



Engineering Standard

SAES-L-110

18 May 2008

Limitations on Pipe Joints and Components

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Table of Contents

1	Scope.....	2
2	Conflicts and Deviations.....	2
3	References.....	2
4	Definitions.....	4
5	Welded Joints.....	5
6	Prohibited Piping Joints and Components.....	6
7	Threaded Joints.....	6
8	Flanged Joints.....	7
9	Seal Welding of Threaded Joints.....	8
10	Pipe Fittings General Requirements.....	9
11	Threaded and Socket Welding Fittings.....	9
12	Steel Butt Welding Fittings.....	10
13	Branch Connection Type and Fittings.....	10
14	Specialty and Proprietary Couplings.....	11
	Chart 1 – Branch Connections.....	12

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Revised paragraphs are indicated in the right margin

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Page 1 of 12

1 Scope

- 1.1 This Standard covers the limitations on various types of piping joints and components used in metallic piping for pressure piping systems within the context of [SAES-L-100](#).
- 1.2 This Standard covers additional requirements to ASME B31.1, B31.3, B31.4 and B31.8 piping codes and defines requirements governing the selection of metallic pipe fittings, bends, miters, laps, and branch connections for plant piping and pipelines. Tube fittings and other specialty fittings are outside the scope of this standard.

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 (CSD) 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-B-017](#)

Fire Water System Design

[SAES-L-100](#)

*Applicable Codes and Standards for Pressure
Piping Systems*

<u>SAES-L-101</u>	<i>Regulated Vendor Lit for Pipes, Fittings and Gaskets</i>
<u>SAES-L-109</u>	<i>Selection of Flanges, Stud Bolts and Gaskets</i>
<u>SAES-L-136</u>	<i>Pipe Selection and Restrictions</i>
<u>SAES-L-350</u>	<i>Construction of Plant Piping</i>
<u>SAES-W-011</u>	<i>Welding Requirements for On-plot Piping</i>
<u>SAES-W-012</u>	<i>Welding Requirements for Pipelines</i>
<u>SAES-W-013</u>	<i>Welding Requirements for Offshore Structures</i>

Saudi Aramco Materials System Specifications

<u>02-SAMSS-001</u>	<i>Piping Components for Low Temperature Service</i>
<u>02-SAMSS-005</u>	<i>Butt Welding Pipe Fittings</i>

Saudi Aramco Standard Drawings

<u>AD-036090</u>	<i>Joints for Welding Cement Lined Pipe</i>
<u>AE-036175</u>	<i>Detail of Welding Boss, Threaded Connection to Vessels and Lines</i>
<u>AC-036404</u>	<i>Flame Impingement Shield for Flangeless Valve</i>
<u>AE-036643</u>	<i>Heavy Welding Boss, Socket Weld Connections</i>
<u>AB-036719</u>	<i>Reinforcement of Welded Branch Connections</i>

3.2 Industry Codes and Standards

American Petroleum Institute

<i>API SPEC 6A</i>	<i>Wellhead and Christmas Tree Equipment</i>
<i>API STD 602</i>	<i>Compact Steel Gate Valves - Flanged, Threaded, Welding, and Extended-Body Ends</i>

American Society of Mechanical Engineers

<i>ASME B16.11</i>	<i>Forged Steel Fittings, Socket-Welding and Threaded</i>
<i>ASME B1.20.1</i>	<i>Pipe Threads, General Purpose (Inch)</i>
<i>ASME B16.25</i>	<i>Buttwelding Ends</i>
<i>ASME B16.3</i>	<i>Malleable Iron Threaded Fittings</i>
<i>ASME B16.9</i>	<i>Factory-Made Wrought Buttwelding Fittings</i>

<i>ASME B31.1</i>	<i>Power Piping</i>
<i>ASME B31.3</i>	<i>Process Piping</i>
<i>ASME B31.4</i>	<i>Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids</i>
<i>ASME B31.8</i>	<i>Gas Transmission and Distribution Piping Systems</i>
<i>ASME SEC VIII D2</i>	<i>Pressure Vessels, Alternative Design</i>

American Society for Testing and Materials

<i>ASTM A105</i>	<i>Standard Specification for Carbon Steel Forgings for Piping Applications</i>
<i>ASTM A182</i>	<i>Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service</i>
<i>ASTM A350</i>	<i>Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components</i>

Manufacturers Standardization Society

<i>MSS SP-43</i>	<i>Wrought Stainless Steel Butt-Welding Fittings</i>	
<i>MSS SP-75</i>	<i>Specification for High Test Wrought Butt Welding Fittings</i>	
<i>MSS SP-79</i>	<i>Socket-Welding Reducer Inserts</i>	
<i>MSS SP-83</i>	<i>Steel Pipe Unions, Socket-Welding and Threaded</i>	
<i>MSS SP-95</i>	<i>Swaged (d) Nipples and Bull Plugs</i>	
<i>MSS SP-97</i>	<i>Integrally Reinforced Forged Branch Outlet Fittings-Socket Welding, Threaded, and Buttwelding Ends</i>	

International Standardization Organization

<i>ISO 15156</i>	<i>Petroleum and Natural Gas industries Materials for use in H₂S-Containing Environments in Oil and Gas Production</i>	
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4 Definitions

Metal to Metal Seal Joint: A joint that relies on the mechanical fit between metals to seal against pressure.

Proprietary /Specialty Coupling: A joint that is developed and possibly patented by a particular firm and could be not covered by any Industry Code.

LokRing: It is a proprietary coupling used to join two pipes together. It relies on the mechanical grip between the pipe (female) and the joint (male).

Positive Seal Coupling: It is a proprietary coupling used to join two pipes together. It relies on the mechanical grip between the pipe (male) and the joint (female).

5 Welded Joints

5.1 Pipe Welds

Welds in metallic piping shall conform to the requirements to the applicable welding standard which are [SAES-W-011](#), [SAES-W-012](#) and [SAES-W-013](#) and other Standards referenced therein.

5.1.1 When wall thickness ratio of joined pipes is less than or equal to 1.5, joint design details shall comply with the respective ASME B31 design code.

5.1.2 When wall thickness ratio of joined pipes is greater than 1.5, end preparations and geometry shall comply with ASME B16.25 "Butt Welding Ends".

5.1.3 For all four piping codes stated in paragraph 5.1.2 above, refer to Figure 434.8.6(a)-(2) in ASME B31.4 or Figure 15 in ASME B31.8 for graphic details of joint designs.

5.1.4 When the wall thickness of the fitting or pipe at the welding end exceeds the wall thickness of the matching pipe resulting in an unequal external and/or internal diameters, the welded joint design shall comply with Fig. 434.8.6(a)-(2) of ASME B31.4 (regardless of the design code).

5.2 Socket Welds

5.2.1 The maximum size of socket-welded joints in hazardous services shall be 1½-inch for new construction. Maximum 2-inch may be used in hazardous service for maintenance, minor field modifications of existing piping systems, and when necessary to match existing equipment connections.

5.2.2 For sour service, socket-welded joints should be avoided. In case they could not be avoided the maximum size of socket-welded joints shall be 1-inch.

Commentary Note:

Generally, socket welded joints should be avoided in any service where crevice corrosion, severe erosion, or cyclic loading may occur.

5.2.3 Socket weld joints are not permitted in location where high vibration can occur (such as high velocity gas control valves and reciprocating pumps).

5.2.4 The axial gap between male and female component, as shown in Figure 328.5.2C of ASME B31.3 code, shall be maximum of 3 mm and minimum of 1.5 mm. This gap is required prior to welding.

Commentary Note:

This axial gap requirement is only applicable to new installation of socket welds for new construction, maintenance and modification. It does not apply to piping already installed and welding was completed successfully.

5.3 Fillet Welds

The use of sleeve couplings per Standard Drawing [AD-036090](#) shall be limited to cement lined pipe in water services such as fire fighting piping systems and oily water service.

6 Prohibited Piping Joints and Components

The following piping components are not allowed and shall not be used in pressure piping system within the scope of [SAES-L-100](#).

- a) Caulked joints.
 - b) Soldered, brazed, and braze-welded joints.
 - c) Expanded joints: They are slip on type of joints using O-ring to seal the pressure.
 - d) Bell-type and packed joints
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7 Threaded Joints

7.1 The thread joints shall be taper pipe thread (NPT) conforming to ASME B1.20.1 unless otherwise required by specifications for specific connections. Threaded connections for fire services are exempted and shall be in accordance with [SAES-B-017](#).

Commentary Note:

Generally, threaded joints should be avoided in any service where crevice corrosion, severe erosion, or cyclic loading may occur.

- 7.2 In hazardous services, the maximum size of threaded connections shall be 1½-inch for standard fittings and valves, and 2-inch maximum when required for maintenance, minor field modifications of existing piping systems, and to match threaded specialty devices such as scraper signals and access fittings for corrosion monitoring.
- 7.3 In non-hazardous services, the maximum size of threaded connections shall be 3-inch for standard fittings and valves, and 4-inch maximum on special items such as fire hydrants unless a larger size is approved by the assigned Chairman, Piping Standards Committee for the specific application.
- 7.4 The minimum length of the engaged threads pipe shall meet the requirements of ASME B1.20.1 for taper pipe thread. The minimum number of engaged pipe threads shall meet the requirements of Table 1.

Table 1 – Thread Engagement Requirements for Taper Pipe Threads

Nom. Pipe Size	Number of Threads Engaged
1/2" & 3/4"	6
1" through 1-1/2"	7
2" through 3"	8
4"	10

- 7.5 PTFE (Teflon) tape shall not be used for service temperature greater than 204°C on threaded connections.

8 Flanged Joints

- 8.1 Flanged connections shall be avoided when butt-welded joints can be used in services and locations where leaks are likely to occur (e.g., cyclic or vibration services), or will cause serious hazard (e.g., potentially toxic material), or are difficult to control, such as the following:
 - a) Steam in ASME class 900 pressure rating
 - b) In the fully restrained portion of cross-country pipelines and in underwater pipelines
 - c) In locations where the piping will be subjected to large bending or other external loads
 - d) On buried piping system

- 8.2 Flanged connections with long exposed bolts for sandwiched components, other than standard spectacle plates and blinds, shall not be used in fire hazardous areas unless the bolting is protected by a fire resistant shield such as illustrated on Standard Drawing [AC-036404](#) or equivalent method. (Ref. [SAES-B-006](#)).
- 8.3 Selection of flanges shall be in accordance with [SAES-L-109](#).

9 Seal Welding of Threaded Joints

- 9.1 Seal welds are permitted to be used to prevent leakage of threaded joints. It shall not be considered as contributing factor to the strength of the threaded joints.
- 9.2 Seal welding of all threaded joints up to the first block valve is required in the following services and applications:
 - a) All hydrocarbons.
 - b) Boiler feed water, condensate, and steam systems utilizing ASME Class 300 and higher flange ratings.
 - c) Toxic materials such as chlorine, phenol, hydrogen sulphide, etc.
 - d) Corrosive materials such as acid, caustic, etc.
 - e) Oilfield chemicals (e.g., corrosion inhibitors, emulsifiers, electrolytes, etc.)
 - f) Piping which is subject to vibration, whether continuous or intermittent
- 9.3 Seal welding is not required for the following services and applications:
 - a) Thermowells
 - b) Bar stock plugs downstream of a seal-welded block valve.
 - c) Special devices such as access fittings and scraper signals.
 - d) Joints which require frequent disassembly and are located downstream of a seal welded block valve, e.g., sample connections.
 - e) Instrument piping downstream of the primary instrument isolation valve.
 - f) Pipe union ring threads and joints with elastomer o-rings.
 - g) Threaded joints, downstream of a seal welded root valve, which discharge directly to an open drainage system or to the atmosphere.
 - h) Extended body valves with integrally reinforced welding end per API STD 602.
- 9.4 Where seal welding is required, the seal weld shall be a fillet weld going from the outer diameter of the female part, and it should be smooth with slight

concavity as allowed by ASME B31, to the male part covering all exposed threads without undercut.

- 9.5 PTFE (Teflon) tape or joint compounds shall not be used in threaded connections requiring seal welding.

10 Pipe Fittings General Requirements

- 10.1 All metallic pipe fittings shall be fully compatible with the adjoining pipe and shall be subject to the limitations of [SAES-L-136](#) for carbon steel line pipe.
- 10.2 The pipe fittings shall be sourced from an approved manufacturer per [SAES-L-101](#).
- 10.3 Carbon steel fittings shall be in accordance with the requirements of [02-SAMSS-005](#).
- 10.4 For service with design minimum temperature between minus 18°C to minus 45°C, the fittings shall comply with additional requirements of [02-SAMSS-001](#).

11 Threaded and Socket Welding Fittings

- 11.1 For steel piping in hazardous services, threaded and socket welding fittings shall conform to ASME B16.11 Class 3000, Class 6000 or higher.
- 11.2 Pipe unions in hazardous services shall be limited to Class 3000 threaded or socket welding forged steel unions in accordance with MSS SP-83. The material shall be carbon steel per ASTM A105, ASTM A350 or alloy steel per ASTM A182. Pipe unions shall not be installed in the pipe section between the main pipe run and root valve.
- 11.3 Threaded bushings with one size reduction shall not be used. When bushings are allowed, only hex head steel bushings shall be used. Flush steel bushings are not permitted.
- 11.4 Welding bosses shall be forged steel ASTM A105, ASTM A350 or ASTM A182, as applicable, as shown on Standard Drawings [AE-036175](#) or [AE-036643](#).
- 11.5 Integrally reinforced welding outlets of approved design (such as Weldolets, Threadolets, Sockolets, etc.) in Class 3000, 6000 or higher, as applicable, which abut the pipe wall with a full penetration weld are acceptable.

- 11.6 Malleable iron screwed fittings shall conform to ASME B16.3 Class 150 and shall be galvanized and limited to non-hazardous services, except that pipe unions shall be Class 300.
- 11.7 Pipe plugs for use in metallic piping shall be solid body, bar-stock, or forged steel plugs in accordance with ASME B16.11.

12 Steel Butt Welding Fittings

- 12.1 The material and purchasing requirements of carbon steel butt weld fittings to: ASTM A234 Grade WPB and MSS SP-75 shall conform to the requirements of [02-SAMSS-005](#).
- 12.2 Steel butt welding fittings shall conform to [02-SAMSS-005](#).
- 12.3 Integrally reinforced welding outlets not listed in SAMS Catalog shall be of a design approved by the Chairman of the Piping Standards Committee. Refer to [SAES-L-350](#) for post weld heat treatment requirements for welding outlets.
- 12.4 Miter elbows are not permitted. In case miter bends have to be used prior approval by the Chairman of the Piping Standards Committee is required.

13 Branch Connection Type and Fittings

- 13.1 Selection of the tee branch connections type and fittings shall be as follows:
 - 13.1.1 For new construction of metallic piping selection shall be made in accordance with the Chart 1.
 - 13.1.2 In case a branch connection with reinforcement has been selected according to paragraph 13.1.1, the size of the reinforcement pad shall be per the applicable code.
 - 13.1.3 For field modifications to existing piping, the branch connections as shown on SASD [AB-036719](#) with proper reinforcement are acceptable.
 - 13.2 Laterals and crosses
 - 13.2.1 Crosses are not permitted. Laterals shall be used only when required by Saudi Aramco standards. They should be used for low pressure system (less than 150 psig) such as flare lines.
 - 13.2.2 Laterals fittings shall be designed for a bursting strength at least equal to the bursting strength of the adjoining pipe.
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13.2.3 Laterals made by welding the branch pipe directly to the run pipe shall be designed according to the code and shall have complete encirclement reinforcement. Laterals shall be shop fabricated according to [01-SAMS-010](#) and subjected to minimum 90% SMYS hydrotest pressure.

13.3 Branch connections, such as those for drain and vent connections, on tees, elbows and reducers are not permitted. When not avoidable, the piping design shall be reviewed and approved by the Chairman of Piping Standards Committee.

14 Specialty and Proprietary Couplings

14.1 Any new proprietary or specialty mechanical joints regardless of service shall be evaluated and approved by the Chairman of Piping Standards Committee, prior to specification and installation. Examples are Victaulic couplings and Dresser couplings.

14.2 Metal to Metal Seal Coupling

The following proprietary pipe couplings are acceptable within the limitations specified for each one:

14.2.1 Positive Seal Coupling

The use of Positive Seal Coupling is limited to on shore pipelines for non-hazardous service and limited to 12 inch maximum diameter.

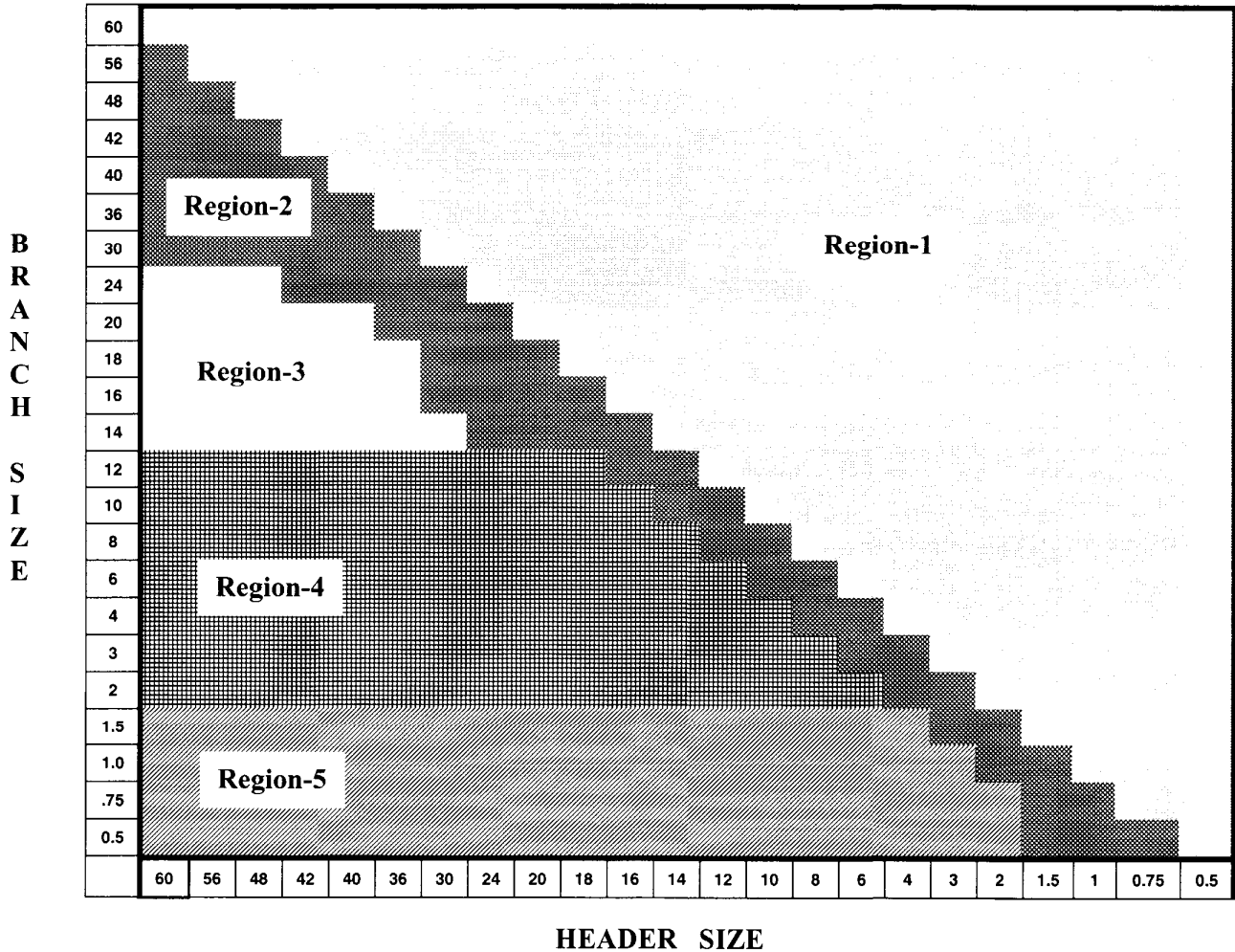
14.2.2 LokRing Coupling

The use of LokRing coupling is limited to piping 2 inch maximum for instrument air, nitrogen gas, and water service.

14.3 Clamp-type connectors for high pressure services shall conform to API SPEC 6A or shall be proprietary connectors of a design based on ASME SEC VIII and approved by the Chairman, Piping Standards Committee in the Consulting Services Department (for example, Grayloc, Techlok, etc.).

14.4 Proprietary couplings for pipeline repair, such as Plidco, Weld + Ends couplings, proprietary swivel joints, such as Chiksan, or similar specialties shall be of a design approved by the Chairman, Piping Standards Committee in the Consulting Services Department.

Chart 1 – Branch Connections



LEGEND

- Region-1: Equal Tee
- Region-2: Reducing Tee
- Region-3: Reducing Tee or Branch weld with reinforcing pad or full encirclement sleeve
- Region-4: Weldolet or branch weld with reinforcing pad
- Region-5: Weldolet, Sockolet, Thredolet or Welding boss per SASD AE-036175 and AE-036643

Revision Summary

18 May 2008

Revised the "Next Planned Update". Reaffirmed the contents of the document and reissued with minor revision.