How to choose and install roof drains for maximum effect

Flexible systems

Flexible roof drain systems are installed in new or existing petrochemical aboveground storage tanks (ASTs) to prevent the accumulation of rain water on external floating roof tanks (EFRTs).

EFRTs are typically built with either a pontoon-type floating roof or double deck floating roof. These floating roofs slope toward either a single drain sump or multiple drain sumps built into the floating roof to collect rainfall. The bottom end of the drain is connected directly to the shell nozzle or floor spool piping extending from the shell nozzle. The top end of the flexible drain system is connected to the sump nozzle or to a section of roof spool piping extending from the roof sump.

Compatibility

The installed flexible roof drain assembly is immersed in the stored product and must withstand the temperature and chemical properties present in the tank. Flexible roof drains are designed to be compatible with products found in petroleum storage and chemical refining operations.

In cold climates, water may be present in the drain system at the time that temperature drops to the freezing point. Some flexible drains are designed to allow for expansion from freezing water inside the drain. These types of drains can be installed directly to the tank shell nozzle and operate without damage from freeze/thaw action. In the case of steel piping or other flexible drains with metal interior fluidways, expansion from freezing can compromise the integrity of these types of drain systems.

Tank owners may also be concerned with compatibility of the flexible drain system in high temperatures. This concern may present itself when the storage tank is equipped with heating coils or when the product has undergone a high temperature process during refining, for example. Flexible drain system manufacturers design the drain to withstand the high temperature requirements specified by the tank owner.

Flow rates

In addition, tank owners must consider the differences in flow rates among the drain systems available to them. Flexible drain systems with smooth internal fluidways offer superior flow rates than flexible drain systems with corrugated internal fluidways. A smooth internal fluidway also helps to prevent sediment from building up in the system. Accumulating sediment can reduce the flow rate exponentially (similar to a clogged artery). In addition, accidental introduction of stray materials from the roof into the sump are drained away most effectively using a drain with a smooth internal fluidway.

A variety of items, including metal scraps, welding rods or wildlife, such as birds or frogs, may find their way into the drain if certain precautions aren't taken. Also, due to the wind patterns that can develop around the storage tanks in a refinery or terminal, debris from the ground can be blown onto the floating roof.

Angles and elbows in the drain system also decrease the flow rate. To properly locate the drain in the tank, some drains incorporate elbows or multiple joints, which greatly reduce the flow rate. Other flexible drain systems operate without forcing a change in the directional flow. In tanks with this more flexible type of drain system, the hard piping at the sump points directly to the shell connection, eliminating the flow rate losses from additional elbows.

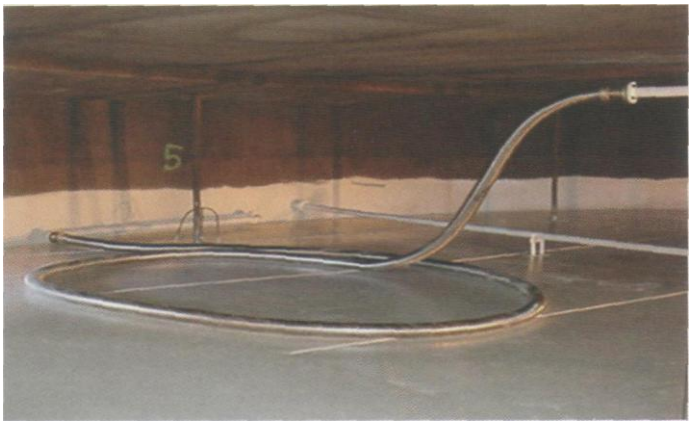
Tank requirements

To determine size and number of flexible roof drains for a floating roof tank, the manufacturer and the tank owner (or contractor) analyse the dimensions of the tank, including the lowest roof operating height. The slowest flow rates for any type of drain system can be expected when the roof is at its lowest level. They will also allow for the maximum hourly rainfall that can be expected in that geographical area. Based on these considerations, the manufacturer will recommend a drain system that will meet or exceed the amount of water that could accumulate on the floating roof.

Drain sizes typically range from 3 inches on the small end of the spectrum to 8 inch diameters in the largest tanks. API standard 650, the source for aboveground

storage tank fabrication in the US and increasingly a popular reference tool used in other parts of the world, specifies roof drain sizing for storage tanks, stating: 'primary roof drains shall not be smaller than NPS 3 for roofs with a diameter less than or equal 36 m (120 ft) or smaller than NPS 4 for roofs with a diameter greater than 36 m (120 ft).' Primary roof drains are differentiated from emergency roof drains, which are designed to operate only if water accumulated on the roof reaches an excessive level.

While the guidelines above provide a useful reference point, the number and size of flexible roof drains cannot be determined on tank size alone. The drain system must also be capable of meeting the rainfall amounts in the area. API-650 states that: "primary roof drains shall be sized and positioned to accommodate the rainfall rates specified on the data sheet...while preventing the roof from accumulating a water level greater than design, without allowing the roof to tilt excessively or interfere with its operation.'



Flexible roof drain shown after installation

Tank owners cannot simply install 4 inch drains in tanks over 35 m diameter without considering expected rainfall amounts. For example, a tank with diameter of 79 m (259 ft) may include two 6 inch drains to handle the amount of water that can accumulate on that size roof in that part of the world. Special care must be taken if the tank is located in a geographical area that can experience brief heavy rains, monsoon rain events or tropical storms.

Manipulation of the floating roof

Flexible roof drains do not cause any manipulation of the floating roof. As the roof moves up and down and even slightly side to side, the flexible roof drain allows itself to be manipulated by the floating roof. API-650 specifies that the drain system shall not allow more accumulation of rainfall than the roof is designed to support while not "allowing the roof to tilt excessively or interfere with its operation.' Hard piping systems may manipulate the floating roof and cause the roof to become off centre. This interference with the roof operation can lead to gaps in the perimeter seal, unwanted fugitive emissions, damage to the floating roof or leakage between hard piping flanges.

Positioning of the drain

The tank owner and manufacturer consider the position of the drain compared to other elements within the tank, such as roof support legs, drain sump(s), tank shell nozzle(s), vacuum lines, heating coils and other objects. With this knowledge, the flexible roof drain manufacturer establishes the appropriate drain length, location and connection points. Leg guards are used to prevent the flexible drain from coming into contact with any roof support legs in the immediate area of the roof drain.

Certain types of flexible drains can be installed directly to the shell nozzle, eliminating problems of floor spool pieces binding or leaking if subjected to tank floor settlement. This feature of certain flexible drains is an advantage in locations with sandy soil where tank owners will choose to avoid floor spool piping because of potential settlement of the tank floor.

Some flexible drain systems are designed with a predictable repeating lay pattern. This lay pattern allows the drain to raise and lower in a predictable space as the roof level changes. When correctly installed, the flexible drain picks up directly off the floor and lowers with no horizontal movement, dragging or damage to the tank floor. The lay pattern of this type of flexible drain also allows tank owners to lower the floating roof as low as the roof support legs will allow. This capability keeps the tank efficient by allowing the maximum amount of liquid product to be stored and used.

Once a flexible roof drain system is accepted by a customer, the manufacturer prepares a drawing to help ensure that the drain system is correctly installed. This installation drawing will detail pipe spool pieces (as required) and designate the number of leg guards to be used in the tank.

Once the tank has been prepared, the actual installation of a flexible drain assembly can be accomplished in one to two hours depending upon the drain size and site conditions. This relatively short installation time allows the crew to install and hydrostatically test several flexible roof drains in a single day. •

For more information:
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