

Engineering Standard

SAES-B-055

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Plant Layout

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Saudi Aramco DeskTop Standards

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1 Scope

This Standard provides minimum spacing requirements for equipment and structures in the design and layout of new plants and expansions or modifications of existing plants.

2 Conflicts and Deviations

- 2.1 Any conflicts between this Standard and other applicable Saudi Aramco Engineering Standards (SAESs), Saudi Aramco Materials System Specifications (SAMSSs), Saudi Aramco 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 of 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 of Saudi Aramco, Dhahran.

3 References

The selection of material and equipment, and the design, construction, maintenance, and repair of equipment and facilities covered by the Standard shall comply with the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

<i>SAEP-302</i>	<i>Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement</i>
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Saudi Aramco Engineering Standards

<i>SAES-B-005</i>	<i>Spacing and Diking for Atmospheric and Low-Pressure Tanks</i>
<i>SAES-B-006</i>	<i>Fireproofing In Onshore Facilities</i>
<i>SAES-B-009</i>	<i>Fire Protection and Safety Requirement for Offshore Production Facilities</i>
<i>SAES-B-014</i>	<i>Safety Requirements for Plant and Operations Support Buildings</i>
<i>SAES-B-054</i>	<i>Access, Egress, and Materials Handling for Plant Facilities</i>

<i>SAES-B-058</i>	<i>Emergency Isolation, Shutdown, and Depressuring</i>
<i>SAES-B-062</i>	<i>Onshore Wellsite Safety</i>
<i>SAES-B-064</i>	<i>Onshore and Nearshore Pipeline Safety</i>
<i>SAES-B-068</i>	<i>Electrical Area Classification</i>
<i>SAES-B-069</i>	<i>Emergency Eyewashes and Showers</i>
<i>SAES-B-070</i>	<i>Bulk Plants</i>
<i>SAES-D-109</i>	<i>Design of Small Tanks</i>
<i>SAES-F-007</i>	<i>System Design Criteria of Flares</i>
<i>SAES-J-502</i>	<i>Analyzer Shelters</i>
<i>SAES-S-020</i>	<i>Industrial Drainage and Sewers</i>
<i>SAES-X-700</i>	<i>Cathodic Protection Onshore Well Casings</i>

Saudi Aramco Standard Drawings

<i>AA-036246</i>	<i>Helipad Onshore 24400 mm x 24400 mm</i>
<i>AA-036247</i>	<i>Windsock Pole OS Helipad or Air Strip</i>
<i>AD-036683</i>	<i>Roads and Earthen Dikes in Tank Farms</i>

4 Design Considerations

4.1 General

Plant layouts for new construction shall provide for a maximum of safety and exposure protection from the spread of fire, with ease of operation and maintenance consistent with economical design. Requirements for future expansion shall be recognized and reasonable allowances made.

4.2 Basic Objectives

The basic objectives of the Spacing Design criteria given in this Standard are as follows:

- 4.2.1 To minimize involvement of adjacent facilities in a fire.
 - 4.2.2 To permit access for fire fighting.
 - 4.2.3 To ensure that critical emergency facilities will be accessible for operators to perform emergency shutdown actions in the event of a fire or explosion.
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- 4.2.4 To segregate high-risk facilities or equipment from less hazardous operations and equipment.
- 4.2.5 To separate continuous ignition sources from probable sources of release of flammable materials.
- 4.2.6 To permit access by plant personnel for normal operation and maintenance of equipment.
- 4.2.7 To avoid danger or nuisance to persons or facilities beyond the adjacent property lines.
- 4.2.8 To ensure site security.
- 4.2.9 To minimize equipment damage from a fire or explosion to the immediate area.

4.3 Spacing Basis

The spacing distances given in this Standard are based on the average type and size plant and storage facility being currently installed by Saudi Aramco. They are recommended minimum figures which will satisfy the above objectives. There will be instances however, when special considerations for a particular plant or local factors will cause deviations from the recommended standards.

4.4 Deviations from Spacing Standard

Any reduction in the spacing distances in this Standard requires compensation for the increased degree of risk. This may be achieved by providing additional safety features such as fireproofing, automatic water spray systems, emergency shutdown facilities or additional fire fighting equipment.

5 Instructions for Use of Spacing Charts and Tables

5.1 Spacing Distances - Where to find

The required minimum spacing distances for buildings and equipment are presented in the Onsite Spacing Chart

(Figure 1) and the Offsite Spacing Chart (Figure 2).

5.2 Spacing Charts - Basic Spacings

For each facility covered in the charts, the basic spacing is given. This basic spacing is the required distance to be maintained between a given facility and other general processing equipment, building or support facility unless a deviation is indicated in the body of the chart. (See paragraph 5.3 for spacing between two facilities). This distance is required to minimize the likelihood of a specific facility becoming involved in fires originating on other equipment, or vice versa. This basic spacing is not normally required between items of equipment in similar services, such as a pump and its spare, or pumps and compressors and their individual drivers.

5.3 Spacing Between Two Facilities

The spacing requirement between two facilities is obtained from Figure 1 or Figure 2 at the inter-section of the appropriate horizontal and vertical columns.

5.4 Reference to Spacing Guides in Appendix

It is essential that the onsite and offsite charts be used in conjunction with the spacing guides provided in Appendix of this standard. These guides are intended to supplement their respective charts with the following information:

5.4.1 Explanation of the basic spacing requirements for each facility. Normally, spacing between facilities will be the larger of the two basic spacings involved.

5.4.2 Explanation of variations from the basic spacing requirements. These explanations are given in the guide for only one of the two facilities involved. Therefore, reference should be made to the write-up for both categories to obtain the reasoning for basic spacing variations.

5.4.3 General remarks on location and spacing for each facility.

5.5 Special Equipment

Gas expansion turbines and hydraulic turbines shall be treated in their spacing similar to compressor or pumps handling flammable fluids.

6 Miscellaneous Onsite Spacing Requirements

6.1 Introduction

It is impractical to include all spacing requirements in Figure 1. For this reason, spacings are established in this section for additional items of equipment where fire prevention or safety spacing is considered to be important. This includes personnel safety items, as well as equipment involved in hydrocarbon releases or providing a source of ignition for such releases.

6.2 Air Intake Locations

Air intakes are required for a number of items of equipment which are normally located in or near plants. Included are internal combustion engines and turbines, air compressors, inert gas generators, forced draft furnaces, buildings (including substations) containing unclassified electrical equipment, and boilers. These equipment items represent an internal source of ignition for any flammable vapors which might have been pulled in with the air, and the potential for internal explosion. For this reason, the locations of air intakes in relation to adjacent equipment must be carefully selected.

Factors to be taken into account include prevailing wind direction, probable horizontal and vertical dispersion patterns, and the degree of hazard which would result from contamination of the air and possible formation of a flammable vapor/air mixture. In instances where air conditioning equipment is utilized for buildings in hydrocarbon processing plants, additional factors for protection of personnel hazards or nuisance from toxic or other vapors shall be applied as follows:

- 6.2.1 For details prescribing design and location of air intakes for buildings situated within plot limits, refer to SAES-B-014.
- 6.2.2 For use of unclassified window type air conditioning units and window type air conditioning units suitable for NEC Class I, Division 2, Group D atmospheres, refer to SAES-B-014.

6.3 Facility Layout and Spacing for Offshore GOSPs

- 6.3.1 Living quarters may not be located on a platform handling crude oil or gas. Living quarters platforms shall be separated from the other platform by a minimum of 45 m.
 - 6.3.2 The tie-in platform with production headers and safety shutoff valves shall be not less than 45 m from the GOSP and/or gas compression platform(s), and preferably 90 degrees from the prevailing wind.
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6.3.3 Diesel engines designed to eliminate sources of ignition (i.e., air start, water cooled exhaust manifold, water injection into exhaust stream) may be situated on a platform handling crude oil or gas, and shall be no less than 7.5 m from the nearest hydrocarbon release point.

6.4 Analyzer Houses

Analyzer houses may be located within the plot-limits of a plant.

The analyzer houses shall be located with free access of 3 m on all sides. For details see SAES-B-014 and SAES-J-502.

6.5 Turbine and Engine Exhausts

Atmospheric exhausts from steam turbines, combustion gas turbines, and internal combustion engines shall be located so that they will not present a hazard to personnel and/or equipment on the same platform or on adjacent working platforms. They shall be at least 3 m higher than any platform or access within a horizontal distance of 7.5 m.

6.6 Exhaust Stacks

The exhaust stack for combustion gas turbines and internal combustion engines shall discharge above the turbine or engine at a level outside the classified electrical area.

Where the turbine or engine is driving a compressor or pump handling flammable fluid, the pump area shall not be enclosed and shall be freely ventilated, and the stack shall be covered by insulation and an outer jacketing impervious to liquids.

6.7 Emergency Eyewashes and Showers

Refer to SAES-B-069.

6.8 Portable Gas Cylinders

Portable gas cylinders are used in some plant areas. They may be supplying for ammonia, nitrogen, hydrogen, etc., and their vulnerability to fire exposure shall be considered in selecting their location within the plant. The following guidelines shall apply:

- 6.8.1 High-risk cylinder installations involving multiple cylinders of flammable or toxic fluids shall be located at the edge of the plant area, 7.5 m from other hydrocarbon equipment. Good access for fire fighting shall be provided. Bulk storage of such cylinders shall be located in a remote offsite area.
- 6.8.2 Lower-risk installations of single cylinders containing flammable material or multiple cylinders of inert gases shall be located at least 7.5 m from high fire risk equipment such as pumps, gas compressors, furnaces, and equipment operating over 315°C. In all instances, cylinders must be adequately chained or supported to avoid the possibility of falling or being knocked over.

6.9 Cathodic Protection

Cathodic protection spacing shall meet the requirements of SAES-X-700.

- 6.10 Windsocks shall be installed at plant facilities handling flammable gases, volatile liquids or toxic materials. These areas include, but are not limited to, GOSPs, gas processing and compression plants, chlorination facilities, bulk plants, production or injection wellsites in populated areas, permanent outdoor storage areas for portable gas cylinders, and near gas flare systems. Windsocks (SAMS 47-947-030-00) shall be mounted where they can be clearly seen from most ground-level points within the plant boundary; mounting shall be on the tops of structures or on a pole per SA Standard Drawing AA-036247 (more than one windsock may be required at a plant site). Windsocks shall also be installed at heliports according to Standard Drawings AA-036246 and AA-036247 and shall be lighted if required for night flights by the Chief Pilot. Windsocks are not required along pipelines except in hydrocarbon pumpstations and major manifolding and scraping stations.

7 Introduction to Offsite Spacing Chart - Figure 2

- 7.1 This chart provides spacing distances for the typical facilities being used by Saudi Aramco. These recommended minimum figures will satisfy the objectives listed in paragraph 4.2. The provisions of paragraph 4.4 shall apply if reductions are made in the spacing requirements.
- 7.2 Since it is impractical to include all offsite spacing requirements in Figure 2, additional spacings for miscellaneous facilities are included in Section 8. Appendix should also be used in conjunction with this chart as outlined in 5.4.

8 Miscellaneous Offsite Spacing Requirements

8.1 GOSP, Bulk Plant, and Storage Facilities

All facilities within the plot-limits shall be located a minimum of 300 meters from major roadways or railroad lines.

8.2 Marine Loading Facilities

No basic spacing of onshore or offshore tanker loading facilities is being established. Normally, the spacing will be dictated by operational and sailing requirements of the tankers being loaded.

8.3 Offshore Platforms

Spacing for the auxiliary platforms associated directly with a GOSP is covered under paragraph 6.3 of this standard, as well as SAES-B-009.

Other offshore platforms are normally unmanned and support no process, separating or storage facilities. Examples are water injection platforms and platforms supporting piping manifolds only. Such platforms shall normally be placed at least 45 m from any platform containing oil and gas separation, processing, handling or storage facilities.

8.4 Electrical Grid Transmission Lines

Spacing between overhead electrical grid transmission lines and pipelines shall be in accordance with SAES-B-064.

The following minimum spacing shall be kept from:

- A) Flares and burn pits - 150 m horizontal.
- B) Major highways - 30 m horizontal.
- C) All items - 9 m vertical.

8.5 Roadways in Plants and Other Facilities

8.5.1 The layout and spacing of roads is of considerable importance in a refinery or other major plants. They provide a means of access for normal maintenance equipment and also for firefighting equipment.

8.5.2 Three types of roads are normally associated with oil processing plants, refineries, and similar facilities.

- A) Primary roads are outside the plant site limits and normally carry general traffic with no restrictions.
- B) Secondary roads are roads which are inside the plant site limits and normally carry general traffic with no restrictions.
- C) Accessways are usually within the plant site limits and restricted to maintenance or emergency vehicles or to the delivery of operational supplies after permission is secured from the plant operator.

8.5.3 The following requirements shall be followed in laying out roadways:

- A) Primary roads should be 8 m wide, with 2 m shoulders on each side and secondary roads should be 7 m wide, with 1.5 m shoulders on each side. For primary and secondary roads the following clear spaces from the edge of the shoulder shall be maintained:
 - 5 m from pipeways or onsite equipment, with barriers placed between road and pipeline, to prevent vehicle/equipment collisions.
 - 7.5 m from high risk equipment such as pumps handling flammable materials, compressors handling flammable gases, equipment operating at over 315°C, and furnaces.
 - 9 m below overhead obstructions, viz: overhead pipeways, electrical transmission lines, and other similar obstructions to heavy transportation equipment.
- B) Accessways should be a minimum of 6.1 m wide. Refer to A1.2.3 for further details.
- C) For roadways in tank farms, refer to SAES-B-054.
- D) For roadways in well site areas, refer to SAES-B-062.

8.6 Residential Housing

Where residential housing facilities, under Saudi Aramco's control are within a distance of 1.5 km of a hydrocarbon processing plant area perimeter fence the facilities shall be preferably located upwind of the prevailing wind direction. The prevailing wind direction applicable to a particular location shall be determined after consultation with the Environmental Protection Department, Environmental Unit.

However, in no case shall such housing be located closer than 500 m of a hydrocarbon processing plant area perimeter fence.

8.7 Restrictions on the Use of Plastic/RTR Tanks and Vessels

8.7.1 The use of tanks and vessels made of thermoplastic resins is prohibited.

8.7.2 Tanks and vessels made of reinforced thermosetting resins (RTR) may in some services be a technically acceptable alternative to steel and may be used with the concurrence of the Chief Fire Prevention Engineer and Supervisor, Piping & Mechanical Unit, Consulting Services Department, with further restrictions as follows:

- A. Small tanks or vessels shall meet SAES-D-109.
- B. All RTR vessels and tanks shall be located a minimum distance of 30 m from any critical piping or equipment. Consideration shall also be made to ensure that these tanks/vessels and any associated loading equipment or tank trucks, will not pose a hazard to other facilities.
- C. Firefighting equipment and emergency procedures that are consistent with the type of chemical being stored or processed shall be provided at each installation.
- D. Unless waived by the Chief Fire Prevention Engineer or his representative, 100% diking of each RTR tank or vessel shall be provided.
- E. Drainage per SAES-S-020 of any diked area to a suitable drain shall be provided.

Revision Summary

15 March 2006 Revised the "Next Planned Update". Reaffirmed the contents of the document and reissued with no other changes.

Appendix – Supplemental Information

A1.1 Scope

The Appendix provides supplemental information to be used in conjunction with the spacings given in Figure 1 and Figure 2 of this Standard.

A1.2 General Onsite Layout

A1.2.1 Facilities Location Guidelines: Within plant plot limits, the locations of major facilities such as control houses, furnaces, compressors, electrical substations, etc., shall be determined in accordance with the spacing standards, with consideration given to proximity of adjoining facilities, location of roadways, prevailing wind direction, site topography, and other similar factors.

A1.2.2 Accessways in Layout-General: The overall layout of the process area shall be designed with accessways for fire fighting, maintenance, and turnaround isolation. The typical rectangular block pattern is recommended for large plants and major complexes. This block layout will provide for at least two approaches to all major process units. All-weather roads should be provided in all instances.

A1.2.3 Accessways in Layout - Specific widths: The following guidelines shall be observed wherever possible in overall plant layouts:

A1.2.3.1 Accessways shall be a minimum edge distance of 6 m to equipment. These preferably should be arranged in rectangular patterns such that the shorter dimension of each subdivision area does not exceed 30 m. This layout arrangement will permit effective fire fighting attack from two opposite sides, with at least one side expected to be available even under emergency conditions. Consideration shall also be given to limiting the longer dimension of each continuous equipment area to 60 m by the inclusion of additional fire fighting accessways.

A1.2.3.2 Provide 7.5 m clear space under overhead pipeways, with or without air cooled heat exchangers above them, if this area is to be considered as fire fighting access from one side of an area subdivision.

A1.2.4 Equipment Stacking: Some equipment stacking may be necessary to effectively utilize plot space, but extensive stacking creates the potential of heavy fire involvement. Thus the following restrictions on this practice shall apply:

A1.2.4.1 Avoid stacking more than three levels of equipment in height. Generally, equipment stacked should basically be in the same service in the normal process flow path (i.e., column overhead condensers and accumulators).

A1.2.4.2 Other equipment shall not be installed directly over any of the following:

- A) Pumps or compressors handling flammable materials.
- B) Air-cooled heat exchangers.
- C) Heat exchangers or drums containing flammable materials at temperatures above 315°C, or above the known autoignition temperatures, if lower.

A1.3 Onsite Spacing - Guide to Figure 1

Commentary Note:

The notation "From A-1, B-1", etc., found in the spacing discussions of various items, refers to the spacing between the equipment with those reference letters in Figure 1 and the particular item being discussed.

A-1 Control Buildings

General: Location shall be separated from any facilities creating an explosion risk and shall be directly accessible by a roadway.

Spacing	Distance, m.	Remarks
Basic	30	Spacing is provided to avoid fire involvement
Blast Resistant	35	Blast resistant construction may be required. Refer to SAES-B-014.
From E-1 T-1	30	Pipeways closer than 30 m from central control houses should be avoided. This spacing may be reduced on one side of the control building only to 15 m minimum, if the lines are all welded and flanges and valves are minimized.

B-1 Satellite Instrument Buildings

General: Location shall be at unit plot-limits, accessible by roadway.

Spacing	Distance, m.	Remarks
Basic	15	Spacing is provided to avoid fire involvement. It also provides a limited degree of protection from explosion. Any explosion significantly damaging the satellite instrument building would also involve associated plant equipment, thus loss of the satellite instrument building would not in itself cause prolonged downtime of the associated plants. Reduced spacing may be allowed for low risk plants handling high-flash stocks at temperatures below their flash points. The electrical area classifications outlined in SAES-B-068 should also be given consideration as they relate to spacing. To avoid need for special pressurization or classified electrical equipment, elevate the building 0.5 m above grade or increase spacing to 30 m from any hydrocarbon equipment except pipeways.
From E-1, T-1	5	Satellite instrument buildings may be closer to pipeways than to general process equipment, provided that the lines are all welded, and flanges and valves are minimized.

C-1 Plant Main Electrical Load Centers or Substations

Spacing	Distance, m.	Remarks
Basic	15	This spacing helps protect electrical equipment from fires or explosions in the plant equipment it is meant to serve. The spacing also assists in meeting the electrical area classification requirements given in SAES-B-068, when elevated 0.5 m above grade.
From T-1	5	Pipeways can be located closer if they do not contain manifolds with extensive flanges or valves.

D-1 Electrical Switchracks Critical to Emergency Shutdown Systems

Spacing	Distance, m.	Remarks
Basic	7.5	To avoid damage in a moderate fire, as it has relatively little resistance to fire exposure. The area classification requirements of SAES-B-068 shall also be met by this equipment.
From F-1	15	Due to the possibility of more severe fires in furnaces where split tubes can occur, additional space is provided to minimize damage to switch equipment.

E-1 Emergency Valves for Shut Off, Snuffing Steam, Water Sprays, Isolation, Etc.

General: Spacing for emergency valves or controls relates to the equipment being protected by the emergency facilities. For example, a shutoff valve for a pump should be located as specified in SAES-B-058, but may be located adjacent to other equipment.

Spacing	Distance, m.	Remarks
Basic	7.5	Provides access to critical valves or controls during emergency situations.
From F-1	15	Additional spacing provided for snuffing steam valve for a furnace.
From U-1	25	Water spray valves provided for pressure storage vessels require additional spacing because of the higher risk associated with pressure storage.

F-1 Furnaces, Heaters and Boilers

General: Furnaces, heaters and boilers present a constant source of ignition to any hydrocarbon release; therefore, their location must be carefully selected. The required location is on the upwind side of a unit, near the plot-limits. Consideration shall be given to adjacent equipment which is potentially hazardous, whether in the same or a nearby unit. The top of the furnace stack shall be at least 3 m higher than any working platform within 60 m horizontally.

Spacing	Distance, m.	Remarks
Basic	15	This spacing separates a constant source of ignition from equipment handling flammable materials. It also provides for reasonable access to emergency valves in case of a furnace split tube.
From D-1 G-1, I-1	7.5	Spacing will minimize damage to equipment in case of a furnace fire or explosion. Reduced spacing provided since there can be no flammable material releases from D-1, and the materials handled by G-1 and I-1 are already above their autoignition temperatures so that furnaces do not represent the primary source of ignition.
From F-1	As Required	If all furnaces shut down together for test and inspection, only normal maintenance spacing is required. Furnaces, which are shut down individually, require 7.5 m spacing if low pressure [less than 690 kPa(ga) operating pressure at coil inlet] and 15 m spacing if high pressure [above 690 kPa(ga) at coil inlet].
From H-1, V-1	25	Greater spacing is required due to potential for large vapor releases.
From M-1	15	As an exception, fuel gas knockout drums may be spaced as close as 7.5 m to their respective furnaces, but outside any furnace spill walls.
From T-1	7.5	As an exception, this spacing does not apply between a furnace and its own individual process and utility lines. This spacing minimizes the involvement of major plant pipeways in furnace fires.

From W-1 5 Spacing provided to minimize damage to equipment in case of a furnace fire or explosion. Equipment higher than 3 m should be spaced 7.5 m from furnaces having liquid in the tubes.

G-1 Compressor and Pump Drivers with High Skin Temperatures

General: This spacing requirement is intended for drivers such as diesel engines, gasoline engines and combustion gas turbines where elevated operating temperatures, develop as a characteristic of the unit, presenting a constant source of ignition for possible hydrocarbon releases. They do not create as positive an ignition source as an open flame in a furnace.

Spacing	Distance, m.	Remarks
Basic	10	Provides spacing from hot surfaces on drivers to equipment handling hydrocarbons.
From F-1 I-1, O-1 P-1, Q-1	7.5	Releases from such equipment will self ignite and driver ignition source is not important. Spacing is based on minimizing damage to the driver from other fire exposure.
From G-1	3	Provides access for operation and maintenance, and fire fighting around associated pump or compressor.
From H-1, J-1	10	As an exception, this spacing does not apply to the particular compressor or pump being driven. Paragraph 6.3.1 (B) applies for diesel engines and Paragraph 6.6 applies for any intern combustion engine.

H-1 Gas Compressors

General: Equipment associated with the compressors, such as air cooled heat exchangers, knockout drums, etc., may be located in the compressor area and need not comply with the 7.5 m spacing to non-associated equipment, provided they do not restrict access for fire fighting and maintenance. However, in such instances, fireproofing shall be in accordance with SAES-B-006. Access to compressors for fire fighting purposes must be maintained on at least two sides of the installation. Compressors handling inert gases or air may be spaced closer to each other than is shown for gas compressors. Air intakes for air compressors must be located in a safe area as discussed in paragraph 6.2 of the standard. Steam or electric motor-driven gas compressors with less than 150 kW drivers may be treated as pumps for spacing and location purposes.

Spacing	Distance, m.	Remarks
Basic	7.5	Spacing provides a degree of protection to expensive compressor equipment from fires or explosions involving adjacent equipment, and vice-versa.
G-1	10	As an exception, spacing does not apply to the driver for the particular compressor being driven. Spacing is based on the driver being a possible ignition source.
H-1	3	Provides access for operation and maintenance, and allows increased fire fighting access between units. Two compressors may be grouped in the same risk area, 7.5 m spacing would be required for fire fighting access on at least two sides in this case.

I-1 Pumps Handling Flammable Materials at Temperatures Above 315°C.

General: Flammable liquid pumps are frequently the source of hydrocarbon leakage. They shall not be placed beneath other equipment such as towers, drums, air-cooled heat exchangers or pipeways, in order to avoid fire involvement of such equipment. They shall also be located clear of overhead obstructions in order that they may be reached by mobile equipment for maintenance operations.

Spacing	Distance, m.	Remarks
Basic	5	Since these flammable liquids are above their autoignition temperatures, they will ignite on release. Added spacing is provided between pumps, with their higher fire frequency, and adjacent high valued equipment. Additional access is also provided for fire fighting purposes.
From F-1	7.5	Furnaces do not represent a primary ignition source. Spacing based on minimizing damage if a release occurs, with a subsequent fire on either piece of equipment.
From I-1	1.5	Spacing allowable for pumps in the same service only. If in different services, even if both are operating at temperatures above 315°C, the basic spacing requirement of 5 m must be met.

J-1 Pumps Handling Flammable Materials at Temperatures Below 315°C.

General: Because of the high leakage potential, flammable liquid pumps should be located away from ignition sources.

Spacing	Distance, m.	Remarks
Basic	3	Spacing minimizes damage in case of fire, by providing clear access for fire fighting. Spacing less than I-1 since pumps operating below autoignition temperature of hydrocarbon do not represent as great fire risk as those operating above autoignition temperature.

K-1 Cooling Towers

General: Spacing requirements are based on dispersion of hydrocarbon vapors carried to cooling tower with return water, due to exchanger leakage. Also, consideration is given to corrosion from water in the exhaust plume. Location of towers in relation to other equipment shall consider these effects.

Spacing	Distance, m.	Remarks
Basic	15	Spacing provides reasonable distance for hydrocarbon vapors released with plume to be dispersed before reaching a source of ignition. Equipment that does not represent a source of ignition and is lower than the cooling tower should be spaced 15 m away.
From High	30	Equipment higher than the cooling tower Equipment shall be spaced a minimum of 30 m away because of impingement of the plume.

L-1 Air Cooled Heat Exchangers

General: Due to the extensive heat transfer surface and type of metals used in those surfaces, air cooled heat exchanger bundles are highly vulnerable to damage within a few minutes under fire exposure. Air cooled heat exchangers shall be located on the opposite side of the plant, away from furnaces, to avoid ignition in case of air cooled heat exchanger leakage. They shall not be located over equipment listed in A1.2.4.2, which may provide a high fire potential.

Also, location over major pipeways with equipment on both sides should be carefully considered and avoided. This is based on limited fire fighting access, and the maintenance difficulties which are introduced. When layout dictates that they be located above major pipeways, then the following requirements shall be applied:

- A) Adequate headroom of at least 3 m shall be provided between the lowest part of the air-cooled heat exchanger and the top of the pipe rack.
- B) Flanges and valves shall be minimized in all hydrocarbon lines below the air-cooled heat exchanger.
- C) The normal horizontal spacing requirements as given in Figure 1 from both the air-cooled heat exchanger and the pipeway must be met.
- D) Access must be provided for mobile equipment used in the removal or replacement of the air-cooled heat exchanger units.
- E) Supports for the air-cooled heat exchanger and pipeway shall be fireproofed if so required by SAES-B-006.

Spacing	Distance, m.	Remarks
Basic	3	Spacing to minimize fire exposure to air-cooled heat exchangers, since they are more vulnerable to fire damage than shell and tube exchangers.
From M-1, R-1, S-1, T-1	-	This equipment can be located beneath air cooled heat exchangers, subject to general requirements.

M-1 Drums

Spacing	Distance, m.	Remarks
Basic	1.5	Spacing is primarily to provide access for operating and maintenance; it also allows some access for fire fighting.

N-1 Towers and Columns

Spacing	Distance, m.	Remarks
Basic	3	This spacing provides access for operation and maintenance, with some additional spacing for fire fighting access.

O-1 Reactors Above 315°C (Internally Insulated)

General: Releases from connections on reactors operating at temperatures above 315°C will be expected to autoignite. Reactors operating at temperatures below 315°C shall be treated as columns for spacing purposes.

Spacing	Distance, m.	Remarks
Basic	7.5	Spacing provides protection to exposed shells, and also provides access for fire fighting. Internally lined reactors are more susceptible to fire damage than unlined vessels.
From L-1	5	An air-cooled heat exchanger fire would not be expected to expose reactor; thus reduced spacing allowed, based upon fire exposure from reactor to fin fan.
From O-1	1.5	Access is provided for operation and maintenance. Reactors in same service may be grouped together for operating efficiency.
From S-1	5	Spacing minimizes damage to structures during a reactor fire, and also provides access for fire fighting, around the base of the reactor. Spacing to equipment within structure must meet individual spacing requirements.

P-1 Reactors Above 315°C (Externally Insulated)

General: Releases from connections on reactors at temperatures above 315°C will be expected to autoignite. Reactors below 315°C may be treated as columns for spacing purposes.

Spacing	Distance, m.	Remarks
Basic	5	Damage to other equipment is minimized by spacing. Spacing takes into account the protection afforded from fires on other equipment by the external insulation. Access for fire fighting is also provided.
From P-1	1.5	Spacing provides access for operation and maintenance. Reactors in same service may be grouped in the same area.

Q-1 Exchangers Operating Above 315°C

General: The spacing requirements for this item apply to any exchanger containing flammable materials above 315°C inlet temperature, where autoignition on release can be expected.

Spacing	Distance, m.	Remarks
Basic	5	Spacing minimizes damage to adjacent equipment and also provides some access for fire fighting. The probability of fire is greater than with exchangers operating below 315°C, where autoignition is unlikely if leakage of process fluid occurs.
From F-1	7.5	Spacing provides for more distance between the exchanger and a furnace, since releases from cold side of exchanger may not autoignite or ignite from hot side flanges of the exchanger.
From Q-1	1	Exchangers which are directly connected by a process stream and operating above 315°C may be spaced as shown. The basic 5 m spacing should be applied to other exchangers.

R-1 Exchangers Operating Below 315°C

General: Spacing not as critical since any flammable materials released will generally be below their autoignition temperatures.

Spacing	Distance, m.	Remarks
Basic	1.5	Primarily provides access for operation and maintenance.
From R-1	1	For exchangers in similar service.

S-1 Main Equipment Structures

General: Spacing to the structure from other equipment is primarily to provide access for maintenance operation and fire fighting, and to minimize exposure to the structure.

T-1 Onsite Pipeways

Spacing	Distance, m.	Remarks
Basic	5	Spacing is primarily provided between pipeways and equipment to allow for operation and maintenance, and to reduce involvement from fires in adjacent equipment. Equipment handling flammables shall not be located under or above onsite pipeways. There is no spacing requirement relative to motor or steam drivers from pipeways.
From J-1	1.5	Same comment on drivers as for I-1. Reduced spacing is permitted to minimize need for extra pipe supports for handling the pump piping on and off the main pipeway.

U-1 Onsite Pressure Storage Vessels

General: Offsite locations for this type of vessel shall be used if not otherwise dictated by process reasons. The inventory of onsite pressure storage shall be held to a minimum. The location of such vessels should be at the unit boundary, at a minimum of 15 m from furnaces and other sources of ignition. This category would basically cover refrigeration or other accumulator vessels of over 40 m³ normal capacity, containing pentane or lighter flammable liquids.

Spacing	Distance, m.	Remarks
Basic	25	Spacing is to minimize exposure to other plant equipment from a potential source of prolonged, severe fire. It also minimizes ignition potential in case of light hydrocarbon release from this equipment.
From U-1	1.5 x Dia.	Provides spacing between vessels for fire fighting operation, and maintenance access.

V-1 Blowdown and Water Disengaging Drums

These spacings are based on blowdown or water disengaging drums which are vented to a flare system.

Spacing	Distance, m.	Remarks
Basic	7.5	This equipment should be located in a separate unit area in order to avoid its involvement in plant fires.

W-1 Equipment Handling Non-Flammables

Spacing	Distance, m.	Remarks
Basic	-	No basic spacing is required for this equipment. However, adequate spacing must be provided for operation and maintenance.
From F-1 I-1, O-1, P-1, Q-1	5	Spacing established to minimize damage to equipment in case of fire in equipment where released materials will normally be ignited.

A1.4 Offsite Spacing-Guide to Figure 2

Commentary Note:

The notation "From A-2, B-2", etc., found in the spacing discussions of various items, refers to the spacing between the equipment with those reference letters in Figure 2 and the particular item being discussed.

A-2 Process Areas

Spacing	Distance, m.	Remarks
Basic	45	Spacing to limit damage to other equipment in case of fire or explosion in process area, and vice-versa.
From A-2	25	Spacing between process areas allows them to be shutdown independently for test and inspection with general area hot work permits. This is based on LPG, NGL, and high-risk type refinery units. For low-pressure crude handling, such as in stabilizer plants and crude distillation plants, this spacing can be reduced to 15 meters. Where a number of process units are integrated into one process area and shutdown together, the internal spacing should be based on operation and maintenance requirements, access for fire fighting, and spacing between fire-risk areas.

B-2 Major Shipping Pump Areas

General: This involves those pumps whose loss would significantly reduce the capability of delivering crude or products to major pipelines or tanker terminals.

Spacing	Distance, m.	Remarks
Basic	45	Spacing allows access for fire fighting and will minimize damage to pumps in case of fire or explosion in other equipment.

C-2 Blending And Booster Pumps

Spacing	Distance, m.	Remarks
Basic	25	Spacing provides protection to pumps from fire or explosion in other equipment, as well as exposure from pump fires.
From G-2, H-2, I-2, J-2	-	Spacing set by risk of pumps to storage tanks. As a minimum, the pumps must be outside the tank dikes.

D-2 Major Offsite Pipeways

General: Piping which interconnects plants, or plants and storage vessels, must be routed such that it will not remain in service through plant areas which are shut down for turnaround. Pipeways must be outside the dikes protecting any product or crude oil storage vessels.

Cross Country Pipelines: Cross-country pipelines outside plant areas, and inside populated areas shall be spaced according to SAES-B-064.

Spacing	Distance, m.	Remarks
Basic	7.5	Spacing provides for minimizing damage to pipeways in the event of a plant fire or explosion in major plant equipment.
From M-2	-	Personnel should be protected from electric shocks per SAES-B-064.
From N-2	15	Added spacing provided to minimize exposures to normally occupied buildings.
From S-2, T-2	15	Spacing is minimum for buried line. A minimum spacing of 60 m is required for aboveground piping.
From U-2	105	Pipelines offer little risk to wells and this spacing is based on exposure from a well blowout fire.

E-2 TEL And TML Facilities

General: This category covers the tetraethyl lead (TEL) and tetramethyl lead (TML) storage in drums or barrels, the induction equipment, and the associated locker and shower facilities.

Spacing	Distance, m.	Remarks
Basic	30	This spacing provides separation from major equipment handling hydrocarbons which could be involved in sustained fires. This will prevent the overheating of TEL and TML, with resulting possible decomposition explosions.

F-2 Loading Racks for LPG

General: Liquefied Petroleum Gas (LPG) loading racks for road tank trucks shall be consolidated at one location at the periphery of the main plant facilities. This location shall be near an access gate (other than main gate), so that traffic through the plant is minimized and high-risk areas are avoided. Refer to SAES-B-070 for further details.

Tank truck loading racks must be provided with adequate space and roadways for safe truck driving and parking, as well as safe access to and from loading racks and weight-scales where included.

Spacing	Distance, m.	Remarks
Basic	60	This spacing allows for dispersion of vapors that may be released at the rack when making or breaking connections, or in case of a loading arm failure. Damage to other equipment in case of a fire at the rack is also minimized, and vice-versa.

G-2 Pressure Storage Vessels

General: This category includes storage vessels (spheres and spheroids, bullets, dome roof tanks, horizontal storage tanks, etc.) that are used to store fluids with a true vapor pressure higher than 90 kPa (abs). Releases from this equipment can result in large vapor clouds. Also, fires associated with such storage are difficult to handle and constitute a high risk of vessel failure with sudden release of the entire vessel contents. These vessels shall be located downslope and downwind from plant areas or other critical facilities or residential areas. There shall be no other equipment inside the diked areas of these vessels, excepting associated piping. The vessel shell shall be at least 15 m inside the dike wall, with the associated pumps at least 7.5 m from outside the dike. Refer to AD-036683.

Spacing	Distance, m.	Remarks
Basic	60	This spacing provides separation from major plant facilities such as processing areas and buildings. This will help to prevent a fire or explosion at the storage vessel to involve other adjacent facilities or personnel at those facilities. Protection is also provided for the pressure storage vessels in case of fire or explosion at other facilities.
From H-2, I-2	60	This distance may be reduced I-2 depending upon the size of the storage vessel. Refer to SAES-B-005.
From J-2	30	Reduced spacing allowed due to nature of stocks in atmospheric storage tanks. Refer to SAES-B-005.

H-2 Atmospheric and Low Pressure Storage of Low-Flash Stocks

General: Low-flash stocks are fluids with true vapor pressure less than 90 kPa(abs) and a flash point under 54°C and any other fluid that may be stored at temperatures above or within 8°C of its flash point. These normally will be floating roof tanks. Tanks shall be placed downslope from plants or other critical facilities or residential areas.

The spacing between the tank shell and the dike shall meet SAES-B-005. Except for associated piping, there shall not be any equipment within the diked area of these tanks.

Spacing	Distance, m.	Remarks
Basic	60	Spacing is based on large tanks and is reasonable to permit containment of a tank fire and keep it from involving other facilities. It will also protect the tanks in case of fires and explosion at other facilities. This is a maximum spacing, it may be reduced. Refer to SAES-B-005.

I-2 Refrigerated Storage

General: Covers low pressure dome roof tanks of up to 17.5 kPa(ga) design pressure which are insulated to handle refrigerated liquified gases of pentane and lighter flammables. Any spillage will pick up heat from the ground and atmosphere and create large flammable vapor clouds. Fires in such facilities are difficult to handle. This storage shall be located downslope and downwind from process areas or other critical facilities or residential areas. The spacing between the tank shell and the dike shall meet SAES-B-005. Equipment other than associated piping shall not be located within diked areas of storage vessels.

Spacing	Distance, m.	Remarks
Basic	60	Spacing is based on large (more than 60 m diameter) refrigerated tanks, and is provided to permit containment of a tank fire to prevent involving other facilities. Also, it minimizes chances of ignition in case of small spills. Protection is also afforded to this tankage in case of fire at other facilities. Spacing may be reduced if the vessels are less than 60 m in diameter. Refer to SAES-B-005.

J-2 Atmospheric Storage of High Flash Stocks

General: High-flash Stocks are fluids having a flash point over 54°C, stored at temperatures more than 8°C below the flash point. Tanks shall be preferably located downslope and down-wind from process areas or other critical facilities or populated areas. Area within dike of storage vessel must be free of all equipment other than associated piping. The spacing between the tank shell and the dike shall meet SAES-B-055.

Spacing	Distance, m.	Remarks
Basic	30	High-flash stocks as defined represent a reduced fire hazard, therefore, a reduced spacing is called for as compared to the low-flash stocks. This spacing primarily provides for avoiding damage to this tankage from fire or explosion in adjacent facilities. Spacing may vary with size of tank. Refer to SAES-B-005.

K-2 Boiler Houses, Power Generating Facilities

General: These facilities are critical to the continued operation of the plant or refinery. They represent constant sources of ignition for any hydrocarbon releases from plant process areas. They shall, therefore, be placed away from process areas as far as possible, consistent with operating demands.

Spacing	Distance, m.	Remarks
Basic	45	Spacing provides protection for these critical facilities from possible fire or explosion in equipment handling hydrocarbons. Steam generators which supply less than 25% of the total steam demand for a refinery or other multiplant facility, or which supply steam only to a particular plant within that facility, may be located nearer operating equipment with spacing as for furnaces.
From N-2	30	Reduced spacing allowed since boiler and generating stations constitute only a minor risk to these type facilities. Conversely, N-2 facilities do not represent a hazard to boilers or generating facilities.
From P-2	45	Spacing may be reduced to 30 m if the adjoining property has only buildings or other facilities affording little risk to the boiler plant/generating facilities.

L-2 Major Electrical Distribution Centers

General: These facilities are considered critical to the operation of multi-plant facilities. As a minimum, they shall be placed in a nonclassified electrical area, as defined in SAES-B-068.

Spacing	Distance, m.	Remarks
Basic	45	Spacing to protect this critical equipment from potential fire or explosion in equipment processing or handling hydrocarbons. Loss of electrical centers would result in shutdown of major plants of the facility.

M-2 Main Overhead Power Lines

General: These are normally high voltage power lines and they shall be routed away from process areas and tank farms. These power lines are critical to operations and should be protected from fires or explosions in other facilities, as these could cause a failure of the main electrical supply.

Spacing	Distance, m.	Remarks
Basic	60	Minimum spacing to provide protection from fires or explosions in operating equipment or tankage.
From D-2	-	Personnel should be protected from electric shocks per SAES-B-064.

N-2 Buildings (Main Office, Workshops, Laboratories, Firehouses, Etc.)

General: These facilities represent essentially no exposure to other facilities. Spacing is primarily to protect personnel in these buildings from fires or explosions in equipment handling or storing hydrocarbons. In addition, refer to the requirements of SAES-B-014.

Spacing	Distance, m.	Remarks
Basic	45	Spacing to provide protection to buildings and personnel from possible fire or explosion in major equipment.
From A-2, B-2, F-2, G-2, H-2, I-2	60	Additional spacing is provided from these higher risk facilities, mainly for personnel protection.

O-2 Main Fire Pumps

General: These pumps may well represent the difference between minor damage by fire or explosion and the loss of an entire process unit or plant or tankage area.

Spacing	Distance, m.	Remarks
Basic	45	This spacing is to prevent the main fire pumps from becoming involved in a fire or explosion occurring in major plant hydrocarbon handling equipment. Special purpose fire pumps, such as those for special risk protection systems, may be spaced closer to facilities not being protected by this system.
From Q-2	15	Reduced spacing permitted since exposure to fire pumps can be controlled.

P-2 Property Lines

General: Spacing from property lines is primarily provided to minimize the exposure of others to damage from a fire or explosion within the plant itself. Its application must be considered on the basis of the associated exposures.

Spacing	Distance, m.	Remarks
Basic	60	Spacing provides protection between plant facilities and the nearest point which may be built upon or traveled by others. It also provides protection to plant equipment, regardless of the occupancy that may develop in the future on adjacent property.
From J-2	45	Reduced spacing is permitted based upon the small fire risk involved.
From L-2 N-2, O-2	-	Minimum operational and maintenance access spacing is acceptable if the facilities on adjoining property are of the low risk type. Greater spacing should be used if process plants, storage tanks or other similar risks are located adjacent to the property line. In these cases, spacing similar to internal plant requirement shall be used.

Q-2 Fire Training Ground

Spacing	Distance, m.	Remarks
Basic	45	Spacing provides separation of the source of ignition of the training ground from equipment handling hydrocarbons. It also allows for dispersal of the smoke produced, thus minimizing the effect on personnel in the plant areas.
From D-2	15	Increased spacing for pipebands is provided in view of regular spill fires on training grounds.

R-2 Oil-Water Separators And Skimming Ponds

General: This relates to spacing to facilities unassociated with the oil-water separator or skim pond. Spacing within the facility to pumps, small sloop tanks or treating facilities would be developed specifically.

Spacing	Distance, m.	Remarks
Basic	45	Spacing provides separation from operating areas and other sources of ignition, to prevent hydrocarbon vapors discharged at the separator from igniting. It also minimizes exposure from fires at the separators. Spacing may be reduced to low risk facilities that do not represent a source of ignition, or where exposure risk is minimal.

S-2 Elevated Flare

General: The design basis for spacing has to take into account the amount of heat liberated at the flare and the amount of heat that can be tolerated by personnel and equipment for various situations. The spacings given in Figure 2 are basic minimums, the actual spacings used shall be those resulting from design calculation on the particular flare under consideration. Basic information required for these calculations include: Type of gas being flared, heat release of burned gas, exit velocity of gas, proposed height of flare stack and height of adjacent equipment. Refer to SAES-F-007 for details.

A flare is considered to be elevated when its height is more than 15 m.

Spacing	Distance, m.	Remarks
Basic	60	Spacing is nominally based on the radius of fallout of entrained liquid or solid particles (from flare to ignitable materials). Radiant heat factor to personnel and equipment must also be considered in design calculations.
From D-2	15	Reduced spacing for buried lines. Distance shall be at least 60 m from aboveground lines, unless radiant heat calculations indicate that additional spacing is necessary.

Additional Offshore GOSP Flare Requirements: Flares shall be located in the southwest quadrant, 90 degrees from a downwind direction of the GOSP. Where there is a submarine line from the platform to the flare structure, a minimum distance of 550 m is required to reduce the effect of released hydrocarbon liquid.

T-2 Burn Pits and Ground Flares

General: These spacings are bare minimums. They are primarily intended to reduce the effects of smoke on personnel and equipment in nearby facilities and on residential or public areas. The radiant heat effects on personnel and equipment must be included in spacing calculations, as required by SAES-F-007. A burnpit shall cover an area not larger than 1000 m².

Spacing	Distance, m.	Remarks
Basic	150	Basically provides for dispersal of smoke from flares or burn pits. Radiant heat effects must be considered also, as well as prevailing wind conditions.
From D-2	15	Minimum spacing from buried lines. Spacing for aboveground lines shall be at least 150 meters from ground flares and 60 meters from burn pits unless radiant heat calculations indicate otherwise.

Onshore GOSP Flare Location Requirements

The basic spacings given in Figure 2 are generally bare minimums. Actual spacings shall be calculated based on radiant heat effects on personnel and adjacent equipment. The reliability of the flare lightoff system and the possible exposure of adjacent equipment and personnel due to unignited releases during start-up shall also be considered.

In the absence of calculations, the following spacings shall be used as minimums for ground flares:

- A) 450 m from producing oil/gas wells.
- B) 150 m from offsite pipeways, unless buried lines.
- C) 450 m from plot-limits of GOSP.
- D) 450 m from major public roadways. The flare should be located such that glare from it does not interfere with the night vision of vehicle drivers on the GOSP access road, or nearby public roads.

The following minimum spacings to burn pits shall be observed, unless calculations indicate otherwise:

- A) 150 m from GOSP plot-limits.
- B) 150 m from overhead electrical transmission lines.
- C) 90 m from the GOSP ground flare.
- D) 60 m from above ground oil/gas lines.
- E) 15 m from buried oil/gas lines.

U-2 Oil/Gas Wells

General: For wells in populated areas the standard SAES-B-062 applies.

The basic spacings given in Figures 2 shall be used as minimum spacing requirements in the absence of detailed design reviews and hazard assessments.

Spacing	Distance, m.	Remarks
Basic	450	Under normal conditions, this minimum spacing should prevent ignition of an oil/gas well blowout release by another facility. Flares and burnpits of plants or GOSPs should be located 90 degrees to downwind of any oil/gas well.
From M-2	200	Power transmission line is not considered a likely source of ignition, and low exposure risk from well blowout to transmission line allows reduction in basic spacing.
From D-2, R-2	105	Lack of ignition source and low relative degree of exposure risk allows reduction in basic spacing.

V-2 Residential Areas, Main Office Building

General: Residential areas should be kept free of hazards due to oil and gas handling installations. See paragraph 8.6.

Spacing	Distance, m.	Remarks
Basic	500	Under normal weather conditions, this minimum spacing from a hydrocarbon processing plant area perimeter fence should prevent a residential area or main office building from getting involved in hazards caused by oil and gas handling installations.
From D-2	-	Standard SAES-B-064 applies.
From U-2	-	Standard SAES-B-062 applies.

A2.1 Scope

Appendix 2 provides a conversion table of the SI-unit numbers used in this standard to American/English-unit numbers.

A2.2 Conversion Table

SI-unit	American unit	SI unit	American unit
meter	foot	kilometer	Mile
m	ft	km	mi
0.5	2	1.5	1.0
1	3	°C	°F
1.5	5	°C	°F
2	6	54	130
3	10	315	600
5	15	-8	+15
6	20	m ²	ft ²
7	22	m ²	ft ²
7.5	25	1000	10 000
8	26	cubic meter	gallon
9	30	m ³	gl
10	35	40	10 000
15	50	kilowatt	horsepower
25	75	kW	HP
30	100	150	200
45	150	kilopascal(ga)	pounds/inch ² (ga)

60	200	kPa(ga)	psig
90	300	17.5	3.5
150	500	690	100
450	1500	kilopascal	pounds/inch ²
550	1800	(abs)	(abs)
		kPa (abs)	psia
		90	13

Figure 1 - Onsite Spacing Chart

KEY:
 A: Provide spacing based on access for operation and maintenance.
 B: As required, see Appendix.
 C: One and a half times diameter of the largest tank.

Note: This chart gives basic minimum spacings and must be used only in conjunction with the Onsite Spacing Guide for Figure 1. **BASIC SPACING** (far left-hand column) is the distance to be maintained if not indicated in the chart.

Basic Spacing	FACILITY	Reference Letter	FACILITY	Reference Letter
30	Control Buildings	A-1	Control Buildings	A-1
16	Satellite Instrument Buildings	B-1	Satellite Instrument Buildings	B-1
15	Plant Electrical Load Centers or Substations	C-1	Plant Electrical Load Centers or Substations	C-1
7.5	Critical Electrical Switchracks	D-1	Critical Electrical Switchracks	D-1
7.5	Emergency Valves for Shutoff, Isolation, etc.	E-1	Emergency Valves for Shutoff, Isolation, etc.	E-1
15	Furnaces, Heaters, and Boilers	F-1	Furnaces, Heaters, and Boilers	F-1
10	Compressor/Pump Drivers with High Skin Temp.	G-1	Compressor/Pump Drivers with High Skin Temp.	G-1
7.5	Gas Compressors	H-1	Gas Compressors	H-1
5	Pumps above 315°C	I-1	Pumps above 315°C	I-1
3	Pumps Handling Flammable Materials	J-1	Pumps Handling Flammable Materials	J-1
15	Cooling Towers	K-1	Cooling Towers	K-1
3	Air Cooled Heat Exchangers	L-1	Air Cooled Heat Exchangers	L-1
1.5	Drums	M-1	Drums	M-1
3	Towers and Columns	N-1	Towers and Columns	N-1
7.5	Reactors above 315°C (internally insulated)	O-1	Reactors above 315°C (internally insulated)	O-1
5	Reactors above 315°C (externally insulated)	P-1	Reactors above 315°C (externally insulated)	P-1
5	Exchangers Operating above 315°C	Q-1	Exchangers Operating above 315°C	Q-1
1.5	Exchangers Operating below 315°C	R-1	Exchangers Operating below 315°C	R-1
B	Main Equipment Structures	S-1	Main Equipment Structures	S-1
5	Onsite Pipeways	T-1	Onsite Pipeways	T-1
25	Onsite Pressure Storage Vessels	U-1	Onsite Pressure Storage Vessels	U-1
7.5	Blowdown and Water Disengaging Drums	V-1	Blowdown and Water Disengaging Drums	V-1
A	Equipment Handling Non-Flammables	W-1	Equipment Handling Non-Flammables	W-1
	Control Buildings	A-1	Control Buildings	A-1
	Satellite Instrument Buildings	B-1	Satellite Instrument Buildings	B-1
	Plant Electrical Load Centers or Substations	C-1	Plant Electrical Load Centers or Substations	C-1
	Critical Electrical Switchracks	D-1	Critical Electrical Switchracks	D-1
	Emergency Valves for Shutoff, Isolation, etc.	E-1	Emergency Valves for Shutoff, Isolation, etc.	E-1
	Furnaces, Heaters, and Boilers	F-1	Furnaces, Heaters, and Boilers	F-1
	Compressor/Pump Drivers with High Skin Temp.	G-1	Compressor/Pump Drivers with High Skin Temp.	G-1
	Gas Compressors	H-1	Gas Compressors	H-1
	Pumps above 315°C	I-1	Pumps above 315°C	I-1
	Pumps Handling Flammable Materials	J-1	Pumps Handling Flammable Materials	J-1
	Cooling Towers	K-1	Cooling Towers	K-1
	Air Cooled Heat Exchangers	L-1	Air Cooled Heat Exchangers	L-1
	Drums	M-1	Drums	M-1
	Towers and Columns	N-1	Towers and Columns	N-1
	Reactors above 315°C (internally insulated)	O-1	Reactors above 315°C (internally insulated)	O-1
	Reactors above 315°C (externally insulated)	P-1	Reactors above 315°C (externally insulated)	P-1
	Exchangers Operating above 315°C	Q-1	Exchangers Operating above 315°C	Q-1
	Exchangers Operating below 315°C	R-1	Exchangers Operating below 315°C	R-1
	Main Equipment Structures	S-1	Main Equipment Structures	S-1
	Onsite Pipeways	T-1	Onsite Pipeways	T-1
	Onsite Pressure Storage Vessels	U-1	Onsite Pressure Storage Vessels	U-1
	Blowdown and Water Disengaging Drums	V-1	Blowdown and Water Disengaging Drums	V-1
	Equipment Handling Non-Flammables	W-1	Equipment Handling Non-Flammables	W-1
	Control Buildings	A-1	Control Buildings	A-1
	Satellite Instrument Buildings	B-1	Satellite Instrument Buildings	B-1
	Plant Electrical Load Centers or Substations	C-1	Plant Electrical Load Centers or Substations	C-1
	Critical Electrical Switchracks	D-1	Critical Electrical Switchracks	D-1
	Emergency Valves for Shutoff, Isolation, etc.	E-1	Emergency Valves for Shutoff, Isolation, etc.	E-1
	Furnaces, Heaters, and Boilers	F-1	Furnaces, Heaters, and Boilers	F-1
	Compressor/Pump Drivers with High Skin Temp.	G-1	Compressor/Pump Drivers with High Skin Temp.	G-1
	Gas Compressors	H-1	Gas Compressors	H-1
	Pumps above 315°C	I-1	Pumps above 315°C	I-1
	Pumps Handling Flammable Materials	J-1	Pumps Handling Flammable Materials	J-1
	Cooling Towers	K-1	Cooling Towers	K-1
	Air Cooled Heat Exchangers	L-1	Air Cooled Heat Exchangers	L-1
	Drums	M-1	Drums	M-1
	Towers and Columns	N-1	Towers and Columns	N-1
	Reactors above 315°C (internally insulated)	O-1	Reactors above 315°C (internally insulated)	O-1
	Reactors above 315°C (externally insulated)	P-1	Reactors above 315°C (externally insulated)	P-1
	Exchangers Operating above 315°C	Q-1	Exchangers Operating above 315°C	Q-1
	Exchangers Operating below 315°C	R-1	Exchangers Operating below 315°C	R-1
	Main Equipment Structures	S-1	Main Equipment Structures	S-1
	Onsite Pipeways	T-1	Onsite Pipeways	T-1
	Onsite Pressure Storage Vessels	U-1	Onsite Pressure Storage Vessels	U-1
	Blowdown and Water Disengaging Drums	V-1	Blowdown and Water Disengaging Drums	V-1
	Equipment Handling Non-Flammables	W-1	Equipment Handling Non-Flammables	W-1

All Distances are in meters

Figure 2 - Offsite Spacing Chart

KEY:
 W: See SAES-B-064.
 X: Provide separation based on access for operation and maintenance.
 Y: As required, see Appendix.
 Z: See SAES-B-005 when applicable.
Note: This chart gives basic minimum spacings and must be used only in conjunction with the Offsite Spacing Guide for Figure 2. **BASIC SPACING** (far left hand column) is the distance to be maintained if not indicated in the chart.

Basic Spacing	FACILITY	Reference Letter	FACILITY	Reference Letter
45	Process Areas	A-2	Residential Areas, Main Office Buildings	V-2
45	Major Shipping Pump Areas	B-2	Oil / Gas Wells	U-2
25	Blending and Booster Pumps	C-2	Burn Pits and Ground Flares	T-2
7.5	Major Offsite Pipeways	D-2	Elevated Flare Stacks	S-2
30	TEL and TML Facilities	E-2	Oil-Water Separators and Skimming Ponds	R-2
60	Loading Racks for LPG	F-2	Fire Training Grounds	Q-2
60	Pressure Storage Vessels	G-2	Property Lines	P-2
60	Atmospheric Storage of Low-Flash Stocks	H-2	Main Fire Pumps	O-2
60	Refrigerated Storage	I-2	Buildings, Shops, Labs, Firehouses	N-2
30	Atmospheric Storage of High-Flash Stocks	J-2	Main Overhead Power Lines	M-2
45	Boiler Houses, Power Generating Facilities	K-2	Major Electrical Distribution Centers	L-2
45	Major Electrical Distribution Centers	L-2	Boiler Houses, Power Generating Facilities	K-2
60	Main Overhead Power Lines	M-2	Atmospheric Storage of High-Flash Stocks	J-2
45	Buildings, Shops, Labs, Firehouses	N-2	Refrigerated Storage	I-2
45	Main Fire Pumps	O-2	Atmospheric Storage of Low-Flash Stocks	H-2
60	Property Lines	P-2	Pressure Storage Vessels	G-2
45	Fire Training Grounds	Q-2	Loading Racks for LPG	F-2
45	Oil-Water Separators and Skimming Ponds	R-2	TEL and TML Facilities	E-2
60	Elevated Flare Stacks	S-2	Major Offsite Pipeways	D-2
150	Burn Pits and Ground Flares	T-2	Blending and Booster Pumps	C-2
450	Oil / Gas Wells	U-2	Major Shipping Pump Areas	B-2
500	Residential Areas, Main Office Buildings	V-2	Process Areas	A-2

All Distances are in meters