
6"	2"
8"	2 1/2"

TYPICAL BLADDER TANK SYSTEM
PIPING REQUIREMENTS

ANSUL
ANSUL FIRE PROTECTION
MARINETTE, WI 54143-2542

DATE	SCALE		DRAWING NUMBER	REV.
3/19/07	NONE		AE-60059	1
DWN. CNH	CHKD. JEV	APPD. KRO	SHEET 1 OF 1	

001205

Bladder Tank Proportioning System

FLOWMAX® CL Variable Range Proportioner

1.0 The Foam Solution:

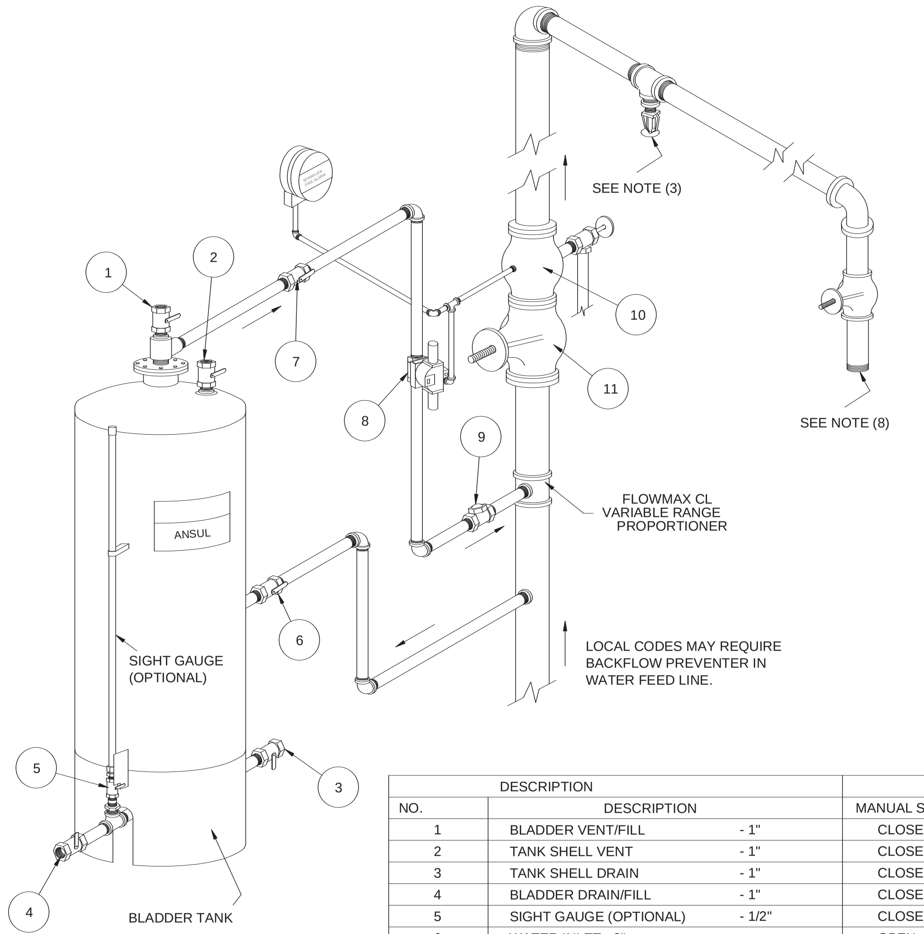
The foam solution shall be produced by introducing foam concentrate into the water stream by the balanced pressure proportioning method using a bladder (diaphragm) pressure tank and a FLOWMAX® CL Variable Range Proportioner.

1.1 Bladder Tank:

Tank shall be a (vertical) (horizontal) cylindrical steel ASME coded pressure vessel with a UL Approved bladder shaped to conform to the inner pressure vessel configuration. Tank shall be designed for working pressure of 175 psi (12.1 Bar) and hydrostatically tested to at least 255 psi (17.6 Bar). The tank interior shall be coated with a high build epoxy sealer for additional corrosion resistance. The bladder tank shall be UL listed or FM approved together with the type of foam concentrate and proportioner(s) being used in the system. The bladder tank is to have a minimum __________________ gallon capacity to provide sufficient foam concentrate for the time specified when the system is discharging foam solution at total maximum system flow. The bladder tank is to be complete with all necessary outlets and supports such as a continuous welded skirt equal to tank diameter or two saddle supports as appropriate. Associated trim on the bladder tank shall include bronze pipe and fittings, four 1 in. bronze ball valves with secured nameplate depicting the valve name and operating position, and a break-resistant polycarbonate sight gauge. The tank exterior shall be primed and painted red (Standard Paint System) or (Corrosion Resistant “CR” Epoxy Paint System) for added corrosion protection. The bladder tank, proportioner, and foam concentrate shall all be the products of a single manufacturer. The bladder tank shall be an Ansul Part No. ________________ or equal.

1.2 Proportioner:

The foam proportioner(s) is to be a FLOWMAX CL Variable Range Proportioner designed to accurately proportion and control the mixing of pressurized foam concentrate (3% AFFF or 3X3LV AR-AFFF) into the water stream from 25-3000 GPM. The proportioner body shall be designed to fit between two 6 in. 150 lb. pipe flanges. The proportioner shall be UL listed and FM approved with the type of foam concentrate and bladder tank being used together in the system. The proportioner body shall be of brass construction with a stainless steel deflector, spring, foam metering cone and orifice. The proportioner(s) shall be an Ansul Part No.________________.



NOTES:

1. SPRINKLER VALVE MAY BE ALARM CHECK, DRY PIPE, OR PRE-ACTION TYPES AS REQUIRED BY SYSTEM DESIGN.
2. IT IS RECOMMENDED THAT THE FLOWMAX CL PROPORTIONER IS LOCATED ON THE SUPPLY SIDE OF THE SPRINKLER VALVE TO ALLOW STANDARD SPRINKLER VALVE DRAIN TRIM TO BE UTILIZED IF REQUIRED.
3. DISCHARGE DEVICE MAY BE SPRINKLER HEADS (AS SHOWN) OR OTHER TYPE DEVICE SUCH AS MONITOR NOZZLES, HANDLINE NOZZLES, OR FOAM CHAMBERS AS REQUIRED BY SYSTEM DESIGN.
4. ARROWS INDICATE DIRECTION OF FLOW.
5. RECOMMENDED INTERCONNECTING PIPE, FITTINGS, AND VALVE (SEE CHART, NUMBERS 6 THRU 9) SIZES TO BLADDER TANK ARE GIVEN CORRESPONDING TO PROPORTIONER SIZE.
6. THE FLOWMAX PROPORTIONER(S) CAN BE LOCATED UP TO 35 EQUIVALENT LENGTH FEET OF PIPING FROM THE CONSENTRATE OUTLET OF THE BLADDER TANK (VALVES AS SHOWN ON THIS DRAWING ARE NOT REQUIRED TO BE INCLUDED IN EQUIVALENT LENGTH CALCULATION).
7. THE HYDRAULIC CONCENTRATE VALVE (VALVE #8) MAY BE ELIMINATED ON AN AUTOMATIC SYSTEM HAVING ONE PROPORTIONER PROVIDED THE FLOWMAX PROPORTIONER IS LOCATED AT AN ELEVATION AT OR ABOVE THE BLADDER TANK FOAM CONCENTRATE OUTLET CONNECTION LOCATED AT THE TOP OF THE TANK.
8. TEST CONNECTION FOR WET PIPE SYSTEMS SHOULD BE LOCATED AT END OF SYSTEM MAIN FOR PREPRIMING PURPOSES. THE VALVE SHOULD BE SIZED FOR THE REQUIRED FLOW OF THE PROPORTIONER. CONSIDERATION SHALL BE GIVEN TO FRICTION LOSSES BEYOND THE VALVE FOR TEMPORARY FIRE HOSES USED TO DISCHARGE INTO THE SOLUTION COLLECTION AREA. METHODS OF DISPOSAL VARY-REFER TO TECHNICAL BULLETIN 52 AND 60.

DESCRIPTION			NORMAL POSITION	
NO.	DESCRIPTION		MANUAL SYSTEM	AUTO SYSTEM
1	BLADDER VENT/FILL	- 1"	CLOSED	CLOSED
2	TANK SHELL VENT	- 1"	CLOSED	CLOSED
3	TANK SHELL DRAIN	- 1"	CLOSED	CLOSED
4	BLADDER DRAIN/FILL	- 1"	CLOSED	CLOSED
5	SIGHT GAUGE (OPTIONAL)	- 1/2"	CLOSED	CLOSED
6	WATER INLET - 2"		OPEN	OPEN
7	CONCENTRATE SUPPLY - 2"		CLOSED	OPEN
8	HYDRAULIC CONCENTRATE - 2"		---	CLOSED
9	SWING CHECK - 2"		---	---
10	SPRINKLER ACTUATION/ALARM - 6"		---	CLOSED OR OPEN
11	OS&Y - 6"		CLOSED	OPEN
12	FLOWMAX CL PROPORTIONER - 6"		---	---

TYPICAL BLADDER TANK/FLOWMAX CL SYSTEM PIPING REQUIREMENTS

ANSUL®
ANSUL FIRE PROTECTION
MARINETTE, WI 54143-2542

DATE	SCALE		DRAWING NUMBER	REV.
03-19-07	NONE		AE-60124	1
DWN. EEH	CHKD.	APPD.	SHEET 1 OF 1	

007596

In-Line Balanced Pressure Proportioning

1.0 The Foam Solution: The foam solution shall be produced by introducing the foam concentrate into the water stream by the balanced pressure proportioning method using a positive displacement foam pump, atmospheric concentrate tank, and factory assembled and tested in-line balanced pressure (IBP) proportioner(s).

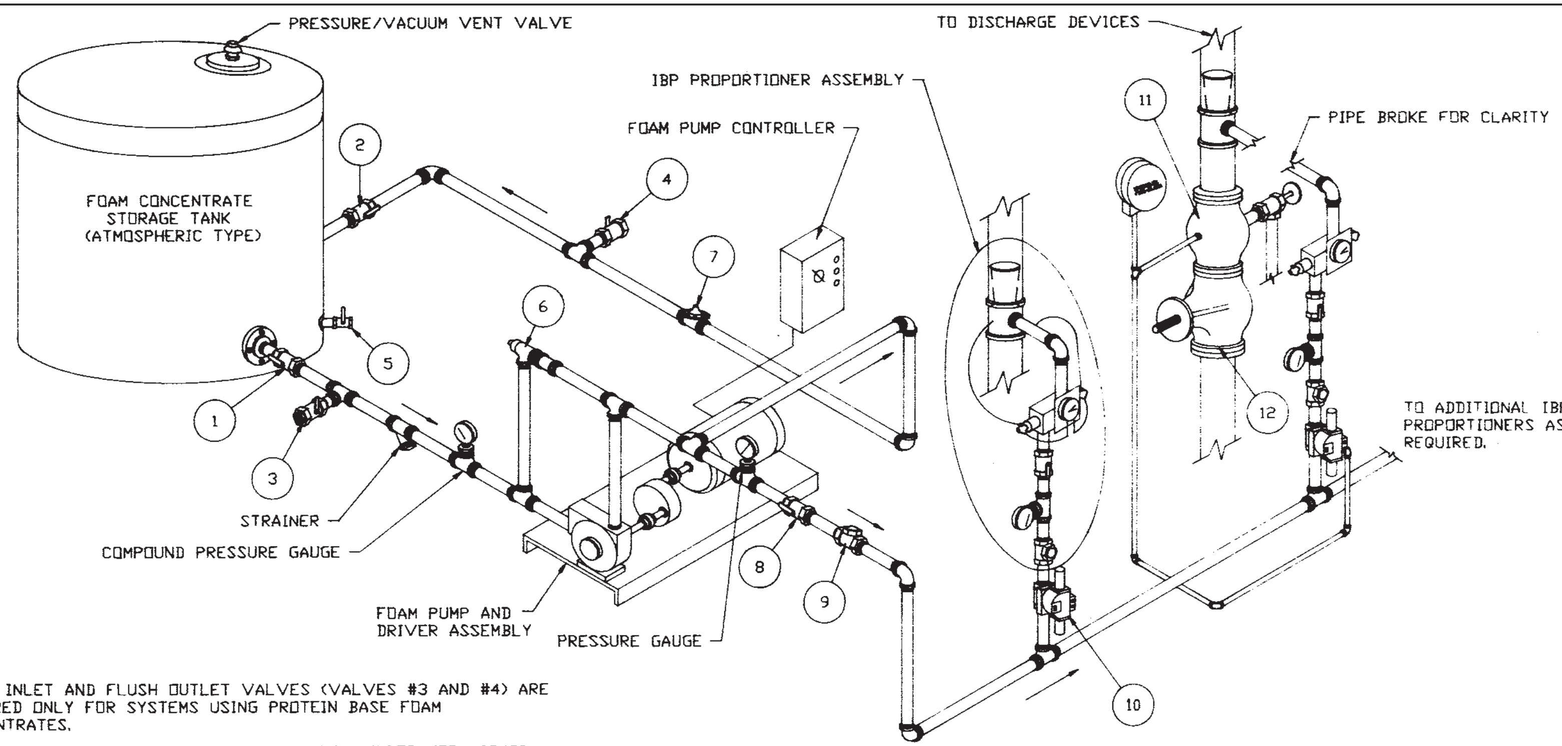
1.1 Foam Concentrate Storage Tank: Tank shall be designed for storage of foam concentrate at atmospheric pressure and shall be of vertical, cylindrical, high density cross-linked polyethylene construction. Tank shall be equipped with the following: valved drain/fill connection, foam concentrate pump suction and return connections, inspection hatch, pressure/vacuum vent valve, and gauge or unbreakable sight glass to permit visual determination of level of tank contents. The foam concentrate storage tank shall have a minimum __________________ gallon capacity to provide sufficient foam concentrate for the time specified when the system is discharging foam solution at total maximum system flow.

1.2 Foam Concentrate Pump: Pump(s) shall be a positive displacement type constructed of materials compatible with manufacturer's foam concentrate. The pump(s) shall be rated for a minimum __________ gpm at __________ psi (________ Lpm at __________ bar) using the type of foam concentrate as specified. Each pump shall be furnished with a pressure safety relief valve sized appropriately to the rated pump capacity. Pump shall be mounted on a carbon steel base and shall have guards over all couplings. Concentrate pump shall be electric motor driven, open drip-proof enclosure, 3 Phase, 60 Hertz, 230/460 Volts AC (specify if other).

1.3 Pump Controller: The foam concentrate pumps shall operate automatically and shall be controlled by a listed or approved full-service or limited-service (providing the electric motor driver is 30 HP or less) fire pump controller.

1.4 Pressure Control Valve: The pressure control valve (returning excess foam concentrate back to the storage tank) shall be a pressure-sustaining, back-pressure, hydraulically operated, pilot controlled, modulating type arranged to maintain constant upstream pressure in the foam concentrate piping as the flow rate varies. Valve shall be sized to pass the full foam concentrate pump output through it. Materials of construction shall be compatible with the foam concentrate type.

1.5 In-line Balanced Pressure (IBP) Proportioner: The IBP proportioner assembly shall be UL listed or FM approved with the type of foam concentrate being used together in the system. The IBP proportioner shall be a self-contained unit fully assembled and tested at the factory and delivered complete and ready for use. Field connections shall be limited to water, foam concentrate input, and foam solution output. The IBP proportioner(s) shall include a proportioner, integral pressure balancing spool valve, duplex gauge, inlet pressure gauge, check valve and manual ball valve with nameplate. These principle components; pipe, and fittings shall be constructed of either brass or stainless steel. The IBP proportioner(s) shall be an Ansul Part No. __________________ or equal.



NOTES:

1. FLUSH INLET AND FLUSH OUTLET VALVES (VALVES #3 AND #4) ARE REQUIRED ONLY FOR SYSTEMS USING PROTEIN BASE FOAM CONCENTRATES.
2. A FOAM CONCENTRATE STRAINER IS NOT RECOMMENDED FOR HIGHER VISCOSITY ALCOHOL RESISTANT TYPE AFFF CONCENTRATES.
3. A FOAM CONCENTRATE STRAINER MAY BE ELIMINATED WITH STORAGE TANKS NOT SUBJECT TO CORROSION INCLUDING POLYETHYLENE AND FIBERGLASS.
4. ALCOHOL RESISTANT TYPE AFFF CONCENTRATE IN AN ATMOSPHERIC STORAGE TANK SHOULD HAVE A 1/4" TO 1/2" LAYER OF MINERAL OIL ADDED TO SEAL THE CONCENTRATE AND MINIMIZE THE EFFECTS OF EVAPORATION.
5. FOAM SYSTEM MAY BE WET PIPE, DRY PIPE, PREACTION, DELUGE OR MANUAL TYPE.
6. ARROWS INDICATE DIRECTION OF FLOW.
7. THE HYDRAULIC CONCENTRATE VALVE MAY BE ELIMINATED ONLY ON MANUAL SYSTEMS WHERE THE OPERATOR WILL MANUALLY OPEN THE CONCENTRATE VALVE ON THE IBP PROPORTIONER ASSEMBLY.

VALVE DESCRITPION		NORMAL POSITION
VALVE NO.	DESCRIPTION	AUTO SYSTEM
1	FOAM CONCENTRATE SUPPLY	OPEN
2	FOAM CONCENTRATE RETURN	OPEN
3	FLUSH INLET	CLOSED
4	FLUSH OUTLET	CLOSED
5	CONCENTRATE DRAIN/FILL	CLOSED
6	PRESSURE RELIEF	---
7	PRESSURE CONTROL	---
8	CONCENTRATE SUPPLY	OPEN
9	SWING CHECK	---
10	HYDRAULIC CONCENTRATE	CLOSED
11	SPRINKLER ACT./ALARM	CLOSED OR OPEN
12	OS&Y	OPEN

TYPICAL IN-LINE BALANCED PRESSURE (IBP) PROPORTIONING SYSTEM PIPING REQUIREMENTS

ANSUL. ANSUL FIRE PROTECTION MARINETTE, WI 54143-2542

DATE	SCALE		DRAWING NUMBER	REV.
12-23-92	NONE		AE-60060	0
DWN. T. CAYER	CHKD. J. BEHNKE	APPD. K. OLSON	SHEET 1 OF 1	

001206

ASPIRATED VS. NONASPIRATED DISCHARGE DEVICES

Once a foam concentrate has been added to water to form a foam solution, there must be a point in the system to add air to the solution to produce expanded foam. This is accomplished using a discharge device of either the aspirated or nonaspirated type.

In an aspirated discharge device, foam solution passes through an orifice, past air inlets, into a mixing or expansion area, and through a discharge outlet. (See Figure 3-1.)

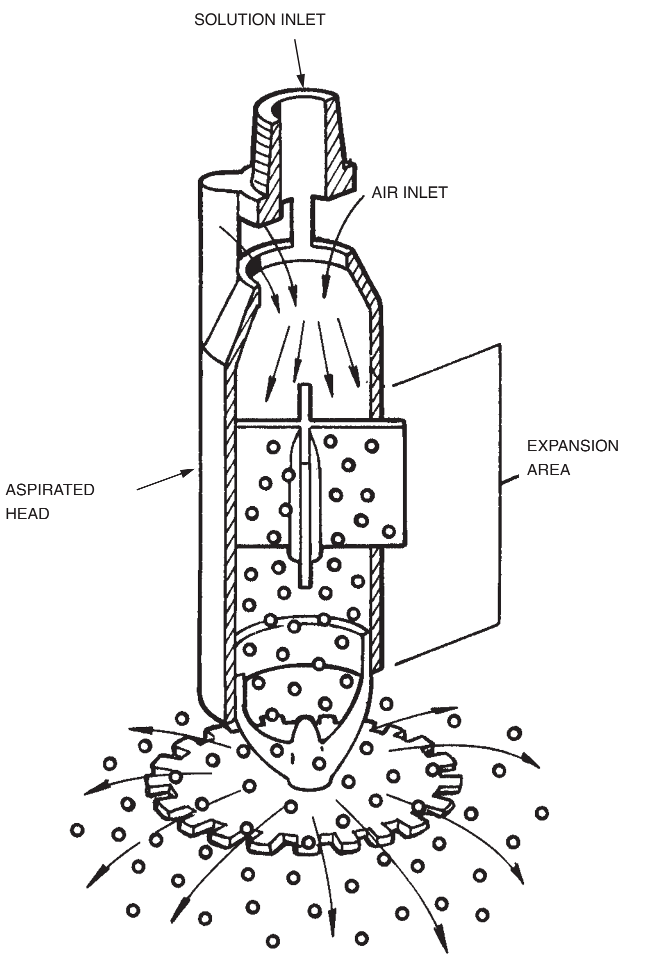


FIGURE 3-1
001207

In a nonaspirated device, foam solution passes through an orifice and stream deflector to produce droplets of solution. These droplets combine with air between the device outlet and the fuel surface to produce foam. (See Figure 3-2.) Nonaspirated devices are only used with film-forming solutions which require less energy to expand as compared with protein based or nonfluorochemical synthetic foams.

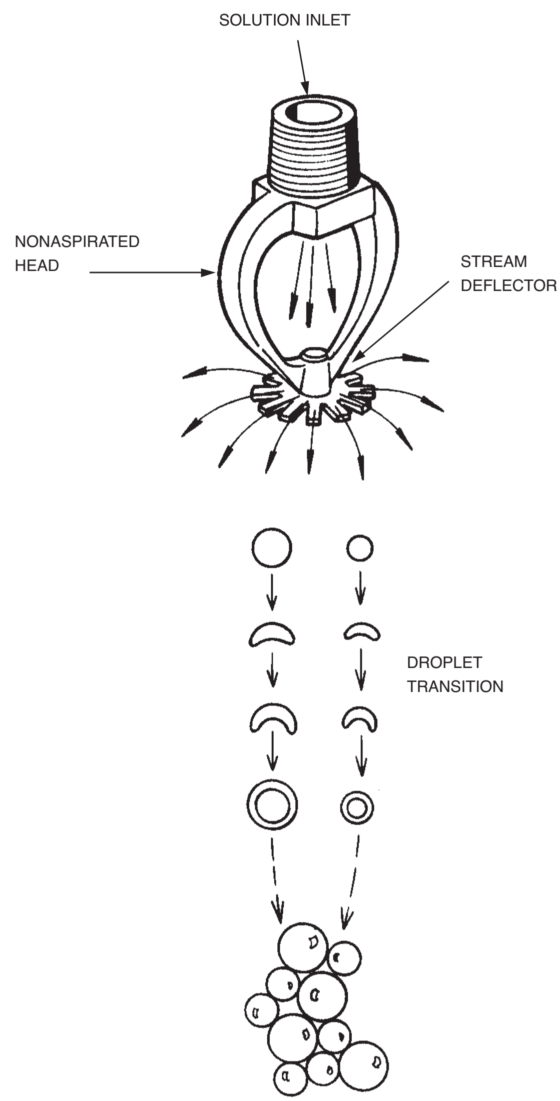


FIGURE 3-2
001208

Discharge Devices

DISCHARGE DEVICE CLASSIFICATIONS

Discharge devices are defined according to the way that they apply foam to a liquid surface.

The National Fire Protection Association classifies discharge devices as follows:

Type I Discharge Outlet – An approved discharge outlet which will conduct and deliver foam gently onto the liquid surface without submergence of the foam or agitation of the surface.

Type II Discharge Outlet – An approved discharge outlet which does not deliver foam gently onto the liquid surface, but is designed to lessen submergence of the foam and agitation of the surface.

Underwriters Laboratories lists discharge devices under the following classifications:

Type I Discharge Outlet – A device that conducts and delivers foam onto the burning surface of a liquid without submerging the foam or agitating the surface.

Type II Discharge Outlet – A device that delivers foam onto the burning liquid and partially submerges the foam and produces restricted agitation of the surface.

Type III Discharge Outlet – A device that delivers foam in a manner that causes the foam to fall directly onto the surface of the burning liquid and does so in a method that causes general agitation.

NOZZLES

The general purpose of a nozzle is to provide a restriction of flow to build fluid pressure. This pressure provides usable fluid velocity to project a stream a determined distance. In the case of foam solution, the nozzle also assists in the generation of foam.

Handline nozzles and master stream nozzles may be air aspirating or non-air aspirating devices. Air aspirating nozzles (Figure 3-3) can be used with all low expansion foam agents. These nozzles contain air inlets and an expansion tube.

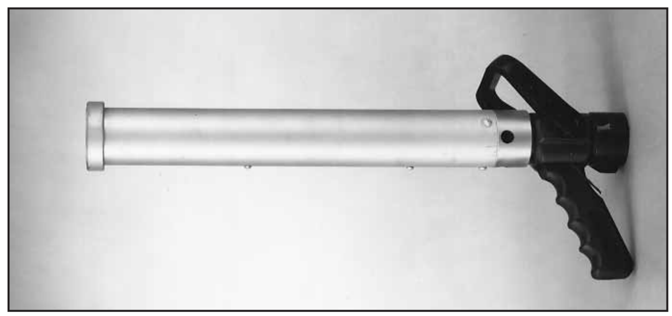


FIGURE 3-3
001209

Non-air aspirating nozzles (Figure 3-4) are standard for many fire departments where they are used mainly for applying water. In certain circumstances, these nozzles can be used for the application of AFFF and ARC solutions. In contrast, protein and fluoroprotein foams should NOT be used with non-air aspirating nozzles.

FIGURE 3-4
007686

Both aspirated and nonaspirated nozzles can be used with handlines, on monitors, and in fixed spray systems.

Discharge Devices

MONITORS

A monitor is a directional control device which delivers a large capacity stream from a nozzle. It is mounted on a stationary support at grade or elevated. A monitor can be directed by one person and may be fed solution by permanent piping or hose.

Manual Monitors

The basic monitor is a manually-operated device (Figure 3-5). It contains a swivel joint for vertical movement (elevation) and a swivel joint for horizontal movement (rotation) to direct the stream of foam/water to the required area.

FIGURE 3-5
001211

Water Oscillating Monitors

Variations of the basic manual monitor have evolved in an effort to satisfy the requirements of specific applications. The water oscillating monitor (Figure 3-6) is designed to automatically oscillate horizontally over a set area. It is powered hydraulically by water flowing through an oscillating mechanism attached to the rotation swivel joint. The elevation joint is preset by means of a locking knob. This type of monitor is also equipped with a manual override.

FIGURE 3-6
001212

Remote-Controlled Monitors

Remote-controlled monitors typically operate using an electric joystick controller and electrical motors on the monitor that control movement. This allows operation at a safe distance from the fire. Refer to FJM-High Flow Series Monitor Data Sheets.

SPECIALIZED DISCHARGE DEVICES

Specialized foam discharge devices have been manufactured for specific hazard applications.

Foam Chambers

Foam chambers (Figure 3-7) are air aspirating discharge devices (Type II) used for the protection of flammable liquid storage tanks. These devices are designed to generate foam and apply the expanded foam to the fuel surface in a manner that lessens submergence and agitation as the foam contacts the fuel.

The foam chamber contains an orifice plate (sized for the required flow and inlet pressure), air inlets, an expansion area, and a discharge deflector to direct the gentle application of the expanded foam. This device also contains a vapor seal that prevents the entrance of vapors into the foam chamber and supply pipe.

FIGURE 3-7
001214

Discharge Devices

SPECIALIZED DISCHARGE DEVICES (Continued)

High Back-Pressure Foam Makers

High back-pressure foam makers (Figure 3-8) were developed to discharge foam through a hydrocarbon liquid. This device generates foam between a 2:1 and 4:1 expansion ratio and forces the expanded foam into the bottom of a flammable liquid storage tank. The foam then rises to the top of the fuel where it blankets the surface. This type of application is not suitable for Class IA hydrocarbon liquids or polar solvent (water soluble) liquids.

The foam maker can discharge against a back-pressure as high as 40% of the operating inlet pressure. The back-pressure is the combination of the expanded foam friction loss in the piping and the static head pressure of the liquid in the tank.

FIGURE 3-8
001215

Floating Roof Foam Makers

The floating roof foam maker (Figure 3-9) is an air aspirating discharge device used primarily for the protection of open top, floating roof, storage tanks. It is also used for other applications such as dike protection where expanded foam is piped to the hazard.

The foam maker contains an orifice plate (sized for the required flow and inlet pressure), air inlets, and an expansion area. The device is connected in-line to pipe or hose.

FIGURE 3-9
001216

MANUAL MONITOR MM-1000 SERIES

Data/Specifications

ANSUL

GENERAL DESCRIPTION

The MM-1000 is designed to deliver approximately 1,000 GPM (3785 LPM), however, actual flow rate is dependant on nozzle choice. This monitor is constructed of continuous tubing which produces less friction loss and better stream reach. The balanced design reduces unwanted torque and swing, while the range of movement is easily operated with the single tiller bar.

FEATURES

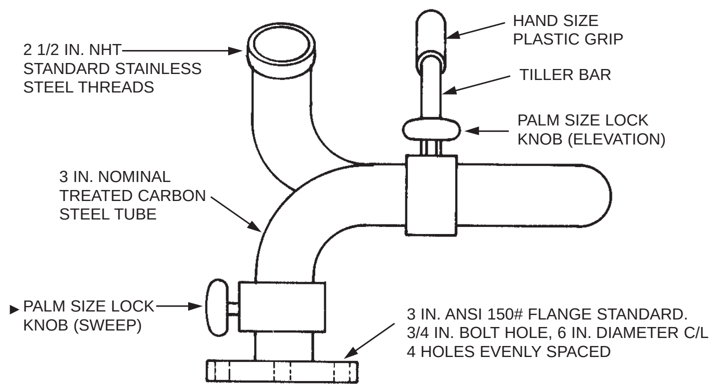
- Waterway: 3 in. nominal continuous tubing
- Nozzle: Use of Spitfire, D5 or AFN-1 Series nozzle recommended
- Sweep (rotation): Full 360°
- Elevation: 140° total vertical movement. (+90° elevation, –50° depression)
- Nozzle Threads: Male 2 1/2 in. – 7 1/2 TPI NHT, stainless steel
- Mounting: 3 in., 150 lb. ANSI flange standard. Optional 4 in., 150 lb. ANSI flange
- Finish: Red polyurethane paint
- Material: Durable carbon steel. Optional stainless steel model available (unpainted)
- Stability: Lock knobs for sweep (rotational) and elevation (vertical) movements
- Weight: 38 lb. (17.2 kg) with 3 in. flange; 40 lb. (18.1 kg) with 4 in. flange, not including nozzle. Shipping weight: 45 lb. (20.4 kg)

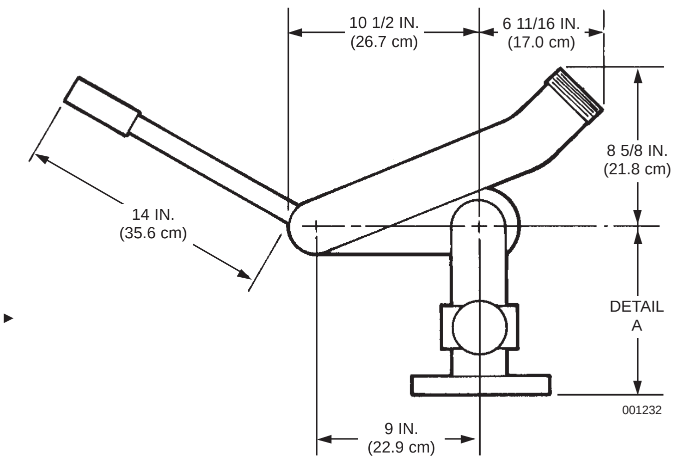
ORDERING INFORMATION

Part No.	Description
400276	MM-1000-3 Monitor with 3 in. flange
400286	MM-1000-4 Monitor with 4 in. flange
402825	SS-MM-1000-3 Stainless Steel Monitor with 3 in. flange
402826	SS-MM-1000-4 Stainless Steel Monitor with 4 in. flange

FLANGE DESCRIPTION

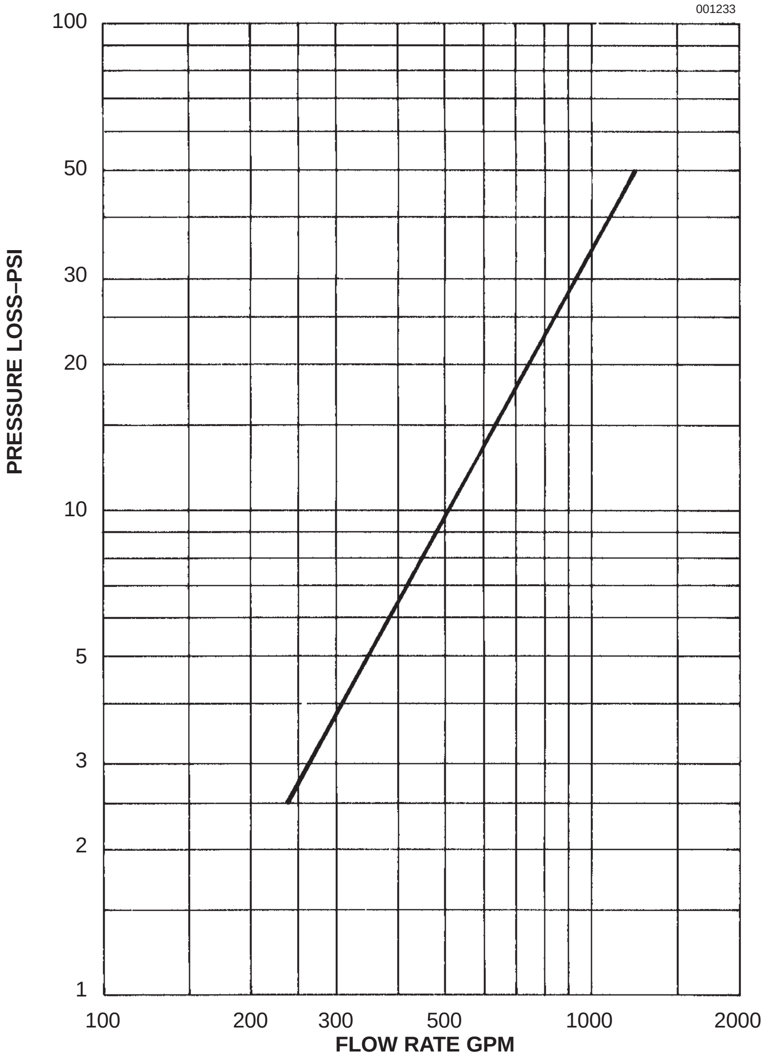
Flange Size	Hole Size	No. of Holes	Center Line Diameter
3 in. (standard)	3/4 in.	4	6 in. evenly spaced
4 in. (optional)	3/4 in.	8	71/2 in. evenly spaced





DETAIL A:
3 IN. FLANGE = 10.5 IN. (26.7 cm)
4 IN. FLANGE = 11.75 IN. (29.9 cm)

MM-1000 Monitor Friction Loss vs Flow Rate
(3 in. Waterway, 4 in. Flange, 2 1/2 in. NH Outlet



ANSUL tyco

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Form No. F-85105-3

PROTECTOR STATION MONITOR

Data/Specifications

ANSUL

FEATURES

- Built-in on/off valve
- Corrosion-resistant aluminum construction
- Direction control handle
- Valve position indicator
- Elevation locking knobs
- Pressure gauge 1/4 in. port
- Drain valve 1/4 in. port

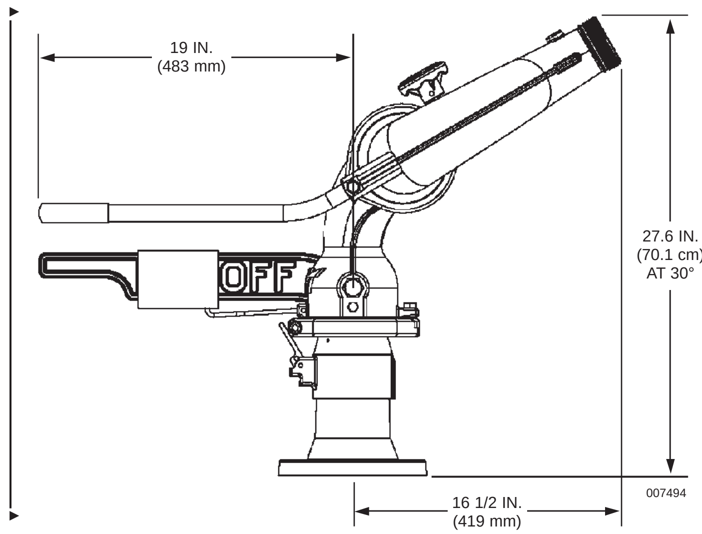
DESCRIPTION

The Protector is a completely packaged fixed station monitor with many unique features. Its unique (patent pending) waterway has low friction loss and delivers water to the nozzle with fewer twists and turns than a conventional monitor. The built-in on/off valve with position indicator eliminates the need to add a costly valve to the monitor installation.

The Protector can be directly bolted to a common 4 in. pipe flange. The outlet is available with 2.5 inch male NH threads. A long stream-straightening vane in the discharge section reduces turbulence. The simple and basic design requires no grease or other maintenance. Swiveling elements and seals (including valve seat) can be replaced in a few minutes with common hand tools.

Threaded ports (1/4 in. NPT) are provided for drain valve and pressure gauge installation. Maximum pressure is 250 psi. The Protector is constructed of UNS A03560 alloy heat treated to T6 with poly-impregnation casting treatment. It is also hardcoat anodized per military specification MIL-A-8625F Type III, Class 1 and features polyester powder-coated outer surfaces inside and out. The swivel clamps, 3 in. valve ball, trunnions and hardware are 18-8 stainless steel. The monitor may be used to deliver water or foam streams.

The Protector Station Monitor is recommended for use with ANSUL® Master Stream nozzles and ANSUL Master Foam nozzles.



DEPTH: 12 1/2 IN. (318 mm)

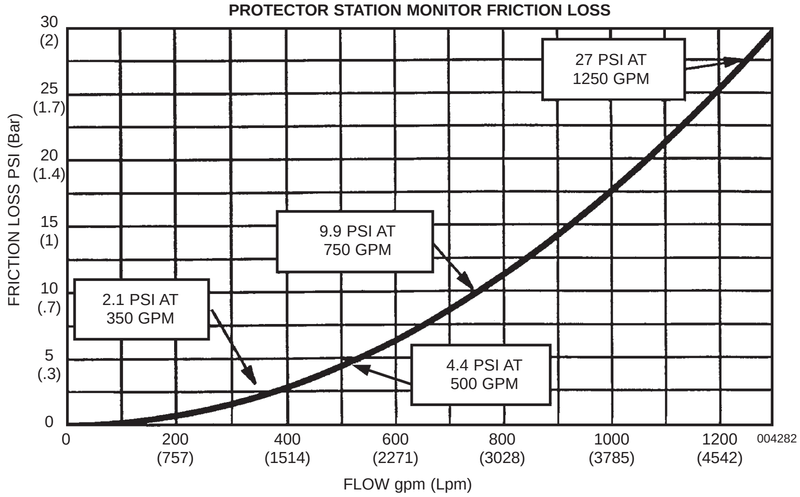
VALVE OPERATION

The built-in valve indicates the flow is OFF when the valve handle is horizontal and ON when the handle is vertical. Parts are manufactured so that the valve cannot be assembled out of phase. A position indicator shows the valve positions as “OFF: or “ON.” The position that the valve is normally left in will depend upon your particular location’s standard operating procedure.

ORDERING INFORMATION

Part No.	Description	Approximate Shipping Weight lb	(kg)
427469	Protector Station Monitor	51	(23)

PROTECTOR STATION MONITOR FRICTION LOSS



AUTOMATIC WATER OSCILLATING MONITOR
MODEL WOM-3

Data/Specifications

ANSUL

FEATURES

- The elevation lock is easily set to any angle without tools.
- Controls are **externally** accessible. (These include the test connection, selector valve, speed control valve, and in-line filter.)
- Quick winterization is easy – no readjustment of end stops, breaking of plumbing, or use of glycol pumps.
- The simple manual override is obvious in function thus reducing training requirements.
- The automatic valve circuit is simple, using only one four-way valve.
- An alternate filter package is available for applications where there is a problem with suspended particles in the water.
- Reliable chain drive which is fully accessible by an easily removable cover.
- An optional 304 stainless steel waterway is available.
- All of the working parts are made of, or plated with, corrosion-resistant materials.

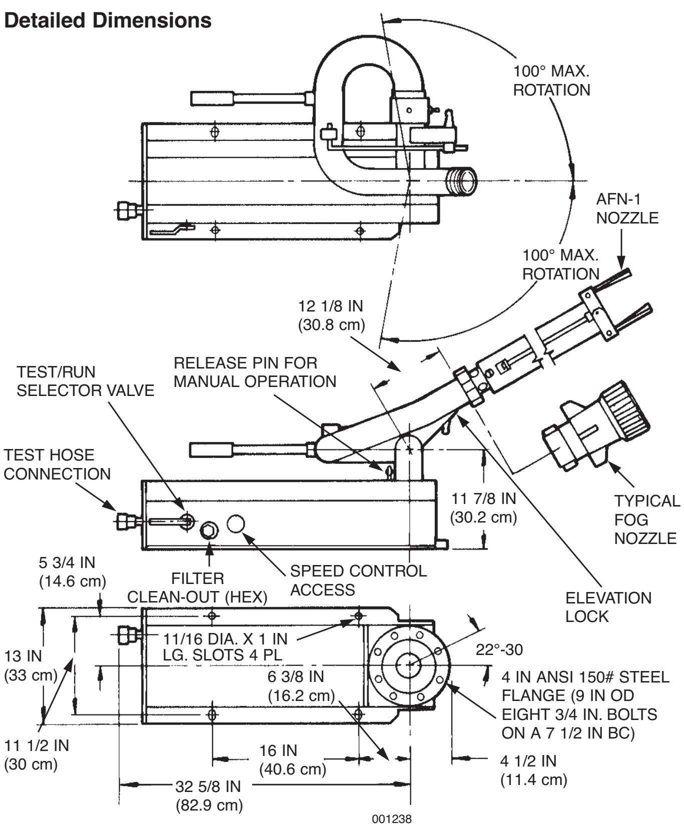
DESCRIPTION

For use with water or foam, the WOM-3 (formerly WOM-1) is a master stream device for fixed locations. The sweep is preset at installation to cover the hazard area but is also field adjustable.

Power to oscillate the monitor up to 200° horizontally comes from the water flowing through the device, eliminating the need for wiring, or hydraulic controls. Elevation is preset by means of a non-slip lock.

Water fog, straight bore or air aspirating nozzles may be used with this 1,000 gpm (3785 Lpm) capacity device.

Detailed Dimensions



SPECIFICATIONS AND MATERIALS

The monitor is operated by a reciprocating, water-powered piston and cylinder. A small flow of water, by-passed from the monitor inlet through a four-way valve, drives the cylinder. A stroke adjustment nut at each end of a threaded rod actuates the toggle action four-way valve, automatically reversing the cylinder at each end of the stroke. A stainless roller chain, attached to the cylinder heads and engaging a sprocket on the monitor base, converts the reciprocating cylinder motion to the oscillating motion.

INLET
4 in. 150 lb (8-hole) steel flange.

DISCHARGE
2 1/2 in. – 7 1/2 TPI NHT male thread.

VERTICAL RANGE SETTING
30° below horizontal to 60° above.

ARC OF OSCILLATION
0° through 200°. Stock setting is 100° to either side of front center. Sweep of arc is field adjustable in 12° increments throughout 360°.

WEIGHT
92 lb (41.7 kg) without nozzle.

MATERIALS USED
Waterway – 304 S.S.

Chain – stainless steel.

Tube fittings, cylinder heads, valves, and piston – brass.

Rigid tubing – stainless steel.

Flex tubing – nylon.

Rod – stainless steel, hard chrome plated.

Finish on chassis, covers and waterway – polyurethane enamel over primer.

Fasteners – stainless steel.

Cylinder – oriented fiberglass in epoxy matrix with non-corrosive, lubricating, isophthalic polyester lining.

Seals – BunaN and Teflon.

Swivels and balls – stainless steel.

Working steel parts – plated with bright zinc.

MOUNTING
Direct to 4 in. 150 lb customer companion flange. Four holes for 5/8 in. diameter bolts are provided in the chassis for mounting if customer plumbing is not adequate to support the monitor.

TEST CONNECTION
3/4 in. – 11 1/2 TPI NHT (garden hose) brass female swivel fitting with screen, externally accessible.

SPEED CONTROL
Brass needle valve, externally accessible.

"RUN-TEST" SELECTOR
3-way brass body ball valve with stainless steel ball and Teflon seats, externally accessible with provision for security seal in "run" position.

STANDARD FILTER
Brass body and cap with reusable 90 micron sintered bronze element. Cap externally accessible for cleaning.

ALTERNATE FILTER
The filter package is available for areas where water supply contains suspended particles. Mounting filter below mechanism requires 19 in. (48 cm) clearance to floor; 9 1/2 in. (24 cm) for side mounting.

FREEZE PROTECTABLE
Without use of tools, glycol pumping devices, adjustment of end stops, or breaking of plumbing.

SPECIFICATIONS AND MATERIALS (Continued)

MANUAL OPERATION
Possible by use of selector valve and removal of ring pin.

NOZZLE
ANSUL® Model AFN-1 air aspirating foam nozzle or master stream nozzles for water and AFFF are recommended. Order separately.

APPROVALS AND LISTING

The water oscillating monitor in combination with the AFN-1 air aspirating foam nozzle is FM approved.

APPLICATION

- Aircraft Hangers
- Fueling Areas
- Helipads
- Refineries
- Tank Farms
- Docks
- Railroad Yards
- Lumber Mills
- Coal Storage
- Paper Mills
- Dust Abatement
- Satellite Facilities
- Exposure Protection
- Chemical Processes

OSCILLATING MONITOR NOZZLE DATA

Formula to determine the maximum arc of oscillation to achieve a specific foam application rate (gpm/ft^2) given a known nozzle flow rate and range:

Formula:

$$X^\circ = \frac{F\,(360^\circ)}{(R)^2(\pi)(A)}$$

Where: X = Maximum arc of oscillation in degrees
R = Nozzle range in feet
π = 3.1416
F = Nozzle flow rate in gpm
A = Application rate in gpm/ft^2

Example:

Given – Nozzle flow rate of 534 gpm @ 100 psi, desired nozzle range of 105 feet, desired application rate of 0.1 gpm/ft^2 (AFFF)

What is the maximum arc of oscillation allowable?

$$X^\circ = \frac{F\,(360^\circ)}{(R)^2(\pi)(A)}$$

$$X^\circ = \frac{(534)(360)}{(105)^2(3.1416)(0.1)}$$

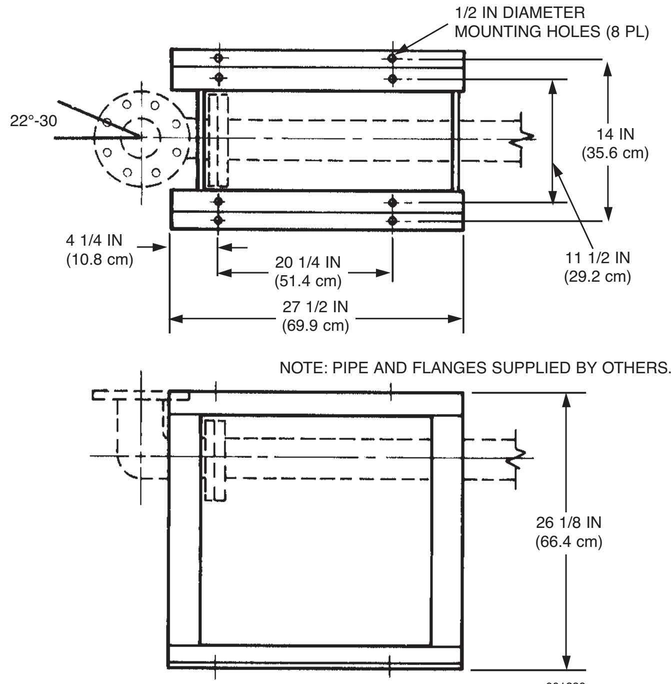
$$X^\circ = 55\ 1/2^\circ$$

ORDERING INFORMATION

Model	Part No.	Approximate Shipping Weight lb	(kg)
WOM-3	400000	110	(49.9)
Alternate Filter	77814	10	(4.5)
WOM-3-SS*	400251	110	(49.9)

*Not FM Approved. Uses the CR paint system and corrosion-resistant materials in construction of oscillating mechanism.

Optional Support Stand



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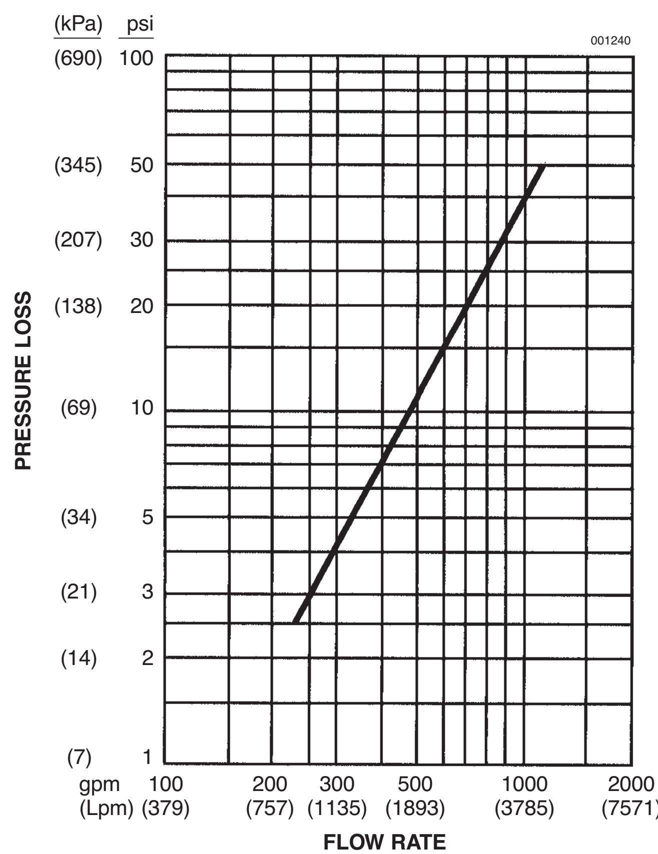
Friction Loss vs Flow Rate – 3 in. Waterway, 4 in. Flange, 2 1/2 in. N.H. Outlet



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AUTOMATIC WATER OSCILLATING MONITOR MODEL WOM-4

Data/Specifications

FEATURES

- Approved by Factory Mutual.
- The elevation lock is easily set to any angle with handwheel.
- Controls are **externally** accessible. (These include the test connection, selector valve, speed control valve, and in-line filter.)
- Quick winterization is easy – no readjustment of end stops, breaking of plumbing, or use of glycol pumps.
- The simple manual override is obvious in function thus reducing training requirements.
- The automatic valve circuit is simple, using only one four-way water valve.
- Reliable chain drive which is fully accessible by an easily removable cover.
- An optional brass waterway is available.
- All of the working parts are made of, or plated with, corrosion-resistant materials.

DESCRIPTION

For use with water or foam, the WOM-4 is a master stream device for fixed locations. The sweep is pre-set at installation to cover the hazard area but is also field adjustable.

Power to oscillate the monitor up to 165° horizontally comes from the water flowing through the device, eliminating the need for wiring, or hydraulic controls. Elevation is pre-set by means of a handwheel worm gear drive.

Water fog, straight bore or air-aspirating nozzles may be used with this (automatic nozzles should not be used) 1750 gpm (3785 Lpm) capacity device. See data sheet titled AFN-2 Air Aspirating Foam Nozzles.

SPECIFICATIONS AND MATERIALS

The monitor is operated by a reciprocating, water-powered piston and cylinder. A small flow of water, by-passed from the monitor inlet through a four-way valve, drives the cylinder. A stroke adjustment nut at each end of a threaded rod actuates the toggle action four-way valve, automatically reversing the cylinder at each end of the stroke. A stainless roller chain, attached to the cylinder heads and engaging a sprocket on the monitor base, converts the reciprocating cylinder motion to the oscillating motion.

INLET
4 in. 150 lb (8-hole) aluminum flange.

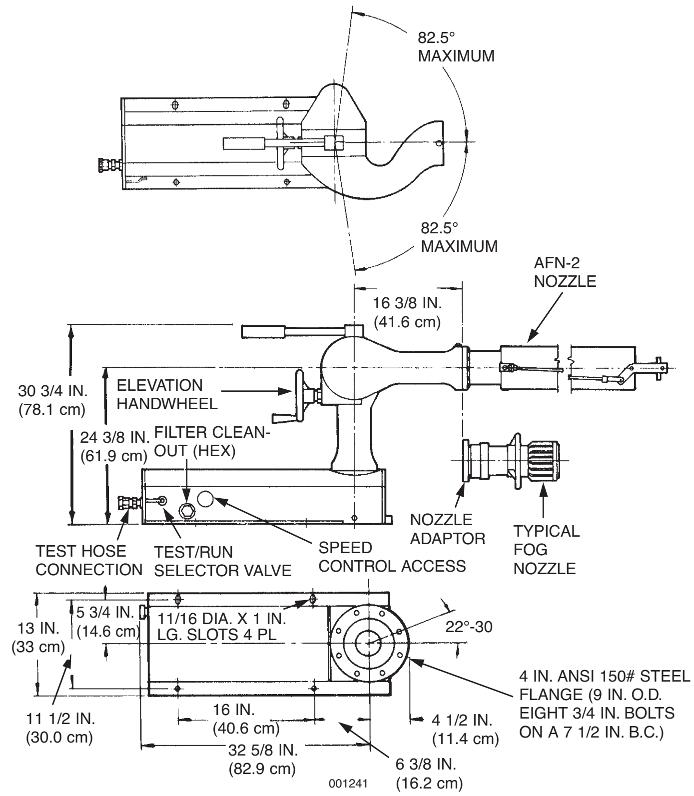
DISCHARGE
Special flanged connection for AFN-2 nozzle. NH nozzle adaptor also available.

VERTICAL RANGE SETTING
24° below horizontal to 90° above.

ARC OF OSCILLATION
0° through 165°. A 165° monitor sweep, when used with a dispersed pattern, will result in 180° coverage. Dispersed pattern with reduced range is required to meet foam application rates. Stock setting is 82.5° to either side of front center. Sweep of arc is field adjustable in 7.5° increments throughout 360°.

WEIGHT
130 lb (59 kg) without nozzle.

Detailed Dimensions



OPERATING PRESSURE
150 psi (1034 kPa) maximum.

MATERIALS USED
Waterway – A-356-T6 anodized aluminum (brass optional).
Chain – stainless steel.
Tube fittings, cylinder heads, valves, and piston – brass.
Rigid tubing – stainless steel.
Flex tubing – nylon.
Rod – stainless steel, hard chrome-plated.
Finish on chassis and covers – enamel over primer.
Fasteners – stainless steel.
Cylinder – oriented fiberglass in epoxy matrix with non-corrosive, lubricating, isophthalic polyester lining.
Seals – BunaN and Teflon.
Swivels – anodized aluminum.
Balls – stainless steel.
Working steel parts – plated with bright zinc.

MOUNTING
Direct to 4 in. 150 lb customer companion flange. Four holes for 5/8 inch diameter bolts are provided in the chassis for mounting if customer plumbing is not adequate to support the monitor. A stand is available for floor mounting.

TEST CONNECTION
3/4 in. – 11 1/2 TPI NHT (garden hose) brass female swivel fitting with screen, externally accessible.

SPEED CONTROL
Brass needle valve, externally accessible.

“RUN-TEST” SELECTOR
3-way brass body ball valve with stainless steel ball and Teflon seats, externally accessible with provision for security seal in “run” position.

SPECIFICATIONS AND MATERIALS (Continued)

FILTER
Brass body and cap with reusable 90 micron sintered bronze element. Cap externally accessible for cleaning (standard). (Optional – 30-square-inch self-cleaning, 25 micron stainless steel strainer.)

FREEZE PROTECTABLE
Without use of tools, glycol pumping devices, adjustment of end stops, or breaking of plumbing.

MANUAL OPERATION
Possible by use of selector valve and removal of ring pin.

NOZZLE
ANSUL® Model AFN-2 air aspirating foam nozzle; or adaptor with non-aspirated master stream nozzles for water and AFFF use.

APPLICATION

- Aircraft Hangars
- Fueling Areas
- Helipads
- Refineries
- Tank Farms
- Docks
- Railroad Yards
- Chemical Processes
- Lumber Mills
- Coal Storage
- Paper Mills
- Dust Abatement
- Satellite Facilities
- Exposure Protection

OSCILLATING MONITOR NOZZLE DATA

Formula to determine the maximum arc of oscillation to achieve a specific foam application rate (gpm/ft^2) given a known nozzle flow rate and range:

Formula:

$$X° = \frac{F\,(360°)}{(R)^2(\pi)(A)}$$

Where: X = Maximum arc of oscillation in degrees
R = Nozzle range in feet
π = 3.1416
F = Nozzle flow rate in gpm
A = Application rate in gpm/ft^2

Example:

Given – Nozzle flow rate of 1250 gpm @ 100 psi, desired nozzle range of 125 feet, desired application rate of 0.1 gpm/ft^2 (AFFF)

What is the maximum arc of oscillation allowable?

$$X° = \frac{F\,(360°)}{(R)^2(\pi)(A)}$$

$$X° = \frac{(1250)(360)}{(125)^2(3.1416)(0.1)}$$

$$X° = 92°$$

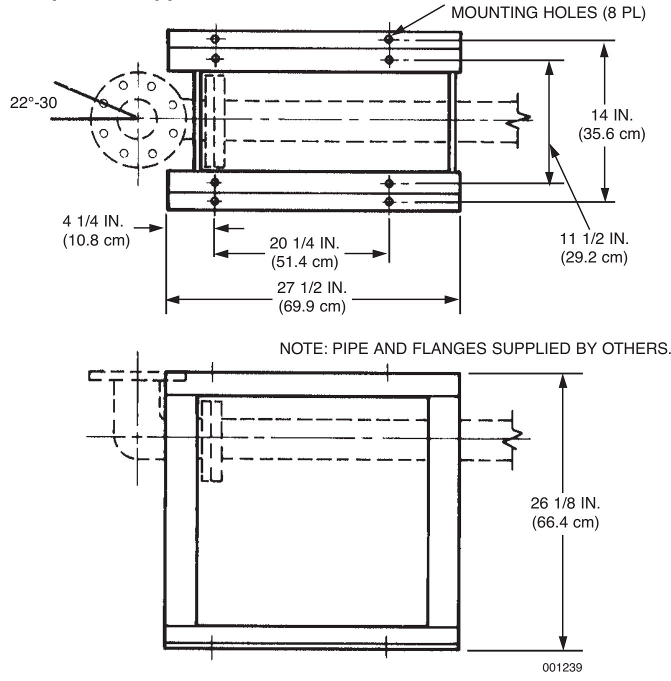
ORDERING INFORMATION

Model	Part No.	Approximate Shipping Weight lb	(kg)
WOM-4	402675	150	(68.0)
Support Stand	400987	70	(31.7)

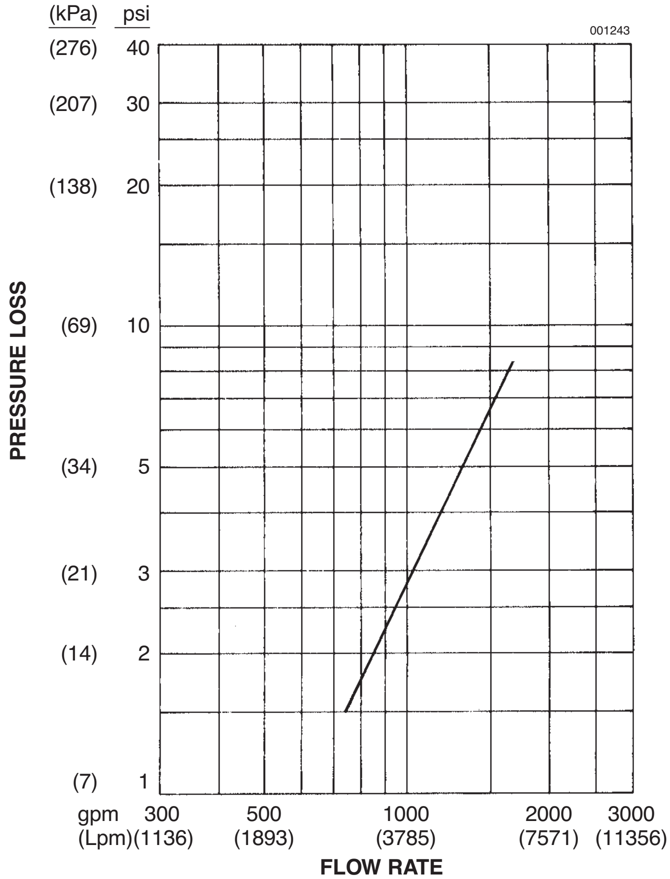
Adaptors

Part No.	Description
73743	WOM-4 Flange x 2 1/2 NH Alum
415794	WOM-4 Flange x 2 1/2 NH Brass
431039	WOM-4 Flange x 3 1/2 NH Brass

Optional Support Stand



Friction Loss vs Flow Rate
4 1/4 in. Waterway, 4 in. Flange, 4 in. Outlet



MASTER STREAM MONITOR NOZZLES

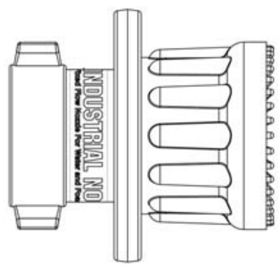
Data/Specifications

ANSUL

INDUSTRIAL NOZZLES

This solidly constructed industrial nozzle offers superior stream quality and reach. Fog angle is user adjustable between 90° wide fog and straight stream.

The rubber bumper is UV resistant. The nozzle's baffle can be removed with a single common tool for flushing debris. A simple and basic design requires no grease or other maintenance. The standard inlet is 2.5 in. NH female thread and the material of construction is UNS A03560 alloy heat treated to T6 and is hardcoat anodized per military specification MIL-A-8625F Type III, Class 1.



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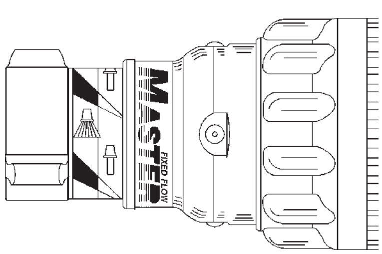
This fixed orifice nozzle rate at 100 psi (7 bar) is available in a choice of 350, 500, or 750 gpm (1325, 1893, or 7835 lpm) or a selected gpm between the range of 150 – 750 (Specify K-Factor 15 – 75).

M-IF NOZZLE

The M-IF Nozzle gives a clean far-reaching straight stream. It is adjustable from straight stream to a dense fog. The factory ordered fixed orifice is available with K-factors of 75 to 105.

The standard inlet is 2.5 in. NH female thread and the material of construction hardcoat anodized aluminum.



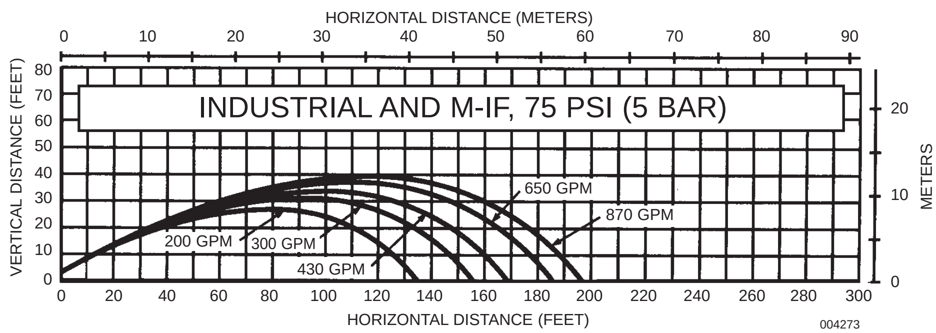
004281

APPLICATION

Both the Industrial and M-IF nozzle are recommended for use with ANSUL's Protector Station Monitor, MM-1000 Series Monitor, or the WOM-3/WOM-4 Automatic Oscillating Monitor.

ORDERING INFORMATION

Part No.	Description	Length in.	(mm)	Weight lb.	(kg)
427471	Industrial Nozzle, 350 gpm (1325 lpm), Hard Anodized Aluminum, 2 1/2 in. NH	7 1/2	(191)	5	(2)
427472	Industrial Nozzle, 500 gpm (1893 lpm), Hard Anodized Aluminum, 2 1/2 in. NH	7 1/2	(191)	5	(2)
427473	Industrial Nozzle, 750 gpm (2839 lpm), Hard Anodized Aluminum, 2 1/2 in. NH	7 1/2	(191)	5	(2)
427474	Industrial Nozzle, Hard Anodized Aluminum, 2 1/2 in. NH, **Specify Flow and Pressure**	7 1/2	(191)	5	(2)
427475	M-IF Master Stream Nozzle, Hard Anodized Aluminum, 2 1/2 in. NH, **Specify Flow and Pressure**	10	(254)	8.5	(3.9)



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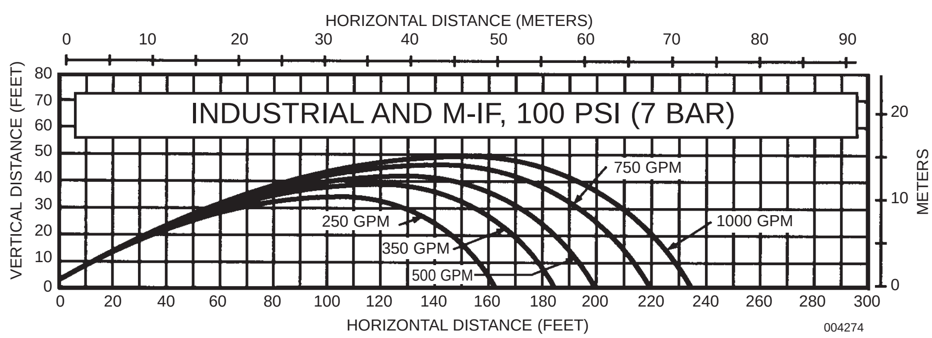

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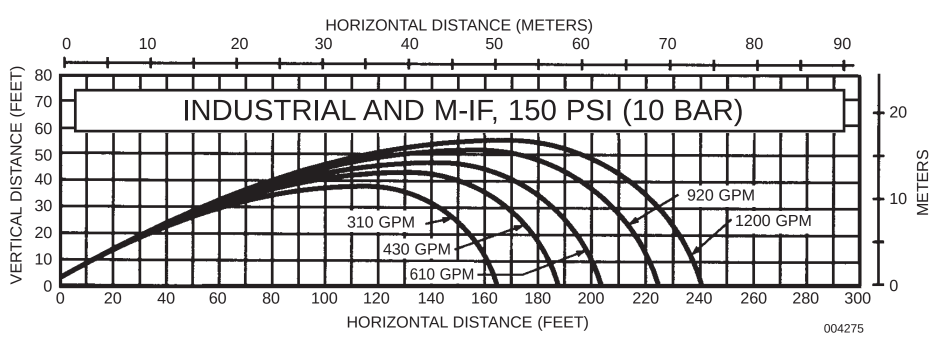

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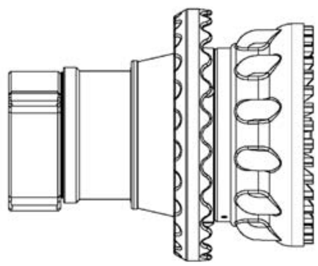
MASTER STREAM 2000 NOZZLE

The Master Stream 2000 is an automatic high volume master stream nozzle with a flow range of 300-2000 gpm (1136-7571 Lpm). The nozzle is designed to a constant 100 psi at the nozzle throughout its range. This produces an excellent hard-hitting stream at any volume from 300 gpm to a maximum of 2000 gpm.

The continuously variable pattern from straight stream to wide fog is adjustable using the halo ring. Massive rubber bumper incorporates "power fog" teeth for full finger-free fog pattern. Lightweight hardcoat anodized aluminum provides maximum resistance to corrosion and water.



007493

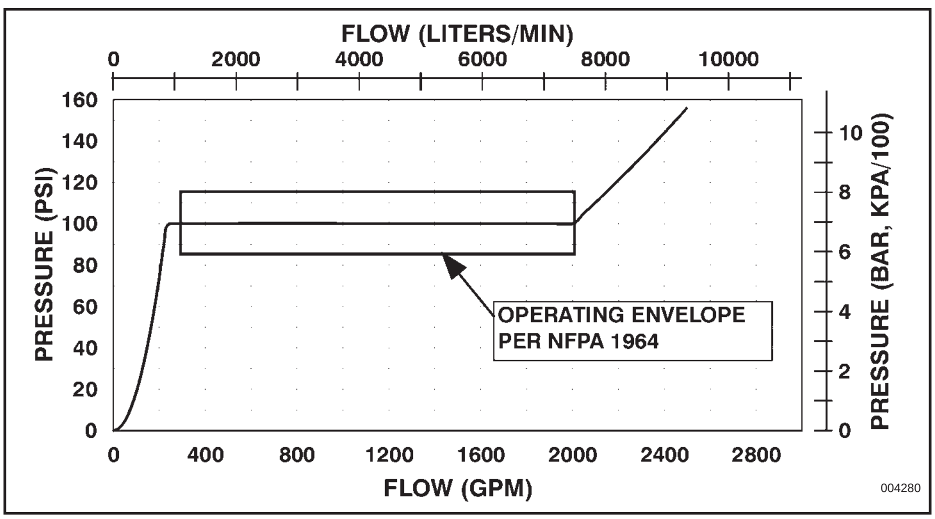
Standard coupling size is 3.5 in. NH female thread. Optional coupling sizes: 2.5 in., 3.0 in., or 4.0 in. NH (specify when ordering).

The Master Stream 2000 nozzle is recommended for use with ANSUL's WOM-4 Oscillating Monitor.

ORDERING INFORMATION

Part No.	Description	Length in.	(mm)	Weight lb	(kg)
427470	Master Stream 2000 Nozzle, 300-2000 gpm (1136-7571 Lpm) Hard Anodized Aluminum	12	(305)	19	(8.62)
431067	Master Stream 2000 Nozzle, fixed flow (specify K factor range of 105-200)*	12	(305)	19	(8.62)

* For K factors of less than 125, ANSUL recommends the 2.5 in. (6.4 cm) coupling.



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www.ansul.com

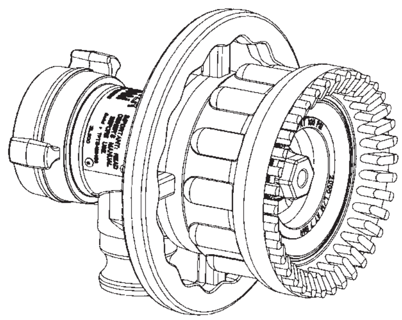
SELF-EDUCTING MASTER FOAM NOZZLES

Data/Specifications

ANSUL

FEATURES

- Superior range
- Excellent/accurate foam proportioning
- Performance proven
- Hard-coat anodized aluminum construction
- Includes fittings and hoses
- Optional two drum application



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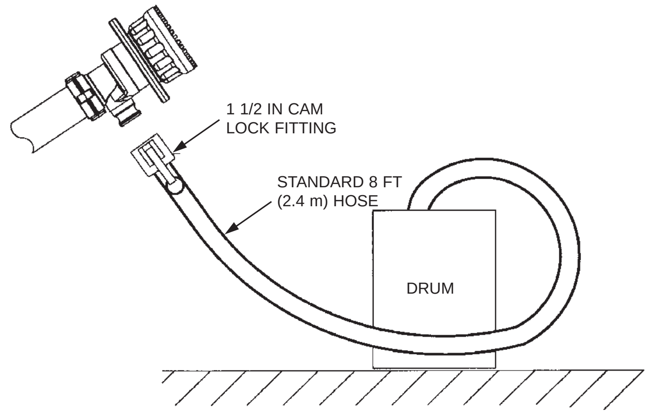


004285

DESCRIPTION

The ANSUL® Master Foam nozzle is an accurate and durable self-educting foam nozzle with superior stream quality and reach. This monitor nozzle is available in your choice of 350, 500, or 750 gpm (1325, 1893, 2839 Lpm) at 100 psi (7 bar). Fog angle is user adjustable between 120° wide fog and straight stream. The nozzle's baffle is easily removed for flushing debris.

The standard swivel coupling is 2.5 in NH female threads. The simple flow geometry (patent pending) can educt foam concentrate at 0.5%, 1%, 3%, or 6% with no small passages to clog. Percentage is easily set with an interchangeable orifice plate. A set of calibrated foam orifice plates is included.

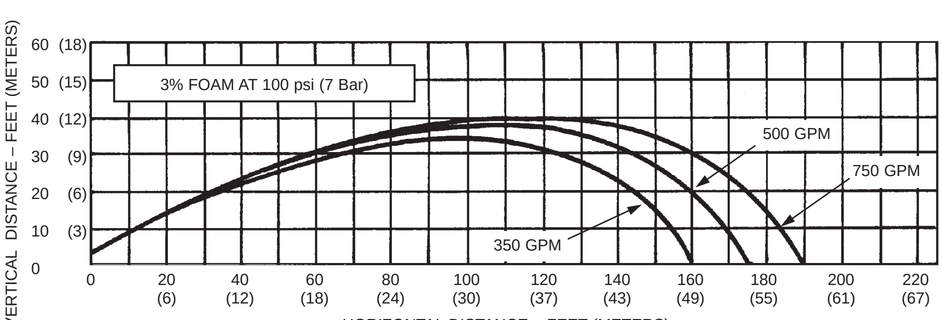
Nozzle comes with an industrial grade UV resistant, 8 ft (2.4 m) long, 1.5 in (3.8 cm) diameter concentrate hose with a cam lock fitting for quick and secure attachment to the nozzle. The simple and basic design requires no grease or other maintenance. The halo ring/stream shaper is made from non-corroding high temperature polymer. The rubber bumper is UV resistant. The Master Foam self-educting nozzle is constructed with UNS A03560 alloy heat treated to T6 and hard-coat anodized per military specification MIL-A-8625F Type III, Class 1.

The ANSUL Master Foam nozzles are recommended for use with ANSUL's Protector Station Monitor, MM-1000 monitors, or SS-MM-1000 monitors.

Refer to reverse side for accessories.

ORDERING INFORMATION

Part No.	Description	ANSULITE Concentrate	Length in	(mm)	Weight lb	(kg)
427460	Self-Educting Nozzle, 350 gpm (1325 Lpm), 2 1/2 in. NH	0.5, 1, 3, 6%	10 1/2	(267)	14	(6.4)
427461	Self-Educting Nozzle, 500 gpm (1893 Lpm), 2 1/2 in. NH	0.5, 1, 3, 6%	10 1/2	(267)	14	(6.4)
427462	Self-Educting Nozzle, 750 gpm (2839 Lpm), 2 1/2 in. NH	0.5, 1, 3, 6%	10 1/2	(267)	14	(6.4)
427463	Self-Educting Nozzle, 350 gpm (1325 Lpm, 2 1/2 in. NH	3x3 LV	10 1/2	(267)	14	(6.4)
427464	Self-Educting Nozzle, 500 gpm (1893 Lpm), 2 1/2 in. NH	3x3 LV	10 1/2	(267)	14	(6.4)
427465	Self-Educting Nozzle, 750 gpm (2839 Lpm), 2 1/2 in. NH	3x3 LV	10 1/2	(267)	14	(6.4)



004283

ACCESSORIES

Single and Dual Drum Kits

Provides a connection between an ANSUL Master Foam nozzle and a 55-gallon foam drum, allowing the nozzle to be used instantly. Each corrosion resistant kit includes a PVC pick-up tube and fittings, brass valve, glass filled polypropylene quick connect fittings and a vacuum relief valve.

The drum kit installs in the 2 in. NPT opening in the drum. The quick connect attached to the end of the hose allows easy changing of drums. The drum kit can be screwed out of an empty drum and screwed into a full drum without tools to remove the hose.

The single drum kit utilizes the hose provided with the nozzle. Cut off about 2 in. (5 cm) of hose, insert the barbed end of the female quick connect and tighten the provided hose clamp and the kit is ready for use.

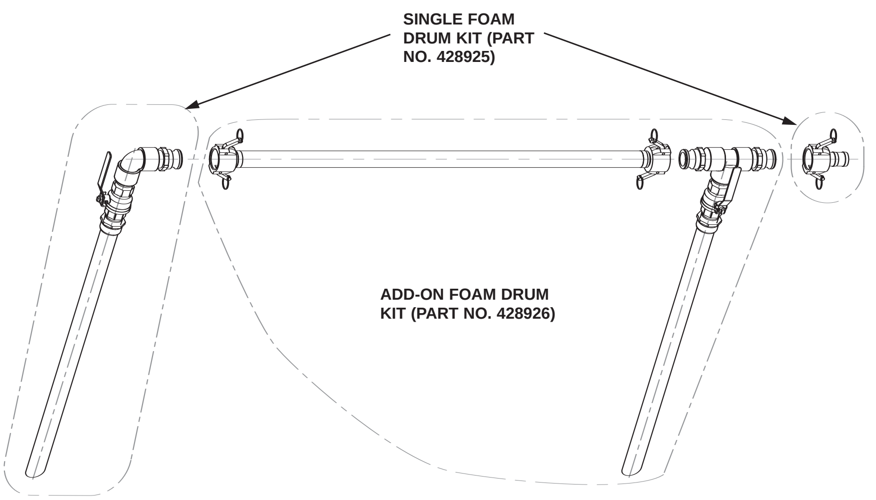
A dual drum kit is available when additional foam supply is required. The dual drum kit includes the single drum kit plus a pick up tube, valve, tee, quick connects and a 4 ft (1.2 m) length of hose with quick connects to provide the same convenience of use as the single drum kit.

The vacuum relief valve installs into the 3/4 in. NPT thread in the 2 in. buttress threaded drum cap. A hole must be cut into the cap at the base of the 3/4 in. threads. The cap/vacuum valve assembly is reusable when replacing drums.

ORDERING INFORMATION

Part No.	Description	Length in	(cm)	Weight lb	(kg)
428925	Single Foam Drum Kit	45	(114)	9	(4)
428926	Add-on Foam Drum Kit	45	(114)	12	(5)
429414*	Dual Foam Drum Kit	45	(114)	21	(10)
434984	Master Foam Nozzle Tote Connection Kit			3	(1.4)
434983	Vacuum Relief Assembly for Totes			3	(1.4)

* Dual Drum Kit contains the single drum kit (Part No. 428925) and the add-on drum kit (Part No. 428926).



DUAL FOAM DRUM KIT (PART NO. 429414 = SINGLE FOAM DRUM KIT + ADD-ON FOAM DRUM KIT)

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AIR ASPIRATING FOAM NOZZLE MODEL AFN-1

Data/Specifications

DESCRIPTION

Constructed of hard anodized aluminum with stainless steel fasteners and adjustment rod, this air aspirating foam nozzle offers minimum weight with durability. Stream pattern is adjustable in the field from an even fan type to a full straight stream.

Flow rates are specifically tailored to individual protection by the insertion of a pre-engineered stainless steel orifice plate.

Orifice plates can be sized for flows from 250 to 1000 gpm (946 to 3785 Lpm) within K-factors of 35 to 125 based on flowing nozzle inlet pressure. (Monitor friction loss must be deducted from monitor inlet pressure to use those K-factors.)

The nozzle attaches to ANSUL® Model WOM-3 automatic water driven oscillating monitor, and the MM-1000 manual monitor. Connector is a female swivel, 2 1/2 in. – 7 1/2 TPI NHT.

ORDERING INFORMATION

When ordering, specify required flow and pressure. Consult ANSUL for engineering assistance.

Part No.	Description
400200	AFN-1 Nozzle
400336	AFN-1M Nozzle with Lever Operator

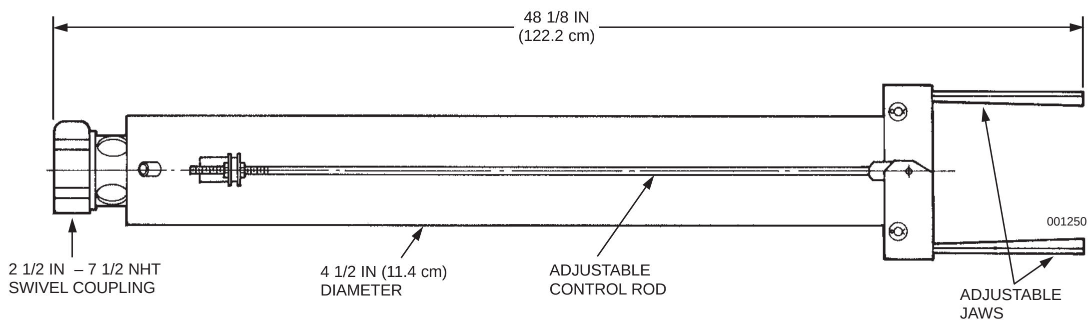
Contact ANSUL if stainless steel versions are required.

NOZZLE FLOW AND RANGE

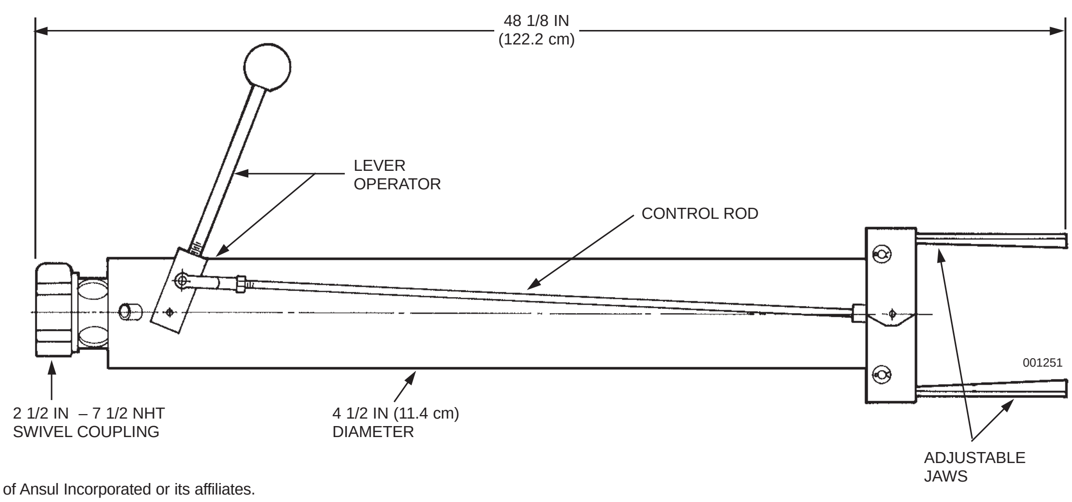
Nozzle Pressure psi	(bar)	Flow Rate gpm	(Lpm)	Range at 30° Elev. ft	(m)	Range at 22.5° Elev. ft	(m)	Range at 15° Elev. ft	(m)	Range at 0° Elev. ft	(m)
44	(3)	385	(1457)	135	(41)	135	(41)	115	(35)	50	(15)
88	(6.1)	534	(2021)	175	(53)	175	(53)	170	(52)	80	(24)
132	(9.1)	656	(2483)	190	(58)	190	(58)	190	(58)	100	(30)

Note: Above based on orifice sized for 500 gpm @ 100 psi (1893 Lpm @ 6.1 bar).

AFN-1 Nozzle



AFN-1M Nozzle



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AIR ASPIRATING FOAM NOZZLE MODEL AFN-2

Data/Specifications

DESCRIPTION

Constructed of hard anodized aluminum with stainless steel fasteners, adjustment rod and deflector; this air aspirating foam nozzle offers minimum weight with durability. Stream pattern is adjustable in the field to a dispersed stream or a full straight stream.

Flow rates are specifically tailored to individual protection by the insertion of a pre-engineered stainless steel orifice plate. Orifice plates can be sized for flows from 700 to 2000 gpm (2650 to 7571 Lpm) within K-factors of 57 to 233 based on flowing nozzle inlet pressure. (Monitor friction loss must be deducted from monitor inlet pressure to use these K-factors.)

The nozzle attaches to ANSUL® Model WOM-4 Automatic Water Driven Oscillating Monitor. Connection is made to the monitor with a special flange joint and O-ring.

ORDERING INFORMATION

When ordering, specify required flow and pressure. Consult ANSUL for engineering assistance.

Part No.	Description
77088	AFN-2 Nozzle
77115	AFN-2M Nozzle with Lever Operator

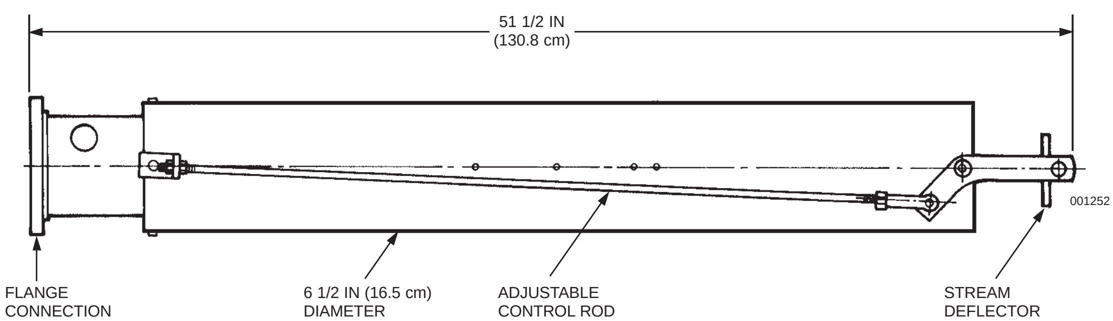
▸ Contact ANSUL if stainless steel versions are required.

NOZZLE FLOW AND RANGE

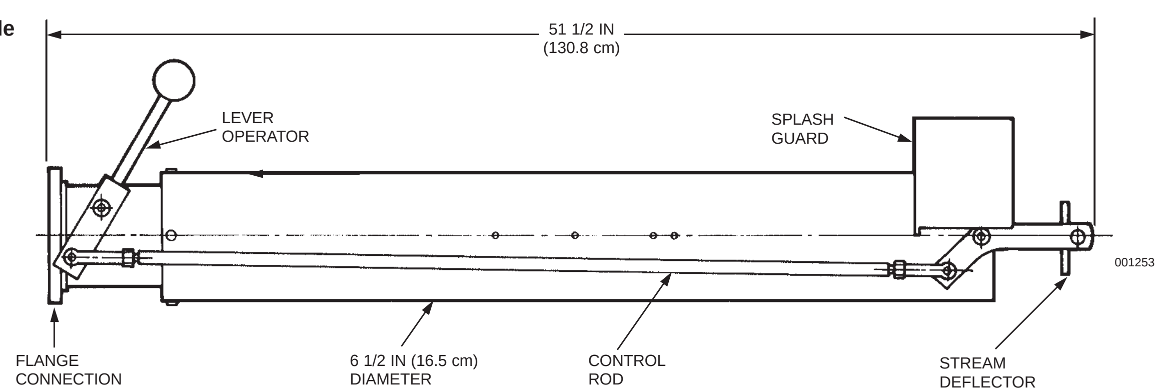
Nozzle Pressure psi (bar)	Flow Rate gpm (Lpm)	Range at 22.5° Elev. ft (m)	Range at 15° Elev. ft (m)	Range at 7° Elev. ft (m)
50 (3.45)	722 (2733)	100 (30)	80 (24)	60 (18)
100 (6.9)	1053 (3986)	160 (49)	140 (43)	120 (37)
150 (10.34)	1265 (4789)	200 (61)	180 (55)	160 (49)

▸ **Note:** Above based on orifice sized for 1000 gpm @ 100 psi (3785 Lpm @ 6.1 bar).

AFN-2 Nozzle



AFN-2M Nozzle



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Form No. F-86187-2

ANSUL

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MANUAL MONITOR/NOZZLE HIGH-FLOW SERIES MODEL FJM-80

Data/Specifications

FEATURES

- Powerful unit with exceptional throw characteristics
- Compact and lightweight
- Welded stainless steel monitor construction which allows for use in corrosive environments and minimizes maintenance
- Patented stainless steel slide-bearing system to prevent unwanted movement or swings
- Versatile nozzle patterns in a solid jet or fog spray pattern with water or foam

DESCRIPTION

The FJM-80 series of monitors is designed to deliver approximately 1,000 gpm (3785 Lpm); however, actual flow rate is dependent on nozzle setting and inlet pressure. This monitor is a dual waterway design. The balanced design reduces unwanted torque and swing, while the range of movement is easily operated with dual handles. The S version of the monitor/nozzle is self educting. The WTO version of the monitor/nozzle is self-oscillating.

SPECIFICATIONS

Waterway: 3 in. (80 mm) nominal

Sweep (rotation): Full 360°

Elevation (vertical movement):

Monitor	Elevation	Depression
FJM-80	+90°	–60°
FJM-80 S	+90°	–45°
FJM-80 WTO	+90°	–60°

Nozzle: Integral with monitor

Nozzle Pattern: Manually adjustable straight to fog

Nozzle Flow: Adjustable by turning deflector and locking

Material: Monitor: 316L Stainless steel
Nozzle: Bronze

Finish: Painted red

Stability: Lock knob for elevation (vertical movements), Balanced slide bearings prevent sweep (rotational movement)

Mounting: 3 in., 150 lb ANSI flange standard

Weight: FJM-80 31 lb (14 kg)
FJM-80 S 33 lb (15 kg)
FJM-80 WTO 55 lb (25 kg)

Maximum Pressure: 232 psi (16 bar)

Range: Up to 230 ft (70 m)

006500

APPLICATION

- Refineries
- Chemical Plants
- Petrochemical Storage
- Marine Tankers/Barges
- Marine Loading Docks
- Loading Docks
- LNG/LPG Storage
- Paper Mills
- Lumber Yards
- Rail Cars
- Coal Storage
- Process Areas
- Fire Trucks/ARFF Vehicles
- Fire Boats
- Aerial Apparatus

NOZZLE K FACTORS

Turns	K Factor FJM-80 FJM-80 WTO	K Factor FJM-80 S
1.5	16	22.2
2	22.6	35.0
3	33.7	52.0
4	45.8	68.0
5	59.7	77.7
6.8	—	85.7
7	70.1	—
9	79.1	—

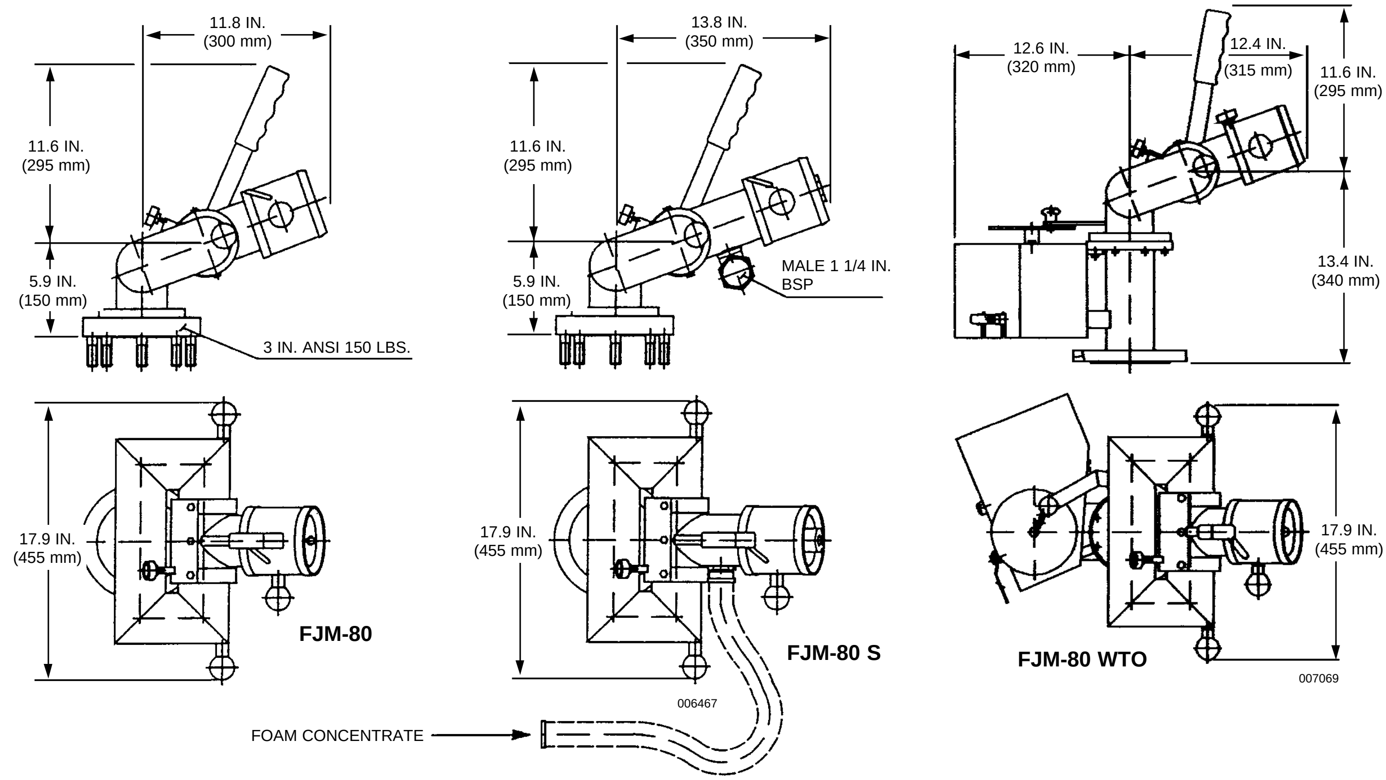
$Q = K\sqrt{P}$ Q = gpm P = psi

ORDERING INFORMATION

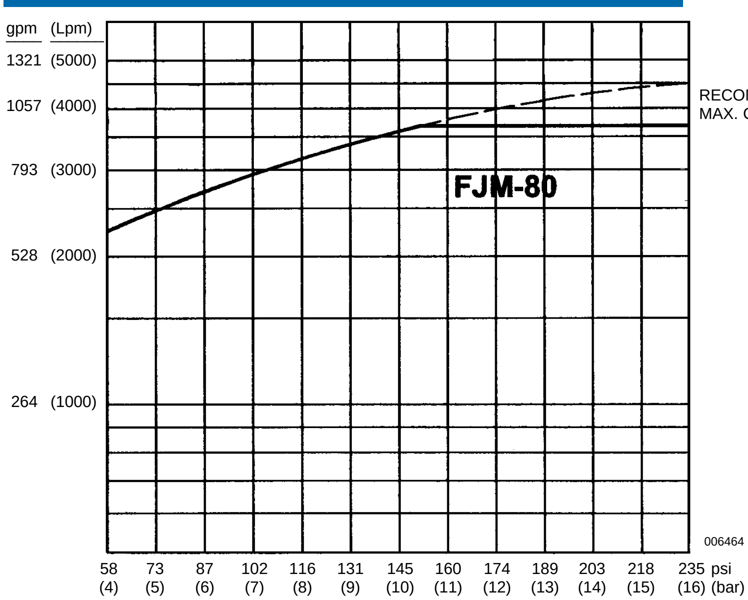
Part No.	Description
431100	FJM-80
431101	FJM-80 S with suction hose*
433233	FJM-80 WTO
433806	FJM-80S WTO*

*Specify flow, inlet pressure, concentrate and % concentration

DRAWINGS OF MONITORS

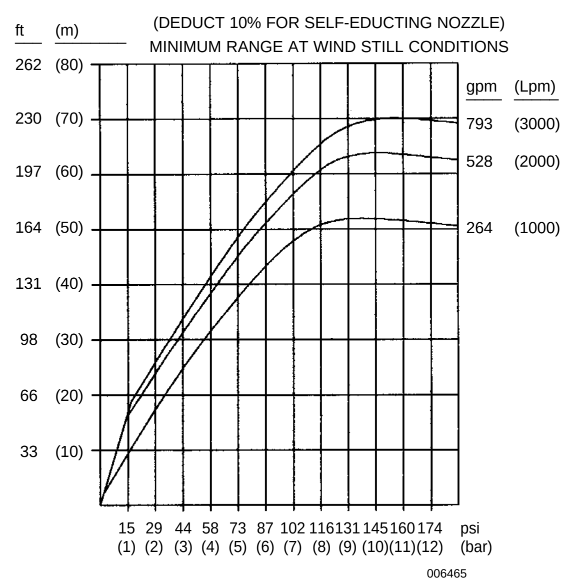


CAPACITY RANGES FOR FJM-80 MONITORS



NOTE: The nozzle is an internal part of the monitor; therefore, performance criteria is based upon pressure at the flanged inlet connection.

FJM-80 MONITOR RANGE OF JET



NOTE: The converted metric values in this document are provided for dimensional reference only and do not reflect an actual measurement.

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MONITOR/NOZZLE HIGH-FLOW SERIES MODEL FJM-100

Data/Specifications

FEATURES

- Powerful unit with exceptional throw characteristics
- Compact and lightweight
- Welded stainless steel monitor construction which allows for use in corrosive environments and minimizes maintenance
- Patented stainless steel slide-bearing system to prevent unwanted movement or swings
- Versatile nozzle patterns in a solid jet or fog spray pattern with water or foam

DESCRIPTION

The FJM-100 series of monitors is designed to deliver approximately 1,600 gpm (6000 Lpm); however, actual flow rate is dependent on nozzle setting and inlet pressure. This monitor is a dual waterway design. The balanced design reduces unwanted torque and swing, while the range of movement is easily operated with dual handles. The S version of the monitor/nozzle is self-educting. The EL/MV version is electric gear motor driven with remote nozzle pattern control. The WTO version is self-oscillating.

SPECIFICATIONS

Waterway: 4 in. (100 mm) nominal

Sweep (rotation): Manual: Full 360°, Electric: ± 165°

Elevation (vertical movement):

Monitor	Elevation	Depression
FJM-100	+90°	–60°
FJM-100 S	+90°	–45°
FJM-100 EL/MV	+70°	–70°
FJM-100 WTO	+90°	–60°

Nozzle: Integral with monitor

Nozzle Pattern: Manually adjustable straight to fog
Electric: Solenoid valve, water driven hydraulic straight to fog

Nozzle Flow: Adjustable by turning deflector and locking

Material: Monitor: 316L Stainless steel
Nozzle: Bronze

Finish: Painted red

Stability: Manual Monitors: Lock knob for elevation (vertical movements),
Balanced slide bearings prevent sweep (rotational movement)
Electric Monitors: Electric gear motors

Mounting: 4 in., 150 lb ANSI flange standard

Weight:

FJM-100	49 lb (22 kg)
FJM-100 S	53 lb (24 kg)
FJM-100 EL/MV	115 lb (52 kg)
FJM-100 WTO	71 lb (32 kg)

Maximum Pressure: 232 psi (16 bar)

Range: Up to 265 ft (81 m)

006497

APPLICATION

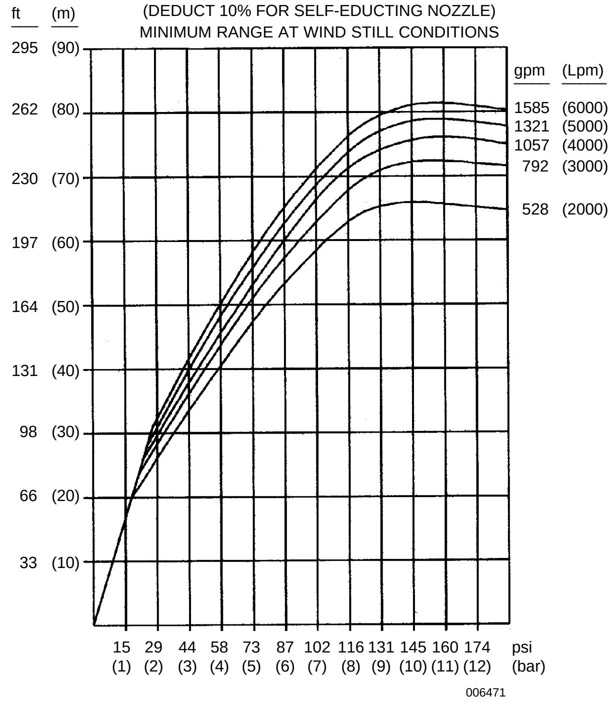
- Refineries
- Chemical Plants
- Petrochemical Storage
- Marine Tankers/Barges
- Marine Loading Docks
- Loading Docks
- LNG/LPG Storage
- Paper Mills
- Lumber Yards
- Rail Cars
- Coal Storage
- Process Areas
- Fire Trucks/ARFF Vehicles
- Fire Boats
- Aerial Apparatus

NOZZLE K FACTORS

Turns	K Factor FJM-100	K Factor FJM-100 S
1.5	—	41.6
2	34	54.1
3	47.2	70.1
4	60.4	87.4
5	74.6	104.1
6	86.7	114.5
7	—	123.5
8	106.5	137.4
8.5	—	142.2
10	120.7	—
11.5	131.8	—

$Q = K\sqrt{P}$ Q = gpm P = psi

FJM-100 MONITOR RANGE OF JET



FJM-100 SELF-EDUCTING ACCESSORIES

Part No.	Description	Shipping Weight lb	(kg)
429414	Drum Kit (double)	7	(3.2)
434980	Kit Connection to Drum Kit (required for double drum kit)	2	(0.9)
434982	Tote Connection Kit	3	(1.4)
434983	Vacuum Relief Assembly for Totes	3	(1.4)

ORDERING INFORMATION

Part No.	Description
431106	FJM-100
431107	FJM-100 S with suction hose*
431108	FJM-100/C EL/MV**
432643	FJM-100 WTO

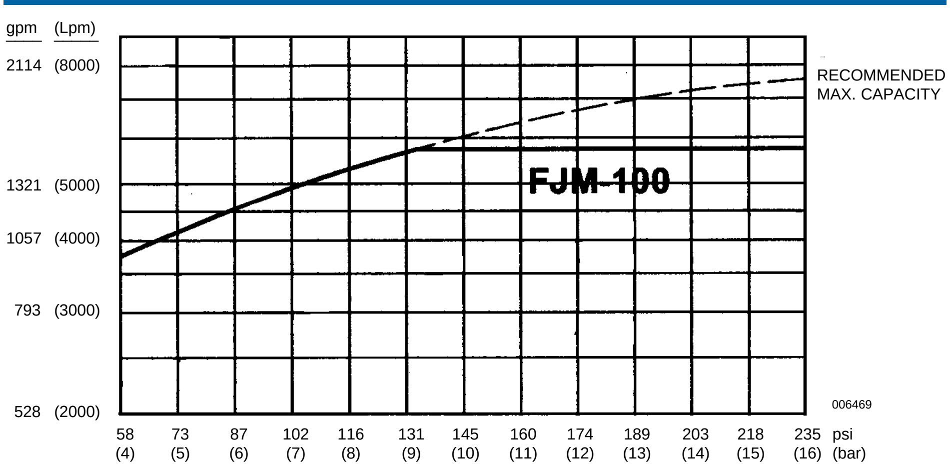
* Specify flow, inlet pressure, concentrate and % concentration (maximum 6%)

** Specify Voltage and current type

NOTE: On EL models, electric gear motors, limit switches, terminal box, control unit and joy-stick are included as standard items. Manual override and optional motors (for hazardous locations) are available as options.

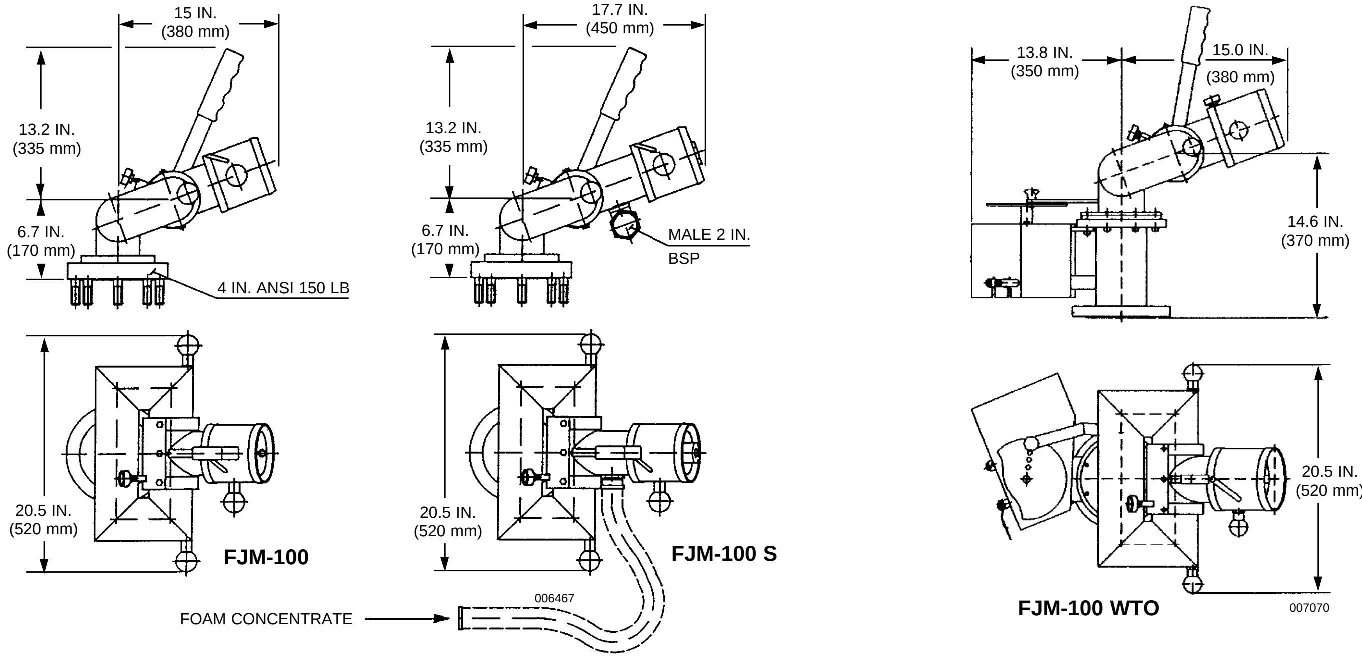
For pricing and availability of various electric remote control options, contact Tyco Fire Protection Products, Technical Services.

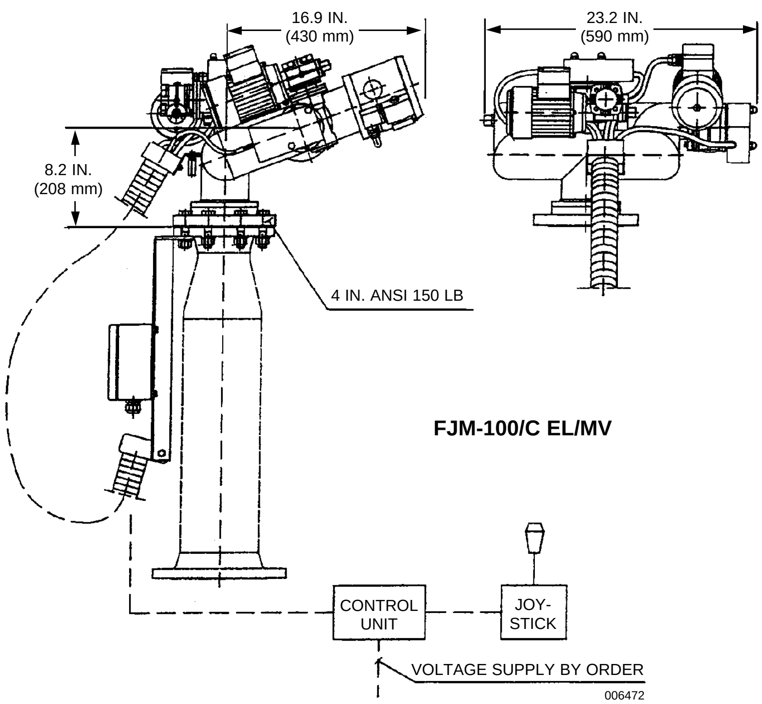
CAPACITY RANGES FOR FJM-100 MONITORS



NOTE: The nozzle is an internal part of the monitor; therefore, performance criteria is based upon pressure at the flanged inlet connection.

DRAWINGS OF MONITORS





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Form No. F-2002073-03

ANSUL

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MONITOR/NOZZLE HIGH-FLOW SERIES MODEL FJM-150

Data/Specifications

FEATURES

- Powerful unit with exceptional throw characteristics
- Compact and lightweight
- Welded stainless steel monitor construction which allows for use in corrosive environments and minimizes maintenance
- Patented stainless steel slide-bearing system to prevent unwanted movement or swings
- Versatile nozzle patterns in a solid jet or fog spray pattern with water or foam

DESCRIPTION

The FJM-150 series of monitors is designed to deliver approximately 3100 gpm (11,700 Lpm); however, actual flow rate is dependent on nozzle setting and inlet pressure. This monitor is a dual waterway design. The balanced design reduces unwanted torque and swing, while the range of movement is easily operated with dual handles. The S version of the monitor/nozzle is self educting. The G version is gear operated. The EL/MV version is electric gear motor driven with remote nozzle pattern control. The WTO version is self-oscillating.

SPECIFICATIONS

Waterway: 6 in. (150 mm) nominal

Sweep (rotation): Manual: Full 360°, Electric: ± 165°

Elevation (vertical movement):

Monitor	Elevation	Depression
FJM-150	+90°	–60°
FJM-150 S	+90°	–60°
FJM-150 G	+70°	–70°
FJM-150 S G	+70°	–50°
FJM-150 EL	+70°	–70°
FJM-150 WTO	+70°	–70°

Nozzle: Integral with monitor

Nozzle Pattern: Manually adjustable straight to fog
Electric: Solenoid valve, water driven hydraulic straight to fog

Nozzle Flow: Adjustable by turning deflector and locking

Material: Monitor: 316L Stainless steel
Nozzle: Bronze

Finish: Painted red

Stability: Manual Monitors: Lock knob for elevation (vertical movements), Balanced slide bearings prevent sweep (rotational movement)
Electric Monitors: Electric gear motors, ball bearings

Mounting: 6 in., 150 lb ANSI flange standard

Weight:

FJM-150	104 lb (47 kg)
FJM-150 S	110 lb (50 kg)
FJM-150 G	126 lb (57 kg)
FJM-150 S G	132 lb (60 kg)
FJM-150 EL	176 lb (80 kg)
FJM-150 WTO	137 lb (62 kg)

Maximum Pressure: 232 psi (16 bar)

Range: Up to 295 ft (90 m)

006498

NOZZLE K FACTORS

Turns	K Factor FJM-150 G FJM-150 EL FJM-150 WTO	K Factor FJM-150 S G
4	105.5	136.0
5	136.0	159.6
6	160.3	185.9
7	182.1	207.5
8	201.9	226.5
10	230.3	254.3
14	256.7	282.4

$Q = K\sqrt{P}$ Q = gpm P = psi

FJM-100 SELF-EDUCTING ACCESSORIES

Part No.	Description	Shipping Weight lb	(kg)
429414	Drum Kit (double)	7	(3.2)
434980	Kit Connection to Drum Kit (required for double drum kit)	2	(0.9)
434982	Tote Connection Kit	3	(1.4)
434983	Vacuum Relief Assembly for Totes	3	(1.4)

ORDERING INFORMATION

Part No.	Description
431109	FJM-150
431110	FJM-150 S with 2 in. suction hose*
431111	FJM-150 G
431112	FJM-150 S G with 2 in. suction hose*
431113	FJM-150/C EL/MV**
433235	FJM-150 WTO

* Specify flow, inlet pressure, concentrate and % concentration; maximum foam concentrate induction 158 gpm (600 Lpm)

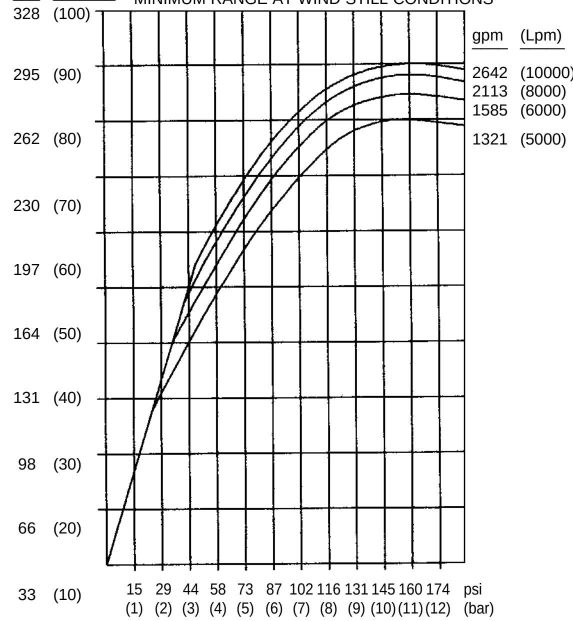
** Specify Voltage and current type

Note: On EL models, electric gear motors, limit switches, terminal box, control unit and joy-stick are included as standard items. Manual override and optional motors (for hazardous locations) are available as options.

For pricing and availability of various electric remote control options, contact Ansul Technical Services.

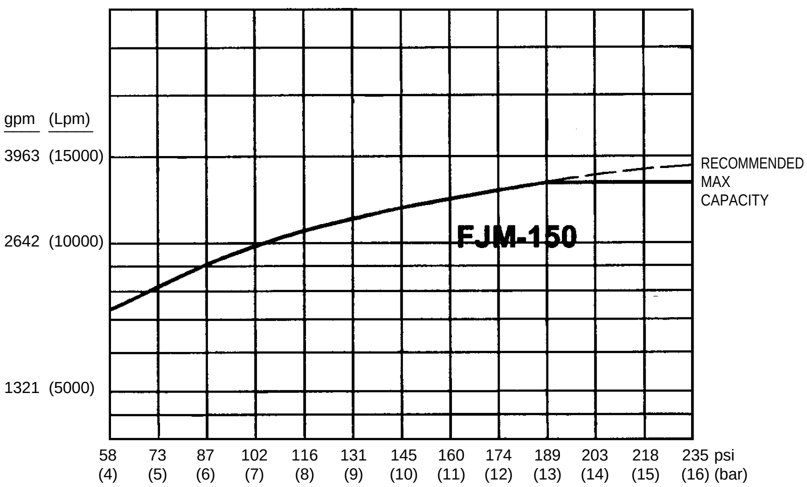
FJM-150 MONITOR RANGE OF JET

(DEDUCT 10% FOR SELF-EDUCTING NOZZLE)
MINIMUM RANGE AT WIND STILL CONDITIONS



006477

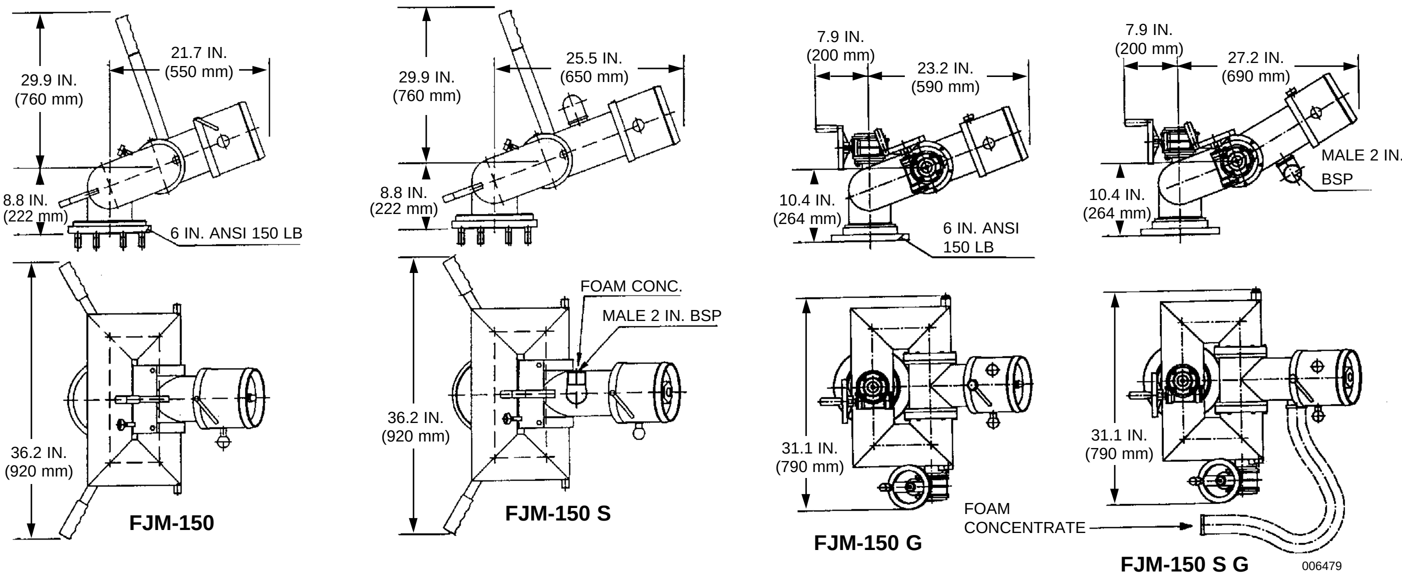
CAPACITY RANGES FOR FJM-150 MONITORS

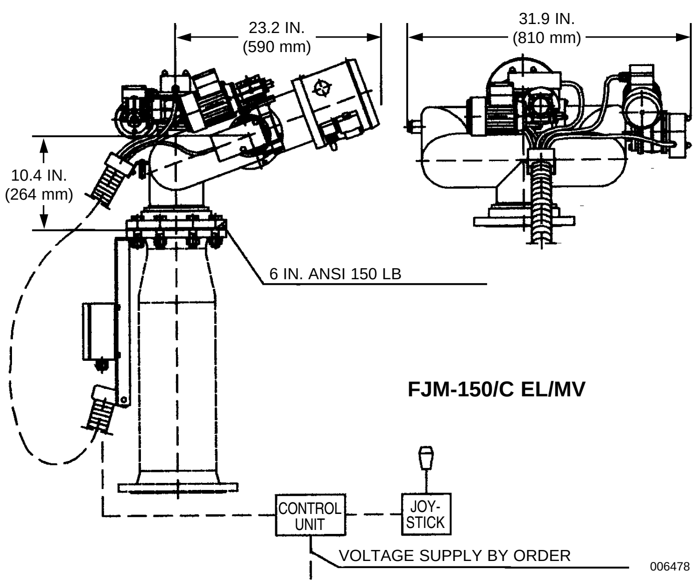


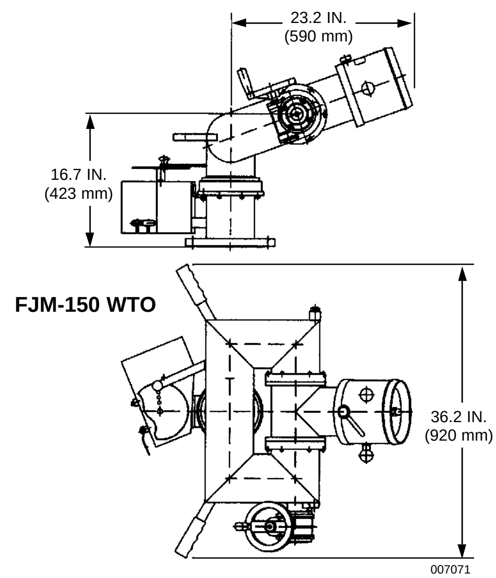
006476

Note: The nozzle is an internal part of the monitor; therefore, performance criteria is based upon pressure at the flanged inlet connection.

DRAWINGS OF MONITORS







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Form No. F-2002074-03

ANSUL
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MONITOR/NOZZLE HIGH-FLOW SERIES MODEL FJM-200

Data/Specifications

FEATURES

- Powerful unit with exceptional throw characteristics
- Compact and lightweight
- Welded stainless steel monitor construction which allows for use in corrosive environments and minimizes maintenance
- Patented stainless steel slide-bearing system to prevent unwanted movement or swings
- Versatile nozzle patterns in a solid jet or fog spray pattern with water or foam

DESCRIPTION

The FJM-200 series of monitors is designed to deliver approximately 5300 gpm (20,000 Lpm), however actual flow rate is dependent on nozzle setting and inlet pressure. This monitor is a dual waterway design. The balanced design reduces unwanted torque and swing, while the range of movement is easily operated with geared handwheels. The S version of the monitor/nozzle is self educting. The G version is gear operated. The EL/MV version is electric gear motor driven with remote nozzle pattern control.

SPECIFICATIONS

Waterway: 8 in. (200 mm) nominal

Sweep (rotation): Manual: Full 360°, Electric: ± 165°

Elevation (vertical movement):

Monitor	Elevation	Depression
FJM-200 G	+70°	–60°
FJM-200 S G	+70°	–45°
FJM-200 EL	+70°	–60°

Nozzle: Integral with monitor

Nozzle Pattern:
Manually adjustable straight to fog, water hydraulic driven
Electric: Solenoid valve, water driven hydraulic straight to fog

Nozzle Flow: Adjustable by turning deflector and locking

Material: Monitor: 316L Stainless steel
Nozzle: Bronze

Finish: Painted red

Stability: Manual Monitors: Worm gear driven
Electric Monitors: Electric gear motors

Mounting: 8 in., 150 lb ANSI flange standard

Weight: FJM-200 G 199 lb (90 kg)
FJM-200 S G 205 lb (93 kg)
FJM-200 EL 276 lb (125 kg)

Maximum Pressure: 232 psi (16 bar)

Range: Up to 400 ft (122 m)

006499

APPLICATION

- Refineries
- Chemical Plants
- Petrochemical Storage
- Marine Tankers/Barges
- Marine Loading Docks
- Loading Docks
- LNG/LPG Storage
- Paper Mills
- Lumber Yards
- Rail Cars
- Coal Storage
- Process Areas
- Fire Trucks/ARFF Vehicles
- Fire Boats
- Aerial Apparatus

FJM-200 SELF-EDUCTING ACCESSORIES

Part No.	Description	Shipping Weight lb	(kg)
429414	Drum Kit (double)	7	(3.2)
434980	Kit Connection to Drum Kit (required for double drum kit)	2	(0.9)
434982	Tote Connection Kit	3	(1.4)
434983	Vacuum Relief Assembly for Totes	3	(1.4)

NOZZLE K FACTORS

Turns	K Factor
5	208.1
6	232.4
7	263.7
9	319.2
11	374.7
13.6	437.1

$Q = K\sqrt{P}$ Q = gpm   P = psi

ORDERING INFORMATION

Part No.	Description
431114	FJM-200 G
431115	FJM-200 S G with suction hose*
431116	FJM-200/C EL/MV**

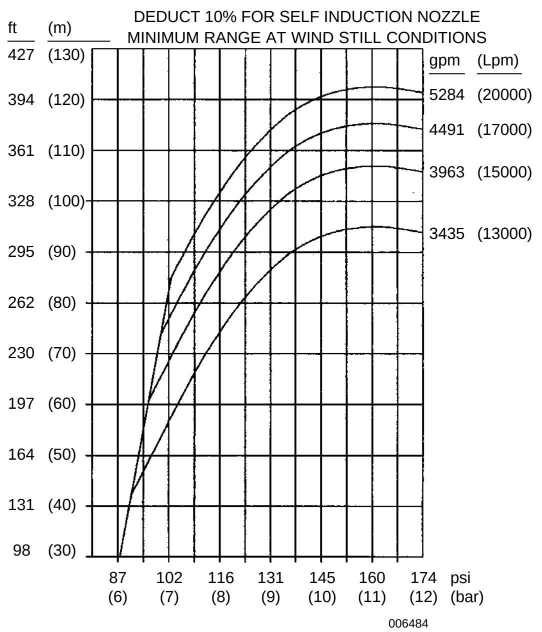
* Specify flow, inlet pressure, concentrate and % concentration, maximum foam concentrate induction 158 GPM (600 LPM)

** Specify Voltage and current type

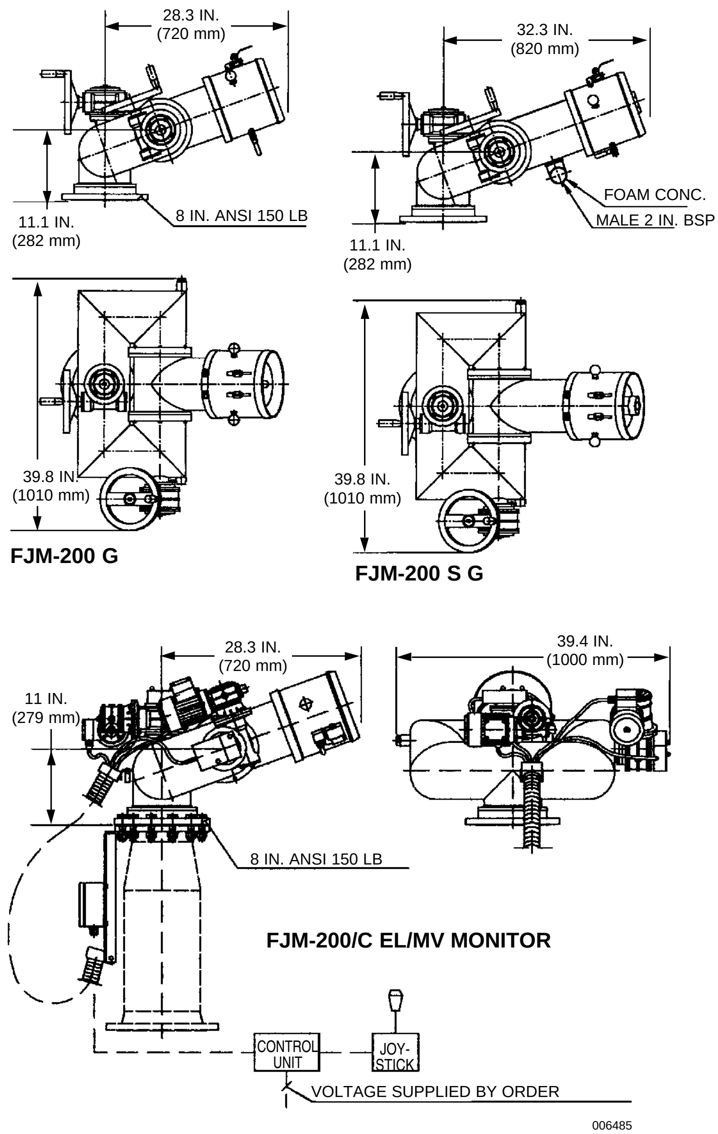
Note: On EL models, electric gear motors, limit switches, terminal box, control unit and joy-stick are included as standard items. Manual override and optional motors (for hazardous locations) are available as options.

For pricing and availability of various electric remote control options, contact Ansul Technical Services.

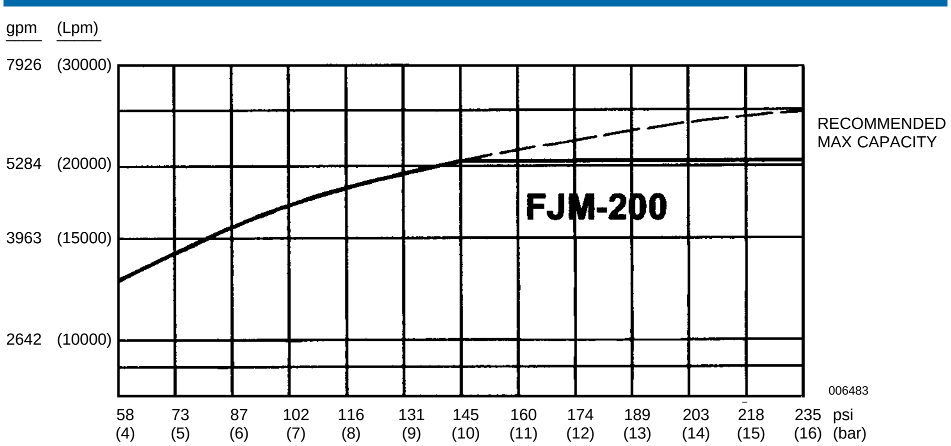
FJM-200 MONITOR RANGE OF JET



DRAWINGS OF MONITORS



CAPACITY RANGES FOR FJM-200 MONITORS



Note: The nozzle is an internal part of the monitor, therefore, performance criteria is based upon pressure at the flanged inlet connection.

Note: The converted metric values in this document are provided for dimensional reference only and do not reflect an actual measurement.

ANSUL

by Tyco Fire Suppression & Building Products

FOAM CHAMBERS

Data/Specifications

FEATURES

- Choice of four foam chamber sizes for various foam solution flow rate requirements.
- Hinged inspection hatch with captive bolt securement for ease of inspection and maintenance.
- Choice of primed or standard red finish. Polyamide "CR" epoxy finish available for marine and other corrosive environments.
- Teflon vapor seal allows unrestricted flow of expanded foam.
- Convenient vapor seal replacement without removal of retaining bolts.
- UL Listed.

APPLICATION

ANSUL foam chambers are air-aspirating foam discharge devices that are used to protect various types of flammable liquid storage tanks including open top floating roof tanks and cone roof tanks with or without internal floaters. Additional applications include most types of open tanks where flammable liquid products are involved.

Foam chambers are defined by NFPA 11 as Type II discharge outlets for delivering foam to the surface of a flammable liquid. They are commonly used with bladder tanks, balanced pressure pump proportioning systems, line proportioners, or foam trucks. These foam chambers can be used with ANSUL low-expansion foam agents that are determined to be suitable for the flammable liquid being protected.

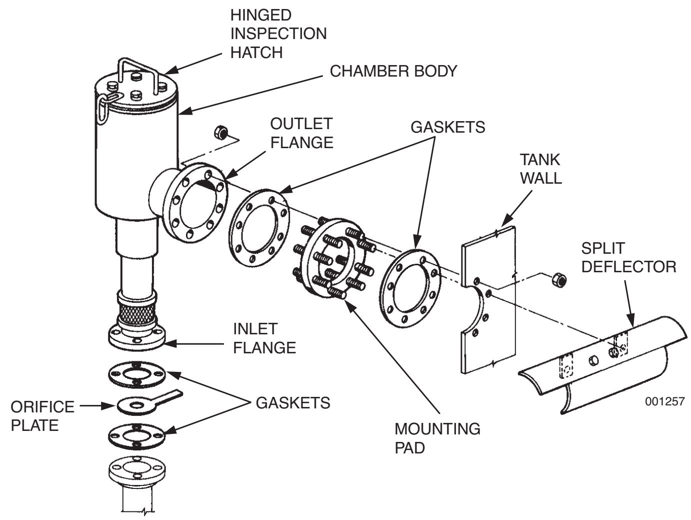
DESCRIPTION

The ANSUL foam chambers consist of a foam expansion chamber and an integral foam maker with a stainless steel screened air inlet. A removable orifice plate located at the flanged inlet to the foam maker is sized to deliver the required flow rate of foam solution at a specified inlet pressure. A frangible Teflon vapor seal is burst upon entry of foam solution allowing an unrestricted flow of expanded foam into the chamber body. From the chamber body, the foam flows through the foam deflector which disperses the foam into the storage tank.

The chamber vapor seal is accessible for inspection and service through a hinged inspection hatch that is secured with captive bolts. The hatch also contains a lifting handle that is designed to support the weight of the foam chamber.

The foam deflector directs the foam stream down the tank sidewall to lessen the submergence of the foam and agitation of the fuel surface (Type II application). The foam deflector is a split (two-piece) style. The split deflector allows for either bolting or welding to storage tanks when installation may be performed from both sides of the tank wall as with newly constructed tanks. The split deflector also allows for insertion of the deflector through the flange opening from the outside wall as is often required with tanks already in service.

The foam chamber and deflector can be bolted to the storage tank using a mounting pad. The pad contains mounting studs to fit standard flange holes.



SPECIFICATIONS

The foam chamber assembly shall consist of a chamber body with an integral foam maker and orifice plate. A foam deflector and foam chamber mounting pad shall be included with the assembly as required.

The foam chamber body shall be of steel construction with a choice of primed, standard red, or "CR" epoxy finish. The discharge outlet shall be of the flat-faced flange design that may be welded or bolted to the storage tank. For ease of access to the vapor seal, the chamber body shall contain a hinged inspection hatch secured with stainless steel captive bolts. The hatch shall also contain a lifting handle designed to support the weight of the chamber for hoisting.

The foam maker shall contain a stainless steel screen that is cylindrically shaped to conform to the air inlet surface to help prevent damage. The vapor seal shall be of Teflon construction to allow an unrestricted flow. The Teflon vapor seal shall be designed of a thickness to meet the UL required burst pressure range of 10 to 25 psi (0.69 to 1.72 bar). The vapor seal retainer shall be designed with slotted keyholes to eliminate bolt removal during replacement. The inlet to the foam maker shall be a raised-face flange with an orifice sized to allow the required flow rate of foam solution at the available pressure.

A split foam deflector shall be provided for either bolting or welding to the mounting surface, or for installation from the outside wall of the storage tank. For bolting applications, a mounting pad shall be available with a stud pattern compatible with the flat-face flange of the foam chamber body and the foam deflector.

A stainless steel nameplate shall be attached to the foam chamber hatch. The nameplate shall specify manufacturer, model number, and part number.

FLOW RANGE

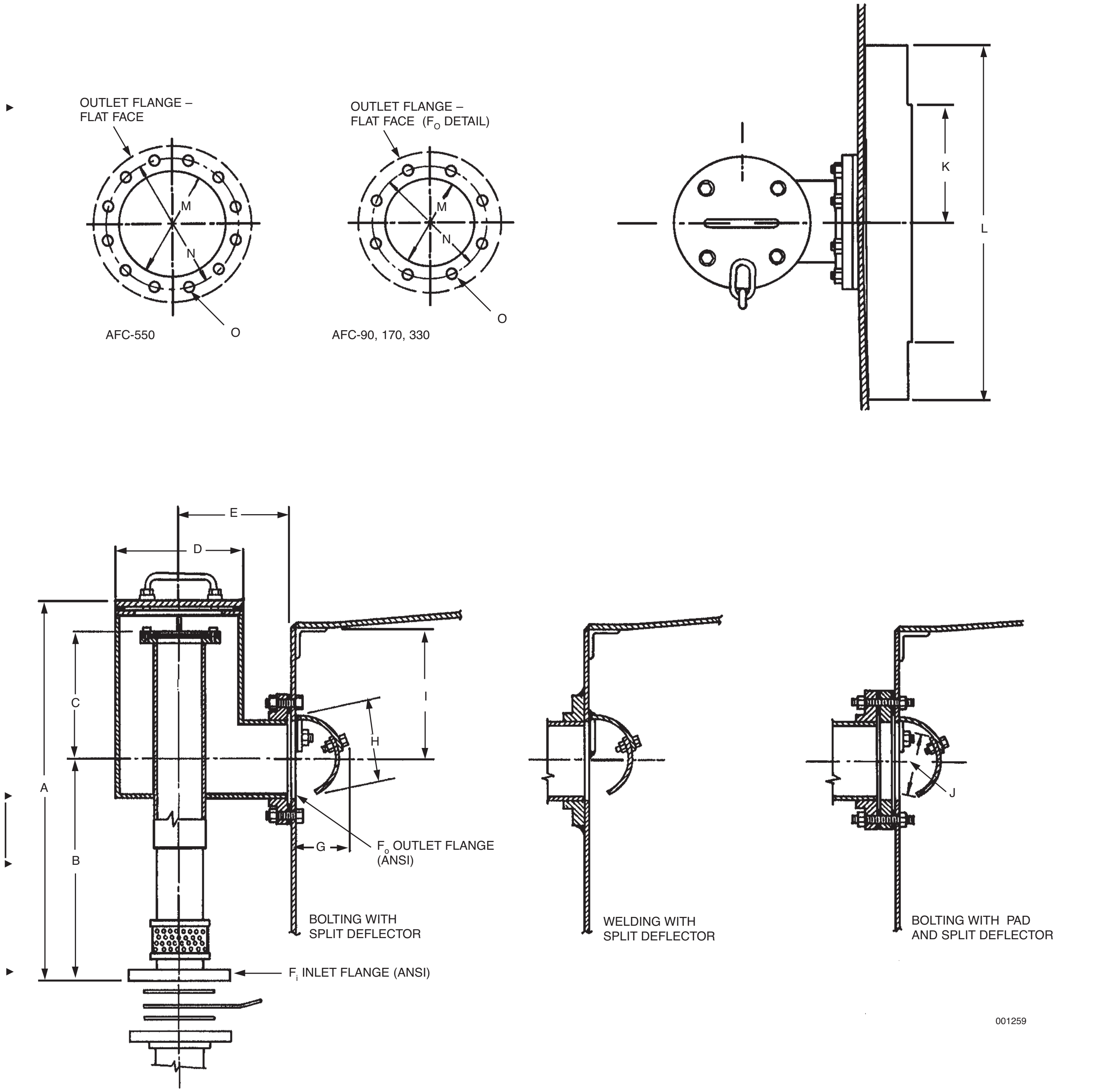
The flow rate of the foam chamber is determined by the orifice size and the inlet pressure. The flow ranges listed in the following table are based on 40 psi (2.76 bar) using the smallest orifice for the minimum flow and 100 psi (6.9 bar) using the largest orifice for the maximum flow.

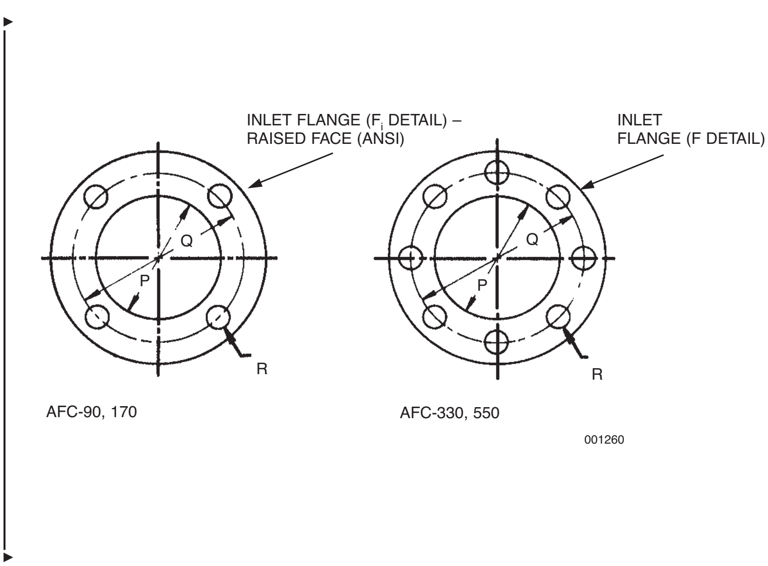
Model	Flow Range	K-Factor Range
AFC-90	49 to 151 gpm (185 to 572 Lpm)	7.8 to 15.1
AFC-170	94 to 279 gpm (356 to 1056 Lpm)	14.9 to 27.9
AFC-330	183 to 610 gpm (693 to 2309 Lpm)	28.9 to 61.0
AFC-550	350 to 980 gpm (1325 to 3709 Lpm)	55.3 to 98.0

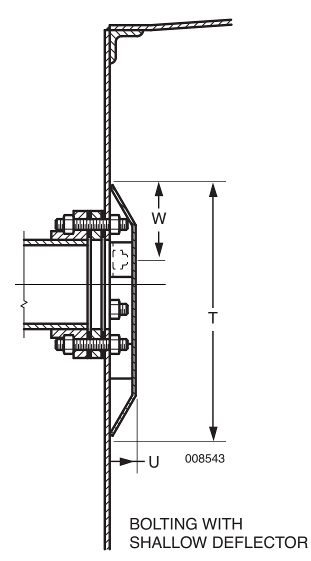
To determine flow rates for specific applications and proper orifice sizing, consult Technical Services, Marinette, WI 54143-2542.

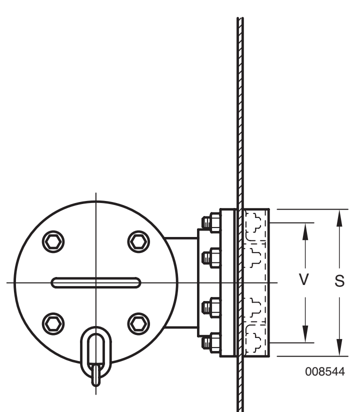
DIMENSION TABLE

Dimension	AFC-90	AFC-170	AFC-330	AFC-550
A	26 1/16 in. (66.2 cm)	31 7/8 in. (81.0 cm)	35 3/8 in. (89.9 cm)	42 in. (106.7 cm)
B	15 5/16 in. (38.9 cm)	19 5/8 in. (49.8 cm)	20 5/8 in. (52.4 cm)	24 3/4 in. (62.9 cm)
C	8 1/2 in. (21.6 cm)	10 in. (25.4 cm)	11 1/8 in. (28.3 cm)	12 3/8 in. (31.4 cm)
D	8 3/8 in. (21.2 cm)	10 3/8 in. (26.4 cm)	12 3/8 in. (31.4 cm)	15 in. (38.1 cm)
E	7 in. (17.8 cm)	9 in. (22.9 cm)	10 in. (25.4 cm)	12 in. (30.5 cm)
F_i	2 1/2 in. (6.4 cm)	3 in. (7.6 cm)	4 in. (10.2 cm)	6 in. (15.2 cm)
F_o	4 in. (10.2 cm)	6 in. (15.2 cm)	8 in. (20.3 cm)	10 in. (25.4 cm)
G	3 1/4 in. (8.3 cm)	4 1/16 in. (10.3 cm)	5 in. (12.7 cm)	6 7/8 in. (17.5 cm)
H	5 5/16 in. (13.5 cm)	7 3/8 in. (18.7 cm)	9 1/8 in. (23.1 cm)	9 3/4 in. (24.8 cm)
I	8 in. (20.3 cm)	9 1/2 in. (24.1 cm)	11 in. (27.9 cm)	12 in. (30.5 cm)
J	4 5/8 in. (11.7 cm)	6 1/8 in. (15.6 cm)	7 3/4 in. (19.7 cm)	8 1/4 in. (20.9 cm)
K	8 in. (20.3 cm)	12 in. (30.5 cm)	16 in. (40.6 cm)	20 in. (50.8 cm)
L	12 in. (30.5 cm)	18 in. (45.7 cm)	24 in. (61.0 cm)	30 in. (76.2 cm)
M	4 1/2 in. (11.4 cm)	6 5/8 in. (16.8 cm)	8 5/8 in. (21.9 cm)	10 3/4 in. (27.3 cm)
N	7 1/2 in. (19.1 cm)	9 1/2 in. (24.1 cm)	11 3/4 in. (29.8 cm)	14 1/4 in. (36.2 cm)
O	3/4 in. (1.9 cm)	7/8 in. (2.2 cm)	7/8 in. (2.2 cm)	1 in. (2.5 cm)
P	2 7/8 in. (7.3 cm)	3 1/2 in. (8.9 cm)	4 1/2 in. (11.4 cm)	6 5/8 in. (16.8 cm)
Q	5 1/2 in. (13.9 cm)	6 in. (15.2 cm)	7 1/2 in. (19.1 cm)	9 1/2 in. (24.1 cm)
R	3/4 in. (1.9 cm)	3/4 in. (1.9 cm)	3/4 in. (1.9 cm)	7/8 in. (2.2 cm)
S	8 1/2 in. (21.6 cm)	12 in. (30.5 cm)	16 in. (40.6 cm)	20 in. (50.8 cm)
T	14 1/2 in. (36.8 cm)	16 in. (40.6 cm)	24 1/2 in. (62.2 cm)	23 1/4 in. (59 cm)
U	1 1/2 in. (3.8 cm)	1 1/2 in. (3.8 cm)	1 1/2 in. (3.8 cm)	3 5/16 in. (8.4 cm)
V	6 15/16 in. (17.6 cm)	8 25/32 in. (22.3 cm)	10 27/32 in. (27.5 cm)	13 3/4 in. (34.9 cm)
W	4 5/16 in. (11 cm)	4 11/16 in. (11.9 cm)	5 3/4 in. (14.6 cm)	7 5/32 in. (18.2 cm)









SHALLOW
DEFLECTORS
REQUIRE
INSTALLATION FROM
INSIDE OF THE TANK

ORDERING INFORMATION

Part No.	Description	Approximate Shipping Weight lb	(kg)
Foam Chambers			
75887	Foam Chamber/Maker, AFC-90, Primed	60	(27.2)
75883	Foam Chamber/Maker, AFC-90, Standard Red	60	(27.2)
75879	Foam Chamber/Maker, AFC-90, CR EpoxyRed	60	(27.2)
74376	Split Deflector, AFC-90, Primed	5	(2.3)
428637	Shallow Deflector, AFC-90, Primed	5	(2.3)
75888	Foam Chamber/Maker, AFC-170, Primed	100	(45.4)
75884	Foam Chamber/Maker, AFC-170, Standard Red	100	(45.4)
75880	Foam Chamber/Maker, AFC-170, CR Epoxy Red	100	(45.4)
74380	Split Deflector, AFC-170, Primed	10	(4.5)
428638	Shallow Deflector, AFC-170, Primed	10	(4.5)
75889	Foam Chamber/Maker, AFC-330, Primed	145	(65.8)
75885	Foam Chamber/Maker, AFC-330, Standard Red	145	(65.8)
75881	Foam Chamber/Maker, AFC-330, CR Epoxy Red	145	(65.8)
74384	Split Deflector, AFC-330, Primed	20	(9.1)
428639	Shallow Deflector, AFC-330, Primed	20	(9.1)
75890	Foam Chamber/Maker, AFC-550, Primed	270	(122.5)
75886	Foam Chamber/Maker, AFC-550, Standard Red	270	(122.5)
75882	Foam Chamber/Maker, AFC-550, CR Epoxy Red	270	(122.5)
74388	Split Deflector, AFC-550, Primed	30	(13.6)
428640	Shallow Deflector, AFC-550, Primed	30	(13.6)

Note: Shallow deflectors are a lower protrusion option than the standard split deflectors illustrated on Page 3. Shallow deflectors may be required for cone roof tanks with internal floaters where the protrusion of a split deflector interferes with the internal floater operation.

Part No.	Description	lb	(kg)
Foam Chamber Accessories			
74392	Foam Chamber AFC-90 Mounting Pad, Primed	15	(6.8)
74390	Foam Chamber AFC-90 Mounting Pad, CR Epoxy Red	15	(6.8)
74396	Foam Chamber AFC-170 Mounting Pad, Primed	20	(9.1)
74394	Foam Chamber AFC-170 Mounting Pad, CR Epoxy Red	20	(9.1)
74400	Foam Chamber AFC-330 Mounting Pad, Primed	35	(15.9)
74398	Foam Chamber AFC-330 Mounting Pad, CR Epoxy Red	35	(15.9)
74404	Foam Chamber AFC-550 Mounting Pad, Primed	50	(22.7)
74402	Foam Chamber AFC-550 Mounting Pad, CR Epoxy Red	50	(22.7)
418581	Foam Chamber AFC-90 Vapor Seal Assembly	0.5	(0.23)
418582	Foam Chamber AFC-170 Vapor Seal Assembly	0.5	(0.23)
418583	Foam Chamber AFC-330 Vapor Seal Assembly	0.5	(0.23)
418584	Foam Chamber AFC-550 Vapor Seal Assembly	0.5	(0.23)
75985	Foam Chamber AFC-90 Cover Gasket	0.3	(0.14)
75986	Foam Chamber AFC-170 Cover Gasket	0.3	(0.14)
75987	Foam Chamber AFC-330 Cover Gasket	0.3	(0.14)
75988	Foam Chamber AFC-550 Cover Gasket	0.3	(0.14)
74610	Foam Chamber AFC-90 Orifice Plate	1	(0.45)
74611	Foam Chamber AFC-170 Orifice Plate	1	(0.45)
74612	Foam Chamber AFC-330 Orifice Plate	1	(0.45)
74613	Foam Chamber AFC-550 Orifice Plate	1	(0.45)
74408	Foam Chamber AFC-90 Foam Diverter Test Tube	15	(6.8)
74412	Foam Chamber AFC-170 Foam Diverter Test Tube	20	(9.1)
74416	Foam Chamber AFC-330 Foam Diverter Test Tube	40	(18.1)
74420	Foam Chamber AFC-550 Foam Diverter Test Tube	65	(29.5)
75968	Foam Chamber Cover Screw, All Models	0.3	(0.14)

Note: Foam chambers, mounting pads, foam deflectors are available constructed of 304 stainless steel. Contact Technical Services for pricing and availability.

www.ansul.com
One Stanton Street
Marinette, WI 54143-2542

FLR AND AFM FOAM MAKERS

Data/Specifications

ANSUL

FEATURES

- Stainless steel construction for corrosive environments
- Cylindrically-shaped air inlet screen helps prevent accidental damage or blockage
- Choice of two models with orifice plates sized for specific flow rate requirements
- Removable foam solution inlet screen for ease of inspection and cleaning (FLR-30 only)

APPLICATION

ANSUL® Floating Roof Foam Makers (FLR) are air-aspirating foam discharge devices that are designed to protect floating roof, flammable liquid storage tanks. Specifically, the protected storage tanks must be of open-top construction with either double-deck or pontoon-type floating roofs. This type of construction eliminates the need for a vapor seal, allowing the use of foam makers rather than foam chambers. Additional applications include protection of diked flammable liquid storage and spill areas.

Floating roof foam makers are used with various types of proportioning systems such as bladder tanks, balanced pressure pump proportioning systems, or line proportioners. The foam makers can be used with appropriate ANSUL low-expansion foam agents for the flammable liquid being protected.

DESCRIPTION

The ANSUL floating roof foam maker is constructed of stainless steel components for corrosion resistance.

A screened air inlet, conforming to the cylindrical body, allows uniform air distribution into the foam solution stream to generate expanded foam. This design also helps prevent damage and inhibits the entrance of foreign materials.

A removable orifice plate at the threaded inlet is sized to deliver foam solution over a range of flow rates depending on the inlet pressure (see Flow Range section). The acceptable operating pressure range is 30 psi (2.1 bar) to 150 psi (10.3 bar).

A stainless steel foam solution strainer is provided at the inlet (FLR-30). The strainer is secured by a snap retaining ring to allow removal for inspection and cleaning. The solution inlet of the FLR-90 does not require a strainer.

SPECIFICATIONS

The floating roof foam maker body, barrel, and sub-component parts shall be constructed of corrosion-resistant stainless steel. The foam maker shall be designed with a female NPT inlet and a male NPT outlet.

A machined brass metering orifice plate shall be provided at the inlet and sized to deliver the required flow rate of foam solution at a specified inlet pressure. The metering orifice and stainless steel foam solution inlet strainer when applicable shall be secured with a snap retaining ring to enable removal for inspection and cleaning. The foam maker orifice shall be stamped with the appropriate diameter.

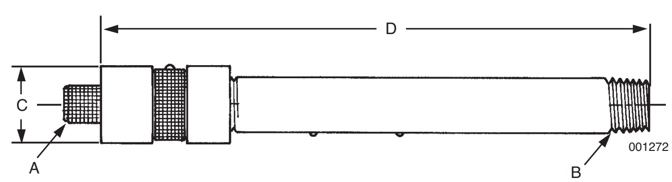
The floating roof foam maker shall have a stainless steel air inlet screen that is cylindrically shaped to the air inlet surface to ensure optimum performance and help prevent damage.

FLOW RANGE

The flow rate of the floating roof foam maker is determined by the orifice size and inlet pressure. The flow ranges listed in the following table are based on 30 psi (2.1 bar) using the smallest orifice for the minimum flow, and 150 psi (10.3 bar) using the largest orifice for the maximum flow.

Model	Flow Range	K-Factor Range
FLR-30	6.7 to 79.6 gpm (25.4 to 301 Lpm)	1.2 to 6.5
FLR-90	31.1 to 197.7 gpm (118 to 748 Lpm)	5.6 to 16.1

To determine flow rates for specific applications and proper orifice sizing, consult ANSUL Technical Services.

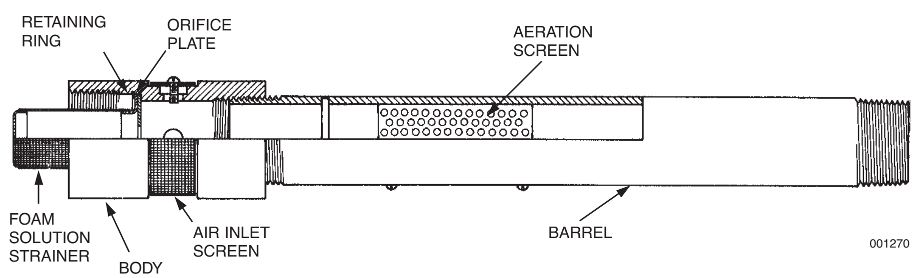


Dimensions

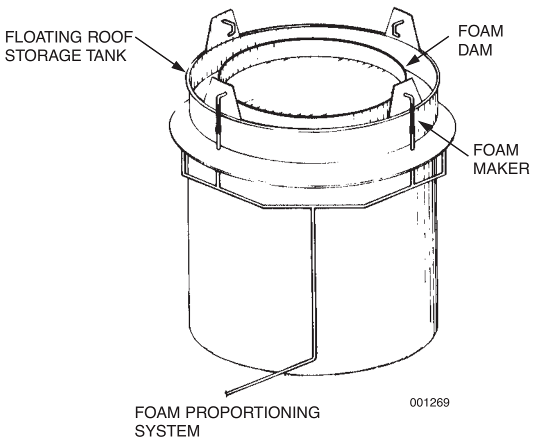
Model	Dim. A – in	Dim. B – in	Dim. C in	Dim. C (cm)	Dim. D in	Dim. D (cm)
FLR-30	1 1/2 NPT	1 1/4 NPT	2.25	(5.7)	16	(41)
FLR-90*	2 1/2 NPT	2 1/2 NPT	3.25	(8.3)	25	(64)

*FLR-90 inlet strainer is not supplied or required.

FLR-30



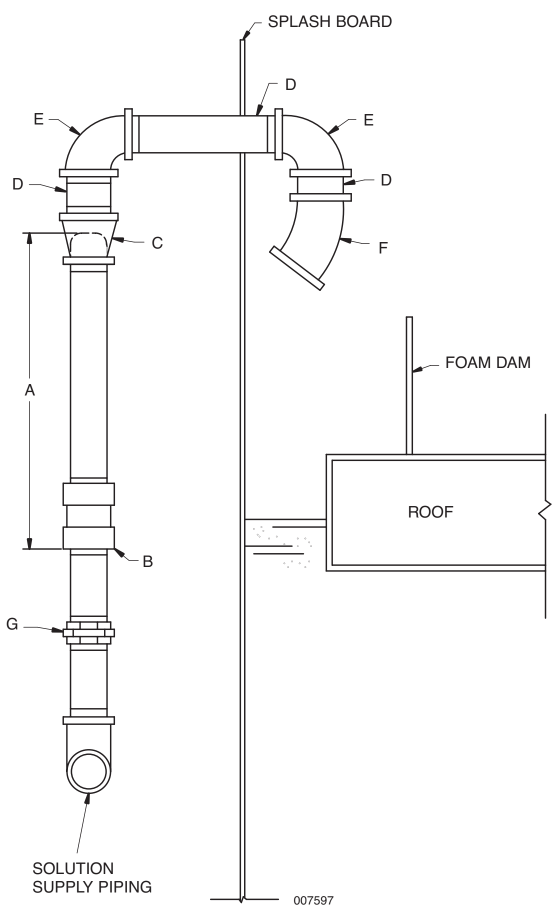
Typical Storage Tank Protection



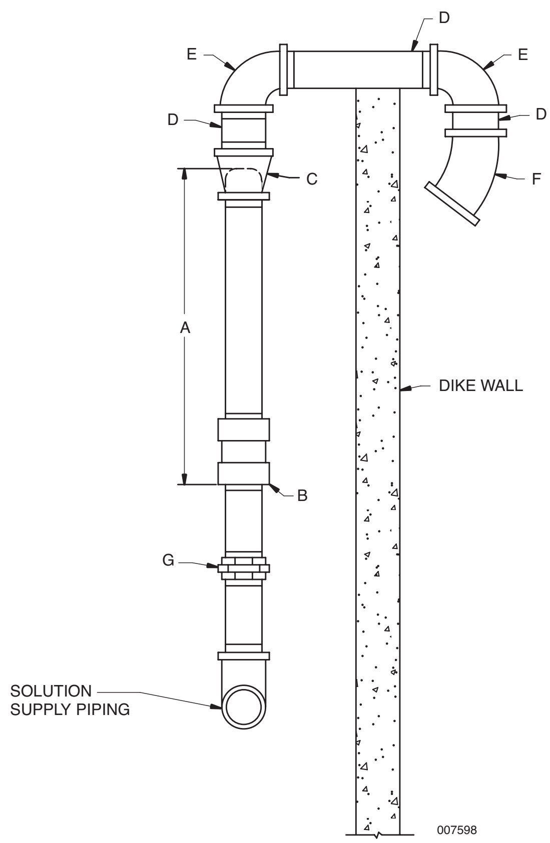
ORDERING INFORMATION

Part No.	Description	Approximate Shipping Weight lb	(kg)
75615	FLR-30 Foam Maker	4.5	(2.0)
75633	FLR-90 Foam Maker	13.0	(5.9)

Typical Floating Roof Tank Foam Maker Installation



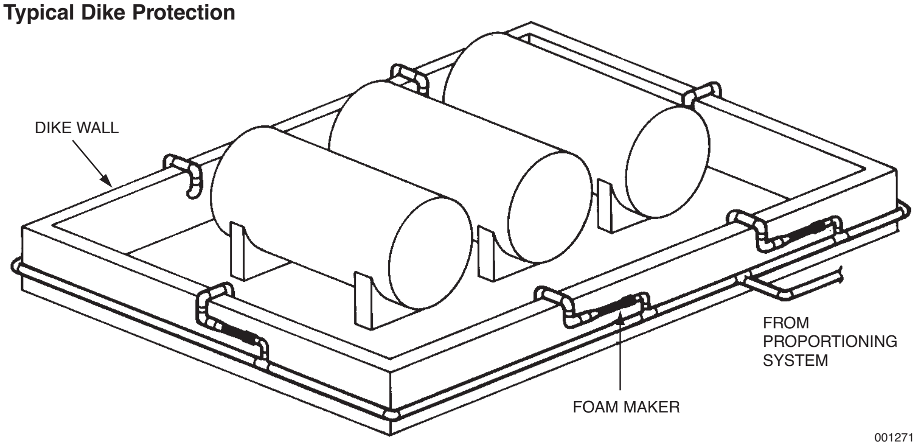
Typical Diked Area Foam Maker Installation



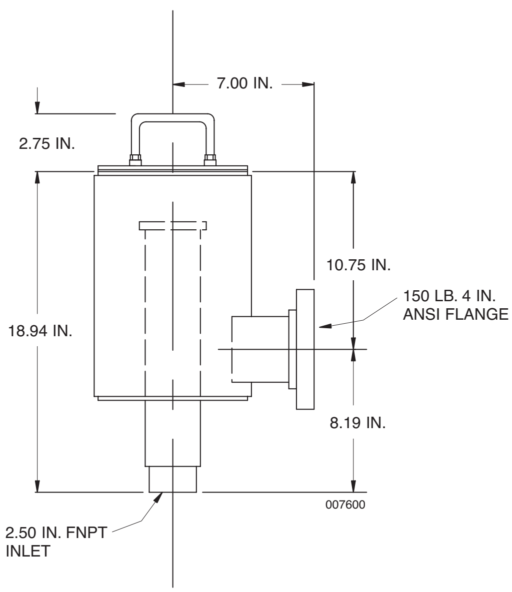
Typical Material List

A	B	C	D	E	F	G
FLR-30	1 1/2 NPT	1 1/4 x 2 1/2 Red. Coup.	2 1/2 in. Nipple	2 1/2 in. 90° Elbow	2 1/2 in. 45° Elbow	1 1/2 in. Union
FLR-90	2 1/2 NPT	2 1/2 x 4 Red. Coup.	4 in. Nipple	4 in. 90° Elbow	4 in. 45° Elbow	2 1/2 in. Union

Typical Dike Protection



AFC-90 FLR Chamber



Note: See also Rim Seal Foam Pourer Data Sheet F-200103 for other methods of mounting FLR Foam Makers.

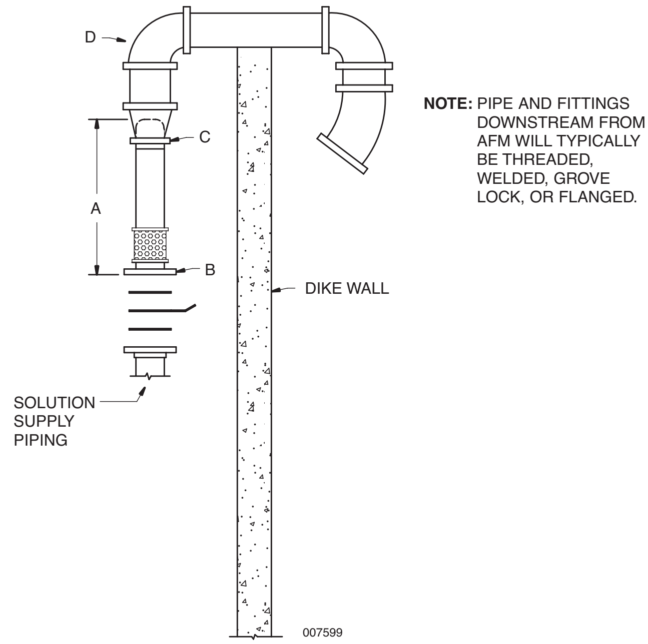
In some FLR installations, mounting may be easily accomplished using the "AFC-90 FLR Chamber" which is the chamber portion only from an ANSUL Foam Chamber (AFC-90). This device is supplied with the cover and outlet gaskets and a 2 1/2 in. NPT inlet. Use of this device with an FLR-30 will require a 2 1/2 in. x 1 1/4 in. reducing bushing not provided by ANSUL. The FLR Foam Makers and other normal AFC accessories such as a Mounting Pad or Split Deflector are sold separately.

Note: The "AFC-90 FLR Chamber" is not supplied with a vapor seal or vapor seal retaining ring and should not be used on hazards that require vapor seals.

ORDERING INFORMATION

Part No.	Description	Approximate Shipping Weight lb	(kg)
415829	AFC-90 FLR Chamber, Standard Red	40	(18)
415830	AFC-90 FLR Chamber, CR Epoxy Red	40	(18)
415831	AFC-90 FLR Chamber, Primed	40	(18)

Typical Diked Area AFM Installation



Model	Length A	Inlet Flange 150 lb ANSI B	Outlet Pipe Size NPT C	Minimum Pipe Size Downstream D
AFM-170	11 1/4 in. (28.6 cm)	3 in. (7.6 cm)	3 in. (7.6 cm)	6 in. (15.2 cm)
AFM-330	12 7/8 in. (32.7 cm)	4 in. (10.2 cm)	4 in. (10.2 cm)	8 in. (20.3 cm)
AFM-550	15 5/16 in. (38.9 cm)	6 in. (15.2 cm)	6 in. (15.2 cm)	10 in. (25.4 cm)

In some Foam Maker installations, particularly very large dikes or jetties, it may be required to have flow rates above those offered with the FLR Foam Makers. The ANSUL Foam Maker "AFM" is the Foam Maker portion of an ANSUL Foam Chamber without the Chamber. The AFM is available as standard product constructed from mild steel with the "CR" Epoxy Red Paint System. The assemblies can be manufactured with the Standard Red Paint System or Primed only for field painting. For highly corrosive environments, the assemblies can be manufactured from 304 Stainless Steel. Contact ANSUL Technical Service for details.

ORDERING INFORMATION

Part No.	Description	Approximate Shipping Weight lb	(kg)
► 75401	AFM-170, CR Epoxy Red	15	(6.8)
75402	AFM-330, CR Epoxy Red	25	(11.4)
► 75403	AFM-550, CR Epoxy Red	35	(15.9)

► Indicates revised information.

tyco
Fire Suppression
& Building Products

One Stanton Street
Marinette, WI 54143-2542

715-735-7411
www.ansul.com

FLR-30-FP/FLR-90-FP RIM SEAL FOAM POURER

Data/Specifications

ANSUL

FEATURES

- Air aspirated foam maker
- Continuous K factors from 1.2 – 16.1
- Operating pressures from 30 to 150 psi (2.1 to 10.3 bar)
- Assembly includes UL Listed FLR foam maker
- Provides wind protection allowing all foam to be applied in the sealing area
- Gentle foam application
- Shipped complete and ready for field installations
- Carbon steel body coated with a corrosion resistant epoxy paint system and stainless steel piping
- Inlet and outlet screened to prevent bird entry
- No welding required for mounting

APPLICATION

ANSUL® FLR-30-FP and FLR-90-FP Rim Seal Foam Pourers are air-aspirating foam discharge devices that are designed to protect floating roof, flammable liquid storage tanks. Specifically, the protected storage tanks must be open-top construction with either double-deck or pontoon-type floating roofs.

Rim Seal Foam Pourers are used with various types of proportioning systems such as bladder tanks, balanced pressure pump proportioning systems, or line proportioners. The Foam Pourers can be used with appropriate ANSUL low-expansion foam agents for the flammable liquid being protected.

DESCRIPTION

The Rim Seal Foam Pourer is designed to discharge fully aspirated foam directly to the annular seal area of open top floating roof storage tanks for fire or vapor suppression. Fully aspirated foam provides the most effective performance for all types of foam concentrates.

The Rim Seal Foam Pourer is designed utilizing the UL Listed FLR-30 or FLR-90 Foam Makers. The pourer design provides protection from the wind, allowing the aspirated foam to gently discharge onto the protected area of the floating roof tank. Gentle application minimizes submergence and agitation, increasing the effectiveness of the foam blanket. The design of the unit allows for uniform and cohesive foam flow.

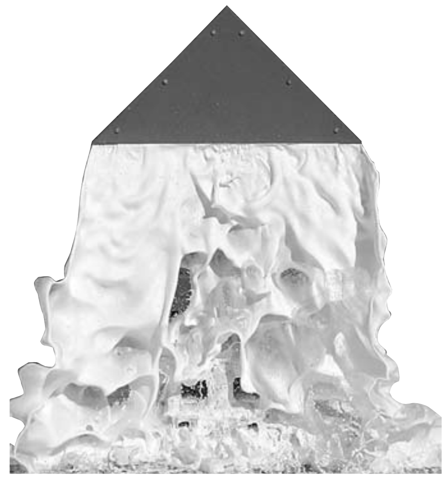
The FLR-30- and FLR-90 Rim Seal Foam Pourers are classified as Type II discharge devices in accordance with NFPA 11, “Standard for Low-Expansion Foam.”

The cover of the unit, opposite of the foam inlet, is designed for removal to allow for internal inspection. The unit can be mounted on the top flange of the fuel storage tank utilizing the mounting holes located in the base of the Rim Seal Foam Pourer or by the use of clamps.

A screened air inlet, conforming to the cylindrical body, allows uniform air distribution into the foam solution stream to generate expanded foam. This design also helps prevent damage and inhibits the entrance of foreign materials.

A removable orifice plate at the threaded inlet is sized to deliver foam solution over a range of flow rates depending on the inlet pressure. The acceptable operating pressure range is 30 psi to 150 psi (2.1 to 10.3 bar).

A stainless steel foam solution strainer (on FLR-30-FP only) is provided at the foam maker inlet. The strainer is secured by a snap retaining ring to allow removal for inspection and cleaning.



004613

004615

SPECIFICATIONS

The Foam Pourers shall be finished in epoxy paint with zinc-rich primer over abrasive blasted steel. The inlet shall have a flat-face 2.5 in. steel flange, and the orifice plate shall be made of field-replaceable machined brass. The fasteners shall be constructed of stainless steel as well as the inlet and outlet screens; the screen prevents birds from entering the foam pourer. The operating pressure shall range from 30 to 150 psi (2.1 to 10.3 bar), and the continuous K factors shall be from 1.2 - 16.1.

FLOW RANGE

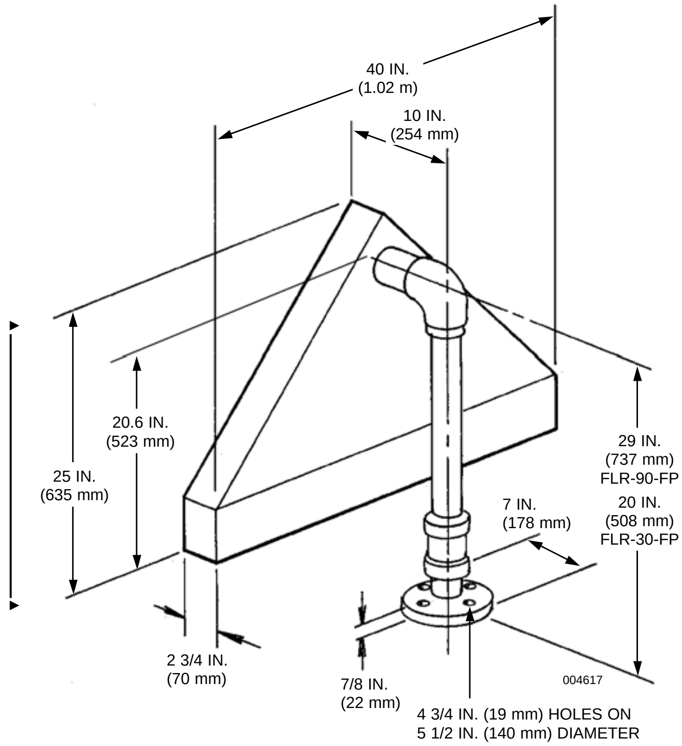
The orifice size and inlet pressure determines the flow rate of the Rim Seal Foam Pourer. The flow ranges listed in the following table are based on 30 psi (2.1 bar) using the smallest orifice for the minimum flow, and 150 psi (10.3 bar) using the largest orifice for the maximum flow.

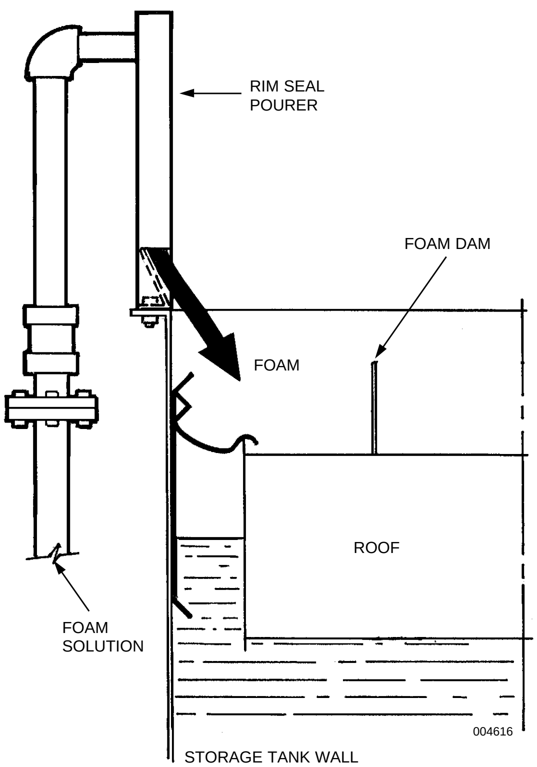
Model	Flow Range	K-Factor Range
► FLR-30-FP	6.7 to 79.6 gpm (25.4 to 301 Lpm)	1.2 to 6.5
► FLR-90-FP	31.1 to 197.7 gpm (118 to 748 Lpm)	5.6 to 16.1

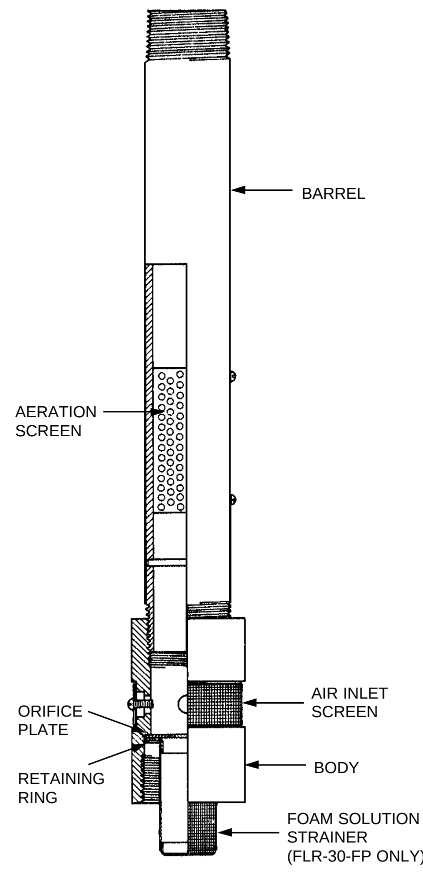
► To determine flow rates for specific applications and proper orifice sizing, consult ANSUL Technical Services.

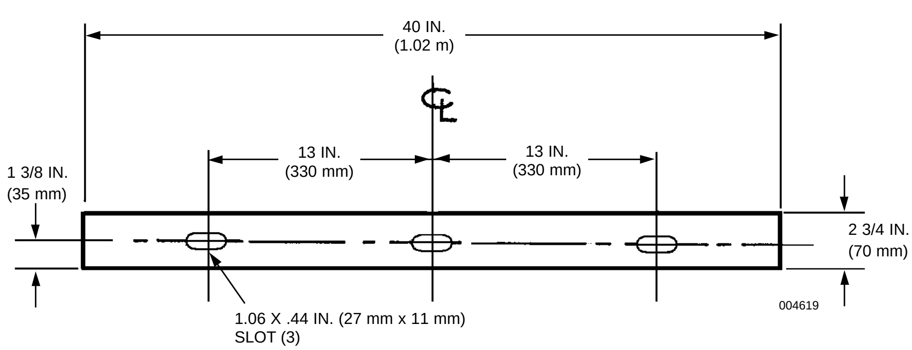
ORDERING INFORMATION

Part No.	Description	Approximate Shipping Weight lb	(kg)
428170	FLR-30-FP	110	(49.9)
428171	FLR-90-FP	120	(54.4)









MOUNTING FLANGE

► Indicates revised information.

tyco
Fire Suppression
& Building Products

One Stanton Street
Marinette, WI 54143-2542

715-735-7411
www.ansul.com

HIGH BACK-PRESSURE FOAM MAKERS

Data/Specifications

ANSUL

FEATURES

- Ten standard sizes to handle a wide range of flow requirements
- Compatible with ANSUL® fluoroprotein and AFFF concentrates for subsurface injection
- Designed to operate with total back pressure as high as 40% of inlet pressure
- Cylindrically-shaped air inlet screen to help prevent accidental damage or blockage

APPLICATION

ANSUL High Back-Pressure Foam Makers (HBPFM) are designed to generate expanded foam for the purpose of subsurface injection into a cone-roof liquid hydrocarbon storage tank.* The foam maker is typically located outside the diked area surrounding the storage tank. Expanded foam is injected through a dedicated foam line or into a product line to the storage tank (refer to Typical Schematics).

The high back-pressure foam maker is capable of generating expanded foam within the optimum expansion ratio range of 2:1 to 4:1 for subsurface injection. The foam maker can discharge against a back pressure as high as 40% of the operating inlet pressure. A minimum foam maker inlet pressure of 100 psi (6.9 bar) is typically required for satisfactory operation.

High back-pressure foam makers can be used with various types of proportioning equipment including bladder tanks, balanced pressure pump proportioning systems, in-line balanced pressure proportioning systems, and foam trucks. (Line proportioning systems are usually unacceptable due to the relatively high pressure loss across the line proportioner – except in instances where back pressure to the foam maker is low and available water pressure to the line proportioner is relatively high.)

* The flammable liquid being protected must be a hydrocarbon product. Polar solvent flammable liquids or hydrocarbons containing more than 10% alcohol are destructive to subsurface injected foams. See NFPA 11.

The storage tank protected should be of cone-roof construction without any type of internal floater. NFPA 11 does not recommend subsurface injection systems for open top or covered floating roof tanks because of the possibility of improper distribution of foam to the fuel surface.

DESCRIPTION

The ANSUL high back-pressure foam maker consists of a preassembled body, discharge tube, turbulator, and metering orifice.

Fixed style foam makers are available in ten models (HBPFM) with nominal flow rates ranging from 100 to 550 gpm (379 to 2082 Lpm). Each of models HBPFM-100 through HBPFM-300 has a 2 1/2 in. NPT female inlet and 2 1/2 in. NPT male outlet. Each of models HBPFM-350 through HBPFM-550 has a standard ANSI 4 in. pipe flange inlet and 6 in. pipe flange outlet.

Portable foam makers are available in five models (HBPFM-P) with nominal flow rates ranging from 100 to 300 gpm (379 to 1136 Lpm). The portable foam maker is equipped with a standard 2 1/2 in. NHT female swivel inlet adaptor and 2 1/2 in. NHT male outlet adaptor.

A screened air inlet allows uniform air distribution into the foam solution stream resulting in the generation of expanded foam. The screened, cylindrical design helps to prevent accidental damage and inhibits the entrance of foreign material.

A pressure gauge, 0 to 300 psi (0 to 20.69 bar), is provided in the foam maker body to allow monitoring of the water inlet pressure. A pressure gauge shroud is integral to the cast metal body to help prevent gauge damage.

SPECIFICATIONS

The high back-pressure foam maker assembly shall consist of an anodized aluminum body and discharge tube. The internal foam turbulator and metering orifice shall be machined from stainless steel and sized to match the designated flow rate and corresponding model designation.

Each of the nominal 100 to 300 gpm (379 to 1136 Lpm) assemblies shall be provided with a 2 1/2 in. NPT female inlet and 2 1/2 in. NPT male outlet. Each of the nominal 350 to 550 gpm (1324 to 2082 Lpm) assemblies shall be provided with a standard ANSI 4 in. pipe flange inlet and 6 in. pipe flange outlet. Portable foam makers shall be equipped with female swivel inlet and male outlet adaptors to mate the 2 1/2 in. NPT thread to the specified fire hose thread.

The high back-pressure foam maker shall have a stainless steel air inlet screen that is cylindrically shaped to the air inlet surface to help ensure optimum performance and avoid damage. A pressure gauge, 0 to 300 psi (0 to 20.69 bar), shall be provided in the foam maker body to monitor operating pressure. A pressure gauge shroud shall be integral to the cast metal body to help prevent gauge damage.

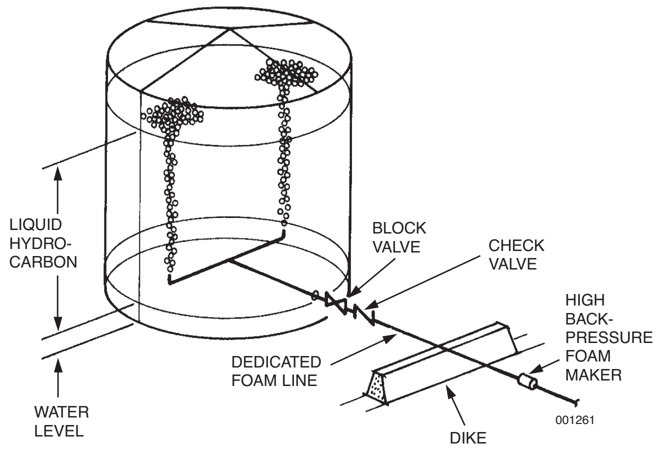
ORDERING INFORMATION

Part No.	Model	Application	Nominal Flow Rate gpm	(Lpm)	Approx. Shipping Weight lb	(kg)
71240	HBPFM-100	Fixed	100	(379)	10	(4.5)
71241	HBPFM-150	Fixed	150	(568)	10	(4.5)
71242	HBPFM-200	Fixed	200	(757)	10	(4.5)
71243	HBPFM-250	Fixed	250	(946)	10	(4.5)
71244	HBPFM-300	Fixed	300	(1136)	10	(4.5)
71286	HBPFM-350	Fixed	350	(1324)	38	(17.2)
71287	HBPFM-400	Fixed	400	(1514)	38	(17.2)
71288	HBPFM-450	Fixed	450	(1703)	38	(17.2)
71289	HBPFM-500	Fixed	500	(1893)	38	(17.2)
71290	HBPFM-550	Fixed	550	(2082)	38	(17.2)
71245	HBPFM-P-100	Portable	100	(379)	12	(5.4)
71246	HBPFM-P-150	Portable	150	(568)	12	(5.4)
71247	HBPFM-P-200	Portable	200	(757)	12	(5.4)
71248	HBPFM-P-250	Portable	250	(946)	12	(5.4)
71249	HBPFM-P-300	Portable	300	(1136)	12	(5.4)

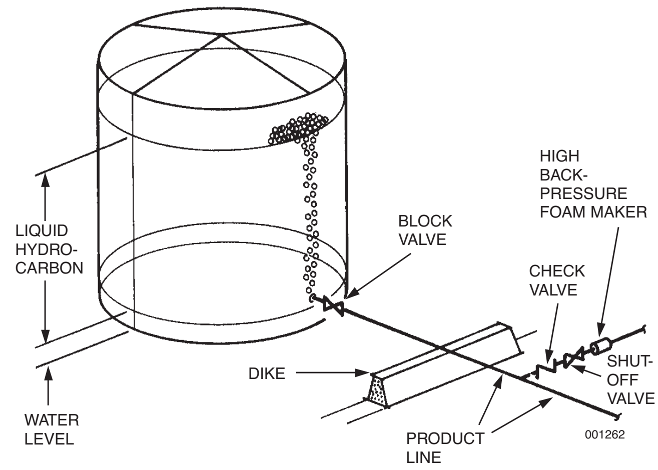
K FACTORS

HBPFM	K Factor
100	7.7
150	13.9
200	17.3
250	22.4
300	25.9
350	30.8
400	35.4
450	40.4
500	44.1
550	48.4

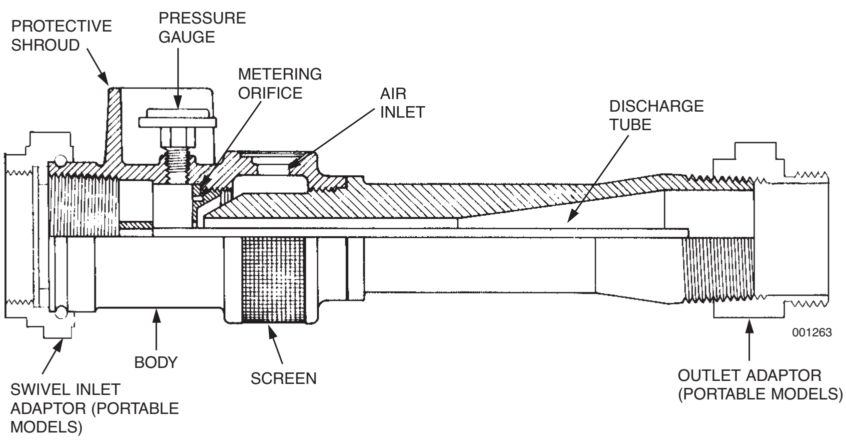
Dedicated Foam Line



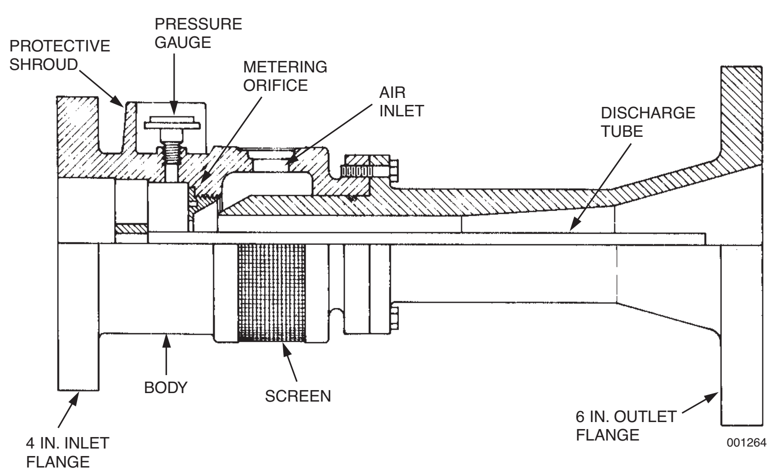
Injection Into Product Line



Models HBPFM-100 Through 300 (Fixed) and HBPFM-P-100 Through 300 (Portable)

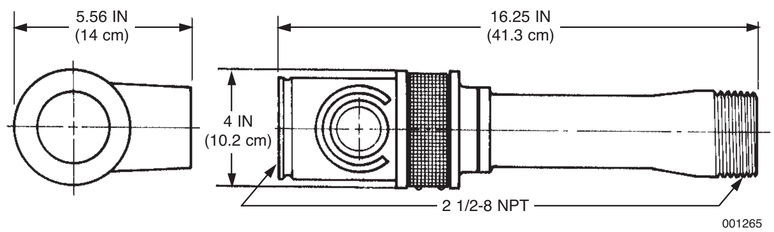


Models HBPFM-350 Through 550 (Fixed)

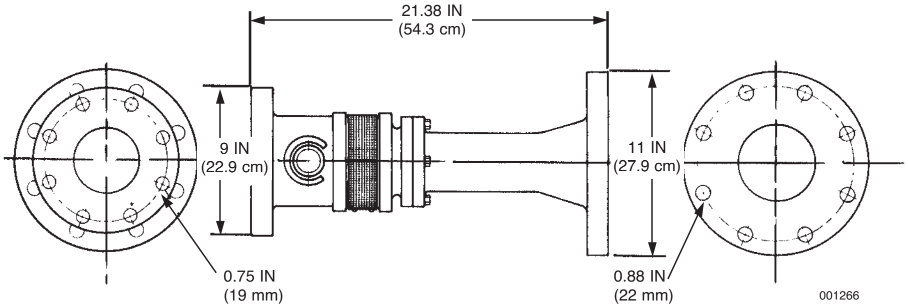


DIMENSIONS

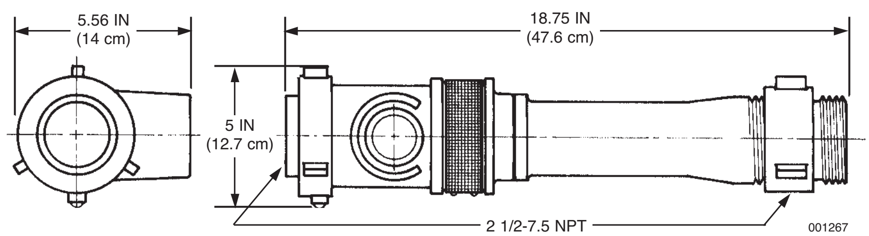
Models HBPFM-100 Through 300 (Fixed)



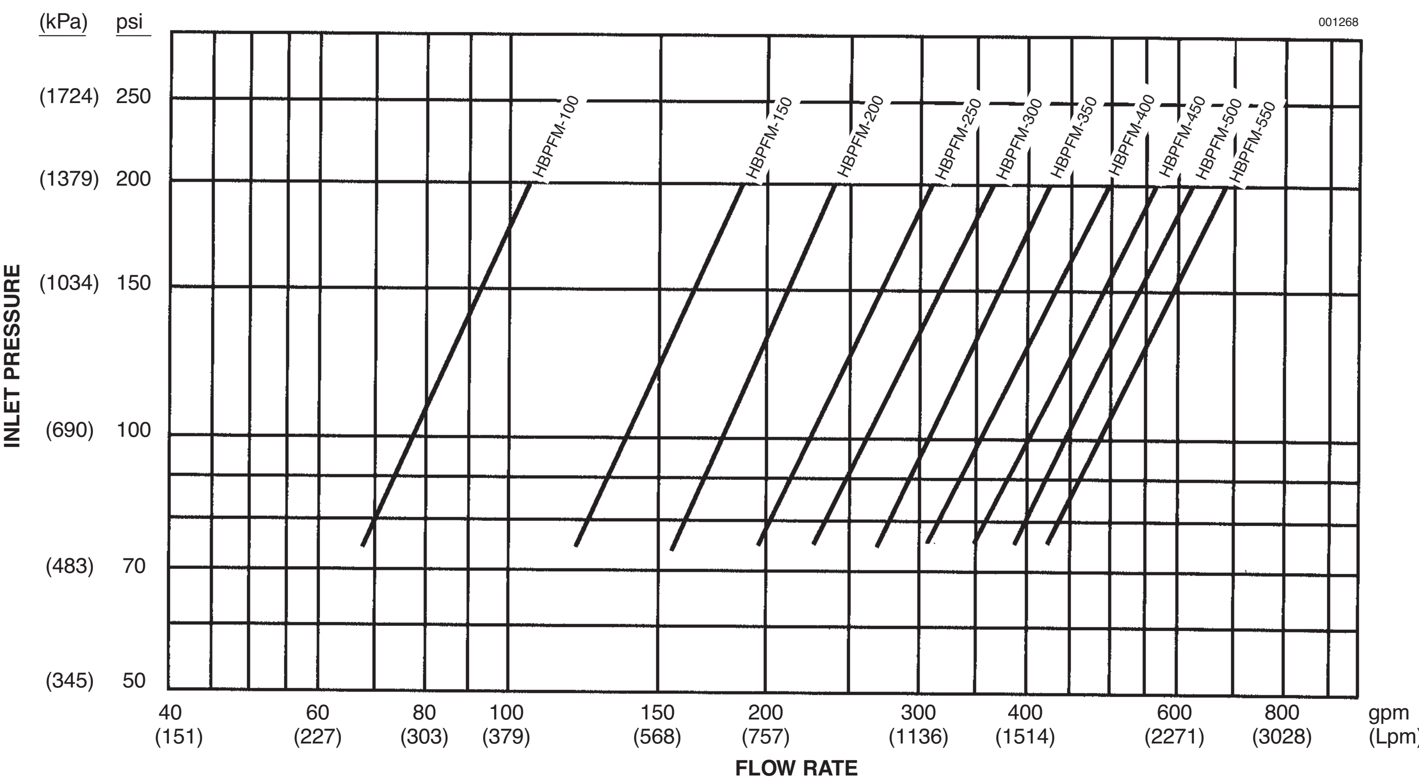
Models HBPFM-350 Through 550 (Fixed)



Models HBPFM-P-100 Through 300 (Portable)



FLOW RATE VS. INLET PRESSURE



ANSUL
A Tyco International Company

JET-X HIGH-EXPANSION FOAM GENERATORS

Data/Specifications

FEATURES

- Reliable, Water Motor Powered
- No Electrical Power Requirements
- Foam Capacities to 28,800 cfm (816 cmm)
- UL Listed Models
- FM Approved Models
- All Models Have CE Marking

001273

APPLICATION

Depending on the type of hazard and its configuration, a JET-X High-Expansion Foam System may be designed for total flooding or local application. Common applications suited for high-expansion foam include:

- Aircraft Hangars
- Hazardous Waste Storage
- Paper Product Warehouse
- Tire Warehouse
- Flammable Liquid Storage
- Mining
- Ship Holds and Engine Rooms
- Power Stations
- Gas Turbine Generators
- Cable Tunnels
- Engine Test Cells
- Transformer Rooms
- Basements, Cellars and Enclosed Spaces
- Communications Switching Stations

In addition to the above hazard types involving Class A and B fires, high-expansion foam is effective in controlling Liquefied Natural Gas (LNG) fires by blocking heat feedback from the flames to the LNG thereby reducing the vaporization rate.

High-expansion foam is also effective in reducing vapor concentrations downwind from un-ignited LNG and other hazardous low-boiling-point gaseous products such as ammonia spills.

BENEFITS

- Minimal water damage is caused to the structure or its contents
- Due to the high-expansion ratios, little water is required to generate large quantities of expanded foam
- Because of its extremely low water content, high-expansion foam can be used in and around many types of electrical equipment (see note)
- The potential for hazardous run-off is reduced as compared to sprinkler systems requiring a large volume of water

Note: Tests conducted by Massachusetts Institute of Technology conclude that high-expansion foam can be used to extinguish fires in rooms containing electrical equipment with little or no damage to the equipment from the foam. If the foam is allowed to dissipate, a very minute residue will be found which can easily be cleaned up.

DESCRIPTION

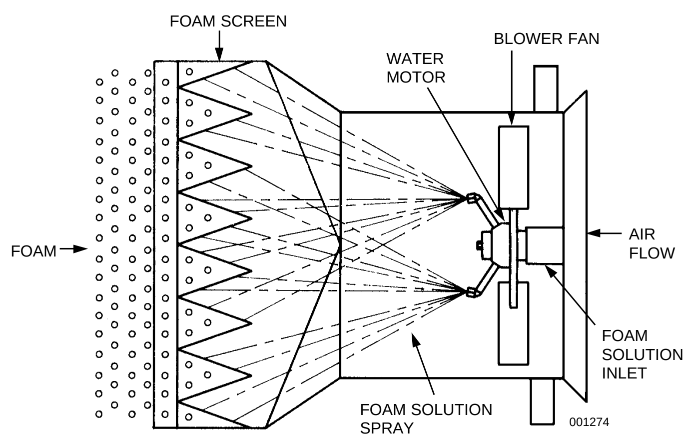
JET-X High-Expansion Foam Generators deliver a mass of uniform bubbles in which the foam solution is expanded in volume to a range of 200:1 to approximately 1000:1. This high-expansion foam is achieved by coating a perforated screen with a foam solution comprised of water and JET-X High-Expansion Foam Concentrate, while a high volume of air is blown on the screen to produce the expanded foam. A continuous supply of JET-X foam solution to the JET-X generator enables the development of a large volume of foam. The largest JET-X generator will produce 28,800 ft^3 per minute (816 m^3 per minute) of foam at 100 psi (6.9 bar) inlet pressure. All JET-X generators are water-powered and require no other source of power, such as electric motors or gasoline engines.

Extinguishment mechanisms of JET-X High-Expansion Foam Systems involve a combination of the following:

- Free air movement necessary for continued combustion is reduced
- Water content of the foam being converted to steam dilutes the oxygen concentration to a level below that necessary to support combustion
- Cooling to a temperature below the combustion point or auto-ignition temperature of Class A or Class B fuels occurs as water is converted to steam
- Reduced surface tension of the foam solution draining from the expanded foam penetrates into Class A materials extinguishing deep seated fires
- Insulating and heat reflective properties of the foam blanket provide a heat shield preventing fire spread

See Tables 2 and 3 for performance characteristics.

GENERATOR COMPONENT INFORMATION



SPECIFICATIONS

Where required, the foam generator shall be powered by a water reaction motor. The water reaction motor shall provide both the screen wetting solution and the energy to drive the fan.

The foam generator shall not require any outside power source, such as electricity or gasoline engines.

All foam generators designed for fixed installations shall be equipped with a stainless steel screen for maximum reliability under fire conditions.

The proportioning system normally used for a high-expansion foam system shall be of the balanced pressure type utilizing a bladder tank and proportioner to provide metering accuracy with minimal loss of available pressure from the water supply.

TYPICAL JET-X SYSTEM CALCULATION (Total Flooding)

Building to be protected is:
Light steel construction
Not sprinklered

Hazard:
Low density combustibles

Fill Time:
As stated in NFPA 11, the fill time for a non-sprinklered building of light steel construction and a hazard of low density combustibles is a maximum of 3 minutes (T).

Area of Building:
100 ft (30.5 m) x 30 ft (9.1 m) = 3,000 ft^2 (278 m^2)

Height of building 10 ft (3 m) = Volume (V) of 30,000 ft^3 (850 m^3)

CALCULATION WITHOUT SPRINKLERS

$R = (V / T) \times C_N \times C_L$

R = Rate of Discharge in cubic feet per minute (cfm)

V = Submergence Volume (ft^3)

T = Submergence Time (minutes)

C_N = Compensation for normal shrinkage (1.15 constant)

C_L = Compensation for leakage
(1.0 no leakage)
(1.2 moderate leakage)

R = (30,000 ft^3 / 3 min) x 1.15 x 1 = 10,000 x 1.15 x 1
= 11,500 cubic feet per minute (cfm) required

11,500 cfm / 6,658 cfm per JET-X-5A @ 50 psi = 1.73 generators

Metric:
R = (850 m^3 / 3 min) x 1.15 x 1
= 283.3 x 1.15 x 1
= 326 cubic meters per minute (cmm) equired

326 cmm / 189 cmm per JET-X-5A @ 3.4 bar = 1.73 generators

Therefore, use two JET-X-5A generators at 6,658 cfm (189 cmm) each (see Table 2 or 3 for options).

TYPICAL JET-X SYSTEM CALCULATION (Local Application)

Group II Aircraft Hangar (Using Inside Air to Generators)

Hangar to be protected is:
Group II hangar measuring 33,000 ft^2 (3066 m^2)
Sprinkler system (wet pipe) for 0.17 gpm/ft^2 over 5000 ft^2 (6.9 Lpm/m^2 over 465 m^2)

Fill time:
As stated in NFPA 409, fill depth of 3 ft (0.9 m) within one minute (T) with sufficient foam concentrate for 12 minutes total.

Area of building:
150 ft x 220 ft = 33,000 ft^2 (45.7 m x 67.1 m = 3066 m^2)

Volume of foam (V):
33,000 ft^2 x 3 ft = 99,000 ft^3 (2803 m^3)

CALCULATION WITH SPRINKLERS

$R = ([V / T] + R_S) \times C_N \times C_A$

R_S = Rate of foam breakdown by sprinklers 10 cfm/gpm x sprinkler system discharge in gpm (0.075 cmm/Lpm x sprinkler discharge in Lpm)

C_N = Compensation for normal shrinkage (1.15 constant)

C_A = Compensation for inside air (1.20 constant – test criteria)

C_L = Leakage factor not required for local application system

R = ([99000 ft^3 / 1 min] + 8500 cfm) x 1.15 x 1.2
= 107,500 x 1.15 x 1.2
= 148,350 cubic feet per minute (cfm) minimum required

148,350 cfm / 27,303 cfm per JET-X-27 @ 75 psi = 5.43 generators

Metric:
R = ([2803 m^3 / 1 min] + 241 cmm) x 1.15 x 1.
= 3044 x 1.15 x 1.2
= 4201 cubic meters per minute (cmm) minimum required

4201 cmm / 773 cmm per JET-X-27 @ 5.2 bar = 5.43 generators

Therefore, use six JET-X-27 generators at 27,303 cfm (773 cmm) each (see Table 2 or 3 for options).

APPROVALS

High-expansion foam systems are designed in accordance with NFPA 11 Standard for “Low, Medium and High-Expansion Foam Systems,” which requires that the high-expansion generator(s) be listed or approved together with the type of high-expansion foam concentrate used. The JET-X generators carry the listings as indicated in Table 1.

ORDERING INFORMATION

Unit Part No.	Model	Weights lb	(kg)	2 3/4% Approval	2% Approval
420001	JET-X-2A	73	(33)	UL, CE	UL, CE
420003	JET-X-5A	255	(116)	UL, FM, CE	UL, CE
420005	JET-X-15A (UL)	397	(180)	UL, CE	UL, CE
420006	JET-X-15A (FM)	397	(180)	FM, CE	CE
420007	JET-X-15A (LNG)	397	(180)	UL, CE	UL, CE
421590	JET-X-20	397	(180)	UL, CE	UL, CE
436899	JET-X-27	720	(327)	CE	UL, CE
Stainless Steel*:					
471066	JET-X 2A	73	(33)	UL, CE	UL, CE
436936	JET-X-5A	255	(116)	UL, CE	UL, CE
436878	JET-X-15A (UL)	398	(180)	UL, CE	UL, CE
472526	JET-X-15A (LNG)	398	(180)	UL, CE	UL, CE
471871	JET-X-20	397	(180)	UL, CE	UL, CE

TABLE 1

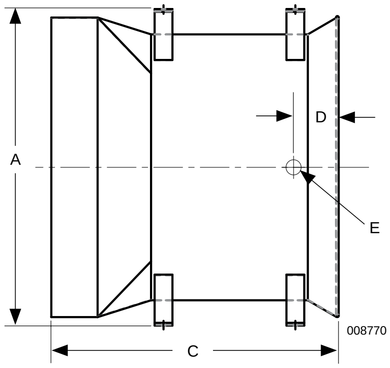
*Stainless Steel Housing and Motor Brackets

GENERAL DIMENSIONAL INFORMATION

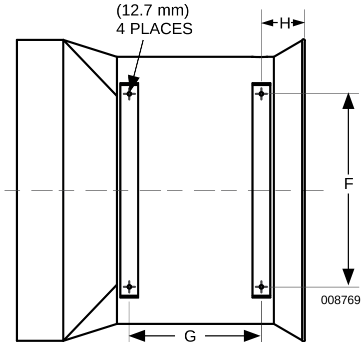
Model	A in.	A (mm)	B in.	B (mm)	C in.	C (mm)	D in.	D (mm)	E* NPT – in.	F in.	F (mm)	G in.	G (mm)	H in.	H (mm)
JET-X-2A	25.0	(635)	25.0	(635)	30.1	(764)	3.9	(99)	1	16.0	(406)	—	—	3.3	(83)
JET-X-5A	44.5	(1130)	42.1	(1069)	40.3	(1024)	6.4	(154)	1 1/2	27.0	(686)	18.5	(470)	6.1	(156)
JET-X-15A (UL)	64.0	(1629)	64.0	(1629)	46.0	(1178)	8.5	(219)	2	36.0	(914)	5.0	(127)	8.0	(213)
JET-X-15A (FM)	64.0	(1629)	64.0	(1629)	46.0	(1178)	8.5	(219)	2	36.0	(914)	5.0	(127)	8.0	(213)
JET-X-15A (LNG)	64.0	(1629)	64.0	(1629)	46.0	(1178)	8.5	(219)	2	36.0	(914)	5.0	(127)	8.0	(213)
JET-X-20	64.0	(1629)	64.0	(1629)	46.0	(1178)	8.5	(219)	2	36.0	(914)	5.0	(127)	8.0	(213)

* Most units are available with rear and side inlets. Exception: JET-X-15A (LNG) and JET-X-20 are rear inlet only.

JET-X-5A

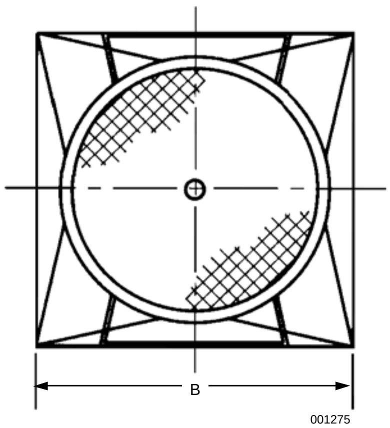


SIDE VIEW



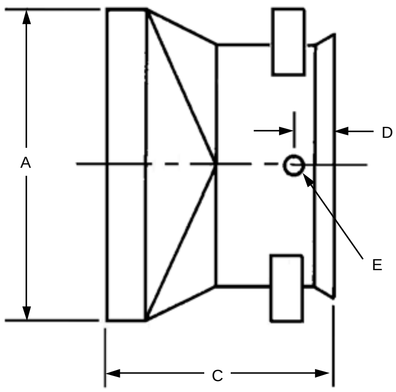
TOP AND BOTTOM VIEW
MOUNTING HOLE LOCATIONS

ALL GENERATORS EXCEPT JET-X-27

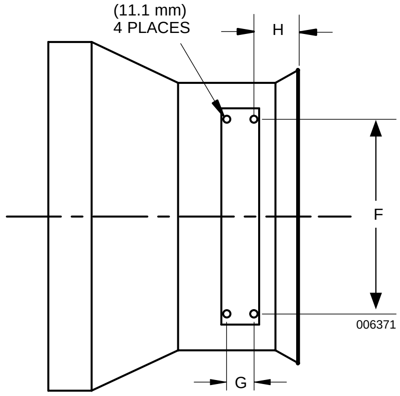


FRONT VIEW (INLET END)

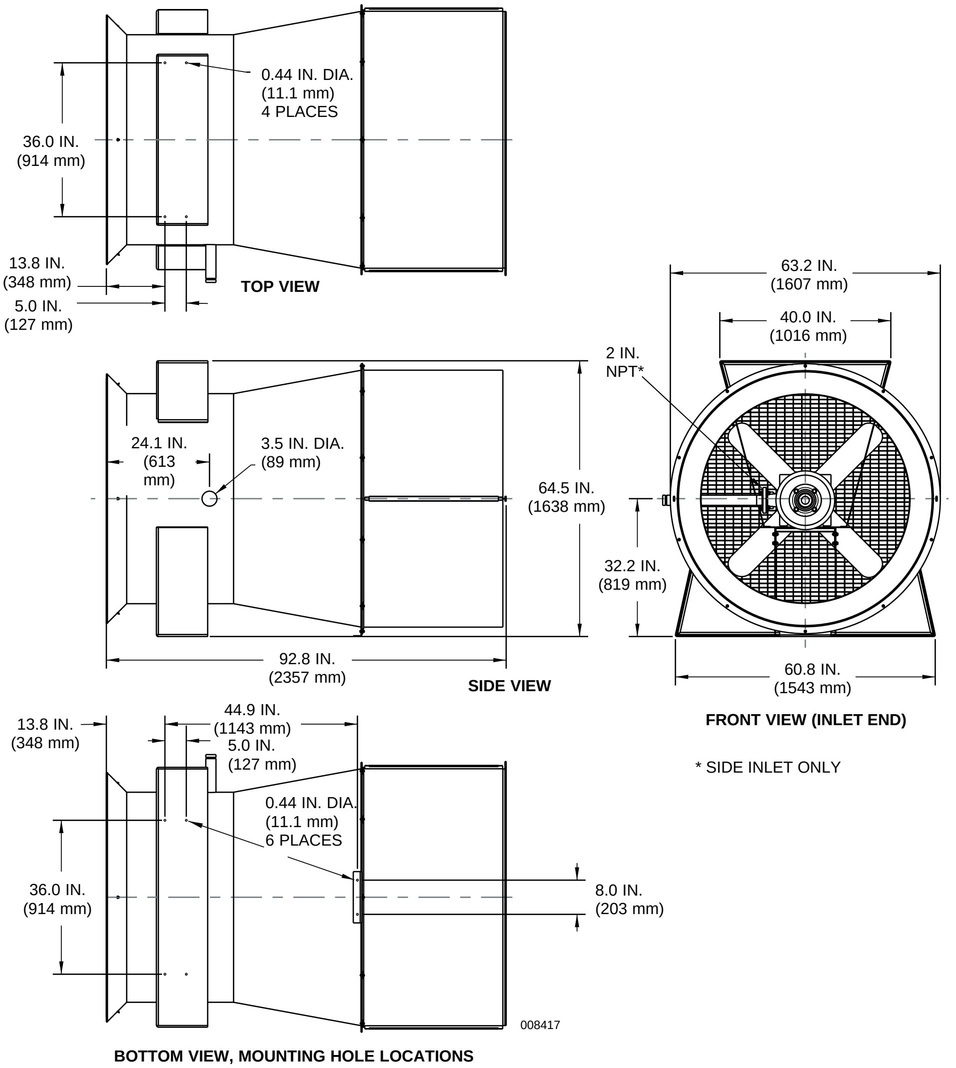
JET-X-2A, -15A (UL, FM, or LNG), -20



SIDE VIEW



TOP AND BOTTOM VIEW
MOUNTING HOLE LOCATIONS


0.44 IN. DIA.
(11.1 mm)
4 PLACES
36.0 IN.
(914 mm)
13.8 IN.
(348 mm)
5.0 IN.
(127 mm)
TOP VIEW
24.1 IN.
(613
mm)
3.5 IN. DIA.
(89 mm)
64.5 IN.
(1638 mm)
92.8 IN.
(2357 mm)
SIDE VIEW
63.2 IN.
(1607 mm)
40.0 IN.
(1016 mm)
2 IN.
NPT*
32.2 IN.
(819 mm)
60.8 IN.
(1543 mm)
FRONT VIEW (INLET END)
* SIDE INLET ONLY
13.8 IN.
(348 mm)
44.9 IN.
(1143 mm)
5.0 IN.
(127 mm)
0.44 IN. DIA.
(11.1 mm)
6 PLACES
36.0 IN.
(914 mm)
8.0 IN.
(203 mm)
008417
BOTTOM VIEW, MOUNTING HOLE LOCATIONS

2% PERFORMANCE CHARACTERISTICS

Model No.	Generator Inlet Pressure psi	(bar)	Foam Output cfm	(cmm)	Solution Flow gpm	(Lpm)	Expansion
JET-X-2A	50	(3.4)	2,188	(62)	35	(132)	468:1
	75	(5.2)	2,727	(77)	42	(159)	486:1
	100	(6.9)	3,010	(85)	50	(189)	450:1
JET-X-5A	50	(3.4)	6,658	(189)	61	(231)	816:1
	75	(5.2)	9,383	(266)	75	(284)	936:1
	100	(6.9)	10,655	(302)	87	(329)	916:1
JET-X-15A	40	(2.8)	12,121	(343)	108	(409)	840:1
(UL)	50	(3.4)	14,491	(410)	119	(450)	911:1
	75	(5.2)	19,141	(542)	145	(549)	987:1
	100	(6.9)	21,796	(617)	169	(640)	965:1
JET-X-15A	50	(3.4)	12,949	(367)	180	(681)	538:1
(LNG)	75	(5.2)	17,769	(503)	220	(833)	604:1
	100	(6.9)	19,503	(552)	260	(984)	561:1
JET-X-20	40	(2.8)	13,530	(383)	212	(803)	477:1
	50	(3.4)	14,746	(418)	238	(901)	463:1
	75	(5.2)	19,007	(538)	294	(1,113)	484:1
	100	(6.9)	22,598	(640)	338	(1,279)	500:1
JET-X-27	40	(2.8)	20,295	(575)	181	(685)	839:1
	50	(3.4)	23,965	(679)	203	(768)	883:1
	75	(5.2)	27,303	(773)	243	(920)	840:1
	100	(6.9)	28,802	(816)	276	(1,045)	781:1

TABLE 2

NOTES:

1. 2% concentrate not to be used for salt water applications.
2. JET-X 2% and JET-X 2 3/4% concentrates are not to be mixed for normal system operation.

2 3/4% PERFORMANCE CHARACTERISTICS

Model No.	Generator Inlet Pressure psi	(bar)	Foam Output cfm	(cmm)	Solution Flow gpm	(Lpm)	Expansion
JET-X-2A	50	(3.4)	2,122	(60)	35	(132)	454:1
	75	(5.2)	2,785	(79)	42	(159)	496:1
	100	(6.9)	3,163	(90)	50	(189)	473:1
JET-X-5A	50	(3.4)	5,575	(158)	61	(231)	684:1
	75	(5.2)	6,628	(188)	75	(284)	661:1
	100	(6.9)	7,182	(203)	87	(329)	617:1
JET-X-15A	50	(3.4)	11,269	(319)	119	(450)	708:1
(UL)	75	(5.2)	15,479	(438)	145	(549)	799:1
	100	(6.9)	18,447	(522)	169	(640)	816:1
JET-X-15A	50	(3.4)	12,985	(368)	105	(397)	925:1
(FM)	75	(5.2)	17,985	(509)	128	(485)	1050:1
	100	(6.9)	17,100	(484)	150	(568)	855:1
JET-X-15A	50	(3.4)	11,735	(332)	180	(681)	488:1
(LNG)	75	(5.2)	16,040	(454)	220	(833)	545:1
	100	(6.9)	19,601	(555)	260	(984)	564:1
JET-X-20	40	(2.8)	13,443	(381)	212	(803)	474:1
	50	(3.4)	16,034	(454)	238	(901)	504:1
	75	(5.2)	21,145	(599)	294	(1,113)	538:1
	100	(6.9)	24,301	(688)	338	(1,279)	538:1

TABLE 3

NOTE:

1. JET-X 2% and JET-X 2 3/4% concentrates are not to be mixed for normal system operation.

Application

ANSUL electric actuated dampers and louvers are available when the use of outside air is required to generate a high-expansion foam blanket. These devices are especially suited for total flooding high-expansion foam systems where combustion products (smoke and soot) and heat produced from the material(s) involved would inhibit foam production. In warmer climates, air exchange may be unnecessary, and actuated dampers and louvers may not be required. However, in cold weather climates, they may be mandatory to reduce building heat loss during winter conditions.

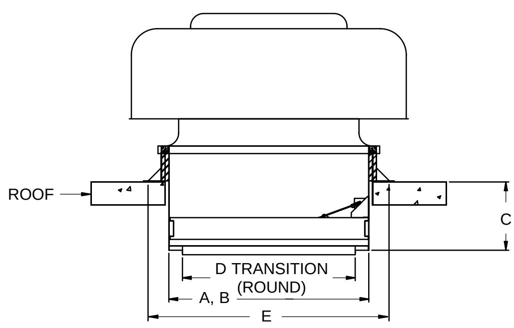
NFPA 11 Standard for "Low, Medium and High-Expansion Foam Systems" states "air from outside the hazard area shall be used for foam generation unless data is provided to show that air from inside the hazard can be successfully employed." Tyco Fire Protection Products has done testing with inside air and there are specific applications where it is recommended. If you have specific questions concerning this matter, contact Tyco Fire Protection Products Technical Services.

Description

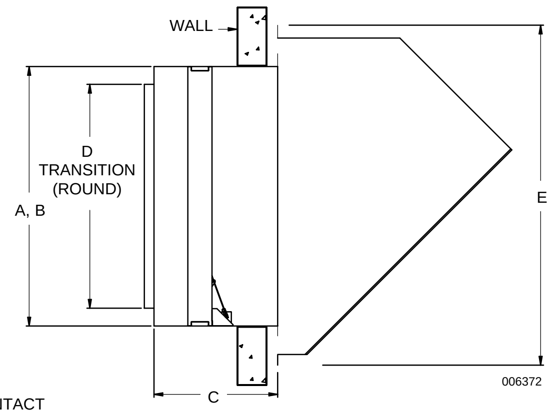
The ANSUL actuated dampers and louvers are powered by 110 VAC and are fail-safe open devices. Energized, the damper or louver is closed with loss of power to open. They are available with either NEMA 4 or NEMA 7 actuators.

Air intake dampers are available for wall or roof mounting. The wall mount damper is a complete package inclusive of the damper with actuator, weatherhood with birdscreen, and transition piece to intake of generator. The roof mount damper includes the same features as the wall mount damper as well as roof curbing. Wall relief louvers are comprised only of a louver with actuator and birdscreen. Wall relief louvers are not required where adequate venting exists.

15/20/27[1] ROOF INTAKE DAMPER ASSEMBLY

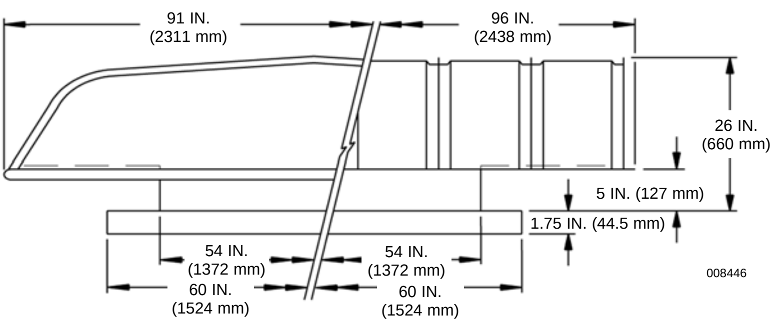


WALL INTAKE DAMPER ASSEMBLY

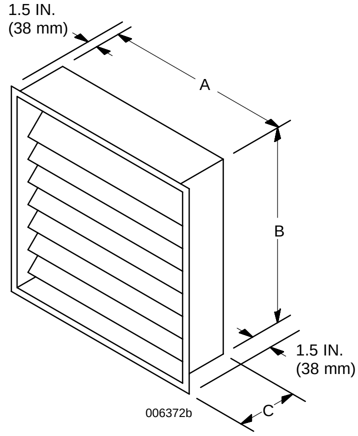


NOTE: ADDITIONAL DETAILED INSTALLATION DRAWINGS ARE AVAILABLE. CONTACT TYCO FIRE PROTECTION PRODUCTS TECHNICAL SERVICES FOR DETAILS.

[1]27 WEATHER HOOD (INCLUDED WITH PART NO. 437018/437097)



WALL RELIEF LOUVER ASSEMBLY



ORDERING INFORMATION – DIMENSIONS

Part No. NEMA 4 / 7	Model	Clearance Dimensions* A in.	A (mm)	B in.	B (mm)	C in.	C (mm)	D in.	D (mm)	E in.	E (mm)	Shipping Weights** lb	(kg)
430060/430061	Wall Intake Damper Assembly – JET-X-5A	44.0	(1118)	44.0	(1118)	24.0	(610)	42.0	(1060)	51.8	(1314)	241	(109)
430062/430063	Roof Intake Damper Assembly – JET-X-5A	46.0	(1168)	46.0	(1168)	16.0	(406)	42.0	(1067)	57.8	(1467)	285	(129)
430064/430065	Wall Relief Louver Assembly – JET-X-5A	30.0	(762)	48.0	(1219)	6.0	(152)	—	—	—	—	50	(23)
430066/430067	Wall Intake Damper Assembly – JET-X-15/20/27	54.0	(1372)	54.0	(1372)	24.0	(610)	53.0	(1340)	57.9	(1470)	315	(143)
430068/430069	Roof Intake Damper Assembly – JET-X-15/20	54.0	(1372)	54.0	(1372)	16.0	(406)	53.0	(1346)	65.8	(1670)	360	(164)
430070/430071	Wall Relief Louver Assembly – JET-X-15/20/27	60.0	(1524)	84.0	(2134)	6.0	(152)	—	—	—	—	140	(64)
437018/437097	Roof Intake Damper Assembly – JET-X-27	54.0	(1372)	54.0	(1372)	14.0	(356)	53.0	(1346)	62.5	(1588)	525	(238)

* Actual dimensions of equipment will be approximately 0.25 in. (6.4 mm) smaller than clearance dimensions listed.

** Weights listed are for NEMA 4 models; add 20 lb (9.1 kg) for NEMA 7 models.

TABLE 5

NOTE: The converted metric values in this document are provided for dimensional reference only and do not reflect an actual measurement.

HIGH BACK-PRESSURE FOAM MAKERS

Data/Specifications

ANSUL

FEATURES

- Ten standard sizes to handle a wide range of flow requirements
- Compatible with ANSUL® fluoroprotein and AFFF concentrates for subsurface injection
- Designed to operate with total back pressure as high as 40% of inlet pressure
- Cylindrically-shaped air inlet screen to help prevent accidental damage or blockage

APPLICATION

ANSUL High Back-Pressure Foam Makers (HBPFM) are designed to generate expanded foam for the purpose of subsurface injection into a cone-roof liquid hydrocarbon storage tank.* The foam maker is typically located outside the diked area surrounding the storage tank. Expanded foam is injected through a dedicated foam line or into a product line to the storage tank (refer to Typical Schematics).

The high back-pressure foam maker is capable of generating expanded foam within the optimum expansion ratio range of 2:1 to 4:1 for subsurface injection. The foam maker can discharge against a back pressure as high as 40% of the operating inlet pressure. A minimum foam maker inlet pressure of 100 psi (6.9 bar) is typically required for satisfactory operation.

High back-pressure foam makers can be used with various types of proportioning equipment including bladder tanks, balanced pressure pump proportioning systems, in-line balanced pressure proportioning systems, and foam trucks. (Line proportioning systems are usually unacceptable due to the relatively high pressure loss across the line proportioner – except in instances where back pressure to the foam maker is low and available water pressure to the line proportioner is relatively high.)

* The flammable liquid being protected must be a hydrocarbon product. Polar solvent flammable liquids or hydrocarbons containing more than 10% alcohol are destructive to subsurface injected foams. See NFPA 11.

The storage tank protected should be of cone-roof construction without any type of internal floater. NFPA 11 does not recommend subsurface injection systems for open top or covered floating roof tanks because of the possibility of improper distribution of foam to the fuel surface.

DESCRIPTION

The ANSUL high back-pressure foam maker consists of a preassembled body, discharge tube, turbulator, and metering orifice.

Fixed style foam makers are available in ten models (HBPFM) with nominal flow rates ranging from 100 to 550 gpm (379 to 2082 Lpm). Each of models HBPFM-100 through HBPFM-300 has a 2 1/2 in. NPT female inlet and 2 1/2 in. NPT male outlet. Each of models HBPFM-350 through HBPFM-550 has a standard ANSI 4 in. pipe flange inlet and 6 in. pipe flange outlet.

Portable foam makers are available in five models (HBPFM-P) with nominal flow rates ranging from 100 to 300 gpm (379 to 1136 Lpm). The portable foam maker is equipped with a standard 2 1/2 in. NHT female swivel inlet adaptor and 2 1/2 in. NHT male outlet adaptor.

A screened air inlet allows uniform air distribution into the foam solution stream resulting in the generation of expanded foam. The screened, cylindrical design helps to prevent accidental damage and inhibits the entrance of foreign material.

A pressure gauge, 0 to 300 psi (0 to 20.69 bar), is provided in the foam maker body to allow monitoring of the water inlet pressure. A pressure gauge shroud is integral to the cast metal body to help prevent gauge damage.

SPECIFICATIONS

The high back-pressure foam maker assembly shall consist of an anodized aluminum body and discharge tube. The internal foam turbulator and metering orifice shall be machined from stainless steel and sized to match the designated flow rate and corresponding model designation.

Each of the nominal 100 to 300 gpm (379 to 1136 Lpm) assemblies shall be provided with a 2 1/2 in. NPT female inlet and 2 1/2 in. NPT male outlet. Each of the nominal 350 to 550 gpm (1324 to 2082 Lpm) assemblies shall be provided with a standard ANSI 4 in. pipe flange inlet and 6 in. pipe flange outlet. Portable foam makers shall be equipped with female swivel inlet and male outlet adaptors to mate the 2 1/2 in. NPT thread to the specified fire hose thread.

The high back-pressure foam maker shall have a stainless steel air inlet screen that is cylindrically shaped to the air inlet surface to help ensure optimum performance and avoid damage. A pressure gauge, 0 to 300 psi (0 to 20.69 bar), shall be provided in the foam maker body to monitor operating pressure. A pressure gauge shroud shall be integral to the cast metal body to help prevent gauge damage.

ORDERING INFORMATION

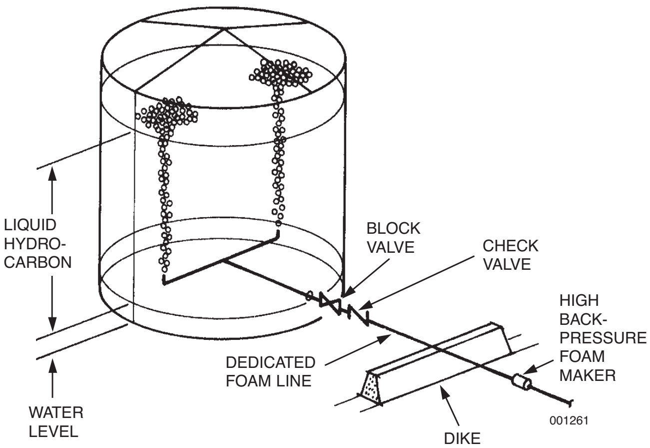
Part No.	Model	Application	Nominal Flow Rate gpm	(Lpm)	Approx. Shipping Weight lb	(kg)
71240	HBPFM-100	Fixed	100	(379)	10	(4.5)
71241	HBPFM-150	Fixed	150	(568)	10	(4.5)
71242	HBPFM-200	Fixed	200	(757)	10	(4.5)
71243	HBPFM-250	Fixed	250	(946)	10	(4.5)
71244	HBPFM-300	Fixed	300	(1136)	10	(4.5)
71286	HBPFM-350	Fixed	350	(1324)	38	(17.2)
71287	HBPFM-400	Fixed	400	(1514)	38	(17.2)
71288	HBPFM-450	Fixed	450	(1703)	38	(17.2)
71289	HBPFM-500	Fixed	500	(1893)	38	(17.2)
71290	HBPFM-550	Fixed	550	(2082)	38	(17.2)
71245	HBPFM-P-100	Portable	100	(379)	12	(5.4)
71246	HBPFM-P-150	Portable	150	(568)	12	(5.4)
71247	HBPFM-P-200	Portable	200	(757)	12	(5.4)
71248	HBPFM-P-250	Portable	250	(946)	12	(5.4)
71249	HBPFM-P-300	Portable	300	(1136)	12	(5.4)

K FACTORS

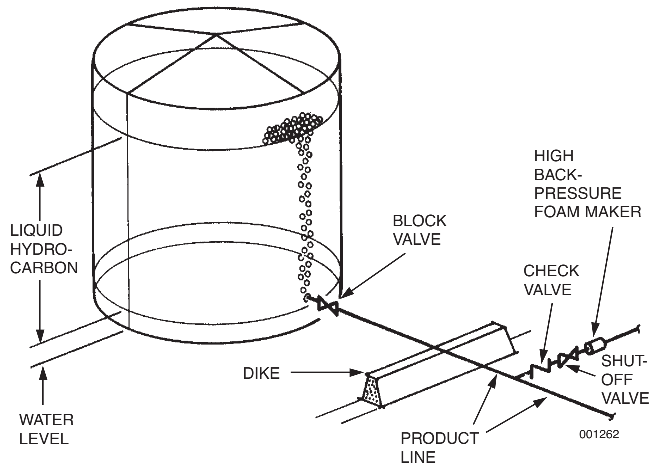
HBPFM	K Factor
100	7.7
150	13.9
200	17.3
250	22.4
300	25.9
350	30.8
400	35.4
450	40.4
500	44.1
550	48.4

TYPICAL SCHEMATICS

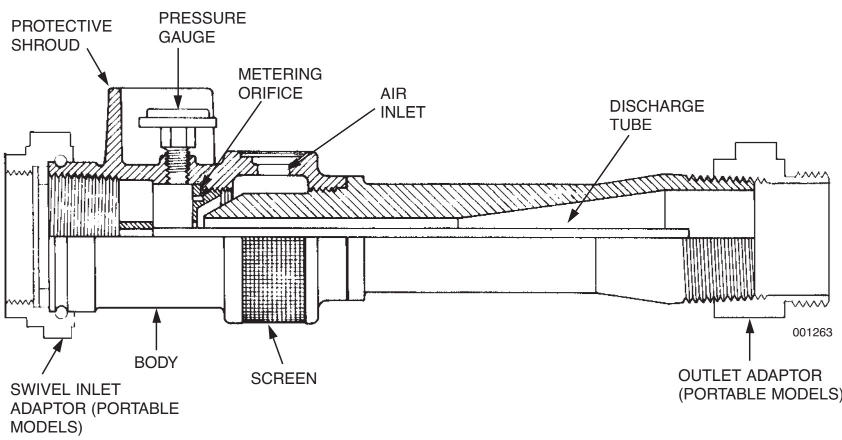
Dedicated Foam Line



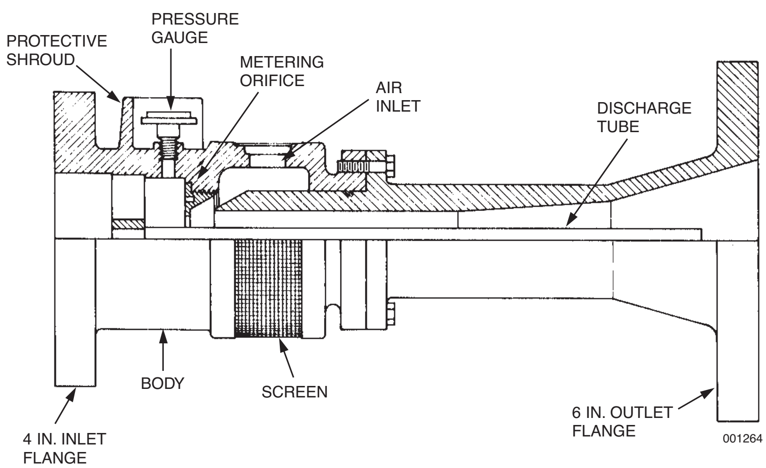
Injection Into Product Line



Models HBPFM-100 Through 300 (Fixed) and HBPFM-P-100 Through 300 (Portable)

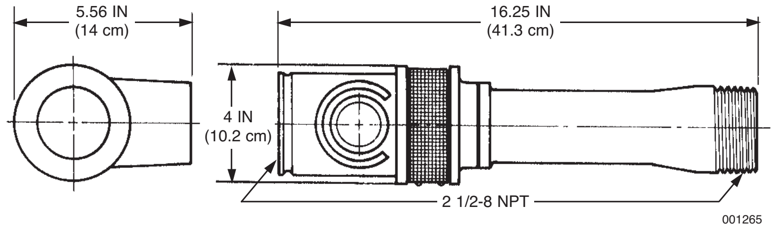


Models HBPFM-350 Through 550 (Fixed)

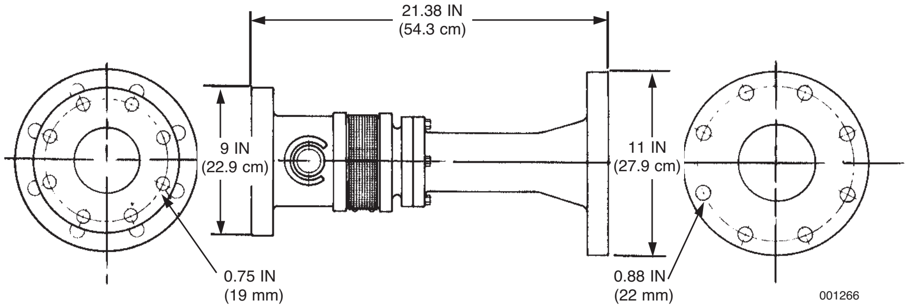


DIMENSIONS

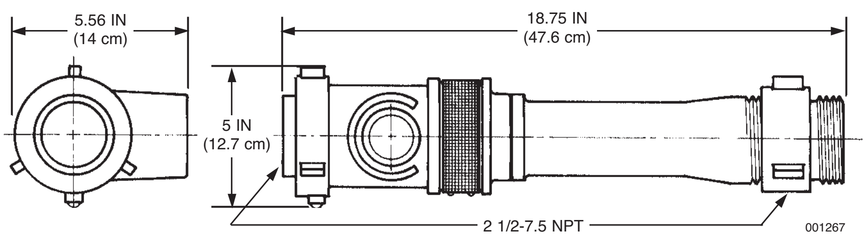
Models HBPFM-100 Through 300 (Fixed)



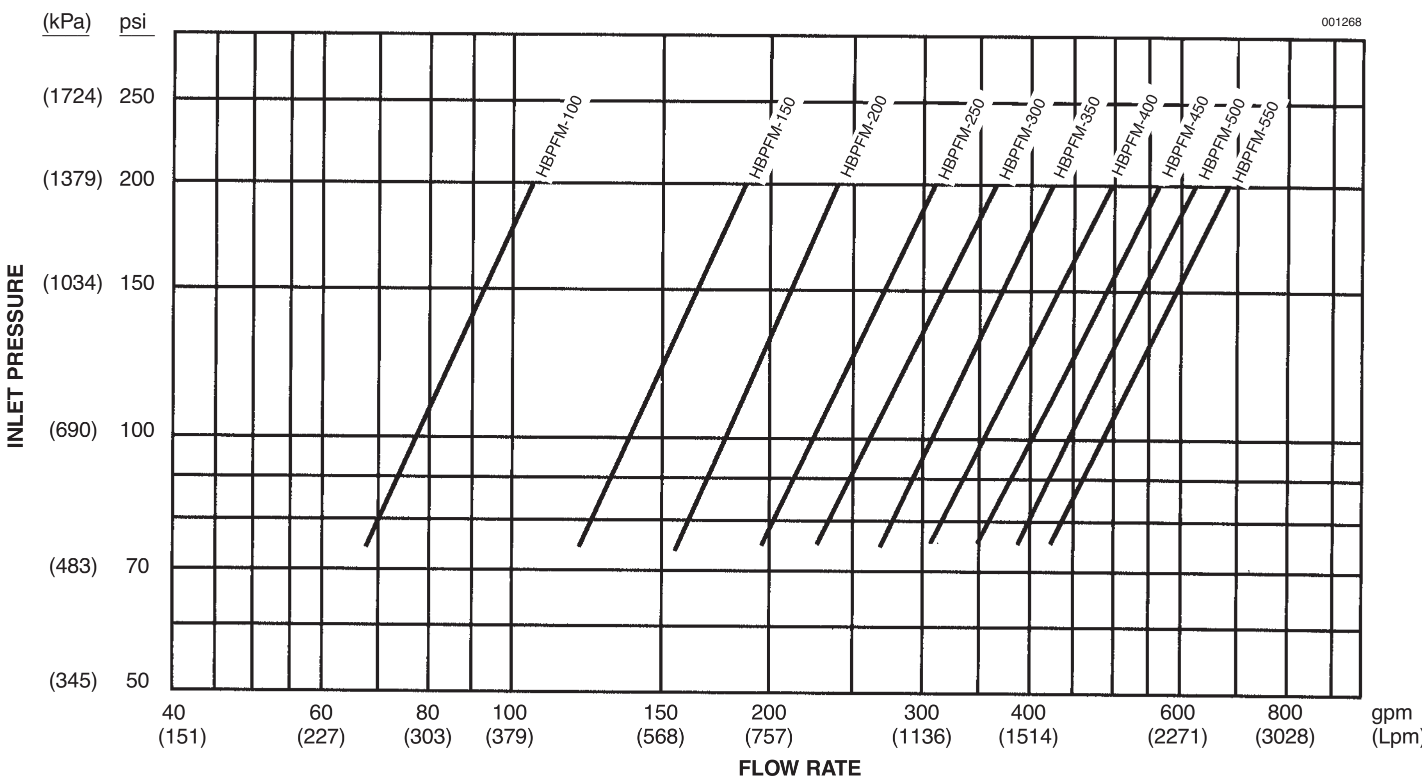
Models HBPFM-350 Through 550 (Fixed)



Models HBPFM-P-100 Through 300 (Portable)



FLOW RATE VS. INLET PRESSURE



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Form No. F-8741-3

ANSUL

A Tyco International Company

AHR CONTINUOUS FLOW HOSE REELS

Data/Specifications

FEATURES

- Heavy gauge welded steel construction
- Hot-dipped galvanized steel
- Greaseless polyethylene bearings
- Lever-action friction brake
- Pre-wound booster hose included
- USCG approved hose
- Suitable for wall or floor mounting
- Manual rim rewind
- Optional hand crank available

APPLICATION

ANSUL® continuous-flow hose reels provide immediate operation in firefighting and/or wash-down applications. Whether used in land-based facilities or offshore applications, these hose reels offer the benefits of rugged steel construction along with the superior corrosion resistance of hot-dip galvanizing. The continuous-flow hose design offers an advantage over collapsible hose, as only the amount of hose required is unreeled without kinks or twists. The reels are supplied with 1 1/2 in. continuous-flow booster hose with NH (NST) hose couplings.

Typical applications involving water or firefighting foam include:

- Aircraft Hangars
- Helipads
- Truck Loading Racks
- Chemical Processing Facilities
- Warehouses
- Offshore Platforms
- Shipboard/Marine Applications

DESCRIPTION

The continuous-flow hose reel assembly includes the hose reel prewound with the desired length of booster hose. This hose is a single, synthetic, reinforced braid booster hose with a 250 psi (17.2 bar) working pressure having a minimum burst pressure of 1000 psi (69.0 bar). Depending on the application, any ANSUL-supplied handline nozzle with 1 1/2 in. NH threads can be used. This includes variable pattern fog/straight stream nozzles suitable for water or AFFF applications, or air-aspirated low and medium-expansion foam nozzles. An optional hand crank is available to convert the standard rim rewind type reel to a hand crank rewind type reel.

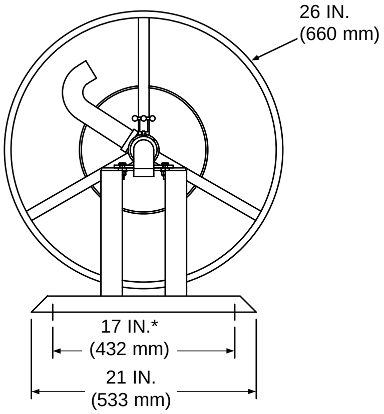
007051

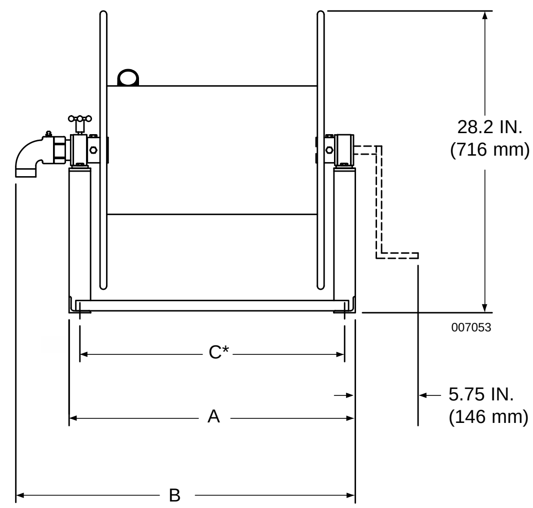
ORDERING INFORMATION

Part No.	Model No.	Description	Approximate Shipping Weight
433077	AHR-1.5-50	Hose Reel w/50 ft (15.2 m) hose	128 lb (58.1 kg)
433078	AHR-1.5-75	Hose Reel w/75 ft (22.9 m) hose	167 lb (75.8 kg)
433079	AHR-1.5-100	Hose Reel w/100 ft (30.5 m) hose	192 lb (87.1 kg)
433080	AHR-1.5-150	Hose Reel w/150 ft (45.7 m) hose	257 lb (116.6 kg)
433081	—	Optional Hand Crank	7 lb (3.2 kg)

008987

Hose Reel with Optional Hand Crank





Part No.	Model No.	Hose Capacity	Dimensions A	B	C*
433077	AHR-1.5-50	50 ft (15.2 m)	16.75 in. (425 mm)	21.75 in. (552 mm)	14.75 in. (375 mm)
433078	AHR-1.5-75	75 ft (22.9 m)	26.75 in. (679 mm)	31.75 in. (806 mm)	24.75 in. (629 mm)
433079	AHR-1.5-100	100 ft (30.5 m)	26.75 in. (679 mm)	31.75 in. (806 mm)	24.75 in. (629 mm)
433080	AHR-1.5-150	150 ft (45.7 m)	36.75 in. (933 mm)	41.75 in. (1060 mm)	34.75 in. (883 mm)

* Center of 1 in. x 13/32 in. (25 mm x 10 mm) slot; suggested bolt size of 3/8 in.

NOTE: The converted metric values in this document are provided for dimensional reference only and do not reflect an actual measurement.

tyco
Fire Protection Products

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AFS FOAM STATIONS

Data/Specifications

ANSUL

FEATURES

- Heavy gauge welded steel construction
- Hot dipped galvanized reels
- Epoxy corrosion-resistant painted stand
- Greaseless polyethylene bearings
- Lever-action friction brake
- Prewound booster hose included
- Manual rim rewind
- Optional hand crank available
- UL Listed foam eductor – 60 or 95 gpm (227 or 360 Lpm)
- Complete trim package with pick-up tube included

APPLICATION

ANSUL® AFS foam stations provide immediate operation in firefighting foam applications when connected to a pressurized water supply. Whether used in land based facilities or offshore applications, ANSUL foam stations offer the benefits of a rugged hot-dipped galvanized reel with a red epoxy corrosion resistant "CR" painted stand. The continuous-flow hose reel design offers an advantage over reels or racks equipped with collapsible hose, as only the amount of hose required is unreeled without kinks or twists. The reels are supplied with 1 1/2 in. (3.8 cm) continuous-flow booster hose with NST (NH) hose couplings. Foam eductors are fixed flow rate devices that typically require flowing water pressure in the range of 100 to 200 psi (6.9 to 13.8 bar). Actual foam solution flow rate is a function of flowing (residual) water inlet pressure and K-Factor of the eductor selected.

Typical applications involving water or firefighting foam include:

- Aircraft Hangars
- Helipads
- Truck Loading Racks
- Chemical Processing Facilities
- Warehouses
- Offshore Platforms
- Shipboard/Marine Applications

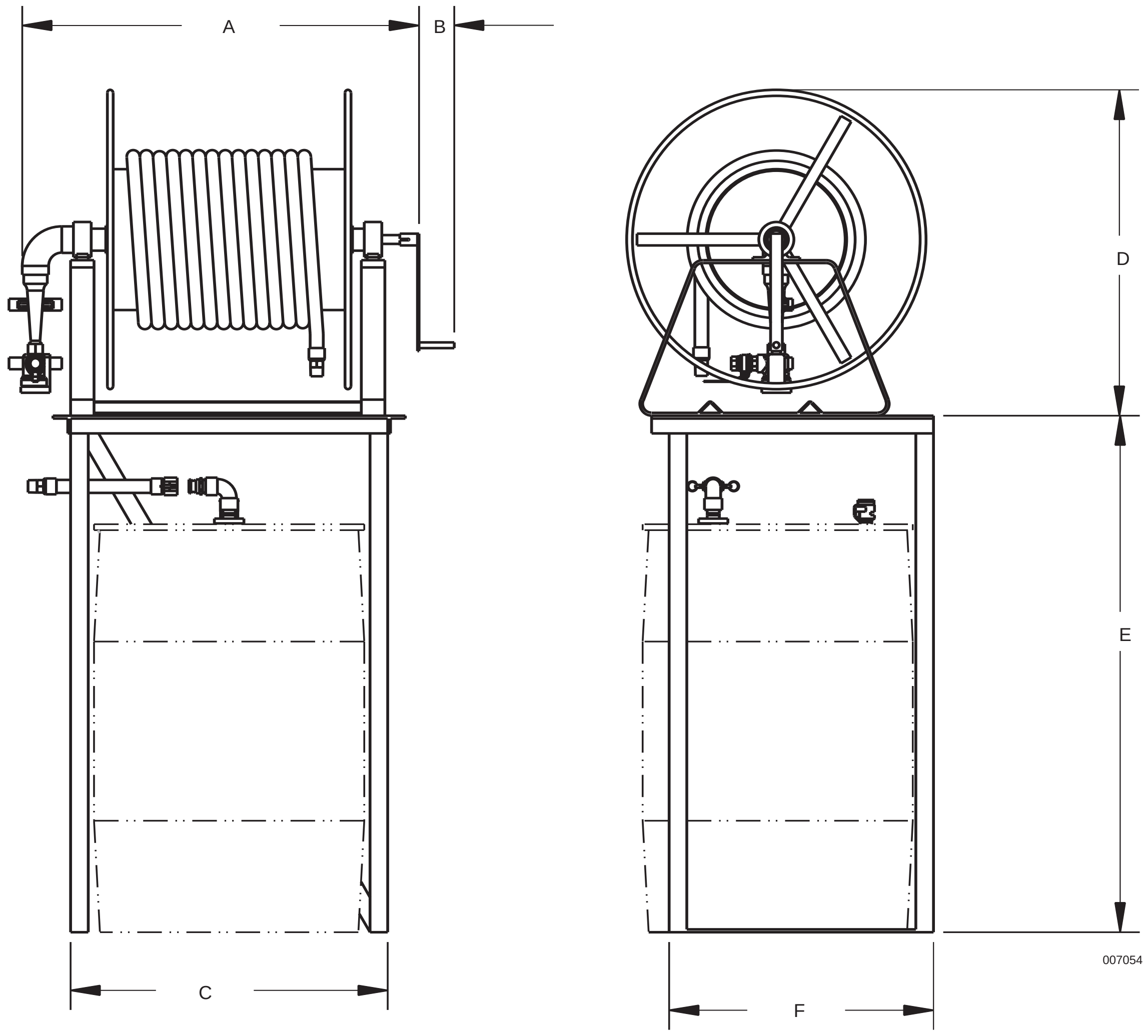
DESCRIPTION

ANSUL AFS foam stations contain a continuous-flow hose reel prewound with 1 1/2 in. (3.8 cm) booster hose, reel support stand with epoxy corrosion-resistant "CR" paint system, foam eductor with orifice matched to type and concentration of foam required, and 55 gal (208 L) drum installation fittings with pick-up tube. The bottom of the frame contains four 5/8 in. (1.6 cm) mounting holes (for 1/2 in. (1.3 cm) bolts not provided). The foam concentrate in drums, along with the desired type of handline nozzle matched to the eductor, must be ordered separately. Please consult ANSUL for recommended nozzles to match with foam eductor flow. The continuous-flow hose reel assembly includes the hose reel prewound with the desired length of booster hose. This hose is a single, synthetic, reinforced braid booster hose with a 250 psi (17.2 bar) working pressure having a minimum burst pressure of 1000 psi (69.0 bar). Depending on the application, any ANSUL-supplied handline nozzle with 1 1/2 in. (3.8 cm) NST threads can be used. This includes variable pattern fog/straight stream nozzles suitable for water or AFFF applications, or air-aspirated low and medium-expansion foam nozzles. An optional hand crank is available to convert the standard rim rewind type reel to a hand crank rewind type reel.

007052

ORDERING INFORMATION

Part No.	Model No.	Description	Approximate Shipping Weight
433221	AFS-60/150	Foam Station w/150 ft (45.7 m) hose and PL60 Eductor	380 lb (172 kg)
433222	AFS-60/100	Foam Station w/100 ft (30.5 m) hose and PL60 Eductor	325 lb (147 kg)
433223	AFS-60/75	Foam Station w/75 ft (22.9 m) hose and PL60 Eductor	285 lb (129 kg)
433224	AFS-60/50	Foam Station w/50 ft (15.2 m) hose and PL60 Eductor	256 lb (116 kg)
433225	AFS-95/100	Foam Station w/100 ft (30.5 m) hose and PL95 Eductor	325 lb (147 kg)
433226	AFS-95/75	Foam Station w/75 ft (22.9 m) hose and PL95 Eductor	285 lb (129 kg)
433227	AFS-95/50	Foam Station w/50 ft (15.2 m) hose and PL95 Eductor	256 lb (116 kg)
433081	—	Optional Hand Crank	7 lbs. (3.2 kg)



Part No.	Model No.	Hose Capacity	Dimensions A	B	C	D	E	F
433221	AFS-60/150	150 ft (45.7 m)	44.1 in (112.0 cm)	3.4 in (8.6 cm)	37 in (94.0 cm)	27.8 in (70.6 cm)	44 in (111.8 cm)	22.5 in (57.2 cm)
433222	AFS-60/100	100 ft (30.5 m)	34.1 in (86.6 cm)	3.4 in (8.6 cm)	27 in (68.6 cm)	27.8 in (70.6 cm)	44 in (111.8 cm)	22.5 in (57.2 cm)
433223	AFS-60/75	75 ft (22.9 m)	34.1 in (86.6 cm)	3.4 in (8.6 cm)	27 in (68.6 cm)	27.8 in (70.6 cm)	44 in (111.8 cm)	22.5 in (57.2 cm)
433224	AFS-60/50	50 ft (15.2 m)	24.1 in (61.2 cm)	3.4 in (8.6 cm)	27 in (68.6 cm)	27.8 in (70.6 cm)	44 in (111.8 cm)	22.5 in (57.2 cm)
433225	AFS-95/100	100 ft (30.5 m)	34.1 in (86.6 cm)	3.4 in (8.6 cm)	27 in (68.6 cm)	27.8 in (70.6 cm)	44 in (111.8 cm)	22.5 in (57.2 cm)
433226	AFS-95/75	75 ft (22.9 m)	34.1 in (86.6 cm)	3.4 in (8.6 cm)	27 in (68.6 cm)	27.8 in (70.6 cm)	44 in (111.8 cm)	22.5 in (57.2 cm)
433227	AFS-95/50	50 ft (15.2 m)	24.1 in (61.2 cm)	3.4 in (8.6 cm)	27 in (68.6 cm)	27.8 in (70.6 cm)	44 in (111.8 cm)	22.5 in (57.2 cm)

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Form No. F-2004139-1

HANDLINE NOZZLES AND EDUCTORS

Data/Specifications

ANSUL

LOW-EXPANSION FOAM HANDLINE NOZZLES

FEATURES

- Noncorrosive materials
- Easy-to-operate ball shut off valve
- Light weight for ease of handling
- Good foam quality with pressure of 45 psi (310 kPa) and greater

APPLICATION

The ANSUL® KR-S low-expansion foam handline nozzles can be used with all low expansion foam agents such as fluoroprotein, AFFF, alcohol resistant AFFF, and Class A foam concentrates. These portable, air aspirating nozzles can be used in a variety of flammable liquid hazard areas using ANSULITE® Class B foam concentrates. Typical applications include municipal fire departments and crash-fire-rescue (CFR) vehicles, or for handline applications around tank farms, loading racks, aircraft hangars, and chemical plants.

Using SILV-EX® Class A foam concentrate, an effective blanketing foam is produced for use for structural fire attack and other deep-seated fires involving tires, rolled paper, baled cotton and coal bunkers.

The advantage of low expansion compared to medium expansion foam is the greater throw range and superior cooling effect achieved by the higher water content.

DESCRIPTION

Two sizes are available for nominal flow rates of 60 gpm (227 Lpm) and 120 gpm (454 Lpm) @ 100 psi (689 kPa). Foam solution is sprayed through the nozzle and foam is produced in the tube as air is drawn in. Each nozzle has a ball shut-off valve. The nozzle tube is constructed of stainless steel with a tough polyurethane handle providing optimum protection against corrosion. Although the normal operating pressure is 75 – 100 psi (517 – 689 kPa), a minimum operating pressure of 45 psi (310 kPa) is recommended. Foam concentrate is usually proportioned to the nozzle using the matching ANSUL Model Z eductor.

TECHNICAL DATA TABLE

Model Number	KR-S2	KR-S4
Flow rate @ 100 psi (689 kPa)	60 gpm (227 Lpm)	120 gpm (454 Lpm)
Normal Operating Pressure	75-100 psi (517-689 kPa)	75-100 psi (517-689 kPa)
Expansion Ratio	8:1 – 15:1	8:1 – 15:1
Stream Range	75 ft (23 m)	85 ft (25.9 m)
Overall Length	30 in (76 cm)	39 in (99 cm)
Maximum Width	8 in (20 cm)	8 in (20 cm)
Recommended Eductor	ANSUL Z-2	ANSUL Z-4

001227

ORDERING INFORMATION

The models listed below are provided with 1 1/2 in. NHT female inlet threads. Other thread types are available upon request. The flow rates listed are nominal; see Technical Data Table for performance characteristics.

Part No.	Description	Approximate Shipping Weight lb	(kg)
415981	KR-S2 Low Expansion Nozzle 60 gpm (227 Lpm)	9	(4.1)
415982	KR-S4 Low Expansion Nozzle 120 gpm (454 Lpm)	11	(5.0)

MEDIUM-EXPANSION FOAM HANDLINE NOZZLES

FEATURES

- Compact and light weight
- Stainless steel and hard polyurethane construction for optimum corrosion protection
- Pressure gauge equipped
- Easy-to-operate ball shut-off valve
- Good foam quality with pressures of 45 psi (310 kPa) and greater

APPLICATION

ANSUL KR-M medium-expansion foam handline nozzles can be used with various types of foam agents. In particular, they are recommended for use with the following foam concentrates for typical applications as noted:

- ANSULITE 3X3 Foam – As a vapor suppressant foam for various hazardous fuming compounds including oleum and chlorosulfonic acids. ANSULITE 3X3 is also effective with these nozzles as a fire extinguishing foam both for flammable and combustible hydrocarbon and polar solvent (water miscible) fuels.
- FULL-EX® Multi-Expansion Foam – As a fire suppressant for hydrocarbon fuel products when proportioned at a 2% concentration.
- SILV-EX Class A Foam – As a high performance fire suppressant on difficult Class A fuel fires including wood, paper, coal and rubber. The medium expansion nozzles, when combined with SILV-EX foam, proportioned between 0.5% to 1.0%, provides for longer surface wetting with reduced risk of ignition/re-ignition. Additionally, it provides a foam blanket which provides an insulating barrier between the fuel and air results.

The advantage of medium expansion foam compared to low expansion foam is that far more foam can be produced using less water. For some hazard types (i.e., tire fires), three-dimensional protection can be achieved. Medium expansion foam is also effective when injected through door, window or basement openings.

DESCRIPTION

Two sizes are available for nominal flow rates of 60 gpm (227 Lpm) and 120 gpm (454 Lpm) @ 100 psi (689 kPa). Foam solution is sprayed through the nozzle and foam is produced in the tube as air is drawn in. Each nozzle has a ball shut-off valve. The nozzle tube is constructed of stainless steel with a tough polyurethane handle providing optimum protection against corrosion. Although the normal operating pressure is 75 – 100 psi (517 – 689 kPa), a minimum operating pressure of 45 psi (310 kPa) is recommended. Foam concentrate is usually proportioned to the nozzle using the matching ANSUL Model Z eductor.

TECHNICAL DATA TABLE

Model Number	KR-S2	KR-S4
Flow rate @ 100 psi (689 kPa)	60 gpm (227 Lpm)	120 gpm (454 Lpm)
Normal Operating Pressure	75-100 psi (517-689 kPa)	75-100 psi (517-689 kPa)
Expansion Ratio	50:1	50:1
Quality of Foam Produced	400 ft^3/min (11.3 m^3/min)	800 ft^3/min (22.6 m^3/min)
Stream Range	25 ft (7.6 m)	30 ft (9.1 m)
Overall Length	20 in (51 cm)	24 in (61 cm)
Maximum Width	7 1/2 in (19 cm)	10 1/2 in (26.7 cm)
Recommended Eductor	ANSUL Z-2	ANSUL Z-4

001228

ORDERING INFORMATION

The models listed below are provided with 1 1/2 in. NHT female inlet threads. Other thread types are available upon request. The flow rates listed are nominal; see Technical Data Table for performance characteristics.

Part No.	Description	Approximate Shipping Weight lb	(kg)
415983	KR-M2 Medium Expansion Nozzle 60 gpm (227 Lpm)	8	(3.6)
415984	KR-M4 Medium Expansion Nozzle 120 gpm (454 Lpm)	9	(4.1)

DUAL-EXPANSION FOAM HANDLINE NOZZLES

FEATURES

- Two foam handline nozzles in one
- Change over from medium to low expansion foam in seconds
- Noncorrosive materials
- Pressure gauge equipped
- Easy-to-operate ball shut-off valve
- Good foam quality with pressure of 45 psi (310 kPa) and greater

APPLICATION

ANSUL KR-S/M dual-expansion foam handline nozzles can be used with various types of foam agents. In particular, they are recommended for use with the following foam concentrates for typical applications as noted:

- ANSULITE 3X3 Foam – As a vapor suppressant foam for various hazardous fuming compounds including oleum and chlorosulfonic acids. ANSULITE 3X3 is also effective with these nozzles as a fire extinguishing foam both for flammable and combustible hydrocarbon and polar solvent (water miscible) fuels.
- FULL-EX Multi-Expansion Foam – As a fire suppressant for hydrocarbon fuel products when proportioned at a 2% concentration in the medium-expansion setting.
- SILV-EX Class A Foam – As a high performance fire suppressant on difficult Class A fuel fires including wood, paper, coal and rubber. The dual-expansion nozzles, when combined with SILV-EX foam proportioned between 0.5% to 1.0%, provides for longer surface wetting with reduced risk of ignition/re-ignition. Additionally, it produces a foam blanket which provides an insulating barrier between the fuel and air.

The advantage of medium expansion foam compared to low expansion foam is that far more foam can be produced using less water. For some hazard types (i.e., tire fires), three-dimensional protection can be achieved. Medium expansion foam is also effective when injected through door, window or basement openings.

DESCRIPTION

Two sizes are available for nominal flow rates of 60 gpm (227 Lpm) and 120 gpm (454 Lpm) @ 100 psi (689 kPa). Foam solution is sprayed through the nozzle and foam is produced in the tube as air is drawn in. Each nozzle has a ball shut-off valve. The nozzle tube is constructed of stainless steel with a tough polyurethane handle providing optimum protection against corrosion. Although the normal operating pressure is 75 – 100 psi (517 – 689 kPa), a minimum operating pressure of 45 psi (310 kPa) is recommended. Foam concentrate is usually proportioned to the nozzle using the matching ANSUL Model Z eductor.

TECHNICAL DATA TABLE

Model Number	KR-S/M2	KR-S/M4
Flow rate @ 100 psi (689 kPa)	60 gpm (227 Lpm)	120 gpm (454 Lpm)
Normal Operating Pressure	75-100 psi (517-689 kPa)	75-100 psi (517-689 kPa)
Expansion Ratio (low)	8:1 – 15:1	8:1 – 15:1
Expansion Ratio (medium)	50:1	50:1
Quality of Foam Produced (medium)	400 ft^3/min. (11.3 m^3/min)	800 ft^3/min. (22.6 m^3/min)
Stream Range (low)	65 ft (19.8 m)	85 ft (25.9 m)
Stream Range (medium)	23 ft (7 m)	26 ft (7.9 m)
Overall Length	30 in (76 cm)	32 in (81 cm)
Maximum Width	11 in (28 cm)	13 in (33 cm)
Recommended Eductor	ANSUL Z-2	ANSUL Z-4

ORDERING INFORMATION

The models listed below are provided with 1 1/2 in. NHT female inlet threads. Other thread types are available upon request. The flow rates listed are nominal; see Technical Data Table for performance characteristics.

Part No.	Description	Approximate Shipping Weight lb.	(kg)
415985	KR-S/M2 Dual Expansion Nozzle 60 gpm (227 Lpm)	15	(6.8)
415986	KR-S/M4 Dual Expansion Nozzle 120 gpm (454 Lpm)	17 1/2	(8.0)

FOAM EDUCTORS

FEATURES

- Tough proven design
- Metering valve adjustable up to 6%
- Efficient, low cost proportioning

APPLICATION

ANSUL Z model eductors are designed to introduce a variable percentage of foam concentrate into a pressurized water stream. They provide an inexpensive foam proportioning means where available water supply pressures are adequate. Typical applications include use by municipal fire departments, industrial fire brigades and CFR type vehicle personnel. These eductors can be used with all ANSUL foam concentrates. It is important that a matched foam nozzle be used with the eductor to ensure proper performance.

DESCRIPTION

Both the Model Z-2 and Z-4 eductor bodies are constructed of brass. The standard inlet and outlet couplings are anodized aluminum with NHT threads. The eductors have a metering valve variably adjustable from 0% to 6% concentration and have a flexible pick-up hose by which foam concentrate is drawn up from a container. A check valve is incorporated to prevent water from flowing back into the pick-up hose and thus into the foam container when a foam handline nozzle is shut off.

The outlet pressure recovery of the ANSUL Z model eductors is 70% of operating inlet pressure. This correlates to an approximate 30% drop in water pressure when matched together with the nozzles covered in this data sheet. Typical operating pressure at the inlet to the eductor should be approximately 125 – 175 psi (862 – 1207 kPa).

TECHNICAL DATA TABLE

Model Number	Z-2	Z-4
Flow/Pressure	60 gpm @ 175 psi (227 Lpm @ 1206 kPa)	120 gpm @ 175 psi (454 Lpm @ 1206 kPa)
Normal Operating Pressure	125-175 psi (862 – 1206 kPa)	125-175 psi (862 – 1206 kPa)
Maximum Allowed Back-Pressure	70%	70%
Maximum Hose Lay (1 1/2 in.) (Eductor to Nozzle)	300 ft (91 m)	100 ft (30.5 m)
Overall Length	14 in (36 cm)	14 in (36 cm)
Maximum Width	6 in (15 cm)	6 in (15 cm)
Maximum Height	6 in (15 cm)	6 in (15 cm)

001230

ORDERING INFORMATION

The models listed below are provided with a 1 1/2 in. NHT female inlet thread and 1 1/2 in. NHT male outlet thread. Other thread types are available upon request. The flow rates listed are nominal; see Technical Data Table for performance characteristics.

Part No.	Description	Approximate Shipping Weight lb.	(kg)
415979	Z-2 Foam Eductor 60 gpm (227 Lpm)	15	(6.8)
415980	Z-4 Foam Eductor 120 gpm (454 Lpm)	17	(7.7)

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Form No. F-92148-2

FOAM SYSTEMS MOBILCART

Data/Specifications

ANSUL

FEATURES

- Mobile; highly maneuverable
- Ready for instant operation
- Simple to use

APPLICATION

The Mobilcart is designed to provide mobile firefighting foam capability for various hazardous areas where flammable liquids are present. Common applications include:

- Tank Farms and Refineries
- Loading Areas
- Chemical Processing Plants
- Diked Areas
- Warehouse Facilities
- Paint Storage Areas
- Any Other Manufacturing Areas Where Flammable Liquids are a Hazard

A broad range of foam concentrates can be used for these applications including ANSULITE® AFFF, Alcohol Resistant AFFF, JET-X® high expansion type, and protein based foam concentrates. Generally, the types of flammable liquids involved and the hazard configuration will best suit a particular type of Class B foam concentrate.

For hazards involving Class A fuel fires including wood, paper, coal, and rubber, a proportioning setting of 1% is recommended for use with SILV-EX® "Class A" Fire Control Concentrate.

DESCRIPTION

The Mobilcart is a highly maneuverable wheeled cart consisting of a 36 gallon (140 L) polyethylene tank with two built-in hose storage locations, eductor with metering valve, and two lengths of 50 ft. (15.2 m), 1 3/4 in. fire hose with choice of foam nozzle. Simply connect to water supply, turn on water, set the eductor metering valve as necessary, and direct the nozzle foam stream. It can be easily transported and operated by one person.

The Mobilcart will supply foam under a wide range of water pressures. Nozzle range is dependent upon the available flowing water pressure and the type of nozzle selected. Flow performance information is given in the following table.

Performance Table

Eductor	Water Inlet psi	(Bar)	Flow gpm	(lpm)	Approximate Operating Time (Minutes) 1%	3%	6%
Z-2	125	(8.6)	51	(193)	60	20	11
Z-2	150	(10.3)	55	(208)	57	19	10
Z-2	175	(12.0)	60	(227)	52	17	9
Z-4	125	(8.6)	101	(382)	31	10	5.5
Z-4	150	(10.3)	111	(420)	28	9	5
Z-4	175	(12.0)	120	(454)	26	8.5	4.5

007063

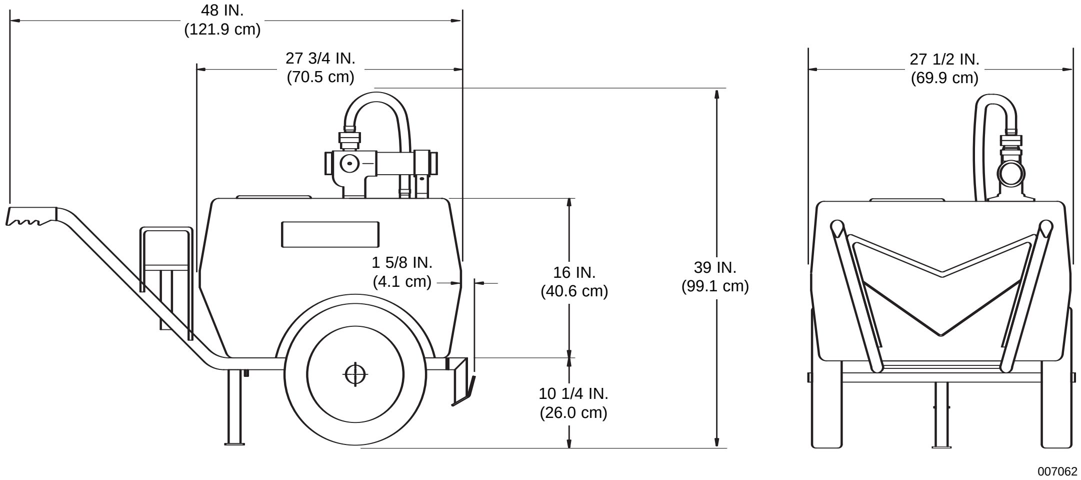
SPECIFICATION

The Mobilcart consists of a 36 gallon (140 L) polyethylene foam tank with built-in hose storage compartment. The chassis is constructed of painted steel tubing. The eductor is a brass 2 in. (5 cm) Model Z-2 or Z-4 complete with pick-up tube and metering valve for adjustment from 1% to 6% proportioning. Two 50 ft. (15.2 m) lengths of coupled 1 3/4 in. double-jacket fire hose with aluminum fittings are included. Nozzle choices are the matching KR-S2 or KR-S4 low-expansion foam nozzle, the KR-M2 or KR-M4 medium-expansion handline nozzle, or the Elkhart Chief Waterfog nozzle.

ORDERING INFORMATION

Ansul Part No.	Description	Shipping Weight lb.	(kg)
429952	MOBILCART (36 gal.)/60 gpm, Low Exp. KR-S2 Nozzle	180	(82)
429953	MOBILCART (36 gal.)/60 gpm, Med. Exp. KR-M2 Nozzle	180	(82)
429954	MOBILCART (36 gal.)/60 gpm, Waterfog Nozzle	180	(82)
429955	MOBILCART (36 gal.)/120 gpm, Low Exp. KR-S4 Nozzle	180	(82)
429956	MOBILCART (36 gal.)/120 gpm, Med. Exp. KR-M4 Nozzle	180	(82)
429957	MOBILCART (36 gal.)/120 gpm, Waterfog Nozzle	180	(82)

NOTE: Foam concentrate is not included with the Mobilcart and must be ordered separately. Optional components such as fittings and nozzles are available upon request.



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AIR ASPIRATING HANDLINE NOZZLE

Data/Specifications

ANSUL

FEATURES

- Stainless Steel Construction for Use in Corrosive Environments
- Nominal Flow Rates of 60, 95, or 120 gpm (227, 360, or 454 Lpm)
- Compatible with ANSUL® PL-60, PL-95, and PL-120 Line Proportioners
- Optional Pistol-Grip Shutoff Available (Anodized Aluminum)
- Lightweight, Portable Design for Maximum Mobility

APPLICATION

ANSUL (HL) foam handline nozzles can be used with all low expansion foam agents: protein foam, fluoroprotein foam, and AFFF. These portable, air aspirating nozzles can be used in a variety of flammable liquid hazard areas. Typical applications include use by municipal fire departments and crash-fire-rescue vehicles; or for handline applications around tank farms, loading racks, aircraft hangars, and chemical plants.

DESCRIPTION

ANSUL handline nozzles are available in three sizes (HL-60, HL-95, and HL-120) with or without pistol-grip shutoff. The nozzles are constructed of stainless steel; the pistol-grip shutoff is anodized aluminum. Lightweight and compact, they maximize fire fighting mobility and ease of use.

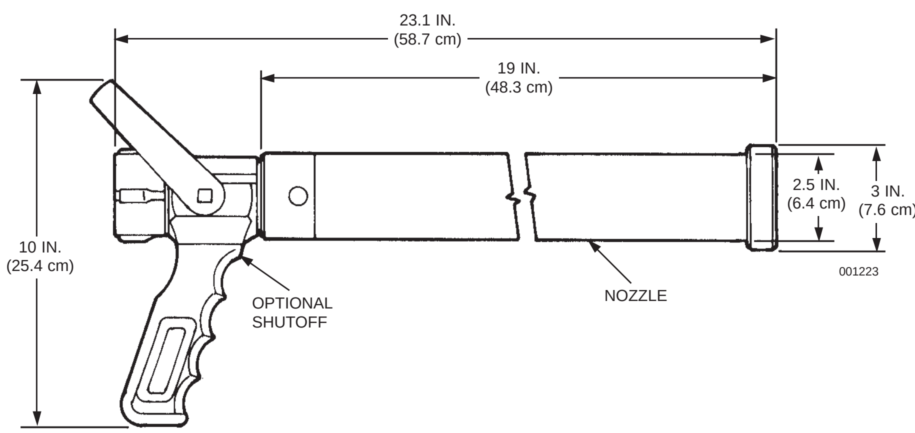
TYPICAL FOAM QUALITY/RANGE DATA

	Protein/ Fluoro-protein	AFFF	3% ARC
Foam Expansion Ratio	8:1	10:1	7:1
Drain Time (25%)	7 min.	3 min.	8 min.
Stream Range @ 50 psi (345 kPa)	50 ft. (15.2 m)	50 ft. (15.2 m)	50 ft. (15.2 m)
Stream Range @ 75 psi (517 kPa)	65 ft. (19.8 m)	65 ft. (19.8 m)	65 ft. (19.8 m)
Stream Range @ 100 psi (690 kPa)	75 ft. (22.9 m)	75 ft. (22.9 m)	75 ft. (22.9 m)

HOSE LENGTH/SIZE DATA

Handline Nozzle	Line Proportioner	Hose Size in.	Maximum Hose Length* ft.	(m)
HL-60	PL-60	1 1/2	200	(61.0)
HL-95	PL-95	1 1/2	100	(30.5)
HL-120	PL-120	1 1/2	100	(30.5)

* Maximum hose length is based on nozzle being elevated a maximum of 8 ft. (2.4 m) above line proportioner.



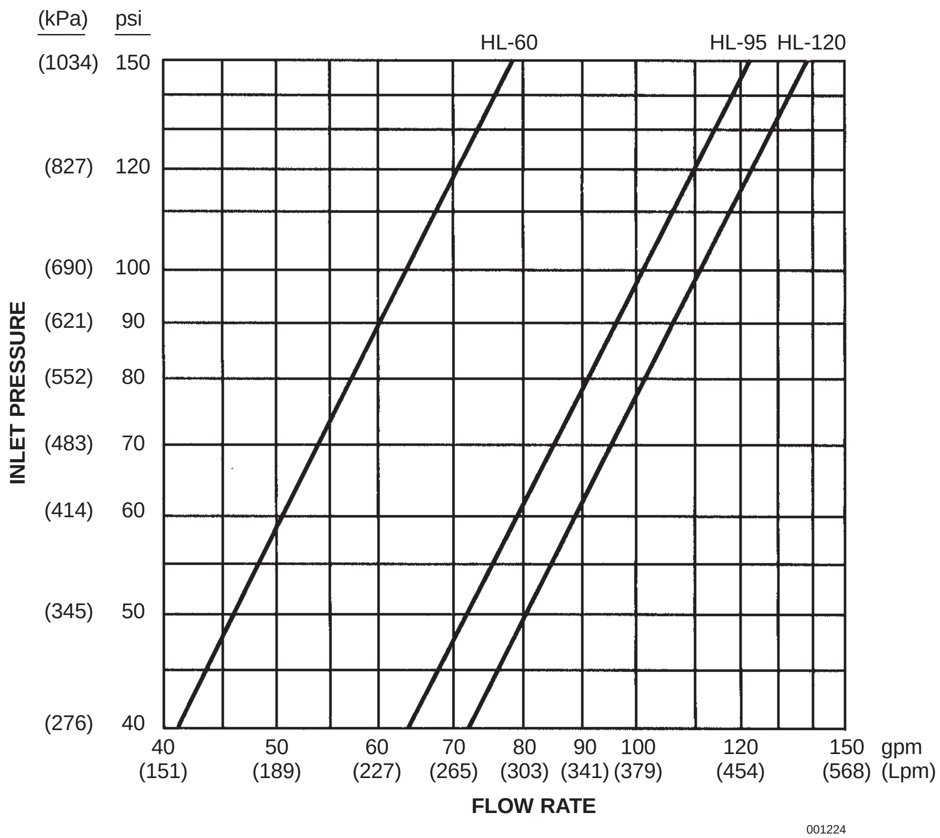
ORDERING INFORMATION

The models listed below are provided with 1 1/2 in. NHT female inlet threads. Other thread types are available upon request. The flow rates listed are nominal; see Flow Rate Data for actual flow rates based on inlet pressure.

Part No.	Description	Approximate Shipping Weight lb.	(kg)
77796*	HL-60 Nozzle without Shutoff, 60 gpm (227 Lpm)	5	(2.3)
77792*	HL-60S Nozzle with Shutoff, 60 gpm (227 Lpm)	7	(3.2)
77797*	HL-95 Nozzle without Shutoff, 95 gpm (360 Lpm)	5	(2.3)
77793*	HL-95S Nozzle with Shutoff, 95 gpm (360 Lpm)	7	(3.2)
77981	HL-120 Nozzle without Shutoff, 120 gpm (454 Lpm)	5	(2.3)
78419	HL-120S Nozzle with Shutoff, 120 gpm (454 Lpm)	7	(3.2)

* UL Listed

FLOW RATE DATA



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PORTABLE MONITOR/NOZZLE HIGH-FLOW SERIES
MODEL FJM-80 P

Data/Specifications

FEATURES

- Powerful unit with exceptional throw characteristics
- Compact and lightweight
- Welded stainless steel monitor construction which allows for use in corrosive environments and minimizes maintenance
- Patented stainless steel slide-bearing system to prevent unwanted movement or swings
- Versatile nozzle patterns in a solid jet or fog spray pattern with water or foam

DESCRIPTION

The FJM-80 P series of portable monitors is designed to deliver approximately 800 GPM (3000 LPM), however actual flow rate is dependent on nozzle setting and inlet pressure. This monitor is a dual waterway design. The balanced design reduces unwanted torque and swing, while the range of movement is easily operated with dual handles. The S version of the monitor/nozzle is self educting. The O version is a water oscillating version.

SPECIFICATIONS

Waterway: 3 in. (80 mm) nominal

Sweep (rotation):
  Manual: Full 220°
  Portable: 60°, (220° with oscillating mechanism disconnected)

Elevation (vertical movement):

Monitor	Maximum Elevation	Minimum Elevation
FJM-80 P	+80	+30
FJM-80 SP	+80	+30
FJM-80 PO	+80	+20
FJM-80 SPO	+80	+20

Nozzle: Integral with monitor

Nozzle Pattern: Manually adjustable straight to fog

Nozzle Flow: Adjustable by turning deflector and locking

Material:
  Monitor: 316L Stainless steel
  Nozzle: Bronze

Finish: Painted red

Stability: Lock knob for elevation (vertical movements),
Balanced slide bearings prevent sweep (rotational movement)

Connection: 3 in. BSP

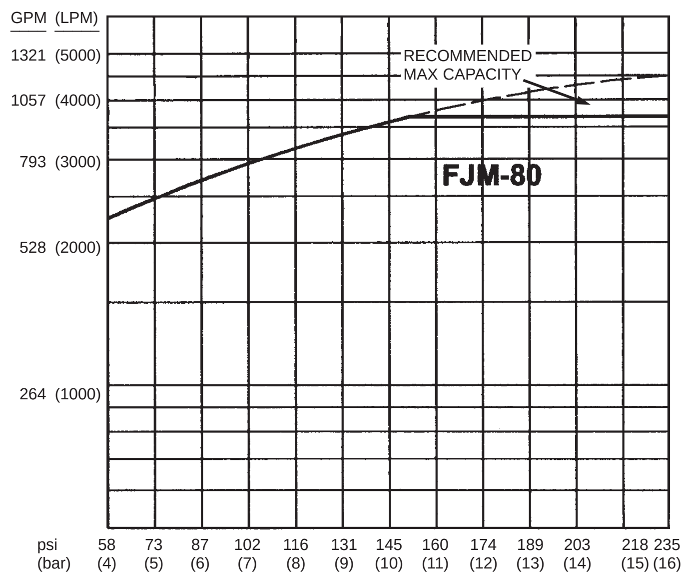
Weight:

FJM-80 P	24 lbs. (11 kg)
FJM-80 SP	24 lbs. (11 kg)
FJM-80 PO	33 lbs. (15 kg)
FJM-80 SPO	33 lbs. (15 kg)

Maximum Pressure: 200 psi (13.8 bar)

Range: Up to 230 ft. (70 m)

CAPACITY RANGES FOR FJM-80 (PORTABLE) MONITORS



Note: The nozzle is an internal part of the monitor, therefore, performance criteria is based upon pressure at the flanged inlet connection.

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APPLICATION

- Refineries
- Chemical Plants
- Petrochemical Storage
- Loading Docks
- LNG/LPG Storage
- Paper Mills
- Lumber Yards
- Structural
- Coal Storage
- Process Areas
- Rail Cars
- Municipal/Fire Brigades

NOZZLE K FACTORS

Turns	K Factor FJM-80	K Factor FJM-80 S
1.5	16	22.2
2	22.6	35.0
3	33.7	52.0
4	45.8	68.0
5	59.7	77.7
6.8	—	85.7
7	70.1	—
9	79.1	—

$Q = K\sqrt{P}$ Q = GPM P = PSI

FJM-80 ACCESSORIES

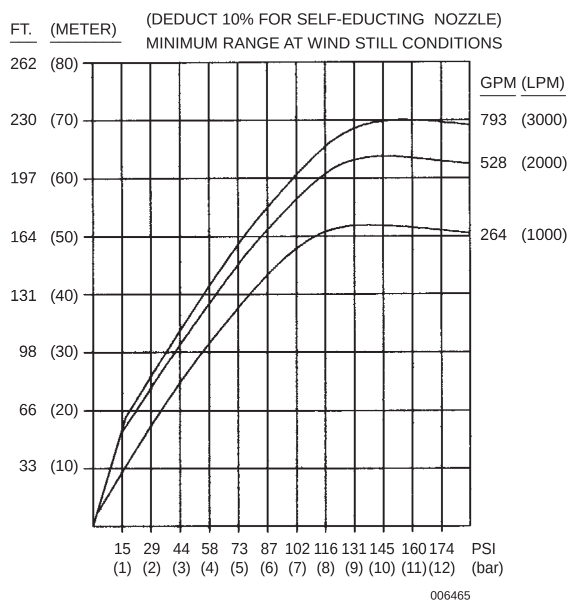
Part No.	Description
428925	Drum Kit (single)
429414	Drum Kit (double)
434980	Kit Connection to Drum Kit (required for single and double drum kit)
434985	Tote Connection Kit
434983	Vacuum Relief Assembly for Totes

ORDERING INFORMATION

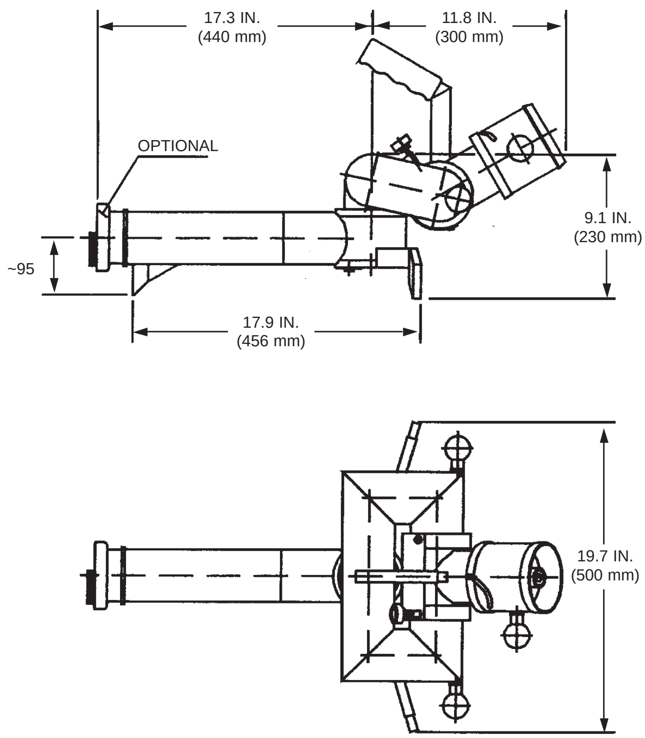
Part No.	Description
431102	FJM-80 P
431103	FJM-80 SP with suction hose*
431104	FJM-80 PO
431105	FJM-80 SPO with suction hose*

*Specify flow, inlet pressure, concentrate and % concentration

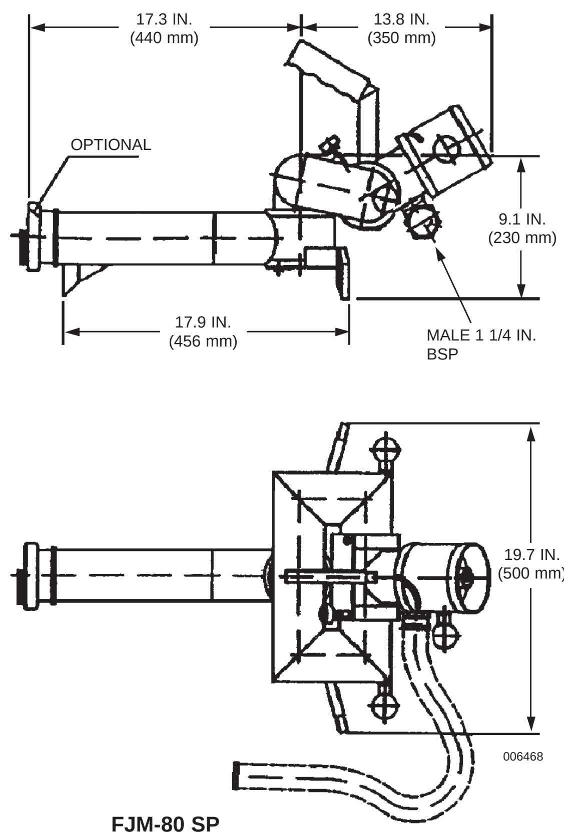
FJM-80 MONITOR RANGE OF JET



DRAWINGS OF MONITORS



FJM-80 P



FJM-80 SP

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Form No. F-2002071-1

ANSUL
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JET-X-PFG-7 AND JET-X-PFG-M PORTABLE HIGH EXPANSION FOAM GENERATORS

Data/Specifications

JET-X-PFG-7 FEATURES

- Portable and lightweight
- Variable expansion with built in bypass control
- Foam capacities up to 7200 CFM (204 CMM)
- Compact unit with recessed controls
- Durable solid rubber feet
- Water powered, no electrical power requirements
- Internal eductor with pick-up tube for foam pail

APPLICATION

Depending on the type of hazard and its configuration, a portable foam generator may be used for total flooding (discharging foam into an enclosed space around the hazard) or local application (discharging foam directly onto the fire or spill). Water damage is minimized using high expansion foam. Common applications include:

- Warehouses
- Ship holds
- Engine rooms
- Machinery spaces
- Electric cable ducting
- Mining
- Communications switching rooms
- Basements, cellars and enclosed spaces
- LNG spill fires and vapor suppression
- Smoke extraction (with optional smoke extraction ducting)

CONSTRUCTION

High impact polyethylene casing, corrosion-resistant pipework and fittings, with a maintenance-free turbine.

DIMENSIONS

Width:	34.25 in.	(870 mm)
Height:	34.75 in.	(883 mm)
Depth:	18.5 in.	(470 mm)
Weight:	109.0 lb	(49.4 kg)

006394

OPERATION

Position the unit, connect the water supply hose to the water inlet and insert pick-up tube into the foam concentrate container. If using the bypass, attach hose to run bypass water to drain. When open, the bypass system diverts a portion of the inlet water to drain allowing for higher expansion and dryer foam (800-1200:1 expansion) to allow ducting to 50 ft (15.2 m). Closing the bypass control utilizes all the water entering the generator and produces wetter foam (550-800:1 expansion). The generator is supplied with 100 ft (30.5 m) of expandable polyethylene ducting. The optional foam extractor version, equipped with a 25 ft (7.6 m) smoke extraction duct, can also extract smoke at the rate of 10,000 CFM (285 CMM) at 100 psi (7 bar).

TYPICAL PERFORMANCE

By-Pass Control	Water Pressure psi	(bar)	Water Flow gpm	(Lpm)	By-Pass Flow gpm	(Lpm)	Flow to Nozzles gpm	(Lpm)	Foam Output CFM	(CMM)	Foam Expansion
Open	58.0	(4)	45	(170)	13	(50)	32	(120)	3400	(96)	800
Open	101.5	(7)	60	(225)	21	(80)	39	(145)	5600	(159)	1000
Open	145.0	(10)	71	(270)	26	(100)	45	(170)	7200	(204)	1200
Closed	58.0	(4)	40	(150)	Nil		40	(150)	2900	(82)	550
Closed	101.5	(7)	53	(200)	Nil		53	(200)	5000	(140)	700
Closed	145.0	(10)	63	(240)	Nil		63	(240)	6800	(192)	800

JET-X-PFG-M FEATURES

- Portable and lightweight
- Foam capacities up to 2600 CFM (74 CMM)
- Compact unit
- Water powered, no electrical power requirements
- Internal eductor with pick-up tube for foam pail

APPLICATION

Depending on the type of hazard and its configuration, a portable foam generator may be used for total flooding (discharging foam into an enclosed space around the hazard) or local application (discharging foam directly onto the fire or spill). Water damage is minimized using high expansion foam. Common applications include:

- Warehouses
- Ship holds
- Engine rooms
- Machinery spaces
- Electric cable ducting
- Mining
- Communications switching rooms
- Basements, cellars and enclosed spaces
- LNG spill fires and vapor suppression
- Smoke extraction (with optional smoke extraction ducting)

CONSTRUCTION

High impact polyethylene casing, corrosion-resistant pipework and fittings with a bronze pelton wheel.

OPERATION

Position the unit, connect the water supply hose to the water inlet and insert pick-up tube into the foam concentrate container. The generator is supplied with 100 ft (30.5 m) of expandable polyethylene ducting. The optional foam extractor version can also extract smoke utilizing 25 ft (7.6 m) of smoke extraction ducting.

DIMENSIONS

Width:	21.7 in.	(550 mm)
Height:	28.0 in.	(710 mm)
Depth:	15.7 in.	(400 mm)
Weight:	39.0 lb	(17.5 kg)

006395

TYPICAL PERFORMANCE

Inlet Pressure psi	(bar)	Total Water Flow gpm	(Lpm)	Foam Output CFM	(CMM)	Expansion
72.5	(5.0)	59	(225)	1750	(50)	225:1
101.5	(7.0)	66	(250)	2200	(62)	250:1
123.0	(8.5)	71	(270)	2600	(74)	275:1

ORDERING INFORMATION

Part Number	Description	Length in.	(cm)	Shipping Weight lb	(kg)
430837	JET-X-PFG-7	34.25	(87.0)	155	(70.3)
430839	JET-X-PFG-M	21.70	(55.1)	101	(45.8)
471803	Extra length of poly ducting for PFG-7 Generator				

tyco Fire Protection Products
One Stanton Street
Marinette, WI 54143-2542
+1-715-735-7411
www.ansul.com

Form No. F-2002007-02

MASTER FOAM TOTE-TRAILER

Data/Specifications

ANSUL

FEATURES

- High volume foam storage
- High capacity flow
- Extremely mobile
- Rugged construction with tandem axle, electric brakes and two rear stabilization jacks
- 5,000 lb (2,268 kg) gross vehicle weight rated trailer meets DOT requirements
- Hose bins on each side
- Monitor with low friction-loss and 3 in. valve with position indicator
- 4 in. inlet piping with 2.5 in. wye connection on each side
- Master Foam self-educting nozzle – 350, 500, or 750 gpm (1,325, 1,893, or 2,839 Lpm)
- ANSULITE® AFFF storage tote is constructed of high density polyethylene and protected by a rigid welded galvanized tubular steel grid
- Quick tote hold down for easy tote transfer
- Dual totes are available

APPLICATION

The ANSUL® Master Foam Tote-Trailer is designed to provide mobile fire protection for flammable liquid hazards typically found in such areas as refineries and associated tank farms, chemical processing plants, truck and rail car unloading facilities and marine terminals. The tote provides large capacity when compared to foam product in pails and drums. It is pre-piped to the monitor so it can be quickly placed into action. The ANSUL Master Foam Tote-Trailer substantially increases the fire fighting capabilities of industrial, municipal and military fire departments all in an economically priced package.

DESCRIPTION

The ANSUL Master Foam Tote-Trailer consists of the following:

- A trailer assembly is constructed with frame, axle(s), wheels and tires designed to carry the gross weight of the trailer with associated equipment and foam concentrate. The trailer frame includes tongue jacks and rear swing down stabilization jacks, standing area with a non-slip surface, bed made of aluminum diamond plate and side rails on trailer deck for tote positioning.
- The standard ANSULITE AFFF storage tote concentrate is 265 gal (1,003 L) capacity constructed of high density polyethylene and protected by a rigid welded galvanized tubular steel grid.
- A completely packaged fixed Protector Station Monitor has a unique waterway with low friction loss and delivers water to the nozzle with fewer twists and turns than a conventional monitor. The built-in on/off valve with position indicator eliminates the need to add a costly valve to the monitor installation.
- The ANSUL Master Foam nozzle is an accurate and durable self-educting foam nozzle with superior stream quality and reach. This monitor nozzle is available in your choice of 350, 500 or 750 gpm at 100 psi (1,325, 1,893 or 2,839 Lpm at 7 bar). Fog angle is user adjustable between 120° wide fog and straight stream. The nozzle baffle is easily removed for flushing debris.

007560

SPECIFICATIONS

Trailer Frame – The trailer frame shall be constructed of structural steel meeting the requirements of either ASTM A-36 or ASTM A 500 Grade B. It shall be fabricated by welders qualified under Section IX of the ASME Code for groove or fillet welds. The trailer shall be equipped with ball hitch, adjustable tongue dolly with wheel and full light package for highway use.

Axles – The axles shall be rated a minimum of 2,500 lb (1,134 kg) load rating each. The axles shall consist of progressive torque action and independent wheel movement to provide maximum shock absorption and handling characteristics.

Brakes – The brakes shall be electric type brakes.

Hose Bins – Two, approximately 15 in. wide, 60 in. long, by 18 in. high (38 x 152 x 46 cm). Placed above the fenders.

Tote Tank – The tank shall be 265 gal (1,003 L). It shall be made of high density polyethylene, supported by a pressed galvanized steel base, and protected by a rigid, welded galvanized tubular steel grid.

Protector Station Monitor – A built-in shut off valve shall be standard. The monitor shall be directly bolted to a common 4-in. pipe flange. The outlet shall be available with 2.5-in. male NH threads. A long stream-straightening vane in the discharge section reduces turbulence. The simple and basic design shall require no grease or other maintenance. Swiveling elements and seals (including valve seat) can be replaced in a few minutes with just one tool. Threaded ports (1/4 in. NPT) shall be provided for drain valve and pressure gauge installation. Maximum pressure shall be 250 psi (17.2 bar). The Protector is constructed of UNS A03560 alloy heat treated to T6 with poly-impregnation casting treatment. It is also hardcoat anodized per military specification MIL-A-8625F Type III, Class 1 and features polyester powder-coated outer surfaces inside and out. The swivel clamps, 3 in. valve ball, trunnions and hardware are 18-8 stainless steel. The swivel clamps, 3 in. valve ball, trunnions and hardware shall be 18-8 stainless steel. The monitor may be used to deliver water or foam streams. The Protector Station Monitor is recommended for use with ANSUL Master Stream nozzles and ANSUL Master Foam nozzles. The built-in valve shall indicate the flow is OFF when the valve handle is horizontal and ON when the handle is vertical. Parts shall be manufactured so that the valve cannot be assembled out of phase. A position indicator shows the valve positions as OFF or ON. The position that the valve is normally left in shall depend upon your particular standard operating procedure.

SPECIFICATIONS (Continued)

Self-Educting Master Foam Nozzle – The standard swivel coupling shall be 2.5 in. NH female threads. The simple flow geometry (patent pending) shall educt foam concentrate at .5%, 1%, 3%, or 6% with no small passages to clog. Percentage is easily set with an interchangeable orifice plate. A set of calibrated foam orifice plates shall be included. The nozzle shall be supplied with one orifice plate corresponding to the ANSULITE foam concentrate for which it is designed.

Nozzle shall come with an industrial grade UV resistant, 8 ft (2.4 m) long, 1.5 in. (38 mm) diameter concentrate hose with a cam lock fitting for quick and secure attachment to the nozzle. The simple and basic design shall require no grease or other maintenance. The halo ring/stream shaper shall be made from non-corroding high temperature polymer. The rubber bumper shall be UV resistant. The Master Foam self-educting nozzle is constructed with UNS A03560 alloy heat treated to T6 and hard-coat anodized per military specification MIL-A-8625F Type III, Class 1.

Options – The model shown is the base unit. Contact ANSUL Technical Services for options on monitors, hoses and other trailer equipment along with price and delivery.

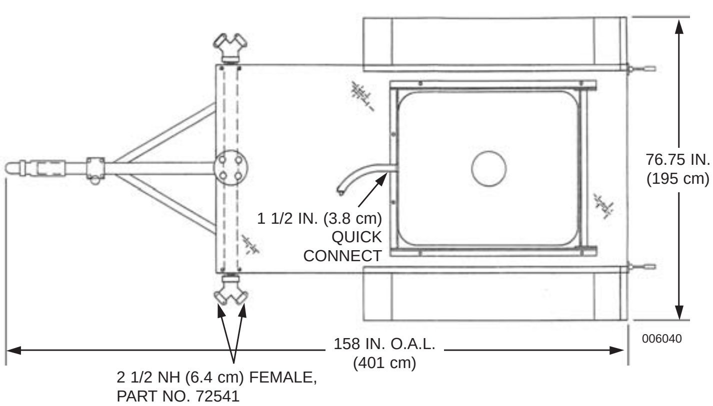
Finish – The complete proportioner foam trailer assembly shall be properly prepared and painted with a standard red paint system.

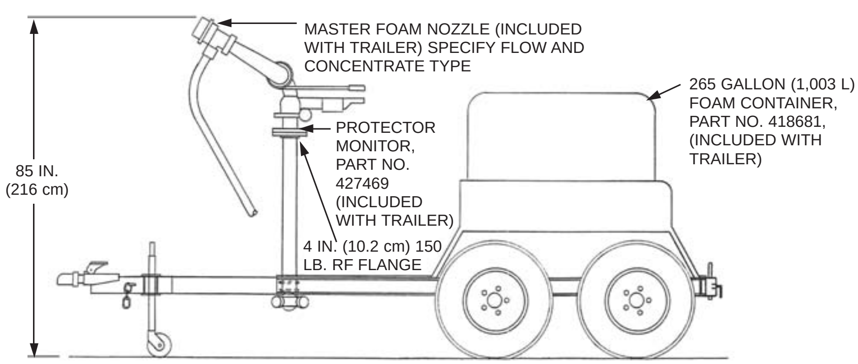
Manufacturer – The manufacturer of the ANSUL Master Foam Tote-Trailer shall have a minimum of 25 years experience in the manufacture and design of fire suppression systems and related fire equipment. The foam trailer and the foam concentrate shall be the products of the same manufacturer.

ORDERING INFORMATION

Contact ANSUL Foam Applications Engineering Department for price and delivery of Master Foam Tote-Trailer, specify Part No. 428560, and other options for trailers such as a Dual Tote-Trailer, alternate monitors, or additional hand line connection options.

DIMENSIONAL INFORMATION





FOAM TOTE-TRAILER ASSEMBLY, PART NO. 428560

APPROXIMATE WEIGHTS: EMPTY 1,550 LB. (703.1 kg); FOAM 2,350 LB. (1,066 kg)

ANSUL tyco
Ansul Incorporated
Marinette, WI 54143-2542
715-735-7411
www.ansul.com

Form No. F-2001061-1

PROPORTIONING FOAM TRAILERS
MODELS PFT-500, PFT-750, PFT-1000

Data/Specifications

ANSUL

FEATURES

- High capacity flow
- Extremely mobile
- Rugged construction
- Wide proportioning range
- Designed per NFPA 11C
- Diesel driven balanced pressure proportioning system
- Easy refill during operation
- Multiple tank options
- UL Listed and FM Approved proportioning system
- Torflex axle assemblies
- Tanks constructed by ASME qualified welders
- Highway ready

APPLICATION

The ANSUL® proportioning foam trailers (PFT) are designed to provide mobile fire protection for flammable liquid hazards typically found in such areas as refineries and associated tank farms, chemical processing plants, truck and rail car unloading facilities, and marine terminals. These trailers provide foam solution to delivery devices such as foam handline nozzles and portable monitors; or in semi-fixed applications supplying stationary monitors, sprinkler systems, foam makers and chambers, or storage tank sub-surface foam injection devices. The ANSUL PFT series substantially increase the fire fighting capabilities of industrial, municipal, and military fire departments without the costs associated with a truck chassis.

DESCRIPTION

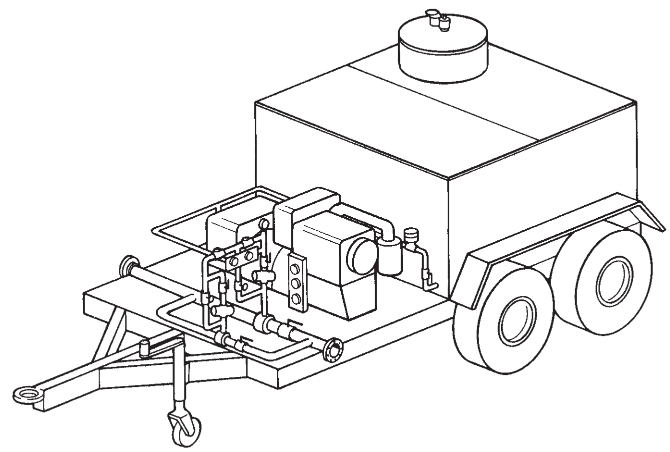
The ANSUL proportioning foam trailer (PFT) consists of the following:

- A trailer assembly constructed of structural steel channel with axle(s), wheels, and tires designed to carry the gross weight of the trailer with associated equipment and foam concentrate.
- Choice of concentrate tanks in 500, 750, or 1000 U.S. gallon (1893, 2839, or 3785 Liter) capacities constructed of carbon steel in accordance with NFPA 11C "Mobile Foam Apparatus" with required swash partitions and removable gasketed top for ease of inspection and cleaning.
- Reliable in-line balanced pressure proportioning system with dual proportioners in parallel to enable wide proportioning flow range with minimum friction loss – less than 10 psi (69 kPa).
- Positive displacement foam concentrate pump driven by air cooled diesel engine complete with electric key start and instrumentation. Pump constructed of materials compatible with all types of foam concentrates and capable of being engineered for use with 1%, 3%, or 6% foam concentrates. Manually-operated clutch to engage or disengage engine while in stand-by condition.

The in-line balanced pressure proportioning system functions by maintaining an equal pressure in the foam concentrate and water inlets to the proportioner. This balancing ability allows the proportioner to be used over a wide range of flows and pressures. The system will also respond quickly and accurately to changes in the water inlet pressures and flow rates.

A pressure control valve, located in the return line to the foam concentrate storage tank, is set to maintain a regulated pressure in the supply manifold that is higher than the pressure in the water supply line. The foam concentrate that is not required by the proportioner is returned to the atmospheric storage tank through the pressure control valve. The spool valve senses the foam concentrate pressure and automatically balances it with the water pressure. A duplex pressure gauge provides a reading of the foam concentrate and water pressure. The foam concentrate then enters the proportioner where a built-in orifice regulates the flow of pressurized foam concentrate entering the water stream.

The trailer is supplied with flanged inlet and outlet for connection to customer-supplied fitting or manifold. Upon request, ANSUL can supply inlet and outlet manifolds constructed to customer specifications.



001179

SPECIFICATION

Trailer Frame – The trailer frame shall be constructed of structural steel meeting the requirements of ASTM A-36. The trailer shall be equipped with 3 in. lunette eye hitch, adjustable tongue dolly with wheel and full light package for highway use.

Axles – The axle(s) shall be rated a minimum of 7000 lb. load rating. The axle(s) shall consist of progressive torque action and independent wheel movement to provide maximum shock absorption and handling characteristics.

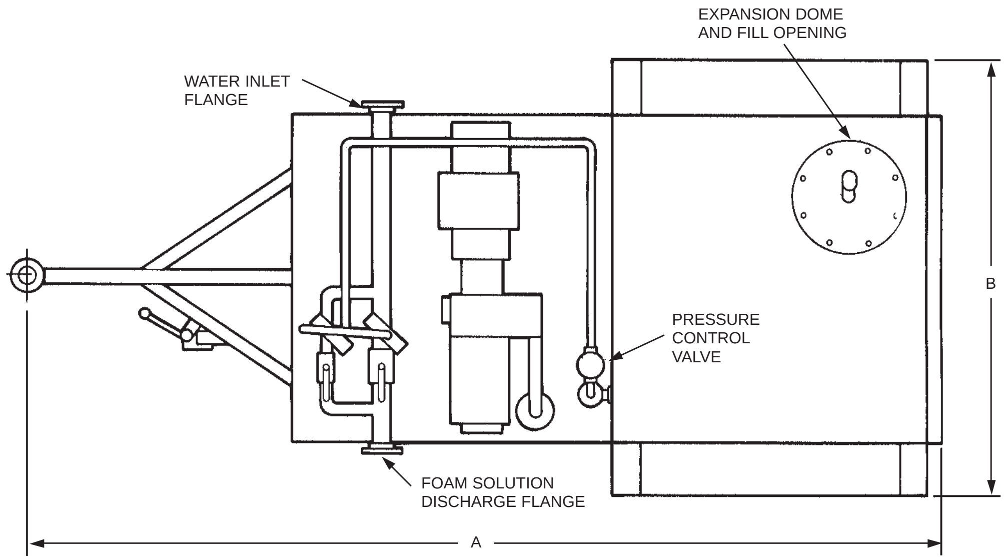
Brakes – The brakes shall be 12 x 2 in. electric type brakes approved by CSA (Canadian Standards Association).

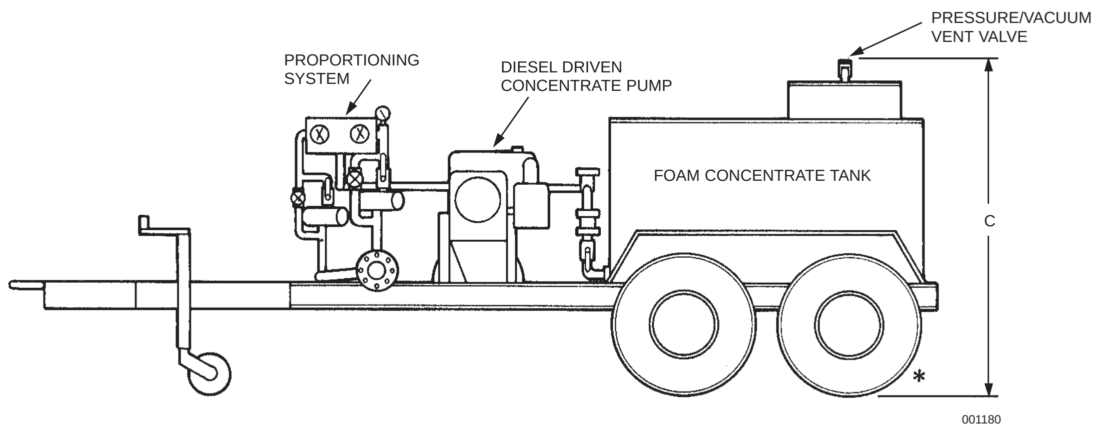
Tank – The tank shall be constructed in accordance with the requirements of NFPA 11C, "Mobile Foam Apparatus." It shall be fabricated by welders qualified per Section IX of the ASME Code. The tank shall be mounted to the trailer frame utilizing cushioning system consisting of spring mounting pads to minimize tank flexing.

Proportioning System – The in-line balanced pressure proportioner assembly shall contain all necessary components including foam proportioner; pressure balancing spool valve; duplex gauge; control, drain and check valves; interconnecting brass pipe and valve identification nameplates.

Balancing shall be accomplished through the use of a spool-type pressure balancing valve. This valve shall sense foam concentrate and water inlet pressures at the outer ends of a dumbbell-shaped piston and shall react to pressure changes by covering or uncovering the foam supply port to the proportioner. The balancing valve shall be of C83600 brass construction with a phosphor-bronze piston and Buna-N rubber O-rings and Seals. Interconnecting foam concentrate piping shall be of brass construction. The in-line balanced pressure proportioner shall be completely pressure tested by the manufacturer.

DIMENSIONAL INFORMATION





Tank Capacity Gallon	Liter	A in	(cm)	B in	(cm)	C in	(cm)	Approximate Empty Weight lb	(kg)	Approximate Full Weight lb	(kg)
500	(1893)	173.5	(441)	96.0	(244)	76.0	(193)	2600	(1180)	6800	(3085)
750	(2839)	196.0	(498)	96.0	(244)	75.0	(191)	3300	(1497)	9550	(4332)
1000	(3785)	218.5	(555)	96.0	(244)	78.0	(198)	3700	(1680)	12000	(5443)

*500 Gallon Trailer (PFT-500) is constructed with a single axle.

SPECIFICATION

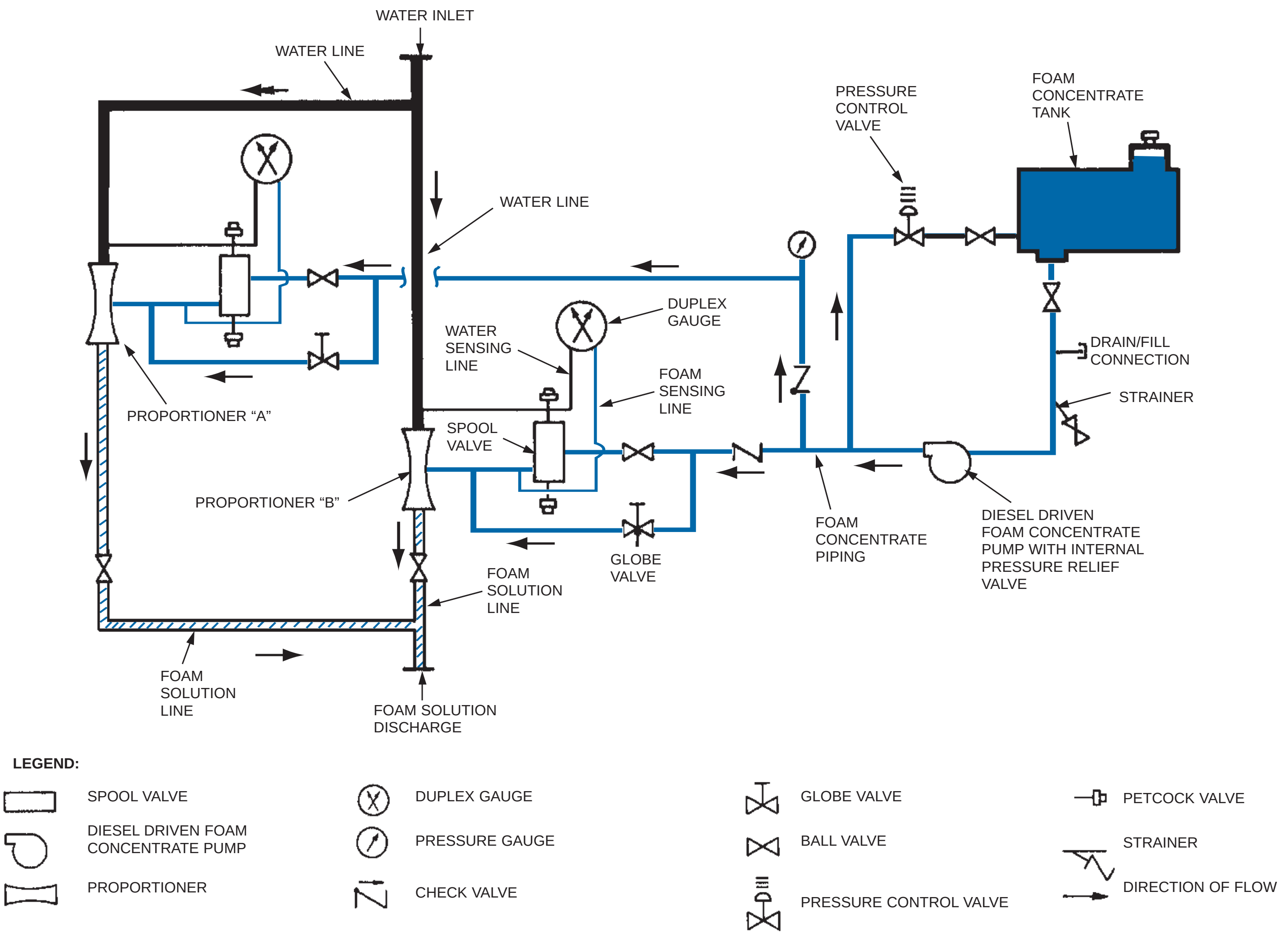
Finish – The complete proportioner foam trailer assembly shall be properly prepared and painted with a red enamel paint system.

Approval – The in-line balanced pressure proportioner assembly shall be listed by Underwriters Laboratories (UL) and approved by Factory Mutual (FM).

Manufacturer – The manufacturer of the proportioning foam trailer shall have a minimum of 10 years experience in the manufacture and design of fire suppression systems and related fire equipment. The foam trailer and the foam concentrate shall be the products of the same manufacturer.

ORDERING INFORMATION

Contact ANSUL Foam Applications Engineering Department for price and delivery of proportioning foam trailers.



Model No.	Part* No.	Tank Capacity gal	(L)	Proportioner "A" Size in	gpm (Lpm)	Proportioner "B" Size in	gpm (Lpm)	Total gpm** Output-Approx. gpm	(Lpm)	Inlet/Outlet Flange Size in
PFT-500	415144	500	(1893)	2 1/2	35 – 400 (133 – 1514)	3	70 – 800 (265 – 3028)	1000	(3785)	3
PFT-750	415145	750	(2839)	2 1/2	35 – 400 (133 – 1514)	4	200 – 1600 (757 – 6057)	1500	(5678)	4
PFT-1000	415146	1000	(3785)	3	70 – 800 (265 – 3028)	4	200 – 1600 (757 – 6057)	2000	(7571)	4

* Type and percentage of foam concentrate to be used in trailer must be specified to ANSUL.

** Total GPM output based on 1% or 3% foam concentrate – total GPM output will be reduced if using a 6% foam concentrate.

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Form No. F-91123-1

Foam System Design and Application

Sprinkler and Spray Nozzle Systems

GENERAL DESCRIPTION

An automatic sprinkler system is designed to distribute water or foam solution to a specific hazard area. The application rate, commonly referred to as "density," is frequently expressed in units of gallons per minute per square foot (gpm/ft^2) or liters per minute per square meter (Lpm/m^2) of area.

The worst potential fire situation is generally used to determine the number of sprinkler heads discharging. This, in turn, determines the water supply demand; and in the case of foam sprinkler systems, the required amount of foam liquid concentrate. Characteristics of some flammable products may require higher densities and special foam liquid concentrates.

Areas protected by sprinkler systems are usually given a class of occupancy (light, ordinary, or extra-hazard). The class of occupancy relates to the probable number of sprinkler heads that may operate in a particular fire situation and governs the maximum spacing allowed between sprinkler heads.

The sprinkler head provides for a nearly uniform distribution of water or expanded foam over a given area. The solution strikes a deflector and is broken into a circular pattern of distribution. Spacing of sprinkler heads results in overlapping patterns to ensure uniform coverage and effective fire control.

Pipe sizing to the sprinkler heads is commonly determined by hydraulic calculations to assure an adequate supply of water and uniform distribution from the sprinkler heads. The standard addressing sprinkler system design is NFPA Standard 13. Additional guidance for foam systems design is contained within NFPA Standards 11, 16, and 30.

TYPES OF SPRINKLER HEADS

Conventional Sprinkler Heads

The conventional sprinkler head (Figure 4-1) is available for either upright or pendent installation. A heat-sensitive element, consisting of either a fusible link or frangible glass bulb, is rated for a specific operating temperature. A standard orifice sprinkler is 1/2 inch; however, various small and large orifice sprinklers are available to achieve the desired density with the available water supply pressure. A comparison of flows of small and large orifice sprinkler heads is given in Table 4-1.

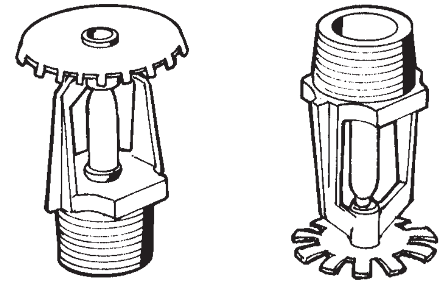

FIGURE 4-1
001278

Nominal Sprinkler Orifice Sizes

Nominal K-factor U.S.	Nominal Orifice Size in.
1.4	1/4
1.9	5/16
2.8	3/8
4.2	7/16
5.6	1/2
8.0	17/32
11.2	5/8
14.0	3/4

TABLE 4-1

Conventional open sprinkler heads, without the heat-sensitive element, are used for total area flooding "deluge" systems.

In applications using AFFF concentrates, the conventional sprinkler is acceptable. The UL listing directory should be consulted to ensure the sprinkler head is listed with the manufacturer's foam concentrate.

Acceptable foam quality is expected from conventional sprinkler heads of similar design to those listed. These sprinklers cannot be used with protein or fluoroprotein base foam concentrates which require air aspirated discharge devices.

Sprinkler and Spray Nozzle Systems

TYPES OF SPRINKLER HEADS (Continued)

Foam/Water Sprinkler Heads

Foam/water sprinkler heads (Figure 4-2) are open type and generate air aspirated foam by drawing air into the foam solution stream. The sprinkler head is available for either upright or pendent mounting and may be used with either foam or water. Patterns of coverage are similar to conventional sprinkler heads; however, only a 3/8 in. orifice is available corresponding to a K-Factor of 3.0.

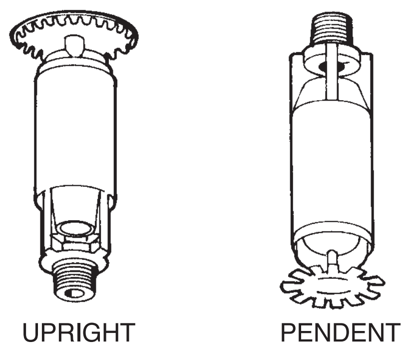

FIGURE 4-2
001279

Directional Foam Spray Nozzles

Directional foam spray nozzles are different than foam/water sprinkler heads in relation to the discharge patterns. They deliver a special directional pattern peculiar to the design of the particular nozzle.

An air aspirated foam spray nozzle is illustrated in Figure 4-3. This type of nozzle is frequently used in truck loading rack systems to provide additional foam to the truck undercarriage. Other types of nozzles, both air aspirating and nonaspirating, are available to meet the needed coverage for specific hazard applications.

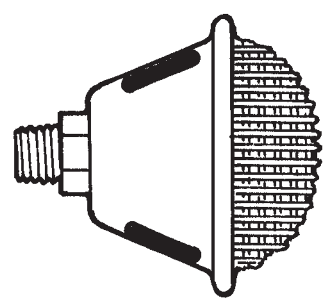

FIGURE 4-3
001280

Sprinkler and Spray Nozzle Systems

TYPES OF SPRINKLER SYSTEMS

Sprinkler systems can be either closed-head or open-head (deluge) systems using conventional sprinkler heads. Sprinkler systems using foam/water sprinkler heads can only be open-head systems as these sprinklers are not available with heat-sensitive elements.

Closed-head sprinkler systems can be of three different types: wet pipe, dry pipe, or preaction. An AFFF foam can be used in any closed-head sprinkler system as covered by NFPA Standard 16 “Foam/Water Sprinkler Systems.”

Wet Pipe Systems

This system uses automatic closed-head sprinklers that are attached to a piping system containing water. (See Figure 4-4.) Water discharges immediately from those sprinklers opened by a fire. A flow of water through the valve sounds an alarm.

Wet pipe systems should not be used where freezing conditions are likely to damage piping.

In systems using AFFF concentrate, the piping to the sprinkler heads can be pre-primed with foam solution to enable immediate effective foam discharge. AFFF solution in contact with steel pipe may gradually lose its fire effectiveness. Samples of this solution should be checked on an annual basis and replenished as needed.

A test discharge connection is recommended downstream from the proportioner and should be located to fill a maximum portion of the sprinkler system piping. The test connection should be of sufficient size to meet the minimum flow rate for the particular proportioner. This type of system is the most reliable, simplest, and fastest responding of all closed-head sprinkler systems. Conversions of water systems to foam can usually be accomplished easily. (Local codes and regulations should be investigated prior to conversion.)

TYPICAL WET PIPE SYSTEM

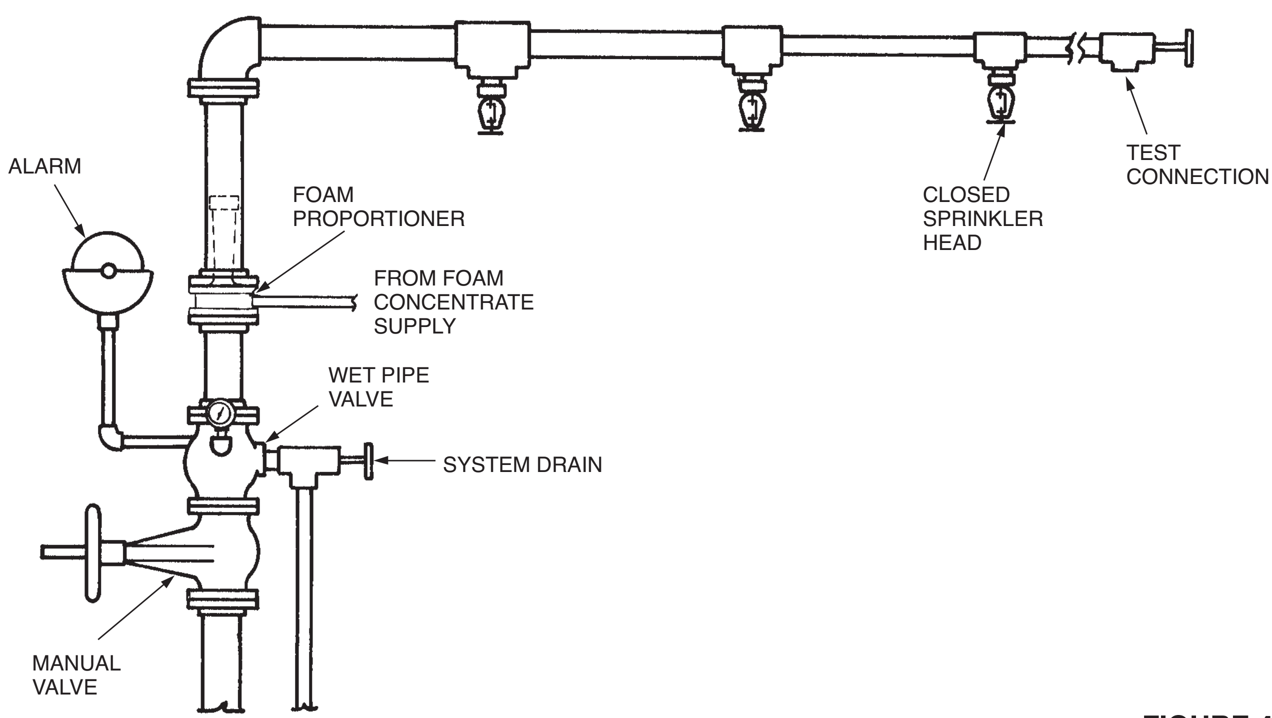

FIGURE 4-4
001281

Sprinkler and Spray Nozzle Systems

TYPES OF SPRINKLER SYSTEMS (Continued)

Dry Pipe Systems

Dry pipe systems use automatic sprinklers that are attached to a piping system containing air under pressure. (See Figure 4-5.) When the air is released from the opening of the sprinklers, the water pressure overcomes the lessened air pressure and opens the dry pipe valve. The dry pipe valve is designed so that a moderate air pressure prevents a higher water pressure from opening the valve. Once the valve is opened, the water flows into the piping system and out the opened sprinklers.

This system provides protection in areas subject to below-freezing temperatures. Piping must be drained of water or foam solution following operation to prevent freezing. Typically, upright sprinklers are used to allow drainage. Otherwise, approved dry pendent sprinklers must be used to prevent freezing.

Dry pipe systems are inherently slower in operating and should be considered less desirable for applications using AFFF.

TYPICAL DRY PIPE SYSTEM

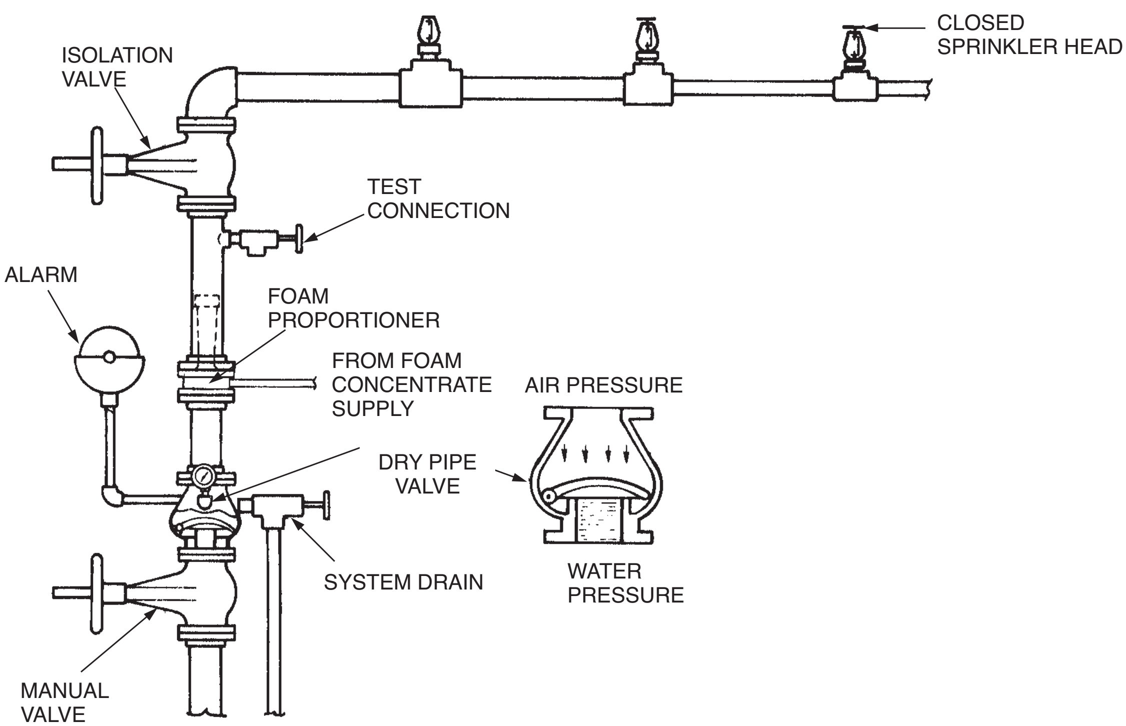

FIGURE 4-5
001282

Sprinkler and Spray Nozzle Systems

TYPES OF SPRINKLER SYSTEMS (Continued)

Preaction Systems

In a preaction system, all sprinklers are closed and normally there is no water in the piping. A preaction system is used when faster response is desired (versus a dry pipe system). When fire occurs, a supplementary detection system (more sensitive than the sprinkler elements) senses the fire and automatically opens a water control valve which allows water to flow into the piping system. Subsequent water discharge occurs from individual sprinklers as they respond to the heat of the fire. The system shown in Figure 4-6 uses HAD's (Heat Actuated Detectors) and a drop-weight release to open the preaction valve. Alternate detection systems can also be used.

Pre-priming foam solution is not needed as foam will be proportioned into the piping during operation.

TYPICAL PREACTION SYSTEM

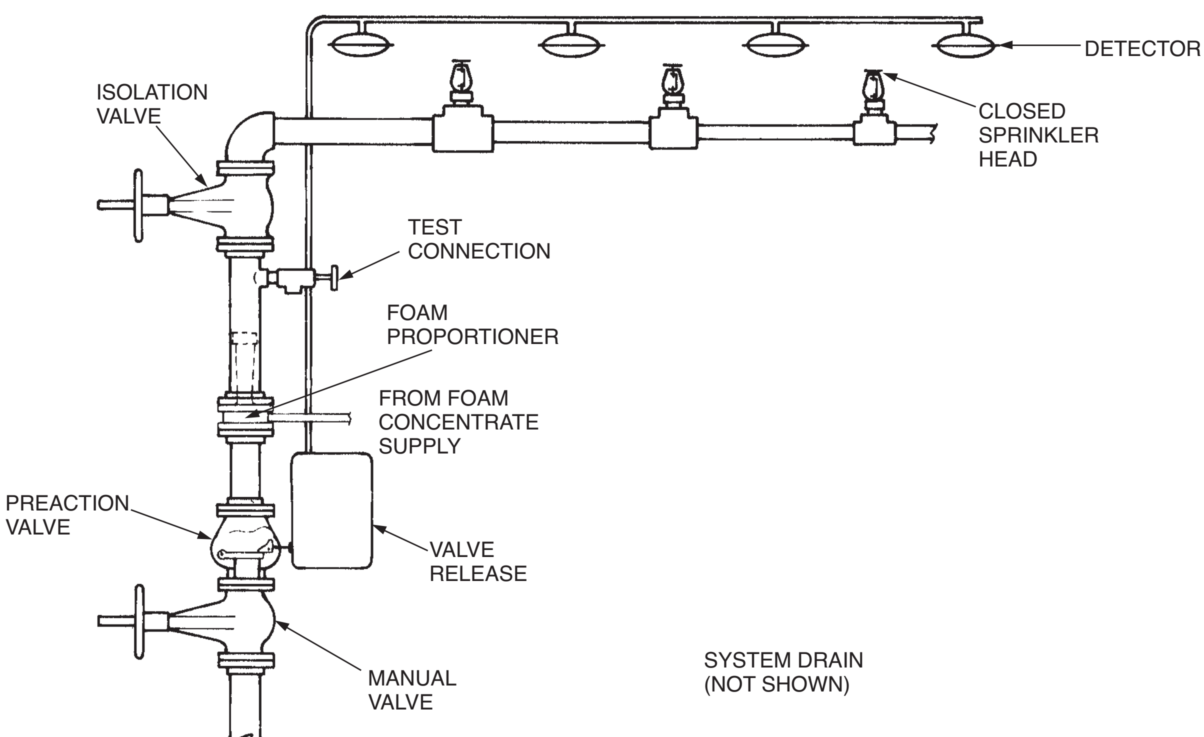

FIGURE 4-6
001283

Sprinkler and Spray Nozzle Systems

TYPES OF SPRINKLER SYSTEMS (Continued)

Deluge Systems

In the deluge system, all sprinklers are open and normally there is no water in the piping. When fire occurs, a supplementary detection system senses the fire and automatically opens a water control valve. This allows water to flow through the piping system to all sprinklers.

The system shown in Figure 4-7 uses HAD's (Heat Actuated Detectors) and a drop-weight release to open the valve. Alternate detection systems, such as thermal rate-of-rise or UV/IR, can be used with a detection and control panel to operate an electric solenoid release. Caution must be observed to ensure the current draw characteristics of the electric release are compatible with the release circuit of the control panel.

TYPICAL DELUGE SYSTEM

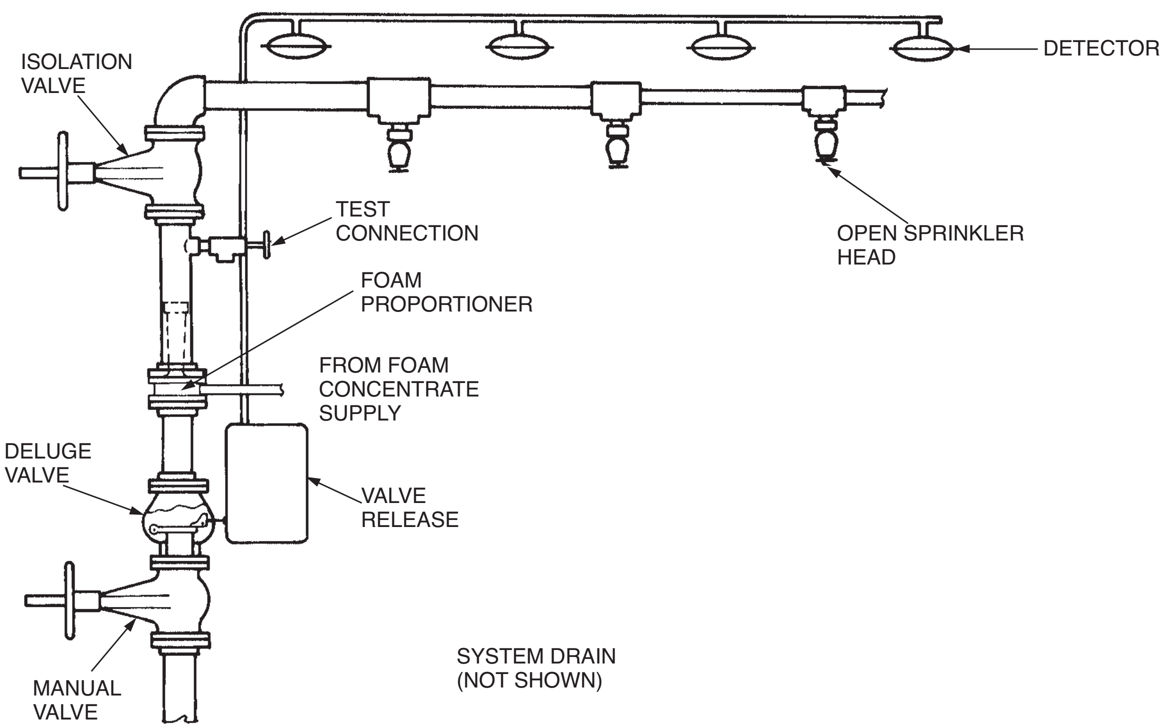

FIGURE 4-7
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POPULAR SPRINKLERS/CONCENTRATES – LISTINGS AND APPROVALS

Data/Specifications

Consult appropriate listing/approval publication for complete list that includes historic and less popular models.

Sprinkler Head	Foam Concentrate	Fuel	Min. Application Rate GPM/Sq Ft (LPM/sq. m)	Min. Inlet Pressure psi (bar)	Agency Approval
Tyco Fire Products, SIN(TY1131, TY1151), (3/8 in. (0.95 cm)) K-Factor 2.8, Upright	ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons	0.16 (6.52)	30.0 (2.1)	UL
Tyco Fire Products, SIN(TY1231, TY1251), (3/8 in. (0.95 cm)) K-Factor 2.8, Pendant	ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons	0.16 (6.52)	30.0 (2.1)	UL
Tyco Fire Products, SIN(TY2131), (7/16 in. (1.11 cm)) K-Factor 4.2, Upright	ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons	0.16 (6.52)	13.0 (0.9)	UL
Tyco Fire Products, SIN(TY2231), (7/16 in. (1.11 cm)) K-Factor 4.2, Pendant	ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons	0.16 (6.52)	13.0 (0.9)	UL
Tyco Fire Products, SIN(TY3121) (1/2 in. (1.27 cm)) K-Factor 5.6, Upright	ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL
Tyco Fire Products, SIN(TY3131,TY3151), (1/2 in. (1.27 cm)) K-Factor 5.6, Upright	ANSULITE 3x3 Low Viscosity (3%) AR-AFFF	Hydrocarbons Alcohols Denatured Ethanol E-85 Blend*	0.16 (6.52) 0.22 (8.96) 0.16 (6.52) 0.16 (6.52)	7.0 (0.5) 14.5 (1.00) 7.0 (0.5) 7.0 (0.5)	UL/FM UL/FM UL/FM UL/FM
	ANSULITE 3% AFFF (AFC-3A)	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL/FM
	ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL
Tyco Fire Products, SIN(TY3231,TY3251), (1/2 in. (1.27 cm)) K-Factor 5.6, Pendant	ANSULITE 3x3 Low Viscosity (3%) AR-AFFF	Hydrocarbons Alcohols Denatured Ethanol E-85 Blend*	0.16 (6.52) 0.22 (8.96) 0.16 (6.52) 0.18 (7.33)	7.0 (0.5) 14.5 (1.00) 7.0 (0.5) 9.0 (0.6)	UL/FM UL/FM UL/FM UL/FM
	ANSULITE 3% AFFF (AFC-3A)	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL/FM
	ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL
Tyco Fire Products, SIN(TY4131,TY4151), (17/32 in. (1.35 cm)) K-Factor 8.0, Upright	ANSULITE 3x3 Low Viscosity (3%) AR-AFFF	Hydrocarbons Alcohols Alcohols Denatured Ethanol	0.22 (8.96) 0.25 (10.19) 0.28 (11.41) 0.22 (8.96)	7.0 (0.5) 9.0 (0.6) 12.0 (0.8) 7.0 (0.5)	UL/FM UL FM UL/FM
	ANSULITE 3% AFFF (AFC-3A)	Hydrocarbons	0.22 (8.96)	7.0 (0.5)	UL/FM
Tyco Fire Products, SIN(TY4231,TY4251), (17/32 in. (1.35 cm)) K-Factor 8.0, Pendant	ANSULITE 3x3 Low Viscosity (3%) AR-AFFF	Hydrocarbons Alcohols Alcohols Denatured Ethanol	0.22 (8.96) 0.27 (11.00) 0.28 (11.41) 0.22 (8.96)	7.0 (0.5) 11.0 (0.8) 12.0 (0.8) 7.0 (0.5)	UL/FM UL FM UL/FM
	ANSULITE 3% AFFF (AFC-3A)	Hydrocarbons	0.22 (8.96)	7.0 (0.5)	UL/FM
Tyco Fire Products, SIN(TY5111, TY5131,TY5151), (5/8 in. (1.59 cm)) K-Factor 11.2, Upright	ANSULITE 3x3 Low Viscosity (3%) AR-AFFF	Hydrocarbons Alcohols Denatured Ethanol	0.32 (16.56) 0.36 (14.67) 0.32 (16.56)	7.0 (0.5) 9.5 (0.7) 7.0 (0.5)	UL/FM UL/FM UL/FM
	ANSULITE 3% AFFF (AFC-3A)	Hydrocarbons	0.32 (16.56)	7.0 (0.5)	UL/FM
Tyco Fire Products, SIN(TY5211,TY5231,TY5251), (5/8 in. (1.59 cm)) K-Factor 11.2, Pendant	ANSULITE 3x3 Low Viscosity (3%) AR-AFFF	Hydrocarbons Alcohols Denatured Ethanol	0.32 (16.56) 0.36 (14.67) 0.32 (16.56)	7.0 (0.5) 9.5 (0.7) 7.0 (0.5)	UL/FM UL/FM UL/FM
	ANSULITE 3% AFFF (AFC-3A)	Hydrocarbons	0.32 (16.56)	7.0 (0.5)	UL/FM
Tyco Fire Products, Model B-1 Foam/Water Sprinkler, K-Factor 3.0, Pendant or Upright	ANSULITE 3x3 Low Viscosity (3%) AR-AFFF	Hydrocarbons Alcohols Denatured Ethanol E-85 Blend*	0.16 (6.52) 0.16 (6.52) 0.16 (6.52) 0.16 (6.52)	30.0 (2.1) 30.0 (2.1) 30.0 (2.1) 30.0 (2.1)	UL UL UL UL
	ANSULITE 3% AFFF (AFC-3A)	Hydrocarbons	0.16 (6.52)	30.0 (2.1)	UL

* E-85 Blend based on 75% Denatured Ethanol / 25% Heptane

Sprinkler Head	Foam Concentrate	Fuel	Min. Application Rate GPM/Sq Ft (LPM/sq. m)	Min. Inlet Pressure psi psi (bar)	Agency Approval
Reliable Automatic Sprinkler Co., Model G, Standard Orifice (1/2 in. (1.27 cm)), Upright, (SIN R1025)	ANSULITE 3x3 Low Viscosity (3%) AR-AFFF	Hydrocarbons Alcohols Ketones Esters	0.16 (6.52) 0.24 (9.78) 0.24 (9.78) 0.24 (9.78)	7.0 (0.5) 16.5 (1.1) 16.5 (1.1) 16.5 (1.1)	UL UL UL UL
	ANSULITE 3% AFFF (AFC-3A) (AFC-5A)	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL
	ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL
	ANSULITE ARC (3%) AR-AFFF	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL
	ANSULITE ARC (6%) AR-AFFF	Alcohols Ketones	0.26 (10.59) 0.26 (10.59)	19.5 (1.3) 19.5 (1.3)	UL UL
Reliable Automatic Sprinkler Co., Model G, Standard Orifice (1/2 in. (1.27 cm)), Pendant, (SIN R1015)	ANSULITE 3x3 Low Viscosity (3%) AR-AFFF	Hydrocarbons Alcohols Ketones	0.16 (6.52) 0.28 (11.41) 0.24 (9.78)	7.0 (0.5) 22.5 (1.6) 16.5 (1.1)	UL UL UL
	ANSULITE 3% AFFF (AFC-3A) (AFC-5A)	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL
	ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL
	ANSULITE ARC (3%) AR-AFFF	Hydrocarbons	0.16 (6.52)	7.0 (0.5)	UL
	ANSULITE ARC (6%) AR-AFFF	Alcohols	0.26 (10.59)	19.5 (1.3)	UL
		Ketones	0.26 (10.59)	19.5 (1.3)	UL
Viking Corp., Model M, Small Orifice (3/8 in. (0.95 cm)) Upright (SIN VK001) Pendant (SIN VK003)	ANSULITE 3% AFFF (AFC-3A)	Hydrocarbons	0.16 (6.52)	30.0 (2.1)	UL
Viking Corp., Model M, Small Orifice (1/2 in. (1.27 cm)), Upright (SIN VK100) Pendant (SIN VK102)	ANSULITE 3% AFFF (AFC-5A) ANSULITE 1% AFFF (1609-95CG)	Hydrocarbons Hydrocarbons	0.16 (6.52) 0.16 (6.52)	7.0 (0.5) 7.0 (0.5)	UL UL

‘SIN’ numbers listed are those accepted at the time of testing. Sprinkler manufacturers may have additional ‘SINs’ that use the same body, orifice, deflector as those shown. Some AHJ’s may require equivalency documentation from the Sprinkler Head Manufacturer for acceptance of ‘SINs’ not shown in the published Listings or Approvals.

Ansul Incorporated
Marinette, WI 54143-2542

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www.ansul.com

Form No. F-2007011

MODEL B-1 FOAM-WATER SPRINKLERS

Data/Specifications

FEATURES

- Pendent or upright installation
- Foam discharge in spray pattern
- Open-head design
- Quickly blankets the area with foam
- UL Listed
- Recognized for use in ANSUL®'s USCG approved systems

DESCRIPTION

The Model B-1 Upright and Pendent Foam-Water Sprinklers manufactured by Tyco Fire & Building Products are air-aspirating foam discharge outlets designed for use in foam-water deluge systems. They are designed for flammable liquid risks where it is desired to apply foam from overhead sprinklers (either upright or pendent) and where follow-up with plain water in a standard spray sprinkler pattern is necessary as in the case of NFPA 16, "Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems."

The Model B-1 Sprinklers were also formerly available as Gem Issue B-1 and Star Model B-1.

APPROVALS

The Model B-1 Sprinklers are UL Listed. Discharge outlets and foam concentrates are listed for use together. Refer to the individual foam concentrate listing for operating limitations and compatibility with the B-1 Foam-Water Sprinklers as provided in the UL Fire Protection Equipment Directory.

The Model B-1 Sprinklers meet the requirements of MIL-S-901C for lightweight Grade A shockproof equipment, as well as the requirements of MIL-H-24146.

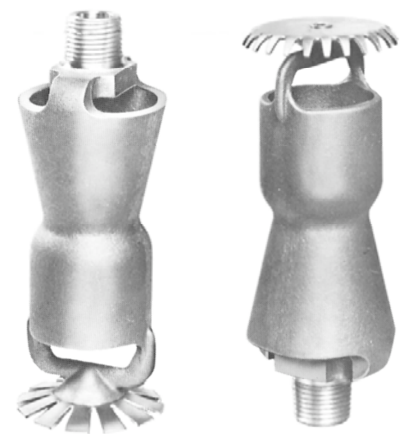
OPERATION

The Model B-1 Foam-Water Sprinklers are designed with a unique venturi-style body. As foam solution (water and foam concentrate mixture) flows through the inlet of the body, air is drawn into the body through the openings adjacent to the wrenching area. The foam solution and air mix is then agitated to create an air-aspirated foam.

The Model B-1 Foam-Water Sprinklers are designed to discharge foam in a pre-determined discharge pattern, as well as to discharge water similar to standard spray sprinklers. To meet the intent of NFPA 16, foam-water sprinklers must be able to sufficiently distribute water after depletion of the foam concentrate.

SPECIFICATIONS

Working pressure:	30 – 175 psi (2.1 – 12.1 bar)
Discharge coefficient:	K = 3.0
Finishes:	Natural Bronze
Physical characteristics:	Body – Bronze, Deflector – Brass, Agitator – Brass
Pipe thread connection:	1/2 in. NPT
Nominal orifice size:	3/8 in. (0.95 cm) at throat
Finish:	Plain



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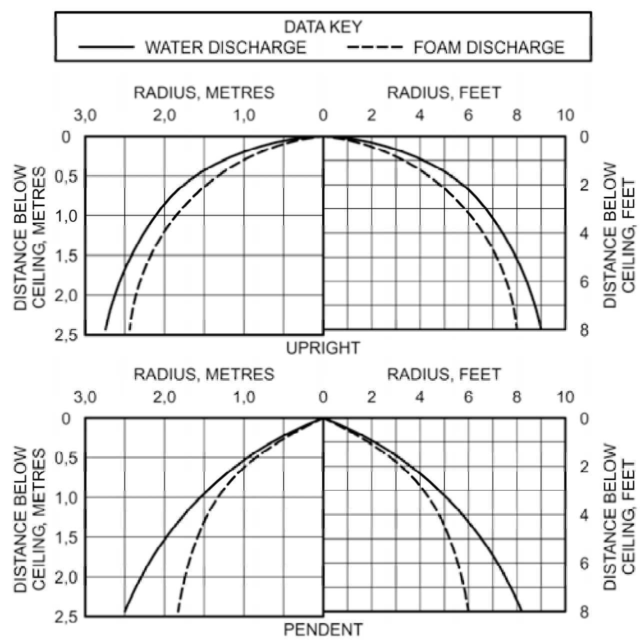

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Figure 1: Nominal Discharge Patterns

(Shown for reference only – not suitable for design purposes)

DESIGN

The Model B-1 Upright and Pendent Foam-Water Sprinklers are intended for fire protection systems designed in accordance with the standard installation rules for foam-water sprinklers systems recognized by the applicable Listing agency (e.g., UL Listing is based on the requirements of NFPA 13 and 16).

Figure 1 provides the nominal discharge patterns for reference use.

Note: The discharge patterns shown in Figure 1 are not to be used for design purposes or to disregard standard installation rules.

Not less than two foam-water sprinklers are to be installed in any area, regardless of size, in order to obtain pattern overlap.

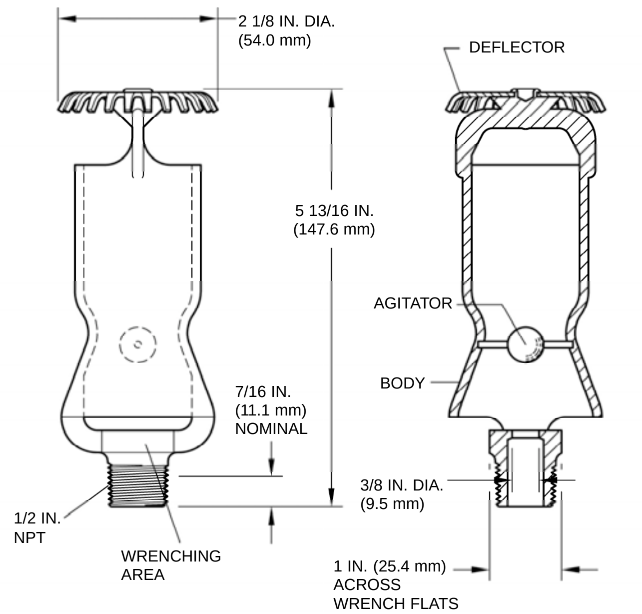
The applied density (flow per unit of area) of foam solution must meet the requirements of the Authority Having Jurisdiction for the type flammable liquid and occupancy. Per NFPA 16, coverage density must not be less than 0.16 GPM/ft^2 (6.52 LPM/m^2) of floor area with a resulting minimum discharge pressure of no less than 30 psi (2.1 bar).

Foam-water sprinkler spacing must not exceed the requirements of NFPA 13 for extra hazard occupancies and the system must be hydraulically calculated to obtain the required density and discharge pressure.

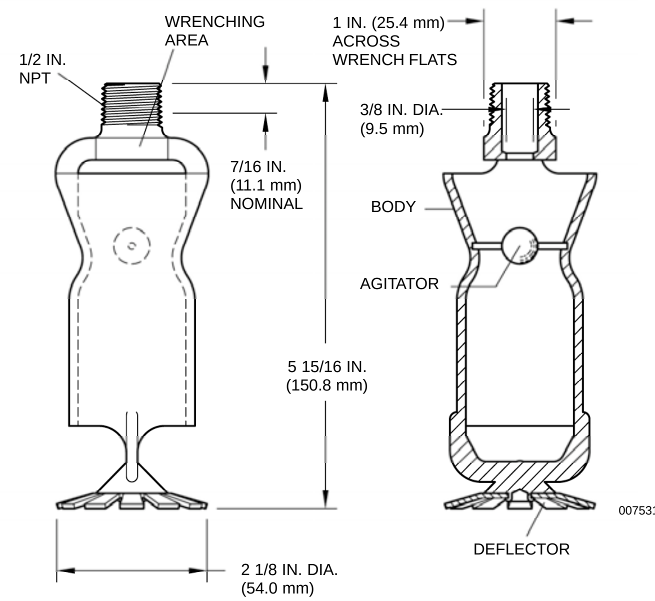
Note: Discharge outlets and foam concentrates are listed for use together. Refer to the individual foam concentrate listing for operating limitations and compatibility with the B-1 Foam-Water Sprinklers as provided in the UL Fire Protection Equipment Directory and shown on the Popular Sprinkler Data Sheet F-2007011 included in Section 4 of the Foam Systems, Design & Applications Manual.

ORDERING INFORMATION

Ansul Part No.	Description
422711	Upright B-1 Foam-Water Sprinkler
72535	Pendent B-1 Foam-Water Sprinkler



UPRIGHT



PENDENT

Figure 2: Model B-1 Upright and Pendent Foam-Water Sprinklers Nominal Dimensions

LOW EXPANSION FOAM WATER SPRINKLER DESIGN – NFPA 16 AND 30

System design is based upon an application rate over an area of coverage for a specific time period.

NFPA 16: Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems

The design density shall be in no case less than 0.16 gpm/ft^2 (6.5 Lpm/m^2) refer to Popular Sprinkler/Concentrates data sheet or actual third party Listings/Approvals for required densities based on fuel/fuel group, concentrate, and sprinkler head selected.

The total demand area for a Closed Head System shall be the hydraulically most remote 5,000 ft^2 (465 m^2) area. If the area of coverage is less than 5,000 ft^2, then the demand area is the area of coverage. As the name implies Deluge Systems are designed over the entire hazard area.

Foam solution discharge duration shall be designed for a period of 10 minutes. Where the actual system discharge exceeds the minimum design, a proportionate reduction shall be permitted, but in no case shall the duration be less than 7 minutes with consideration given to the hydraulically least remote area.

Example calculation as follows:

5,000 ft^2 X 0.16 gpm/ft^2 = **800 gpm (3028 Lpm)**

800 gpm X 10 minutes = 8,000 gal of foam solution required X 3% (0.03) proportioning = **240 gal (908 L) of 3% concentrate required.**

Where the actual system discharge exceeds the minimum design, a proportionate reduction shall be permitted, but in no case shall the duration be less than 7 minutes with consideration given to the hydraulically least remote area.

240 gal of 3% concentrate divided by 7 minutes = 34.28 gpm of concentrate divided by 3% (0.03) proportioning = 1142 gpm (4322 Lpm) is the maximum allowable flow for the system.

Most commonly, AHJ's are not allowing a reduction in discharge duration, therefore an overage allowance is added to the basic system design. Typically 15% is accepted as the overage requirement at system design (demand calculations) as typically the actual available water supply (supply calculations) are not know at this time.
▸ Also NFPA 16 also requires no more than 20% variation between the highest flowing sprinkler head and the lowest flowing sprinkler head when system hydraulic calculations are run for pipe sizing.

Example calculation as follows:

5,000 ft^2 X 0.16 gpm/ft^2 X 1.15 (15% overage) = **920 gpm**

920 gpm X 10 minutes = 9,200 gal of foam solution required X 3% (0.03) proportioning = **276 gal (1045 L) of 3% concentrate required.**

It is important to remember that the proportioner size is based upon the maximum system flow as well as with the lowest expected flow, not based upon the riser size. For closed-head systems protecting flammable or combustible liquids, ANSUL recommends the use of the FLOWMAX® CL Variable Range Proportioner and pre-priming of these wet systems with foam-water solution as the best option.

NFPA 30: FLAMMABLE AND COMBUSTIBLE LIQUIDS CODE

This Standard is commonly used when the primary purpose of the hazard area is for storage of flammable or combustible liquids. In addition to overhead sprinklers, in-rack sprinklers may also be required.

Example calculation as follows: (Always refer to the latest edition of NFPA 30)

For a liquid class of IB, IC, II, or IIIA that are non-miscible or miscible >50%, with a container size of greater than 5 gal but less than 60 gal, a maximum storage height of 25 ft, maximum ceiling height of 30 ft, for Single or Double Row Racks, and with Metal Non-relieving Container Construction.

Ceiling density is 0.30 gpm/ft^2 (12.2 Lpm/m^2) over a design area of 3,000 ft^2 (279 m^2) with in-rack sprinkler at every level.

In-rack sprinklers design is based upon 30 gpm (114 Lpm) per head, with six hydraulically most remote heads operating in each of upper three levels.

The system shall have at least 15 minutes of foam concentrate, based on required design flow rate.

Overhead System: 3,000 ft^2 X 0.30 gpm/ft^2 = 900 gpm X 15 minutes x 1.15 (overage) = 15,525 gal of solution X 3% (0.03) proportioning = **466 gal (1764 L) of 3% concentrate.**

In-rack System: 6 heads per level X 30 gpm per head = 180 gpm per level x 3 levels = 540 gpm x 15 minutes x 1.15 (overage) = 9315 gal of solution X 3% (0.03) proportioning = **280 gal (1060 L) of 3% concentrate.**

Sprinkler System Design

NFPA30: FLAMMABLE & COMBUSTIBLE LIQUIDS CODE (Continued)

Total System Requirements:

466 gallons Overhead + 280 gallons In-rack = **746 gal (2824 L) of 3% Concentrate.**

NFPA 30 requires foam-water sprinkler systems to provide correctly proportioned foam solution to operating sprinklers with only four sprinklers flowing.

If system is pre-primed with foam solution the design area can be reduced to 2,000 ft^2 (186 m^2) and the number of heads in the in-rack can be reduced to 3 heads per level instead of 6.

Calculations with these modifications would require: **451 gal (1707 L) of 3% Concentrate.**

Remember to include concentrate for the purpose of pre-priming and system flow testing.

Factory Mutual (FM), Industrial Risk Insurers (IRI), or others may have their own interpretation of NFPA standards.

Typically FM would require closed head foam-water systems per NFPA 30 to be pre-primed with foam solution to make foam immediately available when the sprinkler system operates. FM may also require the system to have at least 20 minutes of foam concentrate supply.

Important Questions:

1. Who is insurance carrier?
2. What design criteria do they require?

Foam System Design and Application

Foam System Applications

INTRODUCTION

This section covers foam system requirements for some common hazards. The section is divided into seven parts as follows:

Section 5A – Foam Agent Selection

Section 5B – Storage Tank Protection

Section 5C – Aircraft Hangar Protection

Section 5D – Truck Loading Rack Protection

Section 5E – Heliport Protection

► Section 5F – Spill Fire Protection

Section 5G – High Expansion Foam Systems

Section 5A contains general foam agent selection information that should be considered for each hazard individually.

Sections 5B through 5E and 5G contain flow charts which take the system designer through the foam and hardware selection process. Each flow chart will reference specific pages for detailed application information.

Section 5F provides guidelines for those applications where the customer requires spill fire protection only or in combination with other systems.

Detection and control systems are also required for many applications. For detection and control recommendations or for foam system applications not covered in this manual, contact your local ANSUL representative or Ansul Incorporated, Technical Services Department.

Foam Agent Selection

GENERAL CRITERIA

The selection of the correct foam agent depends on an objective hazard analysis.

The hazard analysis consists of an identification of:

– Type of Combustibles

– Quantity of Combustibles

– Configuration of Combustibles

Once these factors are identified, it becomes a matter of selecting those agents and methods of application that are most cost effective in relation to the value of the hazard to be protected. The value of the hazard is usually expressed in terms of:

– Safety to Life

– Cost of Capital Replacement

– Business Interruption Costs

In general, foam agents are used where flammable or combustible liquids are transported, stored, processed, or used. Because of their water content, foam agents can also be used on Class A fuels such as paper, wood, cloth, and some plastics. While there are differences between foam agent types with regard to cost, stability or shelf life, extinguishing characteristics, and application techniques; usually one or two agents will stand out above the others for protection of a specific hazard.

FOAM AGENT LIMITATIONS

1. Foams, except for the high expansion type and then only with special considerations, are not suitable extinguishing agents for fires involving gases, liquefied gases (with boiling points below ambient temperatures such as butane, butadiene, propane, etc.), or cryogenic liquids.
2. Three dimensional flowing liquid fires, such as overhead tank leakage or pressure leaks, are not readily extinguishable with foams.
3. Foams shall not be used to fight fires in materials that react violently with water, such as metallic sodium and metallic potassium.
4. Foam is a conductor of electricity and shall not be used on energized electrical equipment fires.
5. Judgment must be used in applying foams to hot oils, burning asphalts, or burning liquids which are above the boiling point of water. Although the comparatively low water content of foams can beneficially cool such fuels at a slow rate, it can also cause violent frothing and "slop-over" of the contents. This phenomena occurs because the water, upon contact with the very hot fuel, immediately turns to steam.
6. Foams, except for the alcohol-resistant concentrate type, are not suitable for water soluble or polar-solvent liquids.

HYDROCARBONS AND POLAR SOLVENTS

Hydrocarbons and polar solvent (water miscible) fuels are the two basic classifications of flammable or combustible liquids.

Hydrocarbon liquids consist of petroleum products such as heptane, kerosene, diesel, gasoline, fuel oil, jet fuel and, crude oil, none of which are soluble in water. Polar solvent liquids such as alcohol, ketone, ether, aldehyde, and ester are water miscible, or will mix readily with water.

Protein foams, fluoroprotein foams, and AFFF agents are all suitable for hydrocarbon liquid protection. These foams break down or are destroyed rapidly when used or exposed to polar solvent type liquids; therefore an alcohol resistant foam must be used on water miscible liquids.

Foam Agent Selection

FLAMMABLE AND COMBUSTIBLE LIQUIDS

Flammable liquids are defined by NFPA-11 as any liquid having a flash point below 100 °F (38 °C) and having a vapor pressure not exceeding 40 psi (276 kPa) (absolute) at 100 °F (38 °C). Flammable liquids shall be subdivided as follows:

Class I Liquids shall include those having flash points below 100 °F (38 °C) and may be subdivided as follows:

Class IA shall include those having flash points below 73 °F (23 °C) and having boiling points below 100 °F (38 °C).

Example Class IA	Flash Point °F	(°C)	Boiling Point °F	(°C)	Water Soluble
Acetic Aldehyde	–38	(–39)	70	(21)	Yes
Dimethyl Sulfide	0	(–18)	99	(37)	Slight
Furan	32	(0)	88	(31)	No

Class IB shall include those having flash points below 73 °F (23 °C) and having boiling points above 100 °F (38 °C).

Example Class IB	Flash Point °F	(°C)	Boiling Point °F	(°C)	Water Soluble
Ethyl Alcohol	55	(13)	173	(78)	Yes
Gasoline- 92 Octane	–36	(–38)	100–400	(38–204)	No
Cyclohexane	–4	(–20)	179	(82)	No

Class IC shall include those having flash points at or above 73 °F (23 °C) and below 100 °F (38 °C).

Combustible liquids are defined by NFPA 11 as any liquid having a flash point at or above 100 °F (38 °C) and may be subdivided as follows:

Class II Liquids shall include those having flash points at or above 100 °F (38 °C) and below 140 °F (60 °C).

Example Class II	Flash Point °F	(°C)	Water Soluble
Diesel Fuel Oil (No. 1-D/2-D/4-D)	100–130	(38–54)	No
Glacial Acetic Acid	103	(39)	Yes
Jet Fuel (A & A-1)	110	(43)	No

Class IIIA Liquids shall include those having flash points at or above 140 °F (60 °C) and below 200 °F (93 °C).

Example Class IIIA	Flash Point °F	(°C)	Water Soluble
Creosote Oil	165	(74)	No
Butyl Carbitol	172	(78)	Yes
Fuel Oil No. 4	142–240	(61–116)	No

Class IIIB Liquids shall include those having flash points at or above 200 °F (93 °C).

Example Class IIIB	Flash Point °F	(°C)	Water Soluble
Fuel Oil No. 4	142–240	(61–116)	No
Mineral Oil	380	(193)	No
Olive Oil	437	(225)	No

PROTECTION OPTIONS

Large volume storage of flammable or combustible liquids warrants special consideration when providing fire protection for the fuel and surrounding area. The types of liquids and variety of tank styles give way to a variety of foam fire protection systems.

There are three basic types of protection for storage tanks:

– Subsurface Injection

– Surface Application

- Cone Roof (With or Without Internal Floater)
- Floating Roof

– Dike Protection

Subsurface injection is accomplished using a high back-pressure foam maker. Foam must be injected at the base of the tank above the water layer. This method can be used on hydrocarbon fuels stored in cone roof tanks. Subsurface injection is not an acceptable means of protection for floating roof tanks, cone roof tanks with internal floaters, or any tank which contains a polar solvent liquid.

Surface application can be accomplished by several methods including foam chambers, floating roof foam makers, monitors, or handlines. The type of surface application required depends primarily on tank diameter and style. Cone roof and floating roof tanks are primary candidates for surface protection.

Dike protection is generally required for small diameter vertical tanks or horizontal tanks. Dike protection can be accomplished using floating roof foam makers, spray nozzles, or foam monitors.

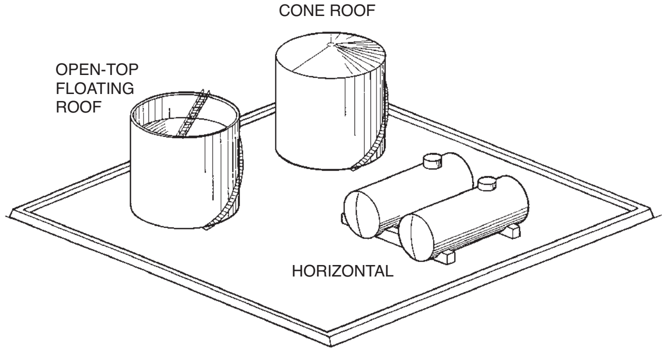


FIGURE 5B-1
001285

SUBSURFACE INJECTION

Subsurface injection is the injection of a low expanded foam, typically 4:1 or less, into the base of a tank. Because of the pressure exerted on the foam supply pipe by the contents of the tank (static head pressure), a special high back-pressure foam maker is required in the supply line to assure proper flow and expansion. The foam can be injected into an existing product line or through a separate inlet dedicated to fire protection.

The expanded foam must always enter the tank above any water layer that may be present on the bottom; it must be injected into the fuel which is contained within the tank. Injection into the water layer will destroy the finished foam.

Subsurface injection can be used on hydrocarbon liquids stored in cone roof tanks. It is not an acceptable method for use on tanks with floating roofs (open or covered), nor is it acceptable for polar solvent liquid storage tanks of any type.

Subsurface injection offers several advantages over other application methods:

– The foam is more efficiently directed to the surface of the burning fuel without interruption by wind and thermal updraught.

– The rising foam causes the contents of the tank to circulate and aids in cooling the fuel at the surface.

– Damage to the foam supply from fire and explosion is reduced as the equipment is located at the base of the tank rather than at the top.

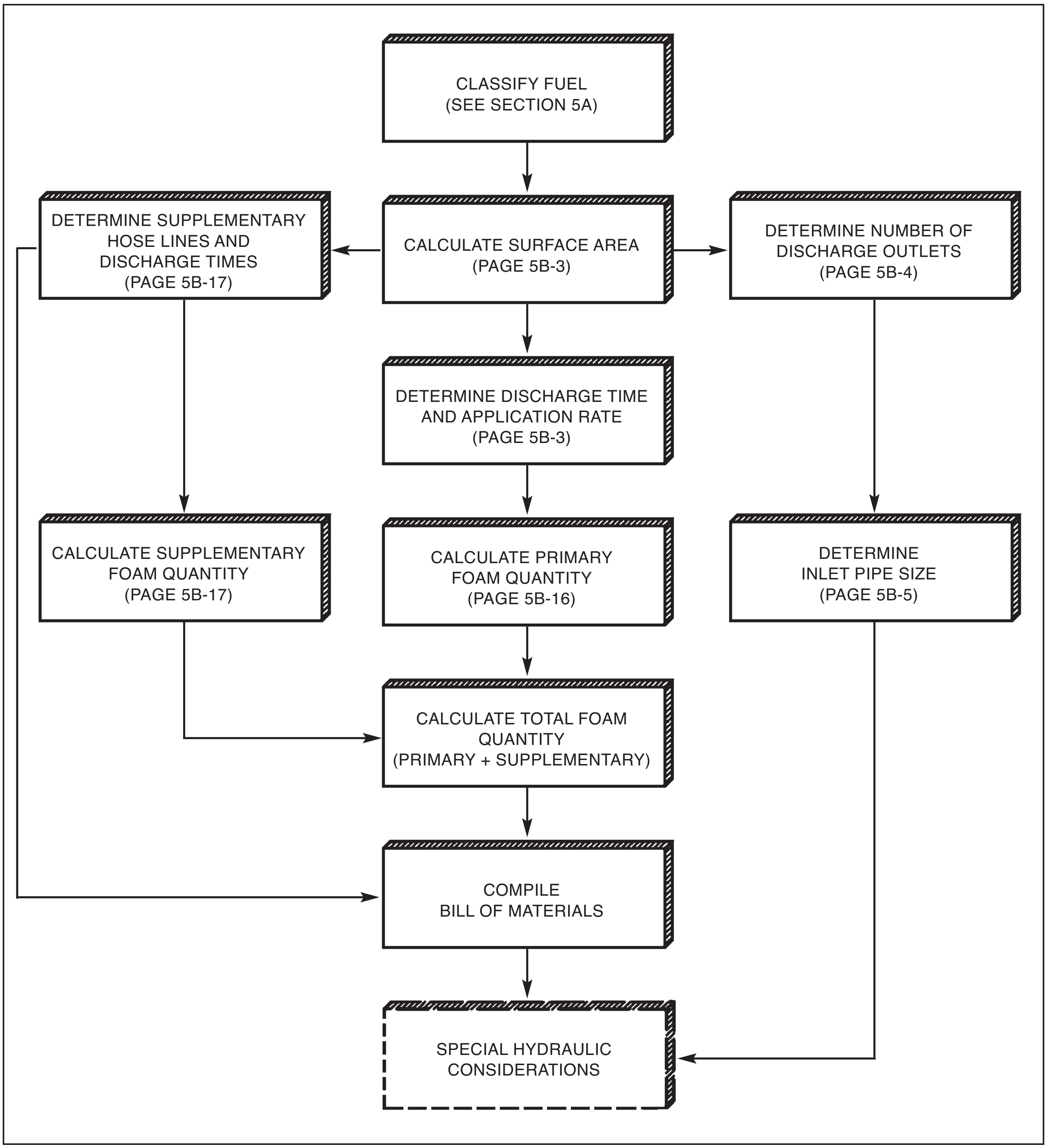
Subsurface injection is a disadvantage if the foam inlet velocity is greater than recommended as excessive hydrocarbon pickup causes destruction of the foam by combustion of the entrained fuel. Thus, it is important that the system be designed NOT TO EXCEED the maximum foam inlet velocity.

Storage Tank Protection

SUBSURFACE INJECTION (Continued)

Subsurface Injection Flow Chart

The following flow chart defines a logical sequence for designing subsurface injection systems.



Storage Tank Protection

SUBSURFACE INJECTION (Continued)

Calculating Surface Area

When protecting a single storage tank, calculate the surface area using the following formula:

SURFACE AREA = π r2

When protecting multiple storage tanks, it is important to calculate the surface area of the MOST SEVERE HAZARD. The most severe hazard is the storage tank that will require the most foam concentrate for protection.

When all tanks contain the same fuel, the largest tank will require the most foam concentrate and is therefore considered the most severe hazard.

When the tanks contain different fuels, the most severe hazard may not be the largest tank. In these cases, it is necessary to determine the surface area, discharge time, and application rate for each tank and then select the tank which requires the most foam concentrate for primary protection.

Determining Discharge Time and Application Rate

Discharge time and application rate are determined according to the type of fuel contained in the storage tank being protected as shown in Table 5B-1. Protein foam concentrate is not acceptable due to fuel pickup of the expanded foam.

Fuel Protected	Foam Concentrate	Application Rate gpm/ft^2	(Lpm/m^2)	Discharge Time
Hydrocarbon Flash point between 100 °F and 200 °F (38 °C and 93 °C)	Fluoroprotein	0.10	(4.1)	30 minutes
	AFFF	0.10	(4.1)	30 minutes
Hydrocarbon Flash point below 100 °F (38 °C) or liquid heated above flash point	Fluoroprotein	0.10	(4.1)	55 minutes
	AFFF	0.10	(4.1)	55 minutes
Crude Petroleum	Fluoroprotein	0.10	(4.1)	55 minutes
	AFFF	0.10	(4.1)	55 minutes

TABLE 5B-1

Calculating Primary Foam Quantity

First, use the following formula to determine Foam Solution Discharge Rate which is required to determine proportioner size:

FOAM SOLUTION DISCHARGE RATE = SURFACE AREA X APPLICATION RATE

Now, calculate the foam concentrate quantity using the following formula:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X DISCHARGE TIME X CONCENTRATE %*

*Concentrate % is expressed as: .01 for 1% concentrates
.03 for 3% concentrates
.06 for 6% concentrates

Storage Tank Protection

SUBSURFACE INJECTION (Continued)

Determining Number of Discharge Outlets

The number of discharge outlets required is based on tank diameter and flash point of fuel. Refer to Table 5B-2 to determine the number of outlets required. Figure 5B-2 depicts typical arrangements for multiple discharge outlets.

Tank Diameter		Number of Discharge Outlets Required	
ft.	(m)	Flash Point Below 100 °F (38 °C)	Flash Point 100 °F (38 °C) or Higher
Up to 80	(24)	1	1
Over 80 to 120	(24 – 36)	2	1
Over 120 to 140	(36 – 42)	3	2
Over 140 to 160	(42 – 48)	4	2
Over 160 to 180	(48 – 54)	5	2
Over 180 to 200	(54 – 60)	6	3
Over 200	(60)	One outlet for each additional 5000 sq. ft. (465 m^2)	One outlet for each additional 7500 sq. ft. (697 m^2)

TABLE 5B-2

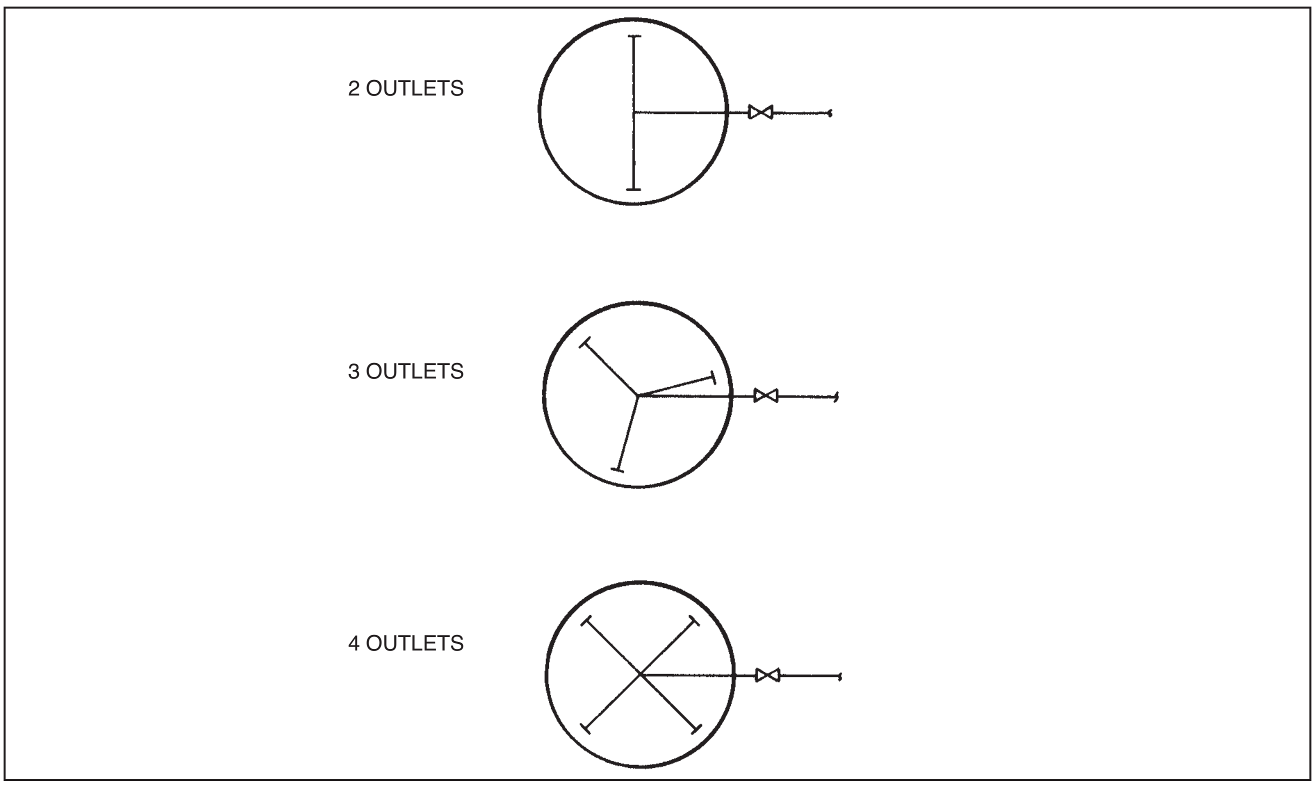


FIGURE 5B-2
001287

Storage Tank Protection

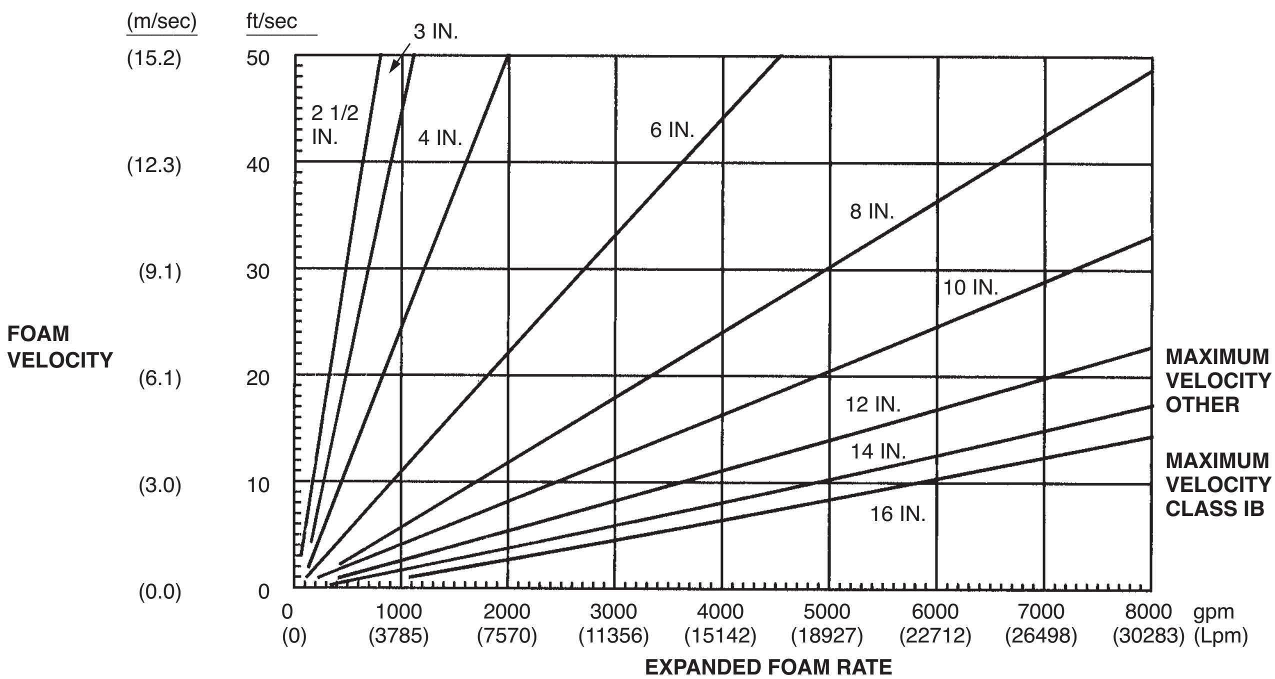
SUBSURFACE INJECTION (Continued)

Determining Inlet Pipe Size

NFPA 11 states that the foam velocity at the point of discharge into the tank shall not exceed 10 ft. per second (3 m/sec) for Class IB liquids or 20 ft. per second (6.1 m/sec) for other liquids, unless actual tests prove higher velocities are satisfactory.

The inlet pipe for subsurface injection must be of adequate size that the expanded foam flow does not exceed the inlet velocity recommendation. Adequate inlet size can be found by multiplying the flow rate needed for the tank by 4 (maximum expansion expected) to get the expanded foam rate, and then comparing this with Figure 5B-3 for the appropriate pipe size.

To use the chart below, find Foam Velocity at left side of chart. Read across the chart to intersection with Expanded Foam Rate. Choose the Inlet Pipe Size from the curve either at or below the intersection.



NOTE: Chart is based on Standard Schedule 40 Pipe.

FIGURE 5B-3
001288

Storage Tank Protection

SUBSURFACE INJECTION (Continued)

Determining Static Head Pressure

To use the chart below, find Static Head (maximum height of liquid) at left side of chart. Read across chart to intersection with Specific Gravity curve for fuel in tank. The Static Head Pressure is the measurement at the bottom of the chart directly below the intersection.

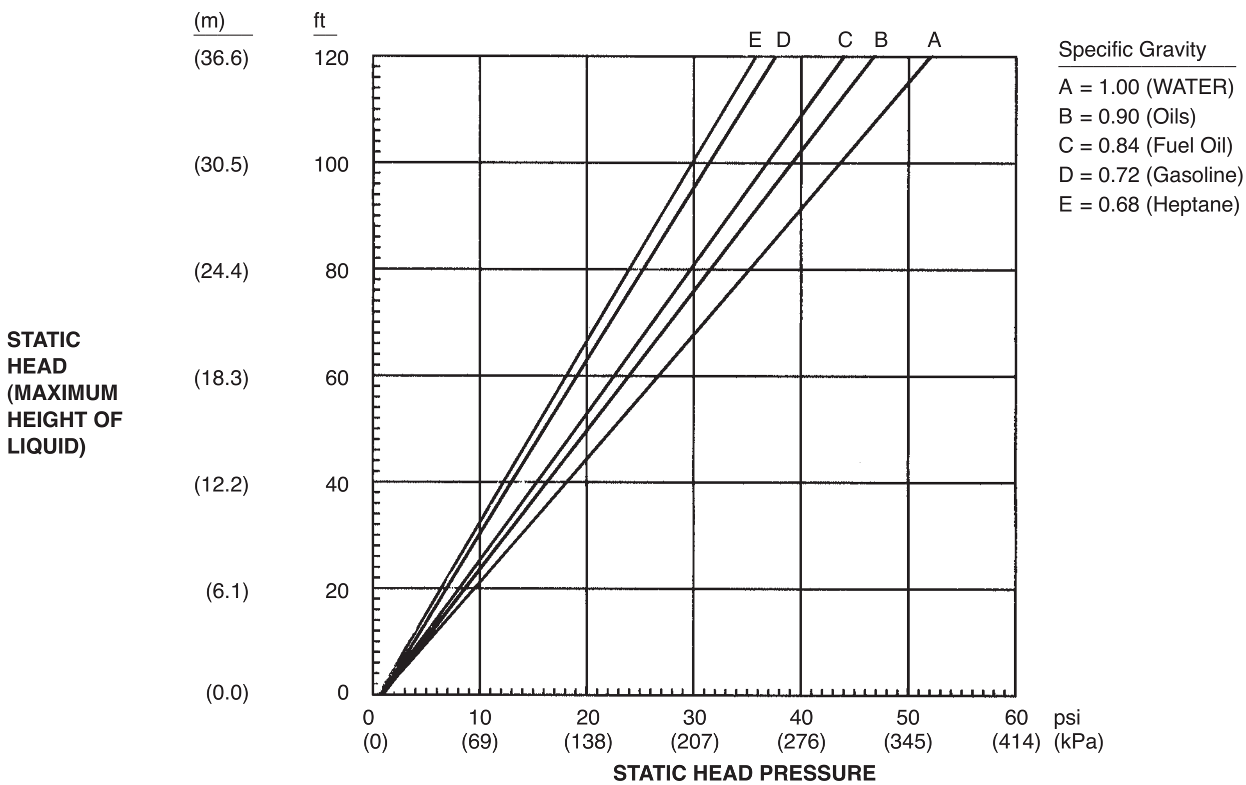


FIGURE 5B-4
001289

Storage Tank Protection

SUBSURFACE INJECTION (Continued)

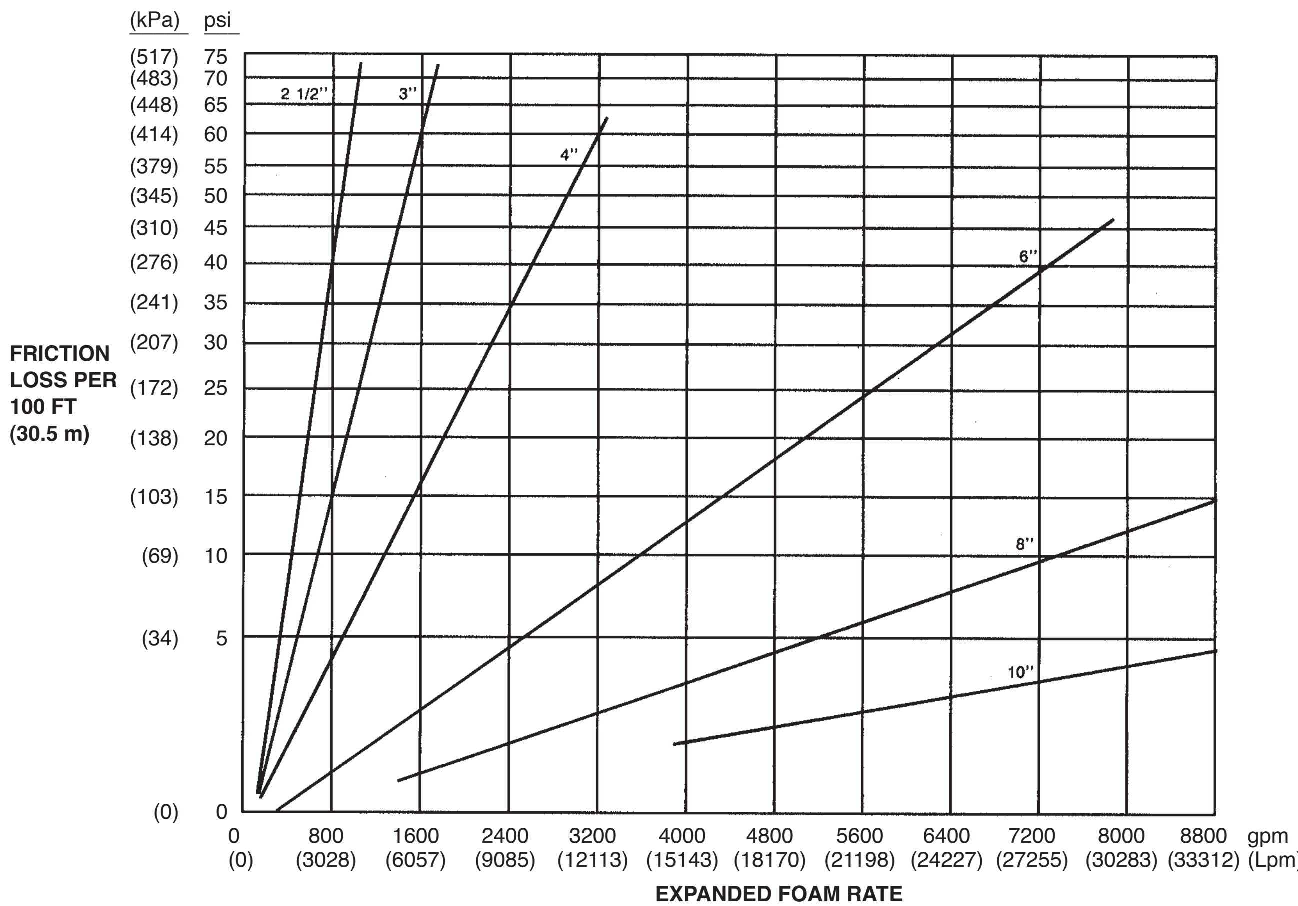
Determining Expanded Foam Friction Losses Vs. Pipe Size

To use the chart below, first determine Maximum Allowable Friction Loss and Expanded Foam Rate using the following formulas:

MAXIMUM ALLOWABLE FRICTION LOSS = MAXIMUM ALLOWABLE BACK-PRESSURE − STATIC HEAD PRESSURE

EXPANDED FOAM RATE = FOAM SOLUTION DISCHARGE RATE X EXPANSION (4) RATIO

Next, find the Expanded Foam Rate at the bottom of the chart. Read up the chart until intersectioning with minimum pipe size that is under Maximum Allowable Friction Loss.



NOTE: Chart is based on Standard Schedule 40 Pipe.

FIGURE 5B-5

001290

EXAMPLE SYSTEM – SUBSURFACE INJECTION

Hazard Specifications

Type of Tank . . . . Fixed Cone Roof

Height . . . . 40 ft (12.2 m)

Diameter . . . . 80 ft (24.4 m)

Contents . . . . Gasoline (92 Octane)

System Design

Following the flow chart on Page 5B-2, the system is determined as follows:

1. CLASSIFY FUEL (SEE SECTION 5A)

Gasoline (92 Octane), Class IB Fuel, Flashpoint: –36 °F (–38 °C), Boiling Point: 100-400 °F (38-204 °C), Not Water Soluble

Agent Chosen: 3% AFFF

2. CALCULATE SURFACE AREA (PAGE 5B-3)

SURFACE AREA = πr^2

SURFACE AREA = 3.14 $(40 \text{ ft})^2$

SURFACE AREA = 5027 ft^2 (467 m^2)

3. DETERMINE DISCHARGE TIME AND APPLICATION RATE (PAGE 5B-3)

Because the fuel flashpoint is below 100 °F (38 °C), it is determined that the Application Rate is 0.10 gpm/ft^2 (4.1 Lpm/m^2) and the Discharge Time is 55 minutes.

4. CALCULATE PRIMARY FOAM QUANTITY (PAGE 5B-16)

First, determine the Foam Solution Discharge Rate:

FOAM SOLUTION DISCHARGE RATE = SURFACE AREA X APPL. RATE

FOAM SOLUTION DISCHARGE RATE = 5027 ft^2 X 0.10 gpm/ft^2

FOAM SOLUTION DISCHARGE RATE = 503 gpm (1904 Lpm)

Then, determine the foam concentrate quantity:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X DISCHARGE TIME X CONC. %

QUANTITY = 503 gpm X 55 minutes X 0.03 (3% AFFF)

QUANTITY = 830 gal (3142 L)

5. DETERMINE SUPPLEMENTARY HOSE LINES AND DISCHARGE TIMES (PAGE 5B-17)

It is determined that a 80 ft (24.4 m) diameter tank requires two, 50 gpm (189 Lpm), hose lines with a discharge time of 20 minutes.

6. CALCULATE SUPPLEMENTARY FOAM QUANTITY (PAGE 5B-17)

QUANTITY = NO. OF HOSE LINES X 50 GPM X DISCHARGE TIME X CONC. %

QUANTITY = 2 hose lines x 50 gpm x 20 minutes x 0.03 (3% AFFF)

QUANTITY = 60 gal (227 L)

7. CALCULATE TOTAL FOAM QUANTITY (PRIMARY + SUPPLEMENTARY)

Primary . . . . 830 gal

Supplementary . . . . 60 gal

Total Foam Quantity . . . . . 890 gal (3369 L) AFFF 3% Foam Concentrate

8. COMPILE BILL OF MATERIALS

NOTICE

This is an example only. Selection of agent and proportioning equipment will vary with each application. For detection and control system recommendations, consult Ansul Incorporated.

Quantity	Description
1	900 Gallon Bladder Tank
1	Proportioner, Sized for 503 gpm (1904 Lpm) – Primary
1	Proportioner, Sized for 50-100 gpm (189-379 Lpm) – Suppl.
1	High Back-Pressure Foam Maker, HBPFM-450
2	Handline Nozzle, 50 gpm (189 Lpm)
900 gal	ANSULITE AFFF 3% Concentrate
As Required	Test Foam, ANSULITE AFFF 3% Concentrate

9. DETERMINE NUMBER OF DISCHARGE OUTLETS (PAGE 5B-4)

Because the fuel flash point is below 100 °F (38 °C) and the tank is 80 ft in diameter, it is determined that one discharge outlet is required.

10. DETERMINE INLET PIPE SIZE (PAGE 5B-5)

EXPANDED FOAM RATE = FOAM SOLUTION DISCHARGE RATE X EXPANSION (4:1)

EXPANDED FOAM RATE = 503 gpm X 4

EXPANDED FOAM RATE = 2012 gpm (7616 Lpm)

Referring to the Foam Velocity Chart (Figure 5B-3), it is determined that the minimum inlet pipe size is 10 in. (fuel with flash point less than 100 °F (38 °C) requires a maximum velocity of 10 ft/sec (3 m/sec.)).

11. SPECIAL HYDRAULIC CONSIDERATIONS

A. Determine Minimum Inlet Pressure required to HBPFM-450. Refer to Ansul High Back-Pressure Foam Makers Data Sheet (Form No. F-8741).

MINIMUM INLET PRESSURE = 160 psi (1103 kPa)

B. Calculate Maximum Allowable Back-Pressure to HBPFM-450. Ansul high back-pressure foam makers have a maximum allowable back-pressure 40% of operating inlet pressure.

MAXIMUM ALLOWABLE BACK-PRESSURE = MINIMUM INLET PRESSURE X 0.4 (40%)

MAXIMUM ALLOWABLE BACK-PRESSURE = 160 psi X 0.4 (40%)

MAXIMUM ALLOWABLE BACK-PRESSURE = 64 psi (441 kPa)

C. Determine Static Head Pressure of product in tank. Refer to "Line D (gasoline)" of Static Head Pressure Chart.

STATIC HEAD PRESSURE = 13 psi (90 kPa)

D. Determine Maximum Allowable Friction Loss in piping between foam maker and storage tank.

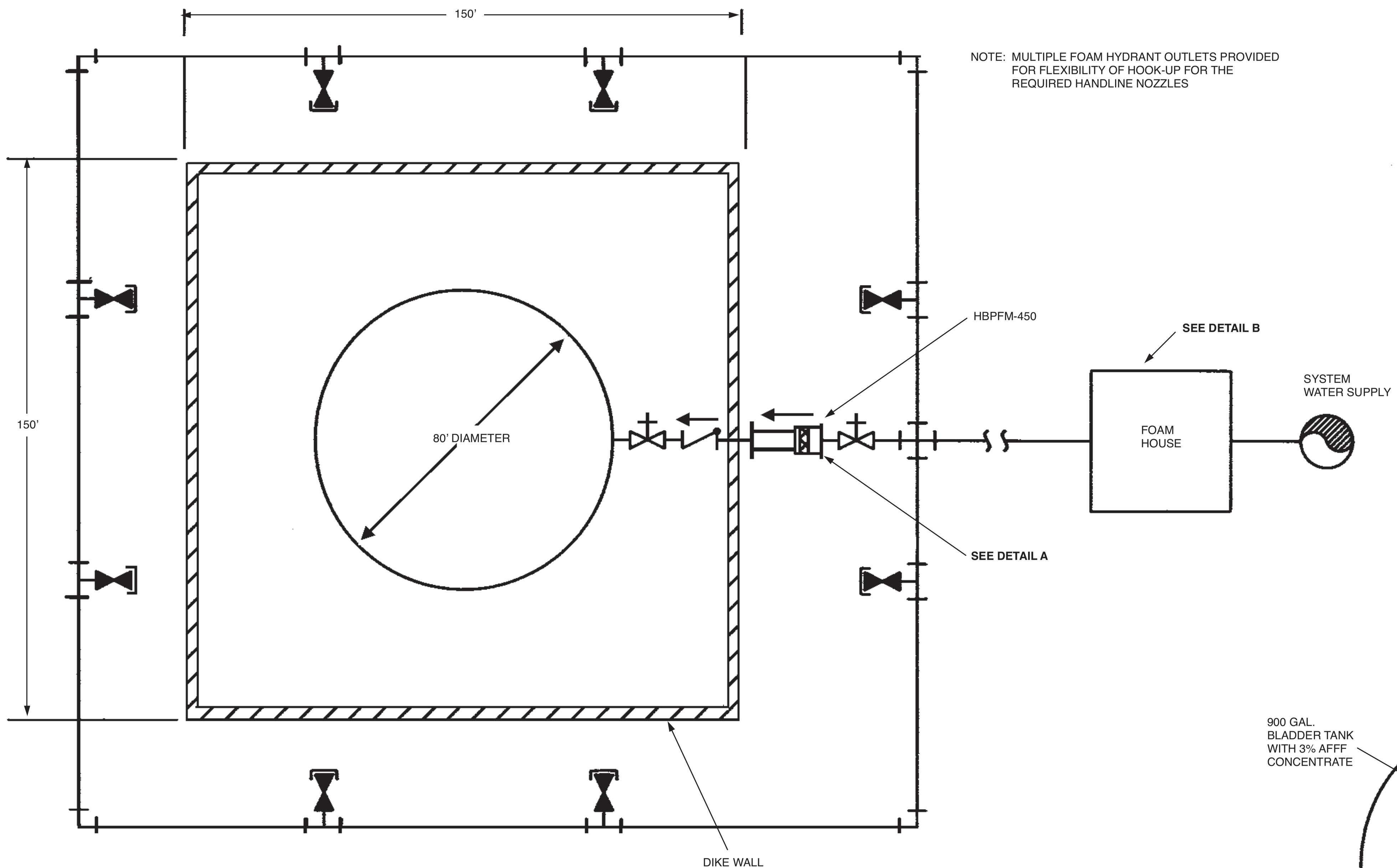
MAXIMUM ALLOWABLE FRICTION LOSS = MAXIMUM ALLOWABLE BACK-PRESSURE – STATIC HEAD PRESSURE

MAXIMUM ALLOWABLE FRICTION LOSS = 64 psi – 13 psi

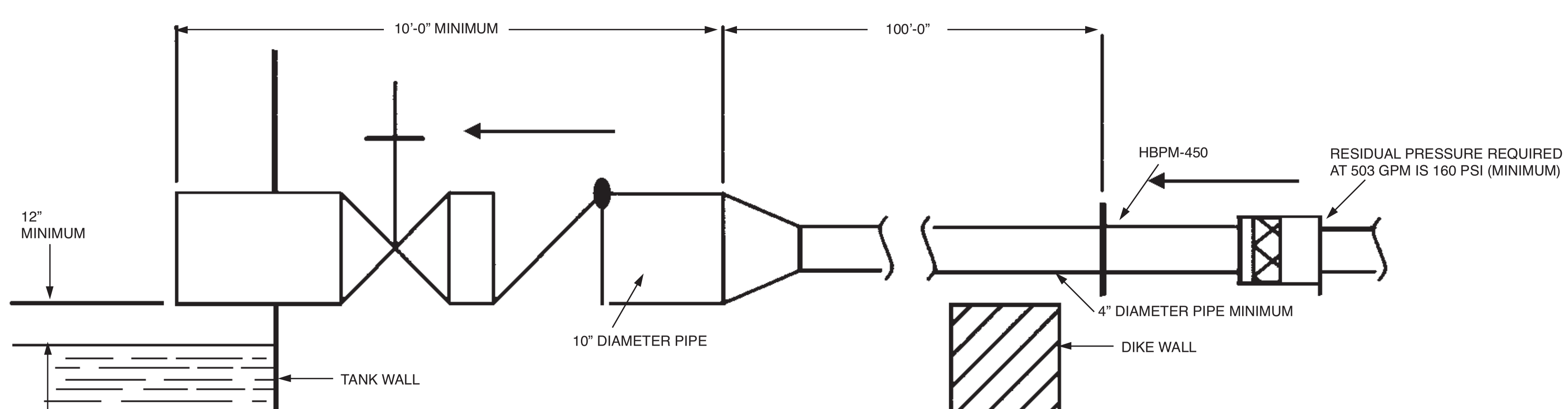
MAXIMUM ALLOWABLE FRICTION LOSS = 51 psi (352 kPa)

E. Assume that there is 100 ft (30 m) of pipe between HBPFM-450 and 10 in. inlet to storage tank. Referring to Foam Friction Loss Chart, it is determined that 4 in. pipe is minimum size required.

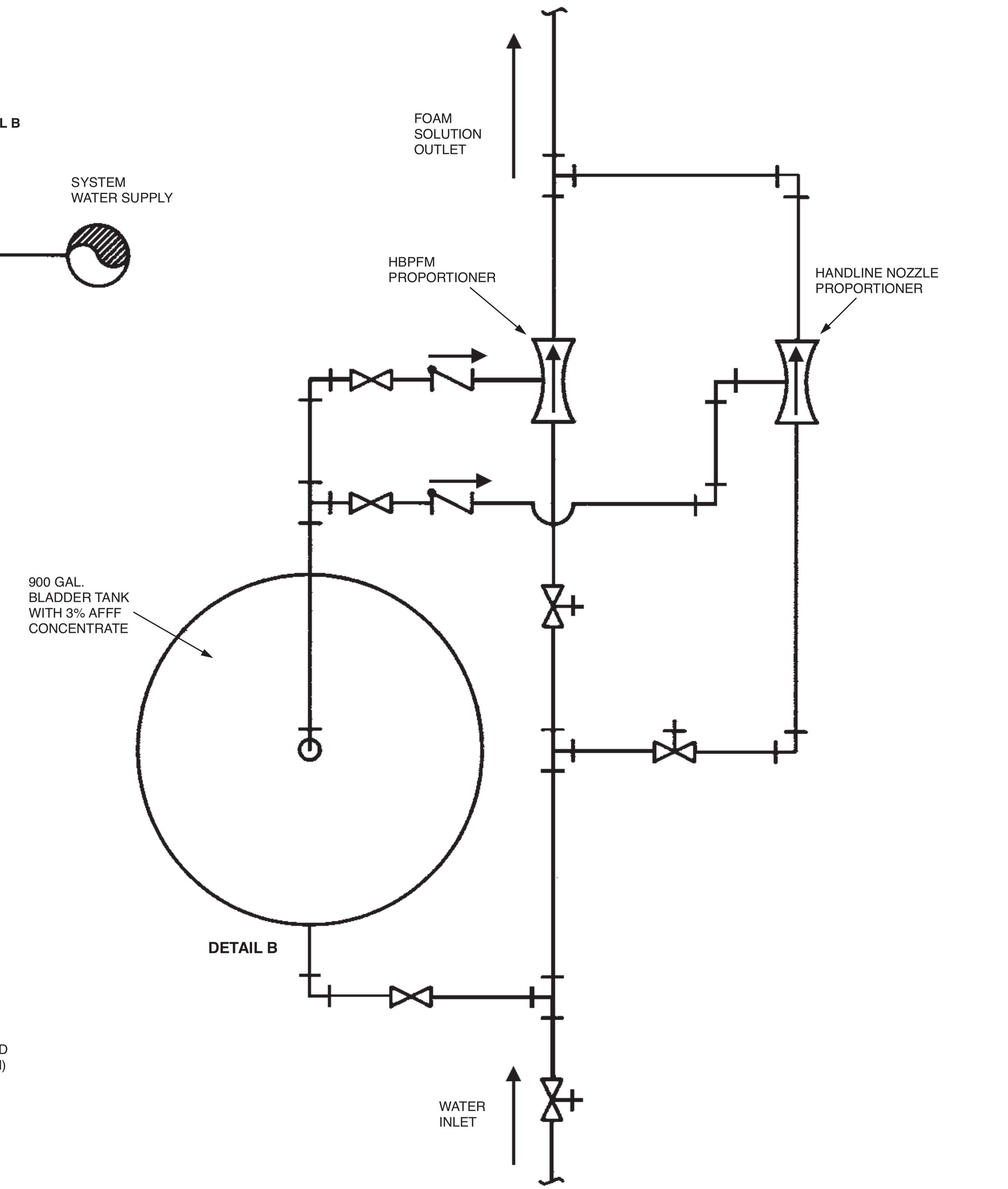
EXAMPLE SYSTEM – SUBSURFACE INJECTION (Continued)



NOTE: PRODUCT LINE CAN ALSO BE USED TO INJECT FOAM SUBSURFACE (SEE DATA SHEET FOR TYPICAL SCHEMATIC)



DETAIL A



DETAIL B

001291

SECTION 5B
STORAGE TANK PROTECTION
EXAMPLE SYSTEM – SUBSURFACE INJECTION
SHEET 2 OF 2

Storage Tank Protection

SURFACE APPLICATION

The application of foam to the fuel surface is accomplished with a dedicated foam supply pipe to either foam chambers or floating roof foam makers. Both devices are air-aspirating and direct the stream down the inside wall of the tank. Tank style dictates which type of discharge device can be used.

Cone roof tanks (with or without internal floaters) require the use of foam chambers for surface application. Because foam chambers contain a vapor seal, they prevent the entrance of flammable vapors into the supply piping. Unlike foam chambers, floating roof foam makers do not contain vapor seals and therefore cannot be used with cone roof tanks. See Page 5B-11 for Cone Roof Surface Application Flow Chart.

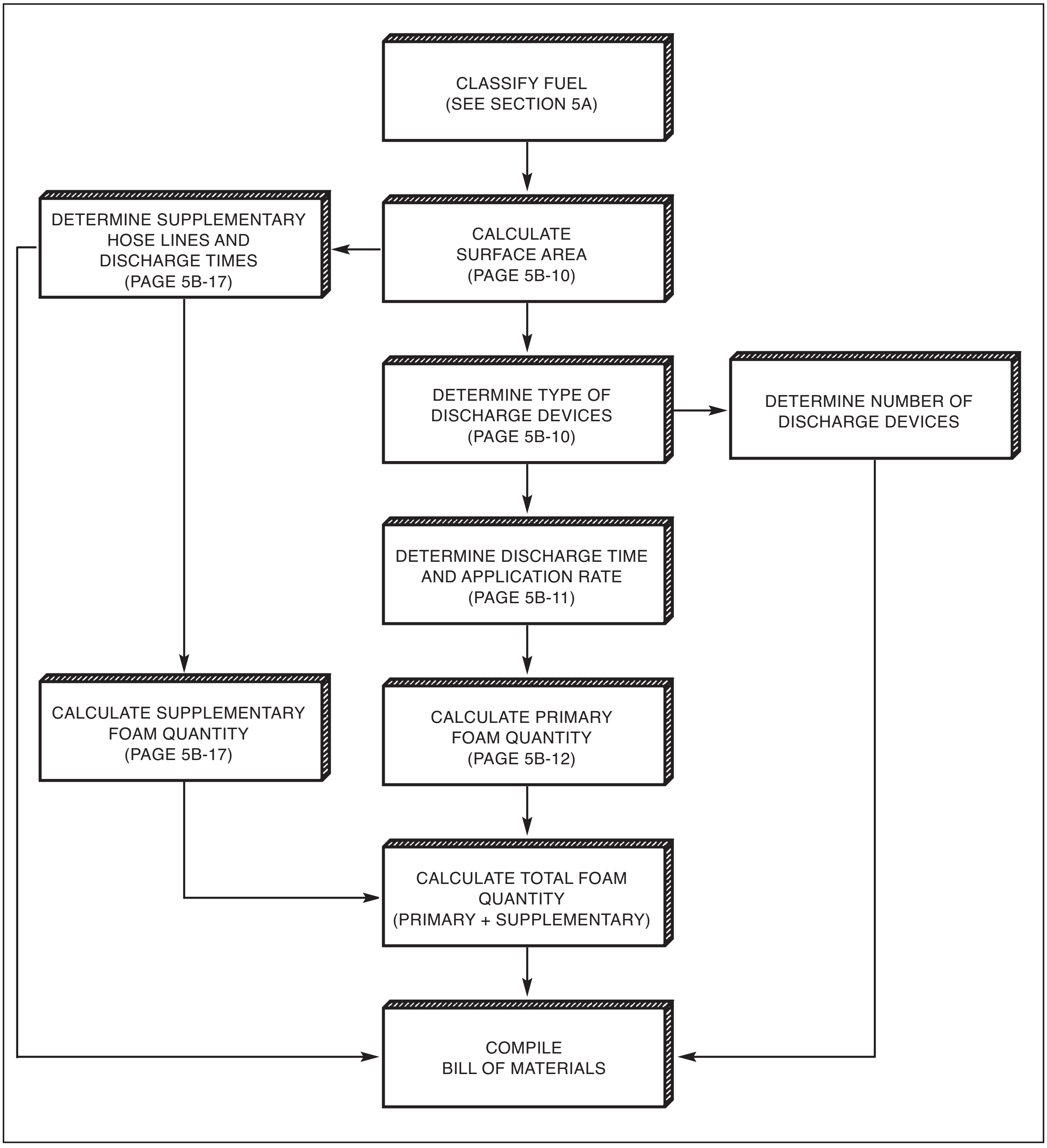
Floating roof tanks can be protected with either floating roof foam makers or foam chambers. Because piping from the floating roof foam maker is above the floating roof of the tank and open to atmosphere, flammable vapors are minimized and a vapor seal is not required. See Page 5B-16 for Floating Roof Surface Application Flow Chart.

Storage Tank Protection

SURFACE APPLICATION (Continued)

Cone Roof Surface Application Flow Chart

The following flow chart defines a logical sequence for designing cone roof surface application systems.



Storage Tank Protection

SURFACE APPLICATION (Continued)

Calculating Surface Area (Cone Roof Tanks)

When protecting a single storage tank, calculate the surface area using the following formula:

$$\text{SURFACE AREA} = \pi r^2$$

When protecting multiple storage tanks, it is important to calculate the surface area of the MOST SEVERE HAZARD. The most severe hazard is the storage tank that will require the most foam concentrate for protection.

When all tanks contain the same fuel, the largest tank will require the most foam concentrate and is therefore considered the most severe hazard.

When the tanks contain different fuels, the most severe hazard may not be the largest tank. In these cases, it is necessary to determine the surface area, discharge time, and application rate for each tank and then select the tank which requires the most foam concentrate for primary protection.

Determining Type of Discharge Devices (Cone Roof Tanks)

Typically, foam chambers are used to protect cone roof storage tanks. However, in certain cases, foam monitors or hand hose lines may be used for smaller tanks.

The use of hand hose lines or monitors as primary foam protection is subject to the following conditions:

– Hand hose lines **shall not** be considered for cone roof tanks over 30 ft. (9 m) diameter nor when tanks are over 20 ft (6 m) high.

– Monitors **shall not** be considered for cone roof tanks over 60 ft (18 m) diameter.

  When using hand hose lines or monitors for primary protection, the application rates and discharge times are greater than those for foam chambers and therefore more foam concentrate is required. This is due to the adverse conditions that may arise when applying the foam stream to the fuel surface through the damaged roof. When applying foam to polar solvent fuels using monitors or handlines, it is important that the streams be directed at the internal tank sidewall to avoid plunging the foam into the fuel.

Storage Tank Protection

SURFACE APPLICATION (Continued)

Determining Discharge Time and Application Rate (Cone Roof Tanks)

Discharge time and application rate are determined according to the type of fuel contained in the storage tank being protected as shown in Table 5B-3.

		Foam Chambers As Primary Protection			–OR–	Monitors/Hand Hose Lines As Primary Protection		
Fuel Protected	Foam Concentrate	Application Rate gpm/ft^2	(Lpm/m^2)	Discharge Time		Application Rate gpm/ft^2	(Lpm/m^2)	Discharge Time
Hydrocarbon								
Flash point between 100 °F and 200 °F (38 °C and 93 °C)	Protein	0.10	(4.1)	30 min.		0.16	(6.5)	50 min.
	Fluoroprotein	0.10	(4.1)	30 min.		0.16	(6.5)	50 min.
	AFFF	0.10	(4.1)	30 min.		0.16	(6.5)	50 min.
Hydrocarbon								
Flash point below 100 °F (38 °C) or liquid heated above flash point	Protein	0.10	(4.1)	55 min.		0.16	(6.5)	65 min.
	Fluoroprotein	0.10	(4.1)	55 min.		0.16	(6.5)	65 min.
	AFFF	0.10	(4.1)	55 min.		0.16	(6.5)	65 min.
Crude Petroleum	Protein	0.10	(4.1)	55 min.		0.16	(6.5)	65 min.
	Fluoroprotein	0.10	(4.1)	55 min.		0.16	(6.5)	65 min.
	AFFF	0.10	(4.1)	55 min.		0.16	(6.5)	65 min.
Alcohols								
Methanol	3X3 L.V.	0.10		55 min.		0.16*	(6.5)*	65 min.*
Ethanol	3X3 L.V.	0.10		55 min.		0.16*	(6.5)*	65 min.*
Isopropanol	3X3 L.V.	0.15	(6.1)	55 min.		0.24*		65 min.*
Ketones								
Methyl Ethyl Ketone	3X3 L.V.	0.15	(6.1)	55 min.		0.24*		65 min.*
Acetone	3X3 L.V.	0.15	(6.1)	55 min.		0.24*	(9.8)*	65 min.*
Carboxylic Acids	3X3 L.V.	0.10	(4.1)	55 min.		0.16*	(6.5)*	65 min.*
Aldehydes	3X3 L.V.	0.16	(6.5)	55 min.		0.26*		65 min.*
Esters	3X3 L.V.	0.10	(4.1)	55 min.		0.16*	(6.5)*	65 min.*
Ethers	3X3 L.V.	0.14		55 min.		0.23*		65 min.*

TABLE 5B-3

*Application rates shown for direct application (Type III) of foam to Polar Solvent fuels that are fuel in-depth (exceed 1 inch depth) are for reference only. The recommended application technique for Polar Solvent fuels (in-depth) is to provide a means to apply foam gently to the fuel surface as with Type II devices. Application rates shown are 60% higher than the Type II rates listed and are usually sufficient to pass fire tests per UL 162. As implied, this is not considered comprehensive fire protection for this type of application of foam to in-depth Polar Solvent fuels.

SURFACE APPLICATION (Continued)

Calculating Primary Foam Quantity (Cone Roof Tanks)

First, use the following formula to determine Foam Solution Discharge Rate which is required to determine proportioner size:

FOAM SOLUTION DISCHARGE RATE = SURFACE AREA X APPLICATION RATE

Now, calculate the foam quantity using the following formula:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X DISCHARGE TIME X CONCENTRATE %*

*Concentrate % is expressed as: .01 for 1% concentrates
.03 for 3% concentrates
.06 for 6% concentrates

Determining Number of Foam Chambers (Cone Roof Tanks)

If foam chambers are selected as primary protection, the number of foam chambers required depends on tank diameter as shown in Table 5B-4.

Tank Diameter ft.	(m)	Minimum Number of Foam Chambers
Up to 80	(24)	1
Over 80 to 120	(24 – 36)	2
Over 120 to 140	(36 – 42)	3
Over 140 to 160	(42 – 48)	4
Over 160 to 180	(48 – 54)	5
Over 180 to 200	(54 – 60)	6
Over 200	(60)	One chamber for each additional 5000 ft^2 (465 m^2)

TABLE 5B-4

Determining Number of Monitor/Hose Lines for Primary Protection (Cone Roof Tanks)

If monitors/hose lines are selected as primary protection, the number required must be adequate to provide the required application rate for those devices. Additional devices may be added to accommodate normal wind direction or obstructions that may affect stream pattern and coverage.

EXAMPLE SYSTEM – SURFACE APPLICATION – CONE ROOF TANK

Hazard Specifications

Type of Tank . . . . Fixed Cone Roof

Height . . . . 40 ft (12.2 m)

Diameter . . . . 100 ft (30 m)

Contents . . . . Fuel Oil No. 4

System Design

Following the flow chart on Page 5B-9, the system is determined as follows:

1. CLASSIFY FUEL (SEE SECTION 5A)

Fuel Oil No. 4, Class III Fuel, Flashpoint: 142-240 °F (61-116 °C), Not Water Soluble

Agent Chosen: 3% Fluoroprotein

2. CALCULATE SURFACE AREA (PAGE 5B-10)

SURFACE AREA = πr^2

SURFACE AREA = 3.14 (50 ft)^2

SURFACE AREA = 7850 ft^2 (729 m^2)

3. DETERMINE TYPE OF DISCHARGE DEVICES (PAGE 5B-10)

It is determined that foam chambers are required as tank specifications do not allow monitors or handline nozzles as primary protection.

4. DETERMINE DISCHARGE TIME AND APPLICATION RATE (PAGE 5B-11)

Because the fuel flashpoint is above 100 °F (38 °C), it is determined from Table 5B-3 that the Application Rate is 0.10 gpm/ft^2 (4.1 Lpm/m^2) and the Discharge Time is 30 minutes.

5. CALCULATE PRIMARY FOAM QUANTITY (PAGE 5B-12)

First, determine the Foam Solution Discharge Rate:

FOAM SOLUTION DISCHARGE RATE = SURFACE AREA X APPL. RATE

FOAM SOLUTION DISCHARGE RATE = 7850 ft^2 X 0.10 gpm/ft^2

FOAM SOLUTION DISCHARGE RATE = 785 gpm (2971 Lpm)

Then, determine the foam concentrate quantity:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X DISCHARGE TIME X CONC. %

QUANTITY = 785 gpm X 30 minutes X 0.03 (3% Fluoroprotein)

QUANTITY = 707 gal (2676 L)

6. DETERMINE SUPPLEMENTARY HOSE LINES AND DISCHARGE TIMES (PAGE 5B-17)

It is determined that a 100 ft (30 m) diameter tank requires two, 50 gpm (189 Lpm), hose lines with a discharge time of 30 minutes.

7. CALCULATE SUPPLEMENTARY FOAM QUANTITY (PAGE 5B-17)

QUANTITY = NO. OF HOSE LINES X 50 GPM X DISCHARGE TIME X CONC. %

QUANTITY = 2 hose lines x 50 gpm x 30 minutes x 0.03 (3% Fluoroprotein)

QUANTITY = 90 gal (341 l)

8. CALCULATE TOTAL FOAM QUANTITY (PRIMARY + SUPPLEMENTARY)

Primary . . . . 707 gal

Supplementary . . . . 90 gal

Total Foam Quantity . . . . . 797 gal (3017 L) 3% Fluoroprotein Concentrate

9. DETERMINE NUMBER OF DISCHARGE DEVICES

Because the tank diameter is 100 ft (30 m), it is determined that two foam chambers are required.

Each foam chamber must deliver 393 gpm (1488 Lpm) of foam solution. This is determined by dividing the Foam Solution Discharge Rate (785 gpm) by the Number of Foam Chambers (2).

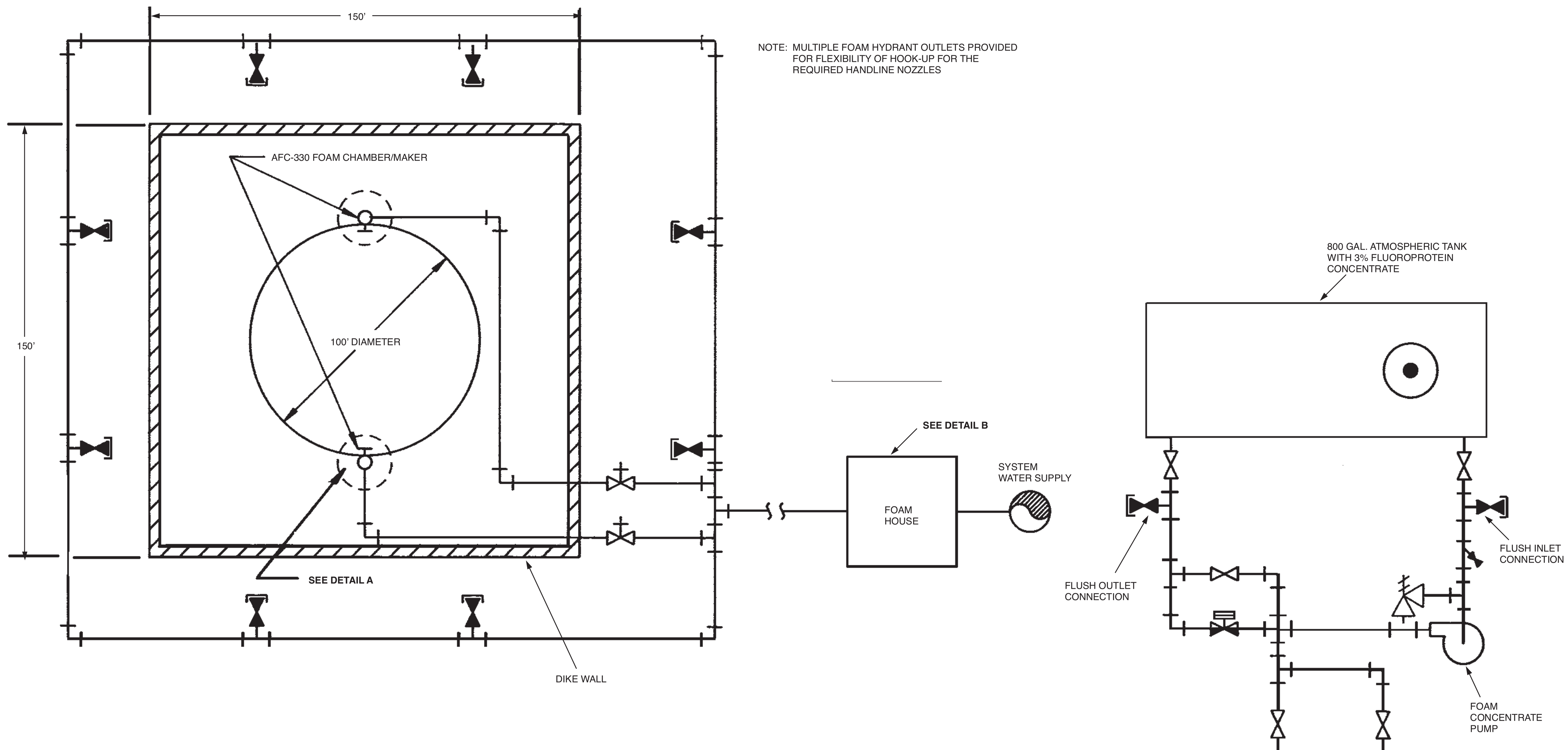
10. COMPILE BILL OF MATERIALS

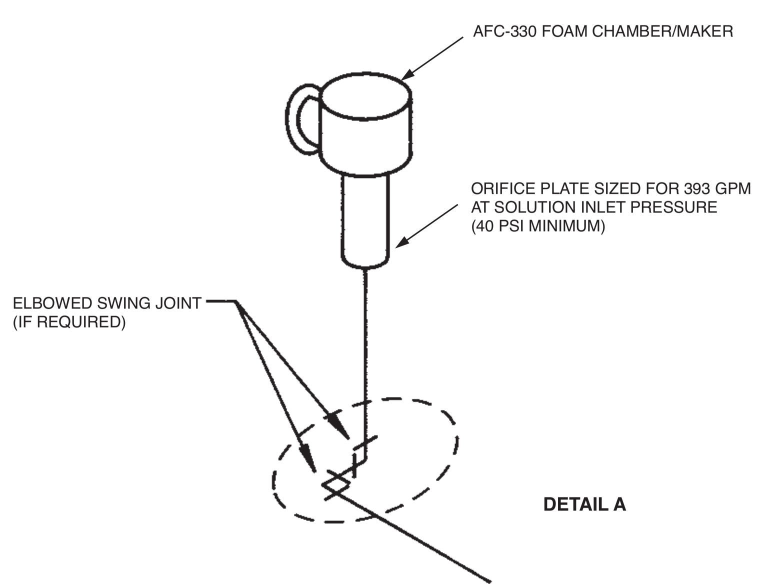
NOTICE

This is an example only. Selection of agent and proportioning equipment will vary with each application. For detection and control system recommendations, consult Ansul Incorporated.

Quantity	Description
1	800 Gallon Atmospheric Storage Tank
1	Balanced Pressure Pump Proportioning System, BPS-4
2	Foam Chamber, AFC-330
2	Handline Nozzle, 50 gpm (189 Lpm)
800 gal	ANSUL 3% Fluoroprotein Concentrate
As Required	Test Foam, ANSUL 3% Fluoroprotein Concentrate

EXAMPLE SYSTEM – SURFACE PROTECTION – CONE ROOF TANK (Continued)





DETAIL A

001293

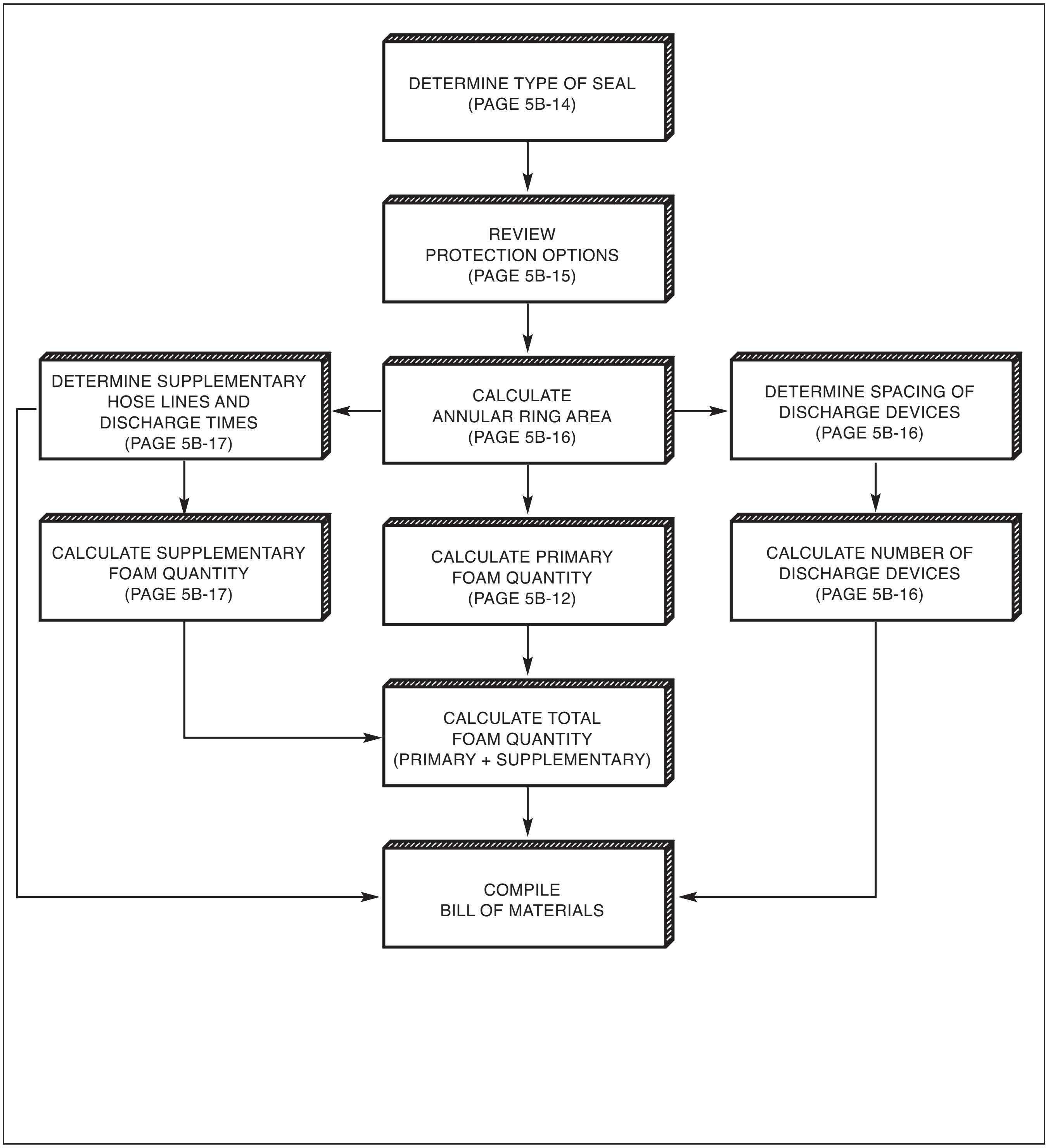
SECTION 5B **STORAGE TANK PROTECTION**
EXAMPLE SYSTEM – SURFACE APPLICATION – CONE ROOF TANK
SHEET 2 OF 2

Storage Tank Protection

SURFACE APPLICATION (Continued)

Floating Roof Surface Application Flow Chart

The following flow chart defines a logical sequence for designing floating tank application systems.



Storage Tank Protection

SURFACE APPLICATION (Continued)

Determining Type of Seal (Floating Roof Tanks)

There are two general types of ring seals according to NFPA 11:

– Pantograph (Mechanical Shoe) Seal

– Tube Seals

A **pantograph** type floating roof typically contains a fabric seal that is anchored to the top of the roof and rides on the inside of the tank wall. A pantograph or mechanical shoe system is attached below the fabric seal to keep the roof aligned within the tank. See Figure 5B-6.

PANTOGRAPH SEAL

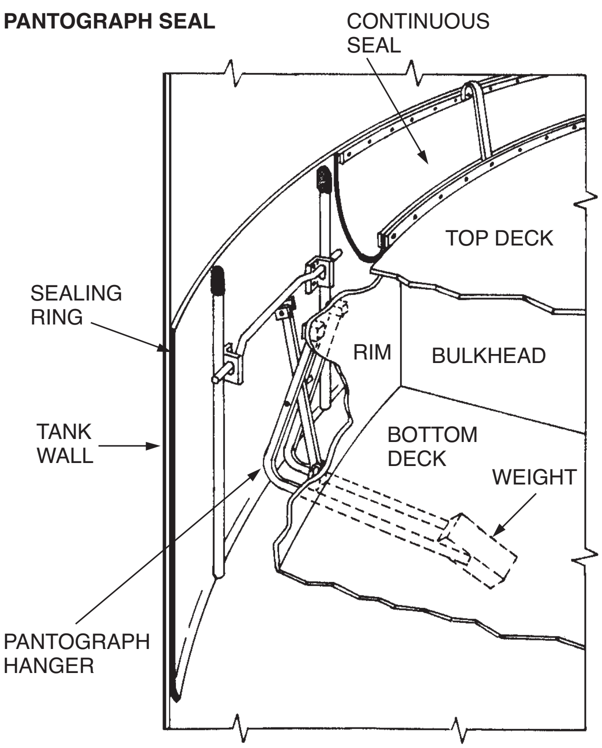


FIGURE 5B-6
001296

Tube seals are typically constructed of a urethane foam contained within a durable envelope. The seal is connected to the edge of the floating roof around the entire circumference of the tank. A weather shield or secondary seal is installed above the tube seal. See Figure 5B-7.

TUBE SEAL

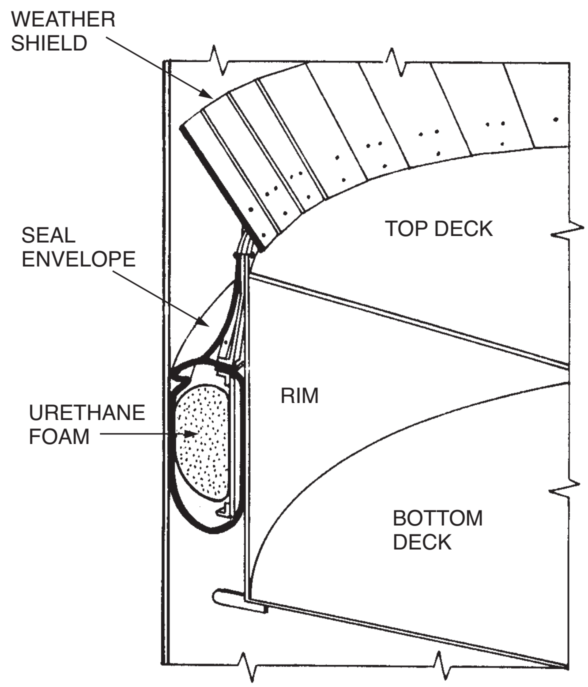


FIGURE 5B-7
001295

SURFACE APPLICATION (Continued)

Protection Options (Floating Roof Tanks)

There are two protection options for floating roof tank systems:

– Top of Seal Protection

– Below Seal Protection

Top of seal protection uses either floating roof foam makers or foam chambers connected to the tank shell above the seal. When this type of protection is used, a foam dam is required to contain the foam in the seal area. (See Figure 5B-8 and Table 5B-5.) The foam dam is typically 12 or 24 in. (30 or 60 cm) high.

Below seal protection is accomplished using a floating roof foam maker mounted on the floating roof. Pipe is run from the foam maker and is injected through the fabric seal, secondary seal or weather shield. (See Figure 5B-9.) A foam dam may be required depending on the seal arrangement. (Refer to Table 5B-5.) Because the foam maker is mounted on the floating roof, a special catenary distribution network is required. (Contact Ansul for catenary system requirements.)

Type of Seal of Seal	Top of Seal Protection	Below Seal Protection
Pantograph	Floating roof foam makers or foam chambers. Foam dam required.	Floating roof foam makers. Foam dam **not** required.
Tube seal (top of seal **more** than 6 in. (15 cm) from top of roof deck)	Floating roof foam makers or foam chambers. Foam dam required.	Floating roof foam makers. Foam dam **not** required.
Tube seal (top of seal **less** than 6 in. (15 cm) from top of roof deck)	Floating roof foam makers or foam chambers. Foam dam required.	Floating roof foam makers. Foam dam required.

TABLE 5B-5

TYPICAL TOP OF SEAL SYSTEM

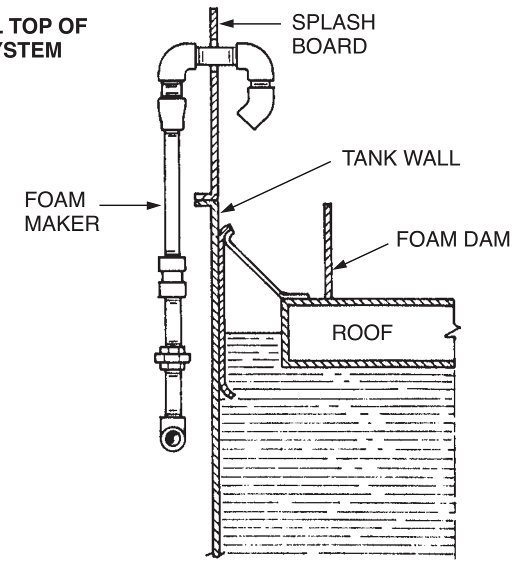


FIGURE 5B-8
001297

TYPICAL BELOW SEAL SYSTEM

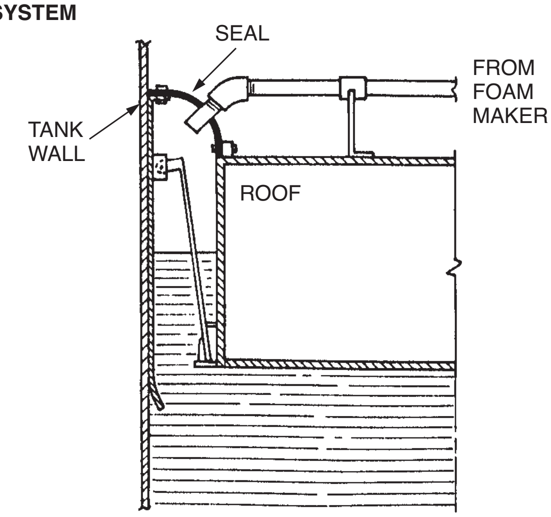


FIGURE 5B-9
001298

Storage Tank Protection

SURFACE APPLICATION (Continued)

Calculating Annular Ring Area (Floating Roof Tanks)

For tanks with foam dams, the annular ring is the area between the foam dam and the tank wall. For tanks without foam dams, the annular ring is the area between the tank wall and the inside base of the secondary seal. It is calculated by subtracting the unprotected roof area from the total surface area of the tank as follows:

$$\text{ANNULAR RING AREA} = \underset{(\pi r^2)}{\text{TOTAL SURFACE AREA}} - \underset{(\pi r^2)}{\text{UNPROTECTED ROOF AREA}}$$

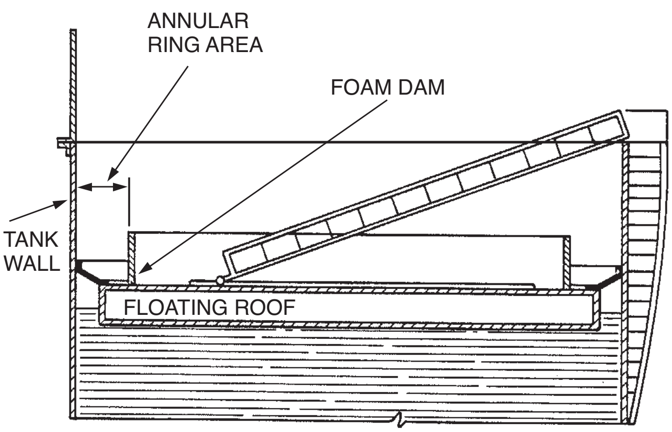


FIGURE 5B-10
001299

Calculating Primary Foam Quantity (Floating Roof Tanks)

Top of seal protection requires a discharge time of 20 minutes and an application rate of 0.30 gpm/ft^2 (12.2 Lpm/m^2). Below seal protection requires a discharge time of 10 minutes and an application rate of 0.50 gpm/ft.^{2} (20.1 Lpm/m^2). Using these requirements, the primary foam quantity is calculated.

First, use the following formula to determine Foam Solution Discharge Rate which is required to determine proportioner size:

FOAM SOLUTION DISCHARGE RATE = ANNULAR RING AREA X APPLICATION RATE

Now, calculate the foam concentrate quantity using the following formula:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X DISCHARGE TIME X CONCENTRATE %*

*Concentrate % is expressed as: .01 for 1% concentrates
.03 for 3% concentrates
.06 for 6% concentrates

Determining Spacing of Discharge Devices (Floating Roof Tanks)

The spacing between floating roof foam makers or foam chambers for top of seal protection is based on the height of the foam dam; below seal protection is based on the type of seal. See Table 5B-6.

	Height of		Maximum Discharge Device Spacing			
	Foam Dam		Top of Seal		Below Seal	
Type of Seal	in	(cm)	ft	(m)	ft	(m)
Pantograph	No Dam		–	–	130	(39.6)
	12	(30)	40	(12.2)	–	–
	24	(60)	80	(24.4)	–	–
Tube Seal (top of seal **more** than 6 in. (15 cm) from top of roof deck)	No Dam		–	–	60	(18.3)
	12	(30)	40	(12.2)	–	–
	24	(60)	80	(24.4)	–	–
Tube Seal (top of seal **less** than 6 in. (15 cm) from top of roof deck)	12	(30)	40	(12.2)	60	(18.3)
	24	(60)	80	(24.4)	60	(18.3)

TABLE 5B-6

Calculating Number of Discharge Devices (Floating Roof Tanks)

The number of discharge devices is determined as follows:

$$\text{NUMBER OF DISCHARGE DEVICES} = \frac{\text{CIRCUMFERENCE OF TANK } (\pi d)}{\text{MAX. SPACING BETWEEN DEVICES}}$$

Storage Tank Protection

Supplementary Storage Tank Protection

Determining Supplementary Hose Lines and Discharge Times

In addition to the primary protection system, a minimum number of foam hose lines are required as protection for small spill fires. This supplementary protection may be either fixed or portable hose lines with a minimum flow rate of 50 gpm (189 Lpm) per nozzle.

Minimum number of hose streams and their discharge times (as they relate to tank size) are as shown in Table 5B-7.

Tank Diameter ft	(m)	Minimum Number of Hose Lines	Minimum Discharge Time
Up to 35	(Up to 11)	1	10 min.
35-65	(11-20)	1	20 min.
65-95	(20-29)	2	20 min.
95-120	(29-37)	2	30 min.
Over 120	(Over 37)	3	30 min.

TABLE 5B-7

Calculating Supplementary Foam Quantity

Minimum discharge times are based on simultaneous operation of the minimum number of hose lines required.

To calculate the quantity of foam concentrate required for supplementary protection, use the following formula. Foam hose streams can be incorporated into the primary system or can be set up as a separate self-contained system.

QUANTITY = NUMBER OF HOSE LINES X 50 GPM X DISCHARGE TIME X CONCENTRATE %*

*Concentrate % is expressed as: .01 for 1% concentrates
.03 for 3% concentrates
.06 for 6% concentrates

EXAMPLE SYSTEM – SURFACE APPLICATION – FLOATING ROOF TANK

Hazard Specifications

Type of Tank . . . . Open Floating Roof

Type of Seal . . . . Tube
Less than 6 in. (15 cm) from top of tube to top of roof

Height . . . . 40 ft (12.2 m)

Diameter . . . . 80 ft (24.4 m)

Contents . . . . Jet Fuel (JP4)

System Design

Following the flow chart, the system is determined as follows:

1. DETERMINE TYPE OF SEAL
(PAGE 5B-14)

Urethane foam tube seal.

2. REVIEW
PROTECTION OPTIONS
(PAGE 5B-15)

Because the top of the seal is less than 6 in. (15 cm) from the top of the floating roof, a foam dam and floating roof foam maker are to be used. The foam dam will be 1 ft (0.3 m) high and constructed 2 ft (0.6 m) from the edge of the roof.

3. CALCULATE
ANNULAR RING AREA
(PAGE 5B-16)

This is the area between the foam dam and the tank wall.

ANNULAR RING AREA = TOTAL SURFACE AREA (π r^2) – UNPROTECTED ROOF AREA (π r^2)

ANNULAR RING AREA = 5027 ft^2 – 4536 ft^2

ANNULAR RING AREA = 491 ft^2 (46 m^2)

4. CALCULATE PRIMARY
FOAM QUANTITY
(PAGE 5B-12)

Top of Seal application is being used; therefore, the Discharge Time is 20 minutes and the Application Rate is 0.30 gpm/ft^2 (12.2 Lpm/m^2).

First, determine the Foam Solution Discharge Rate:

FOAM SOLUTION DISCHARGE RATE = ANNULAR RING AREA X APPL. RATE

FOAM SOLUTION DISCHARGE RATE = 491 ft^2 X 0.30 gpm/ft^2

FOAM SOLUTION DISCHARGE RATE = 148 gpm (560 Lpm)

Then, determine the foam concentrate quantity:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X DISCHARGE TIME X CONC. %

QUANTITY = 148 gpm X 20 minutes X 0.03 (3% AFFF)

QUANTITY = 89 gal (2676 L)

5. DETERMINE SUPPLEMENTARY
HOSE LINES AND DISCHARGE
TIMES (PAGE 5B-17)

It is determined that an 80 ft (24.4 m) diameter tank requires two, 50 gpm (189 Lpm), hose lines with a discharge time of 20 minutes.

6. CALCULATE SUPPLEMENTARY
FOAM QUANTITY
(PAGE 5B-17)

QUANTITY = NO. OF HOSE LINES X 50 GPM X DISCHARGE TIME X CONC. %

QUANTITY = 2 hose lines x 50 gpm x 20 minutes x 0.03 (3% AFFF)

QUANTITY = 60 gal (227 l)

7. CALCULATE TOTAL
FOAM QUANTITY
(PRIMARY + SUPPLEMENTARY)

Primary . . . . 89 gal

Supplementary . . . . 60 gal

Total Foam Quantity . . . . . 149 gal (564 L) AFFF 3% Foam Concentrate

8. DETERMINE SPACING OF
DISCHARGE DEVICES
(PAGE 5B-16)

The foam dam is 12 in. (30 cm) high and the top of the seal is less than 6 in. (15 cm) from the top of the floating roof. Therefore, for Top of Seal protection, the maximum spacing between discharge devices is 40 ft (12.2 m).

9. CALCULATE NUMBER OF
DISCHARGE DEVICES
(PAGE 5B-16)

NUMBER OF DISCHARGE DEVICES = $\frac{\text{CIRCUMFERENCE OF TANK } (\pi \text{ d})}{\text{MAXIMUM SPACING BETWEEN DEVICES}}$

NUMBER OF DISCHARGE DEVICES = $\frac{251 \text{ ft}}{40 \text{ ft}}$

NUMBER OF DISCHARGE DEVICES = 6.28 or 7

Therefore, because the Foam Solution Discharge Rate is 148 gpm (560 Lpm), each device must deliver a minimum of 21.2 gpm (80 Lpm).

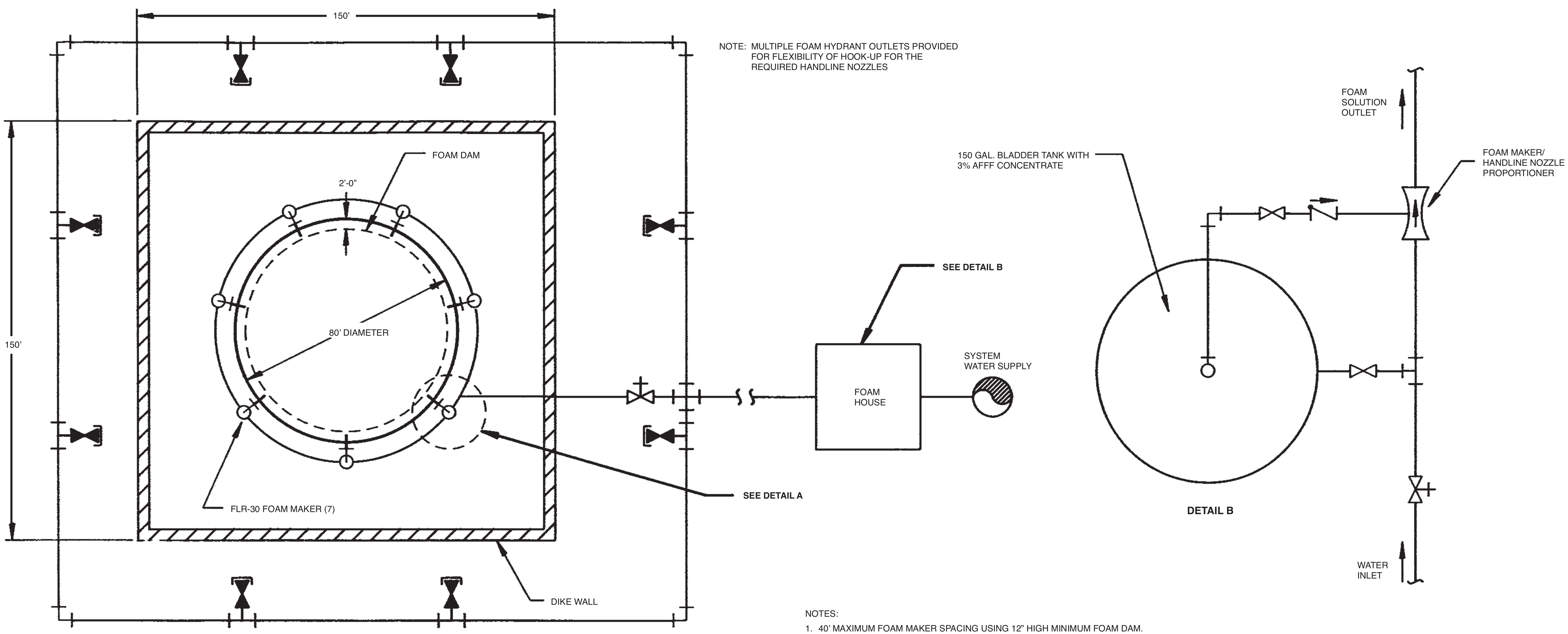
10. COMPILE
BILL OF MATERIALS

NOTICE

This is an example only. Selection of agent and proportioning equipment will vary with each application. For detection and control system recommendations, consult Ansul Incorporated.

Quantity	Description
1	150 Gallon Bladder Tank
1	Proportioner, Sized for 50-248 gpm (189-939 Lpm) – Total System
7	Floating Roof Foam Maker, FLR-30
2	Handline Nozzle, 50 gpm (189 Lpm)
150 gal	ANSULITE AFFF 3% Concentrate
As Required	Test Foam, ANSULITE AFFF 3% Concentrate

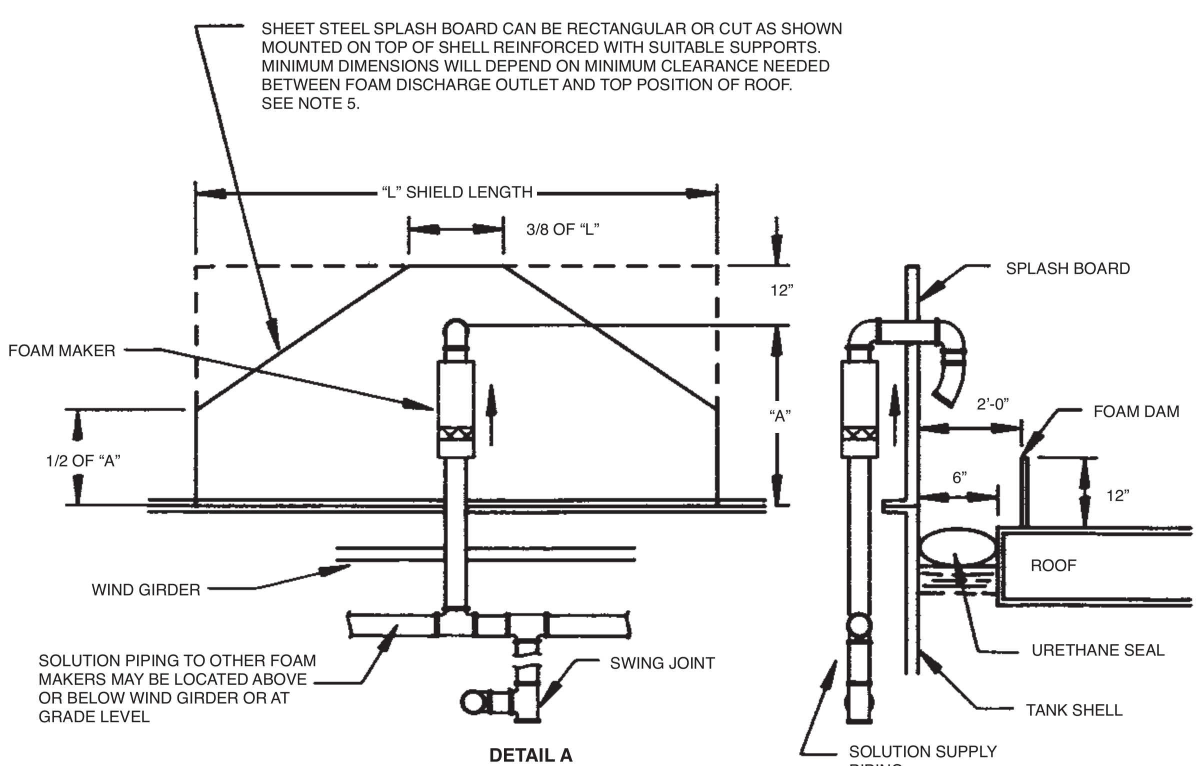
EXAMPLE SYSTEM – SURFACE APPLICATION – FLOATING ROOF TANK (Continued)



NOTES:

1. 40' MAXIMUM FOAM MAKER SPACING USING 12" HIGH MINIMUM FOAM DAM.
2. 80' MAXIMUM FOAM MAKER SPACING USING 24" HIGH MINIMUM FOAM DAM.
3. VAPOR SEALS NOT REQUIRED ON OPEN FLOATING ROOF APPLICATION.
4. FOAM DISCHARGE OUTLET PIPING AND FITTINGS SHOULD BE UPSIZED TO 2 1/2" FOR FLR-30 FOAM MAKER. 4" FOR FLR-90 FOAM MAKER.
5. "A" DIMENSION IS THE HEIGHT OF THE FOAM DISCHARGE OUTLET ABOVE THE TOP EDGE OF TANK SHELL. THE MINIMUM HEIGHT MUST CLEAR THE TOP POSITION OF THE FLOATING ROOF.

"A" DIMENSION	"L" DIMENSION
2'-0"	10'-0"
3'-0"	12'-0"
4'-0"	14'-0"



DETAIL A

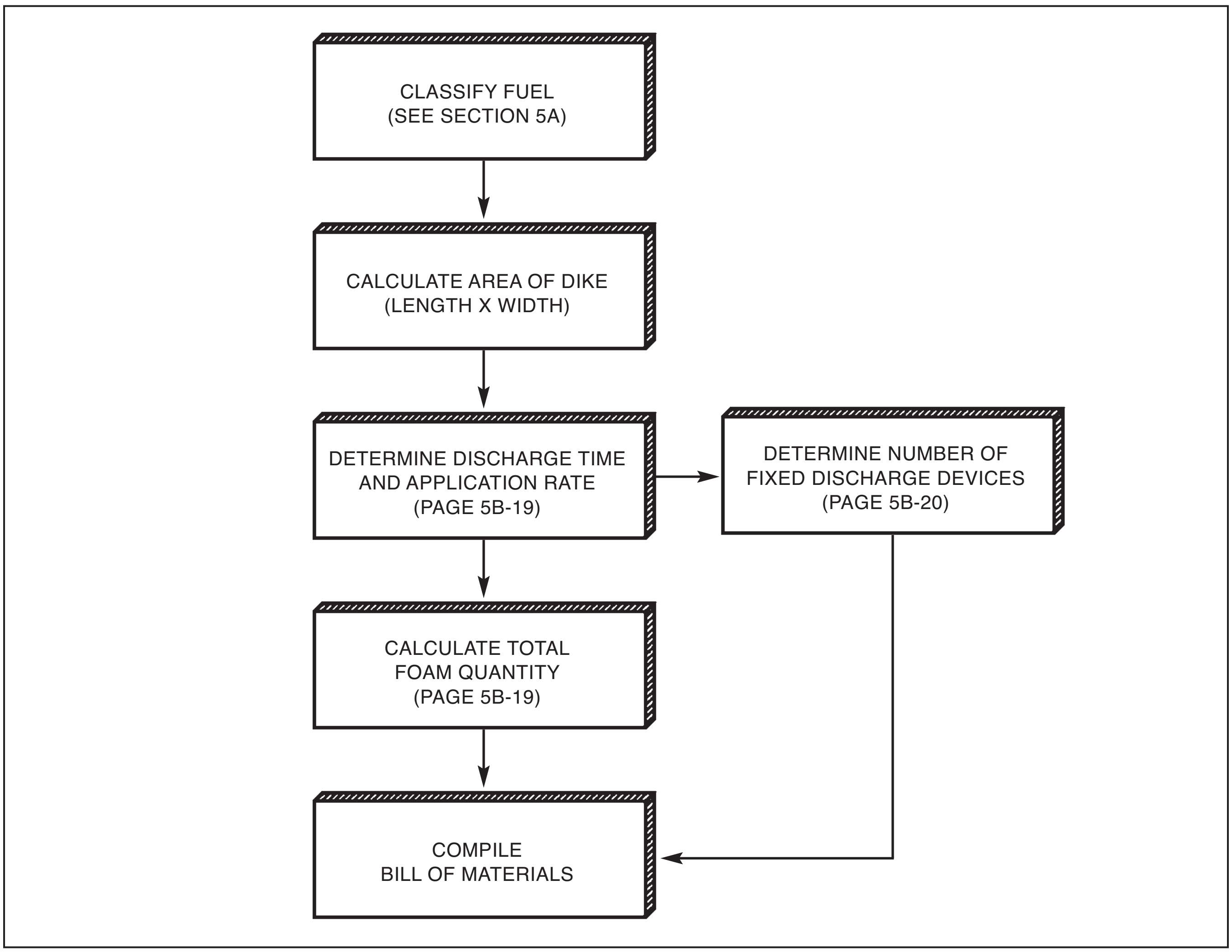
001300

Storage Tank Protection

DIKE PROTECTION

Some flammable liquid storage facilities consist of a number of small tanks within a common diked area. The diked area, rather than the individual storage tanks, may be considered the hazard to be protected and a fixed system using monitors or floating roof foam makers is required.

DIKE APPLICATION FLOW CHART



Storage Tank Protection

DIKE PROTECTION (Continued)

Determining Discharge Time and Application Rate (Fixed Discharge Devices)

Discharge time and application rate are determined according to the type of fuel contained in the storage tank being ▸ protected.

Fuel Protected	Foam Concentrate	Application Rate gpm/ft^2	Application Rate (Lpm/m^2)	Discharge Time
Hydrocarbon	Protein	0.10	(4.1)	20 minutes
Flash point between 100 °F and	Fluoroprotein	0.10	(4.1)	20 minutes
200 °F (38 °C & 93 °C)	AFFF	0.10	(4.1)	20 minutes
Hydrocarbon	Protein	0.10	(4.1)	30 minutes
Flash point below 100 °F (38 °C)	Fluoroprotein	0.10	(4.1)	30 minutes
or liquid heated above flash point	AFFF	0.10	(4.1)	30 minutes
Alcohols				
Methanol	ARC	0.10		30 minutes
	3X3 L.V.	0.10		30 minutes
Ethanol	ARC	0.10		30 minutes
	3X3 L.V.	0.10		30 minutes
Isopropanol	ARC	0.15		30 minutes
	3X3 L.V.	0.15	(6.1)	30 minutes
Ketones				
Methyl Ethyl Ketone	ARC	0.15		30 minutes
	3X3 L.V.	0.10		30 minutes
Acetone	ARC	0.15		30 minutes
	3X3 L.V.	0.15	(6.1)	30 minutes
Carboxylic Acids	ARC	0.17	(6.9)	30 minutes
	3X3 L.V.	0.10	(4.1)	30 minutes
▸ Aldehydes	ARC	0.17	(5.3)	30 minutes
	3X3 L.V.	0.16	(6.5)	30 minutes
Esters	ARC	0.10	(4.1)	30 minutes
	3X3 L.V.	0.10	(4.1)	30 minutes
Ethers	ARC	0.17	(6.9)	30 minutes
(Ethyl Tertiary Butyl Ether)	3X3 L.V.	0.14		30 minutes

TABLE 5B-8

▸ Consult 3x3 L.V. or ARC data sheets for other specific fuels.

Calculating Total Foam Quantity

First, use the following formula to determine Foam Solution Discharge Rate which is required to determine proportioner size:

FOAM SOLUTION DISCHARGE RATE = DIKE AREA X APPLICATION RATE

Now, calculate the foam concentrate quantity using the following formula:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X DISCHARGE TIME X CONCENTRATE %*

*Concentrate % is expressed as: .01 for 1% concentrates
.03 for 3% concentrates
.06 for 6% concentrates

Storage Tank Protection

DIKE PROTECTION (Continued)

Determining Number of Fixed Discharge Devices

If monitors are used, a minimum of two is recommended. This will allow for overlapping spray patterns which helps to ensure complete coverage of the area protected. Additional monitors may be required to accommodate normal wind direction or obstructions that may affect stream pattern and coverage.

When floating roof foam makers are used, the maximum recommended spacing between discharge outlets is 30 ft (9.1 m) at 60 gpm (227.1 Lpm) flow or less. For flows that exceed 60 gpm (227.1 Lpm), spacing may be increased to a maximum of 60 ft (18.3 m).

EXAMPLE SYSTEM – DIKE PROTECTION

Hazard Specifications

Dike Dimensions. . . . . 80 x 60 ft (24.4 x 18.3 m)

Tanks . . . . Two Tanks – 15 ft (4.6 m) Diameter – Contain Isopropanol
One Tank – 25 ft (7.6 m) Diameter – Contains Fuel Oil No. 6

System Design

Following the flow chart on Page 5B-18, the system is determined as follows:

1. CLASSIFY FUEL (SEE SECTION 5A)

Two of the tanks contain Isopropanol; therefore, an alcohol-resistant concentrate is required. ANSULITE 3X3 concentrate is also suitable for use on Fuel Oil. Per Data Sheet (Form No. F-8920), 3% proportioning is required.

2. CALCULATE AREA OF DIKE (LENGTH X WIDTH)

NOTICE: Tank diameter cannot be deducted from area of dike.

AREA OF DIKE = LENGTH X WIDTH

AREA OF DIKE = 80 ft X 60 ft.

AREA OF DIKE = 4800 ft ^{2} (446 m^2)

3. DETERMINE DISCHARGE TIME AND APPLICATION RATE (PAGE 5B-19)

Reference to Table 5B-8 determines that use of ANSULITE 3X3 concentrate with an alcohol fuel requires a Discharge Time of 30 minutes with an Application Rate of 0.15 gpm/ft^2 (6.1 Lpm/m^2).

4. CALCULATE TOTAL FOAM QUANTITY (PAGE 5B-19)

First, determine the Foam Solution Discharge Rate:

FOAM SOLUTION DISCHARGE RATE = DIKE AREA X APPL. RATE

FOAM SOLUTION DISCHARGE RATE = 4800 ft^2 X 0.15 gpm/ft^2

FOAM SOLUTION DISCHARGE RATE = 720 gpm (2725 Lpm)

Then, determine the foam concentrate quantity:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X DISCHARGE TIME X CONC. %

QUANTITY = 720 gpm X 30 minutes X 0.03 (3X3)

QUANTITY = 648 gal (2453 L)

5. DETERMINE NUMBER OF FIXED DISCHARGE DEVICES (PAGE 5B-20)

The customer has requested fixed foam makers. Therefore, referring to Page 5B-25, it is determined that 10 floating roof foam makers are required based on a maximum spacing of 30 ft (9.1 m).

6. COMPILE BILL OF MATERIALS

NOTICE

This is an example only. Selection of agent and proportioning equipment will vary with each application. For detection and control system recommendations, consult Ansul Incorporated.

Quantity	Description
1	700 Gallon Atmospheric Storage Tank
2	Line Proportioner, PL-420, Sized for 360 gpm (1363 Lpm), Minimum Inlet Pressure: 114 psi (786 kPa)
10	Floating Roof Foam Maker, FLR-90
700 gal	ANSULITE 3X3 Foam Concentrate
As Required	Test Foam, ANSULITE 3X3 Foam Concentrate

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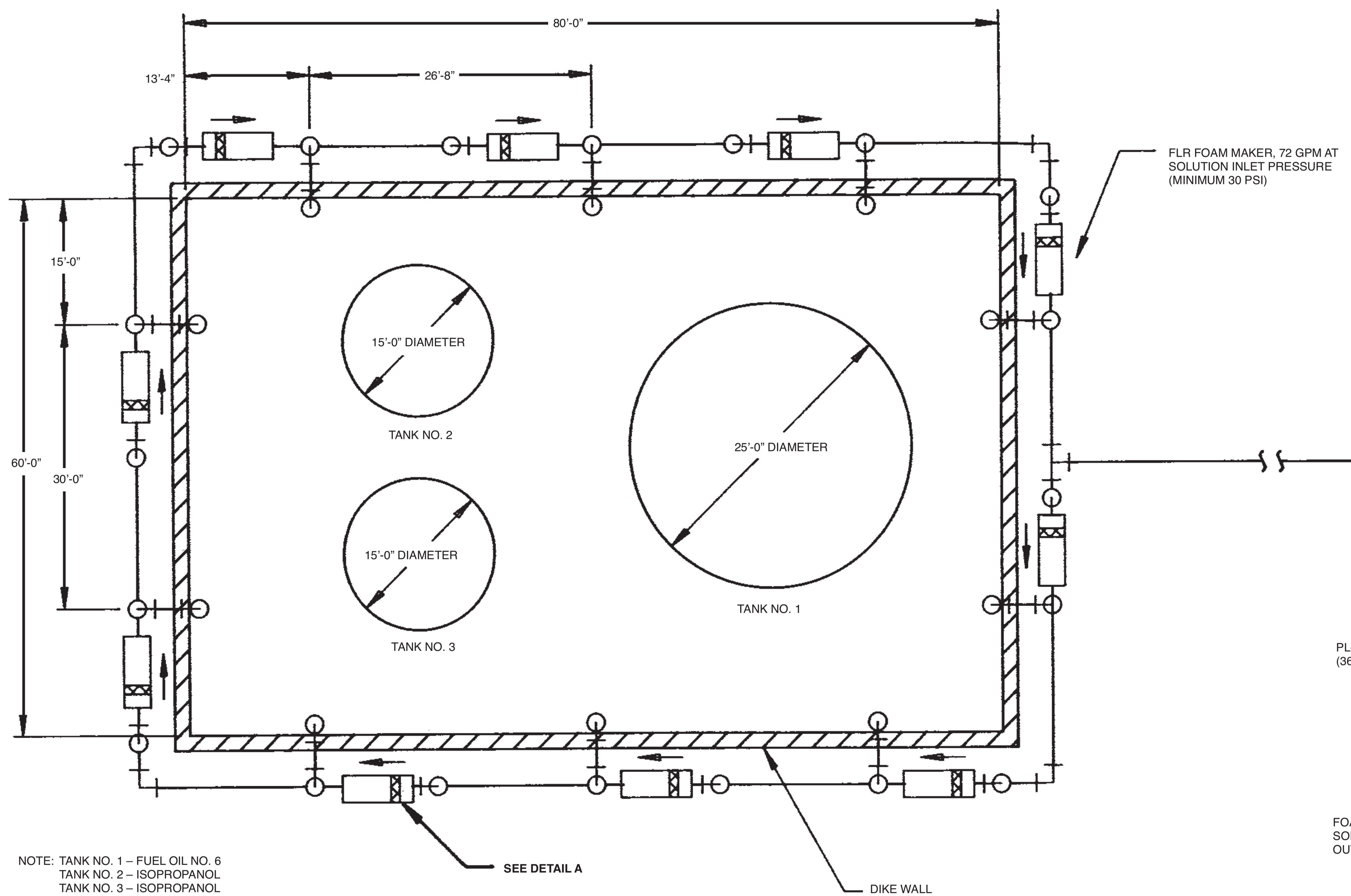
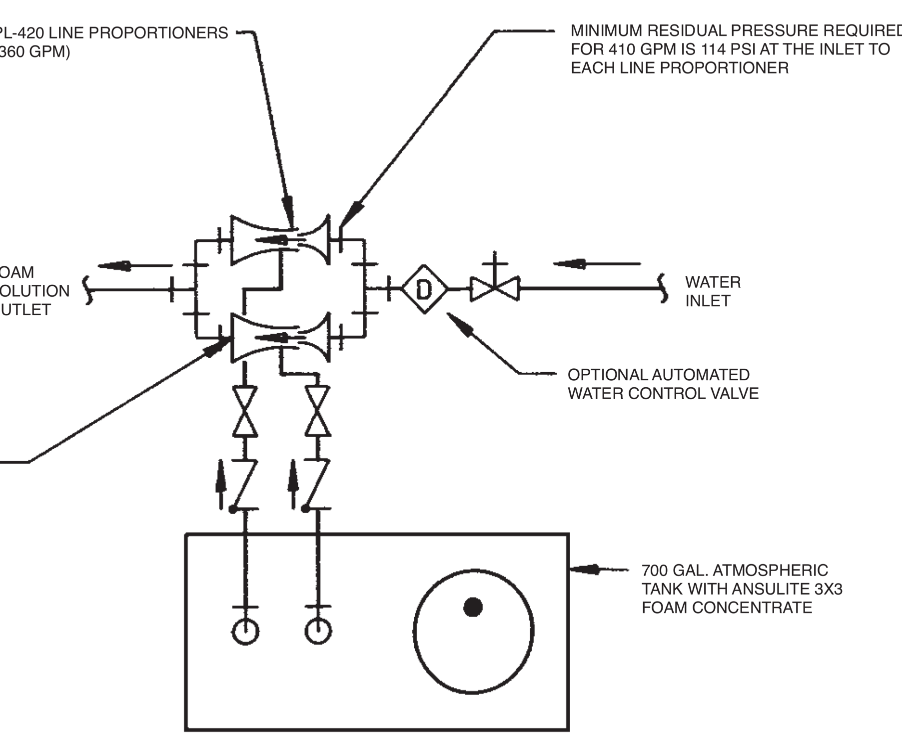
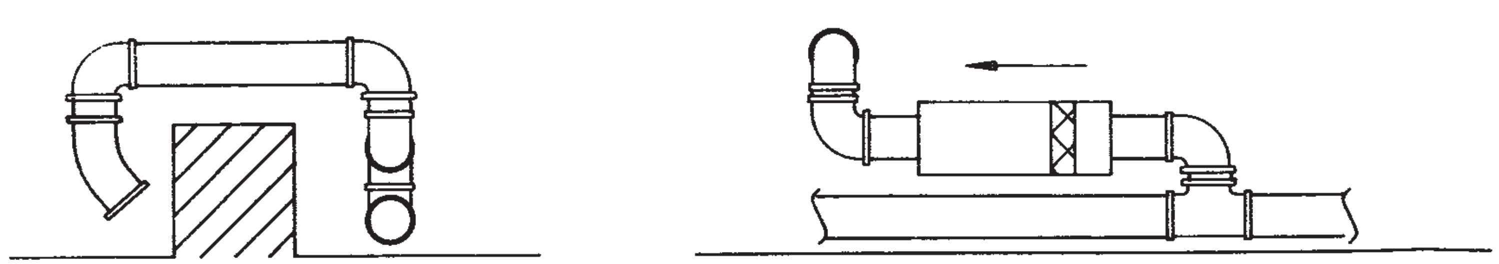
EXAMPLE SYSTEM – DIKE PROTECTION (Continued)





DETAIL B



DETAIL A

001302

PROTECTING AIRCRAFT

Many commercial and military aircraft hangars require fire protection to prevent the potential loss of housed aircraft often worth millions of dollars. Fixed foam fire protection offers improved protection for aircraft in comparison to earlier water deluge sprinkler systems that were designed primarily to protect the hangar structure. Variable factors that affect system design and component selection include hangar floor area, type of hangar construction, aircraft access door height, type and size of housed aircraft, aircraft quantity and parking arrangement, and floor drainage details. Additional information on aircraft hangar protection is covered in NFPA 409 “Standard on Aircraft Hangars.”

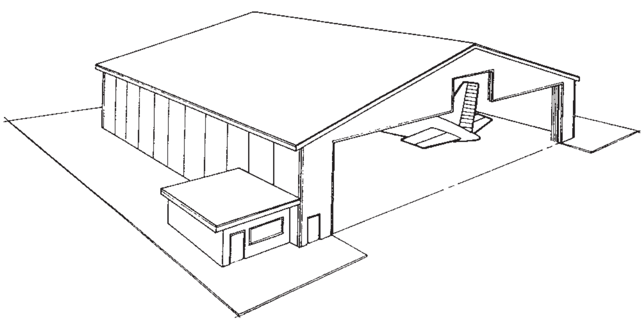
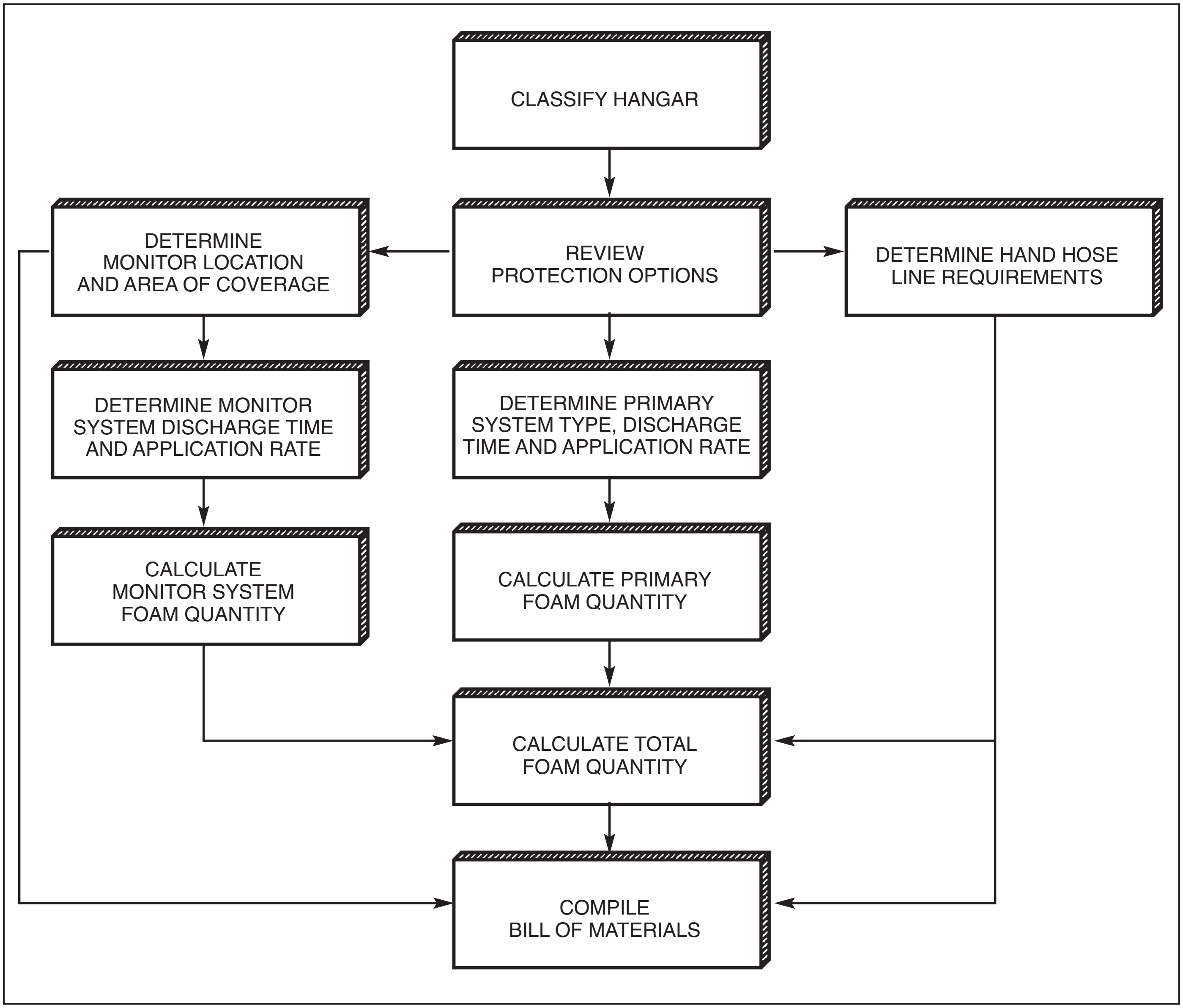


FIGURE 5C-1
000961

Aircraft Hangar Protection

AIRCRAFT HANGAR PROTECTION FLOW CHART

The following flow chart defines a logical sequence for designing aircraft hangar systems.



Aircraft Hangar Protection

CLASSIFICATION OF HANGARS

The classification or "group" of hangar must be determined in order to define the fire protection requirements. The following is a general outline of NFPA 409 which covers hangar grouping.

Group I: A hangar with at least one of the following conditions:

a. An aircraft access door height over 28 ft (8.5 m)

b. A single fire area in excess of 40,000 ft^2 (3716 m^2)

c. Housing an aircraft with a tail height over 28 ft (8.5 m)

d. Housing strategically important military aircraft as determined by the Department of Defense

Group II: A hangar with both of the following conditions:

a. An aircraft access door height of 28 ft (8.5 m) or less

b. A single fire area not larger than 40,000 ft^2 (3716 m^2), but equal to or greater than those specified in NFPA 409, Table 4.1.2 for specific types of construction

Group III: This hangar may be a freestanding individual unit for a single aircraft, a row hangar having a common structural wall and roof system and housing multiple aircraft as well as having door openings for each aircraft, or an open bay hangar capable of housing multiple aircraft, and having both of the following conditions:

a. An aircraft access door height of 28 ft (8.5 m) or less

b. A single fire area up to the maximum permitted for specific types of construction as defined in NFPA 409, Table 4.1.3

Group IV: This is a membrane-covered, ridged, steel frame structure.

PROTECTION OPTIONS

Once the aircraft hangar classification has been determined, fire protection requirements can be established.

There are four types of foam systems available for aircraft hangars:

— Primary Foam-Water Sprinkler Systems

— Foam Monitor Systems

— High-Expansion Foam Systems

— Foam-Water Hand Hose Line Systems

Primary foam-water sprinkler systems are normally deluge systems or preaction systems that require aspirated nozzles when protein or fluoroprotein foams are used; aspirated or nonaspirated sprinkler heads may be used with AFFF agents.

Monitor systems consist of oscillating monitors with aspirated nozzles for protein or fluoroprotein foams and either aspirated or nonaspirated nozzles for AFFF agents. Oscillating monitors are capable of being pre-adjusted for arc and rate of oscillation and are equipped with manual override. The number of monitors, location, flow rates, and nozzle stream performance must be capable of covering the areas as specified by the hangar "group" requirements.

High-expansion foam systems use a high-expansion generator to mix foam concentrate with air and water creating large volumes of foam for an effective foam blanket.

Foam-water hand hose line systems are designed to provide personnel a manual fire fighting capability.

Group I Hangar Protection

Three options are recommended for protecting Group I hangars:

Option 1: The hangar must contain an overhead foam-water deluge system as primary protection. When the hangar contains aircraft with wing areas exceeding 3000 ft^2 (279 m^2), the hangar must be provided with a monitor system. A monitor system is also recommended when the hangar stores several aircraft with wing areas less than 3000 ft^2 (279 m^2) each. The minimum design density for this monitor system is to cover the center fuselage and wing area at a density of 0.10 gpm/ft^2.

Option 2: The hangar must contain a water sprinkler system (wet pipe or pre-action) AND a foam monitor system. The water system is based on 0.17 gpm/ft^2 (6.9 Lpm/m^2) application rate over any 15,000 ft^2 (1394 m^2) area. The foam monitor system is based on covering the entire hangar floor area.

Option 3: The hangar must contain a water sprinkler system (wet pipe or pre-action) AND a high-expansion foam system. The water system is based on 0.17 gpm/ft^2 (6.9 Lpm/m^2) application rate over any 15,000 ft^2 (1394 m^2) area. The high-expansion foam system has a minimum application rate of 3 cfm/ft^2 (0.9 cmm/m^2) over the entire hangar floor area. See design requirements as shown on system calculation form.

Aircraft Hangar Protection

PROTECTION OPTIONS (Continued)

Group II Hangar Protection

Four options are recommended for protecting group II hangars:

Option 1: The hangar must contain an overhead foam-water deluge system as primary protection. When the hangar contains aircraft with wing areas exceeding 3000 ft^2 (279 m^2), the hangar must be provided with a monitor system. A monitor system is also recommended when the hangar stores several aircraft with wing areas less than 3000 ft^2 (279 m^2) each. The minimum design density for this monitor system is to cover the center fuselage and wing area at a density of 0.10 gpm/ft^2.

Option 2: The hangar must contain a water sprinkler system (wet pipe or pre-action) AND a foam monitor system. The water system is based on 0.17 gpm/ft^2 (6.9 Lpm/m^2) application rate over any 5000 ft^2 (465 m^2) area. The foam monitor system is based on covering the entire hangar floor area.

Option 3: The hangar must contain a water sprinkler system (wet pipe or pre-action) AND a high-expansion foam system. The water system is based on 0.17 gpm/ft^2 (6.9 Lpm/m^2) application rate over any 5000 ft^2 (465 m^2) area. The high-expansion foam system has a minimum application rate of 3 cfm/ft^2 (0.9 cmm/m^2) over the entire hangar floor area. See design requirements as shown on system calculation form.

Option 4: The hangar must contain a closed-head foam-water sprinkler system based on the same design requirements of Option 1.

Group III Hangar Protection

Foam protection is not usually required for Group III hangars. However, Group III hangars are to be protected as Group II hangars when hazardous operations (fuel transfer, welding, torch cutting and soldering, doping, spray painting) are performed. If Group III hangars exceed one story they shall be protected as Group II hangars.

Group IV Hangar Protection

Foam protection is not usually required for Group IV hangars. However, Group IV hangars having a fire area greater than 12,000 ft^2 housing fueled aircraft shall have a foam system in accordance with the following options.

Option 1: The hangar must contain a monitor system or low level discharge nozzles to cover the entire hangar floor area.

Option 2: The hangar must contain a high-expansion system to cover the entire hangar floor area. See design requirements as shown on system calculation form. **Note:** R_S may not be required.

*Overhead sprinklers are not required when a foam system is used. Foam systems are not required if the aircraft are unfueled, but a water only sprinkler system is required. With exceptions as modified above, these foam systems when required will be designed like a Group II Hangar.

All Deluge Systems

The maximum deluge zone size is 15,000 ft^2.

All zones within 100 ft radius of any point in protected area must be included in agent quantity calculation.

All Closed-Head Systems

The maximum closed-head zone size is 52,000 ft^2, exception 15,000 ft^2 if meeting closed-head requirements of option IV for Group II hangars.

All Systems

A directly-connected, equal reserve supply of concentrate in a separate, manually-operated tank is required by NFPA 409. However, the authority having jurisdiction may take exception if a supply of concentrate is available within 24 hours. (This does not pertain to Hand Hose Line Systems)

In addition to the previous fire protection, hand portable and wheeled extinguishers must be provided in all hangars in accordance with NFPA 10.

Aircraft Hangar Protection

DETERMINING PRIMARY SYSTEM DISCHARGE TIME AND APPLICATION RATE (AFFF SYSTEMS)

Primary protection using deluge systems requires a discharge time of 10 minutes for foam. For water supply times, refer to Table 5C-1. The required foam application rates are listed in Table 5C-2.

Hangar	Foam Fire Protection System Description	Foam Discharge Duration in Minutes	Water Supply in Duration Minutes
Group I	Deluge foam / water sprinkler	10	60
	Supplementary foam system	10	45
	Closed head water sprinkler with low level foam system	10 (AFFF) 12 (High-expansion)	45
	Hand hose reels	20	20
Group II	Closed head water sprinkler with low level foam system	10 (AFFF) 12 (High-expansion)	30
	Low-expansion foam system	10	At least twice foam discharge time
	High-expansion foam system	12	At least 24 minutes
	Closed head foam/ water sprinkler	10	30
	Hand hose reels	20	20
Group III	Same as Group II Hangar		
Group IV	Low-expansion foam system	10	45
	High-expansion foam system	12	45

Note: Add 500 gpm for outside hose lines and 120 gpm for foam hose reel stations inside the hangar when doing water supply calculations.

TABLE 5C-1

Hangar Group	Aspirated Protein/ Fluoroprotein gpm/ft² (Lpm/m²)	Aspirated AFFF gpm/ft² (Lpm/m²)	Nonaspirated AFFF gpm/ft² (Lpm/m²)
I	0.20 (8.1)	0.20 (8.1)	0.16 (6.5)
II	0.16 (6.5)	0.16 (6.5)	0.16 (6.5)

TABLE 5C-2

CALCULATING PRIMARY FOAM QUANTITY

First, use the following formula to determine Foam Solution Discharge Rate which is required to determine proportioner size:

FOAM SOLUTION DISCHARGE RATE = FLOOR AREA x APPLICATION RATE

Now, calculate the foam concentrate quantity using the following formula:

QUANTITY = FOAM SOLUTION DISCHARGE RATE x 10 MINUTES x CONCENTRATE %* x 1.15 (15% OVERAGE)

*Concentrate % is expressed as: 0.01 for 1% concentrates
0.03 for 3% concentrates
0.06 for 6% concentrates

Note: The foam concentrate supply must be based upon two separate calculations (demand calculation and supply calculations) and the supply calculation is not normally available at the preliminary system design stage. It is recommended that a 15% overage be included to compensate for this unknown factor. (The 15% overage is based upon the maximum variance allowed between the lowest density and highest density sprinkler within an individual sprinkler zone.)

Aircraft Hangar Protection

Wing Areas of Various Aircraft

Monitor systems are required for hangars housing aircraft with wing areas exceeding 3000 ft^2 (279 m^2). Table 5C-2 lists the wing areas of various large transport aircraft.

Aircraft	Gross Wing Area ft^2	(m^2)	Overall Height ft-in	(m)
Airbus A-3xx*			79-0	(24.1**)
Antonov An-124*	6760	(628.0**)	69-2	(21.0**)
Lockheed L-500-Galaxy*	6200	(576.0**)	65-1	(19.8**)
Boeing 747*	5825	(541.1**)	63-8	(19.4**)
Airbus A-340-500, -600*	4703	(437.0**)	54-11	(16.7*)
Boeing 777*	4605	(427.8**)	60-9	(18.5**)
Ilyushin Il-96*	4215	(391.6**)		
DC-10-20, 30*	3958	(367.7**)	58-1	(17.7**)
Airbus A-340-200, -300, A-330-200, -300*	3892	(361.6**)	54-11	(16.7**)
DC-10-10*	3861	(358.7**)	58-1	(17.7**)
Concorde*	3856	(358.2**)	40-0	(12.2**)
Boeing MD-11*	3648	(339.9**)	57-9	(17.6**)
Boeing MD-17*	3800	(353.0**)	55-1	(16.8**)
L-1011*	3456	(321.1**)	55-4	(16.9**)
Ilyushin IL-76*	3229	(300.0**)	48-5	(14.8**)
Boeing 767*	3050	(283.4**)	52-0	(15.8**)
Ilyushin IL-62*	3030	(281.5**)	40-6	(12.3**)
DC-10 MD-10	2932	(272.4)		
DC-8-63, 73	2927	(271.9)		
DC-8-62, 72	2926	(271.8)		
DC-8-61, 71	2883	(267.8)		
Airbus A-300	2799	(260.0**)	54-3	(16.5**)
Airbus A-310	2357	(218.9**)	51-10	(15.8**)
Tupolev TU-154	2169	(201.5**)	37-4	(11.4**)
Boeing 757	1994	(185.2**)	44-6	(13.5**)
Tupolev Tu-204	1963	(182.4**)	45-7	(13.9**)
Boeing 727-200	1700	(157.9**)	34-0	(10.4**)
Lockheed L-100J Hercules	1745	(162.1**)	38-3	(11.6**)
Yakovlev Yak-42	1614	(150.0**)	32-3	(9.3**)
Boeing 737-600, -700, -800, -900	1345	(125.0**)	43-3	(12.5**)
Airbus A-318, A-319, A-320, A-321	1319	(122.6**)	38-8	(11.8**)
Boeing MD-80,	1209	(112.3**)	29-7	(9.0**)
MD-90			30-7	(9.3**)

* Aircraft with wing areas in excess of 3000 ft^2 (279 m^2)

** *Jane's All the Worlds Aircraft,* Editions, Jane's Information Group Limited, Sentinel House, 163 Brighton Road, Coulsdon, Surrey, CR5 2YH, UK

Aircraft Hangar Protection

Wing Areas of Various Aircraft (Continued)

Aircraft	Gross Wing Area ft^2	(m^2)	Overall Height ft-in	(m)
Gulfstream V	1137	(105.6**)	25-10	(7.9**)
Boeing 737-300, -400, -500	1135	(105.4**)	36-6	(11.1**)
Tupolev Tu-334, Tu-354	1076	(100.0**)	30-9	(9.4**)
BAC 1-11-500	1031	(95.8**)	24-6	(7.5**)
NAMC YS-11	1020	(94.8**)	29-5	(8.9**)
Fokker 100, 70	1006	(93.5**)	27-10	(8.5**)
BAC 1-11-300, 400	1003	(93.2*)	24-6	(7.5**)
Boeing 717	1001	(93.0*)	29-1	(8.8**)
DC-9-30	1001	(93.0**)	27-6	(8.4**)
Boeing 737-200	980	(91.0**)	37-0	(11.3**)
Gulfstream IV	950	(88.3**)	24-5	(7.4**)
DC 9-10	934	(86.8**)	27-6	(8.4**)
BAe 146, RJX-70, -85, 100	832	(77.3**)	28-3	(8.6**)
Fokker 50, 60	753	(70.0**)	27-3	(2.7**)
Canadiar RJ-700	738	(68.6**)	24-10	(7.6**)
Dash 8 Q400	679	(63.0**)	24-7	(7.5**)
ATR 72	656	(61.0**)	25-1	(7.6**)
Airtech CN-235	636	(59.1**)	26-10	(8.2**)
Saab 2000	600	(55.7**)	25-4	(7.7**)
Canadiar RJ-100, 200	587	(54.5**)	20-5	(6.2**)
ATR 42	586	(42.5**)	24-10	(7.6**)
Dash 8 Q100, Q200	585	(54.3**)	24-7	(7.5**)
Embaraer ERJ-135, 145	550	(51.1**)	22-1	(6.9**)
Cessna 750	527	(48.9**)	18-11	(5.8**)
Cessna 680	516	(47.9**)	19-2	(5.5**)
Saab 340	450	(41.8**)	22-1	(6.9**)
Embaraer EMB-120	424	(39.4**)	20-10	(6.3**)
Bell Boeing V-22	382	(39.5**)	21-9	(6.6**)
Britten-Norman BN2	325	(30.2**)	13-8	(4.2**)
Cessna 650	312	(28.9**)	16-9	(5.1**)
Beach 1900	310	(28.8**)	15-6	(4.7**)
Beech King Air C90	294	(27.3**)	14-3	(4.3**)

* Aircraft with wing areas in excess of 3000 ft^2 (279 m^2)

** *Jane's All the Worlds Aircraft,* Editions, Jane's Information Group Limited, Sentinel House, 163 Brighton Road, Coulsdon, Surrey, CR5 2YH, UK

TABLE 5C-2

Aircraft Hangar Protection

DETERMINING MONITOR LOCATION AND AREA OF COVERAGE

First, locate the monitors based on customer-approved mounting locations.

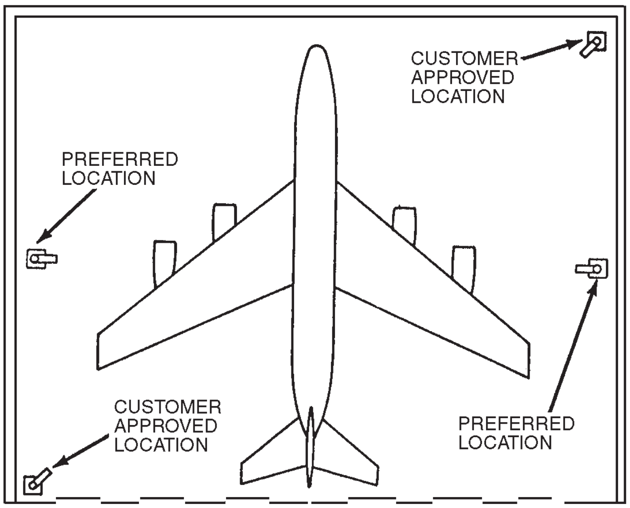


FIGURE 5C-2
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Next, determine the required range (radius) and arc of oscillation (degrees) in order to cover the underwing and center fuselage area of the aircraft from the customer-approved locations.

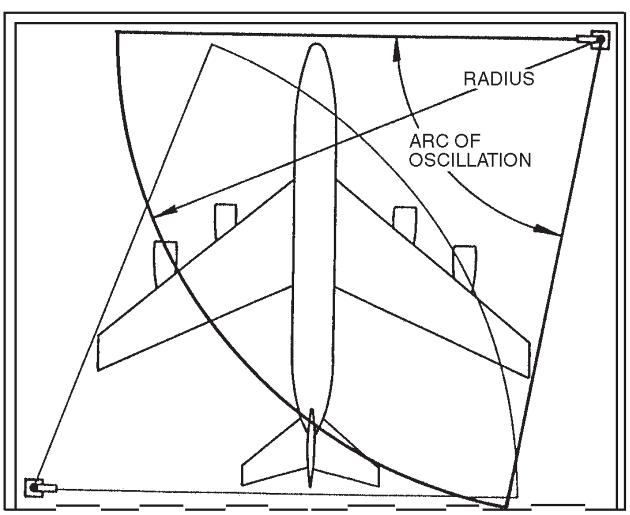


FIGURE 5C-3
000963

Finally, calculate the area of coverage for each monitor using the following formula. Note that each monitor may have a different area of coverage based on its range and arc of oscillation.

$$\text{AREA OF COVERAGE} = \frac{(\pi \text{ R2}) \text{ (ARC OF OSC)}}{360}$$

DETERMINING MONITOR SYSTEM DISCHARGE TIME AND APPLICATION RATE

The discharge time for monitor systems is 10 minutes. Protein or fluoroprotein foam with an aspirating nozzle requires an application rate of 0.16 gpm/ft^2 (6.5 Lpm/m^2). AFFF agents with aspirating or nonaspirating nozzles require an application rate of 0.10 gpm/ft^2 (4.1 Lpm/m^2).

CALCULATING MONITOR SYSTEM FOAM QUANTITY

First, use the following formula to determine Foam Solution Discharge Rate for each monitor in order to select the proper monitor and nozzle:

FOAM SOLUTION DISCHARGE RATE = AREA OF COVERAGE X APPLICATION RATE

Next, determine the Total Foam Solution Discharge Rate which is the combined discharge rates of all monitors. This is required to determine proportioner size.

TOTAL FOAM SOLUTION DISCHARGE RATE = MONITOR #1 DISCHARGE RATE + MONITOR #2 DISCHARGE RATE + ETC.

Finally, calculate the foam concentrate quantity using the following formula:

QUANTITY = TOTAL FOAM SOLUTION DISCHARGE RATE X 10 MINUTES X CONCENTRATE %* X 1.15 (15% OVERAGE) – SEE NOTE NO. 1

*Concentrate % is expressed as: 0.01 for 1% concentrates
0.03 for 3% concentrates
0.06 for 6% concentrates

Aircraft Hangar Protection

HAND HOSE LINE REQUIREMENTS

The hand hose lines must be situated with a sufficient length of hose to provide water or foam on each side and into the interior of the aircraft. The supply of foam concentrate must be sufficient to supply two hand hose lines for a period of 20 minutes at a discharge rate of 60 gpm (227 Lpm) each. (Two hand hose lines are minimum; customer preference may dictate additional hose lines to cover additional areas of the hangar.)

First, use the following formula to determine Foam Solution Discharge Rate which is required to determine proportioner size:

FOAM SOLUTION DISCHARGE RATE = 60 GPM X NO. OF HAND HOSE LINES

Now, calculate the foam concentrate quantity using the following formula:

Quantity = Foam Solution Discharge Rate X 20 Minutes X Concentrate %*

*Concentrate % is expressed as: 0.01 for 1% concentrates
0.03 for 3% concentrates
0.06 for 6% concentrates

The supply for the hand hose lines may be incorporated into the primary system supply and connected to the sprinkler system header, or it may be desirable to have a separate supply for hand hose lines so that the primary system does not require recharge when only the hand hose lines are used.

Aircraft Hangar Protection

HANGAR HIGH-EXPANSION SYSTEM CALCULATION FORM

Design Per NFPA 409

Hangar floor area = ________________ ft^2 x 3 cfm / ft^2 = __________________ **cfm**

Sprinkler breakdown factor (R_S)

"Group **I**" 0.17 gpm/ft^2 x 15,000 ft^2 x 10 cfm/gpm = **25,500 cfm**

or

"Group **II**" 0.17 gpm/ft^2 x 5,000 ft^2 x 10 cfm/gpm = **8,500 cfm**

Therefore;

(_________________ cfm + _________________ breakdown cfm) x 1.15 (shrinkage)

= ________________ cfm of high-expansion foam is required.

Assuming that ______________ **psi** is available at each generator, the ___________________________ model generator will generate _______________ cfm each (flowing ___________ gpm each).

Note: *Minimum inlet pressure to generators must be 40-50 psi (refer to JET-X High-Expansion Foam Generators Data/Specifications (F-93137)).*

__________________ cfm required / _________________ cfm per generator

= ____________ (always round up) = ______________ **Generators are required for the system.**

Concentrate required is then calculated:

_________ generators x ________ gpm each

= _____________ gpm x 12 minute duration = _______________ gal. of foam solution

x 0.02 (2% proportioner for JET-X 2% Concentrate)

= _______________ **gal of JET-X 2% Concentrate**

x 1.15 (for 15% overage) = ______________ gal of JET-X 2% Concentrate in main system tank with connected reserve of equal capacity

Required Sprinkler Demand

0.17 gpm / ft^2 x _________________ ft^2 = __________________ gpm

Required Foam-Water Hose Demand

2 handlines x 60 gpm = 120 gpm

Minimum flow requirements for all Systems

________________ gpm (generators) + __________________ gpm (sprinklers) + 120 gpm =

______________ gpm*

Note: *This does not include any overage allowance or outside hose stream requirements.*

HANGAR HIGH-EXPANSION SYSTEM CALCULATION FORM

Design Per NFPA 409 Exception: the use of Inside Air as recognized by Tyco Fire Protection Products, and many AHJ's.

Hangar floor area = ________________ ft^2 x 3 cfm / ft^2 = __________________ **cfm**

Sprinkler breakdown factor (R_S)

"Group **I**" 0.17 gpm/ft^2 x 15,000 ft^2 x 10 cfm/gpm = **25,500 cfm**

or

"Group **II**" 0.17 gpm/ft^2 x 5,000 ft^2 x 10 cfm/gpm = **8,500 cfm**

Therefore;

(_________________ cfm + _________________ breakdown cfm) x 1.15 (shrinkage) x 1.2 (inside air)

= ________________ cfm of high-expansion foam is required.

Assuming that ______________ **psi** is available at each generator, the ___________________________ model generator will generate _______________ cfm each (flowing ___________ gpm each).

***Note:** Minimum inlet pressure to generators must be 40-50 psi (refer to JET-X High-Expansion Foam Generators Data/Specifications (F-93137)).*

_________________ cfm required / _________________ cfm per generator

= ___________ (always round up) = ______________ **Generators are required for the system.**

Concentrate required is then calculated:

_________ generators x ________ gpm each

= ____________ gpm x 12 minute duration = ______________ gal. of foam solution

x 0.02 (2% proportioner for JET-X 2% Concentrate)

= ______________ **gal of JET-X 2 % Concentrate**

x 1.15 (for 15% overage) = _____________ gal of JET-X 2% Concentrate in main system tank with connected reserve of equal capacity

Required Sprinkler Demand

0.17 gpm / ft^2 x _________________ ft^2 = __________________ gpm

Required Foam-Water Hose Demand

2 handlines x 60 gpm = 120 gpm

Minimum flow requirements for all Systems

_________________ gpm (generators) + __________________ gpm (sprinklers) + 120 gpm =

______________ **gpm***

**Note:* *This does not include any overage allowance or outside hose stream requirements.*

EXAMPLE SYSTEM

Hazard Specifications

Hangar Dimensions . . . . 200 x 150 ft (61 x 46 m)

Clear Door Height. . . . . 30 ft (9.1 m)

Aircraft Housed. DC-10-30

System Design

1. CLASSIFY HANGAR (PAGE 5C-3)

The aircraft access door height is over 28 ft (8.5 m); therefore, the hangar is classified as Group I.

2. REVIEW PROTECTION OPTIONS (PAGES 5C-3 AND 5C-4)

It is determined that:

– an overhead foam-water deluge system is requested.
– because the aircraft wing area is over 3000 ft^2 (279 m^2), an underwing monitor system is required.
– a foam-water hand hose line system must be provided.

3. DETERMINE PRIMARY SYSTEM DISCHARGE TIME AND APPLICATION RATE (PAGE 5C-5)

Customer requires nonaspirated devices with AFFF concentrate. Therefore, based on Table 5C-1, the primary system requires an Application Rate of 0.16 gpm/ft^2 (6.5 Lpm/m^2) and a Discharge Time of 10 minutes.

4. CALCULATE PRIMARY FOAM QUANTITY (PAGE 5C-5)

First, determine the Foam Solution Discharge Rate:

FOAM SOLUTION DISCHARGE RATE = FLOOR AREA X APPL. RATE

FOAM SOLUTION DISCHARGE RATE = 30000 FT^2 (279 m^2) X 0.16 GPM/FT^2 (6.5 Lpm/ m^2)

FOAM SOLUTION DISCHARGE RATE = 4800 GPM (18170 LPM)

Then, determine the foam concentrate quantity:

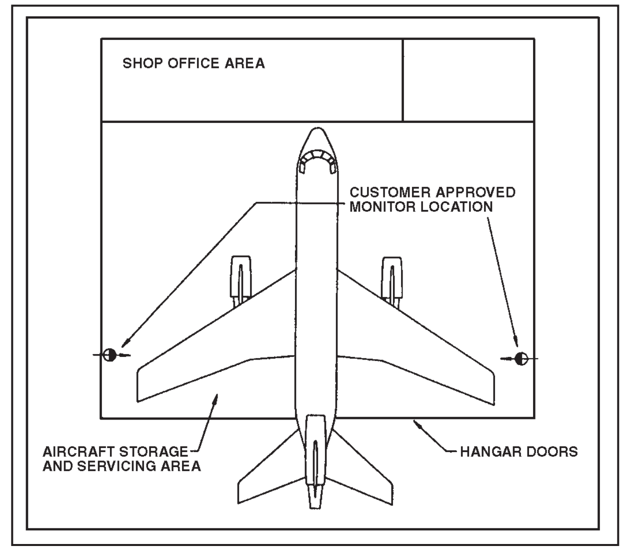
$$\text{QUANTITY} = \frac{\text{FOAM SOLUTION}}{\text{DISCHARGE RATE}} \text{ X } \frac{\text{DISCHARGE TIME X CONC. \% X 1.15}}{\text{(15\% OVERAGE)}}$$

QUANTITY = 4800 gpm (18170 Lpm) X 10 minutes X 0.03 (3% AFFF) X 1.15

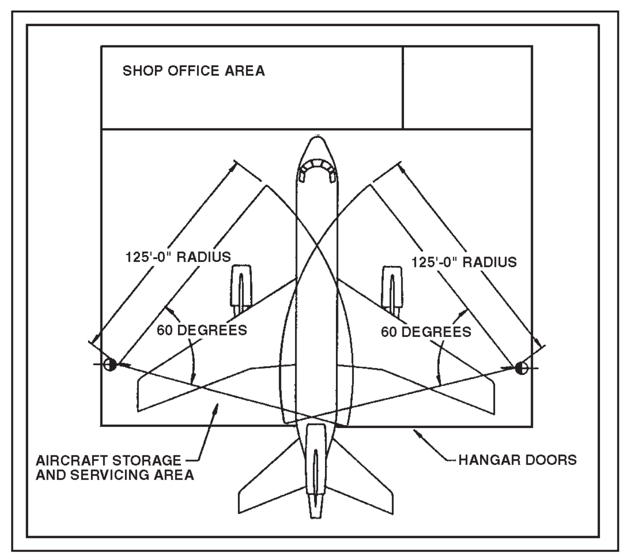
QUANTITY = 1656 gal (6269 L)

5. DETERMINE MONITOR LOCATION AND AREA OF COVERAGE (PAGE 5C-8)

The customer-approved monitor mounting location is as follows:



The required range and arc of oscillation for each monitor must be such that the underwing and center fuselage area of the aircraft are covered as follows:



Finally, calculate the area of coverage for each monitor using the following formula:

$$\text{AREA OF COVERAGE} = \frac{(\pi r^2)\text{ (ARC OF OSC)}}{360}$$

$$\text{AREA OF COVERAGE} = \frac{(3.14)\ (125\text{ ft})^2(60°)}{360}$$

AREA OF COVERAGE = 8177 $ft.^2$ (760 m^2)

6. DETERMINE MONITOR SYSTEM DISCHARGE TIME AND APPLICATION RATE (PAGE 5C-8)

The Discharge Time required for monitor systems is 10 minutes. When using AFFF, the Application Rate is 0.10 gpm/ft^2 (4.1 Lpm/m^2).

7. CALCULATE MONITOR SYSTEM FOAM QUANTITY (PAGE 5C-8)

First, determine the Foam Solution Discharge Rate for each monitor:

FOAM SOLUTION DISCHARGE RATE = AREA OF COVERAGE X APPL. RATE

FOAM SOLUTION DISCHARGE RATE = 8177 ft^2 X 0.10 gpm/ft^2

FOAM SOLUTION DISCHARGE RATE = 818 gpm (3096 Lpm)

Next, calculate the **Total** Foam Solution Discharge Rate of both monitors combined. Note that in this example both monitors are covering the same area and therefore have the same discharge rate. In other situations, the area of coverage may vary from monitor to monitor.

$$\frac{\text{TOTAL FOAM SOLUTION}}{\text{DISCHARGE RATE}} = \frac{\text{MONITOR \#1}}{\text{DISCHARGE RATE}} + \frac{\text{MONITOR \#2}}{\text{DISCHARGE RATE}} + \text{ETC.}$$

FOAM SOLUTION DISCHARGE RATE = 818 gpm (3096 Lpm) + 818 gpm

FOAM SOLUTION DISCHARGE RATE = 1636 gpm (6192 Lpm)

Finally, determine the foam concentrate quantity:

$$\text{QUANTITY} = \frac{\text{TOTAL FOAM SOLUTION}}{\text{DISCHARGE RATE}} \text{ X } \frac{\text{10 MINUTES X CONC. \% X 1.15}}{\text{(15\% OVERAGE)}}$$

QUANTITY = 1636 gpm X 10 minutes X 0.03 (3% AFFF) X 1.15

QUANTITY = 565 gal (2138 L)

8. DETERMINE HAND HOSE LINE REQUIREMENTS (PAGE 5C-9)

Two hand hose lines are required for a period of 20 minutes at a discharge rate of 60 gpm (227 Lpm).

First, determine the Foam Solution Discharge Rate:

FOAM SOLUTION DISCHARGE RATE = 60 gpm X NO. OF HAND HOSE LINES

FOAM SOLUTION DISCHARGE RATE = 60 gpm X 2 HOSE LINES

FOAM SOLUTION DISCHARGE RATE = 120 gpm (454Lpm)

Then, determine the foam concentrate quantity:

$$\text{QUANTITY} = \frac{\text{FOAM SOLUTION}}{\text{DISCHARGE RATE}} \text{ X DISCHARGE TIME X CONC. \% X 1.15}$$

QUANTITY = 120 gpm X 20 minutes X 0.03 (3% AFFF)

QUANTITY = 72 gal (273 L)

9. CALCULATE TOTAL FOAM QUANTITY

Primary . . . . 1656 gal

Monitors . . . . 565 gal

Hand Hose Lines . . . . 72 gal

Total Foam Quantity . . . . . 2293 gal (8680 L) AFFF 3% Foam Concentrate

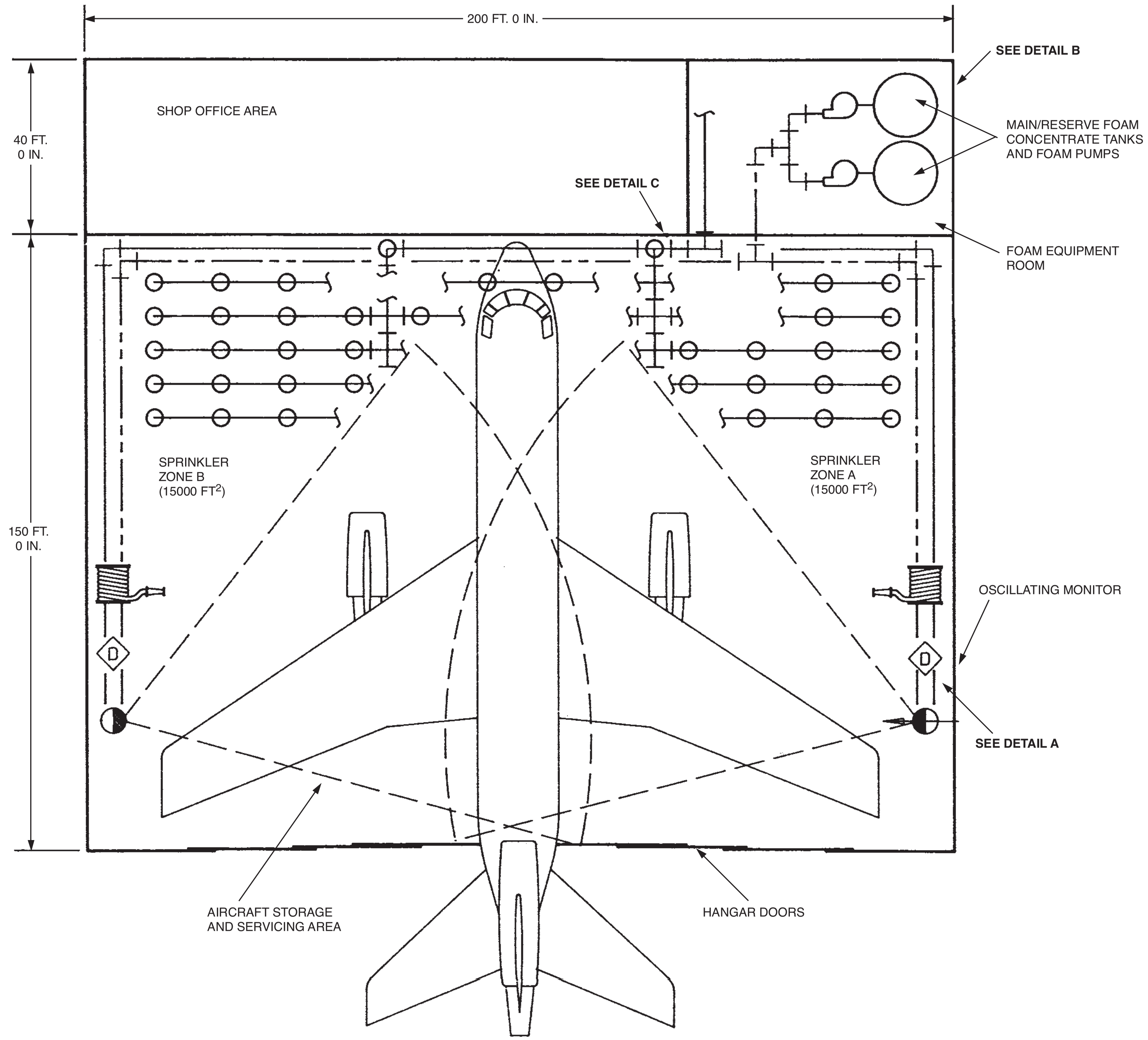
10. COMPILE BILL OF MATERIALS

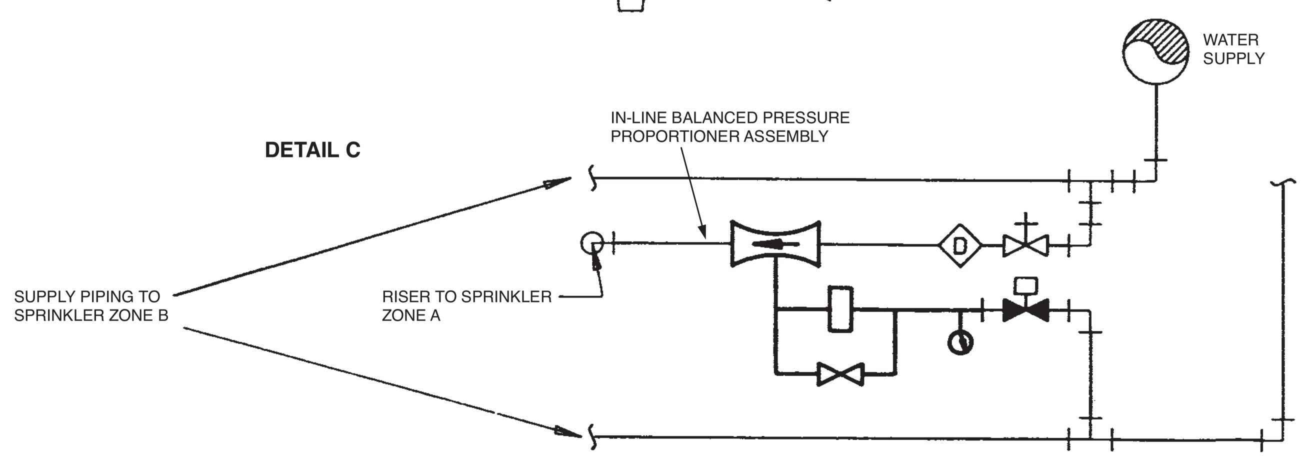
NOTICE

This is an example only. Selection of agent and proportioning equipment will vary with each application. For detection and control system recommendations, contact Ansul Fire Protection.

Quantity	Description
2	2300 Gallon (nominal capacity) Atmospheric Storage Tank
2	Positive Displacement Foam Pump (Nominal 230 gpm) with Controller
2	In-Line Balanced Pressure Proportioner for 2400 gpm (9085 Lpm) Nominal (Sprinkler System)
2	In-Line Balanced Pressure Proportioner for 820 gpm (3104 Lpm) Nominal (Monitor System)
2	In-Line Balanced Pressure Proportioner for 60 gpm (227 Lpm) Nominal (Hose Stations)
300	Sprinkler Head, Based on 10 X 10 ft Maximum Centers
2	Oscillating Monitor with Nozzle
2	Handline Nozzle, 60 gpm (227 Lpm)
4600 gal	ANSULITE AFFF 3% Concentrate
As Required	ANSULITE AFFF 3% Concentrate for Filling Foam Concentrate Piping
As Required	Test Foam, ANSULITE AFFF 3% Concentrate

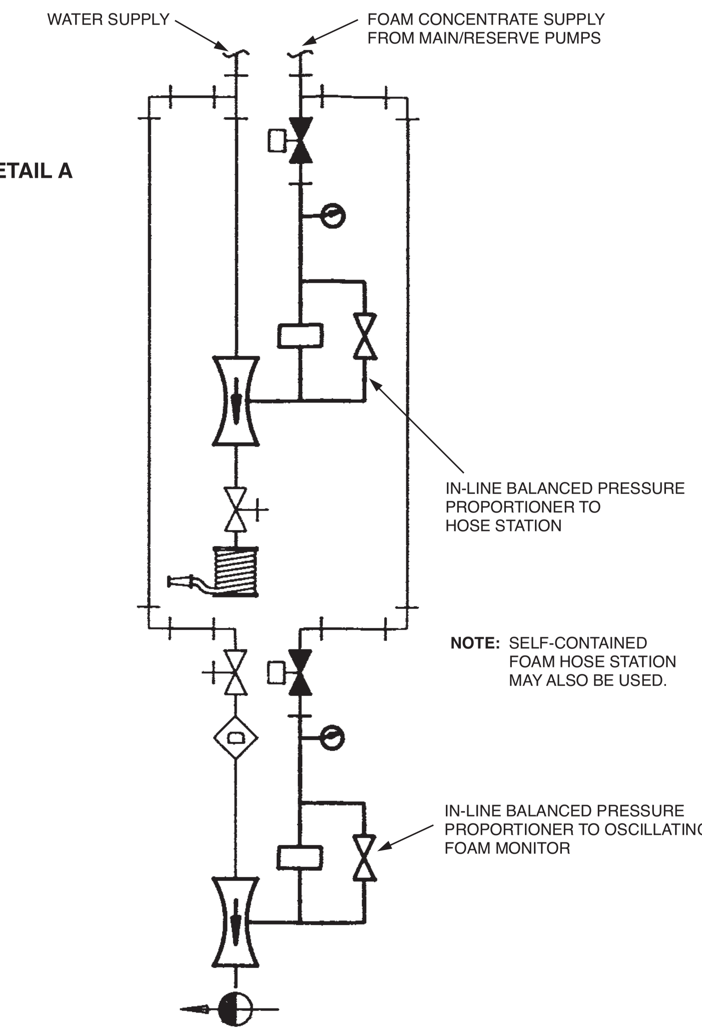
EXAMPLE SYSTEM (Continued)

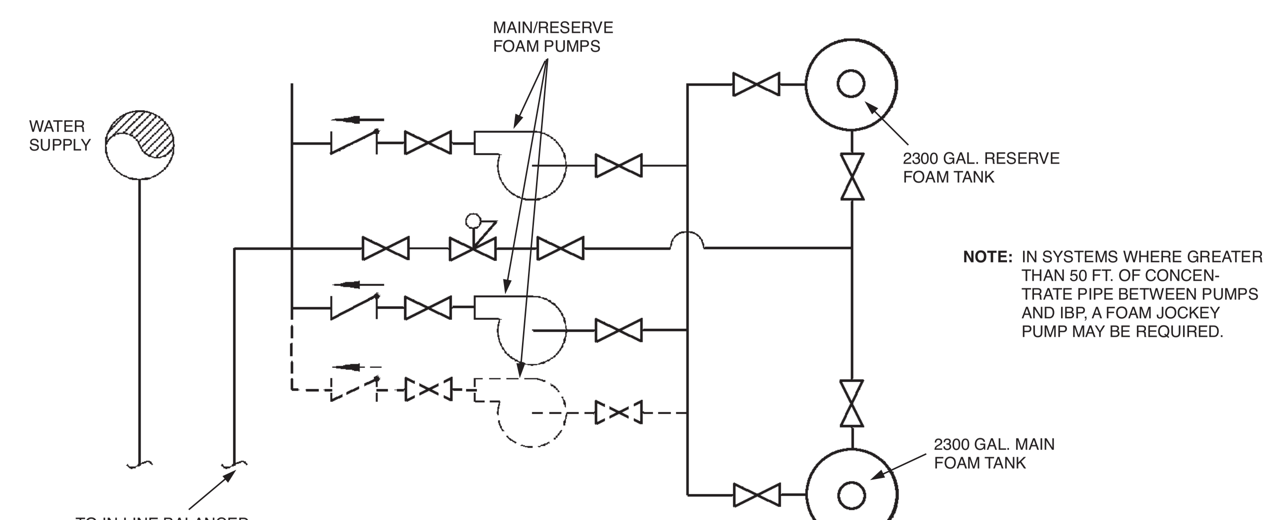




DETAIL C

DETAIL A





DETAIL B

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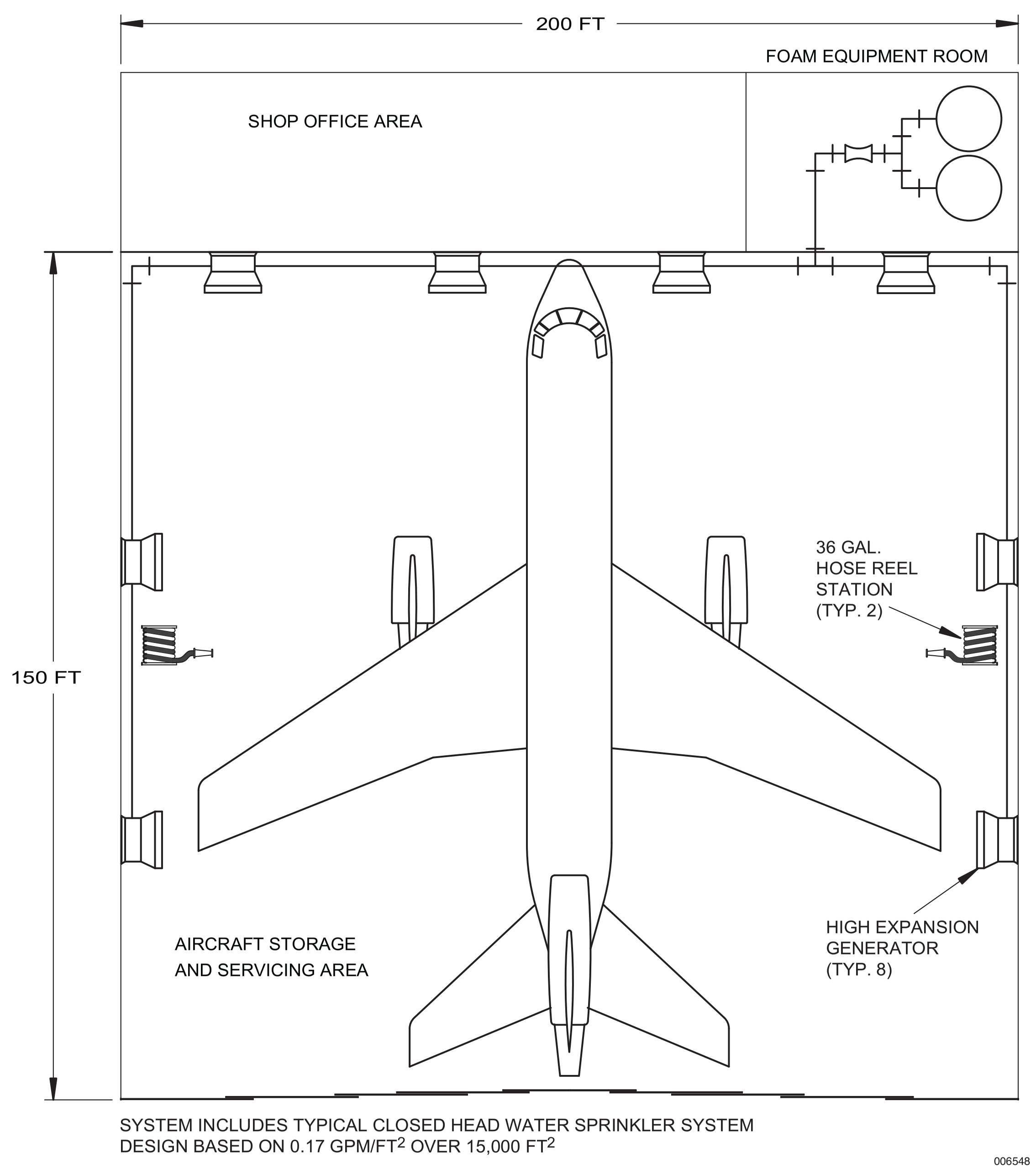
SECTION 5C
AIRCRAFT HANGAR PROTECTION
EXAMPLE SYSTEM – NO. 1
SHEET 2 OF 2



HANGAR HIGH-EXPANSION SYSTEM CALCULATION FORM

Design Per NFPA 409

Hangar floor area = 30,000 ft^2 x 3 cfm / ft^2 = 90,000 **cfm**

Sprinkler breakdown factor (R_S)

"Group I" 0.17 gpm/ft^2 x 15,000 ft^2 x 10 cfm/gpm = **25,500 cfm**

or

"Group II" 0.17 gpm/ft^2 x 5,000 ft^2 x 10 cfm/gpm = **8,500 cfm**

Therefore;

(90,000 cfm + 25,500 breakdown cfm) x 1.15 (shrinkage)

= 132,825 cfm of high-expansion foam is required.

Assuming that 62 **psi** is available at each generator, the JET-X 15A (UL) model generator will generate 16,972 cfm each (flowing 132 gpm each).

Note: *Minimum inlet pressure to generators must be 40-50 psi (refer to JET-X High-Expansion Foam Generators Data/Specifications (F-93137)).*

132,825 cfm required / 16,972 cfm per generator

= 7.82 (always round up) **= 8 Generators are required for the system.**

Concentrate required is then calculated:

8 generators x 132 gpm each

= 1,056 gpm x 12 minute duration = 12,672 gal of foam solution

x 0.02 (2% proportioner for JET-X 2% Concentrate)

= **253 gal of JET-X 2% Concentrate**

x 1.15 (for 15% overage) = 291 gal of JET-X 2% Concentrate in main system tank with connected reserve of equal capacity

Required Sprinkler Demand

0.17 gpm / ft^2 x 15,000 ft^2 = 2,550 gpm

Required Foam-Water Hose Demand

2 handlines x 60 gpm = 120 gpm

Minimum flow requirements for all Systems

1,056 gpm (generators) + 2,550 gpm (sprinklers) + 120 gpm =

3,726 gpm*

Note: *This does not include any overage allowance or outside hose stream requirements.*

Complete Bill of Materials

Quantity	Description
2	300 Gallon Bladder Tanks
1	JET-X Proportioner (sized for system flow)
2	Water Inlet Ball Valves
2	Concentrate Isolation Ball Valves
1	Swing Check Valve
1	Hydraulically Actuated Ball Valve
8	JET-X-15A (UL) Generators
8*	Wall Intake Dampers
4*	Wall Relief Louvers
2	36 Gallon Bladder Tank Hose Reel Stations
582+	Gallons JET-X 2% Concentrate
72+	Gallons 3% AFFF Concentrate

+Additional amounts of concentrate will be required based on the exact testing of the system that is required.

*Note: System calculated per NFPA 409 which requires the use of "outside air" to be supplied to generators. Refer to the JET-X High-Expansion Foam Generators Data Sheet (F-93137) for intake and relief damper packages that can be supplied with ANSUL generators.

Determine Primary System Discharge Time & Application Rate

3 cubic feet per minute per square foot are required. Enough foam concentrate must be available for a 12 minute discharge duration.

The Formula

$$R = ([V/T] + R_s) \times C_n \times C_L$$

R = rate in cfm
V = submergence volume in ft³
T = submergence time in minutes
R_S = rate of foam breakdown from sprinklers
C_n = compensation for normal foam shrinkage
C_L = compensation for leakage (not normally used by ANSUL for these High-Expansion Local Application Foam Systems although some AHJ's may require this factor to be 1.0-1.2)

R_S

Reference NFPA 11 – The rate of sprinkler breakdown is 10 cfm / gpm of water flow from the sprinkler system.

Calculate Required CFM

200 ft x 150 ft = 30,000 ft^2 x 3 cfm / ft^2 = 90,000 cfm
+
0.17 gpm / ft^2 x 15,000 ft^2 x 10 cfm / gpm = 25,500 cfm
x
1.15 (normal foam shrinkage)
equals
132,825 cfm of High-Expansion Foam Output

Calculate # of Generators Required

Based on information provided we will assume that a minimum of 62 PSI will be available at all generators. The customer has indicated that UL Listed Generators be used.
The JET-X-15 A (UL) generator will provide 16,972 cfm at 62 PSI while flowing 132 gpm.
CALCULATION:
132,825 cfm required / 16,972 cfm per generator = 7.82
(8) JET-X 15A (UL) Generators required

Calculate amount of JET-X 2% Concentrate Required

(8) Generators flowing 132 gpm each = 1056 gpm x 12 minute discharge duration x 2% concentrate percentage (.02)
x 1.15 system balancing overage = 291 Gallons of concentrate that is required with the same amount in a connected reserve tank

DETERMINE HAND HOSE LINE REQUIREMENTS

Two hand hose lines are required for a period of 20 minutes at a discharge rate of 60 gpm (227 Lpm).

First, determine the Foam Solution Discharge Rate:

FOAM SOLUTION DISCHARGE RATE = 60 gpm x NO. OF HAND HOSE LINES

FOAM SOLUTION DISCHARGE RATE = 60 gpm x 2 HOSE LINES

FOAM SOLUTION DISCHARGE RATE = 120 gpm (454 Lpm)

Then, determine the foam concentate quantity:

$$\text{QUANTITY} = \frac{\text{FOAM SOLUTION}}{\text{DISCHARGE RATE}} \times \text{DISCHARGE TIME X CONC. \%} \times 1.15$$

QUANTITY = 120 gpm x 20 minutes x 0.03 (3% AFFF)

QUANTITY = 72 gal (273 L)

F-2011075-01

Foam System Design and Application

Truck Loading Rack Protection

PROTECTION OVERVIEW

The transfer of highly flammable fuels at truck loading racks presents a variety of fire protection problems. The fuel could be transferred from storage tanks or pipeline, under pressure or by gravity. Therefore, the potential fire could be ground spill, three dimensional gravity fed, or three dimensional fuel-under-pressure.

The type of foam system used for loading rack protection consists of a foam-water deluge system, and if desired, a supplementary ground sweep nozzle or ‘‘under truck’’ system.

Monitor systems may also be used as primary protection. See Section 5F for guidelines.

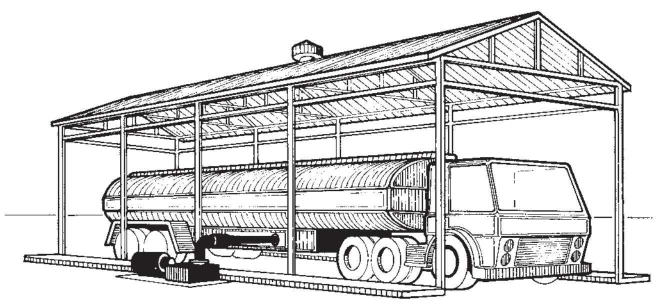
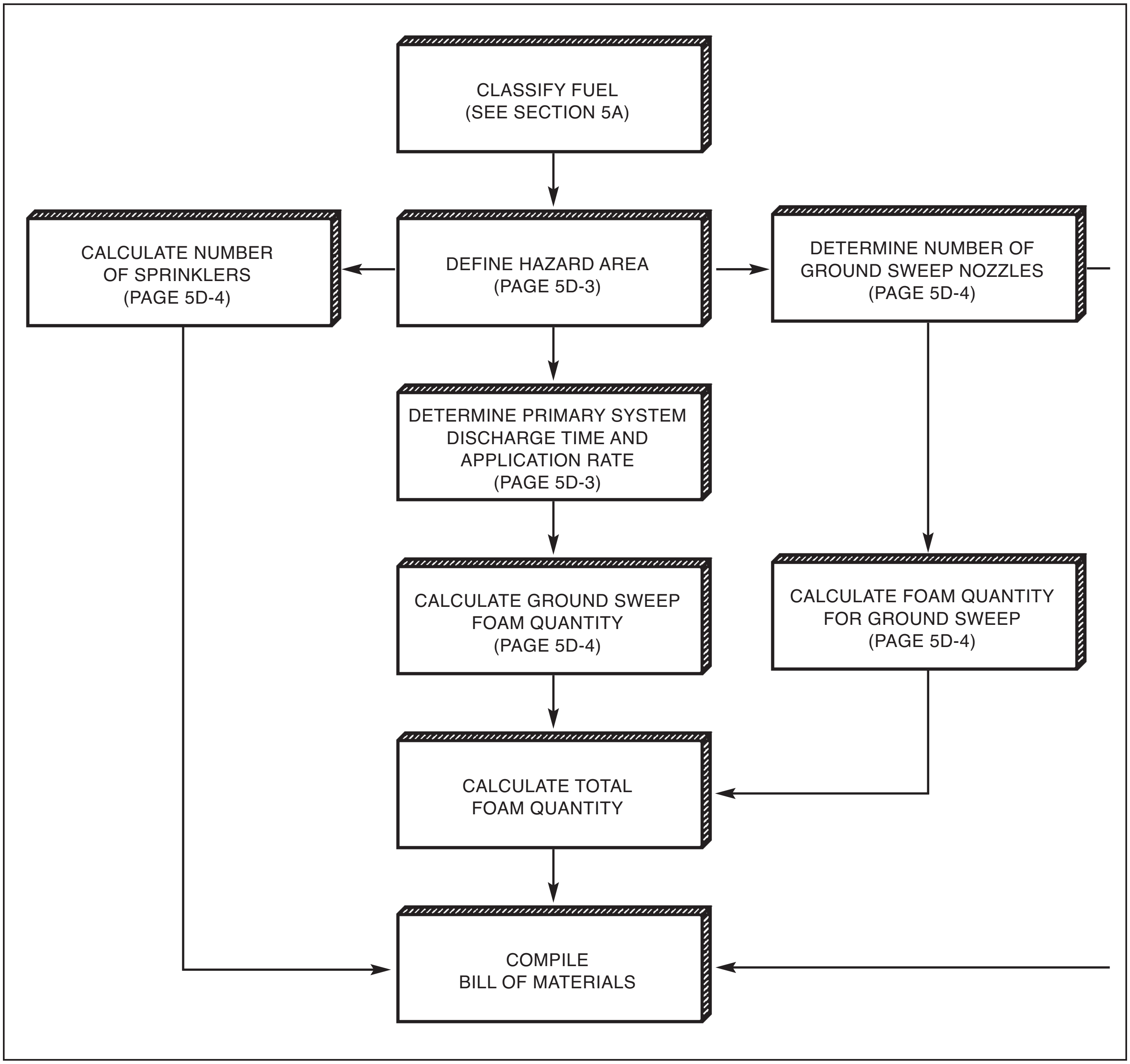


FIGURE 5D-1
001308

Truck Loading Rack Protection

TRUCK LOADING RACK PROTECTION FLOW CHART

The following flow chart defines a logical sequence for designing truck loading rack systems.



Truck Loading Rack Protection

DEFINING HAZARD AREA

A loading rack is normally surrounded by a low-profile dike or curb, or a drainage system which will contain a fuel spill. If no containment is provided, the area under the roof or canopy is usually considered the hazard area to be protected. However, the overall length of the truck and trailer may extend the fire area and must also be considered.

When no canopy or containment area is provided, the hazard area must be defined by the customer or the authority having jurisdiction.

DETERMINING PRIMARY SYSTEM DISCHARGE TIME AND APPLICATION RATE

The discharge time for primary loading rack systems is 10 minutes. The application rate depends on the type of fuel and foam agent used as shown in Popular Sprinkler/Concentrates Data Sheet in Section IV. In addition to Overhead Foam/Water Sprinklers, ANSUL recommends using "Ground Sweep" nozzles for faster fire knock-down under the areas shielded by the vehicle.

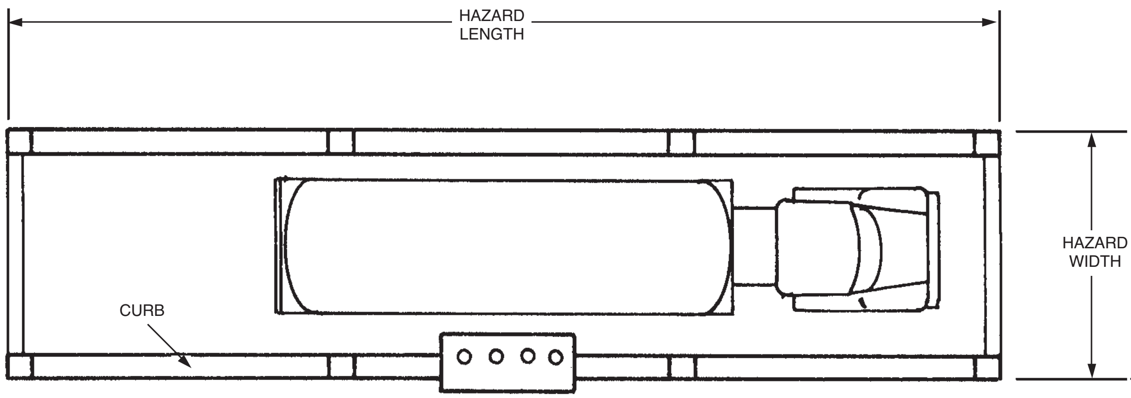


FIGURE 5D-2
001310

Truck Loading Rack Protection

CALCULATING NUMBER OF SPRINKLERS

The number of sprinklers required for overhead foam protection is based on 10 ft (3.1 m) maximum centers. Therefore, to estimate the number of sprinklers required to protect the hazard area, use the following formula.

$$\text{NUMBER OF SPRINKLERS} = \frac{\text{HAZARD LENGTH}}{10} \times \frac{\text{HAZARD WIDTH}}{10}$$

Fractions or decimals must be rounded up to the nearest whole number before multiplying.

CALCULATE PRIMARY FOAM QUANTITY

First, use the following formula to determine Foam Solution Discharge Rate which is required to determine proportioner size:

FOAM SOLUTION DISCHARGE RATE = AREA OF HAZARD X APPLICATION RATE

Now, calculate the foam concentrate quantity using the following formula:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X 10 MINUTES X CONCENTRATE %*

*Concentrate % is expressed as: 0.01 for 1% concentrates
0.03 for 3% concentrates
0.06 for 6% concentrates

DETERMINING NUMBER OF GROUND SWEEP NOZZLES

Ground sweep nozzles are recommended as additional protection especially for bottom loading and open-sided racks. These nozzles will increase the spread of foam under the truck thereby reducing the fire exposure to the truck and surrounding structure. Typically, two or four nozzles are recommended per bay depending on customer requirements. Typically ANSUL would recommend that an additional 0.1 gpm/ft^2 minimum is provided by these nozzles. As this is additional protection, the area covered cannot be deducted from the overhead calculations.

CALCULATING GROUND SWEEP FOAM QUANTITY

The foam quantity for ground sweep protection is in addition to sprinkler system foam requirements. The application rate depends on the flow rate of the nozzle used. The discharge time is the same as for the sprinkler system: 10 minutes.

First, use the following formula to determine Foam Solution Discharge Rate which is required to determine proportioner size:

FOAM SOLUTION DISCHARGE RATE = NOZZLE FLOW RATE X NO. OF NOZZLES

Now, calculate the foam concentrate quantity using the following formula:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X 10 MINUTES X CONCENTRATE %*

*Concentrate % is expressed as: 0.01 for 1% concentrates
0.03 for 3% concentrates
0.06 for 6% concentrates

EXAMPLE SYSTEM

Hazard Specifications

Number of Bays . . . . Two

Fuel Containment System . . . 83 x 55 ft (25 x 17 m)
Drainage System

Fuel. . . . . Gasoline, Diesel

Fuel Loading. . . . . Bottom

System Design

1. CLASSIFY FUEL
(SEE SECTION 5A)

Gasoline and Diesel are not water soluble. Agent chosen: 3% AFFF

2. DEFINE
HAZARD AREA
(PAGE 5D-3)

The drainage system runs around the perimeter of both bays. Therefore, the area including the drainage system must be protected.

3. DETERMINE PRIMARY SYSTEM
DISCHARGE TIME AND
APPLICATION RATE (PAGE 5D-3)

The Discharge Time for overhead systems is 10 minutes. According to Table 5D-1, the Application Rate for water insoluble hydrocarbons using AFFF is 0.16 gpm/ft^2 (4.1 Lpm/m^2).

4. CALCULATE PRIMARY
FOAM QUANTITY
(PAGE 5D-4)

First, determine the Foam Solution Discharge Rate:

FOAM SOLUTION DISCHARGE RATE = AREA OF HAZARD X APPL. RATE

FOAM SOLUTION DISCHARGE RATE = 4565 ft^2 X 0.16 gpm/ft^2

FOAM SOLUTION DISCHARGE RATE = 731 gpm (2767 Lpm)

Then, determine the foam concentrate quantity:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X 10 MINUTES X CONC. %

QUANTITY = 731 gpm X 10 minutes X 0.03 (3% AFFF)

QUANTITY = 220 gal (833 L)

5. DETERMINE NUMBER
OF GROUND SWEEP NOZZLES
(PAGE 5D-4)

Customer requires two ground sweep nozzles per bay because of bottom loading operation – total of four nozzles.

6. CALCULATE FOAM QUANTITY
FOR GROUND SWEEP
(PAGE 5D-4)

Ground sweep nozzle chosen has flow rate of 29 gpm (110 Lpm). The required Discharge Time is 10 minutes.

First, determine the Foam Solution Discharge Rate:

FOAM SOLUTION DISCHARGE RATE = NOZZLE FLOW RATE X NO. OF NOZZLES

FOAM SOLUTION DISCHARGE RATE = 29 gpm X 4 NOZZLES

FOAM SOLUTION DISCHARGE RATE = 116 gpm (439 Lpm)

Then, determine the foam concentrate quantity:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X 10 MINUTES X CONC. %

QUANTITY = 116 gpm X 10 minutes X 0.03 (3% AFFF)

QUANTITY = 35 gal (132 L)

7. CALCULATE TOTAL
FOAM QUANTITY

Primary . . . . 220 gal.

Ground Sweep . . . . 35 gal.

Total Foam Quantity . . . . . 255 gal (965 L) AFFF 3%
Foam Concentrate

8. CALCULATE NUMBER
OF SPRINKLERS
(PAGE 5D-4)

$$\text{NUMBER OF SPRINKLERS} = \frac{\text{HAZARD LENGTH}}{10} \times \frac{\text{HAZARD WIDTH}}{10}$$

$$\text{NUMBER OF SPRINKLERS} = \frac{83\text{ ft}}{10} \times \frac{55\text{ ft}}{10}$$

NUMBER OF SPRINKLERS = 8.3 X 5.5

Fractions or decimals must be rounded up to the nearest whole number before multiplying.

NUMBER OF SPRINKLERS = 9 X 6

NUMBER OF SPRINKLERS = 54

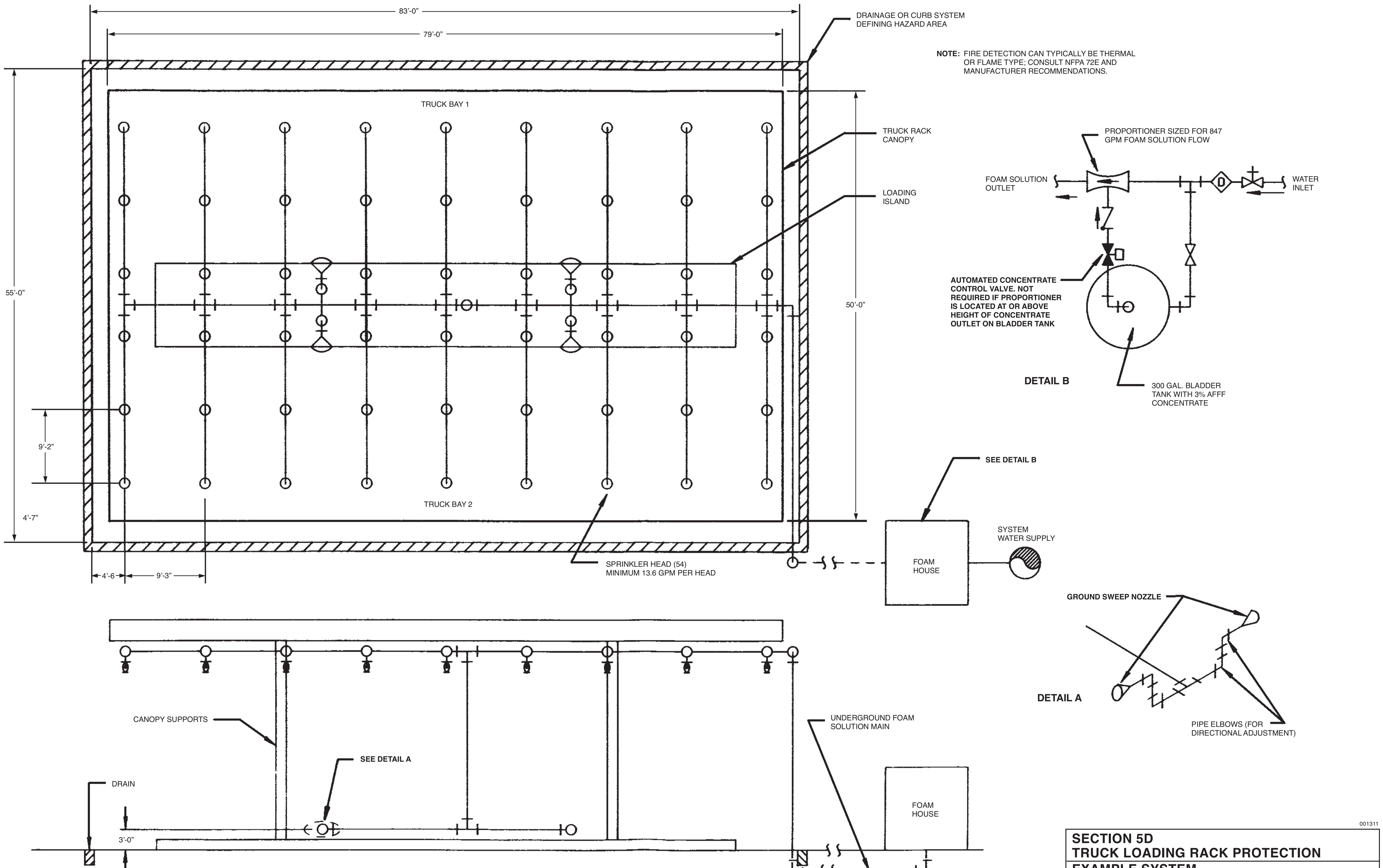
9. COMPILE
BILL OF MATERIALS

NOTICE

This is an example only. Selection of agent and proportioning equipment will vary with each application. For detection and control system recommendations, contact Ansul Incorporated.

Quantity	Description
1	300 Gallon Bladder Tank
1	Proportioner, Sized for 847 gpm (3206 Lpm) – Total System
54	Sprinkler Head
4	Ground Sweep Nozzle, 29 gpm (110 Lpm)
300 gal	ANSULITE AFFF 3% Concentrate
As Required	Test Foam, ANSULITE AFFF 3% Concentrate

EXAMPLE SYSTEM (Continued)



SECTION 5D TRUCK LOADING RACK PROTECTION
EXAMPLE SYSTEM
SHEET 2 OF 2

Heliport Protection

PROTECTION OVERVIEW

With increasing demands for rapid transportation to areas that are difficult to reach quickly, helicopter transportation has been on the uprise in business and the emergency medical fields. This has also increased the demand for fire protection at facilities which accommodate helicopters.

Fire protection at heliports consists generally of foam application using hand hose lines, oscillating monitors, or fixed nozzles depending on the authority having jurisdiction.

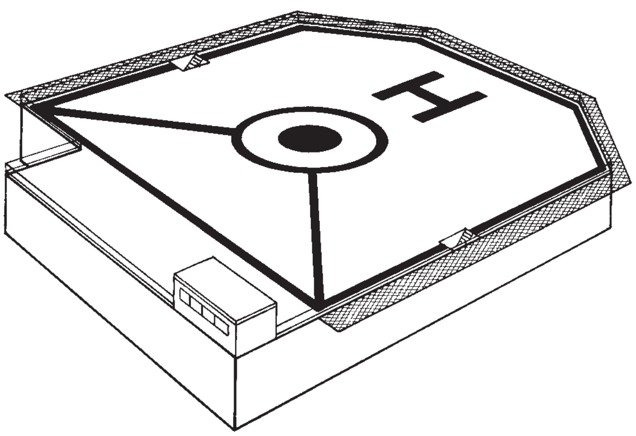
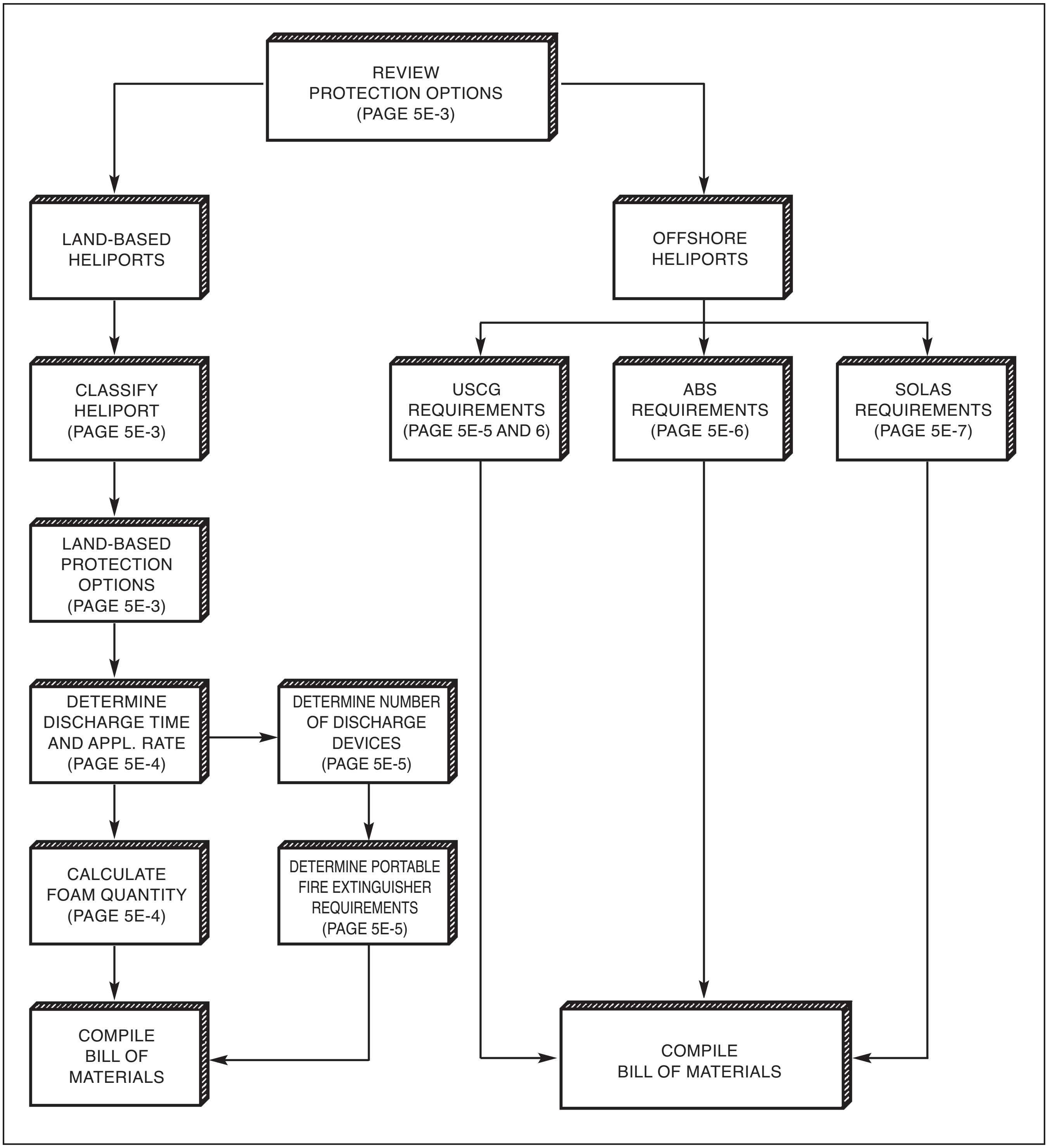


FIGURE 5E-1
001312

Heliport Protection

HELIPORT PROTECTION FLOW CHART

The following flow chart defines a logical sequence for designing heliport systems.



Heliport Protection

PROTECTION OPTIONS

The codes and standards for protecting heliports vary depending on the authority having jurisdiction. Heliport protection is divided into two basic categories: land-based and offshore.

Land-Based Heliports

NFPA 418 "Standard for Heliports" addresses minimum fire protection requirements for land-based heliport facilities. This standard also addresses protection requirements for rooftop landing facilities.

Offshore Heliports

NFPA 418 "Standard for Heliports" also covers offshore heliports which can be either fixed or mobile installations. These heliports shall be approved by the authority having jurisdiction, which may be the United States Coast Guard (USCG) Title 46, American Bureau of Shipping (ABS) Mobile Offshore Drilling Units, and the International Convention for the Safety Of Life At Sea (SOLAS).

CLASSIFYING HELIPORTS

The degree of fire protection recommended is determined by the "practical critical fire area," which has been compiled from factors such as aircraft size, passenger load, fuel capacity, etc. The three categories of heliports are defined by NFPA 418 as follows:

H-1 Heliports

Helicopter overall length* up to, but not including, 50 ft (15 m) with a practical critical fire area of 375 ft^2 (34.8 m^2).

H-2 Heliports

Helicopter overall length* from 50 ft (15 m) up to, but not including, 80 ft (24.4 m) with a practical critical fire area of 840 ft^2 (78 m^2).

H-3 Heliports

Helicopter overall length* from 80 ft (24 m) up to, but not including, 120 ft (36.6 m) with a practical critical fire area of 1440 ft^2 (133.8 m^2).

* Helicopter length, including the tail boom and the rotors.

LAND-BASED PROTECTION OPTIONS

NFPA 418 requires semi-fixed hand hoseline systems for H-1, H-2, and H-3 heliports protection. Fixed foam systems may be used to satisfy the requirement for hand hoselines and may be desirable especially where refueling operations are performed. In addition to foam requirements, at least one portable fire extinguisher for each takeoff and landing area, parking area, and fuel storage area shall be provided.

Other fire protection requirements:

– The water supply for the foam system shall be from a reliable source, approved by the authority having jurisdiction.

– The foam components shall be installed in a readily accessible area of the heliport and not penetrate the approach, departure, or transitional areas.

– Fixed foam system components utilizing deck level nozzles and/or oscillating monitors shall be listed or approved.

– Where freezing is possible, adequate freeze protection shall be provided.

– Where buildings are provided with a fire alarm system, a manual pull station shall be provided for each designated means of egress from the roof.

Heliport Protection

DETERMINING DISCHARGE TIME AND APPLICATION RATE

Hand Hoselines

The discharge rates and minimum amounts of water for foam production for semi-fixed systems are listed in Table 5E-1.

Category (ft)		(ft)	1/2 O.L. of Largest Helicopter (ft)		Fuselage Width Tripled (ft)		Practical Critical Fire Area (ft^2)		Application Rate (gpm/ft^2)		Q_1 (gal)		Q_2		Q (gal)
H-1 0	<	50	25	X	15	=	375	X	0.10	=	37.5	+	100%	=	75
H-2 50	<	80	40	X	21	=	840	X	0.10	=	84	+	100%	=	168
H-3 80	<	120	60	X	24	=	1440	X	0.10	=	144	+	100%	=	288

O.L.: Overall length, measured from tip of main rotor fully extended to tip of tail rotor fully extended. Fuselage width: Actual fuselage width (does not include landing gear) measured from outside of cabin.

Q_1: Water to control within 1 minute. Q_2: Reserve to extinguish. Q: Total water to extinguish.

TABLE 5E-1

Exception: Two portable foam fire extinguishers having a rating of 20-A:160-B each may be used to satisfy overall requirements for Category H-1.

Fixed Nozzles/Monitors

The minimum required discharge time for fixed nozzles/monitors is 5 minutes. When AFFF is supplied, the required minimum application rate is 0.10 gpm/ft^2 (4.1 Lpm/m^2).

CALCULATING FOAM QUANTITY

Fixed Nozzles/Monitors

To calculate the minimum foam concentrate quantity for fixed nozzles and/or monitors, use the following formula to determine Foam Solution Discharge Rate which is required to determine proportioner size and nozzle quantity:

FOAM SOLUTION DISCHARGE RATE = AREA OF LANDING DECK x APPLICATION RATE

Note: For some heliport installations, an allowance should be made to account for adverse site conditions which may effect foam distribution.

Now, calculate the foam concentrate quantity using the following formula:

QUANTITY = FOAM SOLUTION DISCHARGE RATE x 5 MINUTES x CONCENTRATE %

DETERMINING NUMBER OF DISCHARGE DEVICES

Hand Hoselines

The number of hand hoselines required is based upon the discharge rate per Table 5E-1. This is also based upon standard hose nozzle available, such as 60, 95, or 120 gpm (227, 360, or 454 Lpm) that can be handled by a single operator.

Fixed Nozzles/Monitors

Fixed nozzle and monitor quantity is based on the ability of the devices to cover the entire landing deck area.

DETERMINING PORTABLE FIRE EXTINGUISHER REQUIREMENTS

At least one portable fire extinguisher shall be provided for each takeoff and landing, parking area, and fuel storage area.

Minimum rating for portable fire extinguishers for heliport categories are listed in Table 5E-2.

Heliport Category	Minimum Rating
H-1	4-A:80-B
H-2	10-A:120-B
H-3	30-A:240-B

TABLE 5E-2

USCG (UNITED STATES COAST GUARD) REQUIREMENTS (OFFSHORE SYSTEMS)

The following was taken from the Federal Code of Regulations, Title 46, October 1986. Because they are occasionally updated, it is important that the current codes be studied in complete detail before developing final plans. Systems installed in accordance with United States Coast Guard rules and regulations must utilize USCG-approved equipment.

108.486 Helicopter decks.

At least two of the accesses to the helicopter landing deck must each have a fire hydrant on the unit's fire main system located next to them.

108.487 Helicopter deck fueling operations.

(a) Each helicopter landing deck on which fueling operations are conducted must have a fire protection system that discharges protein foam or aqueous film-forming foam.

(b) A system that only discharges foam must –

(1) Have enough foam agent to discharge foam continuously for at least 5 minutes at maximum discharge rate;

(2) Have at least the amount of foam agent needed to cover an area equivalent to the swept rotor area of the largest helicopter for which the deck is designed with foam at –

(i) If protein foam is used, 6.52 liters per minute for each square meter (0.16 gallons per minutes for each square foot) of area covered for five minutes;

(ii) If aqueous film-forming foam is used, 4.07 liters per minutes for each square meter (0.1 gallons per minute for each square foot) of area covered for five minutes; and

(3) Be capable of discharging from each hose at 7 kilograms per square centimeter (100 pounds per square inch) pressure –

(i) A single foam stream at a rate of at least 340 liters (90 gal) per minute; and

(ii) A foam spray at a rate of at least 90 liters (50 gallons) per minute.

(c) Each system must have operating controls at each of its hose locations, be protected from icing and freezing, and be capable of operation within 10 seconds after activation of its controls.

(d) Each system must have at least one hose at each of the two access routes required by 108.235(f) of this part. Each hose must be reel mounted and long enough to cover any point on the helicopter deck. Each hose that discharges foam must have a nozzle that has foam stream, foam spray, and off positions.

Heliport Protection

USCG (UNITED STATES COAST GUARD) REQUIREMENTS (OFFSHORE SYSTEMS) (Continued)

108.489 Helicopter fueling facilities.

(a) Each helicopter fueling facility must have a fire protection system that discharges one of the following agents in the amounts prescribed for the agents over the area of the fuel containment systems around marine portable tanks, fuel transfer pumps and fuel hose reels:

(1) Protein foam at the rate of 6.52 liters per minute for each square meter (0.16 gallons per minutes for each square foot) of area covered for five minutes.

(2) Aqueous film-forming foam at the rate of 4.07 liters per minute for each square meter (0.1 gallons per minutes for each square foot) of area covered for five minutes.

(3) 22.5 kg (50 lb) of dry chemical (B-V semi-portable) for each fueling facility of up to 27.87 square meters (300 square feet).

(b) If the fire protection system required by 108.487 of this subpart is arranged so that it covers both a helicopter fueling facility and a landing deck, the system must have the quantity of agents required by this section in addition to the quantity required by 108.487.

ABS (AMERICAN BUREAU OF SHIPPING) REQUIREMENTS (OFFSHORE SYSTEMS)

The following was taken from the Rules for Building and Classing Mobile Offshore Drilling Units, 1980. Because they are occasionally updated, it is important that the current rules be studied in complete detail before developing final plans.

15.5 Fire-Fighting Equipment for Helicopter Decks

15.5.1 General

Where areas of a unit are designated for helicopter operations, details of the facilities are to be submitted and the fire-fighting systems of 15.5.2 and 15.5.3 are to be provided and stored near the access to those areas.

15.5.2 Helicopter Decks with No Refueling Capabilities

(a) Hoses and Nozzles: At least two approved combination solid stream and water spray and detachable applicator and hoses sufficient in length to reach any part of the helicopter deck are to be provided.

(b) Portable Extinguishers: The helicopter deck area is to be protected by approved dry powder extinguishers of a total capacity of not less than 45 kg (100 lb).

(c) Back-Up System: A back-up fire-fighting system is to be provided, consisting of CO_2 extinguishers of a total capacity of not less than 18 kg (40 lb) or equivalent, one of these extinguishers being equipped so as to enable it to reach the engine area of any helicopter using the deck. The back-up system is to be located so that the equipment would not be vulnerable to the same damage as the dry powder extinguishers required by 15.5.2b.

15.5.3 Helicopter Decks with Refueling Capabilities

(a) Fire-Fighting Systems: A fire-fighting system as required by 15.5.2 is to be provided and arranged so as to adequately protect both the helicopter deck and helicopter fuel storage areas.

(b) Fixed-Foam System: A fixed-foam fire-extinguishing system, consisting of monitors or hose streams or both, is to be installed to protect the helicopter landing deck and fuel storage areas. The system is to be capable of delivering foam solution at a rate of 6.0 liters per square meter per minute (0.15 gpm per square foot) for protein foam or 4.1 liter per square meter per minute (0.10 gpm per square foot) for aqueous film-forming foam (AFFF) of the areas protected for at least 5 minutes. The operation of the foam system is not to interfere with the simultaneous operation of the fire main.

SOLAS (SAFETY OF LIFE AT SEA) REQUIREMENTS (OFFSHORE SYSTEMS)

The following was taken from the Code for the Construction and Equipment of Mobile Offshore Drilling Units, 1983. Because they are occasionally updated, it is important that the current codes be studied in complete detail before developing final plans.

9.11 Provisions for helicopter facilities

9.11.2 On any helicopter deck there should be provided and stored near to the means of access to that deck:

.1 dry powder extinguishers of a total capacity of not less than 45 kilograms (100 lb);

.2 a suitable foam application system consisting of monitors or foam-making branch pipes capable of delivering foam solution at a rate of not less than 6 liters per minute for at least 5 minutes for each square meter (0.15 gpm/ft^2) of the area contained within a circle of diameter "D", where "D" is the distance in meters across the main rotor and tail rotor in the fore and aft line of a helicopter with a single main rotor and across both rotors for a tandem rotor helicopter;

.3 carbon dioxide extinguishers of a total capacity of not less than 18 kilograms (40 lb) or equivalent, one of these extinguishers being so equipped as to enable it to reach the engine area of any helicopter using the deck; and

.4 at least two dual purpose nozzles and hoses sufficient to reach any part of the helicopter deck.

EXAMPLE SYSTEM

Hazard Specifications

Rooftop Dimensions . . . . 150 x 150 ft (46 x 46 m)

Landing Deck Dimensions . . . 75 x 75 ft (23 x 23 m)

Helicopter Overall Length . . . . 70 ft (21.3 m)

System Design

1. REVIEW PROTECTION OPTIONS (PAGE 5E-3)

The heliport is located on a roof top; therefore, the Land-Based guidelines must be followed.

2. CLASSIFY HELIPORT (PAGE 5E-3)

Because the helicopter using the deck has an overall length (including tail boom and rotors) of 70 ft (21.3 m), the heliport is classified as H-2.

3. LAND-BASED PROTECTION OPTIONS (PAGE 5E-3)

Because refueling operations are performed, the customer requests a fixed foam system with fixed deck nozzles.

4. DETERMINE DISCHARGE TIME AND APPL. RATE (PAGE 5E-4)

AFFF is the agent chosen because of the lower application rates.

The Application Rate is 0.10 gpm/ft^2 (4.1 Lpm/m^2) for fixed nozzles using AFFF. The required Discharge Time for fixed nozzles is 5 minutes.

5. CALCULATE FOAM QUANTITY (PAGE 5E-4)

FIXED DECK NOZZLES

First, determine the Foam Solution Discharge Rate as follows:

FOAM SOLUTION DISCHARGE RATE = AREA OF LANDING DECK X APPL. RATE

FOAM SOLUTION DISCHARGE RATE = 5625 ft^2 (522.6 m^2) x 0.10 gpm/ft^2 (4.1 Lpm/m^2)

FOAM SOLUTION DISCHARGE RATE = 563 gpm (2131 Lpm)

Then, determine the foam concentrate quantity:

QUANTITY = FOAM SOLUTION DISCHARGE RATE X 5 MINUTES X CONC. %

QUANTITY = 563 gpm (2131 Lpm) X 5 MINUTES X 0.03 (3% AFFF)

QUANTITY = 85 gal (322 L)

Total Foam Quantity . . . . . 85 gal (697 L) AFFF 3% Foam Concentrate

6. DETERMINE NUMBER OF DISCHARGE DEVICES (PAGE 5E-5)

Deck nozzles chosen have flow rate of 70 gpm (265 Lpm). Because the total Foam Solution Discharge Rate is 563 gpm (2131 Lpm), 8 deck nozzles are used (563 gpm divided by 70 gpm).

7. COMPILE BILL OF MATERIALS

One portable extinguisher is required in takeoff/landing area and one in the fuel storage area. Each must have a minimum rating of 10-A:120-B.

8. DETERMINE PORTABLE FIRE EXTINGUISHER REQUIREMENTS

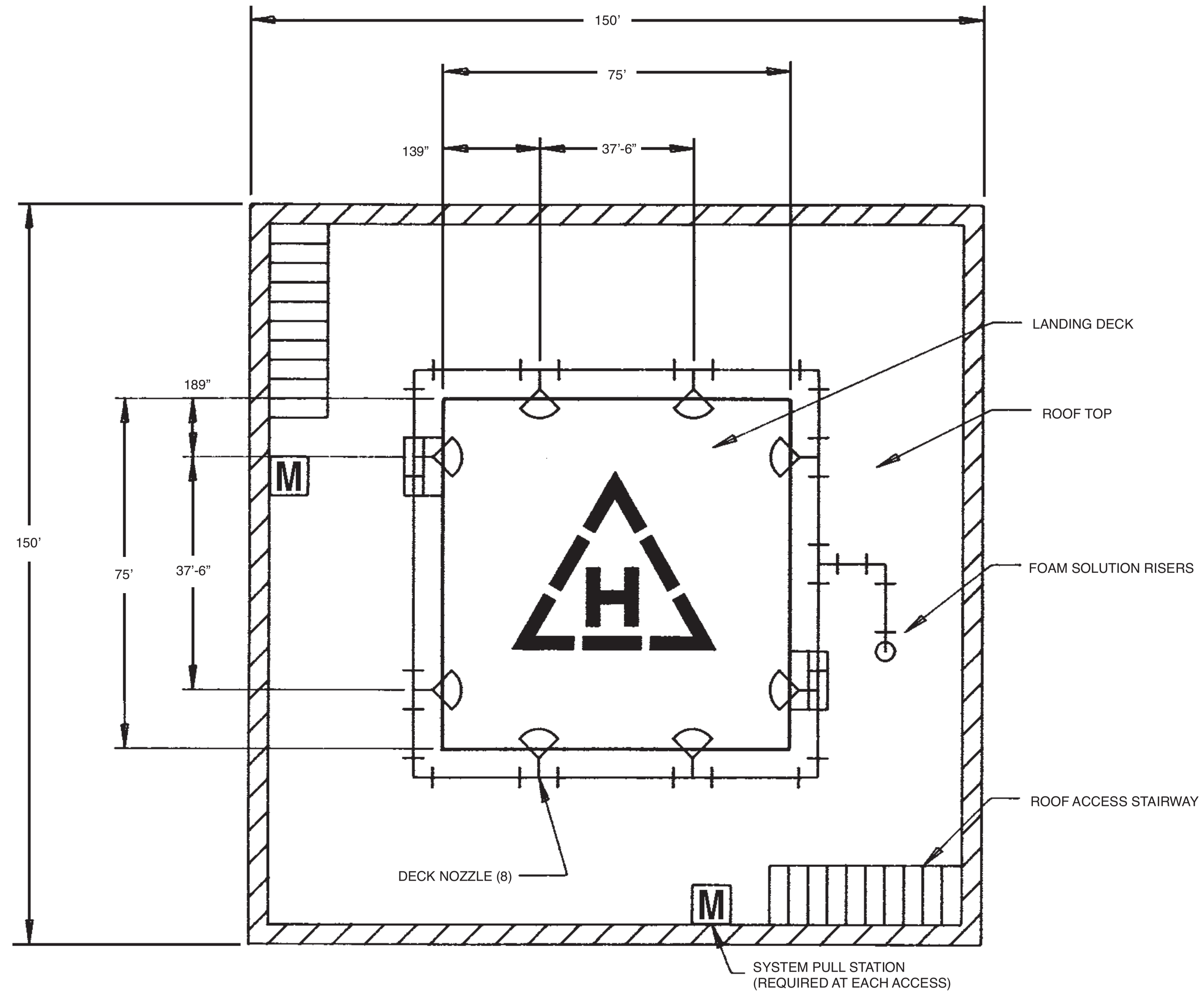
NOTICE

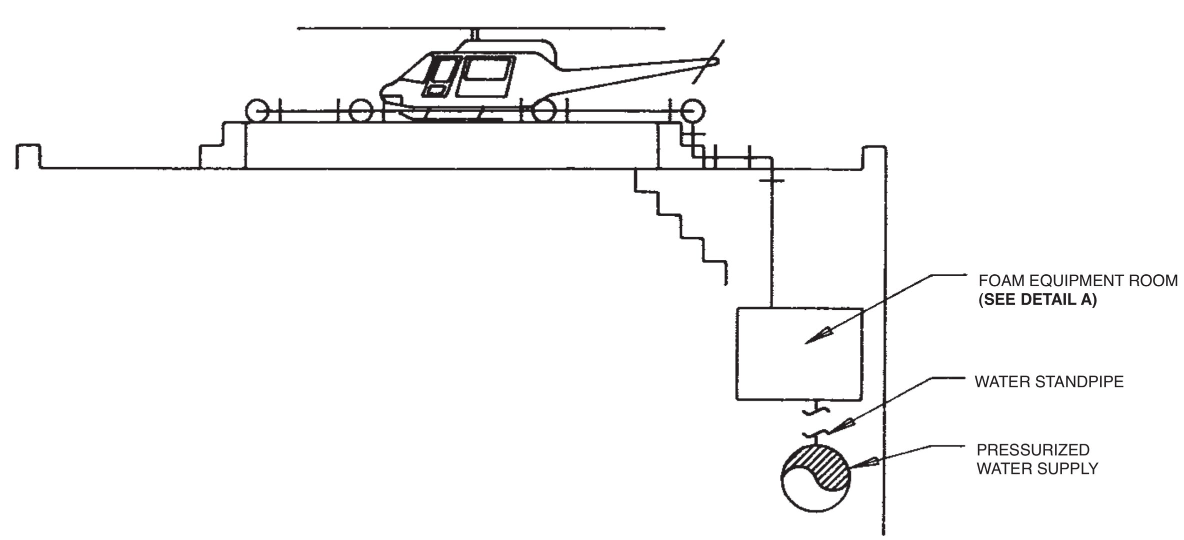
This is an example only. Selection of agent and proportioning equipment will vary with each application. For detection and control system recommendations, contact Ansul Incorporated.

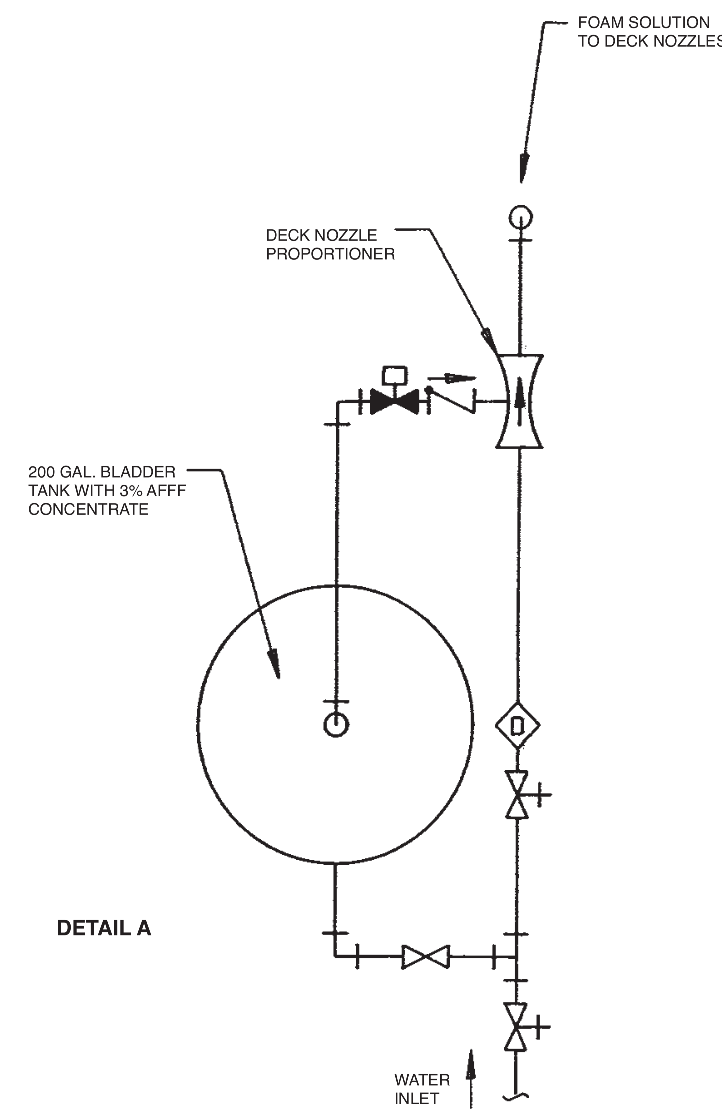
Quantity	Description
1	100 Gallon Bladder Tank
1	Proportioner, Sized for 563 gpm (2131 Lpm) – Deck Nozzles
8	Fixed Deck Nozzle, 70 gpm (265 Lpm)
85 gal	ANSULITE AFFF 3% Concentrate
As Required	Test Foam, ANSULITE AFFF 3% Concentrate
2	SENTRY SY-2014 Hand Portable Fire Extinguisher

F-2011077-01

EXAMPLE SYSTEM (Continued)







DETAIL A

001314

SECTION 5E
HELIPORT PROTECTION
EXAMPLE SYSTEM
SHEET 2 OF 2

Foam System Design and Application

Spill Fire Protection

PROTECTION OVERVIEW

Spill fire protection may be considered for areas where flammable liquids are processed, stored, handled, or transported. Because spill fire size and shape are often unpredictable, spill fire protection should not be considered a replacement for those systems previously discussed in Sections 5B through 5E. The area to be protected should be studied carefully, and the actual system provided must be approved by the end-user and the authority having jurisdiction.

NOTICE

Spill fire protection should not be confused with dike protection requirements (Pages 5B-18 through 5B-20) where fuel-in-depth fires from the failure of a large storage tank are possible.

The largest potential spill area must be carefully considered to determine the number, type, and location of discharge devices; as well as the quantity of foam concentrate required. Factors that must be considered include:

1. Amount, source, and type of potential flammable liquid spill.
2. Physical characteristics of the flammable liquids, such as viscosity, that may limit or aid the spread of a spill.
3. Presence of dikes, curbs, drainage systems, etc., that may contain a spill.
4. Type of ground surface (such as sand, clay, asphalt, concrete, etc.) that may limit or aid the spread of a spill.
5. The surface grade or slope of the areas that may limit, aid, or redirect the spread of a spill.

PROTECTION OPTIONS

Protection for a flammable liquid spill fire may be a fixed system such as an oscillating monitor prepiped to a bladder tank and proportioner, or portable equipment such as hand hose lines supplied from an eductor with a pick-up tube and 5 gal. concentrate containers.

DETERMINING DISCHARGE TIME AND APPLICATION RATE

The amount of foam concentrate must be sufficient for a discharge time of 15 minutes with fixed systems and 15 minutes with portable equipment. The application rates are as follows:

Fuel Protected	Foam Concentrate	Application Rate gpm/ft^2	(Lpm/m^2)
Hydrocarbon (Water Insoluble)	Protein	0.16	(6.5)
	Fluoroprotein	0.16	(6.5)
	AFFF	0.10	(4.1)
Alcohols			
Methanol	ARC	0.10	(6.9)
	3X3 L.V.	0.10	(6.1)
Ethanol	ARC	0.10	(6.9)
	3X3 L.V.	0.10	(6.1)
Isopropanol	ARC	0.15	(6.9)
	3X3 L.V.	0.15	(6.1)
Ketones			
Methyl Ethyl Ketone	ARC	0.15	(6.9)
	3X3 L.V.	0.10	(6.1)
Acetone	ARC	0.15	(6.9)
	3X3 L.V.	0.15	(6.1)
Carboxylic Acids	ARC	0.17	(6.9)
	3X3 L.V.	0.17	(4.1)
Aldehydes	ARC	0.17	(5.3)
	3X3 L.V.	0.17	(6.5)
Esters	ARC	0.10	(4.1)
	3X3 L.V.	0.10	(4.1)
Ethers (Ethyl Tertiary Butyl Ether)	ARC	0.17	(6.9)
	3X3 L.V.	0.14	(6.1)

Consult 3x3 L.V. or ARC data sheets for other specific fuels. Rates are based on Type II discharge devices but can be used for Type III provided the fuel depth does not exceed 1 in. (2.54 cm). If fuel depth exceeds 1 in. (2.54 cm) and Type III application technique is used, above application rates should be increased by 60% and duration for dike protection should be followed (Page 5B-19).

TABLE 5F-1

Spill Fire Protection

TYPICAL SYSTEM

A typical fixed system protecting a spill is shown in Figure 5F-1.

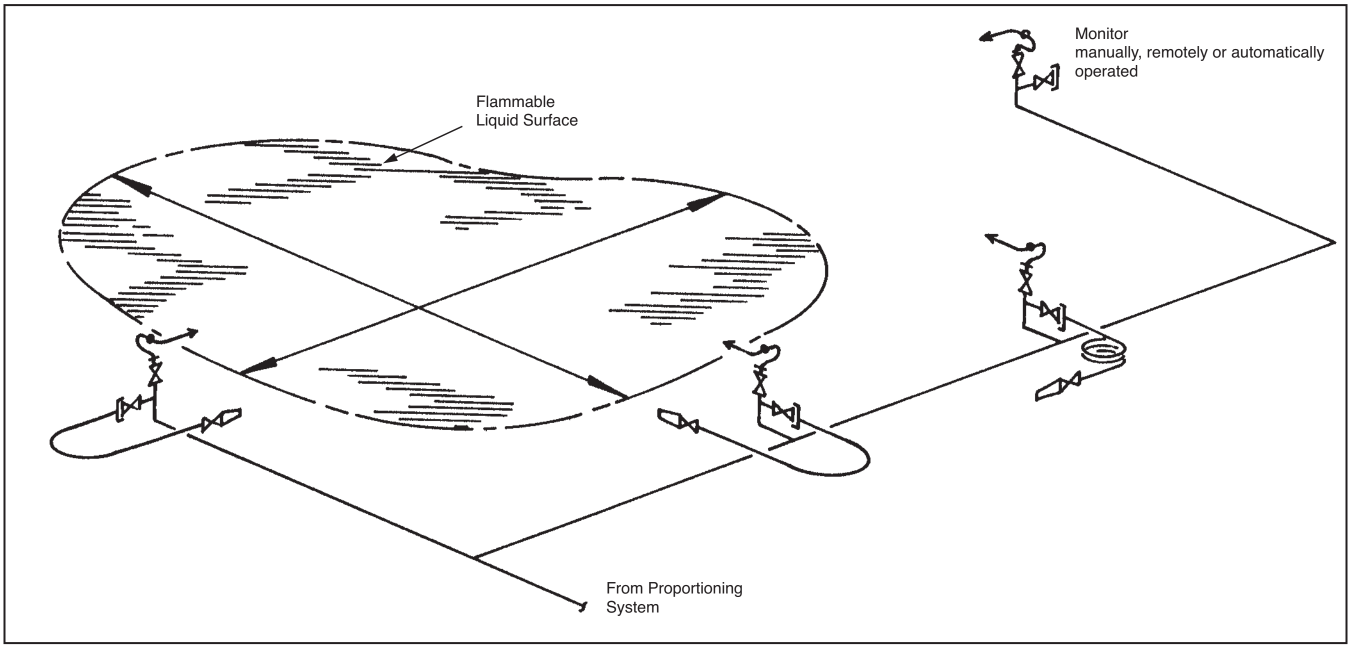


FIGURE 5F-1
001315

PROTECTION OVERVIEW

The ever increasing number of fires occurring in warehouses, storage buildings, basements, tunnels, etc., suggest that many fire situations are now being encountered in which fire fighters using a traditional foam or water extinguishing agent are unable to reach the source of the fire. In addition, the risks are no longer just Class A or B materials, they are hazardous toxic chemicals. The high and medium expansion foam systems offer a fire extinguishing procedure that will automatically seek out and extinguish the fire at the source. The foam blanket that is produced by this system transports water to the fire, suffocates and cools the fire, suppresses escaping vapors and encapsulates the toxic vapors and particulate.

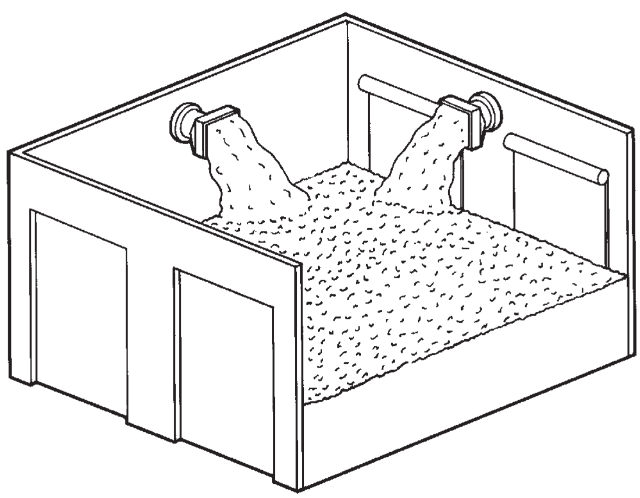


FIGURE 5G-1
001316

PROTECTION OPTIONS

The design standard adopted throughout this section meets the requirements of NFPA 11 “Standard for Low-, Medium-, and High-Expansion Foam”; refer to this standard for further information not mentioned in this section. It is important to note that this standard refers to minimum application rates of expanded foam as cubic feet per minute (cfm) ► (cubic meters per minute (cmm)), not as a solution in gallons per minute (gpm) (liters per minute (Lpm)).

Care should be taken when using either medium or high expansion foams to implement personnel evacuation procedures prior to or simultaneously with the system actuation to prevent individuals from being trapped and disoriented in the rising foam blanket. Due to the limited amount of moisture present in the foam it should be used with caution around exposed electrical equipment; it should not be used if exposed high voltages are involved.

Total Flooding High-Expansion Foam Systems

High-expansion foam generators typically deliver expansion ratios between 200:1 to 1000:1. The foam is capable of totally flooding large rooms and enclosures allowing it to be delivered to the source of the fire and effectively extinguish horizontal and vertical (three dimensional) fires. If the foam is allowed to dissipate, there will be minimal water damage to the enclosure and the contents.

High-expansion foam is effective in controlling Liquefied Natural Gas (LNG) fires by blocking heat feed-back from the flames to the LNG thereby reducing the vaporization rate.

Medium/High-Expansion Foam – Local Application Systems

Local application systems are best suited for the protection of basically flat surfaces such as confined spills, curbed areas, pits, trenches, etc. When utilized to protect multilevel or three dimensional hazards, an acceptable method of foam containment must be provided.

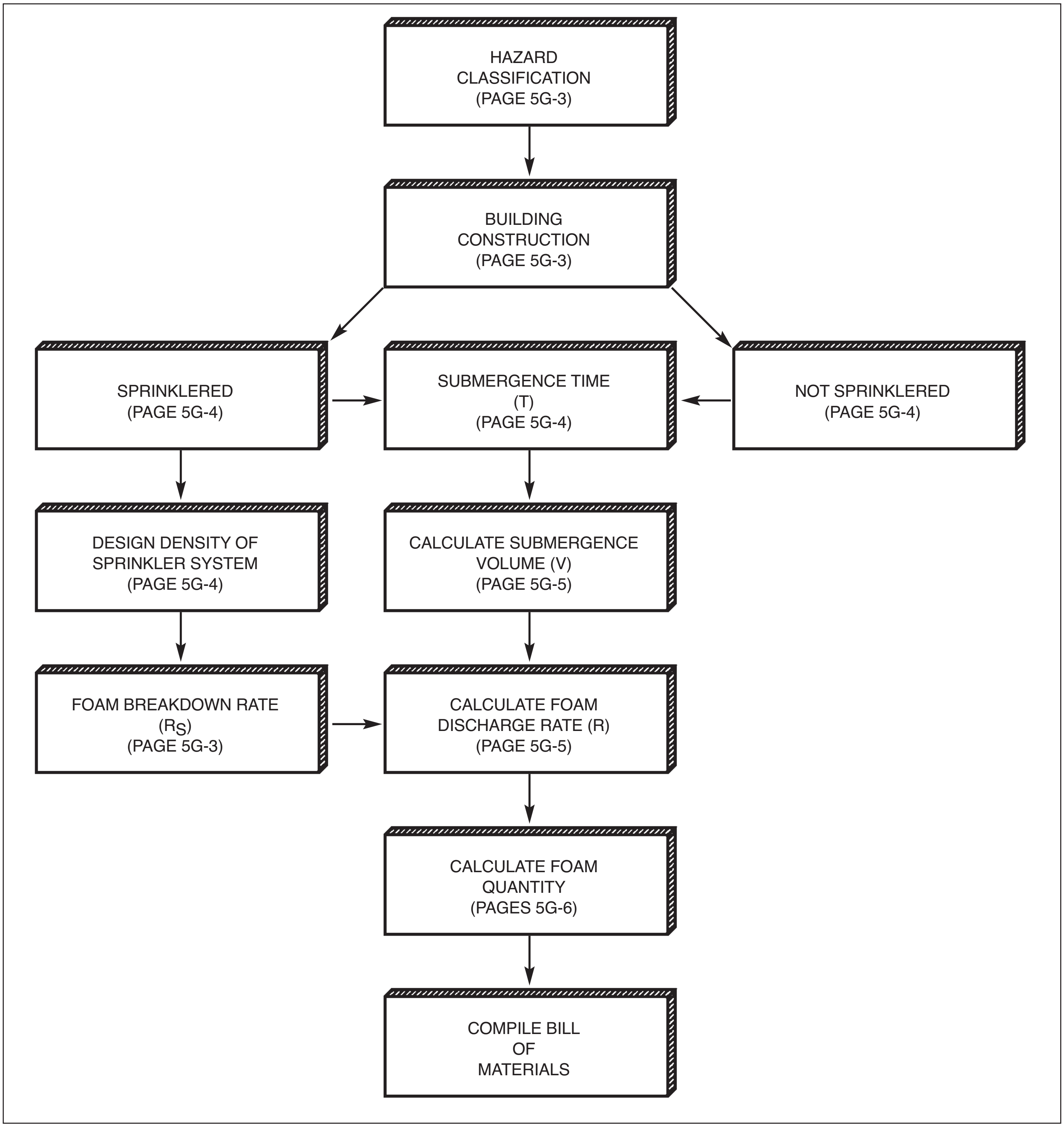
Medium-expansion foam solution is expanded in volume within a range of 20:1 to 200:1. The foam blanket formed by the generator prevents the release of fuel vapor and provides additional cooling due to the higher water content. Medium-expansion foam has benefits in outdoor applications because the foam is less affected by wind conditions.

High-Expansion Foam Systems

TOTAL FLOODING HIGH-EXPANSION FOAM SYSTEMS

Total Flooding System Flow Chart

The following flow chart defines a logical sequence for designing total flooding systems.



High-Expansion Foam Systems

TOTAL FLOODING HIGH-EXPANSION FOAM SYSTEMS (Continued)

The minimum application rate of expanded foam necessary to extinguish or control a fire depends on a number of factors including hazard classification, building construction, the presence of a sprinkler system, submergence time and volume, and foam generator selection.

Hazard Classification

The hazard classification is based on the products to be stored, used or moved in and out of the protected area. When multiple products are present it is important to choose the classification with the most severe hazard. An example of a hazard classification would be Low Density Combustibles (i.e., foam rubber, foam plastics, rolled tissue or crepe paper). These classifications are listed in the left-hand column of Table 5G-1 on Page 5G-4.

Building Construction

Building construction is classified as either (a) light or unprotected steel construction or as (b) heavy, protected or fire-resistive construction. This information in combination with other factors is used to determine the minimum submergence time in Table 5G-1 on Page 5G-4.

Sprinkler Systems and Foam Breakdown Rate (Rs)

If an automatic sprinkler system is installed, the action of the sprinklers will cause a breakdown of the foam. The portion of the foam destroyed is calculated at 10 cfm per gpm (0.0748 cmm per Lpm) of sprinkler discharge. The information for the sprinkler design density and floor area of the sprinklers can typically be found on a design information sign located at the sprinkler system alarm valve, dry pipe valve, or preaction valve. Use the following formula to calculate the foam breakdown rate.

FOAM BREAKDOWN RATE (R_S) = FOAM DESTROYED x SPRINKLER DESIGN DENSITY x FLOOR AREA

Typical calculation:

R_S = 10 cfm/gpm x 0.30 gpm/ft^2 x 3000 ft^2

R_S = 9000 cfm (254.85 cmm)

If the hazard area does not have a sprinkler system, no calculation is required (R_S = 0).

High-Expansion Foam Systems

TOTAL FLOODING HIGH-EXPANSION FOAM SYSTEMS (Continued)

Minimum Submergence Time (T)

After determining the type of hazard, building construction, and presence of a sprinkler system, select the appropriate value for the minimum submergence time (T) from the following table.

	Light or Unprotected Steel Construction		Heavy or Protected or Fire Resistant Construction	
Type of Hazard	Sprinklered	Not Sprinklered	Sprinklered	Not Sprinklered
Flammable Liquids (Flash Points below 100 °F (38 °C)) having a vapor pressure not exceeding 40 psi (276 kPa)	3 minutes	2 minutes	5 minutes	3 minutes
Combustible Liquids (Flash Points at or above 100 °F (38 °C))	4 minutes	3 minutes	5 minutes	3 minutes
Low Density Combustibles i.e., Foam Rubber, Plastics, Rolled Tissue	4 minutes	3 minutes*	6 minutes	4 minutes*
High Density Combustibles i.e., Rolled Paper Kraft or Coated-Banded	7 minutes	5 minutes*	8 minutes	6 minutes*
High Density Combustibles i.e., Rolled Paper Kraft or Coated-Unbanded	5 minutes	4 minutes*	6 minutes	5 minutes*
Rubber Tires	7 minutes	5 minutes*	8 minutes	6 minutes*
Combustibles, in cartons, bags, fiber drums	7 minutes	5 minutes*	8 minutes	6 minutes*

* These submergence times may not be directly applicable to high piled storage above 15 ft (4.6 m) or where fire spread through combustible contents is very rapid.

▸ Table per NFPA 11.

▸ **TABLE 5G-1**

High-Expansion Foam Systems

TOTAL FLOODING HIGH-EXPANSION FOAM SYSTEMS (Continued)

Minimum Submergence Volume (V)

The submergence volume is the floor area of the hazard to be protected, multiplied by the minimum fill depth. The minimum total depth of foam shall be not less than 1.1 times the height of the highest hazard, but in no case less than 2 ft (0.6 m) over the hazard. To determine the minimum fill depth of foam, find the height of the highest hazard and use that height in one of the following formulas.

If hazard height is less than 20 ft (6.1 m), use the following formula:

MINIMUM FILL DEPTH = HEIGHT + 2 FEET (0.6 m)

If hazard height is 20 ft (6.1 m) or more, use this formula:

MINIMUM FILL DEPTH = HEIGHT x 1.1

Now, calculate the minimum submergence volume using the following formula:

MINIMUM SUBMERGENCE VOLUME (V) =
FLOOR AREA x MINIMUM FILL DEPTH

Fractions or decimals should be rounded up to the nearest whole number.

Typical calculation:

EXAMPLE ONE – HEIGHT IS LESS THAN 20 ft (6.1 m)

FLOOR AREA = 100 ft x 30 ft = 3000 ft^2 (279 m^2)

HAZARD HEIGHT = 12 ft (3.7 m)

MINIMUM FILL DEPTH = 12 ft + 2 ft = 14 ft (4.3 m)

MINIMUM SUBMERGENCE VOLUME (V) = 3000 ft^2 x 14 ft = 42,000 ft^3 (1189 m^3)

EXAMPLE TWO – HEIGHT IS 20 ft (6.1 m) or More

FLOOR AREA = 100 ft. x 30 ft = 3000 ft^2 (279 m^2)

HAZARD HEIGHT = 25 ft (7.6 m)

MINIMUM FILL DEPTH = 25 ft x 1.1 = 27.5 ft (8.4 m)

MINIMUM SUBMERGENCE VOLUME (V) = 3000 ft^2 x 27.5 ft = 82,500 ft^3 (2336 m^3)

Compensation for Foam Shrinkage (C_N = 1.15)

This is an empirical number based on the average expanded foam losses that can be expected due to drainage, fire, wetting of surfaces, etc. Unless otherwise specified, this factor shall be 1.15.

Compensation for Foam Leakage (C_L)

This is a compensation factor for the loss of foam due to leakage around doors, windows and other uncloseable openings (vents, etc.). For a totally-sealed area, C_L equals 1. However, this factor could be as high as 1.2 for a building with all openings normally closed depending on foam expansion ratio, sprinkler operation and foam depth. Most often, 1.2 is the factor used for C_L in the systems calculation.

Calculate Foam Discharge Rate (R)

With the information obtained from the previous instructions, calculate the foam discharge rate (R) using the following formula:

$$R = \left(\frac{V}{T} + R_S\right) \times C_N \times C_L$$

Where; R = minimum rate of foam discharge (cfm (cmm))

V = minimum submergence volume (ft^3 (m^3))

T = time to achieve submergence volume (minutes)

R_S = rate of foam breakdown by sprinklers (cfm (cmm))

C_N = compensation for normal foam shrinkage (%)

C_L = compensation for normal foam leakage (%)

High-Expansion Foam Systems

TOTAL FLOODING HIGH-EXPANSION FOAM SYSTEMS (Continued)

Calculate Foam Quantity

To calculate the quantity of foam required to operate the total flooding system, several steps are necessary. Begin by selecting a foam generator from the left hand column in Table 5G-2. Determine the values for foam output and solution flow according to the inlet pressure for the generator selected. Calculate the number of generators needed using the following formula (any fractions should be rounded up to the next whole number):

NUMBER OF GENERATORS = DISCHARGE RATE (R) / GENERATOR FOAM OUTPUT

The system flow rate is the total flow of water and concentrate per minute for the total number of generators required. Calculate the system flow rate with the following formula:

SYSTEM FLOW RATE = NUMBER OF GENERATORS x SOLUTION FLOW

The proportion rate for the 2.75% JET-X High Expansion Foam Concentrate is normally 2.75 gallons (10.4 L) of concentrate to 97.25 gallons (368 L) of water. It is expressed as 0.0275 for use in the formulas. The proportion rate for the 2% JET-X High Expansion Foam Concentrate is normally 2 gallons (7.6 L) of concentrate to 98 gallons (371 L) of water. It is expressed as 0.02 for use in the formulas.

The operating time for the system's foam concentrate and water supply shall be sufficient to (1) continually operate the system for 25 minutes or (2) to generate four times the submergence volume, whichever is less, (3) but in no case less than enough for 15 minutes of full operation.

One of the previous requirements must be met to determine the quantity of foam concentrate required for the system. The formulas for each option are listed below:

1. QUANTITY = SYSTEM FLOW RATE x 25 MIN x PROPORTION RATE
2. QUANTITY = [(4 x SUBMERGENCE VOLUME (V)) / GENERATOR FOAM OUTPUT] x SOLUTION FLOW x PROPORTION RATE
3. QUANTITY = SYSTEM FLOW RATE x 15 MIN x PROPORTION RATE

The lesser quantity from formula 1 or 2 may be used for the system unless that value is less than the quantity for formula 3, then the value for 3 must be used.

A reserve supply of foam concentrate shall be readily available to put the system back in service after operation. This supply may be in separate storage tanks or original shipping containers on the location or available from an approved source within 24 hours.

Typical calculation using JET-X 2% Concentrate:

HAZARD AREA = 125 ft x 180 ft x 30 ft high (38 m x 55 m x 9 m high)

MAXIMUM STORAGE HEIGHT = 25 ft (7.6 m)

CONSTRUCTION = Light Steel, and No Sprinkler System

TYPE OF HAZARD = High Density Combustible (Rolled Paper, Coated-Unbanded)

MINIMUM FILL DEPTH = 25 ft x 1.1 = 27.5 ft (8.4 m)

SUBMERGENCE VOLUME (V) = (125 ft x 180 ft) x 27.5 ft = 618,750 ft^3 (17521 m^3)

SUBMERGENCE TIME (T) = 4 minutes (from Table 5G-1)

FOAM DISCHARGE RATE (R) = (618,750 ft^3 / 4 min) x 1.15 x 1.2 = 213,469 cfm (6045 cmm)

The JET-X-15A (UL) is selected as the generator to be used at 75 psi (5.2 bar) inlet pressure to the generators.

FROM TABLE 5G-2:

GENERATOR FOAM OUTPUT = 19,141 cfm

SOLUTION FLOW = 145 gpm

NUMBER OF GENERATORS = 213,469 cfm / 19,141 cfm = 12 (11.2 rounded up)

SYSTEM FLOW RATE = 12 x 145 gpm = 1740 gpm (6586 Lpm)

The choices for foam quantity are:

1. Quantity = 1740 gpm x 25 min x 0.02
   = 870 gal (3293 L) of JET-X 2% Concentrate
2. Quantity = [(4 x 618,750 ft^3) / 19,141 cfm] x 145 gpm x 0.02
   = 375 gal (1420 L) of JET-X 2% Concentrate
3. Quantity = 1740 gpm x 15 min x 0.02
   = 522 gal (1976 L) of JET-X 2% Concentrate

The quantity of concentrate for four times the submergence volume (formula 2) is less than the 25 minute duration (formula 1) but it is also less than the 15 minute minimum requirement (formula 3). Therefore, the quantity of concentrate required for this system would be the value from formula 3 which is 522 gal (1976 L).

High-Expansion Foam Systems

TOTAL FLOODING HIGH-EXPANSION FOAM SYSTEMS (Continued)

HIGH-EXPANSION GENERATORS FOR USE WITH JET-X 2% CONCENTRATE

TYPICAL DISCHARGE CHARACTERISTICS

Generator Model No.	Generator Inlet Pressure psi	(bar)	Generator Foam Output cfm	(cmm)	Solution Flow gpm	(Lpm)	Expansion
JET-X-2A	50	(3.4)	2,188	(62)	35	(132)	468:1
	75	(5.2)	2,727	(77)	42	(159)	486:1
	100	(6.9)	3,010	(85)	50	(189)	450:1
JET-X-5A	50	(3.4)	6,658	(189)	61	(231)	816:1
	75	(5.2)	9,383	(266)	75	(284)	936:1
	100	(6.9)	10,655	(302)	87	(329)	916:1
JET-X-15A (UL)	40	(2.8)	12,121	(343)	108	(409)	840:1
	50	(3.4)	14,491	(410)	119	(450)	911:1
	75	(5.2)	19,141	(542)	145	(549)	987:1
	100	(6.9)	21,796	(617)	169	(640)	965:1
JET-X-15A (LNG)	50	(3.4)	12,949	(367)	180	(681)	538:1
	75	(5.2)	17,769	(503)	220	(833)	604:1
	100	(6.9)	19,503	(552)	260	(984)	561:1
JET-X-20	40	(2.8)	13,530	(383)	212	(803)	477:1
	50	(3.4)	14,746	(418)	238	(901)	463:1
	75	(5.2)	19,007	(538)	294	(1,113)	484:1
	100	(6.9)	22,598	(640)	338	(1,279)	500:1
JET-X-27	40	(2.8)	20,295	(575)	181	(685)	839:1
	50	(3.4)	23,965	(679)	203	(768)	883:1
	75	(5.2)	27,303	(773)	243	(920)	840:1
	100	(6.9)	28,802	(816)	276	(1,045)	781:1

TABLE 5G-2

NOTES:

1. 2% concentrate not to be used for salt water applications.
2. JET-X 2% and JET-X 2 3/4% concentrates are not to be mixed for normal system operation.

High-Expansion Foam Systems

TOTAL FLOODING HIGH-EXPANSION FOAM SYSTEMS (Continued)

HIGH-EXPANSION GENERATORS FOR USE WITH JET-X 2 3/4% CONCENTRATE

TYPICAL DISCHARGE CHARACTERISTICS

Generator Model No.	Generator Inlet Pressure psi	(bar)	Generator Foam Output cfm	(cmm)	Solution Flow gpm	(Lpm)	Expansion
JET-X-2A	50	(3.4)	2,122	(60)	35	(132)	454:1
	75	(5.2)	2,785	(79)	42	(159)	496:1
	100	(6.9)	3,163	(90)	50	(189)	473:1
JET-X-5A	50	(3.4)	5,575	(158)	61	(231)	684:1
	75	(5.2)	6,628	(188)	75	(284)	661:1
	100	(6.9)	7,182	(203)	87	(329)	617:1
JET-X-15A (UL)	50	(3.4)	11,269	(319)	119	(450)	708:1
	75	(5.2)	15,479	(438)	145	(549)	799:1
	100	(6.9)	18,447	(522)	169	(640)	816:1
JET-X-15A (FM)	50	(3.4)	12,985	(368)	105	(397)	925:1
	75	(5.2)	17,985	(509)	128	(485)	1050:1
	100	(6.9)	17,100	(484)	150	(568)	855:1
JET-X-15A (LNG)	50	(3.4)	11,735	(332)	180	(681)	488:1
	75	(5.2)	16,040	(454)	220	(833)	545:1
	100	(6.9)	19,601	(555)	260	(984)	564:1
JET-X-20	40	(2.8)	13,443	(381)	212	(803)	474:1
	50	(3.4)	16,034	(454)	238	(901)	504:1
	75	(5.2)	21,145	(599)	294	(1,113)	538:1
	100	(6.9)	24,301	(688)	338	(1,279)	538:1

TABLE 5G-3

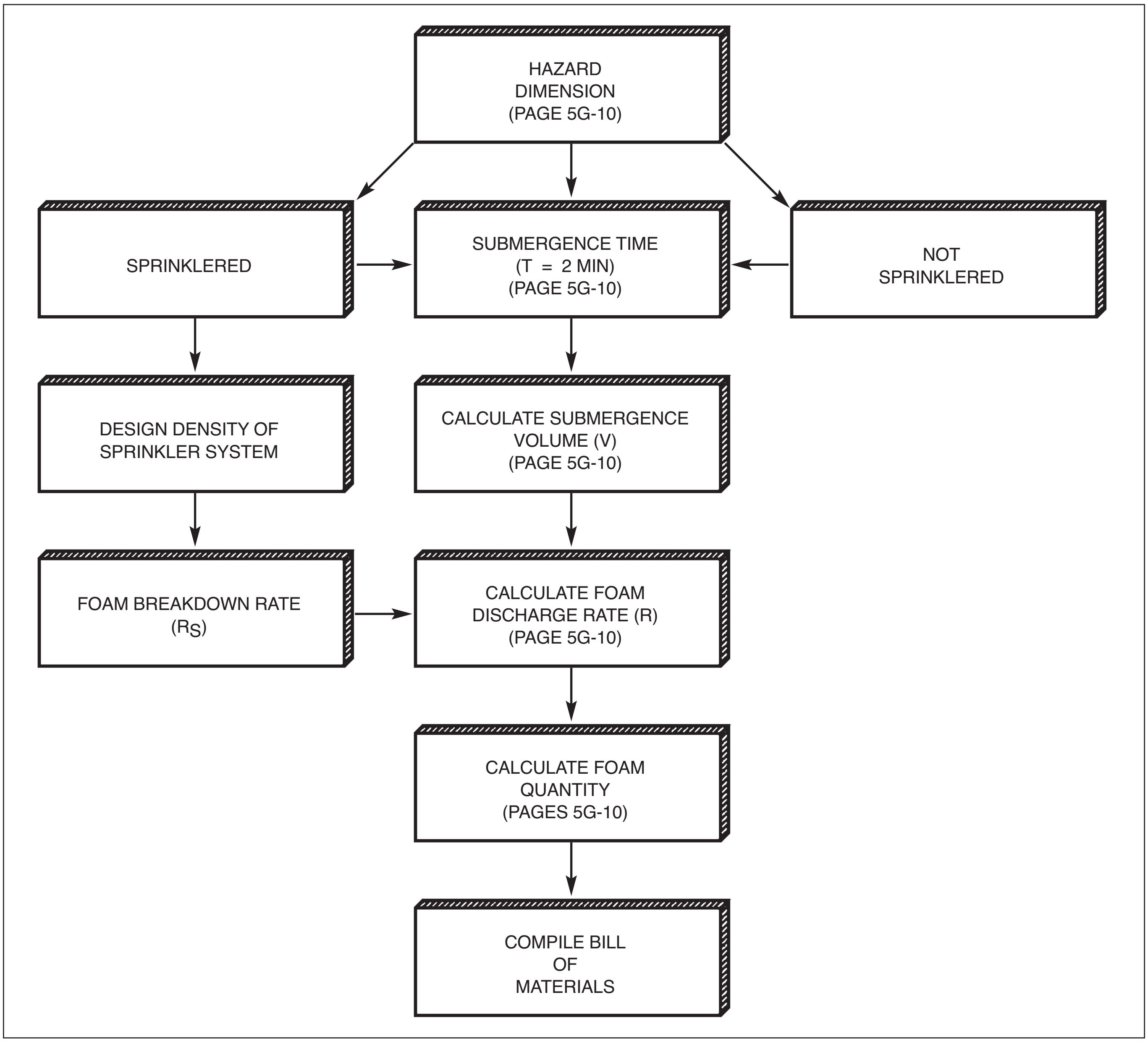
NOTE: JET-X 2% and JET-X 2 3/4% concentrates are not to be mixed for normal system operation.

High-Expansion Foam Systems

LOCAL APPLICATION SYSTEMS

Local Application System Flow Chart

The following flow chart defines a logical sequence for designing local application systems.



High-Expansion Foam Systems

LOCAL APPLICATION SYSTEMS (Continued)

In areas of hazard protection where a total flooding high-expansion system is not feasible and the hazard is not totally enclosed, the medium/high-expansion foam local application system may be more useful.

Hazard Dimension

The protected hazards may be located indoors, partially sheltered or entirely out-of-doors. Containment of the foam to the hazard must be taken into consideration as well as provisions to compensate for winds and other effects of weather.

Sprinkler Systems and Foam Breakdown Rate (Rs)

If the hazard area has a sprinkler system, use the guidelines and formula for sprinkler systems on Page 5G-3 for the total flooding system.

Submergence Time (T = 2 Minutes)

The design criteria for a local application medium/high-expansion foam system is to discharge a sufficient quantity of expanded foam to cover the hazard to a depth of at least 2 ft (0.6 m) within 2 minutes.

Minimum Submergence Volume (V)

The area of protection shall include all areas to which the fire may spread with a minimum required depth of foam to be no less than 2 ft (0.6 m) over the hazard.

MINIMUM SUBMERGENCE VOLUME = HAZARD AREA x (HAZARD HEIGHT + 2 FT (0.6 m))

Calculate Foam Discharge Rate (R)

Use the design formula for total flooding systems on Page 5G-5. Include the standard values for C_N (1.15) and C_L (1.2).

Calculate Foam Quantity

Once the minimum rate of foam discharge (R) has been calculated, select a foam generator from the left hand column in Table 5G-2 or 5G-3. Determine the number of generators required for the system with the following formula:

NUMBER OF GENERATORS = DISCHARGE RATE (R) / GENERATOR FOAM OUTPUT

The system flow rate is the total flow of water and concentrate per minute for the total number of generators required. Calculate the system flow rate with the following formula:

SYSTEM FLOW RATE = NUMBER OF GENERATORS x SOLUTION FLOW

Calculate Foam Quantity (Continued)

The proportion rate for the 2 3/4% JET-X High-Expansion Foam Concentrate is normally 2.75 gallons (10.4 L) of concentrate to 97.25 gallons (368 L) of water. It is expressed as 0.0275 for use in the formulas. The proportion rate for the 2% JET-X High-Expansion Foam Concentrate is normally 2 gallons (7.6 L) of concentrate to 98 gallons (371 L) of water. It is expressed as 0.02 for use in the formulas.

The system's foam concentrate and water supply shall be sufficient to allow continuous operation of the system for at least 12 minutes. Therefore, the quantity of foam concentrate required for a local application system is calculated as follows:

QUANTITY = SYSTEM FLOW RATE x 12 MIN x PROPORTION RATE

A reserve supply of foam concentrate shall be readily available to put the system back in service after operation. This supply may be in separate storage tanks or original shipping containers on the premises or available from an approved source within 24 hours.

Medium Expansion Foam Systems

LOCAL APPLICATION SYSTEMS (Medium Expansion Foam)

These systems use special Medium Expansion Foam Makers similar to those shown on the Handline Nozzles and Eductors Data Sheet F-92148. These “Fixed” nozzles are supplied without an on/off ball valve and have a 1 1/2 in. NPT connection. Engineering data for the KRM-F nozzles is shown on the following drawing AE-60136. Medium Expansion Foam Systems will maximize the duration of protection compared to Low Expansion Foam Systems. Fixed Medium Expansion Foam Systems will typically use ANSULITE 3x3LV or TARGET-7 concentrates and example applications are described in detail in the Case Studies that follow.

The following example is for an application that would typically require ANSULITE 3x3LV for fire extinguishment, but Trichlorosilane is also capable of emitting toxic vapors that must be suppressed for the longest possible duration to provide adequate evacuation and emergency response time. Assume a storage tank of Trichlorosilane (TCS) with a containment dike that measures 360 ft^2. The dike wall has freeboard of two feet under a worst case spill condition. In general a minimum two foot foam maintenance depth is recommended for most chemicals.

Example Calculation:

360 ft^2 X 2 ft^3/2 min/ft^2 = 360 cfm output required.

Rs is not required as a sprinkler system is not used.

360 cfm X 1.15 (Cn – Normal Shrinkage) = **414 cfm output required.**

Each **KRM4-F nozzle** with a **k-factor of 12** will flow **52 gpm** when **75 psi** is supplied to the inlet.

Design calculations for a **KRM-F nozzle** used with **ANSULITE 3x3LV or TARGET-7** foam agents should be based on **30:1 expansion.**

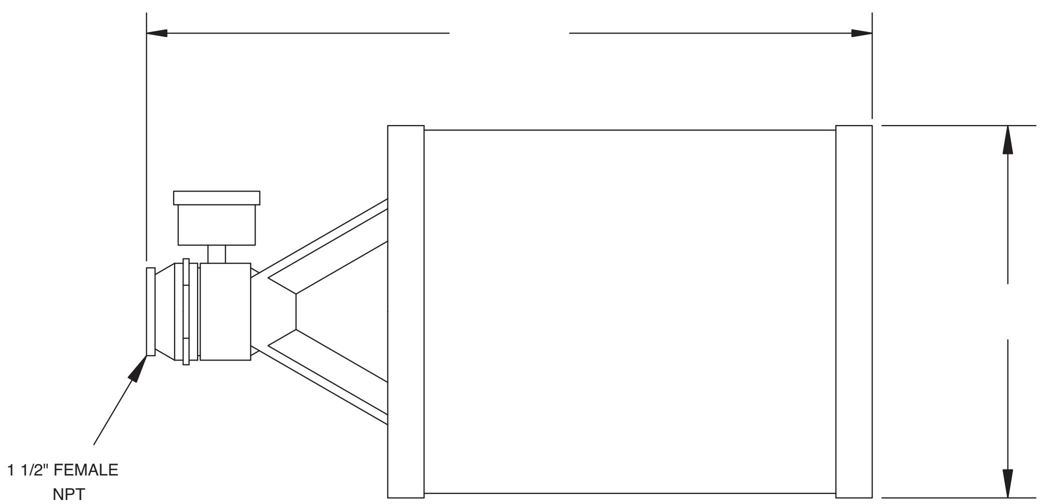
52 gpm X 4.008 (conversion for gpm to cfm with 30:1 expansion) = **208 cfm output per nozzle.**

414 cfm required / 208 cfm = 1.9 or (2) **KRM4-F nozzles required.**

104 gpm (total flow (2) nozzles) X 12 minute discharge duration X 3% proportioning = **38 Gallons of ANSULITE 3x3LV required.** Per NFPA 11, the minimum discharge duration for a local application system is 12 minutes. Specific hazard analysis may require additional agent to extend discharge and/or protection time by cycling system on/off to maintain the minimum foam depth.

Medium Expansion Foam Systems

NO. REV.	BY	DATE	CHKD.	REVISION	APPD.	DATE



TECHNICAL DATA		
MODEL	KR-M2-F	KR-M4-F
ANSUL P/N	428985	428986
OPERATING PRESSURE RANGE	45-100 PSIG	45-100 PSIG
NOMINAL EXPANSION	30:1	30:1
K-FACTOR	6	12
LENGTH (A)	17 1/2"	21"
WIDTH (B)	7 1/4"	10 1/4"
* MULTIPLY CALCULATED FLOW IN GPM BY 4.008 FOR CFM OUTPUT		

FOAM SUPPRESSION SYSTEM
KRM-F FIXED MEDIUM EXPANSION NOZZLE DETAIL

ANSUL®
ANSUL FIRE PROTECTION
MARINETTE, WI 54143-2542

DATE	SCALE	DRAWING NUMBER	REV.
02-26-07	NONE	AE-60136	0
DWN.	CHKD.	APPD.	SHEET 1 OF 1

0007693

EXAMPLE SYSTEM — TOTAL FLOODING

Hazard Specifications

Type of Product . . . Combustible Liquids
(Flash point of 100 °F (38 °C) and above)
Palletized Drum Storage

Type of Building . . . Light Steel Construction
125 ft x 80 ft x 20 ft high
(38.1 m x 24.4 m x 6.1 m high)
Sprinklered
Design Density is 0.25 gpm/ft^2 with Floor Area of 3000 ft^2 (10.2 Lpm/m^2 with Floor Area of 279 m^2)

Maximum Storage Height . . . . 8 ft (2.4 m) – two pallets high

System Pressure. . . 50 psi (3.4 bar)

System Design

1. **HAZARD CLASSIFICATION (PAGE 5G-3)**

The hazard area is a storage building containing combustible liquids in palletized drums.

2. **BUILDING CONSTRUCTION (PAGE 5G-3)**

The storage building is constructed of light steel and has no fire resistant features.

3. **DESIGN DENSITY OF SPRINKLER SYSTEM (PAGE 5G-4)**

and

FOAM BREAKDOWN RATE (R_S) (PAGE 5G-4)

Using the information from the customer's sprinkler system design (0.25 gpm/ft^2 with floor area of 3,000 ft^2), the Foam Breakdown Rate is calculated:

FOAM BREAKDOWN RATE = FOAM DESTROYED x SPRINKLER DESIGN DENSITY x FLOOR AREA

FOAM BREAKDOWN RATE = 10 cfm/gpm x 0.25 gpm/ft^2 x 3,000 ft^2
(0.075 cmm/Lpm x 10.2 Lpm/m^2 x 279 m^2)

FOAM BREAKDOWN RATE = 7,500 cfm (212.4 cmm)

4. **SUBMERGENCE TIME (T) (PAGE 5G-4)**

Referring to Table 1 on Page 5G-5, the submergence time for this light steel building with a sprinkler system that stores combustible liquids is 4 minutes.

5. **CALCULATE SUBMERGENCE VOLUME (V) (PAGE 5G-5)**

First, use the formula for a hazard height of less than 20 ft (6.1 m):

MINIMUM FILL DEPTH = HEIGHT + 2 FEET (0.6 m)

MINIMUM FILL DEPTH = 8 ft + 2 ft

MINIMUM FILL DEPTH = 10 ft (3.1 m)

Then, calculate the submergence volume:

MINIMUM SUBMERGENCE VOLUME = FLOOR AREA x MINIMUM FILL DEPTH

MINIMUM SUBMERGENCE VOLUME = 10,000 ft^2 x 10 ft

MINIMUM SUBMERGENCE VOLUME = 100,000 ft^3 (2,832 m^3)

6. **CALCULATE FOAM DISCHARGE RATE (R) (PAGE 5G-5)**

With the above information and the values for C_N = 1.15 and C_L = 1.2 (from Page 5G-6) determine the Foam Discharge Rate (R).

$$R = \left(\frac{V}{T} + R_S\right) \text{ x } C_N \text{ x } C_L$$

R = ((100,000 ft^3 / 4 min) + 7,500 cfm) x 1.15 x 1.2

FOAM DISCHARGE RATE (R) = 44,850 cfm (1270 cmm)

7. **CALCULATE FOAM QUANTITY (PAGE 5G-6)**

Customer selects a JET-X-15A (UL) to be used in the storage building. With 40 psi (2.76 bar) of pressure available, the values from Table 5G-2 are 12,121 cfm (343 cmm) for GENERATOR FOAM OUTPUT and 108 gpm (409 Lpm) of SOLUTION FLOW.

Determine the number of generators required:

NUMBER OF GENERATORS = FOAM DISCHARGE RATE (R) / GENERATOR FOAM OUTPUT

NUMBER OF GENERATORS = 44,850 cfm / 12,121 cfm

NUMBER OF GENERATORS = 4 JET-X-15A (UL) Generators (3.70 rounded up)

Then determine the system flow rate:

SYSTEM FLOW RATE = NUMBER OF GENERATORS x SOLUTION FLOW

SYSTEM FLOW RATE = 4 x 108 gpm (409 Lpm)

SYSTEM FLOW RATE = 432 gpm (1635 Lpm)

Next, the calculations for foam quantity are determined using the three options available.

(1) QUANTITY = SYSTEM FLOW RATE x 25 MIN x PROPORTION RATE

QUANTITY = 432 gpm x 25 min x 0.02

QUANTITY = 216 gal (818 L) of JET-X 2% Concentrate

(2) QUANTITY = [(4 x SUBMERGENCE VOLUME (V)) / GENERATOR FOAM OUTPUT] x SOLUTION FLOW x PROPORTION RATE

QUANTITY = ((4 x 100,000 ft^3) / 12,121 cfm) x 108 gpm x 0.02

QUANTITY = 72 gal (271 L) of JET-X 2% Concentrate

(3) QUANTITY = SYSTEM FLOW RATE x 15 MIN x PROPORTION RATE

QUANTITY = 432 gpm x 15 min x 0.02

QUANTITY = 130 gal (493 L) of JET-X 2% Concentrate

The quantity of foam concentrate for four times the submergence volume (option 2) is less than that which would be required for the 25 minute duration (option 1), but it is also less than the 15 minute duration. Therefore, the minimum quantity of concentrate required for this system would be 130 gal (493 L) of JET-X 2% Concentrate (option 3). There is a reserve supply of foam available within 24 hours for this location; therefore, no additional solution is needed.

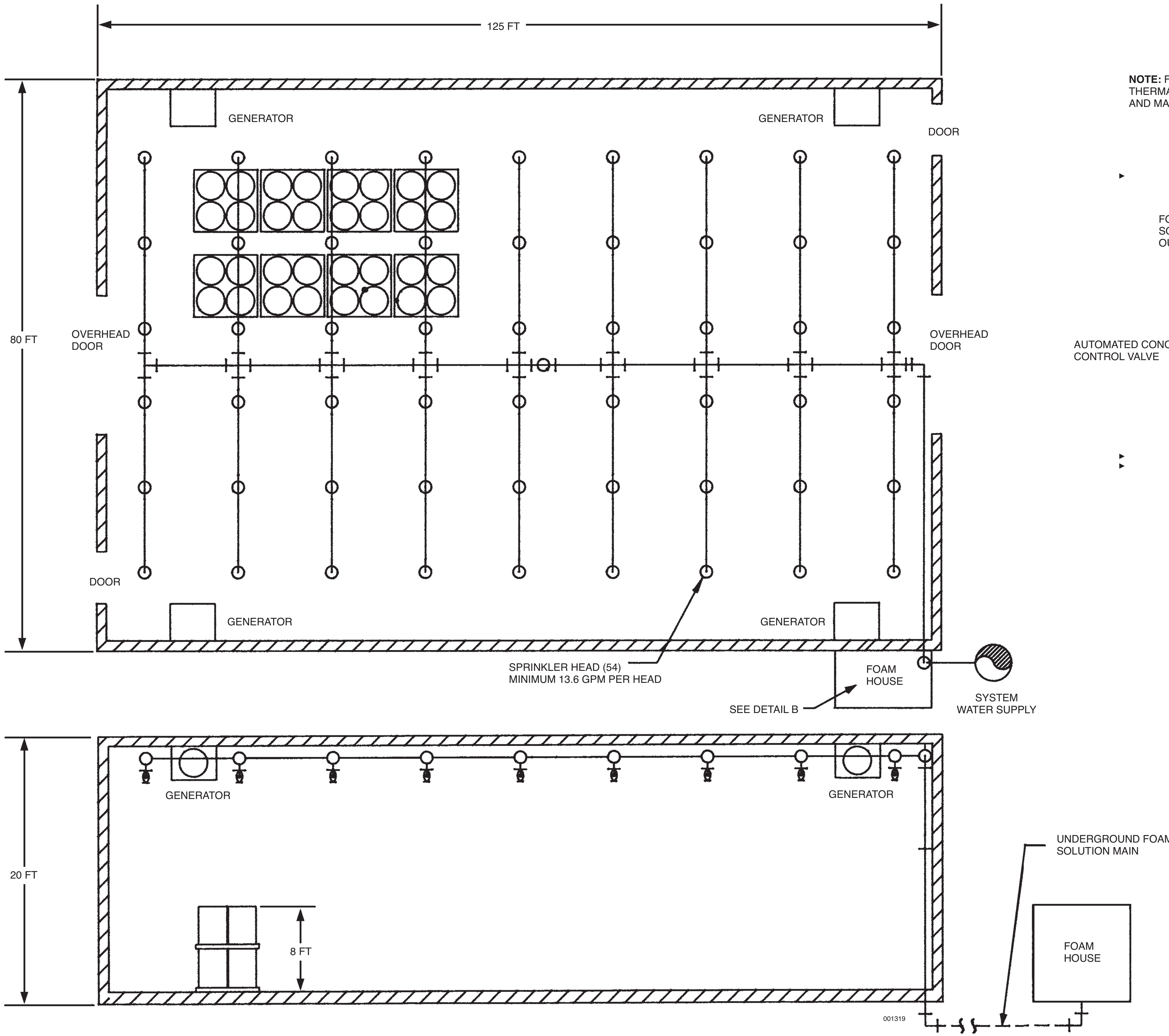
8. **COMPILE BILL OF MATERIALS**

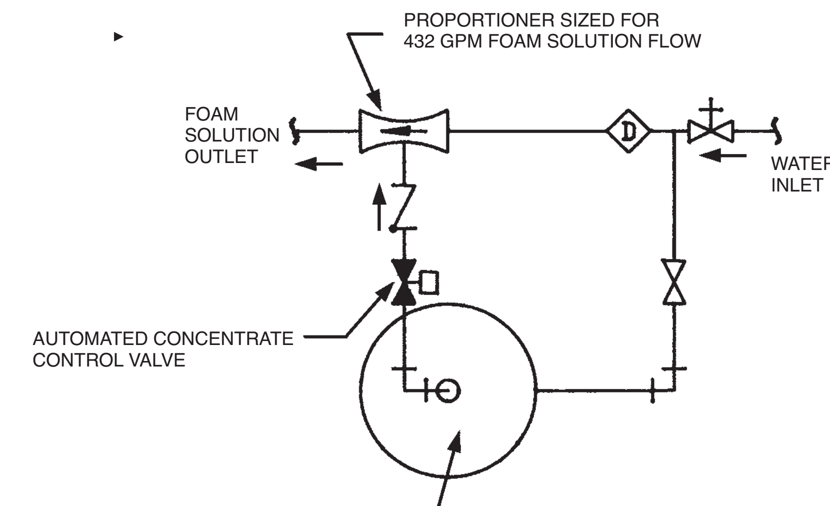
NOTICE

This is an example only. Selection of discharge device and proportioning equipment will vary with each application. For detection and control system requirements, contact Tyco Fire Protection Products.

Quantity	Description
1	150 Gallon Bladder Tank
1	Proportioner, Sized for System Flow of 432 gpm (1635 Lpm)
4	JET-X-15A (UL) Generators
130 gal (493 L)	JET-X 2% Concentrate
As Required	Test Foam, JET-X 2% Concentrate

NOTE: FIRE DETECTION CAN TYPICALLY BE THERMAL OR FLAME TYPE: CONSULT NFPA 72 AND MANUFACTURER RECOMMENDATIONS.





DETAIL B

SECTION 5G **HIGH EXPANSION FOAM SYSTEMS**
EXAMPLE SYSTEM – TOTAL FLOODING
SHEET 2 OF 2

FOAM GLOSSARY

AFFF (Aqueous Film-Forming Foam): A foam concentrate containing fluorocarbon surfactants that control the physical properties of water so that it is able to float and spread across the surface of a hydrocarbon liquid.

► **AR-AFFF:** An AFFF that contains a polysaccharide that forms a layer only on polar solvents to separate and protect the finished foam.

Boilover: The violent ejection of flammable liquid from its container caused by the vaporization of water beneath the body of liquid. It may occur after a lengthy burning period of products such as crude oil when the heat wave has passed down through the liquid and reaches the water bottom in a storage tank. It will not occur to any significant extent with water-soluble liquids or light products such as gasoline.

Burnback Resistance: The ability of the finished foam to resist direct flame impingement such as would occur with a partially extinguished petroleum fire.

Combustible Liquid: A liquid having a flash point at or above 100 °F (38 °C).

Compatibility: The ability of extinguishing agents to be mixed together or applied simultaneously. See Pages 1-7 and 1-8.

Concentration: The amount of foam concentrate contained in a given volume of foam solution. The type of foam being used determines the percentage of concentration required. For example, 3% foam concentrate is mixed in a 3% solution (97 parts water, 3 parts concentrate); 6% foam concentrate is mixed in a 6% solution (94 part water, 6 parts concentrate).

Downstream: The direction in which the water is flowing or will flow.

Drainage Dropout Rate: The rate at which solution drains from a foam generally measured as quarter drain time.

Expansion Ratio: The ratio of volume of foam formed to the volume of solution used to generate the foam. For example, an 8:1 expansion ratio means 800 gallons of finished foam from 100 gallons of solution.

Flammable Liquid: A substance which is liquid at ordinary temperatures and pressures and has a flash point below 100 °F (38 °C).

Flash Back: Reignition of flammable liquid caused by exposure of its vapors to a source of ignition such as a hot metal surface or a spark.

Flash Point: The temperature at which a liquid gives off enough vapor to ignite.

Fluorocarbon: An inert organic compound in which fluorine replaces hydrogen.

Fluoroprotein Foam: A foam based on natural polymers and modified with a selected fluorinate surfactant.

Fire-Fighting Foam: A homogeneous blanket obtained by mixing water, foam concentrate, and air or inert gas.

Foam Concentrate: The foaming agent for mixing with appropriate amounts of water and air to produce mechanical foam.

Foam Maker: A device designed to introduce air into a pressurized foam solution stream.

Foam Solution: A mixture of water and foam concentrate.

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

High Expansion Foam: Special foam designed for high air to solution ratios that have up to 1000 parts air to 1 part solution.

Hydrocarbon: An organic compound containing only carbon and hydrogen.

Hydrocarbon Pickup: The characteristic of a fuel that is suspended or absorbed by expanded foam.

Line Proportioner: A device that siphons foam from a container to form a foam solution.

Minimum Operating Temperature: The lowest temperature at which a foam concentrate will proportion with venturi devices in accordance with UL requirements.

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

Polar Solvent: In fire fighting, any flammable liquid which destroys regular foams. Examples of polar solvents are amines, ethers, alcohols, esters, aldehydes, and ketones.

Polymeric Membrane: A thin, durable, plastic layer formed on a polar solvent fuel surface protecting the foam cells from destruction by the fuel.

Pour Point: The lowest temperature at which a foam concentrate is fluid enough to pour, generally about 5 °F (2.8 °C) above the freezing point.

Product: Another name that can be applied to flammable liquid.

Proportioner: The device where foam concentrate and water are mixed to form foam solution.

Protein Foam: A hydrolyzed natural protein solid combined with additives to form an organic based concentrate.

Appendix

FOAM GLOSSARY (Continued)

Quarter Drain Time: The time required for 25% of the total liquid solution to drain from the foam. Also referred to as 25% drain time or quarter-life.

Skin Fire: A flammable liquid fire, such as a spill on a solid surface where the liquid is present in a depth not exceeding one inch (2.5 cm).

Soluble: The ability to become readily dissolved or mixed with.

Submergence: The 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.

Surfactant: Chemicals that have the ability to alter the surface properties of water.

Upstream: Opposite the direction in which water is flowing or will flow.

Venturi: The constricted portion of a pipe or tube which increases water velocity and momentarily reduces water pressure. It is in this reduced pressure area that foam concentrate is introduced into the water stream.

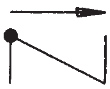
REFERENCES

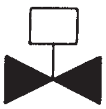
NFPA 11	Standard for Low-, Medium-, and High-Expansion Foams
NFPA 13	Standard for the Installation of Sprinkler Systems
NFPA 16	Standard for the Installation of Deluge Foam-Water Sprinkler and Water Spray Systems
NFPA 30	Flammable and Combustible Liquids Code
NFPA 409	Aircraft Hangars
API Pub 2021	Guides for Fighting Fires In and Around Petroleum Storage Tanks
ASP TR-74-32	Fire Fighting Foam Proportioning System Technology
MIL-F-24385	Fire Fighting Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, For Fresh and Sea Water
AC No. 150/5390-1B	Federal Aviation Administration Heliport Design Guide
UL 162	Foam Equipment and Liquid Concentrates
UL Subject 139	High Expansion Foam-Extinguishing System Equipment and Concentrates

Appendix

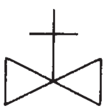
TYPICAL SCHEMATIC SYMBOLS


VALVE

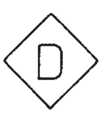

CHECK VALVE


AUTOMATED VALVE

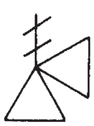

BALANCING VALVE

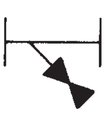

O.S. & Y. VALVE

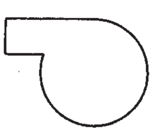

HOSE CONNECTION

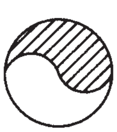


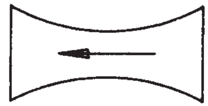
DELUGE VALVE

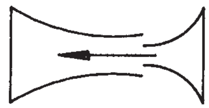

PRESSURE RELIEF

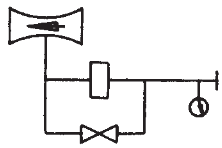

STRAINER

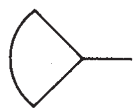

PUMP


WATER SUPPLY


PROPORTIONER

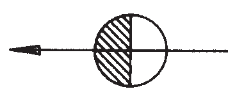

LINE PROPORTIONER

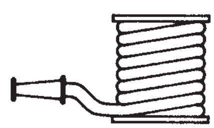

IN-LINE BALANCED PRESSURE PROPORTIONER

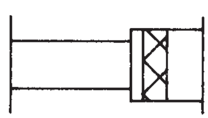

DIRECTIONAL NOZZLE

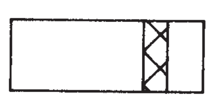

PENDENT SPRINKLER


UPRIGHT SPRINKLER


OSCILLATING MONITOR


HOSE STATION


HIGH BACK-PRESSURE FOAM MAKER


FLOATING ROOF FOAM MAKER

Appendix

BASIC HYDRAULIC CALCULATIONS

I. CALCULATION OF SPRINKLER AND SPRAY NOZZLE WATER DISCHARGE

Water discharge is determined by the formula:

$Q = K\sqrt{P}$ where:

Q = Flow in gpm
K = Constant for the specific Sprinkler or Nozzle
P = Pressure at the nozzle or sprinkler in psi

Example: Find the flow (Q in gpm) of a Viking D2 90° spray nozzle operating at 40 psi

$Q = 4.97 \sqrt{40} = 31.4$ gpm

II. CALCULATION OF FRICTION LOSS, VELOCITY AND VELOCITY PRESSURE

A. **Friction loss through pipe** is based on Hazen and Williams formula which is:

$$P = \frac{4.52 \times Q^{1.85}}{C^{1.85} \times d^{4.87}}$$ where:

P = Friction loss (psi/ft)
Q = Flow in gpm
d = Internal diameter of pipe in inches
C = Constant

The fifth column of the pipe tables give the constant of $\frac{4.52}{C^{1.85} \times d^{4.87}}$

for various sizes and types of pipe. To determine the friction loss in one foot of pipe, multiply this constant by $Q^{1.85}$.

Example: Find the friction loss (p-psi/ft.) with a flow (Q) of 10,000 gpm thru 10” Steel Pipe (Schedule 40) using C = 120.

$P = 8.13 \times 10^{-9} \times Q^{1.85}$

$P = 8.13 \times 10^{-9} \times 25{,}119{,}000$

$P = 0.204$ psi/ft

Effect of Valves and Fittings is commonly expressed as that length of pipe which produces the same friction loss as the valve or fitting. The equivalent pipe length table gives the equivalent length of C = 120 pipe. If the pipe to which the valve or fitting is being made equivalent is other than C = 120, then the equivalent length must be multiplied by the indicated factor.

Example: Find the length of 6” cast iron pipe, unlined class 150 (C = 100), which is equivalent to a 6” deluge valve.

33 ft X 0.713 = 23.5 ft

Metric Conversions: See Page 6-13 for conversion factors.

Appendix

BASIC HYDRAULIC CALCULATIONS (Continued)

II. CALCULATION OF FRICTION LOSS, VELOCITY AND VELOCITY PRESSURE (Continued)

B. Velocity of water in pipe may be found by formula:

$$V = \frac{0.4085\,Q}{d^2}$$ where: V = Velocity in feet per second
Q = Flow in gpm
d = Inside diameter of pipe in inches

The sixth column of the pipe tables give the constant of $\frac{0.4085}{d^2}$

for various sizes and types of pipe. Velocity (fps) may be found by multiplying the constant by flow (Q in gpm).

Example: Find velocity (V-fps) in 10” Schedule 40 steel pipe with a flow (Q) of 10,000 gpm.
V = 0.004 X Q
V = 0.004 X 10,000 = 40.0 fps

C. Velocity pressure is found by the following formula:

$$P_V = \frac{0.001123\,Q^2}{d^4}$$ where: P_V = Velocity pressure in psi
Q = Flow in gpm
d = Inside diameter of pipe in inches

The seventh column of the pipe tables give the constant of $\frac{0.001123}{d^4}$

for various sizes and types of pipe.

Velocity pressure may be found by multiplying the square of the flow (Q^2 in gpm^2) by this Constant.
Example: Find velocity pressure in 10” Schedule 40 steel pipe with a flow of 10,000 gpm.
V.P. = $1.07 \times 10^{-7} \times Q^2$
V.P. = $1.07 \times 10^{-7} \times 10{,}000^2 = 10.7$ psi

III. PRESSURE DROP DUE TO ELEVATION HEAD

To determine pressure drop, multiply elevation (ft) by 0.433 (psi/ft).

Metric Conversions: See Page 6-13 for conversion factors.

Appendix

EQUIVALENT PIPE LENGTHS

(For Common Fittings and Valves expressed in equivalent feet of pipe C = 120)

Symbol	Pipe Size	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6	8	10	12
E	Standard Elbow	2	2	3	4	5	6	7	8	10	12	14	18	22	27
MtE	Medium Turn Elbow	2	2	3	3	4	5	6	6	8	10	12	16	19	22
LtE	Long Turn Elbow	1	2	2	2	3	4	5	5	6	8	9	13	16	18
EE	45° Elbow	1	1	1	2	2	3	3	3	4	5	7	9	11	13
T	Tee-Flow Turned 90°	4	5	6	8	10	12	15	17	20	25	30	35	50	60
GV	Gate Valve					1	1	1	1	2	2	3	4	5	6
Cr	Cross-Flow Turned 90°	4	5	6	8	10	12	15	17	20	25	30	35	50	60
ALV	Alarm Valve						10			20		18	35		
DPV	Dry Pipe Valve							10		10		19	27		
DelV	Deluge Valve					18		29		35		33			
CV	Swing Check Valve									10		11	14		
DkV	Detector Check Valve									14		36	55	45	
FLV	*Flow Control					18		29		35		11			

NOTE: Use above values with C-120. For other valves of "C" multiply the above figures by the following factors:

Value of C	100	120	140	150
Factor	0.713	1.0	1.33	1.51

*If Pressure Regulator is not used.

Metric Conversions: See Page 6-13 for conversion factors.

Appendix

PIPE TABLES

Size (in)	OD (in)	Wall Thickness (in)	I.D. (in)	p (psi/Lin ft) Multiply $Q^{1.85}$ By		V (fps) Multiply Q By	P_V (psi) Multiply Q^2 By
Steel Pipe – 1/2-6 Sch. 40 8-12 Sch. 30				**For C = 120**	**For C = 100**		
1/2	0.840	0.109	0.622	6.47×10^{-3}	8.61×10^{-3}	1.056	7.50×10^{-3}
3/4	1.050	0.113	0.824	1.65×10^{-3}	2.19×10^{-3}	0.602	2.44×10^{-3}
1	1.315	0.133	1.049	5.10×10^{-4}	6.78×10^{-4}	0.371	9.30×10^{-4}
1-1/4	1.660	0.140	1.380	1.34×10^{-4}	1.78×10^{-4}	0.215	3.11×10^{-4}
1-1/2	1.900	0.145	1.610	6.33×10^{-5}	8.39×10^{-5}	0.158	1.68×10^{-4}
2	2.375	0.154	2.067	1.87×10^{-5}	2.49×10^{-5}	0.096	6.17×10^{-5}
2-1/2	2.875	0.203	2.469	7.89×10^{-6}	1.05×10^{-5}	0.067	3.03×10^{-5}
3	3.500	0.216	3.068	2.74×10^{-6}	3.64×10^{-6}	0.0434	1.27×10^{-5}
3-1/2	4.000	0.226	3.548	1.35×10^{-6}	1.80×10^{-6}	0.0325	7.11×10^{-6}
4	4.500	0.237	4.026	7.29×10^{-7}	9.71×10^{-7}	0.0252	4.29×10^{-6}
5	5.563	0.258	5.047	2.43×10^{-7}	3.23×10^{-7}	0.0160	1.74×10^{-6}
6	6.625	0.280	6.065	9.91×10^{-8}	1.32×10^{-7}	0.0111	8.32×10^{-7}
8	8.625	0.277	8.071	2.46×10^{-8}	3.27×10^{-8}	0.0063	2.65×10^{-7}
10	10.750	0.307	10.136	8.13×10^{-9}	1.08×10^{-8}	0.0040	1.07×10^{-7}
12	12.750	0.330	12.090	3.45×10^{-9}	4.59×10^{-8}	0.0028	5.27×10^{-8}
Steel Pipe – 1-3 1/2 Sch. 10 S 4-8 .188 Wt.				**For C = 120**	**For C = 100**		
1	1.315	0.109	1.097	4.10×10^{-4}	5.45×10^{-4}	0.339	7.78×10^{-4}
1-1/4	1.660	0.109	1.442	1.08×10^{-4}	1.44×10^{-4}	0.196	2.60×10^{-4}
1-1/2	1.900	0.109	1.682	5.12×10^{-5}	6.81×10^{-5}	0.144	1.41×10^{-4}
2	2.375	0.109	2.157	1.52×10^{-5}	2.02×10^{-5}	0.088	5.20×10^{-5}
2-1/2	2.875	0.120	2.635	5.75×10^{-6}	7.65×10^{-6}	0.059	2.34×10^{-5}
3	3.500	0.120	3.260	2.04×10^{-6}	2.71×10^{-6}	0.0384	9.97×10^{-6}
3-1/2	4.000	0.120	3.760	1.02×10^{-6}	1.36×10^{-6}	0.0290	5.63×10^{-6}
4	4.500	0.188	4.124	6.49×10^{-7}	8.63×10^{-7}	0.0240	3.89×10^{-6}
5	5.563	0.188	5.187	2.12×10^{-7}	2.82×10^{-7}	0.0152	1.56×10^{-6}
6	6.625	0.188	6.249	8.57×10^{-8}	1.14×10^{-7}	0.0105	7.38×10^{-7}
8	8.625	0.188	8.249	2.22×10^{-8}	2.95×10^{-8}	0.0060	2.43×10^{-7}

Metric Conversions: See Page 6-13 for conversion factors.

Appendix

PIPE TABLES (Continued)

Size (in)	OD (in)	Wall Thickness (in)	I.D. (in)	p (psi/Lin. ft.) Multiply $Q^{1.85}$ By	V (fps) Multiply Q By	P_V (psi) Multiply Q^2 By
Cast Iron Pipe – Unlined Class 150				**For C = 100**		
4	4.80	0.35	4.10	9.35×10^{-7}	0.024	3.99×10^{-6}
6	6.90	0.38	6.14	1.31×10^{-8}	0.011	7.92×10^{-7}
8	9.05	0.41	8.23	3.14×10^{-8}	0.006	2.45×10^{-7}
10	11.10	0.44	10.22	1.09×10^{-8}	0.0039	1.03×10^{-7}
12	13.20	0.48	12.24	4.55×10^{-9}	0.0027	5.02×10^{-8}
14	15.30	0.51	14.28	2.15×10^{-9}	0.0020	2.71×10^{-8}
16	17.40	0.54	16.32	1.12×10^{-9}	0.0015	1.59×10^{-8}
18	19.50	0.58	18.34	6.34×10^{-10}	0.0012	9.95×10^{-9}
20	21.60	0.62	20.36	3.81×10^{-10}	0.00099	6.55×10^{-9}
24	25.80	0.73	24.34	1.60×10^{-10}	0.00069	3.21×10^{-9}
Cast Iron Pipe – Enameline Class 150				**For C = 140**		
4	4.80	0.41	3.98	5.80×10^{-7}	0.026	4.49×10^{-6}
6	6.90	0.44	6.02	7.73×10^{-8}	0.011	8.57×10^{-7}
8	9.05	0.47	8.11	1.81×10^{-8}	0.006	2.60×10^{-7}
10	11.10	0.50	10.10	6.22×10^{-9}	0.004	1.08×10^{-7}
12	13.20	0.54	12.12	2.56×10^{-9}	0.0028	5.22×10^{-8}
14	15.30	0.60	14.09	1.23×10^{-9}	0.0020	2.86×10^{-8}
16	17.40	0.64	16.13	6.36×10^{-10}	0.0016	1.66×10^{-8}
Cast Iron Pipe – Cement Lined – Class 150				**For C = 140**		
4	4.80	0.48	3.85	6.82×10^{-7}	0.0276	5.13×10^{-6}
6	6.90	0.50	5.89	8.60×10^{-8}	0.0118	9.36×10^{-7}
8	9.05	0.54	7.98	1.96×10^{-8}	0.0064	2.78×10^{-7}
10	11.10	0.56	9.97	6.62×10^{-9}	0.0041	1.14×10^{-7}
12	13.20	0.60	11.99	2.70×10^{-9}	0.0028	5.45×10^{-8}
14	15.30	0.70	13.90	1.31×10^{-9}	0.0021	3.02×10^{-8}
16	17.40	0.73	15.94	6.74×10^{-10}	0.0016	1.74×10^{-8}
Copper Tube – Type K				**For C = 150**		
3/4	0.875	0.065	0.745	1.79×10^{-3}	0.736	3.66×10^{-3}
1	1.125	0.065	0.995	4.36×10^{-4}	0.413	1.15×10^{-3}
1-1/4	1.375	0.065	1.245	1.46×10^{-4}	0.264	4.69×10^{-4}
1-1/2	1.625	0.072	1.481	6.29×10^{-5}	0.186	2.34×10^{-4}
2	2.125	0.083	1.959	1.61×10^{-5}	0.106	7.65×10^{-5}
2-1/2	2.625	0.095	2.435	5.59×10^{-6}	0.069	3.20×10^{-5}
3	3.125	0.109	2.907	2.36×10^{-6}	0.0483	1.58×10^{-5}
3-1/2	3.625	0.120	3.385	1.12×10^{-6}	0.0357	8.58×10^{-6}
4	4.125	0.134	3.857	5.95×10^{-7}	0.0275	5.09×10^{-6}
Copper Tube – Type L				**For C = 150**		
3/4	0.875	0.045	0.785	1.38×10^{-3}	0.663	2.97×10^{-3}
1	1.125	0.050	1.025	3.78×10^{-4}	0.389	1.02×10^{-3}
1-1/4	1.375	0.055	1.265	1.36×10^{-4}	0.255	4.40×10^{-4}
1-1/2	1.625	0.060	1.505	5.82×10^{-5}	0.180	2.19×10^{-4}
2	2.125	0.070	1.985	1.51×10^{-5}	0.1037	7.25×10^{-5}
2-1/2	2.625	0.080	2.465	5.26×10^{-6}	0.0672	3.05×10^{-5}
3	3.125	0.090	2.945	2.21×10^{-6}	0.0471	1.50×10^{-5}
3-1/2	3.625	0.100	3.425	1.06×10^{-6}	0.0348	8.18×10^{-6}
4	4.125	0.110	3.905	5.60×10^{-7}	0.0268	4.84×10^{-6}

Metric Conversions: See Page 6-13 for conversion factors.

Appendix

PIPE TABLES (Continued)

Size (in.)	O.D. (in.)	Wall Thickness (in.)	I.D. (in.)	p (psi/Lin. ft.) Multiply $Q^{1.85}$ By	V (fps) Multiply Q By	P_V (psi) Multiply Q^2 By
Copper Tube – Type M				**For C = 150**		
3/4	0.875	0.032	0.811	1.18×10^{-3}	0.621	2.60×10^{-3}
1	1.125	0.035	1.055	3.28×10^{-4}	0.367	9.09×10^{-4}
1-1/4	1.375	0.042	1.291	1.23×10^{-4}	0.245	4.05×10^{-4}
1-1/2	1.625	0.049	1.527	5.42×10^{-5}	0.175	2.07×10^{-4}
2	2.125	0.058	2.009	1.43×10^{-5}	0.101	6.91×10^{-5}
2-1/2	2.625	0.065	2.495	4.96×10^{-6}	0.0656	2.91×10^{-5}
3	3.125	0.072	2.981	2.09×10^{-6}	0.0460	1.43×10^{-5}
3-1/2	3.625	0.083	3.459	1.01×10^{-6}	0.0341	7.37×10^{-6}
Perma Stran – Class 150				**For C = 150**		
4	4.500	.110	4.28	3.58×10^{-7}	0.022	3.36×10^{-6}
6	6.625	.153	6.32	5.37×10^{-8}	0.001	7.06×10^{-7}
8	8.625	.200	8.23	1.48×10^{-8}	0.006	2.45×10^{-7}
10	10.750	.259	10.23	5.14×10^{-9}	0.0039	1.03×10^{-7}
12	12.750	.313	12.12	2.25×10^{-9}	0.0028	5.22×10^{-8}
Cement Asbestos – Class 150 and 250				**For C = 140**		
	*	*	†			
4	5.07	0.54	4.00	5.66×10^{-7}	0.0255	4.40×10^{-6}
6	7.17	0.66	5.85	8.89×10^{-8}	0.0119	9.62×10^{-7}
8	9.37	0.76	7.85	2.12×10^{-8}	0.0066	2.97×10^{-7}
10	11.92	0.96	10.00	6.53×10^{-9}	0.0041	1.13×10^{-7}
12	14.18	1.09	12.00	2.69×10^{-9}	0.0028	5.43×10^{-8}
14	16.48	1.24	14.00	1.27×10^{-9}	0.0021	2.93×10^{-8}
16	18.72	1.36	16.00	6.62×10^{-10}	0.0016	1.72×10^{-8}
18	21.30	1.65	18.00	3.73×10^{-10}	0.00126	1.07×10^{-8}
20	23.64	1.82	20.00	2.23×10^{-10}	0.00102	7.04×10^{-9}
24	28.32	2.16	24.00	9.19×10^{-11}	0.00071	3.39×10^{-9}

*–O.D. and W.T. apply to Class 150 only.

†–I.D. same for Class 150 and 250.

Metric Conversions: See Page 6-13 for conversion factors.

Appendix

FRICTION LOSS TABLE – PSI PER LINEAL FOOT – (WATER)

Quick reference for Newtonian Concentrates - Consult Darcy Formula for increased accuracy.
Non-Newtonian Concentrates must consult ARC graphs.
Nominal Pipe Size (sch 40 black steel I.D.) Hazen-Williams **C - 120**

GPM	1" 1.049	1 1/4" 1.380	1 1/2" 1.610	2" 2.067	2 1/2" 2.459	3" 3.068	3 1/2" 3.548
10	0.0361	0.0095	0.0045	0.0013	0.0006	0.0002	0.0001
11	0.0431	0.0113	0.0053	0.0016	0.0007	0.0002	0.0001
12	0.0506	0.0133	0.0063	0.0019	0.0008	0.0003	0.0001
13	0.0587	0.0154	0.0073	0.0022	0.0009	0.0003	0.0002
14	0.0673	0.0177	0.0084	0.0025	0.0011	0.0004	0.0002
15	0.0764	0.0201	0.0095	0.0028	0.0012	0.0004	0.0002
16	0.0861	0.0226	0.0107	0.0032	0.0014	0.0005	0.0002
17	0.0963	0.0253	0.0120	0.0035	0.0015	0.0005	0.0003
18	0.1071	0.0282	0.0133	0.0039	0.0017	0.0006	0.0003
19	0.1184	0.0311	0.0147	0.0044	0.0019	0.0006	0.0003
20	0.1301	0.0342	0.0162	0.0048	0.0021	0.0007	0.0003
21	0.1424	0.0375	0.0177	0.0052	0.0022	0.0008	0.0004
22	0.1552	0.0408	0.0193	0.0057	0.0024	0.0008	0.0004
23	0.1685	0.0443	0.0209	0.0062	0.0027	0.0009	0.0004
24	0.1823	0.0480	0.0226	0.0067	0.0029	0.0010	0.0005
25	0.1966	0.0517	0.0244	0.0072	0.0031	0.0011	0.0005
26	0.2114	0.0556	0.0262	0.0078	0.0033	0.0011	0.0006
27	0.2267	0.0596	0.0281	0.0083	0.0036	0.0012	0.0006
28	0.2425	0.0638	0.0301	0.0089	0.0038	0.0013	0.0006
29	0.2588	0.0681	0.0321	0.0095	0.0041	0.0014	0.0007
30	0.2755	0.0725	0.0342	0.0101	0.0043	0.0015	0.0007
31	0.2927	0.0770	0.0363	0.0108	0.0046	0.0016	0.0008
32	0.3105	0.0817	0.0385	0.0114	0.0049	0.0017	0.0008
33	0.3286	0.0864	0.0408	0.0121	0.0052	0.0018	0.0009
34	0.3473	0.0913	0.0431	0.0128	0.0055	0.0019	0.0009
35	0.3664	0.0964	0.0455	0.0135	0.0058	0.0020	0.0010
36	0.3860	0.1015	0.0479	0.0142	0.0061	0.0021	0.0010
37	0.4061	0.1068	0.0504	0.0149	0.0064	0.0022	0.0011
38	0.4267	0.1122	0.0530	0.0157	0.0067	0.0023	0.0011
39	0.4477	0.1177	0.0556	0.0165	0.0071	0.0024	0.0012
40	0.4691	0.1234	0.0582	0.0172	0.0074	0.0025	0.0012
41	0.4911	0.1291	0.0610	0.0181	0.0078	0.0026	0.0013
42	0.5134	0.1350	0.0637	0.0189	0.0081	0.0028	0.0014
43	0.5363	0.1410	0.0666	0.0197	0.0085	0.0029	0.0014
44	0.5596	0.1472	0.0695	0.0206	0.0088	0.0030	0.0015
45	0.5833	0.1534	0.0724	0.0214	0.0092	0.0031	0.0015
46	0.6075	0.1598	0.0754	0.0223	0.0096	0.0033	0.0016
47	0.6322	0.1663	0.0785	0.0232	0.0100	0.0034	0.0017
48	0.6573	0.1729	0.0816	0.0242	0.0104	0.0035	0.0017
49	0.6829	0.1796	0.0848	0.0251	0.0108	0.0037	0.0018
50	0.7089	0.1864	0.0880	0.0261	0.0112	0.0038	0.0019
51	0.7353	0.1934	0.0913	0.0270	0.0116	0.0040	0.0019
52	0.7622	0.2005	0.0946	0.0280	0.0120	0.0041	0.0020
53	0.7896	0.2077	0.0980	0.0290	0.0125	0.0042	0.0021
54	0.8173	0.2150	0.1015	0.0301	0.0129	0.0044	0.0022
55	0.8456	0.2224	0.1050	0.0311	0.0133	0.0045	0.0022
56	0.8742	0.2299	0.1085	0.0321	0.0138	0.0047	0.0023
57	0.9033	0.2376	0.1121	0.0332	0.0143	0.0049	0.0024
58	0.9329	0.2453	0.1158	0.0343	0.0147	0.0050	0.0025
59	0.9628	0.2532	0.1195	0.0354	0.0152	0.0052	0.0025
60	0.9932	0.2612	0.1233	0.0365	0.0157	0.0053	0.0026

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Appendix

FRICTION LOSS TABLE – PSI PER LINEAL FOOT – (WATER) (Continued)

Nominal Pipe Size (sch 40 black steel I.D.) Hazen-Williams **C - 120**

GPM	1" 1.049	1 1/4" 1.380	1 1/2" 1.610	2" 2.067	2 1/2" 2.459	3" 3.068	3 1/2" 3.548
61	1.0241	0.2693	0.1271	0.0377	0.0162	0.0055	0.0027
62	1.0554	0.2776	0.1310	0.0388	0.0167	0.0057	0.0028
63	1.0871	0.2859	0.1350	0.0400	0.0172	0.0058	0.0029
64	1.1192	0.2944	0.1389	0.0412	0.0177	0.0060	0.0030
65	1.1518	0.3029	0.1430	0.0423	0.0182	0.0062	0.0030
66	1.1848	0.3116	0.1471	0.0436	0.0187	0.0064	0.0031
67	1.2182	0.3204	0.1512	0.0448	0.0192	0.0065	0.0032
68	1.2520	0.3293	0.1554	0.0460	0.0198	0.0067	0.0033
69	1.2863	0.3383	0.1597	0.0473	0.0203	0.0069	0.0034
70	1.3210	0.3474	0.1640	0.0486	0.0208	0.0071	0.0035
71	1.3561	0.3567	0.1684	0.0499	0.0214	0.0073	0.0036
72	1.3917	0.3660	0.1728	0.0512	0.0220	0.0075	0.0037
73	1.4277	0.3755	0.1772	0.0525	0.0225	0.0077	0.0038
74	1.4640	0.3851	0.1818	0.0538	0.0231	0.0079	0.0039
75	1.5009	0.3947	0.1863	0.0552	0.0237	0.0081	0.0040
76	1.5381	0.4045	0.1909	0.0566	0.0243	0.0083	0.0041
77	1.5757	0.4144	0.1956	0.0579	0.0249	0.0085	0.0042
78	1.6138	0.4244	0.2003	0.0593	0.0255	0.0087	0.0043
79	1.6523	0.4346	0.2051	0.0608	0.0261	0.0089	0.0044
80	1.6912	0.4448	0.2100	0.0622	0.0267	0.0091	0.0045
82	1.7702	0.4656	0.2198	0.0651	0.0279	0.0095	0.0047
84	1.8509	0.4868	0.2298	0.0681	0.0292	0.0099	0.0049
86	1.9333	0.5085	0.2400	0.0711	0.0305	0.0104	0.0051
88	2.0173	0.5306	0.2504	0.0742	0.0318	0.0108	0.0053
90	2.1029	0.5531	0.2611	0.0773	0.0332	0.0113	0.0056
92	2.1902	0.5760	0.2719	0.0805	0.0346	0.0118	0.0058
94	2.2791	0.5994	0.2829	0.0838	0.0360	0.0122	0.0060
96	2.3696	0.6232	0.2942	0.0871	0.0374	0.0127	0.0063
98	2.4618	0.6475	0.3056	0.0905	0.0389	0.0132	0.0065
100	2.5555	0.6721	0.3173	0.0940	0.0403	0.0137	0.0068
110	3.0483	0.8017	0.3784	0.1121	0.0481	0.0164	0.0081
120	3.5806	0.9417	0.4445	0.1317	0.0565	0.0192	0.0095
130	4.1521	1.0920	0.5155	0.1527	0.0655	0.0223	0.0110
140	4.7623	1.2525	0.5912	0.1751	0.0752	0.0256	0.0126
150	5.4106	1.4230	0.6717	0.1989	0.0854	0.0291	0.0143
160	6.0968	1.6035	0.7569	0.2242	0.0962	0.0328	0.0161
170	6.8204	1.7938	0.8467	0.2508	0.1076	0.0366	0.0181
180	7.5811	1.9939	0.9412	0.2787	0.1197	0.0407	0.0201
190	8.3786	2.2036	1.0402	0.3081	0.1322	0.0450	0.0222
200	9.2126	2.4230	1.1437	0.3387	0.1454	0.0495	0.0244
210	10.0828	2.6518	1.2517	0.3707	0.1591	0.0542	0.0267
220	10.9890	2.8902	1.3642	0.4040	0.1734	0.0590	0.0291
230	11.9309	3.1379	1.4812	0.4387	0.1883	0.0641	0.0316
240	12.9082	3.3949	1.6025	0.4746	0.2037	0.0694	0.0342
250	13.9208	3.6613	1.7282	0.5118	0.2197	0.0748	0.0368
260	14.9685	3.9368	1.8583	0.5504	0.2362	0.0804	0.0396
270	16.0509	4.2215	1.9927	0.5902	0.2533	0.0862	0.0425
280	17.1680	4.5153	2.1313	0.6312	0.2710	0.0922	0.0454
290	18.3195	4.8181	2.2743	0.6736	0.2891	0.0984	0.0485
300	19.5052	5.1300	2.4215	0.7172	0.3078	0.1048	0.0516

Appendix

DARCY FORMULA

$$\Delta P = 0.000216 \frac{fL\rho Q^2}{d^5}$$

Reynolds Number

$$Re = \frac{50.6\, Q\, \rho}{d\mu}$$

ΔP = Friction loss (psi)

L = Length of pipe (ft.)

f = Friction factor

ρ = Weight Density of fluid (lb/ft^3)

Q = Flow (gpm)

d = Pipe diameter (in)

μ = Absolute (dynamic) viscosity (centipoise)

Re = Reynolds Number

ANSULITE 1% AFFF

Absolute Viscosity in centipoise = 7.77

Weight Density of Fluid = 64.68 lb/ft^3

ANSULITE 3% AFFF

Absolute Viscosity in centipoise = 3.07

Weight Density of Fluid = 63.93 lb/ft^3

Example Calculation for ANSULITE 3% AFFF Concentrate (flowing 77 gpm through 200 ft of 2 1/2 in. pipe)

First calculate the Reynolds Number to help determine the friction factor (f) to use in the Darcy Formula.

$$Re = \frac{50.6\, Q\, \rho}{d\mu}$$

$$Re = \frac{50.6\ (77\ \text{gpm})\ (63.9\ \text{lb/ft}^3)}{(2.469\ \text{in})\ (3.07\ \text{centipoise})}$$

Re = 32,846

f = ~ 0.0255

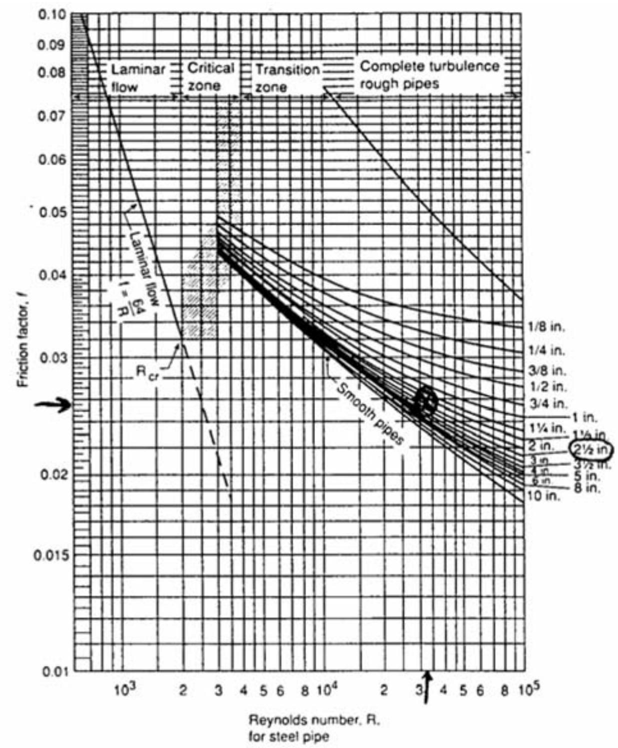


Figure A-4-7.4(d) NFPA 16 (1995 edition)

Once the friction factor (f) is determined, the friction loss for ANSULITE 3% AFFF, flowing 77 gmp through 200 ft of 2 1/2 in. pipe can be calculated using the Darcy Formula.

$$\Delta P = 0.000216 \frac{fL\rho Q^2}{d^5}$$

$$\Delta P = 0.000216 \frac{0.0255\ (200\ \text{ft})\ (63.9\ \text{lb/ft}^3)\ (77\ \text{gpm})^2}{(2.469\ \text{in})^5}$$

ΔP = 4.549 psi

Appendix

STRAIGHT BORE DISCHARGE DATA

Discharge Table For Smooth Nozzles – Nozzle Pressure Measured By Pitot Gauge

Nozzle	Nozzle Diameter in Inches																			
Pressure	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2	1-5/8	1-3/4	1-7/8	2	2-1/4	2-1/2	3
in psi	Gallons Per Minute																			
10	6	9	13	18	23	36	53	71	93	118	146	177	211	248	288	330	376	477	588	848
12	6	10	15	19	25	40	58	78	102	130	160	194	231	271	315	362	412	522	645	928
14	7	11	15	21	27	43	63	84	110	140	173	210	249	293	340	391	445	564	686	1002
16	7	12	16	22	29	46	67	90	118	150	185	224	267	313	364	418	475	603	744	1070
18	7	12	17	24	31	49	71	95	125	159	196	237	283	332	386	444	504	640	790	1136
20	8	13	18	25	33	51	75	101	132	167	206	250	298	350	407	468	532	674	832	1200
22	8	13	19	26	34	54	79	105	139	175	216	263	313	367	427	490	557	707	872	1255
24	8	13	20	27	36	56	82	110	145	183	226	275	327	384	446	512	582	739	910	1311
26	9	14	21	29	37	59	85	115	151	191	235	286	340	400	464	533	606	769	949	1366
28	9	14	21	30	39	61	89	119	157	198	244	297	353	415	481	554	629	799	985	1418
30	10	15	22	31	40	63	92	123	162	205	253	307	365	429	498	572	651	826	1017	1470
32	10	15	23	32	41	65	95	127	167	212	261	317	377	443	514	591	673	854	1050	1515
34	11	16	23	33	43	67	98	131	172	218	269	327	389	457	530	610	693	880	1082	1561
36	11	16	24	34	44	69	100	135	177	224	277	336	400	470	546	627	713	905	1114	1610
38	11	17	25	35	45	71	103	138	182	231	285	345	411	483	561	645	733	930	1144	1650
40	11	18	26	35	46	73	106	142	187	237	292	354	422	496	575	661	752	954	1174	1692
42	11	18	26	36	47	74	109	146	192	243	299	363	432	508	589	678	770	978	1203	1737
44	12	18	27	37	49	76	111	149	196	248	306	372	442	520	603	694	788	1000	1231	1776
46	12	19	28	38	50	78	114	152	200	254	313	380	452	531	617	710	806	1021	1259	1816
48	12	19	28	39	51	80	116	156	205	259	320	388	462	543	630	725	824	1043	1286	1854
50	13	20	29	40	52	81	118	159	209	265	326	396	472	554	643	740	841	1065	1313	1895
52	13	20	29	40	53	83	121	162	213	270	333	404	481	565	656	754	857	1087	1339	1930
54	13	20	30	41	54	84	123	165	217	275	339	412	490	576	668	769	873	1108	1364	1968
56	13	21	30	42	55	86	125	168	221	280	345	419	499	586	680	782	889	1129	1389	2000
58	13	21	31	43	56	87	128	171	225	285	351	426	508	596	692	796	905	1149	1417	2020
60	14	22	31	43	57	89	130	174	229	290	357	434	517	607	704	810	920	1167	1438	2075
62	14	22	32	44	58	90	132	177	233	295	363	441	525	617	716	823	936	1187	1463	2108
64	14	22	32	45	59	92	134	180	237	299	369	448	533	627	727	836	951	1206	1490	2140
66	14	23	33	46	60	93	136	182	240	304	375	455	542	636	738	850	965	1224	1510	2175
68	14	23	33	46	60	95	138	185	244	308	381	462	550	646	750	862	980	1242	1532	2205
70	15	24	34	47	61	96	140	188	247	313	386	469	558	655	761	875	994	1260	1558	2240
72	15	24	34	48	62	97	142	191	251	318	391	475	566	665	771	887	1008	1278	1579	2275
74	15	24	35	48	63	99	144	193	254	322	397	482	574	674	782	900	1023	1296	1600	2300
76	15	24	35	49	64	100	146	196	258	326	402	488	582	683	792	911	1036	1313	1620	2340
78	15	24	36	50	65	101	148	198	261	330	407	494	589	692	803	924	1050	1330	1640	2370
80	16	25	36	50	66	103	150	201	264	335	413	500	596	700	813	935	1063	1347	1665	2400
82	16	25	37	51	66	104	152	204	268	339	418	507	604	709	823	946	1076	1364	1685	2425
84	16	25	37	51	67	105	154	206	271	343	423	513	611	718	833	959	1089	1380	1707	2460
86	16	26	37	52	68	107	155	208	274	347	428	519	618	726	843	970	1102	1396	1723	2485
88	16	26	38	53	69	108	157	211	277	351	433	525	626	735	853	981	1115	1412	1745	2515
90	17	27	39	53	70	109	159	213	280	355	438	531	633	743	862	992	1128	1429	1762	2540
92	17	27	39	54	70	110	161	215	283	359	443	537	640	751	872	1002	1140	1445	1785	2565
94	17	27	39	54	71	111	162	218	286	363	447	543	647	759	881	1012	1152	1460	1802	2600
96	17	27	40	55	72	113	164	220	289	367	452	549	654	767	890	1022	1164	1476	1822	2625
98	17	27	40	55	73	114	166	223	292	370	456	554	660	775	900	1032	1176	1491	1840	2650
100	18	28	41	56	73	115	168	225	295	374	461	560	667	783	909	1043	1189	1506	1860	2680
105	18	29	42	57	75	118	172	230	303	383	473	574	683	803	932	1070	1218	1542	1908	2745
110	19	29	43	59	77	121	176	236	310	392	484	588	699	822	954	1095	1247	1579	1950	2810
115	19	30	43	60	79	123	180	241	317	401	495	600	715	840	975	1120	1275	1615	1995	2875
120	19	31	44	61	80	126	183	246	324	410	505	613	730	858	996	1144	1303	1649	2020	2940
125	20	31	45	63	82	129	187	251	331	418	516	626	745	876	1016	1168	1329	1683	2080	3000
130	20	32	46	64	84	131	191	256	337	427	526	638	760	893	1036	1191	1356	1717	2120	3055
135	21	33	47	65	85	134	195	262	343	435	536	650	775	910	1056	1213	1382	1750	2160	3110
140	21	33	48	66	87	136	198	266	350	443	546	662	789	927	1076	1235	1407	1780	2200	3170
145	21	34	49	68	88	139	202	271	356	450	556	674	803	944	1095	1257	1432	1812	2240	3225
150	22	34	50	69	90	141	205	275	362	458	565	686	817	960	1114	1279	1456	1843	2260	3280
175	24	36	55	74	97	152	218	298	390	494	610	740	883	1030	1200	1380	1572	1985	2460	3540
200	26	40	59	79	104	162	234	318	418	527	653	790	944	1103	1283	1472	1680	2123	2635	3785

Metric Conversions: See Page 6-13 for conversion factors.

Appendix

COMPARATIVE EQUIVALENTS OF LIQUID MEASURES AND WEIGHTS

EQUIVALENT UNITS

UNITS FOR COMPARISON	U.S. GALLON	IMPERIAL GALLON	CUBIC INCH	CUBIC FOOT	CUBIC METER	LITER	POUNDS OF WATER
U.S. Gal.	1.	.883	231.	.1337	.00378	3.785	8.34
Imp. Gal.	1.20	1.	277.27	.1604	.00454	4.542	10.
Cubic In.	.0043	.00358	1.	.00057	.000016	.0163	.0358
Cubic Ft.	7.48	6.235	1728.	1.	.02827	28.312	62.355
Cubic Meter	264.17	220.05	61023.	35.319	1.	1000.	2200.54
Liter	.26417	.2200	61.023	.0353	.001	1.	2.2005
Lb. of Water	.12	.1	27.72	.016	.00045	.454	1.

Appendix

METRIC CONVERSIONS (U.S. to METRIC)

U.S. Unit	Multiply by:	= Metric Equivalent
Area		
Square Foot (ft^2)	0.093	Square Meter (m^2)
Square Inch (in^2)	6.4516	Square Centimeter (cm^2)
Square Inch (in^2)	0.0006	Square Meter (m^2)
Volume		
Gallon (gal.)	3.79	Liter (L)
Cubic Foot (ft^3)	0.028	Cubic Meter (m^3)
Gallon (gal.)	0.00378	Cubic Meter (m^3)
Length		
Inch (in.)	2.54	Centimeter (cm)
Foot (ft.)	0.3048	Meters (m)
Pressure		
Pounds/Square Inch (psi)	6.895	Kilopascals (kPa)
Pounds/Square Inch (psi)	0.06894	Bars
Feet of Water	0.0021	Kilopascals (kPa)
Velocity		
Feet per Second (FPS)	30.48	Centimeters/Second (cm/s)
Feet per Second (FPS)	0.305	Meters/Second (m/s)
Density		
Gallons/Min/Sq Ft (gpm/ft^2)	40.7	Liters/Min/Sq. Meter (Lpm/m^2)
Force		
Pound – Force	4.448	Newton
Temperature		
Degrees Fahrenheit (°F)	$\frac{5(°F-32)}{9}$	Degrees Celsius (°C)

Appendix

EQUIVALENT VALUES OF PRESSURE

In. of Mercury	Ft of Water	Lb per Sq In
1	1.13	0.49
2	2.26	0.98
3	3.39	1.47
4	4.52	1.95
5	5.65	2.44
6	6.78	2.93
7	7.91	3.42
8	9.04	3.91
9	10.17	4.40
10	11.30	4.89
11	12.45	5.39
12	13.57	5.87
13	14.70	6.37
14	15.82	6.86
15	16.96	7.35
16	18.09	7.84
17	19.22	8.33
18	20.35	8.82
19	21.75	9.31
20	22.60	9.80
21	23.78	10.30
22	24.88	10.80
23	26.00	11.28
24	27.15	11.75
25	28.26	12.25
26	29.40	12.73
27	30.52	13.23
28	31.65	13.73
29	32.80	14.22
29.929	33.947	14.6969

Metric Conversions: See Page 6-13 for conversion factors.

Appendix

HOSE FRICTION LOSS

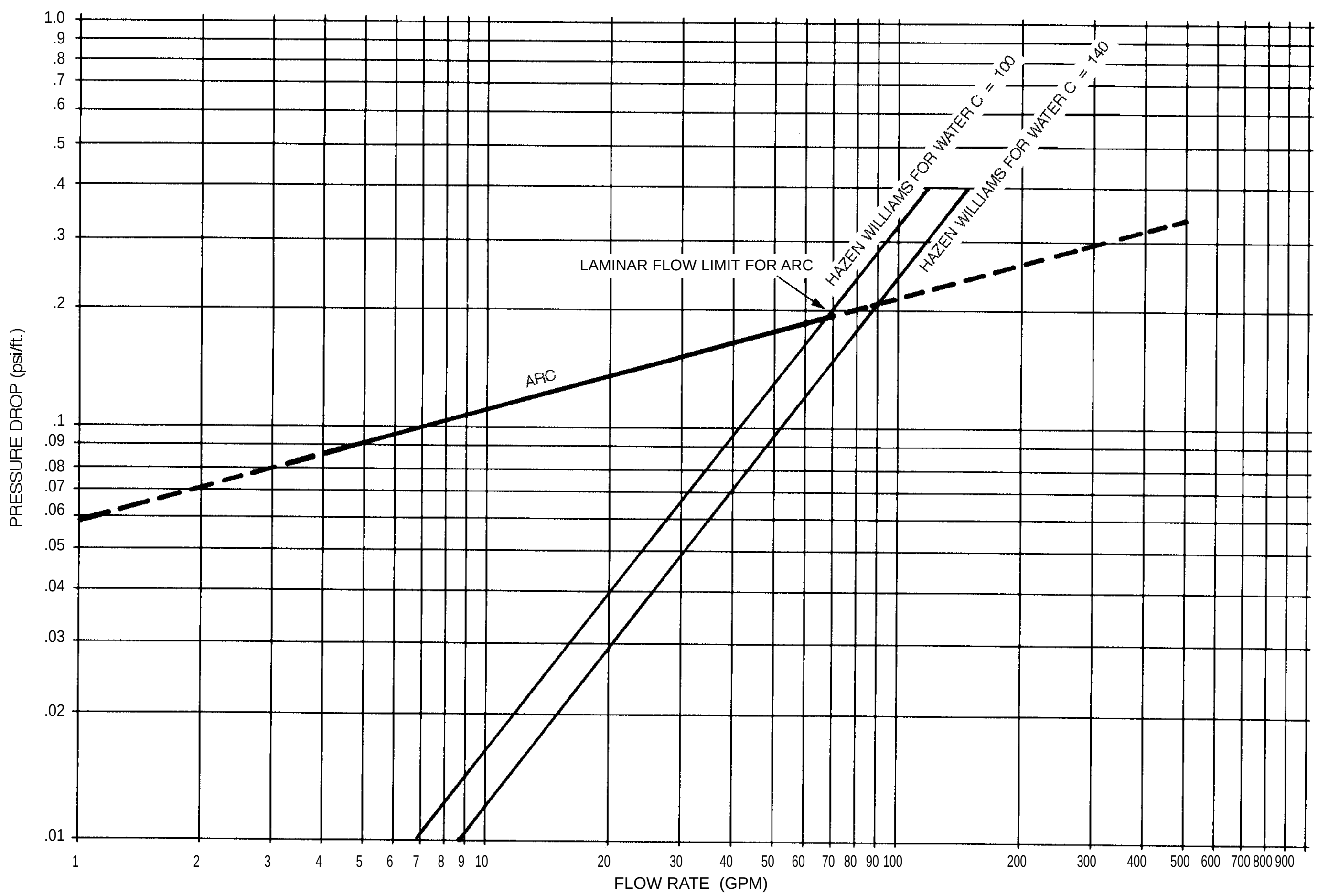
HOSE FRICTION LOSS (psi per 100 ft.)																			
gpm Flowing	3/4 in. Booster	1 in. Booster	1 1/2 in. Hose	gpm Flowing	1 3/4 in. Hose with 1 1/2 in. Couplings	2 in. Hose with 1 1/2 in. Couplings	2 1/2 in. Hose	3 in. Hose with 2 1/2 in. Couplings	3 in. Hose	gpm Flowing	3 in. Hose with 2 1/2 in. Couplings	3 in. Hose	3 1/2 in. Hose	4 in. Hose	gpm Flowing	3 in. Hose	3 1/2 in. Hose	4 in. Hose	5 in. Hose
10	13.5	3.5		150	22.5	11.2	4.0			450	20.3	17.5	7.9	4.1	750	45.0	20.1	11.4	3.7
20	50.0	12.3	1.2	175	34.0	15.8	6.6			475	22.5	19.3	8.7	4.6	800	50.5	22.7	12.4	4.3
30	105.0	26.0	2.5	200	45.6	20.0	8.9	4.0	3.8	500	25.0	21.2	9.5	5.0	850	56.5	25.4	14.3	4.9
40	180.0	44.0	4.3	225	52.1	22.0	11.5	5.1	4.9	525	27.5	23.2	10.5	5.6	900	63.0	28.2	15.9	5.4
50		67.0	7.1	250	61.0	28.2	13.8	6.3	5.9	550	29.0	25.2	11.5	6.0	950	70.0	31.2	17.5	6.0
60		89.0	9.2	275		33.6	16.0	7.6	7.0	575	32.5	27.5	12.4	6.7	1000	76.5	34.3	19.2	6.6
70		118.0	12.3	300		40.0	18.6	9.0	8.2	600	35.0	29.9	13.4	7.2	1100	91.5	41.0	23.0	7.9
80		149.0	15.6	325			22.2	10.7	9.8	625	38.5	32.0	14.4	7.9	1200		49.0	28.5	9.5
90			19.5	350			25.1	12.3	11.0	650	41.0	34.5	15.5	8.5	1300		57.0	30.5	11.0
100			25.5	375			28.4	14.0	12.4	675	44.1	37.0	16.6	9.1	1400		66.5	35.0	13.0
110			29.2	400			33.5	16.0	14.1	700	47.0	39.5	17.7	9.6	1500		74.0	41.5	14.5
120			33.0							725	50.5	42.5	18.9	10.4	2000			68.0	26.0

Metric Conversions: See Page 6-13 for conversion factors.

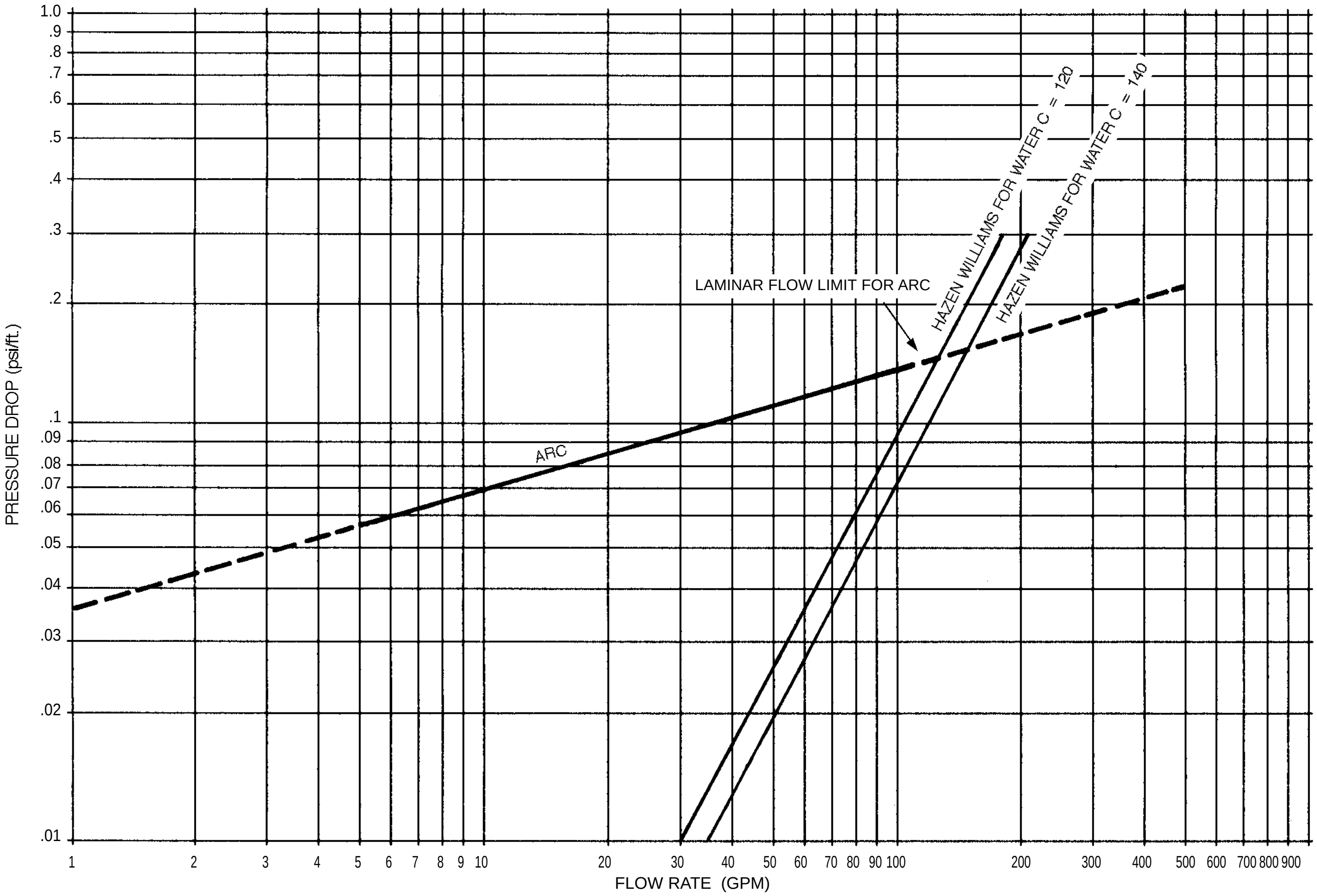
FRICTION LOSS DATA FOR ANSULITE® ARC (ALCOHOL RESISTANT CONCENTRATE)

Data/Specifications

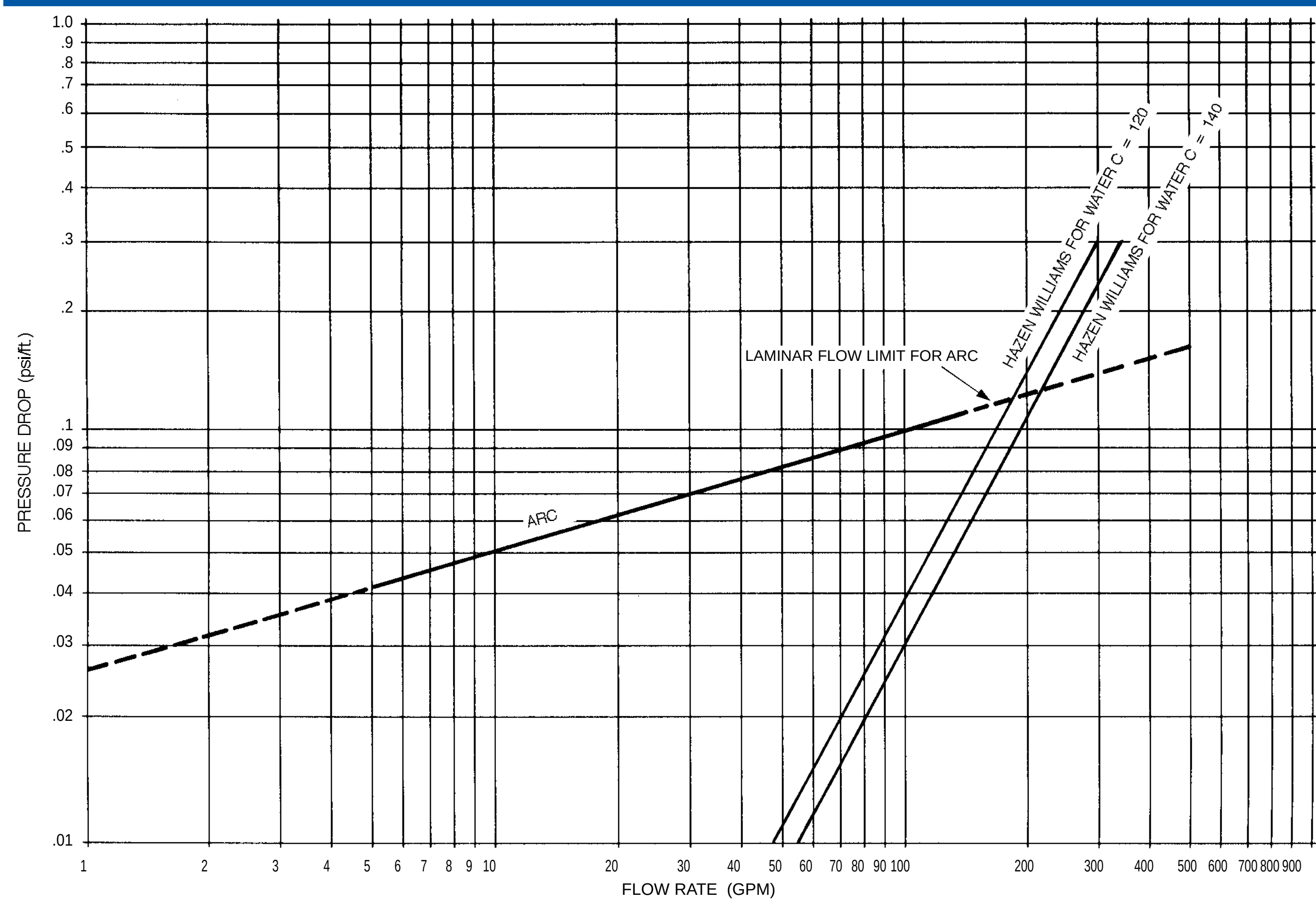
PRESSURE DROP VS. FLOW RATE 1 1/2 IN. SCHEDULE 40 PIPE



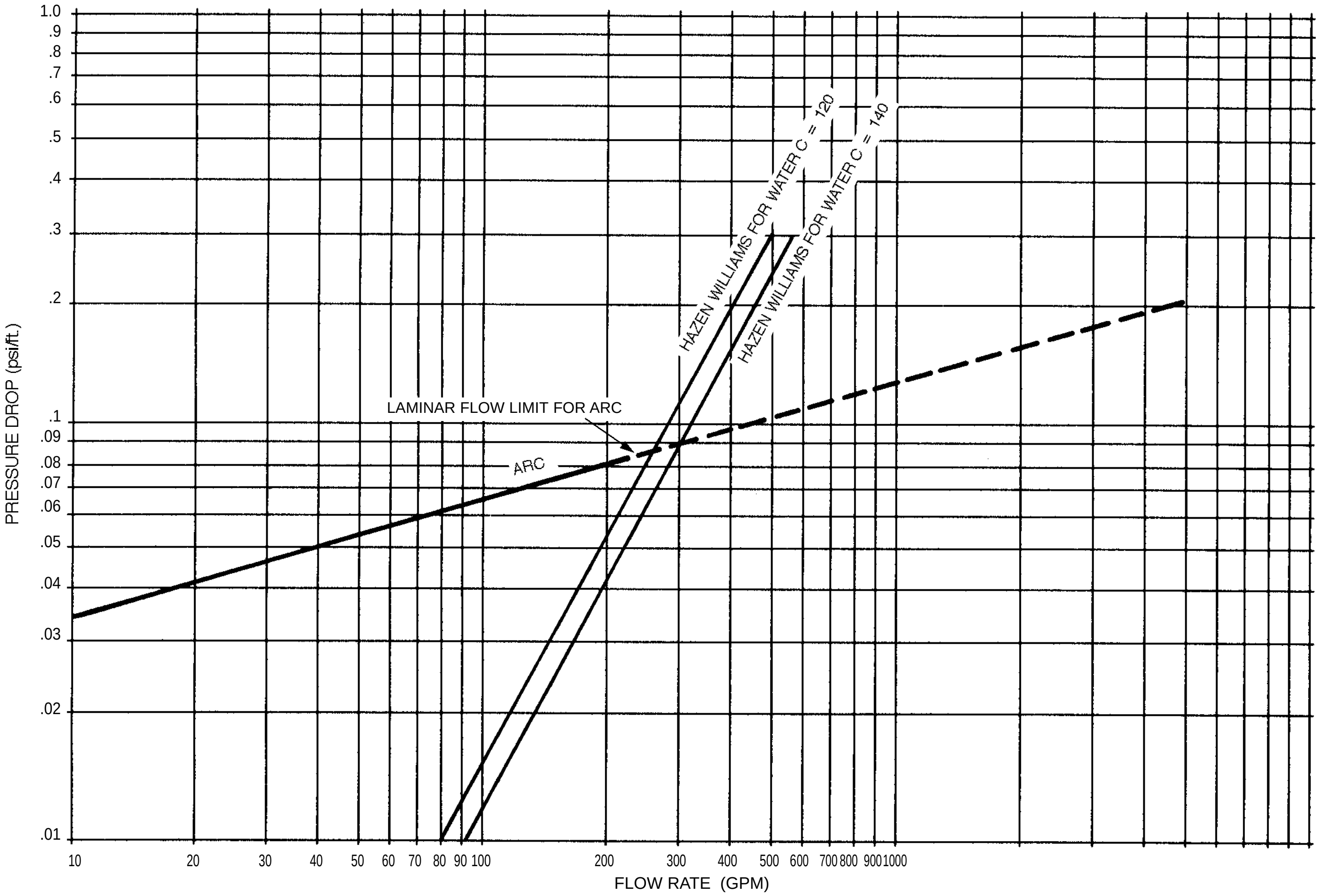
PRESSURE DROP VS. FLOW RATE 2 IN. SCHEDULE 40 PIPE



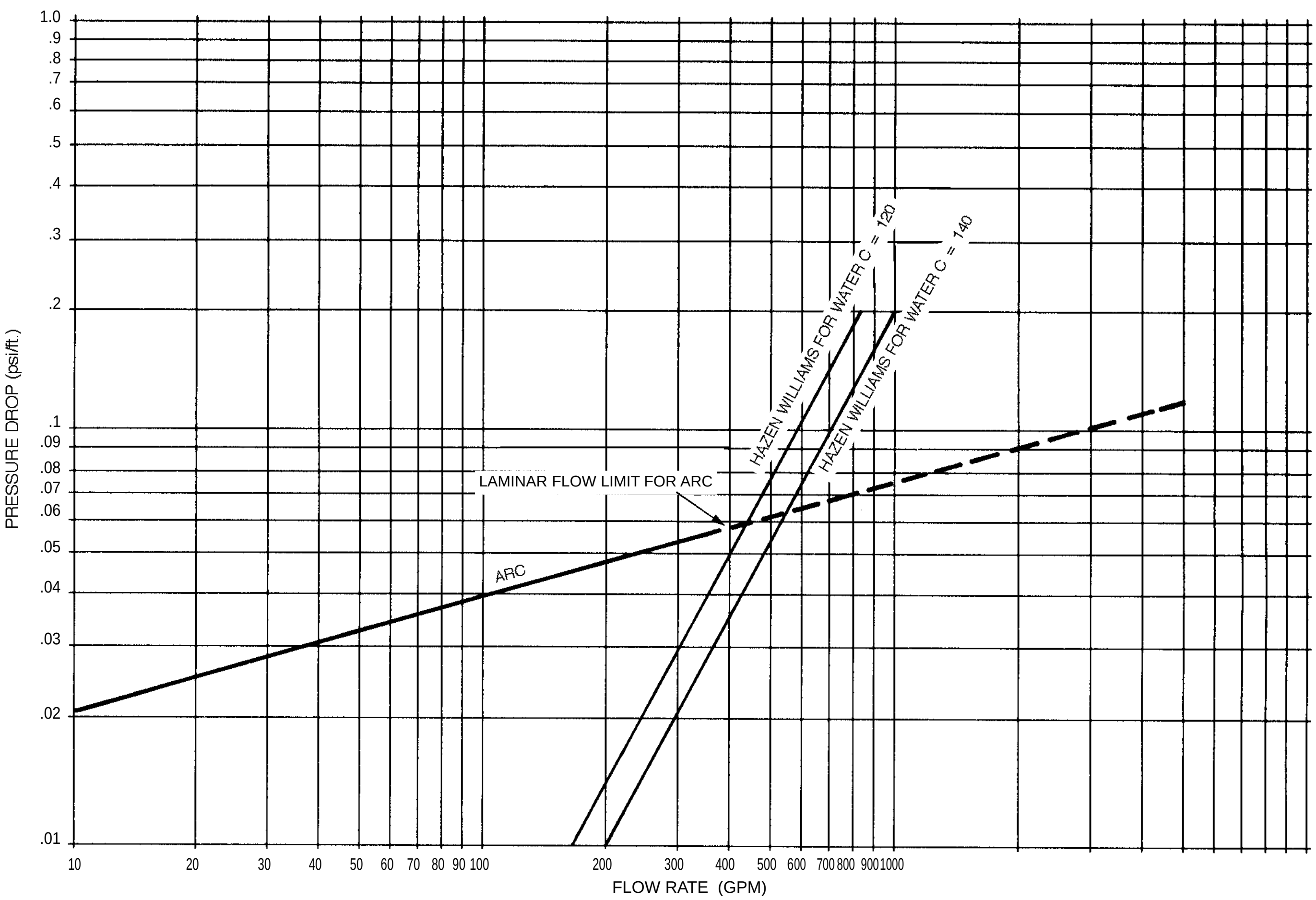
PRESSURE DROP VS. FLOW RATE 2 1/2 IN. SCHEDULE 40 PIPE



PRESSURE DROP VS. FLOW RATE 3 IN. SCHEDULE 40 PIPE



PRESSURE DROP VS. FLOW RATE 4 IN. SCHEDULE 40 PIPE



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Understanding Fire Detection Devices

Performance differences must be recognized for correct applications

A fire detection and alarm system is a combination of devices designed to signal an alarm in case of fire. The system may also accomplish fan control, fire-door hold or release, elevator recall, emergency lighting control and other emergency functions. These additional functions supplement the basic system which consists of detection and alarm devices and a central control unit. This article will discuss fire detection systems, with emphasis on operation and application. A future article will address alarm systems.

Detection Devices

Fire is the process of combustion, a chemical reaction producing heat, smoke, flame, light, water vapor, gases and other products. An automatic detection device, such as a heat, smoke or flame detector, will sense the presence of one or more of the above products and generate an alarm signal.

There can also be human discovery of a fire, resulting in manual activation of an alarm device. The fire alarm box, sometimes called a pull-station, is a manual device and can be either coded or noncoded. The noncoded fire alarm box is nothing more than a switch designed to either open or close a circuit when operated. Once operated, however, the switch cannot be externally reset to the normal position. This feature prevents the actuated alarm from being silenced by unauthorized personnel. The coded fire alarm box, upon actuation, transmits a uniquely coded signal over the system. Older boxes used a rotating code wheel, powered by an internal spring or motor, to transmit this signal. Modern systems employ solid-state modules to generate coded signals. Using coded fire alarm boxes, large areas can be protected by zones, thus directing fire fighting personnel to the exact location of the fire.

Heat Detectors

There are two classes of heat detectors: fixed-temperature and rate-of-rise. Variations of these types, such as the rate-compensation detector and the combination detector, are also available.

Rated operating temperature (sometimes referred to as the rated temperature or operation temperature) of heat detectors is the thermal rating of the device. It is the temperature to which the internal heat-sensitive detection element must be heated before it will operate. Typical ratings for fixed-temperature and rate-compensation devices are 135 °F, 175 °F and 250 °F. The actual operating temperature (not an industrially accepted designation, this term is useful when discussing the operating characteristics of heat detectors) is defined as the temperature of the air surrounding the device at the time of its operation. Ideally, the temperatures of the surrounding air and the heat detector should be equal when the device signals an alarm.

Fixed-Temperature Detectors. Fixed-temperature heat detectors will generate an alarm signal when the temperature of the internal detection element reaches its rated operating temperature. Bimetallic strips or discs and fusible links are normally used as detection elements. The bimetallic element type of detector consists of two metals with different coefficients of thermal expansion. When heated, the metals will expand at different rates, resulting in a distortion of the bimetallic element to operate a set of contacts. Another type of heat detector uses fusible links that, when exposed to heat, will melt, allowing a set of springloaded contacts to operate. As the bimetallic elements return to their original position at normal temperature, they are reusable, whereas fusible elements are nonrestorable. Either the detection element or the complete fusible detector must be replaced after each operation.

Heat detectors, as well as many other types of fire detection devices, may be of spot-type or line-type construction. Spot-type detectors are unitary devices with their operating elements in a single enclosure. Spot-type, fixed-temperature detectors include bimetallic thermostats, snap-action disc thermostats, fusible link thermostats and quartzoid bulb thermostats. Line-type detectors consist of lengths of cable or tubing, usually attached to the ceiling of the protected area. Line-type, fixed-temperature detectors include thermostatic or heat sensitive cable and resistance cable.

When a fixed-temperature heat detector operates, the actual operating temperature will invariably be higher than the rated operating temperature. For example, a detector *rated* for 135 °F may not *actually* operate until the temperature of the surrounding air reaches, perhaps, 150 °F when exposed to a gradually increasing fire, or 175 °F for a rapidly increasing fire. This difference between rated operating temperature and actual operating temperature is called thermal lag. By the time the temperature of the detection element reaches its rated operating temperature to generate an alarm signal, the temperature of the surrounding air has gone even higher. The rate of this heat transfer is primarily dependent upon the rate at which the surrounding air itself is being heated.

Rate-Compensated Detectors. Rate-compensation (or rate-anticipation) heat detectors are designed to compensate for thermal lag. When a rate-compensation heat detector operates, the actual operating temperature will be approximately equal to the rated operating temperature, regardless of the rate at which the air is being heated. The rate-compensation detector, as illustrated in Fig. 1, consists of a pair of expansion struts and electrical contacts enclosed by an expansion shell. The expansion shell is exposed to the surrounding air and has a higher coefficient of expansion than the struts. When subjected to a rapidly increasing fire, only the shell will expand, since it is exposed to the heat. This lengthwise expansion of the shell *quickly* relieves compression on the struts and operates the contacts at precisely the rated operating temperature of the device.

When exposed to a gradually increasing fire, on the other hand, the detector heats up uniformly throughout. The shell will expand more than the struts, due to the difference in coefficients of expansion. This action gradually relieves compression on the struts and again operates the contacts at precisely the rated operating temperature of the device.

Rate of Rise Detectors. Rate-of-rise detectors will generate an alarm

By William E. DeWitt, P.E. Huntsville Div., U.S. Army Corps of Engineers

Detection Devices

(Continued from page 32)

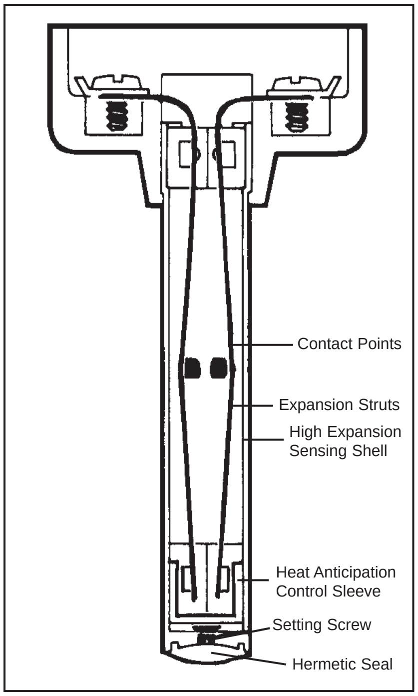
signal when the temperature of the air surrounding the detector rises at a rate in excess of a preselected rate (usually 15 °F per minute). These devices are more responsive than fixed-temperature heat detectors because thermal lag is not a significant factor in the operation of rate-of-rise detectors. One disadvantage of these devices is that they are subject to false alarms when exposed to rapidly increasing temperatures not caused by fire. However, this can be minimized by proper application of the detector.

Line-type rate-of-rise detectors, called pneumatic tube detectors, are also available. A pneumatic tube detector system consists of a continuous loop of tubing located on or near the ceiling of the protected area and operates on the principle of air expansion in a capillary tube instead of in a chamber.

Rate-of-rise detectors should never be located near furnaces, incinerators, freezers, frequently opened exterior doors, or other areas where abrupt changes in ambient temperature may occur. Another disadvantage of rate-of-rise detectors is that they may even fail to operate when exposed to a gradually increasing fire. To overcome this disadvantage, rate-of-rise detectors are combined with fixed-temperature detectors to form a combination heat detector.

Combination Heat Detectors. Figure 2 illustrates a spot-type combination heat detector. Basically the rate-of-rise portion of the detector consists of electrical contacts and a flexible diaphragm mounted inside an air chamber equipped with a breather valve. The fixed-temperature portion consists of a spring and fusible alloy also mounted inside the chamber. When the unit is exposed to heat from a fire, the air within the chamber will expand, forcing the diaphragm upward. The diaphragm will operate the contacts when sufficient pressure builds up within the chamber. Normal changes in ambient temperature, from the heating system for example, allow sufficient time for the pressure to be relieved through the breather valve, and the detector will not operate.

As discussed previously, rate-of-rise detectors may fail to operate when exposed to a gradually increasing fire. Combination detectors are not susceptible to this problem because the fixed-temperature portion of the detector will "back up" the rate-of-rise portion. When the temperature from a gradually increasing fire is high enough to melt the fusible element, the spring will be released and operate the contacts. The fusible element portion of this



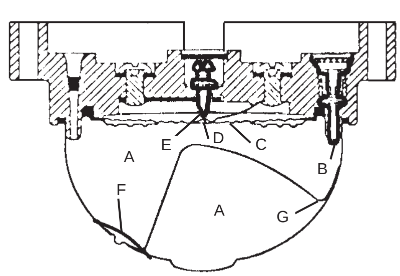
Courtesy Notifier Div., Emhart Industries, Inc.

Fig. 1. Rate-compensated heat detector. These units compensate for thermal lag.

detector, of course, is nonrestorable and must be replaced.

Figure 3 is a comparison of the rate of response for fixed-temperature, rate-compensation and rate-of-rise types of heat detectors. It also illustrates the relationship of rated operating temperature, actual operating temperature and thermal lag.

Rules for the proper spacing and location of heat detectors can be found in National Fire Protection Association (NFPA) Standard 72E, Automatic Fire Detectors. Additional data, such as standard ratings, color coding of detectors,



A—Air Chamber
B—Breather Valve
C—Diaphragm
D—Moveable Electrical Contact
E—Fixed Electrical Contact
F—Fusible Fixed-Temperature Element
G—Fixed-Temperature-Element Spring

Courtesy Edwards Co.

Fig. 2. Combination heat detector. By utilizing both fixed-temperature and rate-of-rise sensors in one unit, these detectors are more responsive to fires.

maintenance and testing requirements, and other application information are also available in the NFPA publication.

Smoke Detectors

NFPA 72E defines smoke as "the totality of the airborne visible or invisible particles of combustion." Visible particles of combustion (e.g., heavy dense smoke from a smoldering fire) consist of a small number of large smoke particles per unit volume, while invisible particles of combustion (e.g., transparent smoke from a rapidly burning fire) consist of a large number of small smoke particles per unit volume. A smoke detector will sense the presence of these visible or invisible particles and generate an alarm signal.

Photoelectric Detectors. Photoelectric (or optical) smoke detectors consist primarily of a photocell and a light source and are normally applied where a fire is expected to generate large amounts of visible particles of combustion. The principle of operation is that smoke entering the path of a light source will block the light and prevent it from striking a photocell, thus generating an alarm signal.

Another principle used is that smoke interfering with a light source will reflect light into a photocell, also generating an alarm signal. Photoelectric detectors can be of spot-type or beam-type construction. The spot-type detector encloses all elements in one small unit while the beam type consists of a light source and photocell located at opposite ends and near the ceiling of the protected area.

Ionization Detectors. Ionization detectors, although capable of detecting the presence of both visible and invisible particles of combustion, are more sensitive to invisible particles. This is because smoke containing a minimum number of particles per unit volume is required to actuate an ionization detector. As previously indicated, invisible particles of combustion contain more smoke particles than do visible particles of combustion. Figure 4 illustrates the principle.

The basic detector consists of a dc source, detection circuitry and an ionization chamber containing a small radioactive alpha source. The dc source, either a battery or a rectifier, maintains an electrical potential between plates P_1 and P_2 as indicated. The air molecules inside the chamber are separated into positive ions and negative electrons by the alpha source, a process known as ionization. Since like charges repel and unlike charges attract, the charged particles between the plates will flow in the directions indicated. When particles of combustion enter the ionization chamber,

Detection Devices (Continued from page 36)

TYPE OF DETECTOR (135 °F Rating)	SURROUNDING AIR TEMP. @ TIME OF ALARM	RATE OF TEMP. RISE FROM 85 °F.	APPROX. TIME TO ALARM	REMARKS
FIXED TEMP.	153 °F	10 °F per minute	6.8 minutes	18 ° Thermal lag.
RATE COMPENSATION	132 °F	10 °F per minute	4.7 minutes	First to operate.
FIXED TEMP.	176 °F	40 °F per minute	2.3 minutes	41 ° Thermal lag.
RATE-OF-RISE	120 °F	40 °F per minute	0.4 minutes	First to operate.
RATE COMPENSATION	125 °F	40 °F per minute	1.0 minute	Second to operate.
FIXED TEMP.	152 °F	Less than 10 °F per minute	8.4 minutes	17 ° Thermal lag.
RATE-OF-RISE	– –	Less than 10 °F per minute	Never	Temp. rate not sufficient to operate.
RATE COMPENSATION	138 °F	Less than 10 °F per minute	5.9 minutes	First to operate.

Courtesy Notifier Div., Emhart Industries, Inc.

Fig. 3. Comparison of response times for different types of detectors. Differences are shown between the rated operation temperature and actual operating temperature.

they will attach themselves to the charged particles and reduce their flow. The detector circuitry will sense this flow reduction and generate an alarm signal.

The proper application of smoke detectors is very important. Consider the following points, and follow the manufacturer's recommendations regarding proper location and spacing.

• To avoid false alarms, smoke detectors should not be located in areas where high levels of particles of combustion normally occur, such as garages, boiler rooms or smoking areas.

• Smoke detectors located close to room air supply diffusers may fail to operate, or have reduced sensitivity, because the HVAC air flow will reduce the amount of smoke entering the detection chamber.

• Environmental conditions, such as humidity, barometric pressure and temperature can cause false alarms or loss of sensitivity in smoke detectors. The dual-chamber ionization detector helps avoid this problem and consists of two ionization chambers. One chamber performs the detection function while the second chamber, called a reference chamber, compensates for variations in humidity, barometric pressure and temperature.

• Care should be exercised when locating smoke detectors outdoors to prevent atmospheric contaminants, such as rain, sleet or snow, from entering the detection chamber.

• Smoke detectors installed in dusty environments may require air filters to prevent false alarms.

Many advances are currently being made in the field of smoke detector technology. Detectors are being made more sensitive to different types of fires and less susceptible to environmental conditions. For example, combination ionization/photoelectric smoke detectors are sensitive to both visible and invisible particles of combustion. These devices capitalize on the advantages of both detector types to provide wide range coverage.

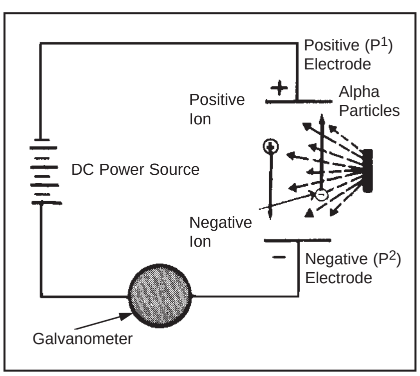


Fig. 4. Operating principal of an ionization detector. These units sense products of combustion.

Flame Detectors

Flame is the visible or invisible burning gases or vapor produced by a fire. Flame detectors are line-of-sight devices that will generate an alarm signal when exposed to the radiant energy from a flame. Since this radiant energy travels at the speed of light, flame detectors have the potential for being fast acting. Care must be taken when applying these line-of-sight devices to insure that their effectiveness is not impaired by obstructions such as structural members, equipment, or the presence of dense smoke or gases.

Flame detectors, because of their fast detection capabilities (their reaction time is in the millisecond range) are, in general, only used where a serious hazard exists, such as fuel storage and transfer areas, industrial process areas and situations in which explosions or very rapid fires may occur.

Ultraviolet Detectors. One type of flame detector is the ultraviolet (UV) detector that responds to invisible radiant energy in the ultraviolet range (below 4000 angstroms). Normally, UV detectors are designed to be responsive only in the range of approximately 1800 to 2500 angstroms. This narrow band eliminates false alarms from electric discharge lighting and solar radiation.

UV detectors are not without limitations. One disadvantage is that they may also respond to radiant energy from X-ray machines, arc-welders and lightning. Recent developments, however, have produced UV detectors that are better able to discriminate between an actual flame and other UV sources. Smoke is another problem because it filters UV radiant energy. Consequently, UV detectors should not be used in areas where large amounts of smoke are likely to occur before the appearance of flame.

Despite many recent improvements in UV detector design, arc-welding and smoke interference remain very real and persistent problems. Therefore, careful study of the environment and proper detector location and positioning are very important considerations in the application of this type of detection system.

Infrared Detectors. The infrared (IR) detector utilizes a photovoltaic or photoresistive cell with a filter and lens system and responds to invisible radiant energy, above 7700 angstroms. Like the UV detector, the IR detector is fast acting. The IR detector responds to many heat sources and is, therefore, susceptible to false alarms, even when equipped with sophisticated discrimination schemes. These detectors are also affected by high humidity. For these reasons IR detectors have limited applications and, when used, they are usually installed in industrial facilities.

Flame Flicker and Photoelectric Flame Detectors. These detectors respond to visible radiant energy, which is in the range of 4000 to 7700 angstroms. The photoelectric device consists of a light sensitive photocell that will generate an alarm signal when exposed to the radiant energy of a flame. The flame flicker device, which also operates on the photoelectric principle, contains a filter that permits detection operation only in response to the radiant energy modulated at a frequency characteristic of the flicker of a flame, making the latter device more accurate in responding to the visible radiant energy from a fire.

Detection Devices (Continued from page 38)

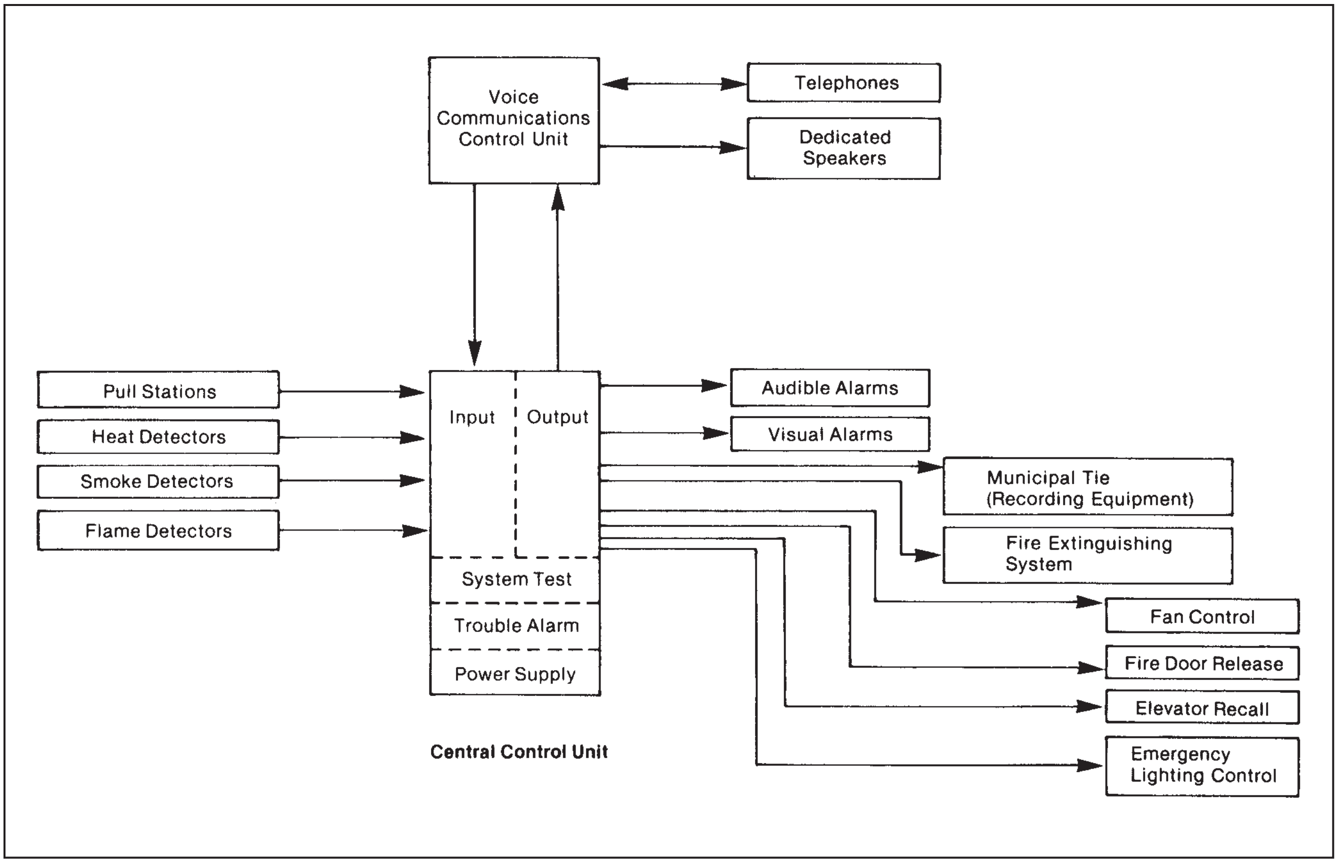


Fig. 5. Typical fire detection, alarm and control/monitoring system. The complete system can range from a simple installation to a complex, sophisticated network that could include security and energy management functions.

Alarm Devices

Alarm devices signal an alarm (either fire or system trouble) when activated. They can be either audible or visual. Audible alarms include bells, horns, klaxons, chimes, buzzers and sirens, while visual alarms include annunciators, strobes and flashing lights. Alarm systems may incorporate solidstate sound reproducers and emergency voice communication using prerecorded or live voice instructions. These systems may also have permanent recording capabilities. Printers that record time, date, location and other pertinent information are normally installed at large facilities or municipalities where a record of all alarms is required.

System Integration

Figure 5 illustrates how the previously discussed devices can be integrated into a typical fire detection and alarm system. Depending upon the application, systems can range from very simple to extremely complex and sophisticated installations. Therefore, all the indicated items may not necessarily be included in all systems.

Modern control units are designed and fabricated on the modular concept. Each system input and output function (i.e., detection, alarm and fan control) is operated by a solide state module which is interchangeable with other modules. Any number of modules and, therefore, any number of functions, can be incorporated into a system. This approach provides a flexible and reliable system of optimum design and minimum cost regardless of complexity. Furthermore, the modular concept simplifies system maintenance.

Nonfire detection functions, such as intrusion detection and equipment monitoring may also be included for more extensive protection of facilities.

Control Unit

The central control unit serves a fivefold purpose. It (1) receives signals from the detection devices, and operates the alarm and supplemental devices as required; (2) provides a trouble signal in case of system malfunction; (3) provides system test points; (4) provides a point of system control; and (5) supplies electrical power to the system.

Conclusion

The understanding of fire detection and alarm systems is of growing importance to electrical consultants who, with increasing frequency, are designing and specifying such systems into their projects. Using the right detectors, recognizing the prevailing conditions, is important. One very important factor is for the electrical consultant not only to be thoroughly familiar with the local fire codes for their projects, but to recognize possible weaknesses in a code and be able to recommend to a client a fire detection and alarm system that effectively provides protection to a building and its inhabitants. Such an installation can frequently exceed code requirements.

The Author

William E. DeWitt has been employed by the U.S. Army Corps of Engineers Huntsville Div., since 1975. He is involved in the design of large industrial production facilities, in addition to other military construction programs. DeWitt received BSEE and MSEE degrees from the University of Tennessee in 1971 and 1973, respectively, and is a Registered Professional Engineer.

Technical Bulletin

ANSUL INCORPORATED
MARINETTE, WI 54143-2542

Number 52

Environmental Impact of ANSULITE® AFFF Products

Background

With the advent of ever increasing environmental concerns, regulations and the increased use of ANSULITE® AFFF products we have been receiving more and more requests on the environmental impact characteristics of the ANSULITE product line. There are four areas of interest with regard to the environmental fate of AFFF products. They are fish toxicity, biodegradability, sewage treatment plant treatability and nutrient loading. All of these are of concern when the end-use foam solutions reach natural or domestic water systems. Since the end-use foam solutions (i.e., after they have been proportioned with water), are all essentially equivalent with regard to levels of active ingredients, we may discuss the product lines as a whole rather than as individual concentrates.

Fish toxicity tests are normally run on both estuarine and fresh water species. The two most common test species are the Killifish, (Fundulus heteroclitus), and the Rainbow Trout (Salmo gairdneri). The Killifish is a tolerant, (eurytopic), fish while the Rainbow Trout is a sensitive, (stenotopic), fish. This combination gives an indication of the broad range over which various fish populations may be affected. The values are given as the 96 hour LC_{50} which is a measurement of the concentration which is lethal to 50 percent of the test population after 96 hours of exposure to that concentration. The units of measure are milligrams/liter or parts per million (ppm) which, in the case of water based solutions, are considered to be equivalent. Obviously, the higher the value, the greater the tolerance of the fish to the AFFF. Testing indicates that Rainbow Trout have a 96 LC_{50} for end-use ANSULITE AFFF solutions of from 4,000 – 6,500 ppm while Killifish have a 96 LC_{50} of from 26,000 – 36,000 ppm. It is evident from this broad range that fish toxicity is extremely dependent upon fish species. Other factors will also include water quality, water temperature, dissolved oxygen levels and general health of the fish population.

The biodegradability of AFFF solutions is a measure of how readily the chemicals in the AFFF are broken down by bacteria in the environment. As the bacteria use up the chemicals as food, (oxidizable carbon source), they also use up dissolved oxygen in the water as part of their metabolic process. To determine the theoretical biodegradability of ANSULITE AFFF, we use two different tests and compare the results. The first test is called a chemical oxygen demand test, (COD), and measures how much oxygen would be required to completely break down the chemicals contained in a given amount of AFFF to their most oxidized state. The second test is called a biological oxygen demand test, (BOD), and measures how much oxygen will be used up by bacteria, over a given time period, as they use up the chemicals contained in a given amount of AFFF as a food source. Normally, BOD tests are conducted over a five day period, however, for AFFF solutions, this period is extended to twenty days. The reason for this extension is that there is a lag phase in the bacterial population growth curve as the bacteria become acclimated to the chemicals in AFFF. After they become acclimated, they exhibit a logarithmic growth cycle as they use up the chemicals in AFFF. This long lag phase is actually an advantage in that it allows the AFFF time to reach "infinite" dilution before there is any substantial demand for dissolved oxygen. To determine the theoretical biodegradability, we look at the ratio of biological oxygen demand, BOD, to the total possible oxygen demand, COD, i.e., BOD_{20}/COD. Masseli et. al. from the Industrial Waste Laboratory of Wesleyan University conclude that a BOD/COD ratio above 50% for a chemical mixture is readily biodegradable while ratios below 15% show that the mixture is nonbiodegradable. ANSULITE AFFF products are well above the 50% level.

As far as sewage treatment plant treatability is concerned, ANSULITE AFFF products are not particularly toxic to the microbial populations normally found in treatment plants. However, a problem does exist with AFFF, (or any type of foam concentrate), entering a sewage treatment plant. That problem, especially if the plant uses the activated sludge process for secondary treatment, is in foaming, which tends to carry over suspended solids, and consequently, a rather large amount of BOD. Present data show that concentrations of AFFF up to 250 ppm can be handled without adverse effects. Often times, the normal volumetric dilution which takes place on the way to the sewage treatment plant will bring the concentration down below the 250 ppm level. If it doesn't, the use of a defoaming agent which is compatible with the treatment plant's flora may allow handling of concentrations above the 250 ppm level.

With regard to the nutrient levels of AFFF, the concern is that, if additional nutrients are added to a body of water which is already high in nutrients, an algal bloom may occur. Nutrients in water act to promote growth the same way that fertilizers do on land. Generally, only two nutrients are of concern in aquatic ecosystems, they are phosphates and nitrates. On very rare occasions, organic carbon may also act as a limiting nutrient. There is no need to worry about any nutrient loading when using ANSULITE AFFF products as they contain no sources of nitrates or phosphates and they are extremely low in total organic carbon when compared to other types of foam concentrates.

ANSULITE AFFF concentrates are formulated to provide maximum fire performance with minimal environmental impact. If additional information is required, contact ANSUL at 715-735-7411. Fire protection is our only business.

Technical Bulletin

ANSUL INCORPORATED
MARINETTE, WI 54143-2542

Number 54

Shelf Life of ANSULITE® AFFF Concentrates and Their Premixed Solutions

Shelf life is a term used to describe the length of time over which an AFFF concentrate or its premixed solution is stable and usable without a significant change in its performance characteristics. The shelf life depends upon the composition, the ambient temperature range encountered, and the container materials of construction. In the case of premixed solutions, it also depends on the type of water that is used to make up the premixed solution. For example, ANSUL® does not recommend that its ANSULITE® concentrates be premixed in salt water. It recommends premixing of the ANSULITE concentrates only with potable water.

In the case of conventional AFFF concentrates (6%, 3%, or 1%) and polar solvent AFFF concentrates (3x3, 3x6, or ARC), the solids content (active surfactant content) is generally low compared with protein based foam agents and therefore much less likely to undergo stratification, sedimentation, or precipitation. Since the chemical surfactants are all synthetic as opposed to naturally occurring (protein foam), natural degradation of the concentrates does not occur. AFFF and polar solvent AFFF agents are capable of being premixed, but the stability of the resulting solution, as pointed out above, depends upon the type of water used to make the premix. It is generally advisable, therefore, to check the quality of the premixed solution on an annual basis during the normal maintenance procedures. (See Ansul Part No. 31274, AFFF Field Inspection Procedures Manual.)

A much more significant factor affecting shelf life is the ambient temperature range encountered. All ANSULITE AFFF concentrates and their premixed solutions are listed by approval testing agencies such as Underwriters Laboratories, Inc. This listing involves determining the usable temperature range for the ANSULITE AFFF concentrate or its premixed solution. The normal usable temperature range for ANSULITE 6%, 3%, 1%, and ANSULITE polar solvent AFFF is +35 °F (1.6 °C) to +120 °F (48.8 °C). There is also an ANSULITE 3% Freeze Protected concentrate that is available where low temperatures are likely to be encountered, which has a usable temperature range from –20 °F (–28.9 °C) to +120 °F (48.8 °C). Freeze protected concentrates are not usually used in a premixed solution configuration as this would destroy the most important feature of the product, i.e., its low freezing point. The usable temperature range is stated on the container in which the concentrate is sold. It is also stated on the operating nameplate of the equipment in which the concentrate or premixed solution is stored.

In the case of ANSULITE AFFF concentrates or their premixed solutions, temperatures below the lower minimum usable temperature represent more of a problem than temperatures above the maximum usable temperature. Since in both cases one is dealing with a mixture of water and high boiling point solvents, going below the minimum usable temperature limit could result in freezing of the solution, which would prevent its use, for example in proportioning equipment.

On the other hand, going above the maximum usable temperature, which should be avoided if possible, will not impair the ability of the concentrate to be proportioned or the premixed solution to be discharged. However, it may result in a decrease in the performance characteristics of the concentrate, its dilute solution, or the premixed solution, when compared to the concentrate or premix subjected to temperatures in the normal usable temperature range. Tests have been conducted with ANSULITE 6% and 3% AFFF agents and their premixed solutions for up to 300 days at 150 °F (65.5 °C) without a significant decrease in performance.

Going below the lower usable temperature of 35 °F (1.6 °C) will obviously result in freezing of the AFFF concentrate or its premixed solution over a period of time. However, because of the composition of AFFF concentrates or their premixed solutions, placing the storage container in an area normally heated to ambient temperatures (60 °F to 70 °F (15.5 °C to 21.1 °C)), will return them to their original condition with little or no change in performance characteristics.

As part of the listing or approval testing, the materials used in the containers for ANSULITE AFFF concentrates or their premixed solutions are tested over the usable temperature range stated on them. If the ANSULITE AFFF or polar solvent AFFF concentrates are stored in accordance with ANSUL's recommendations, a shelf life of 20 to 25 years is reasonable to expect. However, because of the effect of the water type on premixed solution stability, annual inspection is recommended as part of the maintenance program and a shelf life of 3 to 5 years is to be expected.

It is generally advisable to inspect any equipment containing ANSULITE AFFF concentrates or their premixed solutions on an annual basis. Part of this inspection should include the ANSULITE AFFF agent. If changes in the quality of the AFFF concentrate or its premixed solution, as outlined in the Field Inspection Manual (Ansul Part No. 31274), occur, a sample of the concentrate or premixed solution in a clear plastic bottle of 1 liter capacity should be sent to:

ANSUL INCORPORATED
ATTN: QUALITY ASSURANCE DEPT.
ONE STANTON STREET
MARINETTE, WISCONSIN 54143-2542

Technical Bulletin

ANSUL INCORPORATED
MARINETTE, WI 54143-2542

Number 55

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.

Technical Bulletin

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MARINETTE, WI 54143-2542

Number 59

Acceptable Materials Of Construction For Use With ANSUL® Foam Concentrates

Tests have been performed with ANSULITE® AFFF and other ANSUL® foam agents to determine compatibility with various foam system components. The recommendations contained in this bulletin are based upon both controlled test results and proven field applications. Only the most commonly used construction materials are addressed in this bulletin. Alternative pipe, fittings, and valves may be used in some cases if acceptable to the customer and/or the authority having jurisdiction.

Please consult Ansul Incorporated, Distributor Technical Services, for specific guidelines concerning any question of materials compatibility.

RECOMMENDED MATERIALS:

Storage Tanks:

Fiberglass	–	Isophthalic Polyester Resin, Epoxy Resin, or Vinylester Resin (Premium)
Polyethylene	–	High density cross-linked polyethylene
Stainless Steel	–	304 and 316
Carbon Steel	–	Expansion dome required with concentrate filled to mid-point of dome (Interior coatings are not recommended due to surface activity of foam concentrates.)
Aluminum	–	Alloys 3003-H-14 and 6061-T-6 (Only for use with AFFF)

Concentrate Piping:

Teflon tape is recommended on all threaded fittings. Concentrates may dissolve some pipe joint compounds (pipe dope).

Brass	–	Red brass, naval brass
Stainless Steel	–	304 and 316
Plastic	–	Fiberglass (green thread), PVC
Black Iron	–	Recommended for AFFF, including alcohol resistant concentrate when piping is flooded (Not recommended for protein based agents due to problems with corrosion and solids content of protein agents.)

NOTE: GALVANIZED PIPE AND FITTINGS MUST NOT BE USED IN CONTACT WITH UNDILUTED CONCENTRATE AS CORROSION WILL RESULT.

Gaskets:

BUNA-N, EPDM®, Teflon®, Viton®, Asbestos, Blue-Gard Style 3000®

Painted Surfaces:

Any foam concentrate spilled on painted surfaces should be flushed off with water immediately. The solvents in the concentrate may cause peeling or streaking of the paint.

Technical Bulletin

ANSUL INCORPORATED
MARINETTE, WI 54143-2542

Number 60

Foam: The Environment and Disposal Issues

The use of Class B Aqueous Film-Forming Foam (AFFF) has raised concern in the environmental community regarding the proper disposal of foam-water solution. The recent withdrawal from the market by a major manufacturer has resulted in an increased environmental awareness by the market place.

Foam can reach the environment through any of the following means:

1. Fire or catastrophic event
2. System discharge or false activation
3. Training of firefighters
4. System testing or commissioning

In some cases, the resulting discharge may be contained and treated as wastewater before being returned to the environment. If this is possible, the potential for ecological damage is minimized. However, if the release is the result of a fire, other factors must be considered. For example, if there are unburned fuels mixed in with the foam-water solution, they must be contained and arrangements must be made for separation from the foam-water solution.

For water immicible fuels, a fuel-water separator can be used to phase separate the fuel-water solution. The fuel is skimmed from the surface of the foam water solution and reclaimed. The foam-water solution is then suitable for discharge to a sewage treatment plant. The treatment facility must be capable of handling the volume of wastewater to be discharged without upsetting the balance of the system. The potential for foaming must also be recognized and dealt with accordingly in the treatment of the foam-water solution.

In the event of a foam discharge, either accidental or deliberate, the foam-water solution may find its way onto and into the ground or into a stream, river or lake. If this happens, it may not be possible to contain the discharge. Should such a discharge occur, the following should be considered when addressing any clean-up effort.

Toxicity

Toxicity is the ability of a substance to cause damage to living tissue, impairment of the central nervous system, severe illness or, in extreme cases, death when ingested, inhaled, or absorbed by the skin. Toxicity is objectively evaluated on the basis of test dosages made on experimental animals under controlled conditions. The most important of these are the LD_{50} (lethal dose, 50%) and LC_{50} (lethal concentration, 50%) test which exposes the animal to oral ingestion and inhalation of the material being evaluated. LC_{50} is the quantity of a substance administered by inhalation that is necessary to kill 50% of the test animals exposed to it within a specified time. LD_{50} is the quantity of a substance necessary to kill 50% of exposed animals in laboratory tests within a specified time.

Aquatic Toxicity

Toxicity may present a problem if the foam-water solution from a fire or an accidental spill finds its way into the aquatic system. The chemicals used in ANSUL® foams have been selected because of their favorable environmental characteristics. However, any chemical foreign to an ecosystem can have a negative impact on that ecosystem. It is recommended that the Material Safety Data Sheet (MSDS) of the product involved be consulted for environmental impact guidance. Ideally, a foam should have a toxicity rating of "practically non-toxic" or better. This rating means that the foam does not cause more then 50% mortality (LC_{50}) in 96 hours at a concentration of 100mg/L or more. All ANSUL foams meet or exceed these criteria.

Biodegradability

This is the measure of the susceptibility of a substance to decompose by microorganisms. All AFFF, AR-AFFF, FP and FFFP foams are manufactured using chemicals that biodegrade. However, the fluorosurfactants used to manufacture these products are not completely degradable.

Disposal of Class B Agents

If hydrocarbon fuels are mixed with the foam solution, the use of an oil-water separator is recommended. All discharges should be handled in accordance with local, state, or federal regulations. A qualified individual should evaluate these wastes to determine if flammable materials are present at hazardous concentrations and review the applicability of sewer code restrictions. If volatile materials in the waste present an explosion hazard, these wastes should not be discharged to the treatment facility. Such wastes should receive further treatment or they should be incinerated by a facility designed to handle such wastes.

The waste may be metered into the sewer that flows into a waste treatment system only after qualified individuals determine that the waste meets sewer codes and that flammable materials are not present in the waste at concentrations that present a risk of explosion in the sewer. Wastes must be metered into the system at a sufficiently slow rate so that the foam-water solution will not cause foaming in the aeration basin of the waste system. This rate will be determined by the local situation and must follow all local, state and federal regulations. Since these regulations may vary, consult the necessary authorities before discharge. Waste treatment plant authorities must also be consulted to determine the discharge flow into the facility so that appropriate discharge rates can be determined to prevent foaming.

For ANSULITE® 1x3 or 3x3 alcohol-resistant products used at 1% or 3%, the discharge rate of the foam-water solution should be adjusted so that the amount of solution entering the waste treatment facility will be equal to or less than 25 mg of the original product concentrate per liter of sewerage. For ANSULITE® 3x6 alcohol-resistant products, the rate can be adjusted to 50 mg per liter of sewerage when used at 3% or 25 mg/liter when used at 6%.

For ANSULITE® AFFF products, the treatment rate should be equal to or less than 100 mg/liter of sewage for 6% AFFF, 50 mg/liter for 3%, and 25 mg/liter for 1%.

If foaming occurs or there is a need to treat more foam-water solution at a faster rate, antifoam agents may be added to the foam-water waste flow into the treatment facility. These antifoam agents may be obtained from one of the following suppliers:

Dow Chemical

General Electric

Henkel

Union Carbide

Wacker Silicones

Antifoam agents should be based on silicone technology. The amount of antifoam required depends on the volume of foam-water solution to be treated. It is recommended that the amount of antifoam be determined by testing a representative sample of the foam-water solution prior to discharge.

Specific questions concerning foam agent use and disposal should be directed to Ansul Technical Services at 1-800-862-6785 or 1-715-735-7415.

Technical Bulletin

ANSUL INCORPORATED
MARINETTE, WI 54143-2542

Number 64 (Replaces Numbers 48 and 53)

Compatibility of AFFF/Alcohol-Resistant AFFF Concentrates

Compatibility Requirements

The ability to mix Class B foams from different manufacturers has been an issue ever since their introduction. As manufacturers enter or leave the marketplace, the question of compatibility becomes even more urgent. The National Fire Protection Association (NFPA) historically has not permitted the mixing of different brands or types of AFFF or Alcohol Resistant (AR) – AFFF in long-term storage because they may prove to be incompatible. This ruling changed in May of 2002 when the following verbiage was adopted in *NFPA 11: Standard for Low-Expansion Foam.*

> **NFPA 11, 2.4.1 COMPATIBLITY OF FOAM CONCENTRATES**
>
> "Different types of foam concentrates shall not be mixed for storage. Different brands of the same type concentrate shall not be mixed unless data are provided by the manufacturer and accepted by the Authority Having Jurisdiction (AHJ) to prove that they are compatible. Foams generated separately from Protein, Fluoroprotein, FFFP and AFFF concentrates shall be permitted to be applied to a fire in sequence or simultaneously."

Military/Government Specifications

The testing for compatibility of AFFF agents for the U.S. Military has historically been guided by United States Federal Government Specifications. The Mil-Spec tests, as they are known in the industry, have proven to be excellent indicators of the compatibility of AFFF agents. The current Military Specification that guides this testing is MIL-F24385F. This specification reads in part:

> "**Compatibility.** The concentrates of one manufacturer shall be compatible in all proportions with the concentrates furnished by other manufacturers listed on the Qualified Products List."

The Mil-Spec requires that the AFFF agents meet, among other tests, the following compatibility tests...

- Foamability
- Film formation and sealability
- Fire performance on a 28 square foot fire using both fresh and sea water solutions
- Stratification
- Precipitation of solids in the mixed concentrates

All 3% and 6% AFFF agents that qualify under the Mil-Spec can be mixed together in long-term storage without fear of compatibility problems. The Mil-Spec does not cover 1% agents, AFFF that is freeze protected regardless of the concentration, alcohol-resistant agents, Class A foam concentrates, or other types of firefighting agents such as emulsifiers and wetting agents. Anyone desiring to purchase Mil-Spec AFFF should be sure that the product is on the U.S. Military's Qualified Products List (QPL). There have been instances where foam manufacturers have stated that their products "meet the Mil-Spec requirements" but the product is not on the QPL.

ANSULITE® 3% (AFC-5A) and ANSULITE® 6% (AFC-5) AFFF products are listed on the QPL having been successfully tested by the Naval Research Laboratories and found to meet all the requirements of the Mil-Spec.

Alcohol-Resistant (AR) AFFF Agents

With the change to NFPA 11 allowing the mixing of Class B foams, it has now become possible to mix AR-AFFF agents in long-term storage and still conform with the mandates set forth in the NFPA guidelines. Since the use of AR-AFFF is increasing, it is important to understand the difference between AFFF and AR-AFFF. The base material of AR-AFFF is that of a regular AFFF concentrate to which a high molecular weight polysaccharide (a type of sugar) has been added. The reason for the addition of the polysaccharide is to allow the AR-AFFF to form a blanket of foam on (water miscible) polar solvents thus facilitating fire extinguishment by allowing the foam blanket to build up on the polar fuel. If this did not occur, the polar solvent would dissolve the foam blanket. Due to the addition of this polysaccharide and the methods used to manufacture the products, the chemistry of the AR-AFFF products can vary from manufacturer to manufacturer. This manifests itself in several ways through variations in viscosity, color, refractive index, foam expansion, drain time and fire extinguishing performance (the density of the product necessary to extinguish the fire). Currently there are no known products that are identical in all the performance aspects that could be mixed without any testing to assure their compatibility. For this reason, it is very important to ensure that the products you are mixing have been found to be compatible by a reputable laboratory using valid testing procedures. Make sure the report showing this compatibility is verified in writing and signed by an individual who is authorized to represent the manufacturer.

It is important to understand the roles played by Underwriters Laboratories and Factory Mutual concerning mixing foams in storage. Because of the nature of the approval testing done by each agency, any mixing of foam agents in storage will void the UL listing or FM approval. Often, UL listings or FM approvals are essential to the fire protection systems such as when required by an insurance carrier. If UL listings or FM approvals are not required and approval to mix the agents has been received by a qualified testing laboratory, the agents may be mixed in storage.

Also, because of the potential difference in viscosity, some of the agents may not readily mix together. This layering should not cause any problem with the agent's compatibility. However, it is absolutely essential to remember that in many systems, such as a sprinkler system, the device that proportions the agent is designed to work using an agent of specific viscosity. Changing the agent could either increase or decrease the viscosity. Such a change will have an effect on the proportioning device causing it to potentially proportion too rich or too lean. In any event, the resulting foam/water mixture will not be what the system was designed to proportion and may have an effect on fire extinguishment.

Testing conducted at the agents laboratory of the ANSUL® Fire Technology Center has indicated that ANSULITE® 3x6 ARC (Alcohol-Resistant Concentrate) is compatible with National Foam's UNIVERSAL brand and 3M's ATC brand. Additional ANSULITE® ARC's have also been tested for compatibility. Specific questions regarding compatibility testing should be directed to Ansul Technical Services at 1-800-862-6785 or 1-715-735-7415.

FOAM CONCENTRATES AND FOAM PRE-MIX SOLUTIONS

Field Inspection Manual

ANSUL

A Tyco International Company

INTRODUCTION

This manual is designed to serve as a guide to inspection procedures for ANSUL Foam Concentrates and Pre-mix Solutions.

As Tyco Fire Protection Products manufactures many types of foam concentrates, locate the product data sheet for the specific concentrate to be tested. Product Data Sheets can be accessed at **www.ansul.com.**

The designated inspector should be a responsible, experienced person with sound, basic knowledge of fire equipment hardware and extinguishing agents. A thorough briefing on the procedures to be followed should include the need for precise execution of each analysis step.

See Field Inspection Record at the end of this manual to record proportioning results.

Form Part No. 428680, Foam Analysis Request, is for use in recording the information required when sending in samples to the Tyco Fire Protection Products Agents Laboratory. This form also outlines the correct procedure for submitting samples. Review and complete the form as thoroughly as possible. This form is included in the Foam Agent Test Kit, Part No. 428679. It is also available on www.ansul.com under "Foam Products." (**Note:** There is a charge for this testing service.)

FREQUENCY AND ACCURACY OF TESTS

Tyco Fire Protection Products recommends that proportioning tests be done at system commissioning and every three (3) years minimum thereafter.

Exception: Pre-primed foam-water sprinkler systems should be flushed, drained and pre-primed with fresh solution annually. During this process correct proportioning should be verified.

Tyco Fire Protection Products recommends that Standard Quality Analysis Testing be done annually by the Tyco Fire Protection Products Agents Laboratory which not only tests the chemical properties of the sample, but also does lab scale fire testing to assure the product's performance. Packages of two (2) sample containers with labels can be purchased under Part No. 428679.

STORAGE CONDITIONS

Tyco Fire Protection Products recommends that its concentrates be stored at the temperatures indicated on the specific product data sheet.

Accelerated aging studies have been conducted with the concentrate and pre-mix solutions stored at 150 °F (65.5 °C) with no adverse effect. However, Underwriters Laboratory Standard No. 162 requires that the maximum storage temperature be listed at 120 °F (48.9 °C).

Storage of concentrates below the minimum temperature listed on the product data sheets could result in freezing. If the agent freezes, it should be thawed at or near room temperature and agitated or stirred to ensure a homogenous mixture. If previous freezing is suspect, agitation will again ensure a homogenous mixture.

To maximize life of concentrates stored in atmospheric storage tanks, ANSUL recommends that a 1/4 in. (6 mm) layer of mineral oil be added to the air-exposed surface of the concentrate. This is critical for Alcohol Resistant Concentrates.

RELATED INFORMATION

The following is a list of Technical Bulletins that can be found at the ANSUL internet home page **www.ansul.com.**

- Technical Bulletin Number 52
  (Environmental Impact of ANSULITE AFFF Products)
- Technical Bulletin Number 54
  (Shelf Life of ANSULITE AFFF Concentrates and Their Pre-mixed Solutions)
- Technical Bulletin Number 55
  (Aspirated Versus Nonaspirated AFFF)
- Technical Bulletin Number 59
  (Acceptable Materials of Construction For Use With ANSUL Foam Concentrates)
- Technical Bulletin Number 60
  (Foam and The Environment)
- Technical Bulletin Number 64
  (Compatibility of AFFF/Alcohol-Resistant AFFF Concentrates)

REFRACTIVE INDEX VS. CONDUCTIVITY

Tyco Fire Protection Products recommends refractive index testing instead of conductivity testing in the field because there is less chaults being skewed by water quality or temperature. Also, continuous stirring is required during conductivity testing to obtain stable results.

FOAM SOLUTION CONCENTRATION DETERMINATION REFRACTIVE INDEX OR CONDUCTIVITY

This test is used to determine the percent concentrate of a foam concentrate in the water being used to generate foam. It is typically used as a means to determine the accuracy of the system's proportioning equipment.

This method is based upon comparing foam solution test sample to pre-measured solutions (Calibration Standard) that are plotted on a baseline graph of percent concentration versus instrument reading.

A hand-held refractometer is used to measure the refractive index of the foam solution sample. Scales on refractometers vary, but what is actually being used to determine concentration is a change in reading from one pre-measured solution to another (Calibration Standards "Curve" vs. Discharge Samples "Reading"). The philosophy applies when using a conductivity meter which is measuring the changes in the solution's conductivity. (Refer to Proportioning Test Instruments Data Sheet, F-2007003, for more detailed information about the specific meters.)

A base curve is prepared by using the following apparatus:

1. Four 100 ml or larger plastic bottles with leak-resistant screw caps
2. One 10 ml (10 cc) measuring syringe
3. One 100 ml graduated cylinder
4. Four or more eye droppers
5. One Test Meter – Model PA 202, 10419, 1500-32
6. Graph paper
7. Ruler or straight edge

Using water and foam concentrate from the system to be tested, make up three 100 ml calibration standard solutions. For a 6% concentrate, typically a 4%, 6% and 8% samples; for a 3% concentrate, typically a 2%, 3% and 4% samples; and for a 1% concentrate, typically a 0.5%, 1% and 1.5% samples are made.

Label bottles with percent sample calibration solution that will be utilized, i.e. 2%, 3% and 4% for a 3% concentrate. As an example, for the 2% calibration solution sample, measure 98 ml of system water in the graduate cylinder, then pour into the bottle labeled 2%. Then with the measuring syringe, transfer 2 ml (2 cc) of the concentrate into the labeled bottle. Secure the cap on the bottle and shake to thoroughly mix the solution. Repeat for the 3% calibration sample (97 ml water and 3 ml concentrate) and for the 4% calibration sample (96 ml water and 4 ml concentrate). **Increasing sample sizes will increase accuracy relative to the measurement instrument.** After thoroughly mixing the foam sample, a meter reading is taken of each percentage foam solution sample. It is important that temperatures between discharge samples and calibration standards have normalized with temperatures above 50 °F (10 °C) working best. Each instrument has specific instructions for its correct operation.

Using the graph paper, plot the meter reading on the X axis and the percent concentrate reading on the Y axis. This plotted curve will serve as the known baseline for the proportioning test. Meters may have different scales and the plotted resolution should be as large as possible with the complete range of the calibration solutions known. The scale you set must be linear.

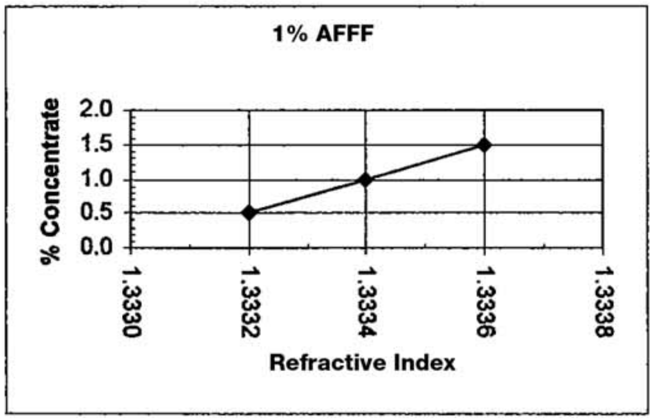
Collect foam solution sample(s) from the proportioning system, using care to ensure that each sample is taken at an adequate distance downstream from the proportioner being tested. (Usually any place downstream of the first change in direction is adequate if samples are taken in the riser room.) Stabilize a water flow through your discharge device within the known acceptable range for the proportioner and open the concentrate control valve. Take the sample about 30 to 60 seconds after foam appears from the test connection. Take meter readings of the sample(s) and compare readings to the plotted curve to determine the percentage for each sample.

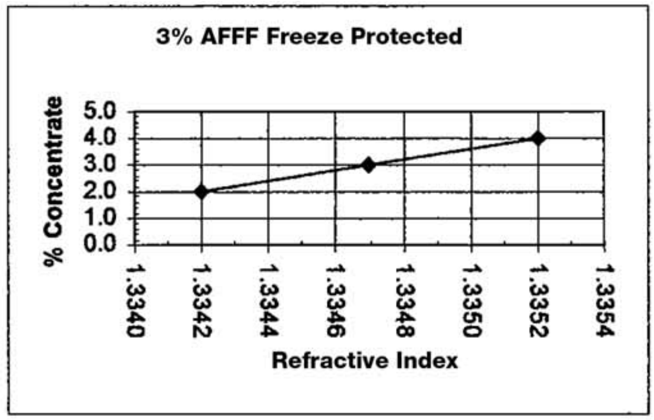
Per NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam,* acceptable ranges of proportioning systems are not less than the rated concentration and not more than 30% above the rated concentration or one percentage point above the rated concentration, whichever is less. For example, the acceptable range for a 3% concentrate is from 3 to 3.9%.

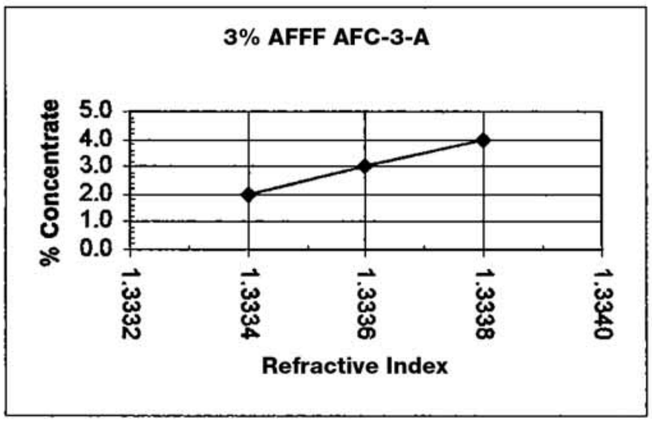
Note: There is some variability dependent on the accuracy of the meter, the accuracy to which the calibration samples were made, and if temperatures between calibration standards and discharge samples have not normalized. Conductivity is especially susceptible to reading fluctuation, thus the sample should be continuously stirred until a stabilized reading can be estimated. Care should be taken to not bump the sides or bottom of the sample container or contaminate the sample with salts or solids, i.e. dirty fingers while stirring. The conductivity of water stored in or for systems can vary throughout a discharge which may affect results. Conductivity should not be used for sea, salt, or brackish water supplies. Although conductivity can be the most accurate means of measuring foam solution in clean water supplies under ideal conditions, the refractive index method is best for most real world testing.

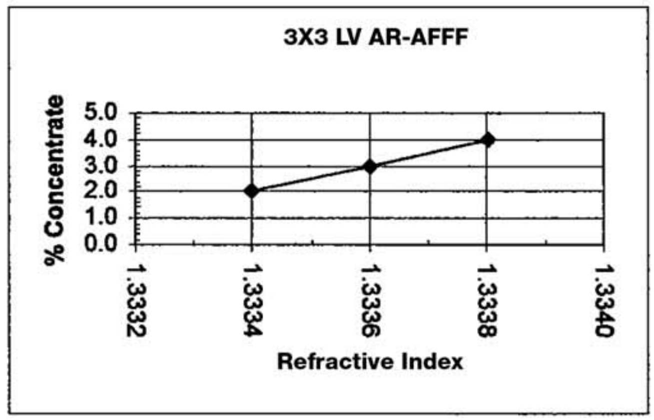
If discharge samples are sent to the Tyco Fire Protection Products Test Lab for analysis, they should be packaged per the instructions with the Test Kit and sent in for immediate processing. Largely dependent on water quality and the type of concentrate used, foam solutions may start to biodegrade in a short period of time which can affect results (possibly as little as three to five days with nutrient-rich water and detergent-based foam concentrates).

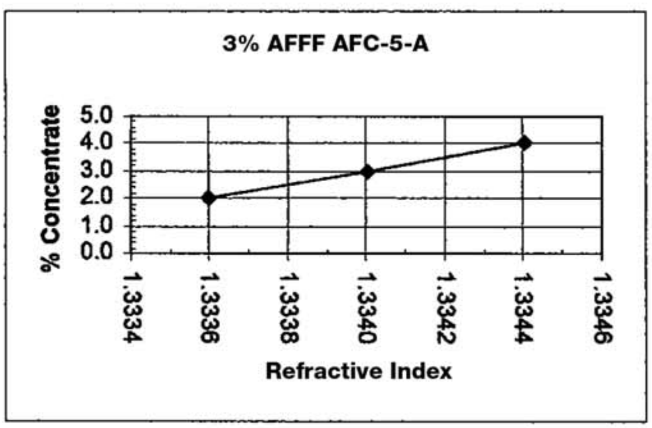
The following graphs are examples of typical refractive index values for various concentrate pre-mixes. Results may vary depending on the concentrate pre-mix type, site water supply, and actual concentrate lot number. Therefore, it is important that a new calibration curve be developed on each date a proportioning test is required.

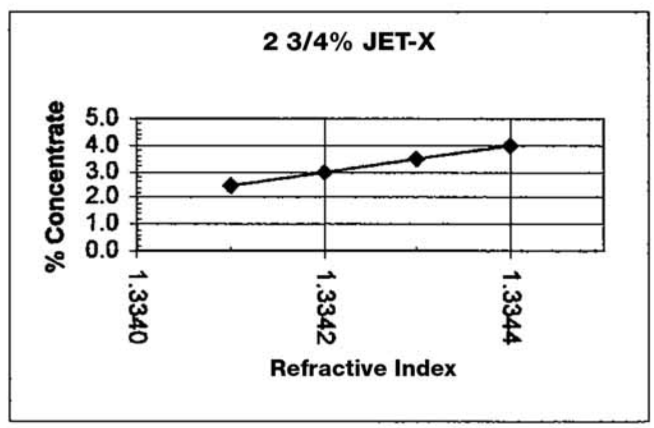

1% AFFF
% Concentrate
2.0
1.5
1.0
0.5
0.0
1.3330
1.3332
1.3334
1.3336
1.3338
Refractive Index

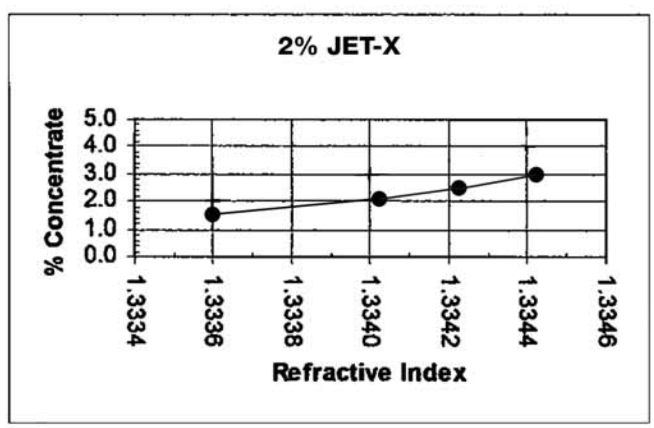

3% AFFF Freeze Protected
% Concentrate
5.0
4.0
3.0
2.0
1.0
0.0
1.3340
1.3342
1.3344
1.3346
1.3348
1.3350
1.3352
1.3354
Refractive Index


3% AFFF AFC-3-A
% Concentrate
5.0
4.0
3.0
2.0
1.0
0.0
1.3332
1.3334
1.3336
1.3338
1.3340
Refractive Index


3X3 LV AR-AFFF
% Concentrate
5.0
4.0
3.0
2.0
1.0
0.0
1.3332
1.3334
1.3336
1.3338
1.3340
Refractive Index


3% AFFF AFC-5-A
% Concentrate
5.0
4.0
3.0
2.0
1.0
0.0
1.3334
1.3336
1.3338
1.3340
1.3342
1.3344
1.3346
Refractive Index


2 3/4% JET-X
% Concentrate
5.0
4.0
3.0
2.0
1.0
0.0
1.3340
1.3342
1.3344
Refractive Index


2% JET-X
% Concentrate
5.0
4.0
3.0
2.0
1.0
0.0
1.3334
1.3336
1.3338
1.3340
1.3342
1.3344
1.3346
Refractive Index

006876

NOTES:

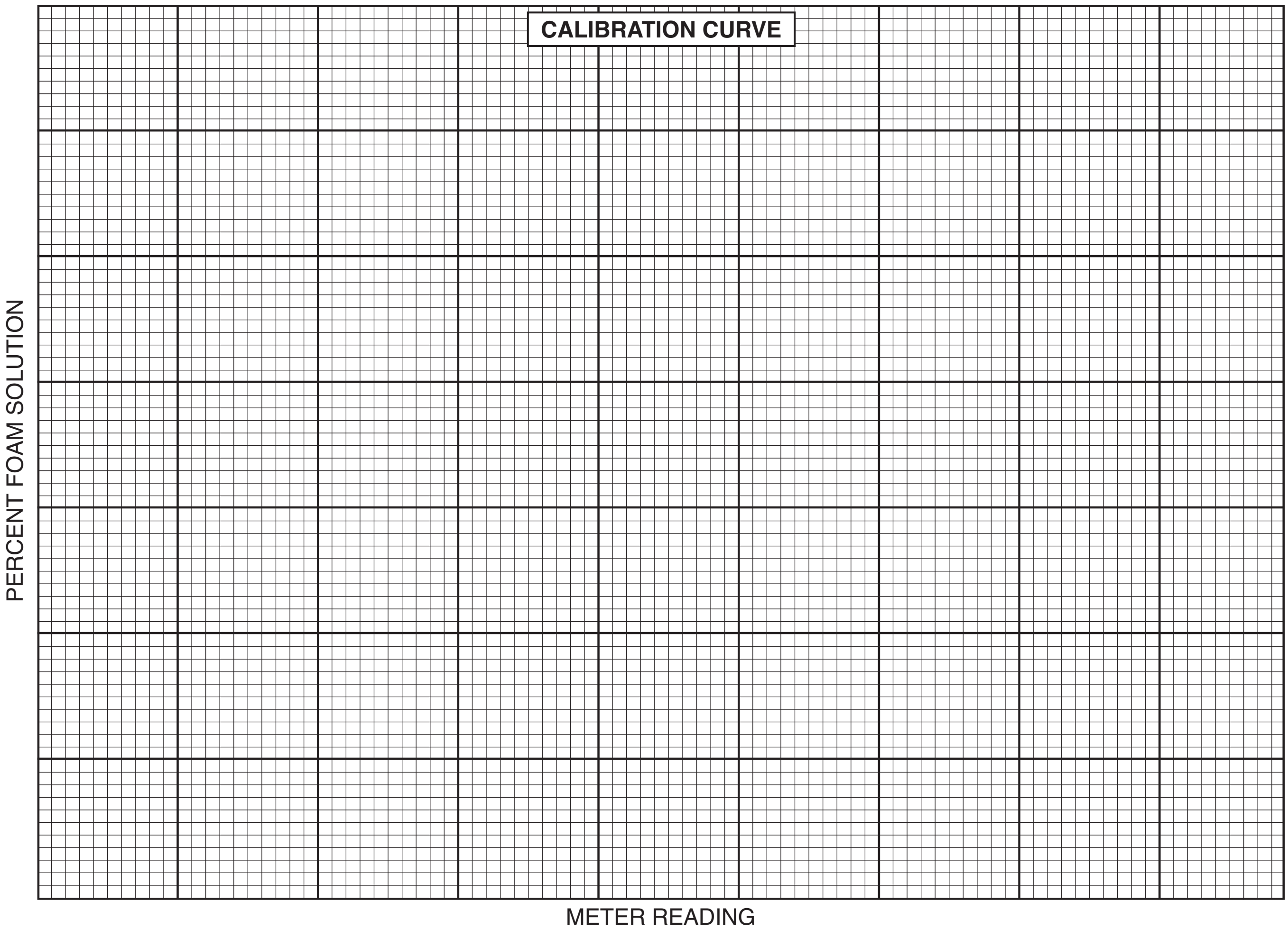
CUSTOMER/LOCATION: ______________________________ FILE NO.: ____________

DATE: ______________________________ TESTED BY: ______________________________

FOAM CONCENTRATE TYPE / LOT NO.:____

METER TYPE:________ CONDUCTIVITY:________ REFRACTOMETER MODEL: ______________________________

CALIBRATION STANDARDS	METER READING
FOAM CONCENTRATE	
WATER	
PRE-MIX #1 —	
PRE-MIX #2 —	
PRE-MIX #3 —	



SYSTEM DISCHARGE SAMPLE	METER READING	PERCENT FOAM SOLUTION

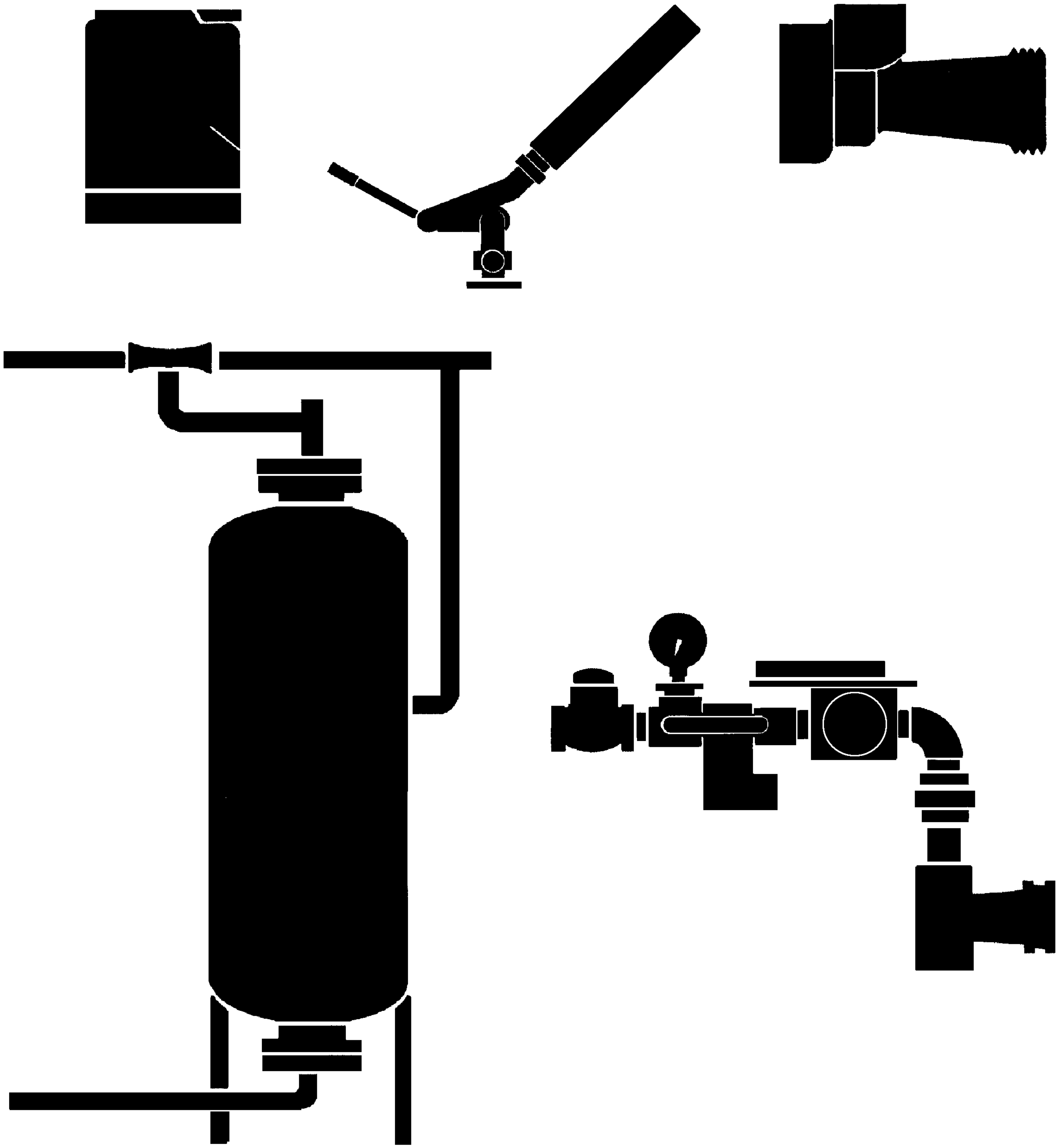
TYCO FIRE PROTECTION PRODUCTS
ONE STANTON STREET
MARINETTE, WI 54143-2542

Part No. 31274-07

ANSUL®

PROPOSAL INFORMATION

FOAM SYSTEMS



End-User:

Name:____ Date:________________

Location:____

Participating Distributor/Contractor:

Name:____

Address:____

Contact:____ Title:_________________________

Phone:____

Fax:_________________________

Due Date (When Ansul's package must be received): ____

____

HAZARD ANALYSIS – FUEL STORAGE TANKS – NFPA 11

Cone roof______________; Cone roof with floater______________; Floating roof______________

Dimensions of hazard area:______________ft. diameter, by______________ft. height

Contents of hazard: Hydrocarbons Polar Solvents

____

____

Owners preference: Top side______________; Subsurface__________________________________

Water source: Static pressure______________psi Residual pressure______________gpm at______________psi

Power available: Phase______________Hertz______________Voltage______________

Recommended proportion system:____

<u>Formula</u>

For multiple tanks, the system is sized for the largest single hazard. All tank types, locations, and contents must be indicated.

ATTACH PLANS/SPECIFICATIONS IF APPLICABLE.

HAZARD ANALYSIS – AIRCRAFT HANGAR – NFPA 409

Hangar classifications: Group I______________, Group II______________, Group III______________

Hangar length______________by width______________

Hangar door height______________; ceiling height______________

Type of aircraft housed?____

Water source: Static pressure______________psi Residual pressure______________gpm at______________psi

Power available: Phase______________Hertz______________Voltage______________

Underwing protection: required wing area 3,000 sq. ft. plus______________

Desired by owner? Yes______________No______________

ATTACH PLANS/SPECIFICATIONS IF APPLICABLE.

HAZARD ANALYSIS – TRUCK/RAIL CAR LOADING FACILITIES – NFPA 11, NFPA 16

Dimensions of hazard area:________________ft. long, by________________ft. wide, by________________ft. high

Contents of hazard: Hydrocarbons Polar Solvents

____

____

____

Overhead canopy: Yes________________Size:________________

No________________

Water source: Static pressure________________psi Residual pressure________________gpm at________________psi

Power available: Phase________________Hertz________________Voltage

Recommended proportion system:____

Detection/Control system:____

ATTACH PLANS/SPECIFICATIONS IF APPLICABLE.

HAZARD ANALYSIS – HELIPORTS – NFPA 418

Heliport length________________by width________________

Location: Roof top________________, off shore________________, other________________

Oscillating monitor(s)________________, handlines________________, both________________

Largest expected helicopter____

Will refueling be accomplished____

Water source: Static pressure________________psi Residual pressure________________gpm at________________psi

Power available: Phase ________________Hertz________________Voltage________________

Recommended proportion system ____

Manual or automatic actuation? ____

ATTACH PLANS/SPECIFICATIONS IF APPLICABLE.

HAZARD ANALYSIS – CLOSED HEAD FOAM/WATER SPRINKLER SYSTEM – NFPA 16A, NFPA 30

Contents of hazard: Hydrocarbons Polar Solvents

____

____

____

Insurance carrier: IRI________________ FM________________; Other____

Water source: Static pressure________________psi Residual pressure________________gpm at________________psi

Power available: Phase________________Hertz________________Voltage

Design requires______________gpm/ft^2 density, over______________ft^2 area, with______________minute discharge duration

Sprinkler system is a wet pipe________________, dry pipe________________, preaction system________________

ATTACH PLANS/SPECIFICATIONS IF APPLICABLE.

HAZARD ANALYSIS – HIGH EXPANSION FOAM SYSTEM – NFPA 11A

Dimensions of hazard area:________________ft. long, by________________ft. wide, by ________________ft. high

Contents of hazard: ____

____

____

Height of hazard________________

Building construction: Light or unprotected steel________________

Heavy or protected or fire resistive________________

Water source: Static pressure________________psi Residual pressure________________gpm at________________psi

Area sprinklered: Yes________________; ________________gpm/ft^2 over________________ft^2 density

No ________________

ATTACH PLANS/SPECIFICATIONS IF APPLICABLE.

Scale: 1 square equals ______

Scale: 1 square equals ______________

Scale: 1 square equals ____________

Scale: 1 square equals ____________

Form No. F-94146