Engineering Standard

16 February 2022

SAES-L-108
Selection of Valves

Document Responsibility: Valves Standards Committee

Contents

Summary of Changes

Paragraph Number		Change Type	Technical Change(s)
Previous Revision 07 May 2019	**Current Revision** 16 Feb 2022		
3	3	Modification	Added SAES-A-134. Updated title for 04-SAMSS-001, 047, 051, and 055. Updated description for API 6D and API 6FA. Added API 6A and removed ISO 10423. Added API RP 615 and NACE MR0103/ISO 17945.
4.5 and 7.9	4.5	Modification	Replaced "*All requisitions, except those for ISO 10423 valves and chokes, shall reference 04-SAMSS-035 and 04-SAMSS-048.*" with "*All requisitions, except those for API 6A valves and chokes, shall reference 04-SAMSS-035 and 04-SAMSS-048. All requisitions for API 6A valves and chokes shall reference 04-SAMSS-055.*"
4.6	4.6	Modification	*Added note* "For project reviews, list all Valve Data Sheets for 04-SAMSS valves and chokes under Index L."
4.7.1	*4.7.3*	*Editorial*	*Renumbered 4.7.1 as 4.7.3. Renumbered other sections accordingly.*
4.7.2	*4.7.1*	*Editorial*	*Added note and included* additional definition for proponent in parenthesis.
4.7.6	4.7.7	Editorial	Updated note.
4.8	4.8	Modification	Changed "*The use of ANSI FCI 70.2 to specify seat leakage criteria is not permitted without the specific approval of the Chairman of the Valves Standards Committee. Chokes are exempt from this requirement." to "The use of ANSI/FCI 70.2 to specify seat leakage criteria for valves covered under this engineering standard is not permitted. Note: Chokes are exempt from this requirement.*"
4.9	4.9	Editorial	Added new note
-	4.10	Addition	Added new section to address dead-legs.
-	4.11	Addition	Handling, hauling, receiving inspection, and storage of valves and chokes shall be in accordance with SAEP-35.
4.10	4.12	Modification	Changed "*Valve preventive maintenance shall be in accordance with SAEP-29.*" to "*Preventive maintenance of valves and chokes shall be in accordance with SAEP-29. Critical valves shall be included in the Equipment Inspection Schedule (EIS) as per SAEP-20 requirements*."
-	4.13	Addition	When a service type is referenced in this specification and no definition has been provided, refer to the definition in API RP 615.
5.1.1	5.1.1	Editorial	Reworded paragraph
5.1.2	5.1.2	Modification	Changed "*Bonnets retained by split rings and sealed by means of an O-ring or a seal-welded membrane shall only be used after approval by the Chairman of the Valves Standards Committee.*" to "*Bonnets retained by split rings and sealed by means of an O-ring or a seal-welded membrane are not permitted.*"
5.1.4	5.1.4	Modification	Removed *"Other proposals for securing bonnets shall be specifically approved by the Chairman of the Valves Standards Committee".* Added exception
5.2.2	5.2.2	Modification	Removed *"and the Chairman of the Valves Standards Committee*". Added note.
5.2.3	5.2.3	Modification	Removed "*provided it is specifically approved by the Chairman of the Valves Standards Committee*."
-	5.2.4	Addition	Added new paragraph
-	5.2.5	Addition	Added new paragraph
5.5	5.5	Modification	Removed *"except as permitted by an approved SAMSS."*
5.7.1	5.7.1	Modification	Removed *"specifically approved by the Chairman of the Valves Standards Committee."*
-	5.7.2	Modification	Added new section for unidirectional Isolation valves
-	5.7.3	Addition	Added new paragraph

5.7.2	5.7.4	Editorial	Renumbered section 5.7.4
6.1	6.1	Modification	Removed term "*handwheel*"
6.2.2	6.2.2	Modification	Removed term "*high performance*". Removed "*unless otherwise approved by the Chairman of the Valves Standards Committee*."
6.2.2 a)	6.2.2 a)	Modification	Included term "*double or triple*"
6.3.1	6.3.1	Modification	Deleted term "*wafer*"
6.3.2	6.3.2	Modification	Replaced "*A non-slam internal-spring-assisted type check valve shall be installed at the discharge of pumps and compressors. Other check valve types shall be specifically approved by the Chairman of the Valves Standards Committee*." with "*A non-slam internal-spring-assisted nozzle/piston type check valve shall be installed at the discharge of pumps and compressors. Other check valve types shall be supported by a hydraulic analysis to verify that the selected check valves have the correct dynamic response to prevent slamming and limit pressure surge to an acceptable level (the analysis shall include consideration of the "worst case" operating mode scenario) and specifically approved by the Proponent (Operating organization)."*
-	6.3.3	Addition	added new paragraph to include basic information when specifying a check valve
-	6.3.4	Addition	added new paragraph to verify check valve suitability.
6.3.3	6.3.5	Editorial	Reworded paragraph.
6.3.4	6.3.6	Addition	Added *"to minimize potential wear/damage to internal valve part"* and changed *"Chairman of the Valves Standards Committee" to "Proponent (Operating organization)"*
6.3.5	6.3.7	Modification	Removed "*unless specifically approved by the Chairman of the Valve Standards Committee".*
6.3.6	6.3.8	Modification	Added "*double*" to the term "*flanged*".
6.3.7	6.3.9	Modification	Changed "*Spring-assisted non-slam piston check valves (also referred to as nozzle check valves) shall be long-pattern with face-to-face dimensions in accordance with API SPEC 6D. Short-pattern valves shall not be used without the review and approval of the Chairman of the Valves Standards Committee.*" to "*Spring-assisted non-slam piston-type and nozzle-type check valves shall be long-pattern with face-to-face dimensions in accordance with API SPEC 6D.*"
5.8	6.5	Editorial	Changed "*Gate valve designs which include internal coating on the body seat area or guides shall be supplied with a rubber-lined wedge.*" to "*Gate valve designs which include internal coating on the body seat area (such as some AWWA valve designs for waterworks applications) or guides shall be supplied with a rubber-lined wedge.*"
-	6.6	Addition	Added new section covering manual globe valves
-	6.7	Addition	Added new section covering chokes
7.1.1	7.1.1	Editorial	Editorial change
7.1.2	7.1.2	Editorial	*revised paragraph to reference* materials listed in *ASME B 16.34, Table 1 and ASME B31.3, Table A-1 for the valve design temperature.*
7.3	7.3.1	Modification	Changed "*high performance butterfly (flanged)*" to "*butterfly (double-flanged API 609 Category B triple offset-type)*"
7.4.1	7.4.1	Modification	Changed "*high performance butterfly*" to "*butterfly (double-flanged API 609 Category B triple offset-type)*".
7.5	7.5.1	Modification	Changed "*high performance butterfly (flanged)*" to "*butterfly (double-flanged API 609 Category B triple offset-type)*"
7.5	7.5.2	Modification	Changed "*Soft seated valves shall be fire safe in accordance with API STD 607, API SPEC 6FA, or ISO 10497*" to "*Soft seated Valves shall be fire-safe type-tested and certified designs in accordance with API STD 607, API STD 6FA, or ISO 10497".*
7.8	7.8	Modification	Changed "*Flangeless valves shall not be used as the first block valve against storage tanks or vessels containing hazardous materials unless specifically approved by the Chairman of the Valves Standards Committee"* to "*Flangeless*

			valves shall not be used as the first block valve against storage tanks or vessels containing hydrocarbons or hazardous materials".
7.9	4.5	Modification	Removed section covering ISO 10423 valves and chokes. Now covered by 4.5.
7.10.1	7.9.1	Modification	Changed "*Scraper trap mainline isolation valves shall be full bore through conduit gate or ball valves in accordance with API SPEC 6D. The seating configuration shall provide DIB-2 functionality unless otherwise specified. Other valve types are permitted subject to the review and approval by the Chairman of the Valves Standards Committee and the Proponent Operating Department on a case-by-case basis."* to "*Scraper trap mainline isolation valves shall be full bore through conduit gate or ball valves in accordance with API SPEC 6D. The seating configuration shall provide DIB-2 functionality unless otherwise approved by the Proponent (Operating organization) on a case-by-case basis.*"
7.10.2	7.9.2	Editorial	*Renumbered paragraph.*
7.10.5	7.9.3	Modification	*Listing the requirement as an exception under 7.10.3. changed reference to ISO 10423 to API SPEC 6A.*
7.10.4	*7.9.4*	*Modification*	*Changed "The scraper trap isolation valve and the kicker valve shall have a minimum trim metallurgy of Stainless Steel F51, for sour service the minimum trim metallurgy shall be Alloy 625 or Alloy 718. In addition, the valve seat pockets (applicable to spring loaded seats only) shall be specified to have an Alloy 625 weld overlay."* to *"Scraper trap isolation valves and kicker valves shall have: (a) a minimum trim metallurgy of 22Cr Duplex Stainless Steel (UNS S31803); and, (b) the valve seat pockets for spring loaded seat designs only shall be specified to have an Alloy 625 weld overlay.*"
7.11.1	*7.10.1*	*Modification*	*Removed "Approval of equivalents shall be referred to the Chairman of the Valves Standards Committee". Added exception "modular piping class valve assemblies in 7.11.2 are an exception".*
7.11.2	*7.10.2*	*Modification*	Removed "*subject to specific review and approval by the Chairman of the Valves Standards Committee on a case-by-case basis*". Added considerations and criteria for evaluation and use of such valve assemblies.
7.12	*7.11*	*Modification*	*Removed "Other gate type shall be specifically approved by the Chairman of the Valves Standards Committee."*
7.13	*7.12*	*Editorial*	*Renumbered paragraph.*
7.14	*7.13*	*Editorial*	*Renumbered paragraph.*
7.15	*7.14*	*Editorial*	*Renumbered paragraph and reworded exception.*
7.16	*7.15*	*Modification*	*Removed* "*The use of rising stem valves is not permitted without the specific approval of the Chairman of the Valves Standards Committee.*"
7.17	*7.16*	*Modification*	*Removed* "*Other isolation valve types are permitted subject to the review and approval by the Chairman of the Valves Standards Committee and the Proponent Operating Department on a case-by-case basis.*"
8.3	*8.3*	*Modification*	Removed "*A material which is equivalent or better than a material listed in the Materials Appendix attached to this standard can be used subject to the approval of the Chairman of the Valves Standards Committee. For service conditions which differ from those listed in the Materials Appendix attached to this standard, consult the Chairman of the Valves Standards Committee.*" Modified "*See SAES-L-132 and SAES-A-133*" to "*See SAES-L-132 and SAES-A-133 for additional requirements and material limitations."*
8.4, 8.5, 8.6, 8.8	-	*Deletion*	Removed sections which are covered by the references in 8.3.
8.7	*8.5*	*Modification*	Renumbered section.
Materials Appendix Table I	*Materials Appendix Table I*	*Modification*	Table I: changed TEFZEL to ETFE in the remarks column for crude oil or product; added general notes (H) and (I); changed ISO 10423 to API 6A in note 18.

1 Scope

1.1 This Standard covers limitations on the selection of all valves normally classified under Saudi Aramco Materials System (SAMS) Class 04. This will normally include ball, butterfly, check, choke, diaphragm, gate, globe, needle, and plug valves used for on-off, for manual control service or for prevention of reverse flow, as appropriate.

1.2 Specifically excluded from the scope are:

a) Control, safety-relief, relief, surge relief, solenoid, pilot, and other valves classified under SAMS Class 34.

b) Applications involving flues and chimneys, air conditioning and ventilation ducts.

c) Drilling and wellhead valves classified under SAMS Class 45.

1.3 Where applicable, this Standard supplements the requirements of ASME B31, Code for Pressure Piping.

2 Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Coordinator.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

3 References

All referenced specifications, standards, codes, drawings, and similar material are considered part of this engineering standard to the extent specified, applying the latest version, unless otherwise stated.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedures

SAEP-29	General Instructions and Guidelines for Online Valve Preventive Maintenance
SAEP-35	Valves Handling, Hauling, Receipt Tests, and Storage
SAEP-302	Waiver of a Mandatory Saudi Aramco Engineering Requirement

Saudi Aramco Engineering Standards

SAES-A-007	Hydrostatic Testing Fluids and Lay-up Requirements

SAES-A-133	Internal Corrosion Protection Requirements
SAES-A-134	External Corrosion Protection Requirements
SAES-B-017	Fire Water System Design
SAES-L-109	Selection of Flanges, Stud Bolts, and Gaskets
SAES-L-110	Limitations on Pipe Joints and Components
SAES-L-132	Materials Selection for Pipelines, Piping, and Process Equipment
SAES-L-136	Pipe, Flange, and Fitting Material Requirements
SAES-L-310	Design of Plant Piping
SAES-H-001	Coating Selection and Application Requirements for Industrial Plants and Equipment
SAES-H-002	Internal and External Coatings for Steel Pipelines and Piping
SAES-H-004	Protective Coating Selection and Application Requirements for Offshore Structures and Facilities
SAES-W-011	Welding Requirements for On-plot Piping
SAES-W-012	Welding Requirements for Pipelines

Saudi Aramco Materials System Specifications

04-SAMSS-001	Gate Valves, Supplementary Requirements to IOGP S-611
04-SAMSS-002	Steel Globe Valves - Flanged and Butt-welding Ends
04-SAMSS-003	Additional Requirements for Low Temperature Valves
04-SAMSS-005	Check Valves: Flanged, Lug, and Butt-welding
04-SAMSS-035	General Requirements for Valves
04-SAMSS-041	Expanding Plug Valve
04-SAMSS-042	4-Way Diverter Valves
04-SAMSS-047	Butterfly Valves– API 609 Category B
04-SAMSS-048	Valve Inspection and Testing Requirements
04-SAMSS-050	Gate Valves, Through Conduit Type, API SPEC 6D
04-SAMSS-051	Ball Valves, Supplementary Requirements to IOGP S-562
04-SAMSS-053	Steel Lubricated Plug Valves - Flanged and Welding End
04-SAMSS-055	Valves and Chokes, API SPEC 6A

Saudi Aramco Form and Data Sheet

SA-6233-1	Valve Data Sheet

3.2 Industry Codes and Standards

American National Standards Institute/Fluid Controls Institute

ANSI/FCI 70.2	Control Valve Seat Leakage

American Petroleum Institute

API SPEC 6A	Specification for Wellhead and Tree Equipment
API SPEC 6D	Specification for Valves
API STD 6FA	Standard for Fire Test for Valves
API STD 598	Valve Inspection and Testing
API STD 602	Gate, Globe, and Check Valves for Sizes DN 100 (NPS 4) and Smaller for the Petroleum and Natural Gas Industries
API STD 607	Fire Test for Quarter-turn Valves and Valves Equipped with Non-metallic Seats
API STD 609	Butterfly Valves: Double-flanged, Lug- and Wafer-Type
API RP 615	Valve Selection Guide

American Society of Mechanical Engineers

ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.34	Valves - Flanged, Threaded, and Welding End
ASME B31	Code for Pressure Piping

International Organization for Standardization (ISO)

ISO 10497	Testing of Valves — Fire Type-Testing Requirements

Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.

MSS SP-45	Bypass and Drain Connections

National Association of Corrosion Engineers/International Standardization Organization

NACE MR0103 / ISO 17945	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments
NACE MR0175 / ISO 15156	Petroleum, Petrochemical and Natural Gas Industries - Materials for Use in H2S Containing Environments in Oil and Gas Production

4 General

4.1 Valves and chokes shall be purchased in accordance with the Saudi Aramco Regulated Vendors List (RVL).

4.2 The selection of valves and chokes shall normally be limited to the materials, types and sizes that are listed in Saudi Aramco Materials System (SAMS) Class 04 specifications unless no suitable valve is listed.

4.3 Whenever applicable, the relevant Saudi Aramco Materials System Specifications (SAMSS's) listed in Section 3 of this standard shall be included in all requisitions.

4.4 At times it is necessary to purchase a valve that is generally similar to that covered by an SAMSS but differing from it in some specific design, construction, materials, or performance characteristics. In such cases, the SAMSS shall be included in the purchase requisition in addition to the required modifications provided that these modifications are in accordance with all other Mandatory Saudi Aramco Engineering Requirements.

4.5 All requisitions, except those for API 6A valves and chokes, shall reference 04-SAMSS-035 and 04-SAMSS-048. All requisitions for API 6A valves and chokes shall reference 04-SAMSS-055.

4.6 Form SA-6233-1, Valve Data Sheet, shall be filled out for each non-SMG (System Materials Group) line item and attached to every purchase requisition.

Note: For project reviews, list all Valve Data Sheets for 04-SAMSS valves and chokes under Index L.

4.7 Field Tests

4.7.1 If requested by the Proponent (Operating organization), new valves designated for isolation service (as specified by the Proponent Operating organization) shall be subjected to a high pressure hydrostatic seat test prior to installation in the line.

Note: The requirements in SAEP-35 are independent of the requirement above. SAEP-35 mandates pressure testing of all valves which have been in long term storage prior to installation.

4.7.2 Valves selected for seat testing shall be subjected to a shell pressure test at the valve rated pressure unless otherwise agreed with the Proponent (Operating organization).

4.7.3 Testing location shall be subject to Proponent (Operating organization) acceptance. The test location shall be approved by Saudi Aramco Inspection Department through a formal assessment.

4.7.4 A low pressure pneumatic seat test at 35 kPa (5 psig) shall be substituted for the high pressure hydrostatic seat test for flare system valves.

4.7.5 Buttweld and socketweld end valves in nominal pipe size (NPS) 2-inches and smaller are exempt from the above field testing requirements.

4.7.6 Test procedures, pressures, durations, and leakage acceptance criteria shall be equal to those that the valves were originally purchased to, except for the shell test pressure which should be limited to the valve rated pressure. All resilient (soft) seated isolation valves shall have zero leakage.

4.7.7 If valves are subjected to field hydrotesting, see SAEP-35 and SAES-A-007. For major projects where numerous valves are to be subjected to field hydrotesting, a preservation package shall be developed and approved prior to the initiation of any testing.

Note: Consider the valve features and materials at design stage and when developing a preservation package, see SAES-A-133.

4.8 The use of ANSI/FCI 70.2 to specify seat leakage criteria for valves covered under this engineering standard is not permitted.

Note: Chokes are exempt from this requirement.

4.9 Trim material includes the stem, the body and closure seating surfaces, bushings, pins, springs, guides, and any other small parts in contact with the service fluid.

4.10 Drain valves, valves at low points and body cavity auxiliary drains (piping and valves) where water may collect under stagnant flow conditions shall be addressed per the dead leg sections in SAES-L-310.

4.11 Handling, hauling, receiving inspection, and storage of valves and chokes shall be in accordance with SAEP-35.

4.12 Preventive maintenance of valves and chokes shall be in accordance with SAEP-29.

Note: Include critical valves in the SAEP-20, Equipment Inspection Schedule (EIS).

4.13 When a service type is referenced in this specification and no definition has been provided, refer to the definition in API RP 615.

5 General Design Limitations

5.1 Bonnet/Cover

5.1.1 Pressure seal bonnet/cover designs are permitted in steam or other clean non-corrosive services. The use of pressure seal bonnet/cover designs in other services is only permitted if the body has been inlayed in the bonnet sealing area with an 18-8 material or higher alloy suitable for the service.

5.1.2 Bonnets retained by split rings and sealed by means of an O-ring or a seal-welded membrane are not permitted.

5.1.3 The use of welded bonnet valves in hydrocarbon services shall be limited to NPS 4 and smaller provided it is approved by the Manager of the responsible operating department.

5.1.4 Screwed bonnet and screwed body valves shall not be used in any hydrocarbon or hazardous material services unless the bonnets and body end connections are tack welded to the body or provided with locking pin.

Exception: Choke bonnet designs that are self-locking by design (such as the Stub ACME threaded type) can be exempted from the above requirement provided the choke manufacturer has design calculations that demonstrate the design is self-locking and the calculations have been reviewed by an independent third-party certification body.

5.1.5 Straight-thru union body check valves shall be used only in portions of piping systems where pipe unions are permissible.

5.1.6 Union bonnet valves shall not be used in any hydrocarbon or hazardous material services.

5.2 End Connections

5.2.1 The requirements of SAES-L-110 are applicable to all valves.

5.2.2 Integral flanged valve bodies with tapped bolt holes shall not be used except with specific approval of the Proponent (Operating organization). This requirement does not apply to lug type valves.

Note: Integral flanged valve bodies with tapped bolt holes can be considered when other options are not feasible or where there is a strong technical justification for their use. Prior to using such designs, consider installation, removal and potential for stuck bolting.

5.2.3 If requested by the Proponent (Operating organization), critical valves, welding end valves, and others that cannot be removed from the line without serious difficulty (e.g., in restrained pipelines), NPS 8 and larger, shall be of a type that is repairable in the line such as a top-entry design.

5.2.4 When replacing existing valves with non-standard flange dimensions (such as NPS 30 and larger in Class 1500), the Purchaser shall include the applicable standard drawing in the purchase documents.

5.2.5 When raised face flanges are to be used for hydrogen service, the Purchaser must specify the special flange face surface finish requirements per SAES-L-109 in the valve purchase documents.

5.3 Ratings

5.3.1 Valves utilizing soft seats do not necessarily follow ASME B16.5 or other industry standard pressure-temperature (P-T) relationships at temperatures above 38°C. The specific valve manufacturer's literature shall be consulted when the pressure-temperature ratings for higher temperatures have not been specified by the relevant SAMSS or the Purchase Order.

5.3.2 In hydrocarbon services, the minimum body rating of threaded and socketweld end NPS 2 and smaller valves shall be equivalent to API STD 602 Class 800.

5.4 Sizes

Valves shall be subject to the same size limitations specified for pipe in SAES-L-136.

5.5 Stem Packing

Isolation valves NPS 3 and larger in hydrocarbon services shall not be provided with pure polymer/elastomer stem packing or stem seals unless the valves have been qualified as fire-safe.

5.6 Operator

5.6.1 The need for power actuation of all valves NPS 12 and larger in all pressure classes shall be reviewed with the responsible operating organization.

5.6.2 Chainwheel operation shall not be provided for emergency isolation valves or valves having a threaded body connection.

5.7 Installation

5.7.1 Gate valves with back-seats

Gate valves with back-seats shall not be installed with their stems below the horizontal except in the following cases: (a) clean services, (b) when they function as isolation valves in pressure relief and flare system piping, and (c) when in utility or other similar non-critical services (firewater is considered to be critical service). Critical / non-critical valves shall be specified by proponent (Operating organization).

5.7.2 Unidirectional Isolation valves

The blockage direction required during operation and also during maintenance shall be considered prior to selecting unidirectional isolation valves.

Notes: Isolation valves that include an equalizing hole in the closure member to connect the valve body cavity with the high-pressure (HP) side of the valve when the closure member is in the closed position to relieve excess cavity pressure are unidirectional designs. Such isolation valves are designed to block flow when the pressure source is on the side of the valve designated HP.

It may not always be obvious to the valve installer(s) whether the marking on a valve body (e.g., a directional arrow) indicates the direction of normal flow or the direction of pressure against which the valve shall seal when in the closed position. This can be opposite of the normal flow direction.

Care needs to be taken when interpreting directional arrows and marking on valve bodies to ensure the valve is installed in the correct direction.

The system drawings (for example, piping isometrics or P&ID) shall show the valve installation orientation with reference to the marking on the valve.

5.7.3 When ductile and cast-iron bodied valves are supplied with coating on the flange gasket seating face, the gaskets used during valve installation shall be compatible with the valve and pipe flange facing.

5.7.4 Seal welding

5.7.4.1 All threaded connections on valve bodies and associated piping shall be seal welded.

Exceptions: Exceptions are those connections that are frequently disassembled (such as vent and drain plugs) and those that are adjacent to elements that contain small moving parts (such as injection fittings and body relief valves).

5.7.4.2 Seal welding shall follow the general requirements of SAES-L-110.

6 Specific Valve Type Limitations

6.1 Ball and Plug Valves

Lever operated valves shall be equipped with a self-locking handle to prevent accidental operation.

6.2 Butterfly Valves

6.2.1 Concentric butterfly valves, such as the API STD 609 Category A type (typically with internal rubber linings), are permitted only in non-hydrocarbon applications.

6.2.2 The use of butterfly valves in hydrocarbon service shall be limited to a maximum rating of Class 600 and clean service. Minimum requirements in hydrocarbon service are as follows:

a) Valves shall be designed in accordance with API STD 609 Category B with double or triple offset-type construction.

b) Valves shall be qualified fire-safe to either API SPEC 6FA, API STD 607, or ISO 10497, except in applications where other components of the system are not designed to be firesafe such as Single-Point-Mooring (SPM) systems.

c) The body shall be of the lug-type design with tapped bolt holes or the double-flanged type. Use of the wafer-type body is not permitted.

d) Valves shall be full-rated.

Exception: In systems where the normal operating pressure is 103 kPa (15 psig) or less, the valve may be specified with half-rated trim (approximately 50% of the full-rated pressure).

e) Valves shall be bi-directional, although they may have a "preferred" direction. Valves shall be installed in the "preferred" direction indicated on the valve.

6.3 Check Valves

6.3.1 Dual- and single-plate check and swing check valves shall not be used in reciprocating pump and compressor suction and discharge services or similar pulsating services.

6.3.2 A non-slam internal-spring-assisted nozzle type check valve shall be installed at the discharge of pumps and compressors. Other check valve types shall be supported by a hydraulic analysis to verify that the selected check valves have the correct dynamic response to prevent slamming and limit pressure surge to an acceptable level (the analysis shall include consideration of the "worst case" operating mode scenario) and specifically approved by the Proponent (Operating organization).

6.3.3 The service, design and operating scenarios, including minimum flowrate, maximum flowrate and frequency, shall be included in the valve purchase documents.

6.3.4 Check valve sizing and dynamic response characteristics shall be evaluated by the system designer and the valve manufacturer to verify the suitability of the selected check valves for the application.

6.3.5 If requested by the Proponent (Operating organization), for parallel pump systems with individual pump discharge piping of NPS 20 and greater, a hydraulic analysis shall be conducted to verify that the selected check valves have the correct dynamic response to prevent slamming and limit pressure surge to an acceptable level. The analysis shall include consideration of the "worst case" operating mode scenario.

6.3.6 For piping NPS 4 and larger, a turbulence-free minimum distance of 5 pipe diameters upstream and 2 pipe diameters downstream of every check valve shall be maintained to minimize potential wear/damage to internal valve parts. Pipe fittings (e.g., elbows, reducers, tees, etc.) or flow-restricting devices (e.g., orifices, control valves, etc.) shall not be installed in these zones unless the

design is supported by analysis and specifically approved by the Proponent (Operating organization).

Exceptions: Valves in intermittent service and valves in skid-mounted systems are exempt from these requirements.

6.3.7 Check valves in sizes NPS 3 and above shall not be installed in vertical lines.

Exceptions: Valves in skid-mounted systems are exempt from this requirement.

6.3.8 Check valves in hydrocarbon service up to Class 600 shall either have a lug-type body with tapped bolt holes or a double-flanged body. In class 900 and higher ratings, a double-flanged body is mandatory. Wafer-type bodies are not permitted in any hydrocarbon service.

6.3.9 Spring-assisted non-slam piston-type and nozzle-type check valves shall be long-pattern with face-to-face dimensions in accordance with API SPEC 6D.

6.4 Plug Valves

Flanged plug valves in hydrocarbon service shall be of the inverted lubricated pressure balanced design, except that Class 150 valves NPS 6 and smaller may have a standard plug with springs for balancing the plug.

6.5 Gate Valves

Gate valve designs which include internal coating on the body seat area (such as some AWWA valve designs for waterworks applications) or guides shall be supplied with a rubber-lined wedge.

6.6 Manual globe valves

Goble valves should be sized to have the disc at least 20 % open.

Note: Operating globe valves with the disc/plug in a pinched down position can lead to accelerated wear and flow-induced vibration and associated damage. See API RP 615 for industry guidance.

6.7 Chokes

6.7.1 Chokes shall not be used as shutoff valves.

6.7.2 Multi stage anti-cavitation trims shall be selected for water services with a pressure drop ratio exceeding 0.65. The pressure drop ratio is calculated by dividing the pressure drop by the upstream pressure.

Exception: Start-up cases of short duration which are infrequent can normally be exempted from this requirement.

7 Specific Service Limitations

7.1 Low Temperature Services

7.1.1 Valves in service with a low temperature between -19°C and -45°C shall meet the requirements of 04-SAMSS-003. If the service is also sour, compliance with NACE MR0175/ISO 15156 shall be specifically stated in the purchase requisition.

7.1.2 All valves in service below -45°C shall be of full austenitic stainless steel materials listed in ASME B 16.34, Table 1 and also listed in ASME B31.3, Table A-1 for the minimum design temperature. The marking shall meet the requirements of 04-SAMSS-003, paragraph 6.3.

7.1.3 All valves in service below -100°C shall have an extended bonnet.

7.1.4 For LPG or high pressure gases which auto-refrigerate, an upstream gate valve shall be installed in addition to the throttling valve in any line that discharges to the atmosphere or to a low pressure system.

7.2 Underwater Valves

Isolation valves shall be ball type per 04-SAMSS-051 with a minimum rating of Class 300. The flange face shall be the ring joint type.

7.3 Pressure Relief Valve Piping

7.3.1 Isolation valves in stand-alone pressure relief valve inlet and discharge piping shall be gate, ball, butterfly (double-flanged API 609 Category B triple offset-type), or plug valves that can be car-sealed open.

7.3.2 A gate valve in this service shall be installed with the stem in or below the horizontal position.

7.3.3 For clean gas service, the valves shall be soft seated with double block and bleed capability if temperature permits.

7.4 Flare Systems

7.4.1 Isolation valves in flare system piping shall be gate, ball, butterfly (double-flanged API 609 Category B triple offset-type) or plug valves.

7.4.2 A gate valve in this service shall be installed with the stem in or below the horizontal position.

7.5 Emergency Isolation Valves

7.5.1 Emergency isolation valves (EIVs) shall be gate, ball, butterfly (double-flanged API 609 Category B triple offset-type) or plug valves.

7.5.2 Soft seated Valves shall be fire-safe type-tested and certified designs in accordance with API STD 607, API STD 6FA, or ISO 10497. Metal seated valves

shall meet the same requirement if they do not have graphite seals or their standard specified leakage rate exceeds that of API STD 598.

7.6 Firewater Systems

Valves in firewater systems shall meet the requirements of SAES-B-017.

7.7 Drains and Vents

Atmospheric drain and vent valves shall be provided with a plug or blind on the discharge side.

7.8 Storage Tanks and Vessels

Flangeless valves shall not be used as the first block valve against storage tanks or vessels containing hydrocarbons or hazardous materials.

7.9 Scraper Trap Valves

7.9.1 Scraper trap mainline isolation valves shall be full bore through conduit gate or ball valves in accordance with API SPEC 6D. The seating configuration shall provide DIB-2 functionality unless otherwise approved by the Proponent (Operating organization) on a case-by-case basis.

7.9.2 Drain valves shall be inverted pressure balanced lubricated plug valves with hardfacing on the plug and body seating surfaces.

7.9.3 Kicker valves and vent valves shall be inverted pressure balanced lubricated plug valves.

Exception: For API SPEC 6A services rated above 5,000 psi, metal seated ball valves for isolation and chokes for throttling service may be used for drain, kicker and vent valves, as appropriate.

7.9.4 Scraper trap isolation valves and kicker valves shall have:

(a) a minimum trim metallurgy of 22Cr Duplex Stainless Steel (UNS S31803); and,

(b) the valve seat pockets for spring loaded seat designs only shall be specified to have an Alloy 625 weld overlay.

The requirements of this paragraph override the materials requirements listed in the Material Appendix, unless those are more stringent.

Note: An obturator (e.g., ball) in low alloy or carbon steel with corrosion resistant alloy material weld overlaid on all process wetted surfaces is acceptable for meeting the above requirement on valves larger than NPS 4.

7.10 Instrumentation Root Isolation Valves

7.10.1 Instrumentation root isolation valves shall be API STD 602 gate valves.

Exception: Modular piping class valve assemblies in 7.11.2 are an exception.

7.10.2 Modular valve assemblies consisting of a root isolation valve together with bleed/vent and other types of valves (such as ball or needle) are permitted.

Prior to selecting a modular valve assembly, evaluate the likelihood and impact of taking a modular valve assembly out of service when there is no separate root valve.

Modular piping class valve assemblies incorporating needle or globe type valve units disposed around the circumference of a body shall be restricted to applications where scaling, waxing, or other fouling of the flow passages is unlikely to occur, owing to the extremely convoluted flow passage.

Modular valve assemblies shall be of a piping class design of bolted bonnet configuration.

Notes: Instrumentation class valve assemblies do not meet the requirements. Valve designs with threaded spindle nut arrangements (e.g., EEMUA 182, 2nd Edition, Figure 5.4.15) do not meet the requirements.

7.11 Steam Service

Isolation valves, NPS 2 and larger, in Class 600 and higher rated systems shall be parallel slide gate valves equipped with a cavity pressure relief system.

7.12 Blowdown Valves

Blowdown valves in gas pipelines shall be plug valves.

7.13 Bypass/Equalization Valves

Mainline bypass/equalization valves in gas service shall be inverted pressure balanced lubricated plug valves.

7.14 Buried Valves

Valves shall be an API SPEC 6D valve type which is designed for buried service in accordance with the requirements in API SPEC 6D and 04-SAMSS-035.

Exceptions: Other valve types are permitted for buried service when specified and designed with appropriate features (e.g., stem/shaft extension to raise the operator above ground; extension casing/housing for protecting extended stems/shafts; sealed interfaces to prevent ingress of external contaminants and moisture; means of preventing pressure buildup in stem extension casing/housing assemblies and operators resulting from stem or bonnet seal leakage; position indicators; valve and auxiliaries protected from external corrosion with suitable coating system in accordance with SAES-H standards in Section 3).

Note: See SAES-L-110 for restrictions on flanged joints and SAES-L-109 for requirements for protection of bolting.

7.15 Auto-Ignition services

Isolation valves shall be quarter turn non-rising stem designs.

7.16 Sectionalizing and lateral valves for pipelines

Isolation valves shall be in accordance with API SPEC 6D and shall be designed with bidirectional sealing capability and DBB functionality.

8 Materials Limitations

8.1 Valves with bodies of cast iron, ductile iron, or low melting point alloys (such as brass or bronze) shall not be used in hydrocarbon services.

8.2 Valves with steel bodies shall be used in the following cases:

a) The first valve on all tanks and other vessels if failure could create a personnel or fire hazard or result in a large monetary loss.

b) In hazardous areas where it is essential that the valve not fail in a fire.

8.3 Minimum (basic) material requirements are specified in the attached Materials Appendix, except as modified above.

All environmental factors and production/process variables must be evaluated and where necessary higher corrosion resistance material grades shall be used. Environment changes during the design life must also be considered.

See SAES-L-132 and SAES-A-133 for additional requirements and material limitations.

8.4 Refer to paragraph 4.4 for cases where the required materials differ from those in the 04-SAMSS.

8.5 See SAES-W-011 and SAES-W-012 for restrictions on dissimilar metal welds (DMWs).

Document History

16 February 2022	Major periodic revision.
19 February 2019	Major revision as it is due for regular update
1 March 2016	Revised the Next Planned

Materials Appendix

Table I - Service and Application Requirements Valve Body and Trim Materials

	Conditions		Valve Materials		
Environment	**Conc.(%)**	**Temp.(C)**	**Body**	**Trim**	**Remarks**
Acid, Hydrochloric	LT 37	5 - 50	PVC B-2	PVC B-2	No ferric ions or other oxidants for B-2
Acid, Hydrofluoric non-oxidizing	1 - 70 GT 65	5 - 50 5 - 40	M400 PTFE, PFA	C-276 PTFE, PFA	No glass or glass reinforced plastics; no titanium, zirconium or tantalum
Acid, Hydrofluoric (aerated or oxidizing)	All conc.	to 50	20	20	
Acid, Nitric	1 - 70 70 - 99	5 - 50 30 max.	304L (6) 304L	304L 304L	304L is preferred to 316L for nitric acid
Acid, Phosphoric	1 - 85	5 - 50	316 G-3(X)	316L G-3(X)	Applies to chloride or fluoride free grades of phosphoric acid only
Acid, Sulfuric(8) or Sulfurous	90 -100+ 1 -103 to 60 1 - 100	to 50 to 65 to 65 100	316 20 CPVC C-276	316L 20 CPVC C-276	
ADIP (Amino-Diisopropanol)	20 - 30	5 - 150	CS	316	No copper alloys allowed
Air or Nitrogen gas	N/A	0 - 400	CS BR	410 BR	
Ammonia, Anhydrous (10)	100	0 - 50	CS	410	No copper alloys allowed
Carbon Dioxide					
dry	100	0 - 150	CS	410	
wet	LT 100	5 - 90	316	316	
Chlorine,					
dry (12)	100	0 - 70	CS M400	M400 M400	
wet (13)	LT 100	0 - 70	CPVC C-276	CPVC C-276	For castings, Alloy C-4
	LT 10	0-49	PVC	PVC	is preferred to C-276
Chlorine/Water	1 - 5	to 50 50 - 80 to 80	PVC CPVC C-276	PVC CPVC C-276	For castings, Alloy C-4 is preferred to C-276

(Refer to General and Specific Notes at the end of Table 1)

Table I (Cont'd)

Environment	Conditions		Valve Materials		Remarks
	Conc.(%)	Temp.(C)	Body	Trim	
Crude Oil or Product (15)	N/A	to 220	CS	ENP	Up to 10% water cut only during the design life. ETFE or PEEK soft seals and seats shall be specified if valves will be exposed to acidizing conditions
		to 280	CS	410	
			CS	316	
			CS	TC	
		280 to 340	CrMo5	410	See note (30)
		340 to 500	316	316	
Diglycolamine (DGA) or	to 100	to 65	CS	410	Use 316 bodied valves where 304 or 316S.S. pipe is employed or for throttling applications
			CS	316(X)	
Diethanolamine (DEA)	20 - 70	5 - 190	CS	316	
			316(X)	316	
Flare Lines	N/A	to 400	CS	410	
			CS	316	
Freon	100	0 to 70	CS	410	
		-100 to 0	316	316	
Hydrocarbon Gas including Khuff Gas (15, 18)	N/A	-18 to 220	CS	ENP	ENP trim not permitted for wet or sour gas
		- 18 to 280	CS	410	
			CS	TC	
Hydrogen (16)	100	0 - 220	CS	ENP	Same restriction on ENP as above
			CS	410	
			316(X)	316(X)	
		220 to 325	CrMo22	410	
			316(X)	316(X)	
		325 to 400	316	316	
Hypochlorite, Sodium or Calcium	to 5 to 15	5 - 50 0 – 60	PVC PTFE/PFA	PVC PTFE/PFA	Treat same as chlorine/water solutions
Light Hydrocarbons (Butane, Ethane, Hexane, Methane, Pentane and Propane) and NGL	100	-18 to 220	CS	ENP	ENP trim not permitted for wet or sour gas
		-18 to 400	CS	410	
			CS	316	
			CS	TC	
		-45 to -18	LTS	316	
		LT -45	304	304	
			316	316	
Lube Oil	100	5 - 120	CS	410	
			304	304	
			316	316	

(Refer to General and Specific Notes at the end of Table 1)

Table I (Cont'd)

Environment	Conditions Conc.(%)	Valve Materials Temp.(C)	Body	Trim	Remarks
Naphtha	100	0 - 150	CS CS	410 316(X)	
Sewer, Oily Water	N/A	5 - 50	DI (7)	Br(20)	
Sewer, Storm or Sanitary	N/A	5 - 50 to 80	DI (7) Br (20) PVC PP	Br(20) Br(20) PVC PP	
Sodium Hydroxide	50	5 - 50 50 - 80 20 7 7	D2 316(X) CS M400(X) CS 304L(X) CS CS M400	20 316(X) M400 M400 (2) M400 304L(X) 316 M400 M400	
Steam	100	120 - 400 400 - 480	CS CRMoll	410 410	Seat rings shall be overlayed with Hard Facing. For Class 600 systems and higher, all seating areas shall be overlayed with Hard Facing
Steam Condensate	100	5 - 120	CS CS	410 410	
Sulfur Dioxide (Solution)	0.5		C-276	C-276	Solution in deaerated sea-water, pH 1.5
Sulfur Molten	100	GT 107	CS	316	Keep dry. Moisture causes corrosion
Water Non-corrosive (oxygen free or (inhibited)	N/A	0 - 100	CS D1 (7) Br CS	410 Br Br 316	Includes deaerated and/or inhibited sea, raw, well water Zeolite softened, chilled, and boiler feed water. pH GT 6, oxygen LT 25 ppb
Potable (Sweet) (31)	N/A	5 - 50 50 - 72 5 - 72	Br (20) PVC CS (26) D1 (7) Br (20) CS (26) CPVC	Br (20) PVC 316 Br (20) Br (20) 316 CPVC	Nickel Aluminum Bronze is not permitted.

(Refer to General and Specific Notes at the end of Table 1)

Table I (Cont'd)

Environment	Conditions		Valve Materials		Remarks
	Conc.(%)	Temp.(C)	Body	Trim	
Saline (includes all untreated sea, raw, well, and aquifier waters) (Aerated, corrosive) (14, 28, 29)	N/A	5 - 80	SSS SSS Br (20)	SSS Ti Br (20)	For sour brine, formation and disposal water, and other highly corrosive waters such as untreated sea water, Wasia water, up to NPS 4-inch. (21,23)
			CS	SSS	For larger sizes, body shall be internally lined or coated.
			CS (24) CS DI	Br (20) 316 (27) Br (20)	(22)
			Br (20) D2 DI (7)	Br (20) Br (20) Br (20)	For low pressure utility service waters (raw water, well water) which are not as aggressive.
		to 60 to 80	PE-HD PP	PE-HD PP	
Soft or Pure	N/A	5 - 50	304 316	304 316	Includes Zeolite softened, distilled or demineralized.
		5 - 50 5 – 72 to 80	PVC CPVC PP	PVC CPVC PP	

General Notes:

(A) All valve designs shall incorporate features required to resist galling of mating surfaces by means of necessary hardness differentials, weld overlays, galling resistant material combinations, etc.

(B) Trim material includes the stem, the body and closure seating surfaces, bushings, pins, springs, guides, or any small parts in contact with the service fluid.

(C) The gate, disc, piston, ball, or plug that provide closure are normally made from the “trim” material in smaller valve sizes (less than about 6 inches). The closure may be made from material equivalent to the valve body except that the closure seating surfaces shall be of the material having a corrosion resistance equal to or “better” than the trim.

(D) See Table IV(a), (b) and (c) for material designations.

(E) LT means “Less Than”, GT means “Greater Than.”

(F) (X) indicates materials for critical applications such as hazardous service, poor accessibility for maintenance, or significant loss of production in the event of failure.

(G) Austenitic (“300 Series”) stainless steel components that are to be welded or weld overlaid shall be low carbon (.03% carbon maximum) grades. Low carbon grades may be substituted for regular carbon grades, but not vice versa.

(H) In making the material selections, consider all internal and external environmental factors, production/process variables, changes during the design life, and the additional limitations and requirements in SAES-L-132, SAES-A-133 and SAES-A-134.

(I) All materials for valves and chokes in sour service shall meet the requirements of NACE MR0175/ISO 15156. Only use NACE MR0103 to define sour service in refinery process environments; see SAES-A-133 and SAES-L-132.

Table I (Cont'd)

Specific Notes:

(2) Alloy K-500 may be substituted for Alloy 400 where additional hardness or strength is required.

(6) Do not expose stainless-steel trim to HCl acid-cleaning.

(7) Gray cast iron valve bodies may be substituted for ductile iron. However, ductile iron is preferred.

(8) Sulfuric acid concentrations over 100% ("Oleum") contain free sulfur trioxide.

(10) Inhibited against stress corrosion cracking of steel with minimum 2,000 ppm water.

(12) Dry chlorine contains less than 2,000 ppm water; do not use with titanium components.

(13) Wet chlorine contains at least 2,000 ppm water.

(14) These services are subject to additional considerations such as galvanic compatibility, velocity effects or additional water chemistry factors. For example, high velocities or low pH may dictate against the use of bronze trim or Ductile Iron (DI) bodies. Copper alloy bodied valves shall not be used with carbon steel pipe in corrosive water service without the use of insulating sets.

(15) Materials for valves in wet sour service shall meet the requirements of NACE MR0175/ISO 15156. NACE MR0175/ISO 15156 defines sour service. See also SAES-A-133.

(16) See Nelson Charts for details concerning the influence of temperature and partial pressure of hydrogen on material selection.

(18) Body materials for Khuff Gas valves are per API 6A. Drain valves and valves at low points where water may collect under stagnant conditions shall be addressed per the dead leg sections in SAES-L-310.

(20) Where indicated, the zinc content of wetted copper alloy components shall be 16% or less.

(21) Availability of bronze valves in ratings above Class 150 is limited, and have not yet been tried in Saudi Aramco.

(22) Linings are generally used in butterfly valves, non-lubricated plug valves, and some wedge gate valves. Coatings are used on ball, check, globe and gate valves; internal coatings shall be in accordance with SAES-H-002 and 04-SAMSS-035.

(23) Sour brine services may require specification of NACE MR0175/ISO 15156.

(24) Use ductile iron body, if available, for butterfly valves in non-hydrocarbon services.

(26) For potable water service, carbon steel body valves with SS316 trim are allowed in NPS 4-inch and above only. For critical service, use coated or lined valves.

(27) Type 316 trim is only acceptable when there is a high degree of confidence that occasional oxygen ingress cannot occur due to startup conditions, pump or valve packing leaks, etc. All trim shall be full SS316.

(28) Carbon steel overlaid with Alloy 625 may be substituted for super austenitic or duplex stainless steels (SSS) provided that (a) the entire exposed area is overlaid and (b) the fused material has no more than 30% dilution.

(29) Where seawater is chlorinated, residual chlorine should be limited to 2 ppm or less for SSS alloys rated A in Table IV-B, 1 ppm for those rated B, and 0.5 ppm for those rated C. Where residual chlorine exceeds 2 ppm, the Alloy C family of alloys in Table IV-A should be considered.

(30) For refinery applications, follow SAES-L-132, Table 2.

(31) Materials for drinking water applications shall be in accordance with National Sanitation Foundation (NSF 61).

Table II - Alternate Stem and Spring Materials

The stem and spring alloys listed below may be used in valves having the trim materials specified in Table I. These alloys usually may be fabricated to the required strength levels more readily than the general trim materials and their corrosion resistance is approximately equal to or better than that of the corresponding general trim.

Specified Trim	Alternate Stem Materials	Alternate Spring Materials (2)
Stainless Steels		
410	17-4, A286	17-4, X750, 600
6NM	17-4, A286	17-4, X750, 600
304	17-4, A286	17-4, X750, 600
316	N50, 718	718, R30035, Elg
20	625	R30035, Elg, 625, C-276
SSS	625	R30035, Elg, 625, C-276
Low Alloy Steels		
CrMoll, CrMo22, CrMo5	17-4, 410	17-4, X750
Copper Alloys	M400, MK500, SSS,	625, C-276, R30035, Elg
Br	Aluminum Bronze, Nickel Aluminum Bronze, Silicon Bronze C69400	
Nickel Base Alloys		
M400	MK500, 718, C-276 (1)	R30035, Elg, C-276, 625, 718
G-3	625, C-276	R30035, Elg, C-276, 625

Notes:

(1) A specialized application for gaseous chlorine service.

(2) Iron base alloy springs shall not be used in sour service.

Table III - Service and Application Requirements - Plastic/Elastomeric Components

M A T E R I A L S (2)
(See Table IV)
(See Notes 7 and 8)
Regarding Fluorocarbon Materials)

Environment (1)	O-Rings, Diaphragms & Resilient Seats (8)	Plastic Parts (7)
Acid, Hydrochloric	EPDM, T, OT, EOT, IIR, CR	PVC, CPVC, PE, PP
Acid, Hydrofluoric	CSM, T, OT, EOT	PP, PE, PVDC, CPE
Acid, Nitric		
to 100%	PTFE/Elastomer (3) FFKM	CPE, PTFE, FEP
to 60%	Fluorocarbon Elastomer	CPVC, CPE
Acid, Phosphoric	EPDM, IIR, CR, NR, CSM	PVC, CPVC, PE, PP, CPE, PVDC
Acid, Sulfuric Oleum	PTFE/Elastomer, FFKM	Fluorocarbon Plastics only, except PVDF and ECTFE
Acid, Sulfuric		
90%+	CSM	PVDC, CPE
LT 60%	CR, CSM, IIR, EPDM	PVDC, CPE, CPVC
Acid, Sulfurous	Fluorocarbon elastomers	
Air	Any within dry temperature and pressure limits	
Ammonia (8)	Any except amine cured FKM, TFE/P	Any except Nylon
Amines (MEA, DEA, DGA, ADIP) (8)	VMQ, EPDM, T, OT, EOT, CSM (amine cured FKM, TFE/P not suitable)	FEP, PTFE
Carbon Dioxide, Dry 150°C	Any within dry temperature limits and pressure limits	
Carbon Dioxide, Wet 90°C	Any within temperature/ pressure limits	
Chlorine, Dry	Fluorocarbon Elastomers FVMQ (4)	Fluorocarbon Plastics
Chlorine, Wet	Fluorocarbon Elastomers FVMQ	PVC, CPVC
Crude Oil		
to 50°C	Fluorocarbon Elastomers	PVC, CPVC, PP, PPS
to 200°C	Fluorocarbon Elastomers	Fluorocarbon Plastics
Freon 11 or 12	NBR, HNBR, CSM, CO, ECO, GECO, TFE/E (FKM not suitable)	CPVC, Nylon

Table III (Cont'd)

M A T E R I A L S (2)
(See Table IV)
(See Notes 7 and 8)
Regarding Fluorocarbon Materials)

Environment (1)	O-Rings, Diaphragms & Resilient Seats (8)	Plastic Parts (7)
Gas [T LT 121°C (250°F)]	Fluorocarbon Elastomers (5)	PVC, CPVC, PPS
Gasoline (9)	FKM, T, OT, EOT, FVMQ	PVDF, PVDC, CPE
Gasoline, MTBE blend	NBR (min. 40% acrylonitrile), HNBR, FFKM	Fluorocarbon plastics
Hydrogen Sulfide	T, OT, EOT, CSM, EPDM	PE, PP, PVC, PVDF
Hypochlorite, Ca/Na	Butyl, CSM, CR, CO, ECO, GECO, EPDM	PVC, CPVC, PVDC
Light Hydrocarbons (Butane, Ethane, Methane, Pentane, Propane)	T, OT, EOT, CO, ECO, GECO, FKM, FMQ, FVMQ	Fluorocarbon Plastics, PPS
Naphtha	T, OT, EOT, CO, ECO, GECO, FVMQ	PVDC, CPE
Sewage, Oily	CR, NBR, HNBR, , T, OT, EOT	PVC, CPVC, PVDC
Sewage, Sanitary	Any	Any
Sodium Hydroxide	Any except FKM and TFE/P at high conc.	Any except PVDC
Sodium Carbonate (all conc.)	Any	Polypropylene, NR, PVC, CPVC
Sodium Sulfite	Any	Any
Sulfur, Molten	PTFE/Elastomer, FFKM	Fluorocarbon Plastics
Sulfur Trioxide Solution 0.5%	Fluorocarbon Elastomers	
Sulfamic Acid (to 30%)	EPDM, IIR, CSM, NR	PP, PVC
Water, All Services	Any except EU (ester-based polyurethane)	Any (6)

Notes:

(1) Temperatures are 49°C or less unless otherwise indicated.

(2) See Table IV-A, B and C for material designations.

(3) “Elastomer” indicates any backup elastomer within the permissible temperature range.

Table III (Cont'd)

(4) Do not use diaphragm valves in dry chlorine service.

(5) FKM (such as Viton) shall be the peroxide cured Grade GF, GLC, or equal where amine inhibitor is employed.

(6) For water services, use PVC up to 50°C. Use CPVC in range between 5°C and 72°C.

(7) The fluorocarbon plastics PTFE, FEP, ETFE, ECTFE, CTFE, PFA and PVDF are compatible with all of the services listed in Table III, except that PVDF and ECTFE are not suitable for oleum service. To avoid excessive repetition, these materials are not referred to in Table III, except for the notation “fluorocarbon plastics” where the above are the only suitable materials for plastic liners.

(8) Services not compatible with fluorocarbon elastomers are the exception. These materials are not listed under “O-Rings, Diaphragms and Resilient Seats,” except for services where fluorocarbon elastomers are the only suitable materials for these components. The term “fluorocarbon elastomers” refers to FFKM, FKM, TFE/P, or PTFE/E in Table IV-B, but not FMQ or FVMQ (Fluoro-silicone Rubber). FFKM (Perfluoroelastomers), and PTFE backed elastomers (PTFE/Elastomer) are suitable for all services in Table III. FKM and TFE/P are not resistant to concentrated nitric acid (G.T. 60%), oleum, concentrated caustic, ammonia, many amines (except “GF”), steam, Freon. Peroxide cured FKM (grades GF or GLC) may be used in amines or ammonia, but not amine cured FKM.

(9) Nitrile Rubber (NBR) is not suitable for gasoline or sour fluids.

Table IVA - Metallic Material Designations

Alloy Designation	Description	UNS No.
17-4	17-4 PH Stainless Steel	S17400
20	Alloy 20	N08020
304	AISI 304 Stainless Steel	S30400
304L	AISI 304L Stainless Steel	S30403
316	AISI 316 Stainless Steel	S31600
316L	AISI 316L Stainless Steel	S31603
410	AISI 410 Stainless Steel	S41000
4140	AISI 4140 Steel	G41400
600	Alloy 600	N06600
625	Alloy 625	N06625
6NM	13 Cr-4Ni Stainless Steel (Grade CA6NM) (3)	J91540
718	Alloy 718	N07718
800	Alloy 800	N08800
825	Alloy 825	N08825
A286	Precipitation - Hardening Stainless Steel	S66286
B-2	Alloy B-2	N10665
Br	Bronze (See Note 1 and Table IV-B)	-
C-4	Alloy C-4	N06455
C-276	Alloy C-276	N10276
CI	Gray Cast Iron	-
CS	Carbon Steel	-
CrMoll	1-1/4 Cr 1/2 Mo Steel	J11872
CrMo22	2-1/4 Cr 1 Mo Steel	J21890
CrMo5	5 Cr-1/2 Mo Steel	J42045
D2	Ductile Ni Resist	F43000
DI	Ductile Iron	-

Table - IVA (Cont'd)

Alloy Designation	Description	UNS No.
Elg	Alloy R30003	R30003
ENP	Electroless Nickel Plating	-
G-3	Alloy G-3	N06985
LTS	Carbon Steel for Low Temperature Applications (2)	-
M400	Alloy 400	N04400
MK500	Alloy K-500	N05500
R30035	Alloy R30035	R30035
N50	XM-19 (ASTM A479) / F XM-19 (ASTM A182)	S20910
NiRe	Ni Resist Type 1	F41000
NiRe2	Ni Resist Type 2	F41002
SSS	Special Stainless Steels	(See Table IV-B)
St12	Alloy 12	R30012
St6	Alloy 6	R30006
TC	Tungsten Carbide	-
Ti	Titanium (Unalloyed)	-
X750	Alloy X750	N07750

Notes:

(1) Copper alloys shall have 16% or less zinc when used in corrosive aqueous service.

(2) Reference: 04-SAMSS-003.

(3) CA6NM Stainless Steel may be substituted for Type CA15 (AISI 410) for cast valve components.

Table IVB - Special Stainless Steels and Copper Base Alloys

Alloy Designation	Generic/Popular Name		Form	UNS No.	Spec or Grade
SSS	Duplex Stainless (1)				
		(A)	Wrought	S32550	A240
		(A)	Wrought	S32750	A276, 182
		(A)	Wrought	S32760	A276, 182
		(A)	Cast	J93380	
		(B)	Wrought	S31803	A182-F51
		(B)	Cast	J92205	A890-4A
	CD4MCu	(C)	Cast	J93370	A743, A890
	CD4MCu	(B)	Cast		DIN 9.4462
		(B)	Cast	J93345	A890-2A
		(B)	Cast		A890-3A
		(A)	Cast	J93404	A890-5A
SSS	Superaustenitic				
		(A)	Wrought	N08366	B675, B690
		(A)	Wrought		B475, B649
		(A)	Wrought	N08926	A240, A479
		(A)	Wrought	S31254	A182, A312
		(A)	Cast		A351 CKMCuN
		(B)	Wrought	S20910	A479-XM19
		(B)	Wrought	N08904	B625, B649
		(B)	Wrought	N08700	B672, B599
		(B)	Cast		A743-CN3M
BR	Copper Alloys				
	Aluminum Bronze		Cast	All	B148 (2)
	Aluminum Bronze		Wrought	C60600	B169
	Aluminum Bronze		Wrought	All	B150
	Valve Bronze		Cast	C92200	B61
	Ounce Metal		Cast	C83600	B62
	Copper-Silicon Alloy		Wrought	C65100	B98
	Copper-Silicon Alloy		Wrought	C65500	B98
	Copper Alloy		Cast	C84400	B584

Notes:

(1) SSS alloy rankings for pitting and crevice corrosion resistance are shown in parentheses next to the name, (A) being best. SSS alloys for seawater or sour brine service must be those ranked (A).

(2) ASTM B148 components for seawater service shall receive a temper anneal heat treatment per ASTM B601 Condition “TB”.

Table IVC - Plastics and Elastomers

Material Designation	Generic Names	Chemical Name
PLASTICS		
PVC	PVC	Polyvinyl Chloride
CPVC	Chlorinated PVC	Chlorinated Polyvinyl Chloride
PE	Polyethylene	Polyethylene
PP	Polypropylene	Polypropylene
PVDF		Polyvinylidenefluoride
FEP		Fluorinated Ethylene-Propylene
ETFE		Ethylene-Tefrafluoro Ethylene
ECTFE		Ethylene-Chlorotrifluoro-Ethylene
CTFE		Chlorotrifluoro-Ethylene
PTFE		Polytetrafluoro-Ethylene
	Nylon	Polyamide
PVDC		Polyvinylidene Chloride
CPE		Chlorinated polyethylene
PPS		Polyphenylene Sulfide
PEEK		Polyetheretherketone
ELASTOMERS		
NR	Natural Rubber	Poly-Isoprene
CR	Chloroprene	Poly-Chloroprene
EPDM		Ethylene-Propylene
IIR	Butyl Rubber GR-1	Isobutylene Isoprene
NBR	Nitrile Rubber	Butadiene-Acrylonitrile
CSM		Chlorosulfonated Polyethylene
T, OT, EOT	Polysulfide Rubber	Polysulfide

Table - IVC (Cont'd)

Material Designation	Generic Names	Polymer
ELASTOMERS (Cont'd)		
CO, ECO, GECO	Epichlorohydrin Rubber	Epichlorohydrin
EU, AU	Polyurethane Rubber	Polyurethane (ester-, ether-based)
MQ,VMQ,PMQ,PVMQ	Silicone Rubber	Polysiloxane
FMQ, FVMQ(1)*	Fluorosilicone Rubber	Polyfluorosiloxane
FLUOROCARBON-ELASTOMERS		
FFKM		Perfluoroelastomer
FKM		Vinylidene Fluoride-Hexafluoropropylene
TFE/P		Tetrafluoroethylene-Propylene
PTFE/Elastomer	PTFE with any elastomer backing	Poly-tetrafuoro-ethylene/Elastomer

Note:

* FMQ and FVMQ are NOT categorized as fluorocarbon elastomer.