



Member of the FM Global Group

Examination Standard for Foam Extinguishing Systems

Class Number 5130

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1 INTRODUCTION

1.1 Purpose

- 1.1.1 This standard describes requirements for fixed fire extinguishing systems that use an aqueous foam as the extinguishant.
- 1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

- 1.2.1 This standard applies to low expansion (including CAF) and high expansion foam fire extinguishing systems for use in Class B applications and which are designed for manual or automatic control. Medium expansion foam systems and the Class A applications with high expansion foam systems are excluded from the scope of this standard. Compatible Certified detectors and detection and release controls are required for automatic operation of these systems but are not included in the scope of this standard.
- 1.2.2 A basic foam fire extinguishing system comprises at least the following three aspects; a concentrate, a device to proportion the concentrate in the proper ratio into water, and a discharge device to deliver the foam to a burning liquid surface. A discharge device may assume the entire task of expanding the foam, or function primarily to distribute foam which has been partially or completely expanded by an upstream device, such as a foam maker. Compatible certified detectors and detection and release controls are required for automatic operation of these systems, but are not included in the scope of this standard

With the exception of variable viscosity proportioners outlined in 1.2.3, this standard requires the examination of complete foam fire extinguishing systems. Incomplete systems (i.e. foam concentrates without associated system hardware or system hardware components without a specified foam concentrate) shall not be evaluated.

- 1.2.3 Variable viscosity proportioners shall be certified for use with certified foam concentrates having viscosities that are within the variable viscosity proportioners certified range, and as part of a complete certified foam fire extinguishing system including its associated discharge devices. Use of these products with foam concentrates or as part of foam fire extinguishing systems, including discharge devices, that are not certified shall not be considered a certified foam Extinguishing System.
- 1.2.4 It is the responsibility of the manufacturer to ensure that the submitted system is complete and suitable for the proposed application(s) in the field. To be considered complete, a system shall consist of at least the component parts and auxiliary equipment arrangements detailed in Appendix K, these being the minimum considered necessary for the system to be viable and operate satisfactorily, as well as at least one specified concentrate.
- 1.2.5 Any purchased devices which form part of the complete system such as pumps, tanks, control valves, and sprinklers, must be submitted by the system manufacturer for evaluation as a part of their system along with design, installation, operation, and maintenance instructions. Following initial certification, the manufacturer may submit additional separate component parts or auxiliary equipment for use on their system for assessment.

- 1.2.6 This standard sets performance requirements for foam extinguishing systems in product categories that are identified by the following class numbers.

Table 1.2.6 Product Categories and Class Numbers

<i>Class</i>	<i>Product Category</i>
5130	Extinguishing Systems, Fixed Foam
5135	Low Expansion Foam Systems
5136	Compressed Air Foam (CAF) Systems
5137	High Expansion Foam Systems
5139	Variable Viscosity Proportioners

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists has also been considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of foam fire extinguishing systems (hereinafter referred to as “systems”) for the purpose of obtaining certification. Systems having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate
- the suitability of the product;
 - the performance of the product as specified by the manufacturer and required for certification; and as far as practical,
 - the durability and reliability of the product.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance

1.5 Basis for Continued Certification

The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agencies product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this Standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection and are used in this Standard.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*
ASTM B 117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*
ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension*
ASTM D 1141, *Standard Practice for the Preparation of Substitute Ocean Water*
ASTM D 1331, *Standard Test Methods for Surface and Interfacial Tension of Solutions of Surface-Active Agents*
ASTM D 5798, *Standard Specification for Ethanol Fuel Blends for Automotive Flexible-Fuel Automotive Spark-Ignition Engines*
FM Approvals, Examination Standard Class 2000, *Automatic Control Mode Sprinklers for Fire Protection*
FM Approvals, Examination Standard Class 3010, *Fire Alarm Systems*
FM Approvals, Examination Standard Class 3810, *Electrical and Electronic Test, Measuring, and Process Control Equipment*
FM Approvals, Examination Standard Class 1313, *Positive Displacement Fire Pumps (Rotary Gear Type)*
FM Approvals, Assessment Standard Class 5138, *Assessment Standard for Proportioning Testing*
National Electrical Manufacturers' Association (NEMA) 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*
National Fire Protection Association (NFPA) 11, *Standard for Low-, Medium-, and High Expansion Foam*.
National Fire Protection Association (NFPA) 72, *National Fire Alarm and Signaling Code*

1.9 Terms and Definitions

For purposes of this standard, the following terms shall apply:

Accepted

This term refers to installations acceptable to the authority enforcing the applicable installation rules. Acceptance is based upon an overall evaluation of the installation. Factors other than the use of certified equipment impact upon the decision to accept, or not to accept. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere.

Air-Aspirating Discharge Device

A discharge device which mixes air into a foam solution to create a controlled expansion of the foam at the point of discharge.

Alcohol-Resistant Foam (AR)

A foam produced from a synthetic or protein foam concentrate that resists being dissolved in liquids normally miscible with water, and that can also be used to protect liquids immiscible in water.

Aqueous Film-Forming Foam (AFFF)

A foam produced from a synthetic concentrate and that forms an aqueous vapor barrier film on the surface of liquids immiscible in water, and is measured to have a spreading coefficient greater than zero when tested as described in Section 4.6.

Area of Coverage

The maximum area which can be protected by a foam discharge device, based upon the minimum effective application rate for the hazard, the maximum application rate which will not cause substantial differences in the foam quality from that producing successful extinguishment in tests, and the maximum distance from the application device to the burning surface which will also not significantly effect foam quality.

Aspirating High Expansion Foam Generator

A high expansion foam generator in which airflow is induced by the spraying of the concentrate solution.

Automatic Control

A device or arrangement of devices for initiating foam discharge including a panel which monitors fire detectors and releases the agent when pre-established conditions have been met, without requiring human intervention.

Automatic Foam Concentrate Control Valve

A valve controlling the flow of foam concentrate to the proportioner. The valve is automatically actuated by either hydraulic, pneumatic, or electrical power and incorporates means to supervise its position.

Automatic Sprinkler

A discharge device that is actually a certified fire protection sprinkler designed for use with plain water, and that does not aspirate air into the water discharge.

Balanced Pressure Bladder Tank

A foam concentrate supply tank fitted with an internal bladder to separate water from the concentrate. Water pressure on the outside of the bladder pressurizes the concentrate inside and drives it through a modified venturi type Proportioner into the water stream at the Specified rate, based upon the pressure differential created by the venturi.

Balanced Pressure Pump-Type Proportioning

Foam proportioning using a foam concentrate pump and an automatic pressure balancing valve that is operated by water supply pressure and is located in the concentrate bypass line to the pump to balance concentrate and water pressures to a modified venturi-type proportioner.

Blower Type High Expansion Foam Generator

A high expansion foam generator in which airflow is produced by a blower driven by an electric motor, water jet, or turbine, or other device powering the blower's fan blades

CAF Nozzle

The discharge device for a CAF system that is designed to distribute the pre-expanded CAF over a specified area with minimal destruction of bubbles.

Calm Air

Wind conditions of 0 – 8.0 miles/hour (0 – 3.6 m/s)

Class A Fires

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

Class B Fires

Fires in ignitable liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

Class C Fires

Fires in which the ignition source is energized electrical equipment.

Compressed Air Foam (CAF)

Foam produced by combining a low expansion foam solution with compressed air or an inert gas in a mixing device and typically having a very small and uniform bubble size.

Compressed Air Foam System (CAFS)

A foam generation and delivery system that consists of a pressurized air or inert gas source, a source of foam solution (water pump and proportioner), and a means to apply the foam. In a CAF system, the distribution piping carries already expanded foam and the discharge device only distributes the foam without further expansion. CAF systems have unique hydraulic considerations which must be addressed by the manufacturer to ensure delivery of an effective foam to the discharge device. These systems may be pre-engineered or engineered designs.

Concentration

The volume percent of a foam concentrate in water. May also be referred to as ‘concentration ratio’, ‘mixture strength’ or ‘ratio’.

Design Application Rate

The application rate that may be considered when designing a system. The design application rate is derived from the test application rate and either includes an additional safety factor or is a multiplier to be applied to the test application rate as applicable to the equipment concerned.

Discharge Device

A nozzle or other device that is used to distribute the extinguishing foam uniformly over or into a specific area, within a specific volume, or both.

Discharge Outlet

A discharge device that is permanently affixed to an ignitable liquid containment vessel or other structure to protect a defined hazard.

Discharge Duration

The time interval between the first appearance of foam at the discharge device and the time at which the foam concentrate primary supply is depleted.

Direct Injection Variable Pump Output Proportioning

Proportioning using flowmeters for both concentrate and water supply and a control system to vary foam concentrate pump flow in proportion to water supply flow.

E85

A blend of nominal 85 percent ethanol and 15 percent hydrocarbons and other additives, as defined by ASTM D 5798 and that may contain as much as 30 percent non-ethanol constituents, depending on the volatility class specified for a particular geographical region and season.

E85 Test Fuel

A blend of 70 percent ethanol and 30 percent normal heptane used as a conservative representative test fuel to qualify the fire extinguishment capabilities of foam.

Eductor

A device that uses the Bernoulli pressure reduction caused by the flow of water through a venturi to allow atmospheric

pressure to drive foam concentrate into the water stream to produce a mixture of the specified concentration. May also be referred to as an 'inductor'.

Engineered System

A fire extinguishing system design in which friction loss of piping, nozzles, and other components, and an analysis of the piping configuration, are used in hydraulic calculations to predict flows and pressures at individual nozzles.

Expansion Ratio

The ratio of the volume of expanded foam to that of the same weight of the foam solution.

Film-Forming Fluoroprotein Foam (FFFP)

A foam produced from a fluoroprotein concentrate that includes a fluorinated surfactant to form a vapor barrier film on the surface of liquids immiscible in water.

Fire Control

Fire Control is the state achieved following the beginning of foam application when the average radiative heat flux levels, 1 ½ pool widths from the pool center measured in the crosswind direction, have reached 10 percent of the initial steady-state uncontrolled values. For the purposes of fire testing, this may be considered to be achieved when 90% of the fuel surface is covered with delivered foam solution.

Fire Control Time

Fire Control time is the elapsed time from the beginning of foam application when fire control is reached.

Fluoroprotein Foam

A foam similar to protein foam, but which also includes a fluorinated surfactant.

Floor nozzle system

A system that provides low-expansion foam discharge nozzles installed flush with the structural floor, supplied with foam-water solution through piping installed in trenches in the floor.

Foam

A stable aggregation of bubbles produced from an aqueous solution of foam concentrate that has a sufficiently low density and sufficient fluidity to allow it to float on top of and form a blanket on the surface of a liquid being protected.

Foam Chamber

A Type I or II discharge outlet normally installed along the perimeter of an ignitable liquid storage vessel or containment structure to ensure delivery of foam to the contents, when required.

Foam Concentrate

A concentrated aqueous liquid formulated to produce firefighting foam when mixed in the proper concentration with water and in which air can be entrained to reach the specified Expansion Ratio.

Foam Generator

A device used with high expansion foam concentrates to produce foam by spraying the concentrate solution onto a screen and forcing air through the screen.

Foam Maker

A device that generates foam and that is intended to be installed between the supply piping of foam solution and piping leading to discharge outlets.

Foam-Water Sprinkler

A discharge device that is an air-aspirating, usually-open fire protection sprinkler designed to create foam, as well as providing effective water discharge upon depletion of the foam concentrate supply.

Foam-Water Sprinkler System

A modified sprinkler system that is pipe connected to a source of foam concentrate and to a water supply. The system is equipped with appropriate discharge devices for foam-water solution discharge and for distribution over the area to be protected. Upon opening of the water control valve, water flows through the piping system and foam concentrate is proportioned and injected into the water, and the resulting solution discharges through devices that generate and distribute the foam. Upon exhaustion of the foam concentrate supply, water continues to discharge until shut off manually. These systems can be of wet pipe, dry pipe, deluge, or preaction designs, paralleling the design and using most of the components of the equivalent water-only sprinkler systems. They differ primarily in the addition of foam concentrate proportioning equipment or pre-priming of the sprinkler piping with foam-water solution. The introduction of the foam concentrate may be controlled by a detection system and can precede or follow the water-only discharge.

Foam Solution

A solution of foam concentrate in water that is named by the concentrate's name and the specified concentration.

High Expansion Foam

A foam that is produced in foam generators and has an expansion ratio greater than 200:1.

Ignitable Liquid

For the purposes of this standard, an ignitable liquid is simply a liquid that will burn. While some other organizations use different terms to identify liquids that burn, we believe that our approach is consistent with the hazard that is created by these liquids. Liquids that burn create challenging fire hazards and those hazards are not defined by the closed cup flash point of the liquid. The hazard is driven by the simple fact that the liquid burns (i.e., has a fire point).

In-Line Balanced Pressure Proportioning

Balanced foam proportioning using a concentrate pressure which is greater than the water supply working pressure under all operating conditions. Automatic pressure balancing valves operated by the water supply pressure to the proportioner are used to regulate the concentrate pressure individually to each proportioner. Concentrate pressure may be created by either a bladder tank or a concentrate pump.

Inline Eductor

An eductor that is installed upstream of the discharge device and which uses a foam concentrate supply at atmospheric pressure.

Local Application System

A fire extinguishing system designed to protect a defined area by the direct discharge of foam onto burning materials.

Lock-Out Valve

A lockable manually operated valve which can be used to isolate the foam supply from the rest of the system during maintenance and service.

Low Expansion Foam

A foam having an expansion ratio less than 20:1 and that may be produced by various devices.

Manual Control

A device or arrangement of devices for initiating system discharge that requires action by a human to release the agent.

Maximum Working Pressure

The pressure in a foam extinguishing system at the maximum available pressure of the water and foam concentrate supplies.

Minimum Working Pressure

The pressure in a foam extinguishing system below which it will not produce foam of acceptable quality.

Monitor

A fixed or portable device that is mounted on a supporting structure and delivers a large foam stream from a nozzle that may be aimed over a variety of vertical and horizontal angles. May also be referred to as 'foam cannon'.

Non-Air-Aspirating Discharge Device

A discharge device, such as a fire protection sprinkler, which delivers unexpanded foam concentrate solution to the hazard and relies on subsequent turbulence to entrain the air required for expansion.

Nozzle

A discharge device that may be either hand held or mounted on a monitor, is designed to expand the foam solution, and is capable of directing a stream of foam into a narrow targeted area.

Operable Pressure Range

The pressure range corresponding to the pressures in the water supply at the specified minimum and maximum flow rates at which the system is intended to be operable.

Oscillating Monitor

A monitor that can be set to move the direction of its stream automatically and continuously over a range of horizontal angles by means of a water pressure driven or electrically powered device.

Polar Solvent

An ignitable liquid such as an alcohol or ketone that is miscible in water and that tends to dissolve foams and thereby reduce their fire extinguishing effectiveness.

Pre-Engineered System

A fire extinguishing system design in which a predetermined range of piping and nozzle characteristics and configurations are used to predict individual nozzle flow rates.

Premixed Foam Solution

A foam solution produced by introducing a measured amount of foam concentrate into a known amount of water in a storage vessel.

Pressure Proportioning Tank

A bladderless foam concentrate supply tank that uses water flow through a port located high in the tank to displace the concentrate in the tank through a low mounted port with an orifice. Since buoyancy is the only mechanism separating the concentrate from the water, this method is only suitable for concentrates with a minimum specific gravity of 1.15. The concentrate orifice controls its flow rate into the water stream to approximate the specified concentration in the combined stream.

Proportioner

A device used to meter foam concentrate into a water stream at the prescribed nominal concentration within the specified tolerances.

Proportioning

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

Pump Proportioner

A system using a venturi eductor installed in a bypass line between the discharge and suction lines of a water supply pump and suitable orifices or a metering valve to control the amount of concentrate supplied in proportion to pump discharge (system water supply) pressure.

Protein Foam

A foam produced from concentrate consisting primarily of products from a protein hydrolysate, plus stabilizing additives and inhibitors to protect against freezing, to prevent corrosion of equipment and containers, to resist bacterial

decomposition, to control viscosity, and to otherwise ensure readiness for use.

Proportioning Testing Service Provider

A commercial entity that has been successfully evaluated for competency to test installed foam systems using the test liquid or water equivalency proportioning methods.

Ratio Controller

A modified venturi proportioning device designed to meter foam concentrate into the water stream over a defined flow range as part of a balanced pressure proportioning system. Typically, an orifice plate is installed at the concentrate inlet with the quantity of foam metered controlled according to the size of the orifice. Different size orifices may be used for different concentrates and concentrations.

Salt Water

Manufactured artificial sea water, as defined by ASTM D 1141, *Standard Practice for the Preparation of Substitute Ocean Water*. May also be referred to as 'synthetic seawater'.

Self-Educting Nozzle

A nozzle that includes a venturi to draw foam concentrate into the water stream through a short length of flexible tubing connected to a supply container, effectively incorporating a nozzle and an eductor in one device.

Semisubsurface Foam Injection

Discharge of foam at the liquid surface within an ignitable liquid storage tank from a floating hose that rises from a piped connector near the tank bottom upon system actuation.

Specified

The value of a design parameter set by the manufacturer.

Spray Nozzle

A discharge device that may be an open automatic sprinkler or specially designed nozzle attached to fixed piping and discharges water or foam in a fixed spray pattern.

Subsurface Foam Injection

Discharge of foam from an outlet near the bottom of an ignitable liquid storage tank. The foam then rises to the liquid surface due to buoyancy.

Synthetic Foam

A foam produced from concentrate consisting of foaming agents other than hydrolyzed protein.

Synthetic Fluorine Free Foam (SFFF)

A foam produced from a synthetic concentrate which excludes any fluorinated surfactants other than trace elements.

System Water Supply

In most cases, the water flow and pressure available to the foam system after the point of foam concentrate introduction. For systems using a premixed foam solution it is the flow and pressure available at the connection to the discharge piping, downstream of any pump or other pressure source.

Test Application Rate

The ratio of quantity of foam discharged to the discharge time measured within ± 1 second divided by the area covered by the discharge during fire testing. When a minimum test application rate is indicated, reference is made to the minimum quantity of foam solution discharged and the time measured within ± 1 second per unit area of surface covered. The test application rate is expressed in units of gal/min/ft² (L/min/m², which equals mm/min). The volume used to calculate application rate is that of the foam solution prior to expansion into foam for consistency among foams of different expansion ratios.

Test Liquid

A non-foaming liquid that replicates the viscosity, specific gravity, and other relevant properties of the actual foam concentrate used in a system and that is used to test the accuracy of proportioners and similar devices in an installed system.

Test Liquid Proportioning Testing

A method of evaluating the proportioning accuracy of an installed foam fire extinguishing system using a test liquid in lieu of the concentrate to minimize the difficulties in disposing of the required discharge in the annual retesting of a foam system.

Topside Discharge Device

A discharge device such as a foam chamber that applies foam to the surface of a burning liquid from above.

Total Flooding System

A high expansion foam extinguishing system designed to protect an enclosed hazard area by discharging foam to reach and maintain a minimum level 1.1 times the maximum height of or 2 ft (0.61 m) above all protected contents, whichever is greater, throughout the enclosed area sufficiently quickly and of sufficient duration to extinguish a fire. For a given foam, parameters of required depth of submergence, discharge rate, and duration must be determined by test because they are dependent upon the construction of the building, the nature of the contents, and the storage configuration.

Type I Discharge Outlet

A discharge outlet designed to deliver the extinguishing foam gently onto a liquid surface with no submergence or agitation.

Type II Discharge Outlet

A discharge outlet designed to deliver the extinguishing foam onto a liquid surface with minimal submergence or agitation.

Type III Discharge Outlet

A discharge outlet designed to deliver the extinguishing foam onto a liquid surface with significant submergence or agitation.

Vapor Seal

Frangible component designed to prevent tank contents vapors from entering the atmosphere through the foam chamber while allowing foam to flow into the tank during system operation.

Variable Viscosity Proportioner

A proportioner with the capability to accurately proportion foam concentrates at the specified ratio into the water stream to form foam solution at a range of concentrate viscosities and system flow rates without adjustment or modification (such as changing an orifice plate). These are commonly of the water motor driven or electronically controlled types.

Water Equivalency Proportioning Testing

A method of evaluating the proportioning accuracy of an installed foam fire extinguishing system using water in lieu of the concentrate to minimize the difficulties in disposing of the required discharge in the annual retesting of a foam system.

Wide Range Proportioner

A proportioner which automatically adjusts the concentrate orifice size based on the water flow rate (automatically variable geometry) to proportion foam concentrate into the water stream allowing proportioning across wider flow ranges than a traditional ratio controller.

Wood Crib

A square stack of alternate layers of kiln-dried spruce or fir in nominal 2x4 inch trade size and equal lengths placed at right angles to the preceding layer and spaced to allow air flow between the members. Each layer consists of the same number of evenly spaced members placed on edge, except for the top layer, which has fewer evenly spaced members placed on their sides. The outer members of all layers are placed flush with the ends of the members of the adjacent layers. All members are carefully nailed in place to avoid splitting the wood. Wood cribs are a standard test fuel for Class A fire tests. For the purposes of this standard, the high expansion foam Class A fire extinguishment test wood crib shall consist of members 87.125 in. (2213 mm) long arranged in 10 layers of 21 on edge, with a top layer of 14 on side.

Working Pressure

The water supply pressure to a foam extinguishing system at a condition of zero flow. May also be referred to as 'operating pressure'.

2 GENERAL INFORMATION

2.1 Product Information

Foam fire extinguishing systems are special protection systems designed to limit fire damage in an ignitable liquid use occupancy, or as an alternate to providing an emergency drainage system. The expanded foam is used to cool the fire and to coat the fuel, preventing its contact with oxygen.

To meet the intent of this standard, foam fire extinguishing systems shall be examined on a model-by-model, type-by-type and manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical designs, fabricated in identical materials by different manufacturers or, even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample foam fire extinguishing systems, selected in conformance to this criterion, shall satisfy all of the requirements of this standard.

2.2 Certification Application Requirements

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- Any marketing literature showing the general specifications and functions of the system.
- An instruction manual—listing all design, installation, operation, and maintenance instructions.
- Quality control procedures detailing routine testing and final inspection procedures. These may include receiving inspection, in-process inspection, final inspection, and calibration of measuring and testing equipment procedures.
- Procedures detailing the system acceptance testing once the foam fire extinguishing system is installed.
- The following drawings should be provided:
 - Electrical schematic(s) for automatic systems
 - Final assembly drawings and parts lists sufficient to detail primary components (all), operator controls, and their locations;
 - Complete set of mechanical drawings for all machined parts;
 - Complete part specifications (including manufacturer's model numbers, size, ratings, etc.) for all purchased parts;
 - Specification sheets for all parts/components;
 - Drawings showing all construction details, sheet metal gauge and paint finish;
 - Product label drawing(s) showing all required marking information. The label drawing shall show the proposed label location on the equipment and artwork showing the manufacturer's name, address, model and serial numbers, equipment ratings, warning markings, and the certification agencies mark.
- The number and location of manufacturing facilities.
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

- 2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing determined by the certification agency.
- 2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results

of any foregoing tests.

- 2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.
- 2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the foam quality, fire performance and proportioning performance of the system.

3 GENERAL REQUIREMENTS

3.1 Review of Documentation

- 3.1.1 During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of installation and use. The certification examination results may further define the limits of the final certification.
- 3.1.2 Within this standard, the system is the combination of foam concentrate and the mechanical components that contain, proportion, deliver, and discharge the resultant foam. Frequently there is more than one corporate entity involved with the manufacturing of the various components of the system however the responsibility for design control resides with the system manufacturer. Where foam concentrates and mechanical components are made elsewhere, and not covered by their own individual certification, the system manufacturer shall have an agreement with each manufacturer and a process to ensure that design changes are communicated to certification agency in advance of implementation. This information shall be made available during the examination so that the needs for auditing can be accounted for.

3.2 Physical or Structural Construction Features

3.2.1 Foam Concentrate

- 3.2.1.1 Foam concentrates shall be certified with a complete system; certification of a foam concentrate without an associated system shall not be permitted.
- 3.2.1.2 Certification of foam concentrates shall be limited for use as part of certified foam extinguishing systems that have been performance tested specifically with that concentrate and at the nominal concentration ratio(s) at which they are tested. The listing for a foam concentrate shall be shown individually if the manufacturer of the concentrate is different than the manufacturer of the system.
- 3.2.1.3 Foam concentrates shall not be considered for certification if they contain materials regulated by the U.S. Environmental Protection Agency (EPA) or equivalent local authorities, except within the permitted usages of those materials. The foam concentrate industry has committed itself to a voluntary stewardship program to eliminate the use of fluorosurfactants in orders of C8 or higher (greater than eight-carbon chain molecules). In support of this effort, the certification agency will not consider foam concentrates violating this constraint for certification.
- 3.2.1.4 Foam concentrate manufacturers seeking certification as part of a system certification shall supply a controlled formulation document to be retained by the certification agency as part of the examination. Foam concentrate manufacturers shall be enrolled in the certification agency foam concentrate sampling program where samples will be collected at the program's stipulated frequency.
- 3.2.1.5 Foam concentrates shall only be certified at the nominal concentration ratio(s) at which they have shown successful fire extinguishment.
- 3.2.1.6 Unless specified as suitable for fresh water only, extinguishment testing will be performed with salt and fresh water.
- 3.2.1.7 Foam concentrate manufacturers seeking certification as part of a system certification shall publish the nominal viscosity of the concentrate in accordance with the methods stated in Appendix J:
- (Brookfield) Viscometer, stating the spindle number used and the spindle RPM stated at the standard temperature of 68°F (20°C) and at the manufacturers stated minimum use temperature.
 - (Brookfield) Rheometer, stating the dynamic viscosity as function of the shear rate; for pseudoplastic foam concentrates only stated at the standard temperatures of 35°F, 68°F, & 120°F (2°C, 20°C, & 49°C) as well as the minimum or maximum rated use temperatures if outside of this range

Foam concentrate manufacturers shall also publish the acceptable range of viscosity when samples are sent for quality control testing. At the discretion of the certification agency, examinations may be specified in accordance with Section 4 for concentrates at the limits of this viscosity range.

- 3.2.1.8 Foam concentrate manufacturers seeking certification as part of a system approval shall publish documentation/graph/charts on the friction loss of the foam concentrate for various pipe diameters used in the system or absolute (dynamic) viscosity of the foam concentrate to calculate the friction loss.

3.2.2 Components

- 3.2.2.1 With the exception of Variable Viscosity Proportioners, components for foam systems shall only be certified as part of the system(s) with which they have been performance tested.
- 3.2.2.2 All component parts subject to full system operating pressure shall be designed for a minimum working pressure of 175 psi (1205 kPa). Components protected from exposure to full system operating pressure by a pressure relief device may be designed for the reduced pressure, subject to satisfactory evaluation of the protection device or system.
- 3.2.2.3 All components shall be made of corrosion resistant materials suitable for their intended use.
- 3.2.2.4 Elastomeric components used in the system shall be compatible with the concentrate. Compatibility shall be determined by successful performance at maximum and minimum installation temperatures while exposed to the agent. At minimum, tensile strength and ultimate elongation of samples of unreinforced materials shall not be changed by more than 15 percent from new condition by a 60 day exposure to the agent at the maximum storage temperature.
- 3.2.2.5 Bladder tanks and other pressurized containers shall conform to the appropriate regulations for the installation location. In the U.S.A., DOT regulations are appropriate for cylinders which are shipped pressurized and ASME unfired pressure vessel code for cylinders filled after installation. The following documents shall be submitted for each diameter of cylinder design to demonstrate compliance with the relevant design standard.
- Calculation of wall thickness per the method specified in the standard, with appropriate supporting references, as necessary.
 - Certificate of chemical analysis of materials.
 - Certificate of physical properties of materials.
- 3.2.2.6 Automatic concentrate control valves, water supply valves, and water alarm check valves shall be equipped with electrical supervision of operating position to allow for remote monitoring and annunciation and a position indicator. All valves equipped with electrical supervision shall be provided with a minimum NEMA Type 1 or IP-10 housing or enclosure if electrically operated by a solenoid.
- 3.2.2.7 Automatic concentrate control valves must be equipped with an emergency manual operator, and a strainer in the actuation line and means to flush that line, if hydraulically operated. All automatic concentrate control valves shall be provided with a local manual reset.
- 3.2.2.8 Automatic valve actuators shall be provided with tamper resistant construction to restrict access to components and protection to vents or orifices to prevent tampering or clogging that would render the valve inoperable.
- 3.2.2.9 All valves and control devices with exterior movable parts that are vulnerable to obstruction or physical damage shall be protected by paneled enclosures or cages. This requirement shall not apply to levers, push buttons and other operators requiring manual access for their function to the extent necessary to provide such access. Conduit shall be used for cables, tubing, or wires outside the enclosures. Heat detection tubing, in the areas being monitored by the tubing, shall not be installed in conduits but shall be routed and supported to protect it from mechanical damage.

- 3.2.2.10 Manifolds of proprietary designs used in place of standard pipe and fittings shall have minimum internal cross-sectional areas no less than that of their corresponding pipe sizes. All manifolds and foam concentrate and foam solution pipe shall be designed and installed in accordance with the piping section of NFPA 11 and/or the certification agency or the authority having jurisdiction.
- 3.2.2.11 Discharge devices shall be manufactured from corrosion resistant materials that will not be deformed or otherwise damaged by the fire exposure. Fire exposure resistance shall not be required for hand-held devices or other components normally located outside of the fire area.
- 3.2.2.12 Pressure operated switches may be used to shut down fans, conveyors, or other electrical equipment in the protected area and activate alarm and indicator circuits. These switches shall operate at a maximum water supply pressure of 50 psi (345 kPa) and not release water from the system. They may have means for alternate, manual control and shall be designed for manual resetting only.
- 3.2.2.13 Alarms and/or indicators shall be provided to show that the system is operating, warn personnel of the forthcoming discharge of foam and signal the failure of any supervised equipment. Indicators which show that the system has been used and must be serviced shall operate upon actuation of the system and require manual resetting.
- 3.2.2.14 Manufacturers of proportioners as part of a system certification shall publish the following information (at minimum):
- Nominal pipe size corresponding to each proportioner model designation
 - Concentrate(s) that have been specifically tested and certified for use with each proportioner
 - In the case of foam concentrate variable viscosity proportioners, concentrate viscosity ranges that have been specifically tested and certified for use with the subject proportioner
 - Minimum inlet pressure associated with certification and specific concentrate(s)
 - Maximum inlet pressure associated with certification and specific concentrate(s)
 - Inlet pressure vs. Foam solution flow representation throughout certified ranges
 - Friction loss vs. Foam solution flow representation throughout certified ranges
 - Description of test and installation criteria in accordance with the requirements of the certification agency or the authority having jurisdiction with a minimum as follows:
 - Provide a length of either (A) a minimum of five pipe diameters; or (B) the proportioner manufacturer's recommended amount of straight, unobstructed pipe on the inlet and discharge side of the proportioner.
- 3.2.2.15 For proportioners with moving parts specifically designed to operate over wide flow ranges, the proportioner manufacturer must state piping configuration limitations. For installations where there are one or more downstream pipes of smaller diameter than the proportioner nominal pipe diameter, the proportioner manufacturer must state the minimum straight pipe length between the proportioner and the reduction or tee. It shall also be stated in the product literature that using this style of proportioner in the described configuration could lead to a condition where the time necessary to achieve the nominal concentration ratio at low flow rates may be influenced by the large volume of water required to be evacuated in the proportioner nominal diameter piping on the inlet and discharge side of the proportioner.
- 3.2.2.16 Proportioners used in dry valve configurations shall include special procedures addressing flushing of foam concentrate after inspection and operations. In addition, examinations by the certification agency may be administered to proportioning system components used in dry systems.
- 3.2.2.17 Water motor driven variable viscosity proportioners may be configured to allow for remote concentrate injection or concentrate injection further downstream of the water motor. For these configurations it is important that the concentrate line from the outlet of the foam pump is designed properly for the system to function as intended. Accordingly, the remote injection line from the foam pump discharge to injection point should not produce a greater pressure loss than the pressure loss in the water line between

the original injection point and the new remote injection point. A higher pressure loss in the remote injection line can be tolerated, as long as the sum of pressure loss of the remote injection line and the backpressure at the injection point is below the rated pressure of the variable viscosity proportioner foam pump. By ensuring these circumstances, the accuracy of the proportioning rate will not be affected.

- 3.2.2.18 Manufacturers of foam chambers and foam makers seeking component certification as part of a system certification that use an outlet leading to a tank penetration shall define acceptable methods for connecting to the deflector or pourer on the inside of the tank.
- 3.2.2.19 Manufacturers of foam chambers or foam makers leading to a dike shall define acceptable methods for mounting to the deflector or pourer on the side of the dike.
- 3.2.2.20 Foam makers may not be certified for use with “high back pressure” configurations unless explicitly tested and certified for the maximum rated back pressure.

3.2.3 Variable Viscosity Proportioners

- 3.2.3.1 The manufacturer shall state the minimum and maximum rated water flows, minimum and maximum rated backpressure, the nominal foam concentrations, and the minimum and maximum rated viscosities of concentrate which the product is intended to be able to proportion.
- 3.2.3.2 The product shall be capable of performing according to the requirements of this standard when tested according to the limits specified by the manufacturer per Section 3.2.3.1.
- 3.2.3.3 The manufacturer of the variable viscosity proportioner shall be able to supply all necessary fittings and accessories.
- 3.2.3.4 The variable viscosity proportioner housing shall be designed to permit examination and/or removal of rotors and interior parts without disturbing the suction or discharge piping of the (main) water connections. A drain opening(s) shall be provided so that all parts of the variable viscosity proportioner housing can be drained. The opening shall be threaded to receive a corrosion resistant pipe plug a minimum of ½ inch nominal size. Replaceable housing wearing liners may be provided.
- 3.2.3.5 All liquid passages of variable viscosity proportioners shall be designed to minimize the possibility of foreign materials becoming lodged in them (e.g. strainer). For potentially contaminated water sources a strainer may be necessary. Pump housing design strength calculations shall show the wall thicknesses to be adequate with maximum stresses that do not exceed those allowable for the material, and housing bolt strength calculations shall demonstrate design stresses no greater than those allowable for the material according to the appropriate FM Approvals certification standards for the pump type concerned.
- 3.2.3.6 Rotors shall be fixed to the variable viscosity proportioner shaft and so designed to prevent contact with the housing under normal operating conditions (e.g. keyed).
- 3.2.3.7 Variable viscosity proportioners shall be designed with shaft seals that adequately safeguard against excessive fluid leakage when suction pressure is above atmospheric and prevent air leakage when suction pressure is below atmospheric.
- 3.2.3.8 Variable viscosity proportioners fitted with bearings shall be designed to support radial and axial thrust loads encountered during maximum load conditions. Water slingers and dust caps or other suitable means of preventing fluid or other foreign matter from entering the bearings shall be provided. Bearings shall be sized to provide a minimum calculated L10 life rating not less than 5000 hours at maximum load, and be grease lubricated, with a grease fitting and relief hole if lubrication is necessary.
- 3.2.3.9 Variable viscosity proportioners shall be designed with a baseplate that can support the proportioner assembly, including the pump, water motor and all ancillary components without excessive vibration or visible distortion.

- 3.2.3.10 Variable viscosity proportioners that are fitted with closeable valves between the pump discharge and the fire service water shall be equipped with relief valves. Relief valves shall be examined per the requirements of FM Approval standard 1359, as applicable, and selected to provide relieving capacity and relief pressure for each pump model and rated capacity. Valve adjustments shall be preset at factory and tamper resistant.
- 3.2.3.11 Variable viscosity proportioners shall be designed for flow rates equal to or greater than 1 gal/min (3.75 L/min). Rated pump pressures shall be a minimum of 40 psi (275 kPa). Castings shall be free of defects which could make them unfit for the intended use. Flange dimensions, bolt layouts and threaded openings used in pipe connections shall conform to a recognized national or international standard.
- 3.2.3.12 If fabricated (welded) steel or cast fittings which are not certified are provided as part of the variable viscosity proportioner assembly (i.e. suction and discharge adapters), they shall be evaluated as part of the certification program. This shall normally include a review of detail drawings and hydrostatic tests per Section 4.11.

3.2.4 System

- 3.2.4.1 Systems shall only be certified for use with concentrates and at concentration ratio(s) with which they were fire tested.
- 3.2.4.2 Certification of a system is based upon its ability to proportion a concentrate accurately into water and produce and deliver a foam within the limits of expansion ratio and 25 percent drainage times of foams demonstrating successful fire extinguishing performance. The listing shall identify the foam concentrate and concentration ratio(s) used as well as main system components.
- 3.2.4.3 Fire testing shall be performed at the minimum specified test application rate on hydrocarbon fuels and polar solvent liquids specified by the manufacturer. Authorities having jurisdiction may mandate higher design application rates for specific hazards than the certified minimums.
- 3.2.4.4 System components shall operate within the temperature ranges of 35 F to 120 F (1.7 C to 49 C). If the system manufacturer specifies a lower minimum or higher maximum installation temperature, system and component evaluations will be based on the resulting greater range.
- 3.2.4.5 In all cases, certified foam extinguishing systems must be able to be configured to supply a minimum 20 minute duration of foam solution to the hazard area.
- 3.2.4.6 For normal operation, a system shall be either automatically controlled or operable from a manual control that is easily accessible to the hazard, or both. If the normal manual means of actuation utilizes electric power, the source of that power shall be completely independent of any electric power source used for automatic operation. Alternatively, a power source used for both normal and automatic operation shall be provided with an independent back-up, such as a battery. Whether normally operated automatically or manually all systems shall also be provided with an alternate means of fully mechanical manual emergency control. Fully mechanical manual emergency controls shall not require an electric power source but may make use of water supply pressure to operate the release. These emergency controls shall be located at or near the device being controlled.
- 3.2.4.7 Control panels shall comply with NFPA Standard 72, *National Fire Alarm Code*, and FM Approvals requirements for Classes 3010, *Fire Alarm Systems*, Classes 1321 and 1323, *Controllers for Electric and Diesel Engine Driven Fire Pumps* and 3810, *Electrical and Electronic Test, Measuring, and Process Control Equipment*. Control panels need not be submitted as part of the system. However, system design shall be such that the system is operable by at least one certified detection and release panel.
- 3.2.4.8 System manufacturers shall specify that the certification of their system is contingent upon piping designed and installed in accordance with NFPA 11 and/or the requirements of certification agency or the authority having jurisdiction.

- 3.2.4.9 The manufacturer of a system to be certified must have effective control over the configuration and manufacture of the components and the formulation of the concentrate to be included to ensure that all systems produced under the certification will offer essentially the same performance as that originally tested.

This can be accomplished in two ways:

1. The manufacturer can be the manufacturer of all components and the concentrate and demonstrate effective quality control, or the manufacturer can enter into written agreements with the component or concentrate manufacturers to control the designs and formulations per the Certification Agreement, and the certification agency shall be permitted to periodically audit this “outside” manufacturer (either on behalf of the manufacturer or as the result of component listing of the outsourced items), or
2. The manufacturer can demonstrate sufficient quality control of the critical characteristics of the outsourced components as to ensure system performance. Generally, this will include a minimum of some performance testing. System configuration and application shall be prescribed by appropriate design, installation, and operation information to be provided by the manufacturer. The certification agency will review such information to verify completeness and conformance to FM Global loss prevention recommendations and the limits of the certification to be granted.

3.2.5 High Expansion System Configuration Requirements

- 3.2.5.1 A pressure operated release shall be provided on all doors, windows, and other openings below the intended flooding level in the protected hazard area. The release shall operate at a maximum pressure of 50 psi (345 kPa) system water pressure. The release shall not permit the escape of water from the system. It shall automatically reset and may have a control for manual operation.
- 3.2.5.2 A delay device shall be installed on systems when safety dictates the evacuation of personnel from the hazard area. This device may either delay the operation of the system or delay the discharge of foam after the system has been actuated. In the first arrangement the actual discharge may be manually controlled. A manual override shall be provided in the second arrangement to allow for instant discharge.
- 3.2.5.3 High expansion foam systems shall use air from outside the protected space for foam generation. Air must be vented from the protected space at the same rate of flow to allow the foam generators to operate at their specified capacities. Air intake and venting devices for air movement into the foam generators and out of the protected volume shall be automatically operated at system actuation and protected from mechanical damage, corrosion, and freezing.
- 3.2.5.4 Electrical equipment below the design level of flooding shall be designed for submerged operation to eliminate the risks of short circuiting of controls and shocking to personnel.

3.2.6 High Expansion Foam Stability under Sprinkler Discharge

Foam breakdown testing per Section 4.11, *High Expansion Foam Breakdown Due to Sprinkler Discharge*, shall be conducted with the full range of foam concentrates, concentrations, and application rates submitted for certification to determine the breakdown coefficient.

3.3 Markings

3.3.1 Foam Fire Extinguishing System Markings

A conspicuously mounted nameplate shall be affixed to the proportioning device or the main concentrate

supply container, or a combination of both, and shall display the following markings, at minimum:

- Manufacturer's name and address
- System type
- A list of the major components including proportioners
- Concentrate identification
- Concentrate viscosity
- Specified concentration ratio
- Application density
- Allowable ambient storage temperature range
- Year of manufacture
- Location of manufacture if different from manufacturer's address
- Reference to NFPA 11, *Standard for Low-, Medium-, and High Expansion Foam*, or other relevant local standard and the manufacturer's design, installation, operation, and maintenance instructions.
- Volume of main and back-up concentrate supplies
- The actual filled volume of concentrate
- Inspection requirements
- Any additional markings required by certification agency or the authority having jurisdiction

3.3.2 Component Markings

A component of a foam fire extinguishing system covered by this standard (including but not limited to tanks, proportioners, variable viscosity proportioners and discharge devices other than sprinklers) shall be permanently marked where it shall be easily visible with the following information, any additional markings required by certification agency or the authority having jurisdiction shall also be provided:

- Manufacturer's name and address
- Model or type designation
- Allowable ambient storage temperature range
- Year of manufacture
- Location of manufacture if different from manufacturer's address
- Reference to NFPA 11, *Standard for Low-, Medium-, and High Expansion Foam*, or other relevant local standard and the manufacturer's design, installation, operation, and maintenance instructions
- Minimum and maximum rated flow capacity
- Concentration(s) of proportioned fluid in water (e.g. 1%, 3% etc)
- The size of any orifice/restrictor fitted (where multiple options for the model exist)
- Range of viscosity of fluid to be proportioned
- Minimum and maximum rated system pressure
- Direction of flow
- Serial number
- Variable viscosity proportioners shall also be marked with any additional markings required by certification agency or the authority having jurisdiction

3.3.3 Products that are produced at more than one location shall be marked to allow identification of the specific location of manufacture.

3.3.4 The direction of flow shall be cast, permanently engraved, or stamped into the water motor driven variable viscosity proportioners housing, cover, or end plate. A corrosion resistant metal nameplate bearing the direction of flow shall be considered acceptable if permanently fastened to the pump.

3.3.5 Combination instruction and identification plates shall be mounted on or next to all control devices. All significant component parts or assemblies shall also bear an identification mark, such as a part, catalog, or pattern number.

3.3.6 Discharge devices shall be marked with a model or other identifying number to allow determination of

capacity, throw, and other information required to verify appropriateness for the application.

- 3.3.7 Proportioning devices and foam generators shall be marked with a model or other identifying number to allow determination of capacity, and other information required to verify appropriateness for the application.
- 3.3.8 Valves, proportioners, and other devices requiring installation providing the correct direction of flow for proper operation shall be marked with the specified flow direction.
- 3.3.9 Proportioners shall be marked with the orifice size or other configuration details, as required by the design to set the specified proportioning ratio for the installation.
- 3.3.10 Where required by the authority having jurisdiction, provision shall be made to allow attachment of a tag or label stating the actual injection percentage of foam concentrate at the proportioner for the minimum and maximum rate of flow and the actual viscosity of the foam concentrate determined during an acceptance test or annual discharge test.
- 3.3.11 All marking plates shall be made of materials which will not corrode or otherwise become illegible from the action of system liquids or vapors, or normal, local conditions. All markings shall be legible and durable.
- 3.3.12 When hazard warnings are needed, the markings should be universally recognizable.
- 3.3.13 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.4 Design, Installation, Operation and Maintenance Manual

- 3.4.1 Design, installation, operation, and maintenance instruction manual(s) providing complete instructions to properly design, install, operate, and maintain the system including acceptance and reconfirmation testing of a foam system shall be submitted for review. An English version of this manual should be submitted to the certification agency.
- 3.4.2 The review by the certification agency shall verify compliance to the requirements outlined by the certification agency, National Fire Protection Association (NFPA) 11, *Standard for Low-, Medium-, and High Expansion Foam* and the relevant standard(s) recognized by the authority having jurisdiction for the manufacturer's specified market(s).
- 3.4.3 The manual(s) should also reflect those requirements that are applicable to foam extinguishing systems, as outlined in the following sections.
 - The manual(s) shall provide a description and operating details of all equipment associated with the fire protection system by part and/or model number.
 - The mode of fire protection (control, suppression, or extinguishment) afforded by the system shall be indicated.
 - The manual(s) shall specify the size, schedule, supporting method, and material for all piping, tubing, and fittings, as well as allowable shapes.
 - The manual(s) shall specify all critical system valves and identify the proper positioning of the valves.
 - The installation instructions shall be clear and concise and specify all limitations and restrictions. Diagrams of typical system installations shall be included for typical hazards.
 - Any variations of the system shall be discussed in detail, including the limitations and restrictions of each system. The manual(s) shall clearly identify which configurations are certified by the certification agency.
 - The manual(s) shall specify performance criteria for all discharge devices including, but not limited to, maximum ceiling heights, spacing and arrangement, flow rates, area of coverage, spray angle, and application density.
 - The manual(s) shall include guidance on discharge device obstructions in accordance with NFPA

11, *Standard for Low-, Medium-, and High-Expansion Foam*.

- The manual(s) shall clearly identify all requirements for detection and actuation.
- The manual(s) shall state if the fire protection systems can be interconnected. If the systems can be interconnected, the manual(s) shall clearly indicate how the system interconnections are accomplished.
- The manual(s) shall state the ambient operating temperature range of the fire protection system. If the discharge devices and delivery system have different temperature ranges, these shall be specifically noted.
- The minimum and maximum operating pressures of the system and its sub-systems shall be clearly specified at ambient 70°F (21°C) conditions, and at the minimum and maximum operating temperatures.
- The manual(s) shall specify a test connection configuration for systems to protect any application that does not permit the discharge of the foam system.
- The manual(s) shall identify the Resistance to Snow Loading test weight applied to each model of vent tested in accordance with Section 4.25.4.1.
- The manual(s) shall specify the required acceptance and commissioning procedures, as described in Section 4.33, this includes a sample test form for Acceptance Testing.
- The manual(s) shall specify the required inspection and maintenance for the system. In addition, the manual(s) shall specify the frequency and method of the inspections and maintenance.
- The manual(s) shall contain detailed instructions for restoring the complete system to full operation after a complete or partial discharge. In addition, the manual(s) shall specify the estimated time to return the system to operation.
- The manual(s) shall identify either a date or revision to the manual, as well as a designation number, and shall be provided with a means by which the user can readily identify if the manual(s) are of the current revision. These items are to be identified on each page of the manual.
- The manual(s) shall identify the manufacturer or private labeler, address, contact and service information.
- If there are references to other manuals, these publications should be included or summarized so that information needed for proper design and installation is available.

3.5 System Acceptance, Commissioning and Reconfirmation Documentation

- 3.5.1 All foam extinguishing systems shall successfully meet all system acceptance, commissioning and reconfirmation procedures and should be documented with copies to the system owner and manufacturer (at a minimum).
- 3.5.2 All acceptance, commissioning and reconfirmation procedures shall be reviewed by the certification agency. Changes requested by the certification agency may be mandatory prior to the granting of certification.
- 3.5.3 Acceptance, commissioning and reconfirmation testing procedures should include the following, at a minimum, and shall be documented as part of the manufacturer's design, installation, operation, and maintenance manual(s):
 - 3.5.3.1 Acceptance procedures shall be in accordance with the requirements outlined by the certification agency, the authority having jurisdiction, and NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, or the equivalent national code of the country of use.
 - 3.5.3.2 An appropriate Authority Having Jurisdiction representative should be given advance notice of acceptance, commissioning and reconfirmation testing and be present for commissioning of the system.
- 3.5.4 A trained manufacturer's representative should be present to properly test and reset the system following any acceptance, commissioning and reconfirmation testing.
- 3.5.5 Proportioning for periodic reconfirmation testing may be assessed in accordance with the FM Approvals Assessment Standard 5138, *Proportioning Testing Assessment*, April 2011 where the discharge of the system

for test purposes is not permitted by the authority having jurisdiction.

- 3.5.6 Where required by certification agency or the authority having jurisdiction, a full discharge test to verify system performance may be conducted. During the discharge test, a pressure gauge or transducer should be attached at the discharge device and readings to verify proper discharge pressure, consistent with the design calculations recorded or observed.

3.6 Calibration

- 3.6.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.
- 3.6.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of this equipment.