



Materials System Specification

02-SAMSS-008

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Insulating Joints/Spools for Cathodic Protection

Document Responsibility: Piping Standards Committee

Saudi Aramco DeskTop Standards

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1 Scope

This Specification describes the requirements for integral insulating joints and spools. These are required for cathodically protected carbon steel pipelines in hydrocarbon or water service with service pressure ratings of 150 to 1500 of ASME B16.5 class. Insulating joints with a long integral lining are called insulating spools. They may be used for pipelines in wet service (Liquid Hydrocarbon with free water in excess of 0.2 volume percent).

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

Material or equipment supplied to this specification shall comply with the latest edition of the references listed below, unless noted otherwise.

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 Materials System Specification

[02-SAMSS-011](#)

*Forged Steel Weld Neck Flanges for Low and
Intermediate Temperature Service*

Saudi Aramco Engineering Standards

[SAES-H-100](#)

Painting Requirements for Industrial Facilities

[SAES-H-101](#)

Approved Protective Coating Systems

[SAES-H-200](#)

Storage, Handling, and Installation of Externally Coated Pipe

Saudi Aramco Inspection Requirement

Form [175-023800](#)

Joints/Spools: Insulating, for Cathodic Protection

3.2 Industry Codes and Standards

American Society of Mechanical Engineers

ASME B16.5

Pipe Flanges and Flanged Fittings

ASME B31.3

Process Piping

ASME SEC V

Nondestructive Examination

ASME SEC VIII D1

Boiler and Pressure Vessel Code

ASME SEC IX

Welding and Brazing Specifications

American Petroleum Institute

API SPEC 5L

Specification for Line Pipe

American Welding Society, Inc.

AWS A5.1 through AWS A5.30

European Standard

EN-10204/DIN 50049

Inspection Documents for the Delivery of Metallic Products

National Association of Corrosion Engineers / International Standardization Organization

[NACE MR0175/ISO 15156](#)

*Petroleum and Natural Gas Industries-
Materials for use in H₂S-Containing
Environments in Oil and Gas Production*

4 Purchase Order Information

For each insulating joint or spool the following information shall be specified in the Purchase Order:

- a) Internal design pressure
 - b) Matching pipeline material
 - c) Matching pipeline diameter
 - d) Matching pipe wall thickness
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- e) Pipeline hydrostatic test pressure
- f) Fluid composition and temperature range
- g) Length of insulating liner (if applicable)
- h) Additional inspection requirements (if required)

5 Design

- 5.1 Insulating joints and spools designed in accordance with this specification shall be non-flanged type with standard beveled pipe ends. Production models shall be in accordance with the design of the approved prototype per paragraph 7.3.1.

The basic construction shall consist of the following:

- a) A pipe pup welded at one side to a forged hub, beveled at the other side per API SPEC 5L.
 - b) A pipe pup welded at one side to a forged stub end, beveled at the other per API SPEC 5L.
 - c) A retainer that may be one integral forging or an assembly of welded forgings.
 - d) Insulating rings, "O" ring sealing and packing material, suitable for the fluid composition and operating parameters.
 - e) Epoxy resin filler material to seal the annular space between the retainer and the insulating joint stub assembly.
 - f) The pipe pup used in fabricating the insulating joint/spool shall meet the same design parameters and material as the pipe to which the spool will be attached.
- 5.2 The design of forged rings shall be in accordance with ASME SEC VIII D1, Note Appendix 2.
- 5.3 The insulating spool shall be coated internally with APCS-2A in accordance with [SAES-H-100](#) and [SAES-H-101](#), with the exception that it must be holiday free. The internal coating shall extend past the "O" ring groove(s) on the face of the insulating hub internally and within three (3) cm of the beveled spool pipe ends.
- 5.4 The finished overall lengths of insulating joints for specific pipe diameters and pressure ratings shall be as listed below:
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Pipe Size (dia. in inches)	ASME CLASS RATING					
	150	300	400	600	900	1500
up to 14	700 mm	700 mm	1000 mm	1000 mm	1000 mm	1000 mm
16 to 24	1000 mm	1000 mm	1200 mm	1500 mm	1500 mm	1500 mm
26 to 36	1500 mm	1500 mm	1800 mm	2000 mm	2000 mm	2000 mm
38 to 48	2000 mm	2200 mm	2200 mm	2500 mm	2800 mm	2800 mm
50 to 60	2500 mm	2800 mm	3000 mm	3000 mm	3200 mm	3200 mm

- 5.5 The standard length of finished spools shall be 6 m (20 ft) plus the length of the finished spool defined in paragraph 5.4.
- 5.6 Temporary pipe caps shall be welded at each end for the pressure tests. These shall be cut off and the ends beveled per API SPEC 5L.
- 5.7 The material of the insulating parts such as filled phenolic laminate shall be resistant to sour water and crude oil containing H₂S, sulfur compounds, corrosion inhibitors, bactericides and demulsifiers, up to a temperature of 100°C at the required bearing pressure.

6 Fabrication

6.1 Welding Requirements

6.1.1 Approved Welding Processes

Any of the following processes may be used:

- a) Shielded Metal Arc Welding (SMAW)
- b) Gas Tungsten-Arc Welding (GTAW, or TIG)
- c) Gas Metal-Arc Welding (GMAW, or MIG)
- d) Submerged Arc Welding (SAW)
- e) Combinations of above processes

6.1.2 Procedure Qualifications

Welding, welding repair and NDT procedures shall be qualified in accordance with ASME SEC IX, ASME SEC V and ASME B31.3 respectively and shall be approved by the Buyer's Representative prior to fabrication. All welding and materials shall comply with [NACE MR0175/ISO 15156](#) for sour service applications.

6.1.3 Welder Qualifications

Welders shall be qualified in accordance with the requirements of ASME SEC IX.

6.1.4 Consumable Materials

Electrodes, filler wires and fluxes shall conform to AWS A5.1 through AWS A5.30 as applicable.

6.1.5 Weld Details

All joints shall be butt-welded and have full penetration welds except for the final closure weld, which shall be welded in accordance with ASME SEC VIII ULW 17.6, Figure "A".

6.2 Radiographic Requirements

6.2.1 All welds except the final closure weld shall be 100% radiographed. The cost of these radiographs shall be included in the Vendor's quotation. Acceptance standard for radiographs shall be per ASME B31.3 "normal service" category. The final closure weld shall be magnetic-particle tested on the root pass and final weld.

6.2.2 NDT Technique, Sensitivity and Acc/Rej Criteria

NDT procedures technique and sensitivity shall meet the requirements of ASME SEC V. VT, MT and PT shall be interpreted to ASME B31.3, Table 341.3.2A, Normal Fluid Service, Visual Method. RT shall be interpreted to ASME B31.3, Table 341.3.2A, Normal Fluid Service, Spot or Random Radiography Method.

6.3 General Requirements

6.3.1 The surfaces of the annular space between the pup and the retainer shall be abrasive shot-blasted to a near white metal finish (SA 2-1/2). Assembly of the insulating joint shall commence within 2 hours after completion of abrasive shotblasting.

6.3.2 The annular space between the retainer and the pup shall be filled with an epoxy resin filler material; to be approved by the Buyer's Representative.

6.3.3 External coating shall be APCS-104 or APCS-113 and shall be holiday tested in accordance with [SAES-H-200](#), Paragraph 7. Zinc-rich primers shall not be used because of electrical conductivity. The coating shall be applied after the pressure tests.

- 6.3.4 The assembly of insulating joints shall be done in a controlled, clean environment. Welding bevels shall be dry and free from grease and other contaminants.
- 6.3.5 After completion of all tests the insulating joint shall be machined with beveled ends giving it a total length as listed in paragraph 5.4 or 5.5. All leveled ends shall be either MT or PT inspected for laminations.

6.4 Additional Requirements for Spools

- 6.4.1 The internal coating shall extend up the face of the forged hub, past the "O" ring grooves. This will require that the coating be applied prior to spool assembly.
- 6.4.2 "O" ring grooves shall be designed to accommodate the coating layers.
- 6.4.3 Internal coating shall be in accordance with APCS-2A. Surface preparation of the internal surface shall be in accordance with [SAES-H-100](#) and APCS-2A requirements. This shall include but not be limited to removal of all weld splatter, grinding smooth of all welded areas and proper radiusing of all sharp corners (including "O" ring grooves and face-to-bore intersection) prior to blast cleaning.

7 Test and Inspection

7.1 General

Testing shall be witnessed and inspection conducted on the production models and prototype models by the Buyer's Representative, as required by Saudi Aramco Form [175-023800](#) and by the following paragraphs. The Vendor shall afford the Inspector, without charge, all facilities to satisfy him that the fittings are being furnished in accordance with the requirements of the Purchase Order.

7.2 Notification to Customer

The Vendor shall notify the Buyer, in writing, at least 10 days prior to the scheduled test dates, in order to permit the Inspector to be present.

7.3 Prototype Model Inspection and Tests

7.3.1 General

- 7.3.1.1 In any of the diameter ranges A through D listed below, and for each ASME pressure rating class, at least one unit shall be tested as a prototype.

- A = 6 through 12 inch
- B = 16 through 24 inch
- C = 26 through 36 inch
- D = 38 through 60 inch.

7.3.1.2 The prototype insulating joint shall be designed for the highest pressure rating required by the Purchase Order, or higher. The prototype inspection and tests will be valid for all insulating joints subsequently manufactured in accordance with the approved prototype design in the subject diameter range and pressure range.

7.3.1.3 Prototype tests comprise all of the production model tests, listed in section 7.4, and the additional tests, listed in section 7.3. The tests shall be carried out on the prototype in the sequence of the paragraphs as follows: 7.4.1, 7.4.2, 7.4.3, 7.3.2, 7.4.4, 7.3.3, 7.4.5, 7.4.6, 7.4.7. A successfully tested prototype joint or spool shall be acceptable as production model.

7.3.2 Bending Test at Rated Pressure

7.3.2.1 A bending test at rated pressure shall be carried out on each prototype insulating joint or spool before being cut to final length and with both ends capped. The specimen shall be freely supported as a simple beam on two supports such that the center of the larger diameter portion is centered between the supports. The distance between support centers shall be 10 times the nominal pipe size. If the specimen is a spool the excess length at one side shall be a free overhang.

7.3.2.2 Two equal, centrally located point loads shall be applied. The distance between the load centers shall be 2 times the nominal pipe size or more if required to clear the larger diameter portion of the joint.

7.3.2.3 The magnitude of the point loads shall be calculated such that the resulting moment between the loads will produce a bending stress equal to 40% of the minimum specified yield strength in the pipe based on actual minimum wall thickness. The loads shall be applied gradually. The full load shall be maintained for not less than 10 minutes.

7.3.2.4 During the loading the specimen shall be maintained at an internal pressure equal to the rated cold working pressure per ASME B16.5.

7.3.2.5 The relative deflection at the center of the larger diameter portion shall be measured before and after loading and during application of the maximum load. These deflections shall be recorded and compared with the theoretical deflection of a equally specified pipe spool without the insulating joint under the same loading conditions and forwarded to the Buyer's Representative for evaluation.

7.3.2.6 There shall be no permanent deformation. There shall be no signs of any leakage during or after the test.

7.3.3 Thermal Cycling Test

7.3.3.1 A thermal cycling test is required on an initial approval only. It is not required on subsequent prototype tests provided the later prototypes are of a similar design.

7.3.3.2 The test method consists of placing the joint alternately into a cold water and a hot water tank. The holding time shall be 10 minutes minimum in each tank at the temperature stated. After removal from one tank the joint shall be placed immediately in the other. The joint under test shall have open ends to allow water to contact the joint inner surfaces.

7.3.3.3 During the thermal cycling tests the insulating joint shall be immersed completely in water to at least 150 mm (6 in) below the surface.

Hot tank temperature : 95°C (203°F) minimum

Cold tank temperature : 25°C (77°F) maximum

7.3.3.4 The test shall consist of 5 complete cycles ending with joint removal from the cold tank, i.e., 5 hot immersions and 5 cold immersions.

7.4 Production Model Inspection and Tests

The tests shall be conducted in the sequence as listed below:

7.4.1 Dielectric Test and Megger Test

Each insulating joint or spool shall be megger tested with 1000 V DC.

Minimum resistance shall be 60 Megohms. Each insulating joint or spool shall also be dielectric tested at 5000 V AC for 1 minute. Maximum allowable leakage is 5 milliamperes on sizes up to 28-inch nominal pipe size and 8 milliamperes on sizes 30-inch and larger nominal pipe size.

7.4.2 Vacuum Test

A vacuum test shall be conducted on one of each lot of 10 or less insulating joints or spools, irrespective of pipe diameter. A vacuum of 10 mm or less of mercury shall be maintained for not less than 20 minutes.

7.4.3 Hydrostatic Test

A hydrostatic test shall be performed on each insulating joint or spool at the specified hydrostatic test pressure in accordance with ASME B16.5. The full test pressure shall be maintained for not less than 20 minutes on production models and two hours on prototype models.

During the test the model shall be in an unrestrained condition. The hydrostatic test shall terminate with a rapid blowdown.

7.4.4 Low Pressure Leakage Test

A low pressure leakage test shall be carried out on each insulating joint or spool. The joint or spool shall be filled with water, pressurized to 345 kPa (50 psi) and held at that pressure for 10 minutes.

7.4.5 The Dielectric Test and Megger Test described in paragraph 7.4.1 shall be repeated after completion of the tests described in paragraphs 7.4.2 through 7.4.4.

7.4.6 Holiday Tests

Insulating spools shall undergo holiday detection of the internal coating per [SAES-H-100](#), Paragraph 8.2.6. No holidays are permitted anywhere in the entire spool.

7.4.7 Visual Inspection and Dimensional Check

7.4.7.1 Visual inspection of all parts prior to assembly of the insulating joint will be done by the Vendor. Visual inspection of the finished insulating joint is to be carried out by the Buyer's Representative. General appearance shall show good workmanship.

7.4.7.2 Dimensions of the insulating joint or spool shall be checked against the Specifications, Purchase Order description and/or approved Vendor Drawings. The overall length tolerance is ± 10 mm.

7.5 Certification

All material and test certificates for the above testing and inspection shall meet EN-10204/DIN 50049, and be submitted to the Buyer prior to shipment.

8 Marking

The following data shall be stamped with rounded dies on the retainer ring:

Vendor Identification

Joint Serial No.

Other data, as listed below, shall be painted on the retainer ring or pipe ends:

Nominal diameter

ASME Rating

Purchase Order No.

Item No.

SAP Material Group # (if applicable).

9 Preparation and Shipment

9.1 To protect the interior against damage prior to installation in the field, the joint ends shall be closed with slip-on recessed end caps.

9.2 The insulating joint shall be strapped individually on skid-mounted cradles and be enclosed in a crate, in accordance with the Saudi Aramco packing specification.

Revision Summary

13 February 2012 Revised the "Next Planned Update". Reaffirmed the contents of the document, and reissued with editorial changes.