Engineering Standard

SAES-S-010 31 December 2002

Sanitary Sewers

Saudi Aramco DeskTop Standards

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1 Scope

1.1 This Saudi Aramco Engineering Standard (SAES) sets forth the minimum requirements for sanitary sewers that are located in Saudi Aramco facilities; or that are under the operation and maintenance of Saudi Aramco.

1.2 This SAES does not apply to the following:

1.2.1 The collection of sewage in and from buildings as covered by SAES-S-060 or the treatment and disposal of such sewage.

1.2.2 Sanitary sewers that are designed and constructed by Saudi Aramco on behalf of Saudi Arabian governmental agencies, in accordance with their own standards and specifications.

1.2.3 Sanitary sewers that are designed and controlled by Saudi Aramco for Saudi Aramco that serve Saudi Aramco facilities, but are located on land under the jurisdiction of Saudi Arabian governmental agencies, and that comply with government standards and specifications.

1.2.4 Industrial drainage and sewers covered by SAES-S-020.

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-104	*Wastewater Treatment, Reuse & Disposal*
SAES-B-068	*Electrical Area Classification*
SAES-G-005	*Centrifugal Pumps*
SAES-H-002	*Internal and external Coatings for Steel Pipelines and Piping*
SAES-H-003	*Coating Requirements for Concrete Surfaces*
SAES-H-100	*Painting Requirements for Industrial Facilities*
SAES-H-101	*Approved Protective Coating Systems*
SAES-L-005	*Piping Materials Specifications*
SAES-L-032	*Materials Selection of Piping Systems*
SAES-M-006	*Saudi Aramco Security and General Purpose Fencing*
SAES-S-020	*Industrial Drainage and Sewers*
SAES-S-060	*Saudi Aramco Plumbing Code*
SAES-S-070	*Installation of Utility Piping Systems*

Saudi Aramco Materials System Specifications

01-SAMSS-029	*RTR (Fiberglass) Sewer Pipe and Fittings for Gravity Flow*
01-SAMSS-034	*RTR (Fiberglass) Pressure Pipe and Fittings*
09-SAMSS-106	*Epoxy Coating of Steel Reinforcing Bars*

Saudi Aramco General Instruction

GI-0151.006	*Implementing the Saudi Aramco Sanitary Code*

Saudi Arabian Standards Organization

SASO SSA/14	*Pipes for Potable Water of Unplasticized Plastic (Polyvinyl Chloride)*

3.2 Industry Codes and Standards

American National Standards Institute

ANSI A14.3	*Safety Requirements for Fixed Ladders*

American Society for Testing and Materials

ASTM D1785	*Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120*
ASTM D2564	*Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems*
ASTM D2665	*Polyvinyl Chloride (PVC) Plastic drain, Waste, and Vent Pipe and Fittings*
ASTM D2855	*Making Solvent Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings*
ASTM D3212	*Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*
ASTM D3311	*Drains, Waste, and Vent (DWV) Plastic Fittings Patterns*
ASTM D3350	*Polyethylene Plastics Pipe and Fittings Materials*
ASTM F585	*Insertion of Flexible Polyethylene Pipe into Existing Sewers*
ASTM F714	*Polyethylene Plastic Pipe (SDR-PR) Based on Outside Diameter*
ASTM F1216	*Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube*
ASTM F1248	*Determination of Environmental Stress Crack Resistance of Polyethylene Pipe*

4 Definitions

Biochemical Oxygen Demand (BOD): For definitions see SAES-A-104.

Building: A structure built, erected, and framed of component structural parts designed for the housing, shelter, enclosure, or support of human, animals, or material of any kind.

Building Drain: The lowest piping of a drainage system that receives the discharge from soil, waste and other drainage pipes inside the walls of a building and conveys it to the building sewer beginning 0.6 m outside the building wall.

Building Sewer: The horizontal piping of a drainage system which extends from the end of a building drain and which receives the discharge of the building drain and conveys it to public sewer, private sewer, individual sewage disposal system, or other point of disposal.

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

House Connection: A sewer lateral that extends from the public sewer to the property line and to which the building sewer is connected.

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

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

Main: The main of any system of continuous piping is the principal artery of the system to which branches may be connected.

Main Sewer: See Public Sewer.

Private Sewage Disposal System: A septic tank from which effluent discharges into a subsurface disposal field, into one or more seepage pits, or into a combination that consists of a subsurface disposal field and a seepage pit or of other facilities that are permitted and approved by the Saudi Aramco Medical Department.

Private Sewer: A building sewer that receives discharge from one or more than one building drain and conveys this discharge to a private sewage disposal system.

Public Sewer: A common sewer that receives discharge from building sewers and conveys this discharge to a lift station, a sewage treatment facility, or an other point of disposal.

Sewage Wastewater: Any liquid waste that contains animal or vegetable matter in suspension or solution or that includes liquids containing chemicals in solution.

Wet Well Lift Station: A lift station that uses submersible pumps or vertical line shaft pumps within a reinforced concrete or steel sump.

Wet Well/Dry Well Lift Station: A lift station in which the sewage is contained in wet well and pumps are contained in a separate accessible chamber called dry well.

5 Design

5.1 Wastes Prohibited for Discharge into Public Sewers

5.1.1 Public sewers should not receive discharges of the waters and wastes that are specified below, unless these waters and wastes have been pretreated in facilities that conform to SAES-A-104.

5.1.2 Any rain water, surface water, ground water, roof run-off, subsurface drainage, or cooling water, unless there are no other means to dispose off such wastes. A prior approval from the Chairman of Plumbing and Utilities Committee must be obtained. Unpolluted industrial process water shall not be discharged into sanitary sewer system.

5.1.3 Any liquid or vapor having a temperature higher than 65°C (149°F).

5.1.4 Any water or waste containing more than 100 parts per million by weight of animal fat, vegetable fat, oil, or grease.

5.1.5 Any hydrocarbon solids, liquids or gases or any other flammable or explosive solids, liquids or gases.

5.1.6 Any garbage that has not been properly shredded.

5.1.7 Any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, paunch manure, or any other solid or viscous substance capable of causing obstruction to the flow in sewers or causing other interference with the proper operation of waste disposal facilities.

5.1.8 Any waters or wastes having a pH lower than 5.5 or higher than 9.0 or having any other corrosive property capable of causing damage or hazard to structures, equipment, and personnel associated with the waste disposal facilities.

5.1.9 Any waters or wastes containing pesticides.

5.1.10 Any waters or wastes containing a toxic or poisonous substance in sufficient quantity to injure or interfere with any sewage treatment process, to constitute a hazard to human beings or animals, or to create any hazard in the receiving waters of the waste disposal facilities.

5.1.11 Any waters or wastes that, given an average daily flow greater than 4 cubic meters per day, contain more than 350 parts per million by weight of suspended solids or that contain suspended solids of such character

and quantity that unusual attention or expense is required to handle such materials at the waste disposal facility.

5.1.12 Any noxious or malodorous gas or substance that is capable of creating a public nuisance.

5.1.13 Any waters or wastes having a five-day BOD greater than 300 parts per million by weight, given an average daily flow greater than 4 cubic meters per day.

5.2 Gravity Public Sewers

5.2.1 Each gravity public sewer shall be designed to carry the peak flow rate (PFR), which is the average flow rate (AFR) multiplied by the appropriate peaking factor (PF), within the depth-of-flow and velocity ranges stipulated in this chapter.

5.2.2 The AFR shall be determined for each building or facility served. In the absence of measured or known flow rates, the AFR values given in SAES-A-104 shall be used.

5.2.3 Peaking factors (PF's) shall be determined from the following formulae:

a) For an AFR from 0 to 24 million liters per day:

$$PF = (0.00163)(AFR)^2 - (0.08790)(AFR) + 2.90$$

where AFR is in millions liters per day

b) For an AFR greater than 24 million liters per day:

$$PF = 1.73$$

5.2.4 Gravity public sewers shall have the following velocity and depth-of-flow characteristics:

a) The minimum velocity shall be 0.77 m/s (2.5 ft/s) at the applicable AFR. The slope should be continuously down hill, without low points or high points.

Exception:

If the required slope cannot be achieved to maintain the minimum required velocity due to site conditions, tie up connections or any other unavoidable conditions, the minimum slopes for sewer pipes shall not be less than .0033.

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

b) The maximum depth-of-flow shall not exceed 75% of the internal pipe diameter at the applicable PFR.

5.2.5 The minimum size of a public sewer shall be 200 mm nominal diameter.

5.2.6 Public sewers shall be laid in a straight line between manholes.

5.2.7 Pipe shall not reduce in size in the direction of flow.

5.2.8 DWV (drain, waste and vent) type fittings shall be used in gravity flow system.

5.2.9 No elbows, wyes, or other fittings that change the direction of sewers between manholes shall be permitted.

5.2.10 The maximum distance between manholes for public sewers shall be 90 meters (295 ft).

5.2.11 There shall be no physical connection between a potable water supply system and a sewer or a junction that would permit the passage of any wastewater into the potable water supply.

5.2.12 No portion of a sewer system and no discharge from a sewer system shall be located within 15 meters of any well, spring, or other source of potable water supply.

5.2.13 Public sewers that are parallel to potable water lines shall be separated from such lines by a minimum distance of 3 m; and shall be located below the potable water lines. Refer to Saudi Aramco Sanitary Code (GI-0151.006) for minimum horizontal separation distances between sewer lines and water systems.

5.2.14 A sewer crossing a potable water line shall be oriented such that the sewer crosses under the potable water line with a minimum vertical surface clearance of 300 mm.

5.2.15 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.

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) 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.

c) The sewer line shall be encased in a sealed casing of either steel sleeve, PVC or RTR pipe 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.

5.2.16 Public sewers, including any house connection or building sewers, shall have a minimum depth of cover as specified in Table 2 of SAES-S-070.

5.2.17 Manholes shall be constructed of either a nonmetallic material (such as fiberglass-reinforced plastic, high-density polyethylene, or equivalent), or concrete.

5.2.18 Concrete manholes are coated internally with APCS-19B epoxy and externally below grade with APCS-10 bituminous paint per SAES-H-101 or better. Steel reinforcing bars in concrete shall be epoxy coated per 09-SAMSS-106.

5.2.19 Bottom of a manhole shall have concrete benching, which must be channeled smooth from the invert of all pipes entering the manhole. When there is a difference of more than 50 mm to 600 mm between the inverts of incoming sewers, a chute shall be created in the benching to provide a smooth flow. Benching shall not be less than ¾ of the diameter of the sewer pipe. Top of the benching must be sloped towards the open channel at the slope of 4 to 8%.

5.2.20 A drop manhole shall be provided for a sewer entering a manhole at an elevation of 600 mm or more above the manhole invert. The drop connection shall be outside the drop manhole and shall be encased in concrete.

5.3 Lift Stations

5.3.1 General

a) The design and construction of wastewater lift stations shall comply with SAES-A-104 and Saudi Aramco Sanitary Code (GI-0151.006) as applicable.

b) Lift stations that receives 1800 cubic meters per day (475,560 gallons per day) or larger flows based on daily AFR shall be of the wet well/dry well type, and shall be housed in a building.

c) Odor control and ventilation requirements shall be in accordance with SAES-A-104.

d) All lift stations shall have facilities for bypassing the wet wells and pumps.

e) Covers for wet wells shall be aluminum, fiberglass, or concrete. The interior surface of the concrete cover shall be lined with a nonmetallic corrosion-resistant material such as PVC, or coated with APCS-19B per SAES-H-101; and exterior concrete surfaces shall be coated with APCS-1B coating system per SAES-H-003. Steel covers are not permitted.

5.3.2 Pumps

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

b) Lift stations shall use two or more pumps. The group of pumps shall consist of an operating pump or a group of equal capacity operating pumps, and one equal capacity standby pump. The total minimum capacity of the operating pumps (exclusive of the standby pumps) must be greater than or equal to the PFR.

c) All pumps shall be specifically designed for pumping sewage and shall be capable of passing a 75 mm sphere.

Exception:

If a sewage pump is not available that is capable of passing 75 mm sphere due to low flow requirement, then pump with smaller than 75 mm outlet may be used for the service, provided the pump is equipped with a grinder upstream of the pump impeller.

d) Pumps shall be nonclog type.

e) Lift station pumps with suction lifts are prohibited.

5.3.3 Wet Well Operating Volume Sizing

a) The lift station wet well operating volume shall be sized according to the following equation:

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

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 = pump capacity, m^3/min (gallon/minute).

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

Editorial: This requirement is to provide enough storage volume to prevent short cycling of pump and motor. It restricts the time between starts of the pump motor to the minimum 15 minutes. It does not restrict the pump running time.

b) The wet well operating volume shall be based on the sum of the volumes calculated for each operating pump using the equation in Paragraph 5.3.3.a.

5.3.4 The following requirements apply to lift stations that discharge directly to a mechanical-type sewage treatment plant.

a) Such lift stations shall use two or more pumps. The group of pumps shall consist of an operating or a group of equal capacity operating pumps and one equal capacity standby pump.

b) The wet well operating volume shall be sized to provide for diurnal flow rates and shall comply with Paragraph 5.3.3 of this standard.

c) Such lift station shall be designed to supply as continuous and uniform flow as possible.

5.3.5 Wet Well Lift Stations

Wet well lift stations shall meet the following minimum requirements:

a) The pumps shall be spaced to prevent vortexing cavitations when the pumps are operating. In addition to the operating volume as per paragraph 5.3.3, the wet well volume must include enough

volume to prevent suction vortexing with at minimum of 0.5 meter vertical distance between the pump intake and the bottom of the operating volume. The operating volume must have enough volume and vertical height for controls to operate properly. Volume for high-level alarms shall be provided in addition to the operating volume.

b) It shall be possible to remove the pumps without disturbing the discharge piping. Lift stations with submersible pumps or vertical line shaft pumps shall have permanent guide rails for removing the pumps. Such guide rails shall be of type 316 stainless steel. Lifting monorail beams or davit shall be provided for equipment heavier than 70 kilograms.

c) The pump shut-off level shall not be less than 300 mm above the pump suction level or not less than the distance recommended by the pump manufacturer, whichever is greater.

d) Wet well high liquid level shall be at least 300 mm below the invert of the lowest incoming sewer.

e) Bolted-down steel hatches shall be provided for the removal of each pump and for personnel ingress/egress into the wet well.

f) The wet well shall have a corrosion resistant access firmly affixed to the interior wet well wall. Ladders shall be rail type that meets ANSI A14.3. Grab bars are prohibited. Ladder shall be of fiberglass material or plastic coated aluminum.

g) The wet well shall be of air tight construction and shall have a minimum size of 75 mm gooseneck vent that terminates not less than 3 m above the lift station deck level.

h) Emergency pump connections shall be provided on the inlet sewer and on the force main.

i) Concrete shall have a minimum compressive strength of 27.6 MPa (4000 psi).

j) The interior of the concrete wet well shall be internally lined with a nonmetallic corrosion-resistant material such as PVC, or coated with APCS-19B per SAES-H-101 and externally below grade with APCS-10 bituminous paint per SAES-H-100 or better. Exterior concrete surfaces above grade shall be coated with APCS-1B coating system per SAES-H-003. Before coating,

concrete shall be sealed with a low molecular weight epoxy sealer. (Refer to SAES-A-104).

k) Steel reinforcing bars in concrete shall be epoxy coated per 09-SAMSS-106.

5.3.6 Wet Well/Dry Well Lift Stations

Wet well/dry well lift stations shall meet the following minimum requirements:

a) Concrete shall have a minimum compressive strength of 27.6 MPa (4000 psi).

b) Non-skid corrosion resistant stairs or ladders shall be used for access to the dry well.

c) Electrical and electronical equipment and wiring shall be suitable for use in the electrical area classification designated by SAES-B-068 for the wet well, dry well or other part of the sewage lift station.

d) The dry well shall have a forced ventilation system. The ventilation system shall meet the requirements specified in SAES-A-104.

e) The dry well shall have an automatic sump pump with a standby pump that returns spills or wash-down water to the wet well.

f) The dry well deck shall have removable access covers for the removal of pumps and/or motors.

g) It shall be possible to remove the pumps and/or motors without disturbing the suction and discharge piping.

h) The wet well shall have a corrosion resistant access ladder firmly affixed to the interior wet well wall. Ladders shall be rail type that meets ANSI A14.3. Grab bars are prohibited. Ladder shall be of fiberglass material or plastic coated aluminum.

i) Wet well high liquid level shall be at least 300 mm below the invert of the lowest incoming sewer.

j) The wet well shall have a minimum size of 75 mm gooseneck vent that terminates not less than 3 m above the lift station deck level.

k) Emergency pump connections shall be provided on the inlet sewer and on the force main.

l) The interior of the concrete wet well shall be internally lined with a nonmetallic corrosion-resistant material such as PVC, or coated with APCS-19B per SAES-H-101 and externally below grade with APCS-10 bituminous paint per SAES-H-100 or better. Exterior concrete surfaces above grade shall be coated with APCS-1B coating system per SAES-H-003. Before coating, concrete shall be sealed with a low molecular weight epoxy sealer. (Refer to SAES-A-104)

m) Steel reinforcing bars in concrete shall be epoxy coated per 09-SAMSS-106.

n) Pump motors shall be either dry-pit submersible type or TEFC type located above grade with drive shaft.

o) It shall be possible to remove the pumps without disturbing the discharge piping. Lifting monorail beams and lifting devices shall be provided for equipment heavier than 70 kilograms.

5.3.7 Lift Station Enclosures

a) Lift stations in residential areas shall be placed within 3 m high decorative block wall enclosures. The enclosure shall have a lockable double gate for vehicle access and a separate lockable pedestrian gate. The gates shall be of the decorative type and equivalent to at least Type V fence construction, in accordance with SAES-M-006.

b) Lift stations outside of plant areas shall be enclosed with Type IV fence. The enclosure shall have one lockable double gate for vehicle access and one lockable Type IV fence pedestrian gate in accordance with SAES-M-006.

c) Power supply transformers and associated equipment within lift station enclosures shall be separated from the lift station facilities by a Type V fence, in accordance with SAES-M-006. The power supply area shall have an independent lockable gate entrance in the enclosure wall or fence.

d) A power supply area that is independent of the lift station shall be enclosed by a 3 m-high wall in residential areas or by Type IV fence, in accordance with SAES-M-006, in plant areas.

Residential gates shall be of the decorative type and equivalent to Type V fence, in accordance with requirements for construction in SAES-M-006. Plant area gates shall be Type IV fence, in accordance with requirements for construction in SAES-M-006.

5.3.8 Lift Station Power Supply

Each lift station shall have two independent power supply sources, each fed from separate transformers. The power supply sources shall be interconnected with an automatic transfer switch to provide a continuous source of power to the lift station. Emergency generator may also be used as a second power source.

Exception:

Power feeds from a secondary selective bus system with automatic transfer scheme fulfills the above requirement.

5.3.9 Lift Station Control Systems

5.3.9.1 Lift station control systems shall consist of wet well liquid level sensing devices, a motor control panel, and an alarm system.

5.3.9.2 Wet well liquid level sensing devices shall meet the following requirements:

(a) The device shall be either sealed, single-pole, float sensors, conductance-actuated electrodes, admittance probes or ultrasonic probes.

(b) The sensing devices shall be in a stilling enclosure.

5.3.9.3 Sensors for a duplex pump system shall be set to provide the following:

a) Low Level Sensor: All pumps off.

b) First Level Sensor: Lead pump on.

c) Second Level Sensor: Both pumps on.

d) High Level Sensor: Actuate high level alarm.

5.3.9.4 Lift station motor control panels shall have the following features:

a) NEMA Type 1 motor control enclosures with gasketed doors shall be used inside of buildings. NEMA Type

4X with a separate weather and dust proof lock or provisions for locking shall be used outside of buildings. The enclosure shall be of dead front construction and shall have two doors and two compartments that are separated by a barrier. One compartment shall house the motor starter package and the other shall house the liquid level and alarm controls. The doors shall overlap to prevent them from being opened with the pump motor disconnect devices in the "ON" position.

b) Circuit breakers shall be provided for each motor. The handle mechanisms shall be through-the-door linear drive, shall be mounted directly to the front of the disconnect device, and shall be capable of being locked in the "OFF" position. The mechanism shall be interlocked with the door and must be in the "OFF" position before the door can be opened.

c) Motor starters shall be full voltage, nonreversing magnetic, with overload relay protection. The heater coil rating shall be adjustable within 6% of full load motor current.

d) Control transformers equipped with an integral fuse block for secondary protection shall be provided for each starter.

e) The pump alternator shall be a motor driven device with three separate Single Pole Double Throw (SPDT) micro-switches that are positioned by cams located on the shaft of the motor.

f) Liquid level controls shall be off/on switch devices that open and close in response to predetermined liquid elevations and that cause the pump(s) to start or stop.

g) A Double Pole Double Throw (DPDT) control circuit power switching plug-in relay shall be provided to enable each motor disconnect device to provide a continuous 120-volt nominal source of power to the alarm system, to the DPDT plug-in alarm "OFF" relay, to the liquid level controls, and to the moisture detection controls for submersible pumps.

h) Submersible pumps shall have probes within the oil reservoir for the purpose of detecting a leakage of the outer seal of the motor. A warning light, a test light, and a test push button shall be provided for each motor.

5.3.9.5 Alarm systems shall be in accordance with SAES-A-104.

5.3.10 Force Mains

a) Design of force mains shall be based on effluent velocity between .77 meter per second (2.5 fps), and the maximum allowable velocity listed in SAES-L-032 under "Water Sea/Saline" for different piping material.

b) Force main shall be at least one pipe size larger than the pump discharge size.

c) Thrust blocks for underground force mains shall be provided in accordance with SAES-S-070, paragraph 17.

d) All force main connections to a gravity sewer system shall be through a manhole.

e) Air release and vacuum relief valves shall be installed at all high points.

f) Drain valves with drain lines to sewers shall be installed at all low points. This does not apply at the pump connections and the force main outlet.

6 Materials, Installation and Testing

6.1 Materials

6.1.1 Following are the acceptable materials for underground gravity sanitary sewer piping in hydrocarbon handling areas.

a) 80FEOD as per SAES-L-005; RTR (fiberglass) Sewer Pipe and Fittings, as specified in 01-SAMSS-029.

b) High Density Polyethylene (HDPE) pipe liner, as specified in ASTM D3350, ASTM F1248 and ASTM F714. This material shall be used only for sliplining of existing sanitary sewer pipes. The procedure of sliplining shall be in accordance with ASTM F585. This material may only be used for the repair of existing systems.

c) Rehabilitation of existing sanitary sewer pipes by the inversion and curing of a resin-impregnated tube (Cured-In-Place Pipe) in accordance with ASTM F1216. This material may only be used for the repair of existing systems.

6.1.2 Following are the acceptable materials for underground gravity sanitary sewers in all areas other than hydrocarbon handling areas; and above ground gravity sanitary sewers for all areas, unless otherwise prohibited by other Saudi Aramco Engineering Standards.

a) Materials listed in Paragraph 6.1.1.

b) 80PVOD as per SAES-L-005; PVC pipe, 300 mm or less diameter, SASO SSA/14, Class 3. Joints shall be solvent cemented per ASTM D2855 (cement per ASTM D2564) or elastomeric ring gasket conforming to ASTM D3212.

c) 80PVOD1 as per SAES-L-005; PVC pipe, ASTM D2665 and ASTM D3311, Schedule 40. This material may only be used for the repair of existing systems. Joints shall be solvent cemented per ASTM D2855 (cement per ASTM D2564) or elastomeric ring gasket conforming to ASTM D3212.

d) High Density Polyethylene (HDPE) pipe as specified in ASTM D3350 with Cell Class PE345434C minimum, ASTM F1248 and ASTM F714. The joints shall be butt fusion welded, or socket fusion welded. This material is also permissible for use as a pipe liner in existing sewer pipe. The procedure of sliplining shall be in accordance with ASTM F585.

6.1.3 Following are the acceptable materials for underground and above ground force mains in hydrocarbon handling areas:

a) 12FEOU as per SAES-L-005; RTR (Fiberglass) Pressure Pipe as specified in 01-SAMSS-034.

b) High Density Polyethylene (HDPE) pipe liner, as specified in ASTM D3350, ASTM F1248 and ASTM F714. This material shall be used only for sliplining of existing sanitary sewer pipes. The procedure of sliplining shall be in accordance with ASTM F585. This material may only be used for the repair of existing systems.

6.1.4 Following are the acceptable material for underground and above ground force mains in all other areas other than hydrocarbon handling areas; and

above ground force mains for all areas, unless otherwise prohibited by other Saudi Aramco Engineering Standards.

a) Materials listed in Paragraph 6.1.3.

b) 12PVOU as per SAES-L-005; PVC pipe, SASO SSA/14, Class 5, for underground application only.

c) 12PVOU as per SAES-L-005; PVC pipe, ASTM D1785, Schedule 80. This material may only be used for the repair of existing systems. Joints shall be solvent cemented per ASTM D2855 (cement per ASTM D2564) or elastomeric ring gasket conforming to ASTM D3212, for underground application only.

d) High Density Polyethylene (HDPE) pipe as specified in ASTM D3350, ASTM F1248 and ASTM F714, for underground application only.

6.1.5 Following are the acceptable materials for vent piping:

a) 12FEOU as per SAES-L-005; RTR (fiberglass) Pressure pipe as specified in 01-SAMSS-034.

b) Steel pipe, ASTM A53, or API 5L Grade B, Standard Weight, galvanized; and shall be coated externally in accordance with SAES-H-002.

6.2 Installation

PVC, HDPE and RTR (fiberglass) pipes, for sanitary sewer system, shall be installed in accordance with SAES-S-070.

6.3 Testing, Inspection and Backfilling

Gravity sanitary sewers, gravity sanitary sewer manholes and sanitary sewer force mains shall be hydrostatically tested, inspected, repaired and backfilled in accordance with SAES-S-070.

Revision Summary

31 December 2002 Major revision.