

Engineering Standard

SAES-B-005

30 November, 2003

Spacing and Diking for Atmospheric and Low-Pressure Tanks

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1 Scope

- 1.1 This Standard provides the minimum mandatory requirements for spacing and diking of tanks located onshore and above grade that store or process flammable or combustible liquids at atmospheric and at pressures up to 100 kPa_(ga) (15 psig) and temperatures at or above ambient. Tanks include vertical cylinders with fixed or floating roofs, horizontal cylindrical drums, spheres, spheroids, and any other configuration used for the above purpose and designed per the requirements of [SAES-D-100](#) or [SAES-D-109](#). For refrigerated storage vessels, or for pressure storage vessels designed to store flammable materials per the requirements of SAES-D-001, refer to [SAES-B-057](#).
- 1.2 The requirements of this Standard do not apply to skid-mounted tanks that are temporarily located at wellsites and are directly associated with drilling and workover operations.
- 1.3 Tanks of 190 m³ (50 000 gal) or less capacity and built per [SAES-D-100](#) shall have spacing, remote impounding, or diking in accordance with NFPA 30. Spacing between such tanks and other equipment not specified in NFPA 30 shall conform to [SAES-B-055](#) requirements.

Exception:

Remote impounding or diking of such tanks is not required if they are located in a process area that is provided with industrial oily water sewers or surface drainage to remote impounding per [SAES-S-020](#).

- 1.4 The requirements of this Standard do not apply to fuel tanks under 2500 liters (660 gallons) capacity that provide day-tank fuel supply to portable, skid-mounted, engine-driven rotating equipment, or vehicles.

2 Conflicts and Deviations

- 2.1 Any conflicts between this Standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs) or industry standards, codes and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Loss Prevention Department, Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from this Standard in writing to the Company or Buyer Representative, who shall follow internal company procedure [SAEP-302](#) and forward such requests to the Manager, Loss Prevention Department, Saudi Aramco, Dhahran.

3 References

All referenced Specifications, Standards, Codes, Forms, Drawings, and similar material shall be considered part of this Standard to the extent specified herein and shall be of the latest issue (including all revisions, addenda, and supplements) unless stated otherwise.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

[SAEP-302](#) *Instructions for Obtaining a Waiver of a
Mandatory Saudi Aramco Engineering
Requirement*

Saudi Aramco Engineering Standards

[SAES-B-014](#) *Safety Requirements for Plant and Operations
Support Buildings*

[SAES-B-054](#) *Access, Egress, and Material Handling for Plant
Facilities*

[SAES-B-055](#) *Plant Layout*

[SAES-B-057](#) *Safety Requirements: Refrigerated and Pressure
Storage Vessels*

[SAES-D-100](#) *Atmospheric and Low Pressure Tanks*

[SAES-D-109](#) *Design of Small Tanks*

[SAES-F-007](#) *Flare System Design*

[SAES-S-020](#) *Industrial Drainage and Sewers*

Saudi Aramco Standard Drawing

[AD-036683](#) *Details of Roads and Dike Walls in Tank Farms*

3.2 Industry Codes and Standards

American Petroleum Institute

API STD 620 *Design and Construction of Low-Pressure Storage
Tanks*

API STD 650 *Welded Steel Tanks for Oil Storage*

API STD 2000 *Venting Atmospheric and Low Pressure Storage
Tanks*

National Fire Protection Association

NFPA 30 *Flammable and Combustible Liquids Code*

4 Definitions

Asphalt: Highly viscous residual mixture of paraffinic, aromatic, and heterocyclic hydrocarbons obtained in petroleum refining. For purposes of this Standard, the significant feature of asphalt is that, when heated in its usual cut-back state, it is considered to be a flammable liquid.

Combustible Liquid: A liquid that has a flash point greater than 54°C (130°F). Examples are fluids such as diesel, C₇+ feed stocks, bunker fuel, and sulfur.

Flammable Liquid: A liquid that has a flash point equal to or less than 54°C (130°F). Examples would be fluids such as stabilized crude, gasoline, Jet A-1, Jet JP-4, Jet JP-8, C₆ and lighter feed and blending stocks, and methanol. For purposes of this Standard, a combustible liquid stored or processed at a temperature equal to or higher than 8°C (15°F) below its flashpoint shall be considered to be a flammable liquid.

Flashing Liquid: A flammable liquid with a true vapor pressure greater than 90 kPa_(abs) (13 psia) at 54°C (130°F). Examples are fluids such as "gassy" crude oil, C₅ feed streams, and other products which due to their high vapor pressure cannot be stored in atmospheric storage tanks, not including refrigerated liquids and not including fluids with vapor pressures exceeding 67 kPa_(ga) (10 psig).

Hot Oil: A flammable or combustible liquid stored at a temperature equal to or greater than 90°C (195°F). Examples would be fluids such as the storage of hot diesel or fuel oils for a hot belt tank heating system, emulsion breaking, or viscosity reduction of heater fuels.

Commentary:

The primary hazard with hot oil storage tanks is a froth-over problem in the event that water is admitted to the tank, either due to accident or during emergency response.

Molten Sulfur: Sulfur in the liquid state (119°C to 154°C) produced as a by-product of petroleum production/refining. For the purposes of this Standard, molten sulfur is treated as a combustible liquid.

5 Design

5.1 General Requirements

- 5.1.1 A flashing liquid that has a true vapor pressure higher than 90 kPa_(abs) (13 psia) shall not be stored in a cone roof or a floating roof tank.
- 5.1.2 Flammable liquids other than asphalt or hot oil shall not be stored in cone roof tanks larger than 600 m³ (3775 bbl).
- 5.1.3 Covered or internal floating roof tanks that are designed and constructed in accordance with API STD 650 and vented in accordance with API STD 2000 shall be treated as floating roof tanks for the purpose of spacing.
- 5.1.4 Roof selection for internal and external floating roof tanks shall be in accordance with [SAES-D-100](#). Pan type floating roofs or covers are prohibited.

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- 5.1.5 Horizontal cylindrical tanks shall conform to [SAES-D-100](#), [SAES-D-109](#) as appropriate, and NFPA 30 and shall not exceed 190 m³ (50 000 gal) in capacity.
 - 5.1.6 Vertical tanks and low-pressure spheres or spheroids shall conform to API STD 650 or API STD 620 and other requirements of [SAES-D-100](#) and [SAES-D-109](#).
 - 5.1.7 Roadways, access ramps, and stairways shall be provided in accordance with [SAES-B-054](#).
 - 5.1.8 Tanks and associated equipment shall be located such that they are more than 450 m from any other Saudi Aramco plant or facility or other industrial, commercial, or residential land use, that is at a lower elevation.
 - 5.1.9 A storage tank shall not be supported at an elevation higher than its peripheral dike walls.
 - 5.1.10 A diked area shall contain only that piping that is directly associated with tanks permitted within that diked area. All other piping shall be located outside the diked area and a minimum distance of 7.5 m (25 ft) from any tank in the diked area.
 - 5.1.11 Pumps shall be located per process equipment (see Table 1) with the following exception:
Exception:
A pump serving only one tank or one group of tanks in a common diked area must be located outside the dike and at least 7.5 m from the dike wall.
 - 5.1.12 The minimum distance between a tank and any associated dike wall shall be 3 m (10 ft).
 - 5.1.13 A tank shall be at least 30 m (100 ft) from the edge of any diversion channel or impounding area serving process areas or tanks located in other diked areas.
 - 5.1.14 In addition to the requirements in Table 1, the distance between a tank and a flare shall be governed by the limitations on exposure to flare heat radiation provided in [SAES-F-007](#).
 - 5.1.15 Each tank intended for flammable liquid, flashing liquid, slops, hot oil, sulfur, or asphalt service shall be located so that it is adjacent on at least one side of the tank's dike wall to a road or accessway that would permit access for emergency vehicles during a fire.
 - 5.1.16 Each tank intended for combustible liquids shall be located so that on at least one side, only one other tank or diked area separates it from a road or access way for firefighting.
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5.2 Spacing

5.2.1 For tanks larger than 190 m³ (50 000 gal), the shortest straight-line horizontal distance between the surface of a tank and the facing surface of another tank, process equipment, or structure shall be according to Table 1.

**Table 1 – Minimum Distance Between Two Tanks
 or Between a Tank and other Equipment**

Other Tank Service or Equipment (Note 1)	Service of Tank (>190m ³) Which Has Diameter D (Note 2)			
	Flammable Liquid	Flashing Liquid	Combustible Liquid	Asphalt or Hot Oil
Flammable Liquid	0.75 D	1 D or 30 m	Note 5	Note 7
Flashing Liquid	1 D or 30 m	1 D or 30 m	Note 6	Note 8
Combustible Liquid	Note 5	Note 6	0.5 D	Note 9
Hot Oil or Asphalt	Note 7	Note 8	Note 9	1.5 D
Process Equipment (Notes 3 and 4)	1 D or 60 m	1 D or 30 m	0.5 D or 30 m	1.5 D or 60 m
Building	Note 3	Note 3	Note 3	Note 3
Utility and Support (Note 3)	1.5 D or 60 m	1.5 D or 60 m	0.5 D or 30 m	1.5 D or 60 m
Tankage Area Fence (Note 10)	60 m	60 m	45 m	60 m
Elevated Flare (Note 11)	1 D or 60 m	1.5 D or 60 m	1 D or 30 m	1 D or 60 m
Burn Pit or Ground Flare (Note 11)	150 m	150 m	150 m	150 m

Notes:

- 1 See Section 4 of this Standard for explanations of the headings.
- 2 See Section 5.2 of this Standard for guidelines in applying this table. For vessels under the scope of [SAES-B-057](#), use the spacings found in that Standard.
- 3 See requirements in [SAES-B-055](#) and [SAES-B-014](#).
- 4 The process equipment category is not intended to include flowlines or pipelines.
- 5 0.5 D of the combustible liquid tank or 0.75 D of the flammable liquid tank, whichever is greater.
- 6 0.5 D of the combustible liquid tank or 1 D of the flashing liquid tank, whichever is greater.
- 7 0.75 D of the flammable liquid tank or 1.5 D of the hot oil/asphalt tank, whichever is greater.
- 8 1 D of the flashing liquid tank or 1.5 D of the hot oil/asphalt tank, whichever is greater, but in no case less than 30 m.
- 9 0.5 D of the combustible liquid tank or 1.5 D of the hot oil/asphalt tank, whichever is greater.
- 10 Security spacing requirements may, in some cases, exceed these minimums. Refer to O-series standards.
- 11 See [SAES-B-055](#) and [SAES-F-007](#). Where [SAES-F-007](#) requires greater spacing, that Standard shall govern.

5.2.2 All the relevant spacing requirements and combinations per Table 1 shall be evaluated. For spacing between two tanks, each tank must be considered in turn as the tank of diameter D. In all cases, the greater of the maximum computed distance or the default is the required spacing.

5.2.3 The minimum distance between a tank located inside a common diked area and any other tank located outside that diked area shall be 30 m.

5.3 Diking Requirements

5.3.1 Tanks of over 190 m³ (50 000 gal) capacity shall be located in an area bounded by dike walls. The only break permitted in such walls is an access to a diversion channel intended to direct liquids from the diked area to a remote impounding basin. Tanks of 190 m³ capacity or less shall have diking that meets the requirements of NFPA 30.

5.3.2 Any tank with a capacity in excess of 64 000 m³ (400 000 bbl) shall be individually diked.

5.3.3 Tanks containing asphalt, hot oil, molten sulfur, or slops shall be individually diked.

5.3.4 The arrangement of tanks in a diked area and the minimum capacity of the diked area shall be in accordance with Table 2.

Exception:

Where the minimum retention capacity requirements per Table 2 cannot be met by enclosed individual or common diking, a remote impounding area and associated diversion channel may be provided upon prior approval by the Chief Fire Prevention Engineer.

5.3.4.1 The minimum capacity of a remote impounding area shall be the maximum required retention capacity of any tank in the diked area per Table 2.

5.3.4.2 Remote impounding areas and the system of related diversion channels shall be designed to prevent the overflow of one diked area into another.

Table 2 – Diking Capacity

Service of Tanks (Note 1)	Number of Tanks in Common Diked Area		
	One	Two	Three or More
Flammable Liquid	100%	100% of larger tank	100% of largest tank
Crude or Other Boil-Over Liquid	75%	100% of larger tank	Not Permitted
Hot Oil, Asphalt, Slops	75%	Not Permitted	Not Permitted
Flashing Liquid	100%	100% of larger tank	Not Permitted
Combustible Liquid	25%	50% of larger tank	75 of largest tank

Note 1: See Section 4 of this Standard for explanation of the headings.

- 5.3.5 The retention capacity of a diked area for any one tank shall be estimated by:
- Calculating the gross volume of the diked area.
 - Calculating for the other tanks located in the diked area the total tankage volume that is located below the top of the dike wall.
 - Deducting the total calculated volume in b) from the gross volume of the diked area calculated in a).
- 5.3.6 The rate of flow for design of diversion channels to remote impounding shall be based on the maximum of the following:
- Maximum pumping rate into any tank in the diked area.
 - Flow from the failure of one half of the gasket in any flanged piping joint within the drainage pattern (based on tank storage pressure).
 - Flow from failed tank mixer seal.
 - Fire water flow rate for cooling against the heat from fire at an adjacent tank.
- 5.4 Common Diked Areas
- 5.4.1 All tanks located in a common diked area shall be in the same service.
- 5.4.2 The total capacity of tanks located in a common diked area shall not exceed 64 000 m³ (400 000 bbl).
- 5.5 Dike Design and Construction
- 5.5.1 Dike walls shall be designed and constructed per Saudi Aramco Standard Drawing [AD-036683](#) or shall be of reinforced concrete construction. Dike walls shall be liquid-tight and designed to withstand a full hydrostatic head of water. Any penetrations for piping, conduit, or cable shall be sealed in a manner such that the same tightness and hydraulic requirements are met.
- 5.5.2 The minimum height of dike walls shall be 300 mm. The maximum height shall be 2 m measured from grade on either side of the dike wall.
- 5.5.3 The top of any intermediate wall shall be at least 300 mm below the top of the peripheral dike.
- 5.5.4 Surfaces inside a diked area shall be sloped away from the tank, piping, and other equipment to a single point near the dike wall. The minimum slope shall be 1:65 (1.5%). A drainage system shall be provided in accordance with [SAES-S-020](#).
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5.5.5 Surfaces inside sulfur tank diked areas shall not be asphalt. ||

Revision Summary

30 November, 2003 Revised the "Next Planned Update". Reaffirmed the contents of the document, and reissued with minor changes.