



Materials System Specification

02-SAMSS-012

10 September 2013

Weld Overlaid Fittings, Flanges and Spool Pieces

Document Responsibility: Materials and Corrosion Control Standards Committee

Saudi Aramco DeskTop Standards

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1 Scope

This Specification covers corrosion resistant alloy (CRA) clad (weld overlaid) fittings, flanges and spool pieces (pipes) intended for fabrication of clad pipe spools. Weld Overlaid scraper traps are covered by this specification. This specification can also be used for overlaying of valves and valve components. This specification does not apply for clad line pipe nor for girth welding of clad components for the purpose of fabrication of pipe spools.

Commentary Note:

Procurement of Clad/Lined line pipe is covered in [01-SAMSS-048](#).

2 Conflicts and Deviations

- 2.1 Any conflicts between this specification and other applicable Saudi Aramco Materials System Specifications (SAMSSs), Engineering Standards (SAESs), or industry standards, codes, and forms shall be resolved in writing by the Company or Purchaser Representative through the Manager, Consulting Services Department of Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from this specification in writing to the Company or Purchaser 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 manufacture and purchase of material covered by this specification shall comply with the latest edition (as per the purchase order date) of the references listed below, as noted.

A. 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 Specifications

[01-SAMSS-035](#)

API Line Pipe

[01-SAMSS-038](#)

Small Quantity Purchase of Pipe from Stockist

[01-SAMSS-043](#)

Carbon Steel Pipes for On-Plot Piping

[01-SAMSS-044](#)*CRA Clad Pipe Spools*[02-SAMSS-005](#)*Butt Welding Pipe Fittings*[02-SAMSS-009](#)*Design and Fabrication of Scraper Traps*[02-SAMSS-011](#)*Forged Steel and Alloy Flanges***Saudi Aramco Inspection Requirements***Form [175-026600](#)**Weld Overlaid Flanges, Fittings and Spool Pieces***B. Industry Codes and Standards****American Petroleum Institute***API SPEC 6A**Specification for Wellhead and Christmas Trees Equipment***American Society of Mechanical Engineers***ASME SEC II Part C**Specifications for Welding Rods, Electrodes, and Filler Metals**ASME SEC IX**Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators***American Society for Nondestructive Testing, Inc.***ASNT CP-189**Standard for Qualification and Certification of Nondestructive Testing Personnel*[ASNT SNT-TC-1A](#)*Recommended Practice for Personnel Qualification and Certification***American Society for Testing and Materials***ASTM A380**Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipments, and Systems**ASTM A923**Standard test Methods for Detecting Detrimental Intermetallic in Duplex Austenitic/Ferritic Stainless Steel**ASTM E92**Standard Test Method for Vickers Hardness of Metallic Materials**ASTM G48**Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution*

European Standard

[EN 473](#)

Non-Destructive Testing - Qualification and Certification of NDT Personnel - General Principles

International Standardization Organization

ISO 9000 - 9004

Quality Management and Quality Assurance Standards

National Association of Corrosion Engineers

NACE MR0175/ISO 15156

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

4 Definition

Spool Pieces: Double random length pipes or cut length of pipes intended for fabrication of clad pipe spools.

5 Information to be supplied by the Purchaser

- a. If the weld overlaid piping components are intended for sour service, the following statement shall be included in the purchase order: “The components shall be suitable for sour service and [NACE MR0175/ISO 15156](#) shall apply”.
- b. Type of corrosion resistant weld overlay

6 Manufacture

- 6.1 Carbon steel fittings used for weld overlay shall meet the requirements of [02-SAMSS-005](#). Carbon steel fittings may either be procured by the manufacturer from an approved vendor or can be free issue material provided by Saudi Aramco.

Commentary Note:

Sour service requirements, including HIC testing, specified in [02-SAMSS-005](#) are not applicable even if the clad fittings are intended for sour service.

- 6.2 Carbon steel flanges used for weld overlay shall meet the requirements of [02-SAMSS-011](#). Carbon steel flanges may either be procured by the manufacturer from an approved vendor or can be free issue material provided by Saudi Aramco.
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Commentary Note:

Sour service requirements, including HIC testing, specified in [02-SAMSS-011](#) is not applicable even if the clad flanges are intended for sour service.

- 6.3 Spool pieces used for weld overlay shall meet the requirements of [01-SAMSS-035](#) or [01-SAMSS-038](#) or [01-SAMSS-043](#). Spool pieces may either be procured by the manufacturer from an approved vendor or can be free issue material provided by Saudi Aramco.

Commentary Note:

Sour service requirements, including HIC testing, specified in [01-SAMSS-035](#), [01-SAMSS-038](#) and [01-SAMSS-043](#) are not applicable even if the clad pipe spool pieces are intended for sour service.

- 6.4 Weld overlay, including repairs, shall be carried out using automatic GTAW or GMAW process. Overlay by manual welding is not permitted except for repairs. Other welding processes may be used if approved by Materials and Corrosion Control Standards Committee.
- 6.5 Welding heads shall be equipped with automatic voltage control and high frequency or lift start facility (for GTAW only). The direction of weld overlay deposit shall be circumferential irrespective of the diameter of the component.
- 6.6 Overlay thickness shall be 3.0 mm minimum and a minimum of two layers shall be applied. The thickness of each layer shall not exceed 3.0 mm. ID dimensional restrictions, if any, shall be as per the applicable drawings.
- 6.7 All welding consumables, including those used for repair, must have AWS classification. Alternative classification is acceptable, if approved by Materials and Corrosion Control Standards Committee.
- 6.8 Selection of welding filler wire for weld overlays for any of the welding processes that use bare wire shall be as per Table 1 below. Alternative welding consumables can be used if approved by the Materials and Corrosion Control Standards Committee.

Table 1

Cladding	Barrier Layer	Rest of the Layers
316L	ER309LMo	ER316L or ER317L
347	ER309L	ER347
321	ER309L	ER321*/ER347
904L	ER309Mo/ER309LMo	ER385
S31254	ERNiCrMo-3	ERNiCrMo-3

Cladding	Barrier Layer	Rest of the Layers
S31803	ER309Mo/ER309LMo	ER2209
S32205	ER309Mo/ER309LMo	ER2209
S32750	ER309Mo/ER309LMo	ER2553
N08825	ERNiCrMo-3	ERNiCrMo-3
N06625	ERNiCrMo-3	ERNiCrMo-3
N04400	ERNiCu-7/ERNi-1	ERNiCu-7
C71500	ERNiCu-7/ERNi-1	ERCuNi/ERNiCu-7

**ER321 shall not be used for GMAW process.*

Commentary Note:

It is acceptable to use over alloyed welding consumables to obtain the required corrosion properties after dilution.

7 Qualification of Welding Procedures

- 7.1 Welding procedures, including procedures for repair and welders / welding operators shall be qualified as per [ASME SEC IX](#). All qualifications shall be witnessed by third party inspection agency.
- 7.2 The height of the overlay on the PQR test coupon shall not be more than 3.5 mm. It is acceptable to grind the final layer in order to reduce the height of the overlay.
- 7.3 The brand name for nickel based and duplex/super duplex stainless steel filler wire shall be considered as an essential variable.
- 7.4 Chemical analysis shall be carried out at a height of 2.0 mm from the base metal. The chemistry shall be within the range specified in [ASME SEC II Part C](#) or AWS classification. In the case of alloy N06625, the iron content shall not exceed 10%. The PREN (%Cr+3.3%Mo+16%N) value for the overlay shall be as per Table 2.

Table 2

Grade	PREN (min.)
316/316L	24
317/317L	29
N08904	34
S31254	42
S31803	35

Grade	PREN (min.)
S32205	35
S32750	42
N08825	42
N06625	45

- 7.5 Hardness testing shall be performed if the material is intended for sour service. It shall be performed using the Vickers test in accordance with [ASTM E92](#) using 5 kg or 10 kg load. A minimum of 5 indentations shall be taken on the heat affected zone (away from unmixed zone) of carbon steel and on weld overlay. Hardness on the carbon steel HAZ shall not exceed 250 HV. Hardness of the weld overlay shall meet the applicable requirements stated in NACE MR0175/ISO 15156.
- 7.6 The following grades shall be subjected to the corrosion testing as specified in Table 3 below.

Table 3

Steel Grade	Corrosion Test	Test Conditions	Acceptance Criteria
UNS N08904 (904L)	ASTM G48 ^{(a)(b)} Method A	Test temperature: 25°C Test duration : 24 hours	No pitting at 20X minimum magnification.
UNS S31254	ASTM G48 ^{(a)(b)} Method A	Test temperature: 50°C Test duration : 48 hours	No pitting at 20X minimum magnification
UNS S31803	ASTM A923 ^{(a)(c)} Method C	As per ASTM A923	As per ASTM A923
UNS S32205	ASTM A923 ^{(a)(c)} Method C	As per ASTM A923	As per ASTM A923
UNS S32750	ASTM A923 ^{(a)(c)} Method C	As per ASTM A923	As per ASTM A923
UNS N08825	ASTM G48 ^{(a)(b)} Method A	Test temperature: 22°C Test duration : 72 hours	No pitting at 20X minimum magnification
UNS N06625	ASTM G48 ^{(a)(b)} Method A	Test temperature: 50°C Test duration : 72 hours	No pitting at 20X minimum magnification

Notes:

- The surfaces of the specimens shall be pickled before testing.
- Cut edges shall be prepared according to ASTM G48.
- Rapid screening test (ASTM A923 Test Method A) shall not be used as an acceptance test.

- 7.7 Corrosion specimens shall be prepared by removing the backing carbon steel by milling or by other means. The thickness of the specimen shall not be less than 2.0 mm.
- 7.8 All welding procedures, including procedures for repair, must be reviewed and approved by Materials and Corrosion Control Standards Committee.

8 Pickling

Each overlaid component shall be pickled as per [ASTM A380](#). Adequate precaution must be taken to prevent carbon steel from coming in contact with the pickling chemical.

Commentary Note:

If the final commodity is a clad pipe spool, then pickling may be carried out after the fabrication of the spool.

9 Non-Destructive Testing

- 9.1 All NDT operators shall be qualified to ASNT SNT-TC-1A, ASNT CP-189 or EN473 level II or equivalent.
- 9.2 Weld overlays shall be 100% inspected by dye penetrant testing after completion of all layers. If any machining is carried out on the overlay surface (e.g., flange face), testing shall be carried out after the machining operation. Acceptance criteria shall be in accordance with API SPEC 6A PSL3. The repair areas of weld overlay shall be re-examined by dye penetrant testing.
- 9.3 Overlay thickness shall be measured for each component by taking wall thickness measurement by UT before and after the overlay at the same location. Alternatively, clad thickness measurement can be carried out from inside using magnetic induction technique. Thickness measurements shall be taken for each component at least three locations evenly distributed along the length of component. In case of spool pieces, the separation between the overlay thickness reading shall not exceed 500 mm. Overlay thickness shall also be measured at the weld ends at a separation of 90°. If the overlay surface require machining, thickness measurements shall be carried out after machining.
- 9.4 Ferrite content shall be measured in the as welded condition on each component overlaid with austenitic stainless steel. The Ferrite content shall be between 3 to 8%.
- 9.5 Positive Material Identification shall be carried out on the weld overlay surface of each component whenever the ID is large enough to accommodate the PMI equipment. Acceptance criteria shall be as per the chemistry requirement stated
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in [ASME SEC II Part C](#) or applicable AWS standard with a tolerance of 10% (see paragraph 7.4 for acceptance criteria for Fe in 625 overlay).

- 9.6 Visual inspection shall be carried out to ensure that the CRA weld overlay is free of cracks and arc burns. The overlay surface shall be clean, free from any contamination and weld spatter. Other imperfections in the CRA weld overlay shall not exceed 0.8 mm in depth.

10 Dimensional Requirements

- 10.1 Dimensional tolerance at the ends of the component shall be as per Table 4 below:

Table 4

Specified OD	End Tolerance (based on ID)	Out of Roundness at the ends
≤323.9	±0.7 mm	1.5% ID but not exceeding 1.5mm
>323.9 ≤610	±1.0 mm	0.75% ID but not exceeding 3.0mm
>610	±1.6 mm	1% ID but not exceeding 4 mm

- 10.2 It is acceptable to correct the dimensions by pressing, grinding or my machining the inside overlaid surface provided the minimum required overlay thickness is not in violation.
- 10.3 The above dimensional requirements do not apply if the PO is for weld overlaid spools as per [01-SAMSS-044](#).

Commentary:

Maximum allowed mismatch for girth welds in clad piping spools is specified in paragraph 6.6 of [01-SAMSS-044](#).

11 Inspection

Pipes purchased in accordance with this Specification are subject to the requirements of Saudi Aramco Inspection Requirements Form [175-026600](#).

12 Marking

- 12.1 Each component shall be marked Saudi Aramco, followed by the destination, Purchase Order number/Item number and the Saudi Aramco 9COM number.
- 12.2 The marking shall include the specification number [02-SAMSS-012](#).
- 12.3 Material ordered for sour service shall be marked with alphabet 'S'.

- 12.4 The above marking requirements do not apply if the PO is for weld overlaid spools as per Saudi Aramco standard [01-SAMSS-044](#).

13 Handling, Packing and Transportation

The ends of the overlaid components should be suitably covered to prevent contamination from dust or moisture during storage and transportation. Flange faces must be adequately protected from possibly damage during transportation.

14 Certification

- 14.1 The manufacturer shall furnish the mill test certificate of the carbon steel backing material if these commodities are procured by the manufacturer.
- 14.2 All NDT results and PMI shall be supplied.
- 14.3 It shall be certified that the radioactivity level of weld overlaid components is less than 0.5 $\mu\text{Sv}/\text{hour}$ or 100 beckerels/gram. Certification can be based on measurements conducted by the backing carbon steel manufacturer and reported in the mill test certificates of the raw material.

20 November 2011
10 September 2013

Revision Summary

Major revision.

Editorial revision to clarify that Weld Overlaid scraper traps are covered by this specification.