

SCOPE

- I ↗ 1.1 This practice covers the layout, spacing and design of dikes of:
- Above ground pressurized storage vessels** designed for 2.5 psig (17 kPa) or greater containing flammable liquids (mounded storage vessels are not included).
 - Atmospheric storage tanks** designed for 2.5 psig (17 kPa) or less and containing flammable or combustible liquids.
 - Refrigerated storage tanks and vessels** designed for 15 psig (103 kPa) or less, storing flammable materials including anhydrous ammonia which have a Reid Vapor Pressure (RVP) above 20 psia (138 kPa).
- I 1.2 An **asterisk (*)** indicates that additional information is required. If a job is contracted, this additional information is furnished in the Job Specification.

SUMMARY OF ADDITIONAL REQUIREMENTS

- S,I *2.1 **Location and spacing of tanks** for storing **liquids which are unstable**, or which have **special safety or fire protection requirements**, shall be approved by the Owner's Engineer before final tankage layout is established. (Examples of such liquids are triethyl aluminum, organic peroxides, and carbon disulfide.)
- I ↗ 2.2 Where **local regulations** cover the spacing and diking requirements for storage vessels or tanks, the more stringent requirements of the local regulations or this practice shall be used.
- S,I ↗ *2.3 The requirements of this practice are based on the application of **firewater systems per IP 3-2-3** for all of the equipment types listed in **Par. 1.1** and the application of **foam systems per IP 3-2-2** for all atmospheric storage tanks.
- I 2.4 **Table 1** lists the practices which shall be used with this practice.

TABLE 1

PRACTICES	
IP 3-2-1	Sewer Systems
IP 3-2-2	Foam Systems for Storage Tanks
IP 3-2-3	Firewater Systems
IP 4-9-1	Site Preparation and Earthwork
API RECOMMENDED PRACTICE	
API RP 2510	Design and Construction of LPG Installations

DEFINITIONS

- I 3.1 **Combustible liquids.** High flash liquids [flash points 100°F (38°C) or higher] when handled at temperatures more than 15°F (8°C) below flash point.
This category includes high flash stocks such as kerosene, some jet fuels, heating oils, heavy fuel oils, lubricating oils, transformer oils, and some asphalts.
- I 3.2 **Critical area**, as used herein, includes process units, utility plants, manifolds, and loading areas located on marine piers, main line railroads, and public waterways.
- I 3.3 **Crude oils** are hydrocarbon mixtures which have not been processed in a refinery. This category also includes other wide boiling range stocks which may boil-over during a tankage fire.
- I 3.4 **Dike** is an earth or concrete wall providing a specified liquid retention capacity.
- I 3.5 **Diversion wall** is an earth or concrete wall which directs spills to a safe and environmentally acceptable disposal area.
- I 3.6 **Flammable liquids.** Low flash liquids [flash point below 100°F (38°C)] and high flash liquids [flash point 100°F (38°C) or higher] when handled at temperatures above or within 15°F (8°C) of their flash points.
This category includes low flash stocks such as gasoline, some jet fuels, and oils stored at temperatures above or within 15°F (8°C) of their flash points. Crude oils are not included.

- I * 3.7 **Floating and fixed roof tanks**, and their equivalents for the purpose of tank spacing and dike retention capacities, as covered by this practice, are defined as follows:

TYPE OF TANKAGE	EQUIVALENCY
a. Floating Roof Tank	- Open top or fixed roof tank containing pontoon, double deck, or similar bulkhead design floating roof approved by the Owner's Engineer. - Fixed roof tank containing an internal floating cover of a type approved by the Owner's Engineer, e.g.: - metal cover using pontoons for flotation - non-metallic cover - combination metallic/non-metallic cover
b. Fixed Roof Tank	- Dome or cone roof tank. - Dome or cone roof tank containing a pan type (i.e., no bulkhead or pontoon for flotation) floating roof (see Note). - Open top tank containing pan type floating roof (see Note).

Note: Relative to **Subpar. b.2. and 3.** above, pan type floating roofs are no longer specified (1) in new construction, or (2) as a new installation in an existing tank.

- I ♦ 3.8 **Freeboard** is the distance between the top of the contained liquid and the top of the dike or toe wall.
- I 3.9 **Grouped tanks** consist of two or more tanks that pose an acceptable risk and conceivably could be lost in a single fire. The collective storage in these tanks may be viewed as being contained in a single tank. The "Dike Arrangement and Capacities" section, below, describes how the grouping of tanks applies to the various materials stored.
- I 3.10 **Net capacity of dikes** is the actual retention capacity within the dike. The capacity of the diked area enclosing more than one tank shall be calculated after deducting the tank displacement of the other tanks below the height of the dike, assuming that the volume occupied by the largest tank is available for retention. Net capacity shall also exclude the volume of the tank ring wall/foundation which is below the dike height for all tanks within the diked area.
- I 3.11 **Paired tanks** consist of two tanks, except where the "extension of pairing principle" applies, as described below in the "Dike Arrangement and Capacities" section.
- I ♦ 3.12 **Remote retention basin** is a diked-in area which provides spill containment capacity for one or more storage vessel(s) and located at a safe distance from the vessel(s). **A remote retention facility** includes the retention basin and any facilities necessary to drain liquid from the vessel(s) to the retention basin.
- I ♦ 3.13 **Single containment vessel (in reference only to refrigerated storage)** is a vessel consisting of one or two shells, but having only one shell designed for containment of the full head of stored product at minimum temperature.
- I 3.14 **Tank diameter:** Where tank spacing is expressed in terms of tank diameter, the following criteria govern:
 - If tanks are in similar services (type of tank and stock), the diameter of the largest tank is used.
 - If tanks are in different services, or different types of tanks are used, the diameter of the tank which requires the greater spacing is used.
- I 3.15 **Toe wall** is a low earth, concrete, or masonry unit curb that has no capacity requirements and is intended to retain small leaks or spills.
- I 3.16 **Vessel** as used in this specification refers to above ground pressurized storage vessels, including spheres, and horizontal and vertical drums containing flammable liquid.
- I 3.17 **Vessel diameter:** Where vessel spacing is expressed in terms of vessel diameter, the diameter of the largest vessel is used. For double walled vessels, the outside shell diameter is used.
- I ♦ 3.18 **Vessel spacing or tank spacing** is the unobstructed distance between vessel or tank shells, or between vessel shells and the nearest edge of adjacent equipment, property lines, or buildings. For double walled vessels, the outside shell diameter is used.

DESIGN

- S ♦ ***4.1** **Diversion walls and sloping of the ground away from vessels to a remotely located retention basin** is permitted, when approved by the Owner's Engineer.
- S,E ♦ **4.2** **Earth, concrete**, masonry, or any combination of these materials are acceptable for dikes and toe walls.
- S,E ♦ **4.3** **All dikes, diversion walls, toe walls**, and spill containment areas shall be **suitable for the static hydraulic and temperature conditions** which may be encountered, and shall be constructed to retain stored stocks and firewater or stormwater by resisting percolation of liquid. **IP 4-9-1** (Site Preparation and Earthwork) shall be used for the acceptable means of dike construction.
- S,E ♦ **4.4** **Piping within diked or toe walled areas** shall be limited to that serving the vessels/tanks in that area. Piping manifolds shall not be located within diked areas. **Piping located between roadways and dikes** shall be provided with crosswalks to facilitate pedestrian traffic from the road to the tank dikes.
- S ♦ ***4.5** **Pumps** shall be located outside the diked area, unless a high flash viscous stock requires the pump to be located within the diked area. The Owner's Engineer shall approve the pump location.
- S ♦ **4.6** **Other equipment**, such as air eliminators, filters and heat exchangers, shall be located outside the diked area.
- S ♦ **4.7** **Where changes in service are specified**, the layout requiring the greater spacing shall govern.
- S,E ♦ **4.8** **Minimum height of dikes and toe walls**, measured from the tank side of the dike or toe wall and based on the material of construction, shall be as follows:

TYPE DIKE	PRESSURE VESSELS AND ATMOSPHERIC TANKS	REFRIGERATED VESSELS
Concrete	1 ft (300 mm)	3 ft (1 m)
Earth	20 in. (500 mm)	3 ft 8 in. (1.2 m)

The earth dike/toe wall minimum height includes freeboard allowance of 8 in. (200 mm). Additional freeboard may be required for earth dikes for soil consolidation.

- S,E ♦ ***4.9** **Maximum height of pressure vessel and atmospheric tank dikes.** Required capacity shall be provided with dikes no higher than 6 ft (2 m), measured outside the dike on the side adjacent to the road or accessway. In the USA, where OSHA regulations apply, the walls of the diked area shall also be restricted to an average height of 6 ft (2 m) above the interior grade. This height does not include freeboard allowance for soil consolidation, which shall be at least 8 in. (200 mm).

Earthen dike walls 3 ft (1 m) or more in height shall have a flat section at the top not less than 2 ft (610 mm) wide. The slope of an earthen wall shall be designed to withstand the fluid pressure and to resist erosion by rain.

When tanks are located on sloping terrain, portions of the dike may exceed these specified limits except for the side adjacent to the road or accessway.

Where layout considerations require **dikes higher than 6 ft (2 m)**, the requirement and dike design shall be approved by the Owner's Engineer and gas detection inside the dike may have to be included in the design.

- S ♦ ***4.10** Unless otherwise specified, **maximum height of refrigerated storage vessel dikes**, as measured from inside or outside the dike, is limited as follows:

- For vessels storing stocks with a molecular weight of 22 or greater, the dike height, shall not exceed 6 ft (2 m).
- For vessels storing stocks with a molecular weight less than 22, the dike height shall not exceed 12 ft (4 m).

- S ♦ **4.11** **Access and egress provisions** shall be as follows:

- At least one stairway shall be provided over earth and concrete dikes, however, at least two stairways shall be provided for concrete dikes 3 ft (1 m) or more high and earth dikes over 6 ft (2 m) high. When two stairways are provided they shall be on opposite sides of the dike enclosure. At least one stairway shall be located near a fire hydrant.
- Enclosures shall be designed to prevent unauthorized access by motor vehicles.
- Additional stairways shall be provided if the escape distance from any point around the tank exceeds 150 ft (45 m).

- S ♦ **4.12** **Grading of diked or toe wall enclosures** shall direct the liquid from a leak in the vessels, tanks or piping to an area within the enclosure that is remote from the vessels and piping. The grading shall prevent small spills from one vessel flowing under any other vessels. Grading shall be at not less than 1-percent slope.