

Engineering Standard

SAES-S-020

30 November 2002

Industrial Drainage and Sewers

Plumbing and Utilities Standards Committee Members

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Saudi Aramco DeskTop Standards

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1 Scope

- 1.1 This Saudi Aramco Engineering Standard sets forth the minimum requirements for industrial drainage and sewer systems in the following Saudi Aramco onshore and offshore facilities.
 - a) Areas involved in the processing or handling of hydrocarbons and their derivatives.
 - b) Oil-filled transformer areas.
- 1.2 This standard does not apply to sanitary sewer systems and pressure sewer systems.
- 1.3 This standard does not cover the treatment of industrial drainage and sewerage, nor does it cover the use and disposal of oily waste sludge. These are specified in SAES-A-104.

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, Consulting Services 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, Consulting Services 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 this standard shall comply with the latest edition of the references listed below unless otherwise noted.

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-A-100	<i>Survey Coordinates and Datums</i>
SAES-A-102	<i>Ambient Air Quality and Source Emission Standards</i>
SAES-A-103	<i>Discharges to the Marine Environment</i>
SAES-A-104	<i>Wastewater Treatment, Reuse and Disposal</i>
SAES-A-112	<i>Meteorological and Seismic Design Data</i>
SAES-B-005	<i>Spacing and Diking for Atmospheric and Low-Pressure Tanks</i>
SAES-B-006	<i>Fireproofing in Onshore Facilities</i>
SAES-B-009	<i>Fire Protection and Safety Requirements for Offshore Production Facilities</i>
SAES-B-017	<i>Fire Water System Design</i>
SAES-B-055	<i>Plant Layout</i>
SAES-B-068	<i>Electrical Area Classification</i>
SAES-B-070	<i>Bulk Plants and Air Fueling Operations</i>
SAES-G-005	<i>Centrifugal Pumps</i>
SAES-H-002	<i>Internal and External Coatings for Steel Pipelines and Piping</i>
SAES-H-003	<i>Coating Requirements for Concrete Surfaces</i>
SAES-H-101	<i>Approved Protective Coating Systems</i>
SAES-L-001	<i>Basic Criteria for Piping Systems</i>
SAES-L-005	<i>Piping Materials Specifications</i>
SAES-L-032	<i>Material Selection of Piping Systems</i>
SAES-L-050	<i>Construction Requirements for Metallic Plant Piping</i>
SAES-L-060	<i>Nonmetallic Piping</i>
SAES-P-100	<i>Basic Power System Design Criteria</i>
SAES-Q-001	<i>Criteria for Design and Construction of Concrete Structures</i>
SAES-Q-005	<i>Concrete Foundations</i>
SAES-S-010	<i>Sanitary Sewers</i>

<i>SAES-S-030</i>	<i>Storm Water Drainage Systems</i>
<i>SAES-S-060</i>	<i>Saudi Aramco Plumbing Code</i>
<i>SAES-S-070</i>	<i>Installation of Utility Piping Systems</i>
<i>SAES-X-600</i>	<i>Cathodic Protection of Plant Facilities</i>

Saudi Aramco Materials System Specifications

<i>01-SAMSS-034</i>	<i>RTR (Fiberglass) Pressure Pipe and Fittings</i>
<i>09-SAMSS-106</i>	<i>Epoxy Coating of Steel Reinforcing Bars</i>

Saudi Aramco Standard Drawings

<i>AE-036038</i>	<i>Funnel with 1/2" to 2" Pipe Connections</i>
<i>AB-036054</i>	<i>Oily Water Sewer Manholes</i>
<i>AC-036078</i>	<i>Cast Iron Catch Basin</i>
<i>AB-036402</i>	<i>Cast Iron Catch Basin with Side Inlets</i>
<i>AB-036964</i>	<i>Cast Iron Catch Basin (for Refinery Use)</i>

3.2 Industry Codes and Standards

American Petroleum Institute

<i>API SPEC 5L</i>	<i>Specification for Line Pipe</i>
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American Society for Testing and Materials

<i>ASTM A53</i>	<i>Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless</i>
<i>ASTM A74</i>	<i>Cast Iron Soil Pipe and Fittings</i>
<i>ASTM A377</i>	<i>Ductile Iron Pressure Pipe</i>
<i>ASTM A746</i>	<i>Ductile Iron Gravity Sewer Pipe</i>
<i>ASTM D3350</i>	<i>Polyethylene Plastics Pipe and Fittings</i>
<i>ASTM F714</i>	<i>Polyethylene Plastic Pipe, Based on Outside Diameter</i>
<i>ASTM F1248</i>	<i>Environmental stress Crack Resistance of Polyethylene Pipe</i>

International Organization for Standardization

<i>ISO 2531</i>	<i>Ductile Iron Pipes, Fittings and Accessories for Pressure Pipelines</i>
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National Electric Code

NEC

National Electric Code

National Fire Protection Association

NFPA 30

Flammable Liquids Code

4 Design

4.1 Definitions

Air Gap: An air gap is the unobstructed vertical distance through the free atmosphere from the lowest opening from any pipe, equipment, or appurtenance conveying waste to the flood level rim of the receptor. Air gap shall be a minimum of 25 mm and shall not exceed 100 mm.

Catch Basin: A device with an integral sediment trap and outlet liquid seal for the collection of surface runoff and effluent (grate at top).

Cleanout: A resealable port that allows for the inspection and cleaning of piping within sewer systems.

Drain: An outlet pipe that collects product waste and effluents from points such as pump bases, drain points, vessel drains, or other equipment, and discharges those effluents through a sealed connection at a catch basin, or through a sealed connection at a manhole, into the sewer system.

Effluent: Liquid industrial waste, or spillage, process flow releases, cooling water, firewater, or storm water that enters and passes through a sewer system.

Force Main: A discharge pipe that is in full flow condition and that extends from a lift station carrying sewage under pressure.

Invert: The lowest point of the internal surface of a sewer or open channel at any cross section.

Lateral: A branch of sewer piping that collects effluent from two or more sublaterals, and discharges them into a submain, or main.

Lift Station: A facility to pump effluent from a sump to a point of higher elevation, which may be either in the sewer system or at a disposal facility.

Main: It is the central branch for one or more sewer piping networks. Effluents from all of the submains, within these piping networks, are emptied into the main through branch connections along its length of piping. A main may run through or around plot areas to an off-plot ponding area, disposal facility, or lift station.

Manhole: A device on the sewer lines not designed for the collection of surface water (solid cover at the top). It permits changes of direction, diameter and slope of sewer; also provides access and maintenance to sewer.

Manned Platform: As defined in SAES-B-009.

Off Plot: Any area outside of plot limits. Off plot can include plant areas such as roads, pipeways and open lots between plant units. Refer to SAES-L-001.

Oily Water Sewer System: A system that removes surface runoffs and effluents from process areas within a plot limit to a disposal facility, or off-plot ponding area. It operates either by gravity or pumping force. This sewer system consists of catch basins, manholes, and a network of sewer piping consisting of sublaterals, laterals, submains and mains.

Open Channel: A continuous trench (gutter) that directs effluent to an impounding area.

Plant: One or more plot areas. Refer also to SAES-L-001.

Plot: An individual process area made up of one or more risk areas. See SAES-L-001 also.

Pressure Sewer: It is a closed sewer system which removes hydrocarbons or oily water effluents directly from pressure vessels, process piping, valves, etc., to a disposal facility, such as blowdown drum, three-phase separator, burnpit, etc. Pressure sewer systems are outside the scope of this standard. It shall be considered as hydrocarbon process piping and shall be designed in accordance with appropriate piping standards.

Risk Area: see SAES-B-017 for onshore facilities and SAES-B-009 for offshore facilities.

Sewer: A sewer is a system of vessels and a piping network used to collect and transport effluents, such as oily water, spillage from hydrocarbon processing units, and rainwater runoff within a plot limit area, to a final disposal facility.

Sublateral: A sublateral is a branch of the sewer piping network, which conveys effluent from a single catch basin to a run of piping called the lateral branch of the sewer piping system, or serves several drains that tie directly through a sealed connection at a catch basin, or through a sealed connection at a manhole, and shall have a minimum nominal pipe diameter of 200 mm (8 inch.).

Submain: A submain is a branch of a sewer-piping network that connects sublateral and lateral branches of sewer piping. Submains are subsequently connected to the main branch of sewer piping network.

Sewer Piping Network: A network of sewer piping consisting of sublaterals, laterals, submains, and mains.

Toe Wall: A raised curb that controls and directs effluent to a catch basin.

Unmanned Platform: An unmanned platform is either a single or a continuous complex of offshore platforms, upon which operators are not present on a continuous basis.

4.2 General Requirements

- 4.2.1 Except as may be permitted in Paragraphs 4.2.2 and 4.2.3, all plot areas in hydrocarbon plants shall be equipped with an oily water sewer system for the safe removal of effluent from process areas.
- 4.2.2 Where an oily water sewer system is neither justified nor desirable, a storm surface drainage system shall be provided. Approval to use a storm surface drainage system shall be obtained from the Chief Fire Prevention Engineer, Loss Prevention Department, Dhahran with the concurrence of the Proponent Department Manager. The design shall be in accordance with SAES-S-030 and Section 4.3 of this standard and with other details as specified by the Manager, Consulting Services Department.
- 4.2.3 When new increments are added to a facility that has only surface drainage, the new increments shall incorporate an oily water sewer system in accordance with this standard, unless waived per Paragraph 4.2.2.
- 4.2.4 A pressure sewer system shall be provided where flammable liquids, as defined in SAES-B-006, Section 4, are expected. It shall be considered as hydrocarbon process piping and shall be designed in accordance with appropriate piping standards.
- 4.2.5 Any surface drainage flows, liquid industrial waste or spillage, or process flow releases from one risk area, shall not affect any other areas.
- 4.2.6 Effluent shall not stand in open ponds, ditches, or trenches in plant areas. Solid matter carried with the effluent shall be trapped as close as possible to the source. The surface slope of trenches to catch basins or a disposal point as agreed upon by Chief Fire Prevention Engineer, shall be not less than 1:65 (1.5%).
- 4.2.7 All sewer and drain systems shall be identified on plant drawings in accordance with SAES-A-100, "Survey Coordinates and Datum."
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Inverts and locations of seals, vents, and cleanouts shall be shown on the design drawings.

- 4.2.8 Sewer systems shall not be located in areas where their access for any modification or maintenance purpose is made difficult, such as under foundations, bases, or slabs. Sewer piping at road crossings shall be installed in accordance with SAES-S-070.
 - 4.2.9 Sewer piping shall not be located under buildings, except as may be permitted in Paragraph 4.8.4 of this standard.
 - 4.2.10 Corrosive chemicals shall not be discharged into an oily water sewer system without prior neutralization. Refer to SAES-S-060 for the handling and neutralization of acid wastes. No building sewer (sanitary) or building drains (sanitary) as defined in SAES-S-010 shall be connected to any part of oily water sewer system. Refer to Paragraph 4.8.4 of this Standard for oily wastes from buildings.
 - 4.2.11 Effluent temperature shall not be higher than the temperature rating of the drainage piping.
 - 4.2.12 Branches of a sewer piping network, such as sublaterals, laterals, submains, and mains, shall be run in straight lines between their connections, except as permitted in Paragraph 4.2.13 of this standard.
 - 4.2.13 Lateral, sublateral, or submain piping in sizes up to 400 mm (16 inch) in nominal pipe diameter of gravity sewers shall not have more than two horizontal bends. No bend shall exceed 45 degrees without having a cleanout as per Section 4.11 of this standard.
 - 4.2.14 The layout of a sewer piping network shall be designed to minimize any disruptions, caused by maintenance and T & I (Testing and Inspection) operations, to any other area of the plant.
 - 4.2.15 A sewer line shall be separated from a parallel potable water line by a minimum of 3 meters.
 - 4.2.16 A sewer line crossing a potable water line shall be oriented such that the sewer line crosses under the potable water line with a minimum vertical surface clearance of 300 mm.
 - 4.2.17 Any one of the following requirements must apply to sewer piping that, due to existing conditions must crossover a potable water line regardless of vertical separation; and must have less than 300 mm clear separation even though running beneath the potable water line.
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- a) The sewer piping crossing a potable water line shall be one continuous joint of pipe and both ends of that sewer pipe shall be at least 3 meters beyond the point of crossing.
- b) If the sewer piping is lined steel pipe it shall be joined together by full penetration butt-welds.
- c) The sewer piping shall be encased in a concrete sheath for a minimum distance of 3 meters in both directions beyond the crossing point. The concrete sheath shall be at least 150 mm thick. Plastic pipes such as RTR piping and fittings shall be wrapped with neoprene wrapping at the edges of concrete encasement. The wrapping must protrude slightly from the concrete encasement. The thickness and the width of wrap shall comply with Table 4 of SAES-S-070.
- d) The sewer line shall be encased in a sealed casing of either steel sleeve or RTR pressure pipe per 01-SAMSS-034 for a minimum distance of 3 meters, in both directions beyond the point of crossing. Steel sleeve shall be coated in accordance with SAES-H-002 for corrosion protection.

4.2.18 All gravity flow sewer-piping networks shall be designed to be free-flowing and self-draining to ensure that no effluents remain in the piping during no-flow conditions.

Exception:

Effluent standing in a seal and in a seal inlet pipe connecting to a catch basin, is permissible provided that the overall intent of having all parts of the sewer system be free-draining, is preserved.

4.2.19 Effluent velocity within the sewer-piping network shall comply with the requirements in Section 4.5 of this standard.

4.2.20 Catch basins and manholes shall be designed and located for ease of human and equipment access and cleanout.

4.2.21 Catch basins shall be per Section 4.9 of this standard, and manholes shall be per Section 4.10 of this standard.

4.2.22 All effluents in an oily water sewer system shall enter the sewer-piping network through the catch basins, or as permitted in Paragraph 4.8.1 of this standard. All catch basins shall be equipped with a water seal that is a minimum of 150 mm deep.

- 4.2.23 Funnels, as shown in Saudi Aramco Standard Drawing AE-036038, may be used to collect effluents from equipment drain points, fluid sample collection points, drips from pumps, equipment, vessels and other such areas. RTR funnels are acceptable.
 - 4.2.24 No more than six (6) funnels shall be allowed to collectively discharge effluents into a single catch basin, through side inlets of the catch basin per Saudi Aramco Standard Drawing AB-036402 or to a sealed manhole. Such funnels shall be located within 15 meters of the sealed manhole or within the drainage area served by that catch basin. Refer to Section 4.8 of this standard.
 - 4.2.25 Sanitary sewer systems shall not be combined with oily water sewer systems.
 - 4.2.26 Storm water runoffs from off-plot areas and uncontaminated water shall not be discharged into oily water sewer system.
 - 4.2.27 Electrical area classification shall be in accordance with the requirements of SAES-B-068.
 - 4.2.28 Electrical and electronic equipment and associated wiring in oily water sewer systems shall be suitable for the electrical area classification in accordance with SAES-P-100 and NEC (National Electric Code.)
 - 4.2.29 Drawings depicting oily water sewer system shall show risk areas approved by Loss Prevention Department.
 - 4.2.30 Sewers shall be flushed with water to remove foreign matter before putting it into service.
 - 4.2.31 Metallic buried flanges, if used, shall be externally coated with APCS-113 per SAES-H-002.
- 4.3 Surface Drainage
- 4.3.1 All effluents shall be directed away from all buildings, substations, power poles and towers, access roads, diked or racked incoming and outgoing hydrocarbon lines, on-site pipeways, flares, and process equipment.
 - 4.3.2 Foundations supporting steel bases, including structural columns, pipe supports, process equipment, vessels and towers shall be in accordance with SAES-Q-005.
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4.3.3 The ground level of the area surrounding a flare shall be graded to slope down and away from the flare and any associated equipment. The slope down shall not be less than one degree from horizontal grade.

4.3.4 Surface drainage from unpaved areas shall not drain over paved areas.

4.4 Flow Rates

4.4.1 Each risk area sewer-piping network shall be designed to handle the larger of the following design flow rate.

- a) Flow rate caused by the cumulative releases of hydrocarbon during normal operation or maintenance, plus maximum firewater flow from the risk area, as determined per SAES-B-017. Design shall prevent ponding during maximum firewater flow.
- b) Cumulative storm water flow, based on a 5-year return frequency per SAES-A-112, to prevent flooding of buildings or equipment that would disrupt operations or prevent a safe shutdown of the plant. Design may allow ponding during rainstorms as long as flooding of such building or equipment is prevented. Refer to SAES-S-030.

4.4.2 Unless the flow rates determined under Paragraph 4.4.1 are larger, each branch of a sewer network shall be capable of handling the following minimum flow rates:

- a) Sublaterals: 31.5 L/s (500 gpm) from each catch basin.
- b) Laterals: The cumulative flow from the catch basins served, but not less than 63 L/s (1000 gpm).
- c) Submains: The maximum flow produced by the calculated maximum allowable discharge of effluents in a risk area, but not less than 63 L/s (1000 gpm).
- d) Mains: The total flow produced as per Paragraph 4.4.1.b of this standard, but not less than the maximum firewater flow required by any single risk area.

4.5 Line Sizing

4.5.1 Gravity flow piping shall be sized to maintain a minimum flow velocity of 0.9 meters per second (3 feet per second) at the peak flow rate under full flow condition.

- 4.5.2 Forced main sizing shall be based on a minimum flow velocity of 0.9 meter per second (3 fps), and a maximum velocity as listed in SAES-L-032 under "Water Sea/Saline" for different piping material.
 - 4.5.3 Pipe shall not reduce in size in the direction of flow.
 - 4.5.4 DWV (drain, waste and vent) type fittings shall be used in gravity flow system.
 - 4.5.5 90 degree sharp mitered fittings and short elbows are not permitted, except at funnels and as per approved designs at lift / pump stations.
 - 4.6 Drainage Collection Areas
 - 4.6.1 The area served by a single catch basin shall not exceed 232 square meters within any plot location.
 - 4.6.2 The maximum surface travel of any liquid to a catch basin shall not be greater than 15 meters.
 - 4.6.3 The surface slope to catch basins shall be not less than 1:65 (1.5%). Paving shall conform to SAES-Q-001; and maximum drop to catch basins from high point of paving shall be 200 mm. This does not apply to offshore platforms covered in Section 4.15 and diked area covered in Section 4.13 of this standard. Surface grading within oil filled transformers diked areas shall be in accordance with NFPA 30.
 - 4.6.4 Catch basins, or other collection points in each drainage area shall not be located directly beneath any equipment. They shall be located such that the drainage path from a source of spillage does not pass beneath any other equipment or vessels containing hydrocarbons, pipeway, pipe rack, stairs or ladders.
 - 4.7 Toe Walls
 - 4.7.1 Toe walls shall be provided at hydrocarbon pump bases if the boiling point of the hydrocarbon exceeds 5°C at atmospheric pressure, at oil-filled transformers, at furnaces burning liquid fuels, and at furnaces with flammable liquid in the tubes.
 - 4.7.2 Surface area within toe walls shall be graded to direct effluent to the nearest catch basin, and to divert surface flow safely away from equipment. Toe walls are not designed to contain effluent.
 - 4.7.3 Toe walls shall have a minimum height of 150 mm.
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4.8 Drains

- 4.8.1 Drains, as defined in Paragraph 4.1 of this standard, shall run to the nearest catch basin or manhole through a sealed connection at the catch basin or at the manhole. The horizontal distance between the drain opening and the catch basin or the manhole shall not exceed 15 meters.
- 4.8.2 All drain points shall have an air gap between their point of discharge and the point of collection into the oily water sewer system.
- 4.8.3 Funnels, collecting waste effluent, shall be visible from the drain valve and shall be of sufficient size to prevent overflow during maximum flow rates. The lip of a drain funnel shall be elevated 80 mm above the ground to prevent surface drainage from entering the drain. RTR material may be used for drain funnel.
- 4.8.4 Drains from laboratory sinks, analyzer houses, or other facilities where oil releases are possible shall be connected through a liquid trap seal connection to a vented manhole of the oily water sewer system or to a vented holding tank. Holding tanks shall be provided with electronic or manual means of gauging contents.

4.9 Catch Basins

- 4.9.1 Catch basins shall be provided on plot areas for the collection of surface runoff and effluent.
 - 4.9.2 Catch basins shall be of the following types:
 - a) Catch basins with beehive covers for unpaved areas.
 - b) Cast iron catch basins per Saudi Aramco Standard Drawings AC-036078 and AB-036402 in nontraffic areas.
 - c) Catch basins per Saudi Aramco Standard Drawing AB-036964 in traffic areas.
 - d) Catch basins per Saudi Aramco Standard Drawing AB-036402 may be used for collecting drain or sample wastes from equipment, and vessels.
 - e) Custom designed catch basins per the requirements of Paragraph 4.9.4 of this standard. Such catch basins shall have prior approval from the Chairman of Plumbing & Utilities Standards Committee.
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- 4.9.3 The number of catch basins provided in a plot area shall have a total outlet flow capacity equal to or greater than the maximum effluent flow. A standard catch basin shall be provided for each 31.5 L/s (500 gpm) of effluent flow within a plot area, or custom designed catch basins for effluent flows larger than 31.5 L/s (500 gpm).
 - 4.9.4 Custom-designed catch basins shall be provided with not less than a 150 mm liquid seal and a debris pocket not less than 150 mm in depth below the seal. The catch basin outlet shall be accessible for cleaning. Side inlets into the catch basin shall be provided with a minimum 150 mm seal and shall not be located within debris pocket area. The catch basin structure and grating cover shall be able to withstand the maximum expected traffic loads.
 - 4.9.5 Catch basins used for paved area drainage shall be installed flush with the low point of the finished surface.
 - 4.9.6 The flow from one catch basin shall not run into another catch basin, but shall be contained within the sealed and vented sewer system all the way to disposal facilities.
 - 4.9.7 Connection of catch basin's outlet and inlet stubs with RTR drainage piping shall be made in accordance with the RTR piping manufacturer's recommendations. Metallic adapters, if used, shall be suitable for buried application.
- 4.10 Manholes
- 4.10.1 Sealed and vented manholes conforming to Saudi Aramco Standard Drawing AB-036054 shall be used for oily water sewers. Any other design of water seal in a manhole shall have prior approval from Chief Fire Prevention Engineer and the Chairman of Plumbing and Utilities Standards Committee. The manholes shall be sized to permit entrance for cleaning.
 - 4.10.2 Manholes are required at the following locations:
 - a) At the junction of sewers from different risk areas.
 - b) At any change in horizontal direction whatsoever of any main, regardless of size; any sublateral, lateral, or submain larger than 400 mm (16 inch) nominal pipe diameter.
 - c) At maximum intervals of 90 meters for any main, regardless of size; any sublateral, lateral, or submain larger than 400 mm (16 inch) nominal pipe diameter.
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- d) At the junction of any sewers where the lesser sewer line is larger than 400 mm (16 inch) nominal pipe diameter.
 - e) At the dead ends of mains.
- 4.10.3 Seals and vents may be eliminated from manholes where the manholes are provided to meet the requirements of Paragraph 4.10.2(b), and (c) only. However, seals and vents shall be provided where Paragraph 4.10.2(d), or (a) also apply.
- 4.10.4 Manholes at dead ends of mains as per Paragraph 4.10.2(e) of this standard are required to be vented.
- 4.10.5 Invert of the outlet in a manhole shall be at least 25 mm lower than the invert of the lowest incoming sewer in the manhole. Whenever the total available fall is limited, the outlet may be raised until the invert is flush with the lowest inlet invert.
- 4.10.6 Manholes shall be constructed of concrete. Concrete manhole shall be coated internally with APCS-3 epoxy and externally below grade with APCS-10 bituminous paint per SAES-H-101 or better. Exterior concrete surfaces above grade shall be coated with APCS-1B coating system per SAES-H-003. Before coating, concrete surfaces shall be sealed with a low molecular weight epoxy sealer. (Refer to SAES-A-104).
- 4.10.7 Steel reinforcing bars in concrete shall be epoxy coated per 09-SAMSS-106.
- 4.11 Cleanouts
- 4.11.1 Cleanouts shall be provided at following locations to facilitate inspection and cleaning of the sewer piping.
- a) At the upper terminal of each run of piping of each section of sewer system.
 - b) At 30 meters intervals or fraction thereof in a straight length of sewer piping network for sewers 400 mm (16 inch) or less nominal pipe diameter, except as required by Paragraph 4.11.2 of this standard. Manholes may be used in lieu of cleanouts. In this case the maximum distance between the manholes shall not exceed 90 meters.
 - c) For each horizontal change of direction exceeding 45° for sewers 400 mm (16 inch) or less nominal pipe diameter.
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- 4.11.2 Inside plot limits; cleanouts may be used in lieu of manholes, where seals, and vents may be omitted per Paragraph 4.10.3 of this standard, at a change of direction of 45° or smaller. In this case the total sewer pipe length between the cleanout and the next manhole or a cleanout on the downstream shall not be more than 30 meters.
 - 4.11.3 Cleanouts shall be 100 mm (4 inch) for sewers 250 mm (10 inch) and smaller nominal pipe diameter, and 150 mm (6 inch) for larger sewers.
 - 4.11.4 Cleanouts shall be designed to be gastight and watertight without the use of any gasket, packing, or washer.
 - 4.11.5 Each cleanout shall be installed so that it opens to allow cleaning in the direction of flow of sewer, and shall be installed vertically above the flow line of the pipe.
 - 4.11.6 Each cleanout shall be accessible and shall be extended to the grade level. Each 90-degree cleanout extension shall be extended from a wye type fitting or other approved fitting of equivalent sweep.
- 4.12 Vents
- 4.12.1 Vents shall be installed on the following locations of the oily water sewer system:
 - a) All sealed manholes.
 - b) All lift station sumps and collection sumps.
 - c) Those sections of the sewer line located between liquid seals.
 - d) Upstream of the first sealed manhole in an oily water sewer system, but downstream of the farthest catch basin.
 - 4.12.2 Vents shall be 100 mm (4 inch) minimum nominal pipe diameter.
 - 4.12.3 Vents shall be properly supported at horizontal-to-vertical transitions and shall be protected against accidental damage by motorized equipment.
 - 4.12.4 Vents shall not be closer than 15 meters horizontally from a furnace or other source of ignition. Vents within 30 meters of a furnace or other source of ignition shall terminate at least 15 meters above grade. Refer to SAES-B-068 for Electrical Area Classification around vents.
 - 4.12.5 Vents shall terminate at least 3 meters above any equipment handling hydrocarbons or their derivatives, piperacks, or any platforms.
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4.12.6 Vents' openings shall not have any restrictions such as flame arrestors, goosenecks, or raincaps.

4.12.7 Vents from different risk areas shall not be combined.

4.12.8 Terminating points of adjacent vents shall be separated by a horizontal distance of not less than 1.0 meter, unless a prior approval is obtained from the Chief Fire Prevention Engineer.

4.13 Tank Farm Areas

4.13.1 A diked area if provided as per SAES-B-005, shall have an oily water sewer system as specified in Paragraph 4.13.2 of this standard.

4.13.2 Drainage from a tank water draw-off point shall have an air gap and shall pass through a drainpipe or concrete gutter to the required catch basin that discharges into a drainage system outside the diked area. The catch basin drain line shall be valved outside diked area.

4.13.3 Surface grading within a diked area shall be in accordance with SAES-B-005.

4.14 Lift Stations and Force Mains

4.14.1 If necessary, lift stations shall be installed to meet the required flow velocities specified in Section 4.5 of this standard.

4.14.2 The selection and installation of wastewater lift station pumps shall be in accordance with SAES-A-104 and SAES-G-005 as applicable.

4.14.3 Each lift station shall have two sets of pumps, one set to handle normal incoming flow, and the other set to handle the maximum incoming flow.

Exceptions:

- 1. This requirement is not applicable to the controlled drainage of diked area. In this case the lift station shall have at least one set of pumps to handle normal incoming flow.*
- 2. Sumps, outside diked areas, for bulk plants and air fueling operations shall be sized to hold 32000 liters plus a maximum of five minutes of deluge flow as specified in SAES-B-070 as a minimum.*
- 3. Refer to Paragraph 4.14.6 of this Standard.*

4.14.4 The Pump Set handling normal flow shall meet the following requirements:

- a) The Pump Set shall consist of one pump or a group of pumps of equal operating capacity and one equal capacity standby pump.
- b) The total capacity of operating pumps shall be based on normal washdown, sampling, vessel drainage, etc.
- c) The pumps may have a common power source.

Exception:

Sumps for bulk plants and air fueling operations shall have at least one normal flow pump sized to handle normal operational needs but in no case less than the capacity listed in SAES-B-017 for the firewater pumps.

4.14.5 The Pump Set handling maximum flow shall meet the following requirements.

- a) The Pump Set shall consist of one pump or a group of pumps of equal operating capacity and one equal capacity standby pump.
- b) The total capacity of operating pumps shall be based on the flows stated in Section 4.4 of this standard.

Exception:

Sumps for bulk plants and air fueling operations shall have at least one maximum flow pump, sized to handle the design basis of the foam system but in no case less than 63 L/s (1000 gpm).

- c) Two independent power sources, each with its own transformer, shall be supplied.
- d) The transformer shall be interconnected with an automatic transfer switch to provide a continuous source of power to the pumps' motors.

4.14.6 If the difference between normal and maximum flows is 10% or less, a single set of pumps sized for the maximum flow condition may be used. The power supply requirements of Paragraph 4.14.5 of this standard shall apply.

4.14.7 The lift station sump operating volume shall be sized according to the following equation:

$$V=C_r(Q)/4 \quad (1)$$

Where: V = minimum required capacity m^3 (gallons)

C_T = minimum time in minutes of one pumping cycle between successive motor starts. Minimum C_T shall be 15 minutes

Q = maximum flow pump capacity, m³/min (gallon/minute), or increment in pumping capacity when multiple operating pumps are used

Reference: Wastewater Engineering-Collection & Pumping of Wastewater by Metcalf & Eddy, Inc.

4.14.8 The start and stop level settings for the normal flow pump shall allow for five minutes minimum run time.

4.14.9 Incoming sewers lines shall remain dry when not in use. The maximum liquid level in the lift station sump shall not impede incoming flow.

4.14.10 The incoming sewer to a lift station sump shall be provided with a water seal similar to that provided on sealed manholes. The outlet of incoming sewer shall terminate not less than 150 mm below the pump shut-off liquid level.

4.14.11 The lift station sump shall be of airtight construction and shall be provided with a vent per Section 4.12 of this standard.

4.14.12 The lift station sump shall be provided with a high liquid level alarm in the appropriate control room.

4.14.13 Pumps shall be specifically designed for pumping sewage. Pumps shall be nonclog type and shall comply with SAES-G-005.

4.14.14 Lift station pumps with suction lifts are prohibited.

Exception:

Self priming pumps as per SAES-G-005 are acceptable.

4.14.15 The pumps shall be spaced to prevent vortexing cavitations when the pumps are operating.

4.14.16 The pumps shall be removable without disturbing the discharge piping.

4.14.17 Interior of concrete lift station sumps shall be painted in accordance with SAES-H-101, APCS-3.

- 4.14.18 Exterior concrete surfaces exposed to ground water shall be protected with a 3-coat mastic, 2-layer felt or a 2-coat mastic and polyethylene coating.
 - 4.14.19 Force mains in plants that contain oily water shall be installed above ground; and shall be provided with cleanout entries not more than 30 meters intervals.
 - 4.14.20 All force main connections to a gravity sewer system shall be through a sealed connection at a vented manhole.
 - 4.14.21 Force main shall be a minimum of 100 mm (4 inch) in diameter.
 - 4.14.22 Thrust blocks shall be provided for underground force mains in accordance with SAES-S-070.
 - 4.14.23 Pumps on lift stations shall comply with electrical area classification requirements per SAES-B-068.
 - 4.14.24 Pipe supports shall comply with the fireproofing requirements stated in SAES-B-006.
- 4.15 Offshore Platforms
- 4.15.1 The following requirements shall apply to both manned and unmanned platforms:
 - a) All offshore plate deck platforms handling hydrocarbons shall have a gravity sewer system for the safe removal of spills, storm water, and fire water. The system shall be designed using the same minimum requirements as stated in this standard for onshore systems.

A helideck with fueling facilities is a hydrocarbon-handling deck.
 - b) Deck edge drainage troughs with toe walls shall be installed in accordance with SAES-B-009.
 - c) The top of the toe wall shall be 150 mm above the adjacent deck level, and shall be located along the outer edge of the drainage trough.
 - d) Handrails along the inboard side of the deck edge trough shall not have kick plates.
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- e) Each deck penetration shall be surrounded by a toe board or sleeve that shall extend a minimum of 150 mm above the adjacent deck level, and which shall provide only the amount of clearance necessary to allow free movement between the deck and piping, conduit, cable, or equipment in the penetration.
- f) Each plate deck handling hydrocarbons shall constitute at least one surface drainage collection area.
- g) The maximum plate deck and trough travel distance of any liquid as well as the subdivision of plate deck areas shall be in accordance with SAES-B-009.
- h) The plate deck shall have a slope of not less than 1:100 (1%) to a trough.
- i) In-deck troughs shall not be more than 300 mm wide and shall be covered with grating.
- j) All troughs shall have a minimum pitch of 1:65 (1.5%).
- k) A baffle plate shall be installed at the high point of each trough section.
- l) Area and equipment drainage shall include sublaterals and laterals tying into a submain. The submains from each deck shall be connected via a sealed and vented drain box (which has the same function as an onshore manhole) to a common main or riser discharging to the slop tank, or caisson.
- m) Cleanouts shall be provided per Section 4.11 of this standard.
- n) All lines discharging into a slop tank, or caisson shall terminate a minimum of 150 mm below the lowest possible slop tank liquid level, or caisson liquid level.
- o) Each slop tank, or caisson shall be vented. Vents of slop tanks, or slop caissons shall be routed free of pockets and shall terminate as specified in SAES-B-009.
- p) Vents protecting liquid seals shall terminate at least 3 meters above the highest process pipe, process equipment, or platform on the uppermost deck within 7.6 meters horizontally.

4.15.2 The following requirements shall apply only to manned platforms:

- a) All types of flows, such as surface runoff and effluent that flow into the gravity sewer system shall be through sealed catch basins, including entries from drainage troughs.
 - b) Catch basins for drain troughs shall be incorporated into the drain trough, or bolted directly onto the bottom of the drain trough, and shall be accessible for cleaning from the deck containing the drain trough.
 - c) Catch basins must meet the requirements of Section 4.9 of this standard.
 - d) A minimum liquid seal height of 150 mm shall be provided in all individual drains prior to their entering sublaterals or laterals.
 - e) Sewer system from each deck shall be vented.
 - f) Vents shall be located immediately before the last catch basin in a deck sewer system.
 - g) Vents shall terminate in accordance with Paragraph 4.15.1 (p) of this standard.
 - h) The volume of firewater that can be released may be large enough to justify the use of two slop tanks, or caissons. Where two tanks or caissons are provided, there shall be two drainage systems per deck, each with a dependent sublateral, lateral, and submain system to their respective slop tank or caisson.
 - i) Slop tanks or caissons shall be part of the gravity sewer system, and shall not be used as part of the pressure sewer system.
 - j) Slop tanks or caissons shall be provided with normal flow pumps for pumping recovered oil to the Production Trap or another safe location. Refer to Paragraph 4.14.4 of this standard for normal flow pump requirements.
 - k) Slop tank or caisson design shall provide for flows developed during a fire. Discharge into the sea shall be by an overflow or maximum flow pumps. The use of an overflow is preferred. Refer to Paragraph 4.14.5 of this standard for maximum flow pump requirements.
 - l) The overflow shall be able to handle the volume of water without impairing the hydraulic profile of any incoming gravity sewer. It
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shall have a submerged inlet of sufficient depth to prevent the spillage of oil within the tank or caisson.

- m) If maximum flow pumps are required, the slop tank or caisson and the pumps shall be designed as set forth in Paragraph 4.14.7 of this standard.

4.15.3 The following specific requirements shall apply only to unmanned platforms:

- a) A separate drainage system shall be provided for each risk area, which shall independently discharge through an inlet into the required slop tank or caisson. The capacity of each drainage system shall be designed to ensure that anticipated spills will not overflow the toe walls.
- b) Sealed catch basins as inlets to each drainage system are not required.
- c) Any pressure blowdown may be directed to the slop tank or caisson.
- d) The slop tank or caisson shall be provided with a single pump for pumping recovered oil to a safe location downstream of the isolation valve on the main outlet header. The pump shall be sized as a normal flow pump as set forth in Paragraph 4.14.4 of this standard.

4.16 Treatment and Disposal of Effluent

4.16.1 The treatment of wastewater within the scope of this standard shall be per SAES-A-104.

4.16.2 Where economically practical, oil, other hydrocarbons, or chemicals shall be recovered from the effluent and returned to process streams.

4.16.3 The disposal of either treated or untreated effluent shall comply with Saudi Aramco and governmental environmental standards. Refer to SAES-A-102, SAES-A-103, SAES-A-104, and SAES-B-055.

5 Installation

5.1 Materials

5.1.1 Following are the acceptable materials for gravity oily water sewer piping:

- a) 12 LCOU per SAES-L-005, steel pipe, ASTM A53, or API SPEC 5L Grade B, Standard Weight, cement lined and externally coated in accordance with SAES-H-002.
- b) 80DCOD per SAES-L-005, cast iron soil pipe and fittings, ASTM A74, service (SV) weight.
- c) 12FEOU per SAES-L-005, 01-SAMSS-034 RTR (fiberglass) pipe and fittings with restrained joints. Such pipe shall be used only below ground. Temperature ratings and chemical resistant of pipe, fittings and jointing compounds shall be compatible with the effluent.
- d) Ductile iron pipe, ASTM A746, cement lined and externally coated in accordance with SAES-H-002.
- e) High Density Polyethylene (HDPE) pipe liner, per ASTM D3350, ASTM F1248, and ASTM F714 - for sliplining of existing oily water sewer pipes only. Temperature ratings and chemical resistant of the liner shall be compatible with the effluent.
- f) Drainage fittings shall have a smooth interior waterway of the same diameter as the piping served and all such fittings shall be compatible with the type of pipe used. All fittings shall be DWV (drainage, waste and vent) type, such as 45° Ys, long 90° elbows, sixth, eighth and sixteenth bends, and combinations of such fittings.

5.1.2 Following are the acceptable materials for force main piping:

- a) 12 LCOU or 12LEOU per SAES-L-005, steel pipe, ASTM A53, or API SPEC 5L Grade B, Standard Weight or heavier as required by the system pressure, cement lined or fusion bonded epoxy (FBE) internally coated per SAES-H-002, above or below ground. All belowground piping and piping not less than 150 mm above the finished surface shall be externally coated in accordance with SAES-H-002.
 - b) 12FEOU per SAES-L-005, 01-SAMSS-034 RTR (fiberglass) pipe and fittings with restrained joints. Such pipe shall be used only below ground. Temperature ratings and chemical resistant of pipe, fittings and jointing compounds shall be compatible with the effluent.
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- c) Ductile iron pipe, ASTM A377, or ISO 2531, cement lined and externally coated in accordance with SAES-H-002. Flanged joints shall be used above ground.
- d) High Density Polyethylene (HDPE) pipe liner, per ASTM D3350, ASTM F1248, and ASTM F714 - for sliplining of existing oily water sewer pipes only. Temperature ratings and chemical resistant of the liner shall be compatible with the effluent.

5.1.3 Following are the acceptable materials for vent piping:

- a) Steel pipe, ASTM A53, or API SPEC 5L Grade B, Standard Weight, galvanized, above and below ground. All belowground piping and piping not less than 150 mm above the finished surface shall be coated externally in accordance with SAES-H-002.
- b) 80DCOD per SAES-L-005, cast iron soil pipe, ASTM A74, service (SV) weight below ground with a steel pipe riser, steel pipe, ASTM A53, or API SPEC 5L Grade B, Standard Weight, galvanized, above and below ground. All belowground steel piping and piping not less than 150 mm above the finished surface shall be externally coated in accordance with SAES-H-002.
- c) 12FEOU per SAES-L-005, 01-SAMSS-034 RTR (fiberglass) pipe and fittings with restrained joints below ground with a steel pipe riser, ASTM A53, or API SPEC 5L Grade B, Standard Weight, galvanized, above and below ground. The connection between RTR (fiberglass) pipe and steel pipe shall be in accordance with SAES-L-060; and shall be a flanged connection. It shall be installed in such a way that the weight of steel piping shall not be transferred to RTR (fiberglass) piping. All belowground steel piping and piping not less than 150 mm above the finished surface shall be externally coated in accordance with SAES-H-002.

5.2 Installation

5.2.1 Oily water sewers shall be installed in accordance with the following standards:

- a) Steel pipe shall be installed in accordance with SAES-L-050. In addition, refer to SAES-X-600 to determine if cathodic protection is necessary.

- b) Ductile iron pipe, cast iron soil pipe, and 01-SAMSS-034 RTR (fiberglass) pipe shall be installed in accordance with SAES-S-070.

5.2.2 Manufacturer's installation instructions shall be followed for the installation of all equipment that falls under the scope of this standard.

5.3 Testing, Inspection and Backfilling

5.3.1 Oily water sewer system shall be tested for water tightness in accordance with SAES-S-070, unless otherwise stated below.

5.3.1.1 Vents shall be hydrostatically tested by filling the vent pipe from its connection to the sewer or manhole to the top of the pipe. The vent shall be watertight for a period of 4 hours.

Exception:

If hydrotesting of above ground metallic vent pipe is deemed impractical, then it could be substituted with 10% radiography; and all welds shall be 100% visually inspected. However a prior approval of the Chief Fire Prevention Engineer is required.

5.3.1.2 Drain lines shall be tested from the funnel or catch basin to the connection with a catch basin or manhole by filling the line with water to the top of the funnel or catch basin. Drains that have not been backfilled shall be watertight for a period of 4 hours. Drains that have been backfilled shall be watertight for a period of 24 hours.

5.3.1.3 Gravity sewers shall be tested from the catch basin to the first manhole connection, and from manhole to manhole, by filling the line to the top of the catch basin, or the upper manhole. Sewers that have not been backfilled shall be watertight for a period of 4 hours. Sewers that have been backfilled shall be watertight for a period of 24 hours.

5.3.1.4 Force mains shall be hydrostatically tested at a minimum of 1034 kPa (150 psig) or 345 kPa (50 psig) above the pump shut-off head, whichever is greater. Aboveground force mains shall be watertight for a period of 4 hours.

Exception:

If hydrotesting of above ground metallic force main piping is deemed impractical, then it could be substituted with 100% radiography. However a prior approval of the Chief Fire Prevention Engineer is required.

5.3.1.5 Prefabricated catch basins and manholes may be hydrotested at the manufacturing site as standard quality control procedures, prior to shipment to the location specified on the purchase order form. Such catch basins and manholes are exempted from the site hydrotest requirements. However, the joints and piping thereafter shall be hydrotested as per Section 5.3.

5.3.2 Oily water sewer systems shall be inspected, repaired and backfilled in accordance with SAES-S-070.

30 November 2002

Revision Summary
Major revision.