

SCOPE

- I ↗ 1.1 This practice covers the design and installation of fire fighting foam systems using high or low back pressure foam makers for use with fixed roof tanks operating at approximately atmospheric pressure [not exceeding 2-1/2 psig (17 kPa)] or with annular pontoon or double deck open-top floating roof tanks. The systems also are applicable to tanks furnished with internal floating roofs or covers.
- 1.2 **An asterisk (*)** indicates that additional information is required. If a job is contracted, this additional information is furnished in the Job Specification.

MATERIALS

- S ↗ *2.1 **Piping for risers, laterals, and distribution system** shall be of carbon steel, Schedule 40 min. wall thickness, galvanized or lined with a heat-cured epoxy or phenolic-epoxy system with a minimum dry film thickness of 8 mils (200 µm). Use of unlined pipe shall be approved by the Owner.
- S 2.2 **Foam chambers, outlet assemblies, and deflectors** shall be carbon steel, galvanized or epoxy lined. **Foam dams** shall be carbon steel.
- S ↗ 2.3 **Foam backboards** shall be of the same material specification and grade as the shell plate to which they are attached.
- S 2.4 **Frangible diaphragms**, incorporated in the seal chamber of foam chambers, shall be 14 oz [0.061 in. (1.5 mm)] thick common soda lime glass scored to facilitate breakage under foam pressure.
- S ↗ 2.5 **Screening**, installed at the foam deflector, shall be 2 x 2 mesh with 0.459 in. (12 mm) nominal opening.

DESIGN

- S ↗ 3.1 **Lateral terminal connection:**
 - a. Laterals shall terminate on the road side of all pipe lines and drainage ditches.
 - b. The terminals shall be located in relation to fire hydrants so that the total length of hose from the hydrant to fire truck does not exceed 25 ft (7.5 m) and from fire truck to foam lateral terminals does not exceed 50 ft (15 m).
 - c. Terminals shall be from 2 to 4 ft (600 to 1200 mm) above grade and shall be suitably protected against collision.
 - d. A sign shall be installed at each lateral termination point identifying the tank served.
- S ↗ *3.2 **Fire hose coupling type** to be used at terminal connections and at foam outlet stations will be specified. Coupling thread type shall be suitable for use with the Owner's fire fighting equipment. Couplings shall be provided with dust caps or plugs.
- S ↗ 3.3 **For tanks requiring multiple laterals**, up to two laterals can be brought to a single location 4 ft (1200 mm) apart. However, not more than two laterals from any one tank shall be brought to the same location.
- S *3.4 **Where prevailing winds exist**, the lateral terminals shall be located upwind from the tanks.
- S 3.5 **The terminal connections on foam makers** shall be as follows:
 - a. Laterals to single foam outlets up to 250 gpm (56 m³/h) capacity shall terminate in one NPS 2-1/2 (65 mm) size mating hose coupling.
 - b. Laterals to single foam outlets greater than 250 gpm (56 m³/h) capacity or to multiple foam outlets shall terminate in one NPS 2-1/2 (65 mm) size mating hose coupling for every 250 gpm (56 m³/h) of lateral capacity or part thereof.
- S 3.6 **The riser pipe size** from the foam maker to the foam chamber shall not be smaller than the foam chamber inlet flange size.
- S 3.7 **Riser supports** shall be 1/2 in. (12 mm) thick plate, 12 in. (300 mm) length, with the width depending on riser dimension, but selected to maintain the riser a minimum of 4 in. (100 mm) clear from the tank shell. Installation shall be as follows:
 - a. Each support shall be located on about 8 ft (2.4 m) centers and placed perpendicular to the tank shell and centered on the riser pipe.
 - b. The edges of the plate shall be continuously welded on all sides to both tank shell and pipe with 1/4 in. (6 mm) fillet welds to support the shell in event of a fire.

- S ♦ **3.8 Foam lateral size** shall not be less than NPS 2-1/2 (65 mm) size. **Laterals** shall be installed as follows
- Slope continuously towards the termination point outside the dike. If this is impractical, a (normally closed) NPS 3/4 (20 mm) drain valve shall be provided at the low point.
 - Not run through the dike area of any other tank, group of tanks, or paired tanks. However, piping within a group of tanks may cross intermediate toe walls within that group.
 - Extend outside the dike to a safe location (taking into consideration the plant prevailing wind) at least one tank diameter or 50 ft (15 m), whichever is greater, from the tank.
 - Maintain a minimum elevation of 1 ft (300 mm) above finished grade.
- S **3.9 Protection of pipe passing through dikes.** A protective coating system, as for underground steel pipe, shall be applied to portions of piping passing through dikes or dike sleeves. A steel pipe sleeve is required where pipes pass through concrete dikes, with the annular space between pipe and pipe sleeve sealed (with fire retardant material) to prevent dike leakage. A sliding joint packed with fire retardant material or bellows joint (between pipe sleeve and outside surface of pipe) may be used.

ADDITIONAL DESIGN AND INSTALLATION REQUIREMENTS FOR FIXED ROOF TANKS

- S ♦ **4.1 Non water soluble flammable liquids.** A surface application type fire fighting foam system using fixed foam discharge outlets in accordance with NFPA-11 shall be provided in every fixed roof tank (including those with internal floating covers) when the tank contains stocks with a:
- Closed cup flash point under 100°F (38°C), or
 - Closed cup flash point of 100°F and above if such stocks are heated to a temperature above or within 15°F (8°C) of their flash point.

The number of foam chambers (and deflectors) installed shall be as follows:

NOMINAL TANK DIAMETER		NUMBER OF FOAM CHAMBERS PER TANK
ft	m	
< 20	< 6	0
20 to 80	6 to 24	1
> 80 to 110	> 24 to 33	2
> 110 to 130	> 33 to 40	3
> 130 to 150	> 40 to 46	4

For fixed roof tanks without internal floating covers, the design and installation of the foam chamber shall be tank shell mounted per [Figure 1](#).

For fixed roof tanks with internal floating covers, the design and installation of the foam chamber shall be tank shell mounted per [Figure 1](#), provided the deflector does not interfere with the specified upper travel limit of the internal floating roof. Shell extension mounted per [Figure 2](#) is permitted for retrofits.

- S ♦ *** 4.2 Water soluble flammable liquids.** The need for **foam chambers**, and the applicable details of design and installation will be specified by the Owner and the plant Fire Chief.
- S ♦ **4.3** When multiple **foam chambers** are required, they shall be equally spaced around the tank.
- S ♦ **4.4 Foam makers** shall be provided and installed as follows:
- Foam makers with a capacity of 500 gpm at 150 psig (113.5 m³/h at 1034 kPa) inlet pressure, equal to National Foam Type PHB 50 SS shall be used. The foam maker shall be located in the riser piping so that the aspirator opening is 5 ft (1500 mm) above finished grade.
 - * For locations requiring low back pressure foam systems, National Foam Type MCS-33 or MCS-55 or equivalent shall be specified. These foam makers shall be located under the foam chamber at the top of the tank.
 - The foam maker air entry ports shall be provided with a bird screen.
- Note:** National Foam Systems, Inc., 150 Gordon Drive, Lionville, PA 19353
- S ♦ **4.5 Piping layout.** Each foam chamber shall be equipped with its own riser, foam maker, and lateral. Pipe risers and foam makers shall be installed directly below the foam chambers. A flanged spool piece shall be installed upstream of the foam maker (near finished grade) to permit periodic flushing of the lateral.
- S ♦ **4.6 Lateral pipe size.** Laterals shall be sized so that the maximum pressure drop between the end of the lateral and foam maker does not exceed 35 psig (240 kPa).

- S 4.7 **Foam chambers** on internal floating roof tanks shall not be located above ventilation openings on the shell.

ADDITIONAL DESIGN AND INSTALLATION REQUIREMENTS FOR OPEN-TOP FLOATING ROOF TANKS

- S 5.1 **Foam dams** shall be installed **on all floating roof tanks**.
A fire fighting foam system using fixed foam discharge outlets in accordance with NFPA-11 shall be provided in all open-top floating roof tanks that store **crude oils**, or that store **low-flash stocks** with:
- Closed cup flash point under 100°F (38°C), or
 - Closed cup flash point of 100°F and above if such stocks are heated to a temperature above or within 15°F (8°C) of their flash point.
- S 5.2 **For open-top floating roof tanks up to 75 ft (22.5 m) diameter**, a single foam outlet station shall be located by the top platform per **Figure 3**.
Note: This foam station is only intended to provide coverage of the seal area between the shell and the foam dam for approximately 40 ft (12 m) on each side of the top platform, to aid personnel access to the top of the tank.
- S 5.3 **For open-top floating roof tanks larger than 75 ft (22.5 m) diameter**, one foam station shall be installed for each 80 ft (24 m), and fraction thereof, of tank circumference, equally spaced around the circumference per **Figure 4**.
- S 5.4 **The foam outlet assembly** - consisting of a foam maker, foam deflector and mounting assembly - shall be equal to National Foam Systems, Inc., Type MBS-9SA/MCS-9FR. The foam maker shall be furnished with an orifice diameter of 0.65 in. (16.5 mm). The foam maker air entry ports and the foam deflector shall be provided with a bird screen. See **Par. 4.4** for address of National Foam Systems.
- S 5.5 A single foam riser may be used to deliver foam solution to the foam outlets. When multiple foam outlets are installed, the distribution piping to individual outlets shall be located on top of the wind girder to be accessible for inspection.
- S 5.6 The foam system including the lateral, riser and distribution piping shall be sized to deliver 60 gpm (13.6 m³/h) foam solution to each foam maker inlet at a pressure of 60 psig (420 kPa) based on a foam proportioning truck discharge pressure of 100 psig (700 kPa).
- S *5.7 **Foam backboards and foam dams** shall be designed for wind pressure, (design wind velocity shall be specified by the Owner). Foam dam bracing shall be on the outside of the dam, away from the foam, so as not to impede the flow of foam. The foam dam shall extend completely around the roof, and shall be continuously seal welded to the roof for the full length of the dam (except for drain slots per **Figure 3**).
- S 5.8 **Foam backboards mounting and minimum dimensions** shall comply with the following:
- Foam backboards** shall be mounted flush with the ID of the shell.
 - The backboard shall be minimum height, but sufficient to have the foam deflector clear the maximum travel of the roof seal weather shield and other protruding parts at the uppermost position of the roof.
 - * The width of the backboard shall be 10 ft (3000 mm) minimum, unless otherwise dictated by unusual wind conditions or experience at the plant location. Deviation from this minimum width shall be approved by the Owner.
- S 5.9 **Guard railings** shall be installed **on windgirders**, completely around the tank, when multiple foam outlet stations are installed.