

Engineering Standard

SAES-S-070

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Installation of Utility Piping Systems

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Saudi Aramco DeskTop Standards

Table of Contents

1	Scope.....	2
2	Conflicts and Deviations.....	2
3	References.....	3
4	General Requirements.....	6
5	Storage and Handling.....	6
6	Transportation.....	8
7	Inspection Before Assembly.....	8
8	Qualifications of Installers of Plastic Piping...	8
9	Trenching and Bedding for Underground Piping.....	9
10	Assembly of Thermoplastic Piping.....	12
11	Assembly of RTR Piping.....	13
12	Assembly of HDPE (High Density Polyethylene) Pipe.....	14
13	Assembly of Cast Iron Soil Pipe.....	14
14	Assembly of Ductile Iron Pipe.....	15

Table of Contents (Cont'd)

15	Connections Between Dissimilar Piping Materials.....	15
16	Laying RTR Piping in the Trench.....	15
17	Thrust Blocks.....	16
18	Hydrostatic Testing.....	16
19	Inspection.....	18
20	Repair Methods.....	19
21	Backfill.....	19
22	Preparation for Use.....	20

1 Scope

- 1.1 This Saudi Aramco Engineering Standard (SAES) defines the minimum mandatory requirements for the installation of non-electric utility piping systems in all areas except the following:
- a) Installation of metallic piping system within plant areas including those on offshore structures shall be in accordance with SAES-L-350.
 - b) Plumbing systems in buildings, regardless of its locations, shall be in accordance with SAES-S-060.
- 1.2 Metallic piping system, except cast iron and ductile iron piping, shall be installed in accordance with "L" series of Saudi Aramco Engineering Standards.
- 1.3 Utility piping includes:
- a) Potable water system (drinking water and raw water); refer to SAES-S-040;
 - b) Raw/fire combined water system; refer to SAES-S-040;
 - c) Dedicated firewater system; refer to SAES-B-017;
 - d) Sanitary sewers; refer to SAES-S-010;
 - e) Industrial drains and sewers; refer to SAES-S-020.
- 1.4 This standard is also applicable for installation of nonmetallic piping in process application and other than non-electric utility systems.

2 Conflicts and Deviations

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

All referenced specifications, standards, codes, forms, drawings and similar material (including all revisions, addenda and supplements) shall be of the latest issue unless stated otherwise.

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-A-004</i>	<i>General Requirements for Pressure Testing</i>
<i>SAES-A-104</i>	<i>Wastewater Treatment, Reuse and Disposal</i>
<i>SAES-A-114</i>	<i>Excavation and Backfill</i>
<i>SAES-B-017</i>	<i>Firewater System Design</i>
<i>SAES-B-067</i>	<i>Safety identification and Safety Colors</i>
<i>SAES-L-350</i>	<i>Construction of Plant Piping</i>
<i>SAES-L-460</i>	<i>Pipeline Crossings Under Roads and Railroads</i>
<i>SAES-L-610</i>	<i>Nonmetallic Piping</i>
<i>SAES-Q-006</i>	<i>Asphalt Concrete Paving</i>
<i>SAES-S-010</i>	<i>Sanitary Sewers</i>
<i>SAES-S-020</i>	<i>Industrial Drainage and Sewers</i>
<i>SAES-S-040</i>	<i>Saudi Aramco Water Systems</i>
<i>SAES-S-050</i>	<i>Sprinkler and Standpipe Systems in Buildings</i>
<i>SAES-S-060</i>	<i>Saudi Aramco Plumbing Code</i>

Saudi Aramco Materials System Specifications

<i>01-SAMSS-024</i>	<i>Pipe Handling and Nesting</i>
<i>01-SAMSS-029</i>	<i>Unrestrained Gasketed Joint RTR Sewer Pipe and Fittings</i>
<i>01-SAMSS-034</i>	<i>RTR (Fiberglass) Sewer Pipe and Fittings for Gravity Flow</i>

Saudi Aramco General Instructions

<i>GI-0151.006</i>	<i>Implementing the Saudi Aramco Sanitary Code</i>
<i>GI-1021.000</i>	<i>Street and Road Closure: Excavations, Reinstatement and Traffic Controls</i>

Saudi Aramco Standard Drawings

<i>AB-036155</i>	<i>Supports for Plastic Piping</i>
<i>AC-036660</i>	<i>Non-Sleeved Road Crossing for Pipelines</i>
<i>AB-036880</i>	<i>Sleeved Crossing for Restrained Pipelines</i>
<i>AA-036865</i>	<i>Cathodic Protection Electrical Insulating / Isolating Assemblies</i>

Saudi Aramco Library Drawing

<i>DB-950078</i>	<i>Concrete Thrust Blocks, Details for Utility Pipelines (for reference only)</i>
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Other References

Saudi Aramco Construction Safety Manual

Saudi Aramco Sanitary Code

3.2 Industry Codes and Standards

American Society of Mechanical Engineers

<i>ASME B31.3</i>	<i>Chemical Plant & Petroleum Refinery Piping</i>
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American Society for Testing and Materials

<i>ASTM D698</i>	<i>Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. (2.49 kg) Rammer and 305 mm Drop</i>
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<i>ASTM D1556</i>	<i>Density of Soil in Place by the Sand-Cone Method</i>
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<i>ASTM D1557</i>	<i>Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. (4.54 kg) Rammer and 457 mm Drop</i>
<i>ASTM D1559</i>	<i>Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus</i>
<i>ASTM D2321</i>	<i>Underground Installation of Flexible Thermoplastic Sewer Pipe</i>
<i>ASTM D2564</i>	<i>Solvent Cement for PVC Plastic Pipe and Fittings</i>
<i>ASTM D2855</i>	<i>Making Solvent Cemented Joints with PVC Pipe and Fittings</i>
<i>ASTM D2922</i>	<i>Density of Soil and Soil-Aggregate in Place by Nuclear Method</i>
<i>ASTM D4253</i>	<i>Maximum Index Density of Soils Using Vibratory Table</i>
<i>ASTM D4254</i>	<i>Minimum Index Density of Soils and Calculation of Relative Density</i>
<i>ASTM F402</i>	<i>Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings</i>
<i>ASTM F493</i>	<i>Solvent Cements for CPVC Plastic Pipe and Fittings</i>
<i>ASTM F585</i>	<i>Insertion of Flexible Polyethylene Pipe into Existing Sewers</i>

American Water Works Association

AWWA C950 Fiberglass Pressure Pipe

The Plastics Pipe Institute

PPI Handbook of Polyethylene Pipe

Polyethylene Joining Procedures

Underground Installation for Polyethylene Plastic Pipe

4 General Requirements

4.1 Nonmetallic piping System

- a) Requirements and limitations for installation of nonmetallic piping shall be in accordance with SAES-L-610.

- b) Flexibility, support and anchoring requirements shall be in accordance with ASME B31.3 and SAES-L-610.
 - c) Aboveground installation requirements, except as stated above in paragraph 4.1.a, shall be in accordance with ASME B31.3 and Saudi Aramco Standard Drawing AB-036155.
 - d) Prior approval from the Chairman of Plumbing and Utilities Standards Committee is required for installation of nonmetallic piping under slabs or similar concrete structures.
- 4.2 Gasket material including elastomeric seals shall be suitable for the type of fluid used, and the environment to which it will be exposed.
- 4.3 Every precaution shall be taken to locate, protect and support existing services during excavation, pipe-laying and backfilling operations.
- 4.4 Color coding of utility piping, installed above ground or below ground shall be in accordance with SAES-A-104 and SAES-B-067.
- 4.5 CLEAN SAND used for bedding and backfilling (refer to SAES-A-114), shall consist of either of the following:
- a) Dune sand, meeting the gradation listed below.
 - b) Soil material, meeting the gradation listed in Table 5 of this Standard, which contains less than 3% inorganic material, marl and clay.

Table 5 – Gradation

Sieve Size	% Passing
6.25 mm	100
No. 10 (2.00 mm)	90-100
No. 200 (0.075 mm)	10 or less

5 Storage and Handling

- 5.1 Handling and storage of metallic pipe shall be in accordance with 01-SAMSS-024.
- 5.2 Nonmetallic pipe (thermoplastic and RTR pipe) shall be stored as follows:
- a) Pipe shall be stored out of direct sunlight in a building or under a cover that allows free air circulation.
 - b) Racks shall conform to factory shipping packages for each pipe size. Shelves shall be provided for continuous support of the pipe.
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- c) If loose pipes are stacked on each other, the stack height shall not exceed 1.5 m. Adequate side support shall be provided to prevent slipping or rolling.
 - d) If pipe is stored on racks or bearing boards, the supports shall be at least 75 mm wide. Supports shall be spaced on 3 m centers maximum with the first supports 1.5 m from the end of the pipe.
 - e) All supporting surfaces shall be free of sharp objects.
- 5.3 Thermoplastic and RTR fittings shall be stored in their original containers. Fittings shall be stored in a building or under a cover that allows free air circulation.
- 5.4 Solvent cement and primer for thermoplastic piping shall be stored in an air-conditioned building with a maximum temperature of 26.7°C.
- 5.5 Gaskets, O-rings, and locking keys shall be stored flat on racks below 38°C and out of direct sunlight.
- 5.6 Adhesive for RTR piping shall be stored in an enclosure where temperatures do not exceed 38°C.
- 5.7 Pipe and fittings shall be properly protected from impact, especially on their ends. They shall not be thrown, dropped, bumped, hit, or dragged and pushed over abrasive surfaces.
- 5.8 Loose thermoplastic or RTR pipe shall be handled by hand or, if the pipe is too heavy, using nylon or cotton strap spreader slings.
- 5.9 Adhesive and solvent cement containers shall be tightly closed when not in use, and shall be returned to the storage facilities to minimize exposure to excessive temperatures.
- 5.10 Solvent cement and primer for thermoplastic and RTR piping should not be stored if no expiration date is clearly marked on the container.

6 Transportation

- 6.1 Thermoplastic pipe shall have continuous support along its entire length when being transported by either truck or pipe trailer. All sharp edges that could touch the pipe shall be padded with sacks, rubber strips, or other suitable material.
- 6.2 Bearing boards at least 75 mm wide shall be used to protect RTR pipe from sharp objects on the truck beds. Rubber tire sections or other suitable material shall be attached to the bearing boards. Support spacing and height limits shall
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follow paragraph 5.2, except that the end support shall not be more than 1 m from the ends of the pipe.

- 6.3 Thermoplastic and RTR pipe shall be secured with cotton or nylon straps.
- 6.4 Solvent cement primer and adhesive containers shall be protected from direct sunlight.

7 Inspection before Assembly

- 7.1 Each piece of thermoplastic pipe and fitting shall be examined for cuts, scratches, gouges, kinks, buckles, and ultra-violet (sun) damage. Damaged lengths of pipe shall be cut out and discarded. Damaged fittings shall be discarded. Thermoplastic pipe and fittings that show ultra-violet damage and weathering effects shall not be used.
- 7.2 All RTR pipe and fittings shall be visually inspected for scratches, damaged ends, cracks, delamination, crushing, weathering, and cracked O-rings and gaskets. Visual acceptance limits on allowable defect on RTR pipe and fittings shall be in accordance with Table 2 of 01-SAMSS-029 and 01-SAMSS-034. Damaged pipe and fittings shall not be installed.
- 7.3 Ductile iron and cast iron soil pipe and fittings shall be examined. Damaged pipe and fittings shall not be installed.
- 7.4 Pipe and fittings shall be cleaned and dried before installation.
- 7.5 Any primer, solvent cement, or adhesive that is beyond the stamped expiration date shall be discarded. Solvent cement that has gelled or thickened shall be discarded. Leaking or opened containers shall also be discarded.

8 Qualifications of Installers of Plastic Piping

- 8.1 The installation of plastic piping shall be done by personnel trained in the proper handling and usage of applicable materials and equipment prior to the start of installation. Instructions for jointing thermoplastic piping are covered in Section 9 of this Standard. Installation instructions for jointing RTR piping shall be in accordance with the manufacturer's recommendations or a specified jointing procedure developed for the specific job.
 - 8.2 Training shall include familiarization and proper handling of the materials, use of the equipment, and the manufacturer's installation instructions. Each person performing installation shall assemble a trial joint with the same type of materials and techniques to be used in the actual installation. The test joints shall be hydrotested at least 1.5 times the maximum design pressure of the
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piping system but not less than 150 psig for minimum two hours. The test joints shall not be incorporated into the permanent piping system or actual installation.

- 8.3 A training log shall be maintained by the installing organization to indicate the names of the trained individuals, the date of instruction, the instructor, the product, and the manufacturer' name who issued the training certificate or a proof of training.
- 8.4 Training certificate (or a proof of training) for installing RTR piping system must be obtained from any RTR piping manufacturer. This certificate is valid for one year or the duration of the project, which ever is the farthest.

9 Trenching and Bedding for Underground Piping

- 9.1 All excavations shall be restored so its surface contour blends in with the surrounding area. Areas of roadways and pavement shall be excavated and restored in accordance with SAES-Q-006 and GI-1021.000.
 - 9.2 If trench de-watering is necessary no construction shall start until the design of the de-watering system has been approved by the Saudi Aramco Representative. Trench de-watering system shall be in accordance with SAES-A-114. De-watering systems shall not discharge into existing sewers or completed sections of new sewers without the approval of the authorities having jurisdiction on the maintenance of the sewer systems. It shall also not discharge into open surface areas without the approval of the authorities having jurisdiction on the maintenance of the area.
 - 9.3 The bottom of the trench shall be dry or sufficient drained so that there is no standing water before the support and bedding layers are placed and compacted. The bedding layer must be sufficiently drained so that there is no standing water on the bedding layer before the pipe is installed.
 - 9.4 At the end of every work shift, personal performing the pipe installation shall ensure that the pipe ends are capped to prevent the egress of foreign material, and the piping is anchored to prevent floatation.
 - 9.5 The depth of the trench shall be dug deep enough to provide a minimum ground cover above the top of the pipe, as required in Table 2 of this Standard, and a ground bed of at least 150 mm in depth below the bottom of the pipe.
 - 9.6 The width of the trench should be wide enough to allow room for jointing, but in any case not less than shown in Table 1 of this Standard.
 - 9.7 Bedding requirements shall be as follows:
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- 9.7.1 The ground bed shall provide uniform and adequate support and drainage along the entire length of the piping. A base support layer is not required for most trenches. In subkha areas, a base support layer of crushed stone base material 150 mm deep is required. The crushed stone base shall meet the requirements of class B base material as defined in SAES-Q-006 Table A, and shall be compacted to at least 95% of ASTM D698. A non-woven geotextile with a unit weight of at least 100 g/m² must be placed between the crushed stone and the sand bedding layer to prevent filtration of the sand bedding into the crushed stone matrix. Alternatively, a double layer of sand bags may be used for a base support layer, with approval from the chairman of Plumbing and Utilities Standards Committee.
- 9.7.2 A bedding layer of clean sand 150 mm in depth is required for all trenches. The sand shall be free of debris and rocks and compacted to at least 70% relative density in accordance with ASTM D4253 and ASTM D4254. Compaction by water flooding is allowed for clean, freely-draining sand provided the excess water is continuously collected in sumps and pumped out of the trench. Maximum and minimum densities of a representative bedding sample shall be determined in accordance with ASTM D4253 and ASTM D4254 for all locations. In-place density and moisture content methods and frequency of testing shall be in accordance with SAES-A-114.
- 9.7.3 In trenches containing firewater lines and piping with internal pressure in excess of 200 psi, a non-woven geotextile with a unit weight of at least 130 g/m² should enclose the clean sand bedding layer and backfill materials as follows: The geotextile should be placed on the trench bottom and along the sides. The bedding layer is placed and compacted, the pipe laid, and the trench backfilled up to 150mm above the pipe. The geotextile is folded over the backfill, overlapping the full trench width, and backfill placement and compaction is continued as normal. Geotextile sections should overlap a minimum of 200 mm.
- 9.8 The trench bottom shall be continuous, smooth, free of rocks, and to the line and grade shown on the installation drawings. The pipe shall have essentially continuous support and not rest on the joint. For RTR piping, the trench contour shall not cause the joint angular deflection or the pipe-bending radius to exceed the manufacturer's limit.
- 9.9 The minimum trench width from the bottom to 300 mm above the top of the pipe shall be as shown in Table 1 of this Standard.
- 9.10 Sheeting or shoring shall be in accordance with the Saudi Aramco Construction Safety Manual, Section II. The Contractor and installer shall provide all
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underpinning, bracing, and shoring necessary to protect and preserve all existing buildings, fences, walls, utilities, and other structures.

- 9.11 Unless live loads, dead loads, pipe deflections, and pipe stresses are calculated by a method acceptable to the Consulting Services Department (CSD) to verify the adequacy of pipe with less cover, and unless manufacturer's recommendation requires deeper burial, the minimum cover over the top of the pipe shall be as shown in Table 2.
- 9.12 The minimum ground cover requirements, shown in Table 2 of this Standard, reflect normal vehicle loading up to AR-40, as defined in SAES-L-460, and a maximum deflection of 5%. For rig, railroad and runway crossings deeper burial or use of steel sleeves shall be evaluated after calculations are made.
- 9.13 Piping shall have steel sleeves at road crossings and railroad crossings in accordance with Saudi Aramco Standard Drawing AC-036660 or AB-036880.
- 9.14 If it is impossible to achieve the minimum cover as specified in this Standard, the piping shall be protected by a reinforced concrete slab, or metallic casing in accordance with SAES-L-460. A prior approval from the Chairman of Plumbing and Utilities Committee must be obtained.

Table 1 – Trench Width

Type of Pipe	Nominal Pipe Size (mm)	Min. Width of Trench (mm)
Thermoplastic	90 and under	300
Thermoplastic	110 and over	O.D. + 300
RTR	250 and under	O.D. + 300
RTR	300-600	2 x O.D.
RTR	Over 600	O.D. + 600
Cast iron soil	All	O.D. + 400
Ductile iron	All	O.D. + 400

Table 2 – Minimum Cover Over Top of Pipe

Type of Pipe	Nominal Pipe Size and Service	Minimum Cover (mm)
Thermoplastic	Sewers, gravity flow	900
Thermoplastic	Pressure pipe under 100 mm size	600
Thermoplastic	Pressure pipe 100 mm and larger sizes	900
Thermoplastic	Irrigation, under 90 mm size	300 ⁽¹⁾
Thermoplastic	Irrigation, 90 mm and larger	600
RTR	Under 150 mm size	600
RTR	150 mm and larger	900
Cast iron soil	Typical	900
Ductile iron	Typical	900

Note (1): 600 mm under paved roads.

10 Assembly of Thermoplastic Piping

- 10.1 Primer and solvent cement shall be handled in accordance with the safety precautions in ASTM F402 for restrained type joints.
- 10.2 Solvent cement shall not be used past the manufacturer's expiry date on the label or one year past the date of manufacture if there is no expiry date specified.
- 10.3 Joints shall be made in accordance with ASTM D2855 for PVC and ASTM F493 for CPVC. Solvent cement shall conform to the following ASTM Designations:

ASTM D2564 for joining PVC to PVC, and
ASTM F493 for joining CPVC to CPVC or PVC.

After the joint has been made, the piping shall not be moved until the drying time listed in Table 3 of this Standard, has elapsed. To limit movement of a pipe string, the first pipe shall be backfilled with the joint exposed.

Table 3 - Joint Drying Time Before Movement

Through Nominal Pipe Sizes (mm)	Surface Temperature ⁽¹⁾		
	Hot Weather Above 32 - 65°C	Mild Weather 10 - 32°C	Cold Weather Below 10°C
32	12 min	20 min	30 min
63	30 min	45 min	60 min
110	45 min	60 min	90 min
225	60 min	90 min	150 min

Note (1): These temperatures are pipe surface temperatures and are not air temperature limitations.

- 10.5 Field-fabricated, mitered fittings shall not be used.
- 10.6 Thermoplastic flanges when used, shall be of flat face. Mating flanges of different approved material shall also be of flat face. They shall be assembled with full-face elastomeric gaskets, 3 mm thick, and 50 to 60 Shore A Durometer hardness. Refer to paragraph 4.2 of this Standard for gasket material requirements.

Exception:

Ribs on the flat surface of a flange for enhancing the leak proofing ability of the flange are acceptable. Such flanges shall be assembled with full-faced gasket.

Thickness of the gasket shall be as per the flange manufacturer's recommendations.

- 10.7 Flat washers shall be used under nuts and bolt heads on nonmetallic flanges.
- 10.8 Flange pressure rating requirements, and bolt tightening procedures and maximum torque requirements shall be in accordance with SAES-L-610.

11 Assembly of RTR Piping

- 11.1 Joints shall be of restrained type (adhesive-bonded, butt-and wrap lamination joints, or mechanical type joints), or unrestrained type (gasketed bell-and-spigot type joints), as defined in AWWA C950, Section 2.7. These joints shall be assembled in accordance with the manufacturer's procedures for a specific application. Heating blankets shall be used to cure adhesive bonded joints.
 - 11.2 RTR flanges when used shall be of flat face. Mating flanges of different approved material shall also be of flat face. They shall be assembled with full-face elastomeric gaskets, 3 mm thick, and 50 to 60 Shore A Durometer hardness. Refer to paragraph 4.2 of this Standard for gasket material requirements. RTR flanges with factory manufactured confined O-ring gasket groove is also acceptable.
 - 11.3 Flat washers shall be used under nuts and bolt heads on nonmetallic flanges.
 - 11.4 Flange pressure rating requirements, and bolt tightening procedures and maximum torque requirements shall be in accordance with SAES-L-610.
 - 11.5 The following guidelines shall be used for assembly of threaded connections up to 75 mm nominal pipe size:
 - a) RTR piping shall not be threaded in the field.
 - b) Chipped or cracked RTR threads, flattened metallic threads, and metallic threads with burrs shall not be used.
 - c) Threads shall be cleaned with a suitable solvent to remove oil and grease.
 - d) Temporary connections shall use a Teflon-based pipe-thread sealant without lumps or metallic additives.
 - e) Permanent connections shall use an epoxy-resin pipe-joint adhesive.
 - 11.6 Field-fabricated mitered fittings shall not be used.
 - 11.7 1½ inch and smaller connections for instrumentation, vents and drains may employ the pipe manufacturer's recommended saddle type connection.
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12 Assembly of HDPE (High Density Polyethylene) Pipe

- 12.1 HDPE piping shall be installed as per the manufacturer's instructions in conjunction with PPI Handbook of Polyethylene Pipe.
- 12.2 Underground HDPE sewer piping shall be installed in accordance with ASTM D2321.
- 12.3 Sliplining of existing sewer pipe with HDPE pipe shall be in accordance with ASTM F585.
- 12.4 Flange adapters with metal back-up flanges may be used for mechanical joining HDPE pipe to other piping materials, valves, tanks, pumps and other equipment. In this case the flange adapters shall have equal pressure rating as of the HDPE pipe or higher. Such flange adapters shall be heat fused to the pipe as per paragraph 12.1 of this Standard.
- 12.5 Extrusion gun welding, pipe threading, and solvent or epoxy cementing are not permitted for joining of HDPE pipe.

13 Assembly of Cast Iron Soil Pipe

- 13.1 Lead joints shall be made with molten lead or lead wool and oakum. Lead joints may be tested for leakage immediately upon completion of the joints.
- 13.2 Joints with self-caulking compounds, joints with self-sealing compounds, and mechanical joints shall be made in accordance with the manufacturer's instructions.
- 13.3 Cast iron soil pipe shall be cut with a cold chisel or cast iron ratchet cutting tool. Pipe entering manholes shall be neatly cut to fit the inner face of the masonry.
- 13.4 Wye branches installed for future connections shall be plugged.

14 Assembly of Ductile Iron Pipe

Ductile iron pipe shall be assembled in accordance with the manufacturer's instructions.

15 Connections Between Dissimilar Piping Materials

- 15.1 Connections between dissimilar piping materials shall be made in a manner that does not disrupt the flow. All connections shall require prior approval from the Chairman of Plumbing and Utilities Standards Committee.

Exceptions:

- a) *Solvent-cemented joints between PVC and CPVC.*
- b) *Adapters with a thermoplastic socket end by a brass female-threaded end, up to and including 90 mm nominal pipe size.*
- c) *RTR male-threaded adapters in metallic female-threaded components. For buried connections, such metallic component shall be suitable for buried application.*
- d) *Mechanical couplings and flange coupling adapters. For underground installation, all components including bolts, washers, etc., shall be designed for buried application.*

15.2 Dissimilar metals shall be electrically insulated from each other. Refer to Saudi Aramco Drawing AB-036865 for insulating assemblies using flanges.

15.3 For firewater hydrants and associated piping refer to SAES-B-017, Figure 2.

16 Laying RTR Piping in the Trench

16.1 Unrestrained gasketed joint piping must be joined together in the trench.

16.2 Adhesive bonded and restrained gasketed joint piping of 250 mm nominal pipe size and less may be assembled next to, or in the trench. Piping larger than 250 mm nominal pipe size shall be assembled in the trench.

16.3 For trenches 2 m deep or less, pipe assembled next to the trench shall not be moved within three pipe lengths of an uncured joint. The pipeline shall be lowered into the trench progressively to avoid excessive joint angular deflection.

16.4 For trenches deeper than 2 m, pipe shall be assembled in the trench.

16.5 Geotextile shall be used depending upon the soil conditions to prevent soil wash away around the buried pipe.

17 Thrust Blocks

17.1 Thrust blocks (Saudi Aramco Library Drawing DB-950078, for reference only) shall be placed at every change in direction for thermoplastic and RTR piping with the following exceptions:

Exceptions:

- a) *Thrust blocks may not be necessary for piping in gravity flow systems.*
 - b) *Thrust blocks may not be required for 100 mm nominal pipe size and smaller piping with restrained joints, as defined in Sections 10 and 11 of this Standard.*
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- 17.2 If thrust block is required for RTR piping and thermoplastic piping in accordance with paragraph 17.1 of this Standard, a thrust resistance shall be provided prior to hydrostatic testing by temporary wooden supports. Alternatively, the contractor may choose to place concrete thrust blocks before hydrotest at the risk of having to remove and replace any thrust blocks on leaking components.
- 17.3 Thrust blocks shall not cover thermoplastic and RTR piping joints.
- 17.4 Plastic pipes such as PVC, UPVC, CPVC, RTRP, HDPE, PP etc shall be protected from contact with concrete by tape wrapping. Use SAMS stock number for tape wrap 09-966-251/254/257 or equivalent.
- 17.5 At the edges where a thermoplastic or an RTR pipe or fitting enters or leaves a thrust block, it shall be wrapped with neoprene wrapping that will protrude slightly from the block. The thickness and the width of wrap shall comply with Table 4 of this Standard, unless the manufacturer requires more than one piece of wrapping.

Table 4 – Neoprene Wrapping Requirements

Nominal Pipe Size (mm)	Thickness and Width of Tape Wrap for Various Operational Pressures (mm)		
	Atmospheric	To 1600 kPa (230 psig)	Over 1600 kPa (230 psig)
400 and smaller	12 x 150 mm	12 x 150 mm	24 x 250 mm
500 – 700	12 x 150 mm	24 x 150 mm	36 x 300 mm
800 and larger	12 x 300 mm	36 x 300 mm	36 x 300 mm

- 17.6 Vibrators shall be kept clear of the piping while casting concrete thrust blocks.

18 Hydrostatic Testing

- 18.1 Unless prevailing conditions or regulations require full backfilling of the piping prior to the hydrotest, underground piping shall be partially backfilled with all joints exposed during the hydrotest. The exposed joints shall be shaded from direct sunlight, and the hydrotest shall be performed so that the temperature of the thermoplastic piping material or the temperature of the test water does not exceed 40°C during the test period. If the test water is not available at or below 40°C, the resulting hydrostatic test pressure shall be calculated at the available test water temperature in accordance with the respective ASTM standards.
- 18.2 Hydrostatic testing fluids shall be as follows:
- a) Potable water (drinking water and raw water) piping systems shall be

- hydrotested with fresh potable water as defined in SAES-S-040.
- b) Other utility piping systems shall be hydrotested with potable water, well water or seawater.
- 18.3 No thermoplastic piping shall be pressurized until it has cured for 24 hours at a surface temperature of 10°C or higher, or for 48 hours at a surface temperature below 10°C.
- 18.4 No adhesive-bonded RTR piping shall be pressurized until it has cured in accordance with the manufacturer's instructions.
- 18.5 The test pump shall be placed on firm ground away from the piping. The pump and the piping system (piping and equipment) shall be protected from over-pressure by relief valve(s) of adequate capacity set at 5% above the test pressure or a maximum of 170 kPa (25 psig) above the test pressure for pressure piping systems. The relief valve(s) shall be tested, dated, and tagged within one week prior to the test. Sizing of relief valves used for testing shall be in accordance with SAES-A-004.
- 18.6 Requirements of pressure gauges and pressure recorders for pressure piping systems, calibration intervals, and calibration certificates shall be in accordance with SAES-A-004. Calibrated and tagged relief valve(s) may be used as the pressure test instrument upon written approval of the Manager, Inspection Department.
- 18.7 Gravity sewers shall be tested from manhole to manhole, or manhole to sump inlet. The upstream manhole may be tested at the same time.
- 18.8 Lines whose joints have been backfilled shall be tested at the following pressures for 24 hours. Lines whose joints have not been backfilled or are above ground shall be tested at the following pressures for 4 hours:
- a) Irrigation piping downstream of the pressure-reducing valve and/or backflow preventor: 690 kPa (100 psig).
 - b) Water distribution piping network, as defined in SAES-S-040, and fire hydrants connected thereto: 1035 kPa (150 psig) or 345 kPa (50 psig) above the maximum operating pressure, whichever is greater.
 - c) Dedicated firewater systems (except building firewater systems as covered in SAES-S-050) and fire hydrants connected thereto shall be tested in accordance with SAES-B-017 and SAES-A-004.
 - d) Sanitary sewer and storm water force mains: 1035 kPa (150 psig) or 345 kPa (50 psig) above the pump shut-off head, whichever is greater.
 - e) Gravity sanitary sewer pipe tested separately: a column of water equivalent
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to the rim elevation of the upstream manhole.

- f) All water and sewage (sanitary, chemical and industrial drainage and sewer as per SAES-S-020) retaining structures under atmospheric pressure such as tanks / holding tanks, manholes, sumps, catch basins, interceptors, lift stations, grease-traps etc may be tested separately, or as a part of the piping system test: filled to top of rim with water for 8 hours, then topped off to top of rim. Site testing shall take place prior to backfill and / or application of protective coatings.

Exception:

Factory fabricated or prefabricated water and sewage retaining structures as defined above may be hydrotested at the manufacturing site as standard quality control procedure. Such structures are exempted from the site hydrotest requirements. However, joints made on site and piping connections shall be hydrotested.

- g) Gravity storm water sewers and manholes not a part of an oily water sewer system: none, unless called for in the project specifications.
- h) Nonmetallic piping in non-hydrocarbon process applications: 1035 kPa (150 psig) or 345 kPa (50 psig) above the maximum operating pressure, whichever is greater.

18.9 Plumbing and utility systems within buildings shall be tested in accordance with the Uniform Plumbing Code (UPC), with the exceptions as listed in SAES-S-060.

18.10 Building firewater systems shall be tested in accordance with SAES-S-050.

19 Inspection

- 19.1 During hydrotest, all exposed pipe, joints, fittings, valves, and hydrants shall be carefully examined for leakage.
- 19.2 Leaking pipes, joints, and fittings shall be replaced in accordance with Section 20.
- 19.3 The hydrostatic test shall be repeated after the repair of any defects until the system is proved satisfactory.
- 19.4 The piping shall be satisfactory if there is no evidence of leakage or pressure loss after the specified test period.

20 Repair Methods

- 20.1 Permanent repairs for thermoplastic and RTR piping, if required, shall use one of the following:
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- a) Flanges and a flanged spool piece.
 - b) Spigot end adapters for restrained gasketed joint RTR piping, a spool with spigot ends, and bell-by-bell couplings.
 - c) Bell-by-bell couplings for flexible thermoplastic pipe or adhesive bonded RTR pipe.
 - d) Extra-long bells or spigots may be used to insert replacement spools in underground unrestrained gasketed joint RTR piping.
 - e) Field repair of RTR piping shall be made in accordance with the pipe manufacturers' pre-qualified repaired procedures.
- 20.2 Temporary repairs such as compression clamps and repair patches made of partial pipe sections, reinforcing saddles and overwrapping shall not be used for new construction in nonmetallic piping systems, except as permitted in Section 11.7 of this Standard.

21 Backfill

- 21.1 The clean sand bedding shall be compacted to 70% Relative Density (ASTM D4253/ASTM D4254). The clean sand from the bottom of the pipe to 300 mm above the top of the pipe (sand cover) shall be compacted by water flooding and hand tamping only. No compaction testing is required in this section of the trench.
- 21.2 Within 300 mm of the top of the pipe, backfill shall be hand tamped, or a board shall be used to protect the pipe from damage from vibratory plate compactors.
- 21.3 Backfill above 300 mm sand cover in Non-Traffic area shall be on site excavation or borrowed materials that meet the following conditions:
- a) Not more than 3% organic or decomposable material.
 - b) No debris.
 - c) A maximum particle size of 150 mm or one-half the lift thickness, whichever is smaller.
 - d) Minimum compaction shall be per Table 5 of this Standard.

Table 5 – Minimum Compaction

Non-traffic Areas	Traffic Areas
65% relative density per ASTM D4253/ASTM D4254	85% relative density per ASTM D4253/ASTM D4254
or	or
90% of maximum density per ASTM D698	95% of maximum density per ASTM D1557

Commentary Note:

Backfill materials compacted to the densities as specified above per ASTM D4253/ASTM D4254 or ASTM D698/ASTM D1557 whichever is applicable and gives the greater density.

- 21.4 Backfill above the 300 mm sand cover in Traffic Area shall meet the requirements of Section 21.3 of this Standard, except in the final 300 mm of the backfill. This part of the backfill that is the base of the asphalt pavement shall meet Class B base material as defined in SAES-Q-006, Table A.
- 21.5 Any sheeting and shoring shall be gradually removed as the backfill is placed. All voids under and behind sheeting shall be filled as sheeting is withdrawn.
- 21.6 Sheeting shall be cut and left in place where damage to the pipe may occur or failure of the trench walls may cause damage or failure of adjoining buildings or structures.
- 21.7 The pavement base course shall be of the same depth and material as the original base course. The edge of existing pavement and the base course shall be primed. The surface course shall be identical to the original surface course. The patch shall be rolled in both directions with a 5-ton roller so it is compacted to 96% of Marshall density in accordance with ASTM D1559.

22 Preparation for Use

- 22.1 Potable water (Raw water and drinking water) lines as covered in SAES-S-040 shall be disinfected in accordance with Saudi Aramco Sanitary Code (GI-0151.006), Section SASC-W-010 before they are placed in service.
- 22.2 Hypochlorites used in thermoplastic and RTR piping shall be in solution form.
- 22.3 Sewers shall be flushed with water to remove foreign matter.

Revision Summary

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| 28 January 2004 | Revised the "Next Planned Update". Reaffirmed the content of the document, and reissued with minor changes. |
| 28 September 2005 | Minor revision to paragraphs 9.7.2, 10.6 and 11.2. |