Materials System Specification

04-SAMSS-048 28 August 2013

Valve Inspection and Testing Requirements

Document Responsibility: Valves Standards Committee

Saudi Aramco DeskTop Standards

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1 Scope

1.1 This Specification, together with the Purchase Order and appropriate data sheets, cover the minimum requirements for inspection and testing of metallic and nonmetallic valves normally classified under Saudi Aramco Materials System (SAMS) Class 04. Such valves include gate, globe, angle, check, needle, ball, plug, piston, butterfly, choke, diaphragm, etc., used for on-off, manual control service or for prevention of reverse flow, as appropriate.

1.2 Specifically excluded from the scope are: control, safety-relief, relief, surge relief, solenoid, pilot and other valves classified under SAMS Class 34; and wellhead valves classified under SAMS Class 45.

1.3 Requirements for SAMS Class 04 API STD 6A 10,000 psi (1-13/16 inch size and above) valves and chokes are covered in 04-SAMSS-049.

1.4 The typical quality characteristics to be witnessed and the documents to be reviewed by and/or provided to Buyer's Representative by the Vendor, are specified on Saudi Aramco Inspection Requirements Forms 175-043000, 175-043600 and 175-043601 which shall be included as part of the Purchase Order, as applicable.

2 Conflicts and Deviations

2.1 Any conflicts between this specification and other applicable Saudi Aramco Materials System Specifications (SAMSSs), Engineering Standards (SAESs), Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Valves Standards Committee Chairman (VSCC), Consulting Services Department, of Saudi Aramco, Dhahran.

2.2 Direct all requests to deviate from this specification in writing to the Company or Buyer Representative, who shall follow internal company procedure SAEP-302 and forward such requests to the VSCC, 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 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 Standard

SAES-A-206	*Positive Material Identification*

Saudi Aramco Materials System Specification

04-SAMSS-003	*Additional Requirements for Low Temperature Valves*

Saudi Aramco Inspection and Testing Requirements

Form 175-043000	*Valve Materials Certification Requirements*
Form 175-043600	*Metallic and Non-Metallic Valves*
Form 175-043601	*Low Severity, Valves*

Note: *Please check the above form numbers and make sure they are correct.*

3.2 Industry Codes and Standards

American Petroleum Institute

API STD 598	*Valve Inspection and Testing*

American Society of Mechanical Engineers

ASME B16.34	*Valves-Flanged, Threaded, and Welding End*
ASME SEC VIII	*Boiler and Pressure Vessel Code*

American Society for Testing and Materials

ASTM A956	*Standard Test Method for Leeb Hardness Testing of Steel Products*
ASTM B733	*Standard Specification for Autocatalytic Nickel-Phosphorus Coatings on Metals*
ASTM E10	*Test Method for Brinnell Hardness of Metallic Materials*
ASTM E18	*Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials*

Manufacturers Standardization Society

MSS SP-53	*Quality Standard for Steel Castings - Magnetic Particle Examination Method*

MSS SP-55	*Quality Standard for Steel Castings - Visual Method*
MSS SP-93	*Quality Standard for Steel Castings - Liquid Penetrant Examination Method*

4 General Requirements

4.1 Each individual valve shall be at least tested, examined and qualified as specified in the industrial standard (such as ASME, API, AWWA, MSS) referenced in the Purchase Order or to the manufacturer's approved standard if no industrial standard has been specified. Nothing in this Specification shall be construed as waiving any mandatory requirement of the referenced Standard.

4.2 Steel valves shall not be externally painted or coated before the shell pressure tests are completed. Internally coated or lined valves shall be shell tested before and after application of the coating or lining unless reviewed and exempted by the Valves Standards Committee Chairman. Iron valves specified for raw, sweet, seawater and sanitary services are exempt from this requirement.

4.3 Repairs of valve components with unacceptable defects shall be in accordance with the governing material specification for the component. Repair by grinding or redressing of the casting surface is acceptable, provided that during the repair not more than 10% of the original wall thickness will be removed and provided that the minimum required wall thickness is not affected. Repair of major defects shall not be performed without the knowledge of the Saudi Aramco Representative Company. Welding, NDE and heat treatment procedures for major weld repairs shall be approved by Saudi Aramco representative prior to execution. Weld repairs shall be considered major if any of the following conditions apply:

a) Castings leak during hydrostatic testing.

b) The depth of the repair cavity prepared for welding exceeds 20% of the wall thickness or 25 mm (1 in), whichever is smaller.

c) The surface area of the repair cavity exceeds 65 cm^2 (10 in^2).

Welds shall be 100% radiographed and evaluated in accordance with the applicable ANSI/ASME standard with a minimum casting quality factor of 0.95.

4.4 Welding repair requirements (procedures, welder’s performance, welding operators, etc.) shall comply with ASTM A488 and other ASME codes as applicable. All welding procedure specifications, performance qualification records and weld map documents must be available for the purchaser inspector upon his request.

4.5 All valves with weld repair to the pressure retaining components shall receive High-pressure Pneumatic Shell Test (as per API STD 598) after the subject weld repair.

4.6 Positive Material Identification (PMI) Requirements

Positive Material Identification (PMI) shall be performed on alloy steel material valves. PMI shall be performed in accordance with SAES-A-206. PMI alloy verification is required on Pressure Retaining Components (body, bonnet etc.) materials (100%). Alloy verification for trim parts is not required unless specified in the purchase order.

4.7 All steel valves NPS 6" and larger shall be pressure tested in a horizontal position i.e., with stem in vertical position. However, when valve installation orientation (NPS 6" and larger) is specified in the Purchase Order, applicable pressure tests shall be conducted with the valve in the specified orientation.

5 Pressure and Functional Tests

5.1 When there is an industrial standard referenced in the Purchase Order, valves shall be tested to the requirements of that standard (e.g., ASME, API, MSS, AWWA, etc.). In addition to tests per the applicable standard, the testing requirements in the following paragraphs shall apply for steel valves:

5.1.1 For all cast steel valves NPS 2 and below, the shell hydrostatic test shall be maintained for one minute. For larger sizes, valve shall be subjected to cyclic hydrostatic shell test for two cycles as follow:

- Primary pressure-holding period;
- Reduction of the pressure to zero;
- Secondary pressure-holding period.

For the first cycle "Primary Period" the shell test pressure shall be maintained for a minimum of five minutes or as required by the applicable industry standard, whichever is greater. For the second cycle "Secondary Period" shell test pressure shall be maintained for a minimum of 15 minutes.

5.1.2 High pressure flanged cast, steel valves in Class 900 and higher which are specified for gas service shall be subjected to a pneumatic high-pressure shell test per API STD 598 paragraph 3.5. The holding time shall be a minimum of 5 minutes and no visible leakage is allowed.

5.1.3 Valves specified for flare system isolation service, regardless of size, shall receive low pressure pneumatic seat tests at 5 psig.

5.1.4 All valves specified for subsea service, regardless of size, shall receive 100% witnessing of the shell hydrotest.

5.1.5 Metallic valves NPS 2 and larger shall be subjected to a high pressure closure test in accordance to API STD 598 irrespective of type and pressure class.

5.2 When there is a governing industrial standard, but it does not specify test durations or leakage acceptance criteria, paragraph 5.1.1 and API STD 598 requirements for durations and leakage shall apply, unless specified otherwise by the Valves Standards Committee Chairman.

5.3 When there is no referenced governing industrial standard, valve testing shall be in accordance with the following requirements:

5.3.1 Metallic valves smaller than NPS 2, and all non-metallic valves, shall be tested per Vendor's procedure as approved by the Valves Standards Committee Chairman or his delegate.

5.3.2 Metallic valves NPS 2 and larger shall be tested in accordance with paragraph 5.1.1 and API STD 598 requirements for shell tests and closure tests, unless specified otherwise by the Valves Standards Committee Chairman.

5.4 When a valve is ordered together with an actuator, the valve/actuator assembly shall be tested together as a unit. As part of functional testing, the valve shall be opened under the maximum differential pressure that the actuator has been rated for. The vendor shall take necessary steps to ensure that the valve is not damaged during this functional test.

5.5 10% of all valves specified for cryogenic service, regardless of size, shall be tested in accordance with the specified standard at the service temperature specified by the Purchaser. One valve shall be tested from each PO item as a minimum.

6 Hardness Testing

Hardness tests, when required by specified service and/or material specification, shall be conducted by the Vendor on all wetted parts in accordance with ASTM E10, ASTM E18 or ASTM A956 Leeb hardness test.

7 Impact Testing

When 04-SAMSS-003 is specified in the Purchase Order, the Vendor shall conduct impact tests as required by the Specification.

8 Inspection and Testing of Major Components Material

8.1 Visual Inspection

All castings shall be visually inspected in accordance with MSS SP-55. A casting shall be rejected if any surface irregularity exceeds example "a" of any defect type as per MSS SP-55.

8.2 Surface Examination

For cast steel valves NPS 6 and larger, the internal and external surface areas of 10% (minimum one) of all pressure retaining components (bodies, bonnets, covers, ball) per heat shall be magnetic particle or liquid penetrant inspected in accordance with MSS SP-53 or MSS SP-93. If any unacceptable defect is detected, all castings from the quantity on order shall be inspected.

8.3 QA Program Casting Qualification and Volumetric Examination

8.3.1 As part of their QA program, the Vendor shall implement a qualification procedure for all pressure containing steel castings. As a minimum, the vendor shall have qualified each foundry's casting patterns by radiographic examination of the initial casting. Records of these qualifications shall be made available upon request.

8.3.2 Radiography shall be performed on all valves listed in 8.3.3.
The examination shall be in accordance with and have included all critical areas as defined in ASME B16.34, paragraph 8.3.1.1. For valves other than those included in ASME B16.34 figures, ASME SEC VIII, App. 7, Section 7.3(a).1 Footnote 1 shall be used to determine the critical areas. See Acceptance criteria shall be in accordance with ASME B16.34 Appendix I.

8.3.3 The vendor shall radiographically examine and qualify all cast steel valves NPS 24 and larger. For cast steel valves NPS 2 and larger in ASME Class 600 and higher, the vendor shall radiographically examine and qualify one valve per size per heat from the lot on order. If this radiographic sampling results in a rejection (defined as requiring weld repair) then an additional 10% sample from the same size and foundry shall be subjected to radiographic examination as defined in 8.3.2. Further radiographic rejects resulting from this inspection mandates

100% Radiography of castings as defined in 8.3.2.

8.4 Valves fabricated by welding shall be qualified in accordance with ASME B16.34, paragraph 2.1.6.

8.5 Radiography can be replaced by ultrasonic examination for valves with minimum wall thickness higher than 175 mm the acceptance criteria shall be in accordance with ASME B16.34, Appendix I.

9 Plating Tests

The Vendor's Quality Assurance program shall include the following tests of carbon and low alloy steel electroless nickel plated parts on a sample basis:

9.1 Bend Test per ASTM B733 paragraph 9.4.1.

There shall be no evidence of lifting upon insertion of a sharp probe at any ENP-Base Metal interface.

9.2 Ferroxyl Test per ASTM B733 paragraph 9.6.1.

There shall be no indications in primary service exposure areas. When this test is impractical due to the size of the parts, the Vendor shall submit an alternate procedure for approval by the Valves Standards Committee Chairman.

10 Sampling Criteria

Visual inspection and witnessing shall be based on Table 1 sampling plan. At minimum, the sample shall include at least one valve from each Purchase Order item.

The sampling plan does not relieve the Vendor of the responsibility to ensure compliance of each valve with specified requirements and to test each valve.

When a discrepancy is found, the entire lot shall be rejected. The lot shall be re-inspected and re-tested by the Vendor, prior to presenting them again for inspection.

Table 1

Valve Category	Minimum Sample Size (% of Item Quantity)
All valves NPS 2 and smaller all ratings	10%
2< valves < 14 NPS and less than ASME Class 600	25%
All valves NPS 14 and above All valves >2" and ANSI Class 600 and above All valves >2" and API rating 2000 psi and above	100%

However, if Buyer's Representative witnesses a failure of a hydrostatic shell test, all valves in the lot shall be re-tested and witnessed by Buyer's Representative. The cause of failure shall be investigated and reported.

11 Documentation and Traceability Requirements

11.1 Material Test Reports and Certificates shall be supplied in accordance with Saudi Aramco Inspection Requirements Form 175-043000.

11.2 All certificates and test reports shall identify the valve(s) by stating Purchase Order and Item number, Vendor's name, type, size and rating of valves, and quantity of valves covered.

11.3 Certificates of castings shall include weld repair data including extent of repair, WPS, welder qualifications, post weld heat treatment and NDE following the repair(s).

11.4 Vendor shall obtain a release note from Saudi Aramco inspection representative prior to commencing assembly activities.

11.5 All traceability documents shall be made available upon request by Saudi Aramco representative.

Revision Summary

11 October 2010	Revised the "Next Planned Update." Reaffirmed the contents of the document, and reissued with editorial revision to reflect the changes in committee members list.
17 May 2011	Minor revision.
28 August 2013	Minor revision to avoid any conflict or misinterpretation by the vendor with regard to valve testing orientation and to have better quality casting by having a better casting testing and inspection requirements. Also, to avoid getting low quality valves.