PTT Exploration and Production Public Company Limited

PTTEP Engineering General Specification

(Engineering and Development Group)

Standard

Valves

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Revision History

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<tr><td>Old</td><td>New Document
Refer : PEGS-12059-PIP-006
<table><tr><th>Item No./Clause</th><th>Description of Change</th></tr><tr><td>Section 3.2</td><td>Corrected and Re-arranged terminology grouping</td></tr><tr><td>Section 4.1</td><td>Updated and corrected ref PEGS</td></tr><tr><td>Section 4.2</td><td>Corrected and added applicable codes and standards (added ISO 23936-1 and ISO 23936-2)</td></tr><tr><td>Table 1 to 7 and Table 9 to 15</td><td>Revised and corrected table contents and notes</td></tr><tr><td>Table 16 to 22</td><td>Re-number the tables</td></tr><tr><td>Section 5.5.9</td><td>Added criteria for lifting lug requirements and NDE extent</td></tr><tr><td>Section 5.6.3</td><td>Revised minimum bore size to be as per API6D/ ISO 14314, add minimum bore size for sizes above NPS 24 and add tolerance for ID of full bore valves</td></tr><tr><td>Section 5.7.1</td><td>Added general section for the construction requirements of valve flanges</td></tr><tr><td>Section 5.8.4.1</td><td>Corrected the number of ref. table in API 598</td></tr><tr><td>Section 5.11.1.2</td><td>Corrected the number of ref. table in ISO 14313</td></tr><tr><td>Appendix 2</td><td>Corrected the contents in all Tables</td></tr><tr><td>Appendix 6</td><td>Corrected the calculation details</td></tr><tr><td>Appendix 7</td><td>Corrected the contents in sample format of pressure test cert</td></tr><tr><td>General</td><td>Corrected and updated all ref. PEGS number, corrected section number and format including typos</td></tr></table></td><td>11-Nov-16</td></tr>
<tr><td>R00</td><td>Revision note : New document code and formatting
<table><tr><th>Item No./Clause</th><th>Description of Change</th></tr><tr><td>1.0</td><td>Add introduction in this PEGS.</td></tr><tr><td>4.0</td><td>Add responsible action parties in this PEGS</td></tr><tr><td>5.3</td><td>Revise document number in terms and definitions section</td></tr><tr><td>6.1</td><td>Revise document number in PTTEP internal references.</td></tr><tr><td>6.3</td><td>Add API 20A in the code and other standards list.</td></tr><tr><td>7.4.1</td><td>Add sentence “Qualification record as per API 20A shall be submitted to COMPANY for approval”</td></tr><tr><td>7.4.7</td><td>Revise note 4 in table 4 as “Lip seal shall not be used in flammable and toxic service”.</td></tr><tr><td>8.0</td><td>Revise appendix 9 gate/ globe valve data sheet form.</td></tr><tr><td>8.0</td><td>Revise appendix 10 manual operated ball valve data sheet form.</td></tr><tr><td>Appendix10</td><td>Add quality specification level (QSL) in the data sheet form</td></tr></table></td><td>24-Oct-17</td></tr>
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1.0 INTRODUCTION

PEGS (PTTEP Engineering General Specification) is the PTT Exploration and Production PCL internal publishes standard. The objective of PEGS is to set out the recommended standard for good design and engineering practice applied for oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization. The information in PEGS publications is provided to users for their consideration and decision to implements and is expected to be sufficiently flexible allowing user to adapt to diversity of condition, their own environment and requirements.

In particular, for those requirements not specifically covered or contained, Company will expect Contractors or Manufacturers/Suppliers to follow those design and engineering practices which will achieve the same level of integrity as reflected in the PEGS. In case of doubts, shall consult with the technical authority, advisor or specialists.

This document is regularly updated to constitute a unique and extensive repository of the Company's expertise by taking into account experiences feed-back, validated know-how or practices and international or professional standards evolution.

2.0 PURPOSE

The purpose of this General Specification is to specify design requirements, manufacturing and testing; assuring technical integrity and fitness for purpose with optimum life cycle cost of valves for onshore and offshore installation.

3.0 SCOPE

This specification defines the requirements for the manufacturing, inspection and shipment of conventional types of valves including gate valves, butterfly valves, globe valves, plug valves, ball valves, check valves, needle valves, etc., as well as integral manifold valves comprising a combination of several valves in one integral bolted manifold in order to obtain systems such as single or double block and bleed.

Integral manifolds that include two online block valves are not addressed by the specification for online application regardless of the line service. Such manifold are subject to specific agreement by the COMPANY.

This specification shall apply only to valves made of ductile cast iron, carbon steel, alloy steel, corrosion resistant alloys, bronze and other copper alloys, including actuated or motorised versions of such valves, i.e. ESDVs, MOVs, BDVs, HIPS etc.

This specification shall apply to process piping and pipeline valves whatever the line design code.

As a supplement to the present specification, valves in cryogenic service (i.e. for use at operating temperatures lower than -50°C) must also comply with the COMPANY specification PEGS-12059-PIP-025, 10008-STD-6-PIP-013 and valves for use under sour wet service conditions (i.e. according to the NACE definition of such conditions) shall meet the additional requirements of the COMPANY specification PEGS-12060-MMA-002, 10008-STD-6-PIP-016.

4.0 RESPONSIBLE ACTION PARTIES

This specification is distributed under the responsibility of the relevant department and divisions in PTTEP engineering entity in accordance with the procedures, approved by the line management

This specification applies for all PTTEP operated assets and new project at the time of the study phase or pre-project or project sanction phase apply engineering design concept.

5.0 DEFINITIONS

A number of different terms are commonly used to describe the work stages, processes, and approvals which take place during the early stages of a development. This can often be a source of confusion so the following section is intended to show the PTTEP preferred terminology as used in this document.

5.1 LANGUAGE

In this document, the words should and shall have the following meanings:

Shall	Indicates a course of action with a mandatory status. The term “shall” shall be used if a requirement is considered to be necessary to claim compliance with a PEGS document.
Should	Indicates a preferred course of action. Should is a non-mandatory word and is not forbidden, but use in the body of the text should be the exception. Where none mandatory terms are used, each paragraph within these clauses shall also have an associated commentary paragraph that provides the rationale for why the stated choices and modifications are appropriate and circumstance under which the stated choices and modifications might be different.

5.2 TERMINOLOGY

Terminology	Description
Approval	The authorization in writing given by the COMPANY to the Contractor to proceed the work without releasing in any way the Contractor from any of his obligations to conform with the technical specifications, requisitions, etc. The words “Approve”, “Approved” and “Approval” shall be construed accordingly
Company	PTT Exploration and Production Public Company Limited (PTTEP) and affiliates.
Contractor	Per contract: Contractor – ‘The contractor who is a PARTY to this CONTRACT

Terminology	Description
	and where the context so requires including, SUBCONTRACTORS utilized by CONTRACTOR for the performance of the WORK'
Inspection Agency	The body in charge of the inspection of the products on behalf of the purchaser at the manufacturer premises and at any subcontractor's premises as far as necessary.
Manufacturer	The company or its sub-contractors selected by the COMPANY or the Contractor or the Supplier (as applicable) as the Manufacturer of the said material.
Purchaser	The COMPANY or the Contractor or the Supplier (as applicable) which have placed the Purchase Order to the Supplier/Vendor/Manufacturer.
Supplier/Vendor	The company designed on the Purchase Order form or Contract as being the selected supplier of the said materials.

5.3 COMMON ACRONYMS

Set out below in alphabetical order are common acronyms as found within this document:

Abbreviations	
AARH	Arithmetic Average Roughness Height
AED	Anti-Explosive Decompression
AOD	Argon-Oxygen-Decarburization
BDV	Blow Down Valve
CAF	Compressed Asbestos Fibre
CE	Carbon Equivalent
CRA	Corrosion Resistant Alloy
DPI	Dye Penetrant Inspection
ENP	Electroless Nickel Plating Treatment
ESDV	Emergency Shut Down Valve
FAT	Factory Acceptance Test
HIPS	High Integrity Protective System
HVOF	High Velocity Oxygen Fuel
MOV	Motor Operate Valve
NBR	Nitrile Butadiene Rubber
NPS	Nominal Pipe Size
NPT	National Pipe Thread
PQR	Procedure Qualification Record
WPS	Welding Procedure Specification
XXS	Double Extra Strong (pipe)

Terms and Definitions

AED elastomeric O-ring	Elastomeric O-ring that resists to explosion decompression phenomenon and passes the test describes in Appendix 8 of the specification.
ASME B16.34	Reference to the standard ASME B16.34 means reference to the last edition of the standard except for the paragraph 6.1.2.c that shall remain as stated in the edition 2004 of the standard.
Coupling	Driven component (drive adapter, drive tube, drive shaft) that allows transmission of torque and/or thrust from an actuator driving component to the valve shaft/stem.
H_2S Service	Intermediate or severe sour service according to PEGS-12059-COR-032, 10008-STD-6-COR-032.
Intermediate support	Mechanical component (bracket, spool, adapter flange) that allows the attachment between a valve and actuator.
Mounting kit	Components which may comprise combinations of the following components between valve and actuator: Intermediate supports, coupling, drive key(s).

6.0 REFERENCES

The reference documents listed below, including Industry Codes and Standards and COMPANY specifications, form an integral part of this Engineering General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published on the effective date of a contract.

The overall order of precedence of the applicable documents shall be:

1. Applicable Laws, Rules and Regulations of the country in which the system/equipment will be operated (if any);
2. Purchase Order/ Service Order/ Contract Documents (Only applicable for direct purchase by COMPANY);
3. Project Particular Specification (PPS), and relevant data sheet(s) if any;
4. COMPANY General Specification;
5. Codes and Standards in reference.

Any conflict between any of the Contract Documents, or between this specification and any other Contract Documents, shall be reported to COMPANY for decision. In such a case, and unless otherwise agreed or decided by COMPANY, it is understood that the more stringent requirement shall apply.

Exceptions to, or deviations from this specification are not permitted unless previously accepted in writing by COMPANY. For this purpose, requests for substitutions or changes of any kind shall be completed with all pertinent information required for COMPANY assessment. COMPANY's approval, nevertheless, will not, in any way, relieve the responsibility of the Contractor to meet the requirements of the industry Codes and Standards referred to and amended herein, in the event of conflict.

6.1 PTTEP INTERNAL REFERENCES

Internal documents applicable to this document are indicated in the table below.

Document Number	Document Title
10008-STD-6-GEN-005, PEGS-12060-ADM-006	Quality requirements for Contractor/ Vendor
10008-STD-6-COR-010, PEGS-12059-COR-010	Painting of Offshore and Coastal Structures and Facilities
10008-STD-6-COR-011, PEGS-12059-COR-011	Painting of Onshore Structures and Facilities
10008-STD-6-COR-032, PEGS-12059-COR-032	Materials for Sour Service
10008-STD-6-COR-042, PEGS-0710-COR-042	Corrosion Protection of Fasteners for Subsea and Topside Applications

10008-STD-6-FAB-001, PEGS-12060-FAB-001	Welding of Pressure Containing Piping and Equipment
10008-STD-6-INS-011, PEGS-12059-INS-036	On/ Off Valve Control Panels and Actuators Functional and Construction Requirement
10008-STD-6-INT-001, PEGS-12060-INT-001	Inspection and Testing Requirements
10008-STD-6-PIP-016, PEGS-12060-MMA-002	Valves Materials Requirements for Use in Sour Service
10008-STD-6-PIP-010, PEGS-12059-PIP-005	Pipes, Flanges, Fittings and Bolting for Piping
10008-STD-6-PIP-009, PEGS-12059-PIP-007	Piping Material Classes
10008-STD-6-PIP-017, PEGS-12059-PIP-020	Piping or Pressure Vessel Components in Duplex and Superduplex Stainless Steel
10008-STD-6-PIP-013, PEGS-12059-PIP-025	Valves in Cryogenic Service
10008-STD-6-PIP-011, PEGS-12059-PIP-029	Gaskets for Piping and Vessels
10008-STD-6-PLR-006, PEGS-12059-PLR-005	Longitudinally Submerged Arc Welded (LSAW) Pipes for Carbon Steel Pipelines (Mild, Intermediate and Severe Sour Service)
10008-STD-6-PLR-009, PEGS-0710-PLR-007	Design, Materials and Fabrication of Flanges and Branch Outlet Fittings for Carbon Steel Pipelines (Mild, Intermediate and Severe Sour Service)
10008-STD-6-PLR-025, PEGS-12059-PLR-012	Welding of Onshore and Offshore Carbon Steel Pipelines to API 1104
10008-STD-6-PLR-005, PEGS-12059-PLR-017	Seamless Pipes for Carbon Steel Pipelines(Mild, Intermediate and Severe Sour Service)
10008-GDL-5-PIP-003, PEGS-0790-PIP-008	Technical Assessment for Valve Manufacturer

6.2 INTERNATIONAL STANDARDS

International standards applicable to this document are indicated in the table below i.e. ISO, IEC or ITU.

Document Number	Document Title
EN 10204	Metallic Products - Type of Inspection Documents
ISO 10423	Specification for Wellhead and Christmas Tree Equipment
ISO 10497	Testing of valves - Fire type-testing requirements
ISO 14313	Petroleum, Petrochemical and Natural Gas Industries- Pipeline transportation systems – Pipeline Valves
ISO 15614-7	Welding Procedure Test - Part 7: Overlay Welding
ISO 15848 Part 1	Industrial valves – measurement, test and qualification procedures for fugitive emissions – classification system and qualification procedures for type testing of valves
ISO 15848 Part 2	Industrial valves, measurement, test and qualification procedure for fugitive emissions – Production acceptance test of valves
ISO 17292	Metal Ball Valves for Petroleum, Petrochemical and Allied

Document Number	Document Title
	Industries
ISO 23936-1	Petroleum, Petrochemical and Natural Gas Industries – Non-metallic Material in Contact with Media Related to Oil and Gas Production - Thermoplastics
ISO 23936-2	Petroleum, Petrochemical and Natural Gas Industries – Non-metallic Material in Contact with Media Related to Oil and Gas Production - Elastomers
ISO 286-2	ISO system of limits and fits - Part 2: Tables of standard tolerance grades and limit deviation for holes and shafts
ISO 4042	Fasteners - Electroplated Coating
ISO 5208	Industrial valves - Pressure testing of Metallic Valves
ISO 9001	Quality Management Systems - Requirements
ISO/TS 29001	Petroleum, Petrochemical and Natural Gas Industries Specific Quality Management Systems
European Directive 94/9/EC	Equipment for use in potentially explosive atmospheres
European Directive 97/23/EC	Pressure Equipment Directive

6.3 CODE AND OTHER STANDARDS

Codes, standards and regional legislation applicable to this document are indicated in the table below.

Document Number	Document Title
API 20A	Carbon Steel, Alloy Steel, Stainless Steel, and Nickel Base Alloy Castings for Use in the Petroleum and Natural Gas Industry
API 594	Wafer and Wafer-Lug Check Valves
API 598	Valve Inspection and Testing
API 599	Metal Plug Valves- Flanged, Threaded and Welding Ends
API 5L	Specification for Line Pipe
API 600	Steel Gate Valves Flanged and Butt-welding Ends
API 602	Compact Steel Gate Valves - Flanged, Threaded, Welding and Extended-Body Ends
API 604	Ductile Iron Gates Valves Flanged Ends
API 605	Large Diameter Carbon Steel Flanges
API 607	Fire Test for Soft-Seated Quarter-Turn Valves
API 608	Metal Ball Valves - Flanged, Threaded and Welding Ends
API 609	Lug- and Wafer-Type Butterfly Valves
API 6A	Specification for Wellhead and Christmas Tree Equipment
API 6D	Pipeline Valves

Document Number	Document Title
API 6FA	Specification for Fire Test for Valves
API 6FB	Fire Test for End Connections
API RP 14E	Design and Installation of Offshore Production Platform Piping Systems
ASME B1.1	Unified Inch Screw Threads
ASME B1.2	Gauges and Gauging for Unified Screw Threads
ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.10	Face-to-Face and End-to-End Dimensions of Valves
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.20	Metallic Gaskets for Pipe Flanges - Ring Joint, Spiral Wound and Jacketed
ASME B16.21	Non Metallic Flat Gaskets for Pipe Flanges
ASME B16.24	Cast Copper Alloy Pipe Flanges and Flanged Fittings
ASME B16.25	Butt Welding Ends
ASME B16.34	Valves-Flanged, Threaded, and Welding End
ASME B16.47	Large Diameter Steel Flanges (NPS 26 through NPS 60)
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B18.2.1	Square and Hex Bolts and Screws (Inch series)
ASME B18.2.2	Square and Hex Nuts
ASME B31.3	Process Piping
ASME B31.4	Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
ASME B31.8	Gas Transmission and Distribution Piping Systems
ASME B36.10M	Welded and Seamless Wrought Steel Pipe
ASME B36.19M	Stainless Steel Pipe
ASME B46.1	Surface Texture
ASME IX	Welding and Brazing Qualifications
ASME VIII division 1-2	Rules for Construction of Pressure Vessels
ASTM A105	**Standard Specification for Carbon Steel Forgings for Piping Applications**
ASTM A106	Seamless Carbon Steel Pipe for High Temperature Service
ASTM A182	Forged or Rolled Alloy - Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service
ASTM A193	Alloy-Steel and Stainless Steel Bolting Materials for High-temperature Service
ASTM A194	Carbon and Alloy-Steel Nuts for Bolts for High-pressure and High-temperature Service
ASTM A216	Steel Castings, Carbon, Suitable for Fusion Welding, for High-

Document Number	Document Title
	Temperature Service
ASTM A217	Martensitic Stainless Steel and Alloy Steel Castings for Pressure Containing Parts Suitable for High Temperature Service
ASTM A234	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature service
ASTM A240	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Application
ASTM A262	Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
ASTM A320	Alloy-Steel Bolting Materials for Low-temperature Service
ASTM A333	Seamless and Welded Steel Pipe for Low Temperature Service
ASTM A350	Forgings, Carbon and Low-Alloy Steel, requiring Notch Toughness Testing for Piping Components
ASTM A351	Austenitic Steel Castings for High Temperature Service
ASTM A352	Ferritic Steel Castings for Pressure Containing Parts Suitable for Low Temperature Service
ASTM A358	Electric Fusion -Welded Austenitic Chromium - Nickel Stainless Steel Pipe for High-Temperature Service and General application
ASTM A370	Mechanical Testing of Steel Products
ASTM A395	Ferritic Ductile Iron Pressure Retaining Castings for Use at Elevated Temperatures
ASTM A403	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A420	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service
ASTM A435	Straight-Beam Ultrasonic Examination of Steel Plates
ASTM A453	Bolting Materials, High-Temperature, 50 to 120 ksi Yield Strength, with Expansion Coefficients Comparable to Austenitic Steels
ASTM A488	Qualifications of Procedures and Personnel for the Welding of Steel Castings
ASTM A530	General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM A672	Electric-Fusion- Welded Steel Pipe for High Pressure Service at Moderate Temperatures
ASTM A694	Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves, and Parts for High Pressure Transmission Service
ASTM A700	Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment
ASTM A703	Steel Castings, General Requirements, for Pressure Containing Parts
ASTM A705	Standard Specification for Age-Hardening Stainless Steel Forgings
ASTM A815	Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings
ASTM A860	Wrought High-Strength Low Alloy Steel Butt Welding Fittings
ASTM A995	Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts

Document Number	Document Title
ASTM B62	Composition Bronze or Ounce Metal Castings
ASTM B148	Aluminium-Bronze Sand Castings
ASTM B150	Aluminium Bronze Rod, Bar, and Shapes
ASTM B287	Method of Acetic Acid - Salt Spray (Fog)
ASTM B584	Copper Alloy Sand Castings for General Application
ASTM B633	Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM B656	Standard Guide for Autocatalytic (Electroless) Nickel-Phosphorous Deposition on Metals for Engineering Use
ASTM B733	Standard Specification for Autocatalytic (Electroless) Nickel-Phosphorous Coatings on Metals
ASTM D1414	Standard Test Methods for Rubber O-Rings
ASTM D2240	Standard Test Methods for Rubber Property - Durometer Hardness
ASTM D297	Standard Test Methods for Rubber Products - Chemical Analysis
ASTM D412	Standard Test Methods for Vulcanised Rubber and Thermoplastic Elastomers - Tension
ASTM D1418	Standard Practice for Rubber and Rubber Latices – Nomenclature
ASTM E165	Test Methods for Liquid Penetrant Inspection
ASTM E446	Standard Reference Radiographs for Steel Castings Up to 2 inch. (50.8 mm) in thickness
ASTM E562	Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count
ASTM G48	Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steel and Related alloys by Use of Ferric Chloride Solution
BS EN 12266 Part 1and 2	Pressure Tests, Test procedures and acceptances criteria - Mandatory Requirements
EEMUA No. 144	90/10 Copper Nickel Alloy Piping for Offshore Applications: Tubes Seamless and Welded (Sections 1 and 2)
EEMUA No. 145	90/10 Copper Nickel Alloy Piping for Offshore Applications: Flanges -Composite and Solid (Sections 1, 2 and 3)
EEMUA No. 146	90/10 Copper Nickel Alloy Piping for Offshore Applications: Fittings (Sections 1, 2, 3 and 6)
EEMUA No. 182	Integral Block and Bleed Valve Manifolds for Direct Connection to Pipework
MSS SP-6	Standard Finishes for Contact Faces of Pipe Flanges and connecting ends Flanges of Valves and Fittings
MSS SP-9	Spot Facing for Bronze, Iron and Steel Flanges
MSS SP-25	Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-42	Class 150 Corrosion Resistant Gate, Globe, Angle and Check Valves with Flanged and Butt Weld Ends
MSS SP-43	Wrought Stainless Steel Butt-Welding Fittings

Document Number	Document Title
MSS SP-44	Steel Pipeline Flanges
MSS SP-45	By-pass and Drain Connections
MSS SP-53	Quality Standards for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Magnetic particle Examination Method
MSS SP-55	Quality Standards for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Visual Inspection
MSS SP-61	Pressure testing of Steel Valves
MSS SP-67	Butterfly Valves
MSS SP-70	Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-72	Ball Valves with Flanged or Butt-welding Ends for General Service
MSS SP-75	High Test Wrought Butt Welding Fittings
MSS SP-80	Bronze Gate, Globe, Angle, and Check Valves
MSS SP-84	Steel Valves - Socket Welding and Threaded Ends
MSS SP-97	Integrally Reinforced Forged Branch Outlet Fittings-Socket Welding, Threaded and Butt-welding ends
NACE MR0175 / ISO 15156	National Association of Corrosion Engineers MR-01-75 “Material Requirements- Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment”
NORSOK M710	Qualification of non-metallic sealing material and manufacture

7.0 REQUIREMENTS FOR VALVES

7.1 REQUISITION AND VALVE DATA SHEET

Mechanical valves data sheets shall be issued by the Contractor or COMPANY for each type of valve, or each itemised valve, detailing the main features as derived from the relevant piping material classes and the present specification.

Each valve data sheet shall clearly identify the service fluids and line design conditions. The valve design, manufacturing and testing requirements are depending on those regardless of the valve type.

For pipeline valves, the data sheets shall also specify the all through internal bore dimension to match the adjacent pipe requirements.

The template for valve data sheets is shown in Appendix 9 and Appendix 10. The required information for each section shall be completed so the valve description is clearly understood and correct.

For the purpose of the valve service class selection, the temperature range to be taken into account shall be the planned operating temperature range (both higher and lower temperatures) at which the valve is expected to be operated.

The valve data sheet shall be complemented by the itemised instrument valve data sheet for each actuated valve.

7.2 DEFINITION OF SERVICE CLASSES FOR VALVES

Valves shall be classified as per table below depending on their service conditions.

Table 1 - Definition Of Service Classes For Valves

Valve Service Class	A	B	C	D	E
Fluids	Water - Air - Nitrogen Hydraulic oils	Hydrocarbons (liquid and gas)	Hydrocarbons (gas)	Hydrocarbons (liquid and gas)	Hydrocarbons (liquid and gas)
Service	Utility or water injection	General Process Production Process Transport	General Process (Cryogenic)	General Process	(Note 1)
Operating Temperature Range	T < 75°C T ≥ Ambient	T ≤ 200°C T ≥ - 46°C	T < - 46°C	T > 200°C	T ≤ 200°C T ≥- 46°C

Notes: The following valves shall be of service class E.

All ESDV and BDV valves, these two types in size NPS 8 and above,

All HIPS valves, unless otherwise specified,

MOV valves on pipelines or on risers as well as all in-line valves adjacent to pig launchers or pig receivers.

Other valves may also be specified "service class E" on P&ID's, such as valves on production and test manifolds, depending on their criticality.

"Dormant" valves on buried pipelines which are only used to potentially isolate a section of possibly damaged pipe are service class B valves unless otherwise specified by the valve data sheets.

7.3 SUBCONTRACTING

All Valves are deemed to be manufactured, inspected and tested at the Manufacturer's premises. Any deviation to this requires a prior approval from the COMPANY, which must be obtained prior to the Purchase Order issue. In such an event, the Manufacturer shall maintain full QA/QC control over any Sub-Contractor or sub-contracted activity.

First level suppliers for pressure containing parts and pressure controlling parts shall be approved by the COMPANY. The requirement also applies to sub-manufacturers for special process, e.g. weld-overlay, ENP coating, tungsten carbide coating, etc.

Whatever the extent of the sub-contracted activities, the Manufacturer is required to have the full control of the individual valve part design, manufacturing flow process, (heat treatment) delivery conditions, manufacturing tolerances, together with the quality control activities related to those parts all along the delivery process.

This also applies to the supply of the actuators and associated local panel when the valve Manufacturer is in charge of that supply.

7.4 MATERIALS

Materials used in the valves manufacture shall be in accordance with the relevant Valve Data Sheets issued by the Engineering Company. Any material substitution shall be subjected to the approval by the COMPANY.

The following requirements shall apply:

7.4.1 GENERAL REQUIREMENTS AND LIMITATION FOR CASTING MATERIAL

Cast material cannot be proposed as substitute to forged material unless specifically agreed by the COMPANY.

Cast manufacturing process shall be assessed and approved by the COMPANY for its all extent from steel-making to cast product release. It includes assessment of patterns, sand quality and sand treatment, pouring modelling and techniques, heat treatment sequence and means, etc. Qualification record as per API 20A shall be submitted to COMPANY for approval.

Unless otherwise specified steel casting for pressure containing parts shall comply with general requirements of ASTM A703 with its supplementary requirements as indicated in the Project Specifications/ Data Sheets. Use of scraps is not allowed for cryogenic stainless steel, duplex stainless steel and any Nickel alloy if the steel or alloy process system does not include some adequate argon- oxygen-decarburization (AOD) refining treatment unit.

Major weld repairs are not allowed for low temperature carbon steel and for nickel alloy.

Pressure containing casting and pressure controlling part shall be traceable to the foundry by unique identification marking independently of the pattern owner marking. This identification mark shall be embossed with the foundry logo for sand cast supply, stamped or laser printed marking for other casting types. Painted identification marks are not acceptable.

The part identification mark shall also identify the material grade, heat, ladle charge and the sequential number in the ladle as per ASTM A703. Any time of the manufacturing sequence, products of the same heat furnace charge are deemed to be of a single heat. A single product shall not be made from two or several heats poured together in the same mold.

Cast material is not allowed for valve stem whatever the pressure class and valve size.

Seat and obturators may be allowed by casting for valve manufacturers that run their own foundries for their own valve supply. This allowance is given to valve manufacturers that have supplied the COMPANY for a minimum of five years without any supply disruption over the period and without any negative feed-back on such a manufacturing.

Cast material may be used for obturators and seats except for:

- Obturators of valves in pressure class 1500 and above whatever the valve size
- Seats in pressure class 600 and above whatever the valve size.

  NB; Weld repairs are not allowed on seats and obturators.

Approval by the COMPANY of centrifugally cast process for seats and obturators is dependent on the valve manufacturer's proven experience with the same source of supply and same manufacturing process for the valve size, component geometry and thickness, and valve pressure class.

Approval by the COMPANY of cast material for pressure containing parts in pressure class 600 and above may be subject to some specific additional testing not addressed in this document. Such requirements will be detailed in the project specification that will address:

- Test block definition: it can be a test block as defined by ASTM A703 or a valve component pertaining to the requisition.
- Verification of the mechanical tests and impact tests performed on the test blocks related to the supply or on specific additional valve containing parts identical to items of the actual supply. Unless otherwise specified minimum requirements for impact test values are shown in Table 2 below.
- Verification of the microstructure and chemical analysis on test block and valves components.
- The test blocks or valve bodies used for the chemical and mechanical tests shall have passed the same full heat treatment sequence in the same heat furnaces as and along with items of the actual supply.
- As a minimum each individual furnace charge shall include two test blocks or one sacrificial valve body, valve end closure, valve bonnet. One of the two test blocks will be kept for testing by the COMPANY.

For quench and tempering steel or solution annealed grades the heat treatment facilities shall be such that the transfer time from the furnace to the quenching bath is less 50 seconds.

Table 2 - Minimum Impact Requirements on Casting Material in Delivery Conditions

Material	Minimum Design Temp.	Wall Thickness Valve Component	Impact Test Temperature	Minimum Impact Test Value Unless Otherwise Specified
Carbon Steel Low Alloy Steel	T ≥ -29°C	< ½ inch	n.a.	Impact testing not required
		≥ ½ inch	-29°C	Min. 20 J average for 3 specimens min. 16 J for individual specimen
Low Temperature Carbon Steel Low Alloy Steel	T ≥ -46°C	All thickness	-46°C	As per ASTM A352 or: min. 20 J average for 3 specimens min. 16 J for individual specimen, whichever is greater
Duplex St. Steel	T ≥ -46°C	All thickness	-46°C	Min. 40 J average for 3 specimens min. 28 J for individual specimen
For all materials: the minimum impact test values are related to tests performed on full-section impact test specimen (10x10mm). Values for sub-sized specimen (when required) shall be agreed on by COMPANY. Impact testing shall be performed per ladle (furnace) charge.				
These impact test specimen shall be taken at one fourth of the thickness of the block or component or of the valve body. The corresponding wall thickness of the test block or valve component shall not be less than the thickness of the valve component in its critical area as defined by the ASME B16.34.				

7.4.2 CARBON STEEL VALVES

The carbon steel used for the fabrication of the valves shall be produced in an electric furnace, or by the basic oxygen process.

Carbon steel valves with welded ends (either butt-weld or socket-weld ends), or for which welding is used as part of the fabrication method (e.g. end flanges welded to the body, or welded body, etc.) shall comply with the following chemistry requirements, based on ladle analysis of the carbon steel materials used for the construction of the valves (this does not apply to weld overlays):

a) Carbon Content: The carbon content shall be less than 0.23%

b) Carbon Equivalent: The Carbon Equivalent (CE) shall be less than 0.42%,

CE shall be calculated using the formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

If the content of alloying elements other than C or Mn is unknown, and with the prior approval of the COMPANY, the CE formula to be used shall be:

$$CE = C + \frac{Mn}{6}$$

and, in this case, the carbon equivalent shall be less than 0.40%.

CE value on product may be enlarged to 0.44% maximum for forged components made of ASTM A694 F60 or F65 grades in quenched and tempered delivery conditions exclusively and whose thickness does exceed 2 in. (50 mm) in any section as used in valve manufacturing. Such an allowance shall be based on appropriate welding qualification tests performed on the

material of the same source and in same thickness. The short formula is discarded in that case.

7.4.3 AUSTENITIC STAINLESS STEEL VALVES

The types 321 stainless steel shall have a carbon content equal to or greater than 0.02%. The valve bodies and bonnets shall undergo a heat treatment ("Annealing") in accordance with the corresponding ASTM standards.

When type 316 stainless flanged valves in material to ASTM A351 Gr. CF8C are specified, forged materials to ASTM A182 Gr. F316 or Gr. F321 can be acceptable substitutes ("L" grades are not acceptable in that case).

7.4.4 DUPLEX/SUPERDUPLEX STEEL VALVES

Materials shall confirm to the requirements stated in COMPANY specification 10008-STD-6-PIP-017,PEGS-12059-PIP-020.

7.4.5 DUCTILE CAST IRON VALVES

Where cast iron valves are authorised in the relevant piping material classes, only ductile cast iron is allowed. In this case, the valve bodies and bonnets shall be made of spheroidal graphite ductile cast iron in accordance with ASTM A395. They shall undergo the various treatments, including the supplemental tests required by this standard.

7.4.6 COPPER ALLOY VALVES

Except as otherwise indicated in the requisition or in the valve data sheets, the composition of the bodies and bonnets of bronze valves shall be in accordance with UNS reference no. C83600 of ASTM B62. The UNS reference for other copper alloys, in accordance with ASTM B584, shall be stipulated in the data sheets or in the requisition.

7.4.7 SEAL MATERIAL FOR BALL VALVES

This paragraph applies to ball valves of all sizes and ratings, including those being part of integrated manifold valves comprising a combination of several valves in one integrated bolted manifold.

The selection of seal materials for ball valves shall be based on actual maximum and minimum operating temperatures of the valves, pressure, fluid composition and chemical product used on a temporary basis. The selection shall comply with the following rules, in the following order:

a) Reference to a valve service class, according to Table 1. This service class shall be taken from the relevant valve data sheet and/or requisition.

b) Selection of a seal category, according to Table 3.

c) Selection of seal materials, according to Table 4.

d) Selection of a seal arrangement design according to Appendix 2.

Table 3 - Seals Category Selection for Ball Valves

Valve Service Class	Seat Inserts (1)	Dynamic Seals	Static Seals	Fire Safe Graphite Back-up Seals
A	Thermoplastic	Elastomer	Metallic or Elastomer	Not required
B (4)	Thermoplastic	Elastomer AED	Metallic or Elastomer AED	Required (2)
C	Thermoplastic	Thermoplastic	Metallic or Thermoplastic	Required (2)
D	Metallic	Metallic or Bellow seats + Graphite	Metallic or Graphite	Not required
E (4)	Metallic (3) (+ Tungsten Carbide Coating)	Elastomer AED	Metallic or Elastomer AED	Required (2)

Notes:

(1) Elastomer materials are strictly forbidden as seat to ball sealing barrier whatever the valve pressure class and service class.

(2) Graphite back-up seals are not required in case of metallic primary seals (static seals only) and are not required for valves in subsea application.

Metallic seals are either metallic ring joints or spiral wound gaskets exclusively. Spiral wound gaskets are only acceptable for pressure class 150, 300, and 600. Filler material used for spiral wound gaskets shall be made of high purity graphite (≥ 99.8%). In this case, it is emphasised that design calculation notes shall take into account the gasket reaction forces.

(3) Metal to metal contact means tungsten carbide coating on both seat and obturator in conformity with section 7.4.7 and Appendix 4.

(4) To protect the graphite secondary sealing barrier from sea water ingress an additional NBR O-ring is required on the stem, bonnet and body leakage paths to the atmosphere when the valve is installed in the splash zone of the platform, in loading / offloading systems, or inside the buoys. This requirement also relates to the valves of other types installed in same locations.

Table 4 - Seal Materials Selection

	NATURE OF SEAL MATERIAL (OR TRADE MARK)	DESIGNATION	MAXIMUM OPERATING TEMPERATURE RANGE (°C)
		(Designation as per ASTM D 1418)	
ELASTOMERIC	NITRILE RUBBER (SERVICE CLASS A ONLY)	NBR	0 TO + 80
	HYDROGENATED NITRILE	HNBR	-40 TO +150
	VITON ® GLT	FKM	-40 TO +180
	CHEMRAZ ® 526	FFKM	-20 TO +220
	SILICON (70 SHORE A)	VMQ	-60 TO +220
	FLUORINATED SILICON (70 SHORE A)	FVMQ	-60 TO +220
THERMOPLASTIC	TEFLON ® (VIRGIN OR FILLED)	PTFE	-80 TO +200
	KELF ®	PCTFE	-150 TO +100
	TEFLON ® FEP	FEP	- 80 TO +140
	TEFLON ® PFA	PFA	-80 TO +200
	NYLON ® 12	POLYAMIDE	-20 TO +100
	DEVLON V API		-20 TO +100
	PEEK ®	POLYETHER KETONE	- 80 TO +160
	TURCITE ® 243	POLYETHER KETONE	-200 TO +250
	VESPEL ® SP 21	POLYAMIDE	-200 TO +260
OTHER	GRAPHITE	HIGH PURITY GRAPHITE	-240 TO +550
	METALLIC	SPIRAL WOUND	
		RING JOINT	

Notes:

(1) Graphite seals are not acceptable as primary pressure containment seals; they are only used as back-up seals for fire resistance properties. Graphite back-up seals on ball valves and where applicable to any other type of non-rising stem valves, shall be made of single piece, solid graphite compound (braided material is not acceptable).

(2) O-rings cross section diameter shall be a maximum of 6.99 mm if AED property is required. FKM products are not acceptable on methanol fluid services, wherever the methanol content exceeds 5% in volume, and even if methanol is only used for drying of pipelines. Some HNBR or FFKM grades, may be used in this case, subject to appropriate testing.

(3) Nitrile rubber, silicon or fluorinated silicon material shall not be selected when resistance to explosive decompression is required by the valve data sheet.

(4) Stem seals may only be made from O-rings (lip seals shall not be used in flammable and toxic service). "Gland packing" design involving graphite materials is not acceptable for primary pressure containment stem seals (Gland packing with chevrons type seals are acceptable for stem seals).

(5) Seals materials as shown on Table 4 shall not be used beyond the temperature limits shown on this table. Temperature ranges here above are maximum ranges, they are not the same for all materials of the same nature. Individual material temperature range shall be obtained from and confirmed by the seal material Manufacturer.

(6) In case of solid particles in the fluid, the following design is required:

a. No lip seals are permitted except if the valve design is specifically qualified for the application

b. No soft seals are permitted for the seat-to-ball seals: valves must be metal-to-metal seating.

(7) In special cases, particular seal materials other than those listed in Table 3 may be required by the COMPANY. In such a case, such requirements would be spelled-out in the related valve data sheet.

(8) Seal materials other than those listed on Table 4 may be proposed for approval to the COMPANY as alternate materials. Such proposal must be substantiated by appropriate documentation on material properties and testing in similar range of fluid, pressure, and temperature.

(9) All O-rings used for valves in service class other than class A shall be certified having successfully passed the anti-explosion decompression test according to Appendix 8 of this specification. Testing results shall be submitted by the valve Manufacturer to the COMPANY for approval.

(10) All O-rings used for valves in service class other than class A shall be certified compatible with the service fluids of the related valves within the operating temperature range to be considered. In case no such indication is given on the valves requisition, the service fluid shall be assumed to contain methane with about 5% CO_2 at temperatures up to 120°C.

7.4.8 METALLIC COATING REQUIREMENTS FOR BALL VALVES

7.4.8.1 GENERAL

With the exception of stainless steel material having at least 17% chromium (nominal value), trim and seat shall be Electroless Nickel Plated (ENP) to 0.003 inch (75µm) minimum thickness, according to the procedure shown in Appendix 3. This requirement is not applicable to ASTM A705 type 630 (UNS S17400) unless otherwise specified by the valve data sheet.

7.4.8.2 BALL VALVES IN CORROSIVE SERVICE

Carbon steel ball valves (other than service class E) used in corrosive gas service, carbon steel piping material classes having a minimum corrosion allowance of 3 mm, shall receive a 3 mm thick weld overlay in stainless steel grade 316L on all seal pockets and related contact faces. This requirement only applies to dynamic seals (i.e. seat-to-body and also upper stem seals); it does not apply to static seals such as body seals, or to parts already made of stainless steels having a minimum nominal chromium content of 17%. SS 316L weld overlay procedure shall conform to Appendix 5.

In the case of floating ball valves, this requirement does not apply to seat-to-body sealing areas for which the seat ring is made of an integral, solid thermoplastic material (i.e., valves having a fixed seat), but it applies to stem sealing areas in all cases (for floating ball valves which also having a floating seat design, the seat-to-body sealing area must consequently be overlaid). In the case of small size carbon steel valves (typically in sizes less than 2 inches), where it might be difficult or impossible to do the stainless steel overlay on valve bodies or bonnets, this requirement may be waived provided that the related piece is replaced with solid corrosion resistant alloy according to the Table 5 hereafter. In such a case, the end nipples must still be in carbon steel according to the relevant piping material class, and shall be welded by the valve Manufacturer to the corrosion resistant alloy of the body with Inconel 625 filler material exclusively.

Table 5

Valve pressure class	**800**			**1500**		**2500**
Piping pressure class	150	300	600	900	1500	2500
General corrosive service	316L or 321				Duplex stainless steel F51	
H_2S corrosive service					Incoloy 825 or Inconel 625	

7.4.8.3 PARTICULAR CASE OF SOLID PARTICLES IN THE FLUID

Seats and ball contact faces must be Tungsten Carbide coated in order to achieve a minimum surface hardness of 1050 Vickers. The thickness of the Tungsten Carbide coating must be a minimum of 400 µm (thickness of the finished, machined surface).This coating is required in addition to the 75 µm ENP coating requirement which has to be applied on the remaining

parts of the trim (i.e., ball, stems and seats). Tungsten Carbide Coating procedure must conform to Appendix 4.

7.4.8.4 PARTICULAR CASE OF SERVICE CLASS E BALL VALVES

Service class E valves (which must be metal-to-metal contact) shall have the following additional features:

- Seats and ball contact faces must be Tungsten Carbide coated in order to achieve a minimum surface hardness of 1050 Vickers. The thickness of the Tungsten Carbide coating must be a minimum of 400 µm (thickness of the finished, machined surface). This coating is required in addition to the 75 µm ENP coating requirement which has to be applied on the remaining parts of the trim (i.e., ball, stems and seats). Tungsten Carbide Coating procedure must conform to Appendix 4. Tungsten carbide coating and ENP coating shall not be superimposed.
- Tungsten carbide coating shall be supported by an intermediate 3 mm Inconel 625 weld overlay coating for carbon steel, low alloy trim component exposed to sour service condition or when the line can be exposed to any aggressive chemical treatment.
- 3 mm thick weld overlay in Inconel 625 of all seal pockets and related contact faces (whatever the corrosion allowance of the relevant piping material class). This requirement only applies to dynamic seals (i.e. seat-to-body and upper stem-to-bonnet seals); it does not apply to static seals such as body seals. Inconel 625 weld overlay procedure must conform to Appendix 5. Materials in solid Inconel 625 or Inconel X718 grades need not be overlaid. Exception to the weld overlay will also apply to Duplex stainless steel material unless if otherwise specified.
- Alternatively to the Inconel 625 weld overlay process, an Inconel 625 HVOF coating process may be considered, subject to the COMPANY prior approval and under the following conditions.
    - The HVOF coating process is not allowed for stem sealing application
    - The HVOF coating is not allowed for sour service
    - A minimum 300 µm coating thickness is required on dynamic sealing contact faces wherever allowed
- Coating procedures as well as porosity tests method shall be submitted to the COMPANY for prior approval
- Porosity test results on coupons representative of the same substrate material in the same delivery condition and thickness, same HVOF process and equipment and same final machining or surfacing shall be submitted to the COMPANY for approval.

7.4.9 SUBSTITUTION OF EQUIVALENT MATERIALS

No substitution of materials shall be authorised without the prior approval of the COMPANY.

7.4.9.1 VALVES FABRICATED BY WELDING

The replacement of valves specified as being made of cast or forged steel by welded fabrication also requires the prior acceptance of the COMPANY, which must be obtained prior to the purchase order award.

7.4.9.2 INTERNALS

Where the valve data sheet calls for seats and plugs in “F6” (13% chromium) the material may be replaced by stellite-coated seats and/or plugs provided the services conditions permit.

7.4.9.3 WELD OVERLAID PRESSURE CONTAINING PARTS

Use of carbon steel weld overlaid pressure parts instead of solid corrosion resistant material may be considered as an acceptable substitute by the COMPANY for some specific supply.

When permitted by the COMPANY such a substitution will be limited to valves of NPS 16 and above in pressure class 900 and above. The conditions for such substitution are:

- Proven experience of the valve manufacturer with that kind of manufacturing for the range of valve size.
- The valve manufacturing plant is equipped with all the welding and non-destructive examination facilities and these production means are under the responsibility of the in-house welding department.
- Exhaustive list of requirements will be established by the COMPANY including in terms of mock-up requirement as to ascertain the manufacturing capabilities prior to starting the production of such a supply.

7.5 DESIGN

7.5.1 DESIGN APPRAISAL

7.5.1.1 Mechanical Integrity

The Manufacturer shall guarantee the mechanical integrity of the valve for the valve design conditions. In particular, no component of the trim or any other valve internal component shall become loose after installation and during operation.

7.5.1.2 Stresses

For each type of valve, the Manufacturer shall submit a fully detailed calculation note in order to demonstrate that body and internal component stresses are within acceptable levels. Calculations must be based on the applicable code(s) requirements or criteria (VON MISES criteria, for instance). For this purpose, all external loads, tension and bending moments shall

be taken into account, including the maximum torque developed by the actuator (if any) under the design pressure.

Calculation note for valve stem must comply with Appendix 6 of the present specification.

Under extreme conditions (i.e. test, maximum torque, etc.) the maximum allowable stresses used for the stem calculation shall be:

- Combination of tension, bending and shear stresses: $\sigma \leq 0.9$ YS
- Torsional stresses: $\sigma \leq 0.52$ YS

(YS being the specified minimum yield strength of the material under consideration)

The Manufacturer shall also submit detailed drawings (sketches are not acceptable) and material take-off for each type of valve of the supply. The submission for review of drawings and calculation notes to the Engineering Company does not relieve the Manufacturer from any of his responsibilities and liabilities regarding the design of these valves.

7.5.1.3 Fire Safe Design

Regardless of the valve type, at least all valves installed on hydrocarbon or flammable fluid lines, shall be of a fire safe design and shall include a graphite fire safe barrier in the valve bonnet and stem sealing arrangement as a minimum.

All valves pertaining to one of the types listed by ISO 14313 shall comply with the standard ISO 10497. Previous qualifications run to other recognized standards listed by the ISO 10497 will be considered only if fully documented.

Subject to COMPANY approval, metal seated valve design that do not have elastomer or polymer seals may be provided untested if it can be demonstrated that the seat and sealing parts can withstand the fire test temperature.

To demonstrate that valves comply with these requirements, the Manufacturer shall supply with his quotation copies of Certification issued by a recognised Inspection Authority confirming that this requirement has been met for all items offered, and that appropriate testing has been carried out to demonstrate the "firesafe" design per one of the relevant standards listed here- above.

The fire test certificate shall be submitted with the general arrangement drawing and the complete part list of the valve that was qualified as to validate the “firesafe” design of the supply. The validation of the qualification will be limited to valves of the same design, showing the same sealing material and sealing arrangement as the qualification valve.

7.5.1.4 Mechanical Connections

All mechanical connections, threaded, screwed-in, welded connections, between either valve internal or external components shall follow established and recognized design rules

acceptable to the applicable valve standards. The design justification of such connections shall be made available to the COMPANY upon request.

The minimum wall thickness of valves shall always comply with ASME B16.34 rules except for valves designed to ISO 10423.

Flanged ends designed to ASME B16.5 or ASME B16.47 shall always permit the installation of the valve in the piping system using Hexagonal nuts (Heavy series) of ASME B18.2.2 on the piping and valve sides of the flanged connection. The bolting studs shall exceed the nuts over three threads on the valve side after full bolt tightening.

7.5.1.5 Tack Welds

Tack welds are allowed for a temporary assembly only. They are strictly prohibited for a presumed permanent function, whatever the valve type, valve design or valve service conditions.

7.5.2 VALVES DESIGNED TO ISO 10423 (API 6A)

The valve manufacturer must have a valid license certificate to ISO 10423 for the proposed range of products.

All the valves shall be designed and tested to the full rating unless otherwise specified.

Bolt allowable stresses shall not exceed those of ASME VIII division 2 for both the hydrostatic test pressure and the rated working pressure.

Bolt allowable stresses govern all applicable valve loadings and combinations of loading including gasket pre-stressing load, end thrust load etc.

One fourth of the minimum calculated wall thickness of pressure containing parts shall be at the inner side of the body or bonnet bolt holes.

Only valves which have been qualified in accordance to ISO 10423 Appendix F verification test procedure shall be considered.

In addition to the mechanical calculation notes, finite element analyses are mandatory for each valve model and size.

The analyses shall be established with all details related to the meshing and elements characteristics and selection of these. Modelling will address composite material as far as necessary. The scope shall address stress and deformation of pressure containing parts and pressure controlling parts.

The study shall be run for all the major loading cases including hydrostatic test, high pressure closure test at 110% valve design pressure at coincident temperature and operating conditions.

In case line loads are not properly defined by the Engineering Company, the line load shall be established considering the connecting pipe for its material grade at its specified mechanical properties and wall thickness.

The finite element analyses shall be used to evaluate and verify:

- The effectiveness of individual sealing barrier
- The seat to obturator pressure contact range
- The pressure contact on stem and obturator bearings.

Material requirements shall satisfy Product Specification Level PSL3 and quality control requirement PSL3, or PSL3G for valves in gas service, unless otherwise specified.

7.5.3 BONNETS AND STEMS

7.5.3.1 Actuated Valves

For actuated valves, bonnets, stems, stem extensions, etc., shall be designed and calculated to withstand the maximum torque delivered by the actuator at the maximum allowable actuator power (i.e. pressure or otherwise). The maximum valve torque at its most demanding situation along the valve stroke shall be verified during valve testing as to confirm the actuator sizing for the given pressure differential in all situations.

7.5.3.2 HAND-OPERATED VALVES

For hand-operated valves, bonnets, stems, stem extensions, etc., shall be designed to withstand the maximum anticipated torque that might be applied during the operation of the valve.

7.5.4 INTERNALS

In order to prevent the seizing of parts in contact with one another, there must be differences in hardness between seats, obturators, stems, etc. However, this does not apply to parts that are coated (ENP, tungsten carbide, etc.).

The type of plug (solid, flexible, etc.) shall be stipulated in the valve data sheet. If a stellite-coated plug is specified, it must be made of the same material as the valve body.

The seats of globe valves less than or equal to 1-½ in. diameter shall be removable.

7.5.5 PACKING BOX

The stem packing must be suitable for service conditions specified and must contain a corrosion inhibitor to prevent oxidation of the stem, especially in case of prolonged storage. All valves stem shall be adjusted ready for service.

The Manufacturer shall indicate the nature, dimensions and number of disks making up the packing of the packing box, as well as the force required to press the packer and provide any endurance/cyclic test data performed with the same material arrangement.

7.5.6 ACCESSORIES, DRAINS, AND BY-PASS CONNECTIONS ON VALVES

a) In the particular case of swing check valves, a boss shall be provided downstream of each check valve (swing type only) to allow for the drilling of a drain in accordance with ASME B16.34.

b) In the particular case of ball valves, the requirement for accessories is shown on the Table 6 hereafter:

Table 6 - Vents, Drains and other Connections on Ball Valves

Type of Accessory	Above Ground Valves	Underground Valves	Service Class E Valves
Vent plugs (1) All service classes	Yes (2)	Yes (2)	Yes (2)
Drain plugs (1) All service classes	Yes (2)	Yes (2)	Yes (2)
Sealant injection facilities of upper stem (service classes B & E in $\phi \geq 6$")	Yes (3)	Yes, raised to gearbox (3)	Yes (3)
Sealant injection facilities of seat seals (Service classes B & E)	Yes, for class B actuated soft seated of $\phi \geq 16$"	Yes	No, except for buried valves

Notes:

(1) Whatever their design or function all plugs and sealant accessories shall be tested for their tightness at the service conditions when installed on the valves.

Whenever vent and drain NPT threaded plugs are required for the valve testing.

They are solid plugs unless otherwise specified by the valve data sheet. Solid plugs are seal welded after valve testing. Seal weld shall be designed for the full thrust effect on the plug section at 150 % the valve rating pressure.

(2) Seal weld are not allowed on carbon steel valves when used in sour service. NPT threaded anti blow–out plugs equipped with a bleed, as defined in note c) below, shall be used instead. The anti-blow-out plugs shall also be considered as substitutes to solid plugs for valves whose actuators have to be installed on site. In that case the requirement shall be defined by the valve data sheet.

(3) Sealant injection points shall incorporate a check valve and a secondary means of isolation.

- All connections shall be butt-welded to the valve body, or alternatively, shall be seal welded if screwed for valves in all services other than sour service.
- For valves in sour service, welds on carbon steel valves are not authorized and screwed connections with 2 O-rings must be used instead, similarly to the anti-blow-out plug.

c) All anti-blow-out plugs shall be equipped with a bleed and shall be NPT threaded. ISO thread type is not acceptable instead. Two elastomeric O-rings are preferably located at top and bottom of the thread or both of them at the bottom of the threaded section of the plug. These O-rings shall be of the same material as for the other valve sealing barriers. The bleed screw and the mandatory upper protective screw shall be both embedded in the plug head. The two screws shall be operated using the same specific tool. The size of plugs shall comply with the requirements of the ISO 14313.

Such plugs shall be protected and secured against any involuntary or undue operation.

d) In the particular case of integral manifold valves, the vent connection at the bleed valve outlet shall be plugged with a metallic screwed bleed plug fitted with a captive bleed screw (Swagelok, Parker, or equivalent).

The bleed plug must be tested with the valve for tightness.

Any other particular requirement regarding drains and by-pass connections to be provided on valves shall be specified in the valve data sheets and shall be in compliance with MSS SP 45. This information shall be shown on a separate sketch or shall be marked as an annotation on the Manufacturer's drawing of the valve.

e) PTFE or any kind of plastic material tape shall not be used for sealing threaded connections. This requirement also applies to valve ports during valve testing.

7.5.7 BOLTING AND GASKETS

7.5.7.1 BOLTING CALCULATIONS

Except for valves designed to section 7.5.2 above, all bolting calculations must satisfy ASME B16.34 requirements. In particular, the maximum allowable bolt stress used in the body or bonnet joints shall not exceed the maximum value of either 7000 or 9000 psi, respectively, whichever bolt-material grade is used. As a minimum these stress value limitations address both the loadings due to internal pressure and gasket setting pressure wherever it applies.

7.5.7.2 BONNET GASKETS

The gaskets of bolted bonnet or cover flange joints shall be suitable for the pressure class of the valves and the maximum and/or minimum temperatures specified on the valve data sheets and requisitions, as well as for any additional requirement such as "firesafe", etc. The type of facings for the bonnet or cap joints shall correspond to those specified in paragraph 5.7.2.1 for a flange rating at least equal to the valve pressure class. CAF bonnet/ cover flange gaskets are not acceptable on steel valves.

Except as otherwise indicated in the requisitions, bonnet gaskets for gate and globe valves of 900 pressure classes or higher shall be of the metallic ring joint type and gaskets for the 600 pressure classes or lower shall be of the spiral wound or metallic type.

All bonnet gaskets for valves specified in accordance with API 602 shall comply with that standard. Other types of gaskets may be submitted to the COMPANY for approval.

7.5.7.3 BOLTING FOR BONNET, PACKING-BOX, ETC.

Bolting shall comply with ASME B16.34. The threading of the bolting shall be in accordance with the "Coarse" series, class 2B, of ASME B1.1. However, bolting to ISO standards, including metric threading, is allowed as an alternate.

Coating of all carbon steel or low alloy steel bolting shall conform to 10008-STD-6-COR-042,PEGS-0710-COR-042 requirements.

Valve bonnet, packing-box, cover or body bolting material shall be equal or superior (for mechanical properties and corrosion resistance) to that listed in the following table. Compatibility of selected material with service conditions shall be checked.

Table 7 - Valve Bolting Materials

Valve Body Material	Design Temperature Range (1)	Bolting Material
Carbon steels (2)	-29 to +250°C	ASTM A193 Gr. B7 and ASTM A194 Gr. 2H
Low temperature carbon steels (2)	-46 to +250°C	ASTM A193 Gr. B7M and ASTM A194 Gr. 2HM or ASTM A320 Gr. L7 or L7M and ASTM A194 Gr. 4 or Gr. 7
Low alloy steel 3.5% Ni	-101 to +265°C	ASTM A320 Gr. L7 and ASTM A194 Gr. 4 or Gr. 7
Austenitic stainless steels	-196 to +300°C	ASTM A193 or ASTM A 320 Gr. B8 or B8M cl.2 (see note 3) and ASTM A194 Gr. 8MA or 8TA
Aluminium bronze	-196 to +200°C	ASTM B150 Gr. C63000 HR50
Duplex stainless steel to UNS S31803 or Inconel 625	-46 to +200°C	ASTM A453 Gr. 660 (see note 4). F51 bolting will be preferred for small sizes screws(≤ ½")if allowed by the design code
Other non-ferrous		Per applicable valve standard

Notes:

(1) "Design temperature" means temperature @ design pressure for bolting.

(2) Grades B7M for studs and 2HM for nuts must be selected if valves are in H_2S service and confined under heat insulation.

(3) Stainless steel bolting to ASTM A193 Gr. B8 or B8M may conform to class 1 instead of class 2 for bolt diameters larger than 1 ½ inch. ASTM A453 Gr. 660 may also be used down to minus 100°C if satisfactorily tested at that temperature, however material shall be subjected to restriction as specified in ISO 15156-3 in case of sour service

(4) ASTM A453 Gr. 660 shall be impact tested for temperature less than -29°C. Additionally the material is subjected to restriction for use in sour service as per standard ISO 15156-3 where applicable.

7.5.8 OPERATION OF THE VALVES

7.5.8.1 MANUAL OPERATORS

As a general rule, all valves shall be operated by a hand-wheel or by a wrench. Manually operated valves shall be furnished complete with either wrench or hand-wheel.

Unless otherwise agreed wrenches for valves made of corrosion resistant alloy shall be in AISI 316 stainless steel material.

The maximum dimensions of hand-wheel and levers shall be according to requirement of ISO 14313 except the maximum handwheel diameter is limited to 800 mm and the maximum lever length is limited to 450 mm.

For valves operated manually, the maximum force required under design and test conditions, when applied at the rim of the hand-wheel or lever, shall not exceed 300 N during valve opening or closing, and 400 N when unseating the valve. This applies to seating, unseating, and operating at maximum pressure differential for both minimum operating temperature and ambient temperatures.

Gear operator requirements for valves shall be in accordance with the following minimum requirements, as shown in Table 8. However, gear operators may have to be provided beyond these requirements in order to meet the maximum allowable force applied to hand-wheels or levers as stated here above.

Table 8 - Gear Operator Requirements

Valve type	Valve pressure class	Nominal diameter
Gate	150 300 600 900 1500 ≥ 2500	14" and larger 10" and larger 8" and larger 6" and larger 4" and larger 4" and larger
Globe and Plug	150 300 600 900 1500 ≥ 2500	8" and larger 8" and larger 6" and larger 4" and larger 3" and larger 3" and larger
Butterfly	150 300 600	8" and larger 8" and larger 6" and larger
Ball (floating or trunnion mounted type)	150 300 600 900 1500 ≥ 2500	8" and larger 8" and larger 6" and larger 6" and larger 4" and larger 4" and larger

Gear operated valves shall be fitted to the valve in conformance to the attachment requirements in ISO 5210 or ISO 5211.

Gear operators shall be heavy-duty type and shall be weatherproof by total enclosure suitable for a marine environment. Gearboxes shall be sealed, and lubricated for life, and shall be suitable for minimum and maximum temperatures during construction and operation.

Top cover shall give easy access for inspection and maintenance of the mechanism. Top cover sealing shall be made by means of a removable continuous sealing gasket. Sealing by means of a bonded joint is not acceptable.

Gear operators for gate and globe valves shall be bevel types unless a spur type is specifically stated in the requisition. Both bevel and spur gear operators shall be the type with 4 or 8 bolt mountings which allows them to be orientated on site any of 0° to 90° positions.

Gear operated ball and butterfly valves shall be provided with worm gear operators, or with scotch yoke operators. Any other mechanism design shall be submitted to the COMPANY for approval.

Identification of gear boxes shall include the name of the manufacturer and the serial number as a minimum. Marking shall remain visible for the service life. Grey cast iron materials shall not be used for gearboxes or hand-wheel; only steel or ductile iron shall be used. Wrench and

hand-wheel shall be made of solid material. Hollow components are prohibited. Material shall be suitable for ambient temperature of -30°C unless otherwise specified.

Chain wrenches shall be to Manufacturer's Standard.

Chain wheels shall be of the adjustable sprocket rim type, with chain guides included. Chain wheel attached to valve handle by bolting shall use "U" bolts and not "J" bolts.

Extension stems, when specified on the requisition, shall be to proven Manufacturer's Standards. All materials and connection details shall be justified for the application.

For all valves fitted with manual gear operators, the Manufacturer shall submit with his quotation suitable drawings showing the principal dimensions and assembled weight of the valve and of the gear operator, clearly indicating the size(s) and Tag No's of the valve(s) to which the drawings are applicable.

7.5.8.2 ACTUATORS

Valves operated by actuators shall also comply with the relevant instrumentation general and/or particular specifications.

Assembly of the actuator to the valve shall permit a single installation position of the actuator against the valve. That position is identified at time of the valve functional test at the Manufacturer premises and shall be recoverable during any further reinstallation of the actuator to the valve regardless of the valve installation position.

Assembly of the actuator to the valve stem shall be such that the driving train is permanently protected from any water or solid particle ingress, or from icing.

Structural assembly between the actuator and the valve shall be designed for the external loadings, permanent or occasional loads such as wind load or blast effect in the site environmental conditions.

All bolted flanged connections of the mounting kit shall include dowel pin(s). Bolts shall not be subject to any shearing loading resulting from the actuator or the valve installation position, or from external loadings applied on the assembly.

For each actuated valve (i.e. each item), the detailed torque table in Appendix 11 must be completely filled in by the valve Manufacturer and under its responsibility, based on information collected from the actuator Manufacturer. This must be done at both the bid stage (i.e. these tables must be attached to the technical bid documents) and after the purchase order is awarded (i.e. these tables become part of the design documents which are required to receive COMPANY's approval together with drawings, bill of materials, calculation notes, etc.).

The pressure differential shall be addressed by the valve data sheet and shall correspond to the most demanding situation the valve might face during testing, installation start-up or in operation.

The maximum actuator output torque at the maximum supply pressure on the actuator shall not exceed the maximum allowable torque on both the valve and actuator stems. The output torque shall be understood at the connection of the gearbox with the valve stem (or stem extension) wherever such equipment exists in-between. The actuator shall also be capable to operate the valve at the minimum supply pressure on the actuator, and with the maximum pressure differential on the valve. In this case, the safety factor of the actuator output torque over the valve torque requirement must be a minimum of 1.3 in all operating cases of the valve, at any angle along the valve stroke, and in full compliance with the requirements expressed in the Appendix 11.

7.5.8.3 LOCKING DEVICE

All manual valves (whether operated with a lever or a gear operator) shall be provided with adequate pads and holes for enabling locking at both the open and closed positions preventing any possible movement by involuntary external action, vibration, etc. Design and efficiency of the locking device shall be independent of the installation position of the valves.

7.5.8.4 ACCESSORIES

Accessories such as operating extensions, limit switches, emergency manual operation devices for actuated valves, etc., shall be submitted for approval and shall require a specific description and require a full mechanical design justification of the mechanical chain inclusive of the welded connections.

7.5.9 LIFTING LUGS

Lifting lugs shall be provided for valves of nominal size 8 inches and above or valve over 550 lbs (250 kg) weight including accessories. Design of these lugs shall include additional weight of the actuator and the gear box as far as applicable. Design and calculation of these lifting lugs shall be submitted to COMPANY for approval together with all other documents and calculation notes.

Lifting lug positions shall allow for safe handling operations of the valve fully equipped with its gear box or actuator as far as applicable.

Specific additional lugs may also be required when valves are installed with the stem in horizontal position.

Lifting points on the gear box or actuator shall never be used for lifting the actuated valve.

Welded on and integrally cast lifting lugs shall be subjected to the following inspection:-

- 100% visual
- 100% surface examination (MPI or DPI)
- 100% volumetric (RT or UT)

7.5.10 VALVES SUPPORTS

Valves supports (legs or saddles) shall be supplied and installed by the valve Manufacturer on valves of nominal mass of 500 kilograms minimum. Support design documents shall be submitted for approval including calculation notes.

The valve supports are designed for the valve full of water, equipped with its actuator and gear box, excluding any other kind of loading. Such supports are not intended to be line support unless otherwise specified.

7.5.11 MISCELLANEOUS REQUIREMENTS

a) Valves shall be designed to operate freely after the stem has remained in one position for an extended period of service, of up to one year from the date of installation, or since the last periodic maintenance.

b) Valves shall be designed to contain or limit pressure above normal working pressure that may build up in trapped cavities due to thermal expansion or evaporation of liquid.

c) Valves installed underground or with stem extension, piping spools connecting the valve body ports, for example vent port, drain port, sealant injection port, shall be designed according to the appropriate piping and material class. The specification 10008-STD-6-PIP-009,PEGS-12059-PIP-007 will apply to those piping spool components unless otherwise specified. All valves installed in those spools shall comply with this specification. The selected Piing Material Class will be the same as for the main valve and the corrosion allowance value will be the one of the line where the main valve is installed.

d) Anti-static device

All valves shall be of "anti-static" design when installed on hydrocarbon fluid, flammable fluid or chemical fluid lines. All valves shall incorporate suitable devices in their design to ensure electrical continuity between the obturator, stem and body of the valve whatever the seat insert material.

Graphite seals or stem packing are not considered to offer satisfactory electrical continuity. When the test to ISO 14313 is required, the valve shall be new, fully dry, with all graphite seals or graphite impregnated sealing compounds removed from the valve prior to test performance. To test for continuity, the valve shall be cycled five times and the resistances shall be measure using a DC power source not exceeding 12 volts. The anti-static devices shall be identified on the cross-sectional drawings and listed on the part -list.

7.5.12 GENERAL CHARACTERISTICS SPECIFIC TO EACH TYPE OF VALVE

All valves shall comply with the corresponding valve data sheets as well as with the requirements of standard, completed by the following appropriate API or MSS Standards specific to each particular type of valve.

7.5.12.1 Gate, Globe and Check Valves

The following standards: API 600, API 602, ASME B16.10 and MSS SP-42 shall be the main complementary standards for steel gate, globe and check valves. When allowable leakage rates and pressure test minimum duration in these codes (e.g. API 598 or ISO 5208 rates) differ from those stated in this document, COMPANY shall be informed for approval.

In addition to a description of the internals of the valves, the data sheets shall stipulate the type of boring (full or reduced bore) and whether the stems are moving or fixed, externally or internally threaded, and whether with yokes.

Gate and globe valves shall be suitable for re-packing under pressure in the fully open position. Globe valve stem design shall also allow for tightness at intermediate obturator position when the valve is intended for flow control.

The back seat shall be hard faced for carbon steel valves used in corrosive services, i.e. carbon steel lines with corrosion allowance of 3 mm or more

Seats of globe valves NPS 1-1/2 and above shall be renewable. Welded seats are not accepted.

Soft seal valves shall be clearly marked by the Manufacturer with the soft seal material and maximum working temperature.

For carbon steel and ferritic alloy swing type check valves, disc retaining components e.g. studs, nuts, washers and pins shall be of the same material as specified for the "trim" of the valve.

"Wafer" type check valves shall comply with API 594.

7.5.12.2 Ball Valves

a) General

All requirements of this specification which are related to a ball valve size are meant to be related to the valve nominal size unless otherwise required by this specification. All ball valves shall be bi-directional. Ball valves (manual and actuated) shall normally be reduced bore, unless otherwise specified on the requisition; however, valves of diameters ≤ 1-1/2” shall have a nominal size at least equal to the internal bore of the matching pipe. Actuated valves shall be 2 inches minimum in diameter (nominal size).

b) Design code

Ball valves shall comply with ASME B16.34 or ISO 10423 when addressed by related piping material class. Other codes (in particular, ASME VIII division 1) shall only be used as a supplement to ASME B16.34 for additional calculations not already covered in ASME B16.34.

c) Body

The body shall be able to be fully dismantled, with a bolted design (i.e., side entry or top entry exclusively). All-welded or screwed-body design is not acceptable (“screwed body” means bodies made with a screwed-in insert). The pressure-containment top cover of top entry valves must be bolted to the body.

However, all-welded body design is acceptable for valves of diameters not exceeding 1-½ inches, or for buried valves on buried pipelines, except for valves which are subject to the NACE requirements for wet sour service (H_2S).

d) Trim

Ball valves shall be of the "trunnion" type. However, "floating" type ball valves, if manually operated, are acceptable in the following cases only (actuated valves must be trunnion mounted exclusively, whichever their size or pressure class):

- Pressure class 150: Diameters up to 6 inches (included)
- Pressure class 300: Diameters up to 4 inches (included)
- Pressure classes 600, 900, and 1500: Diameters up to 1 ½ inches (included)
- Pressure class 2500 up to 1 ½ inches (included) if operating forces are demonstrated by testing to be within paragraph 5.5.7.1 limits.

e) Anti-static features

The anti-static designed ball valves shall incorporate suitable devices to ensure electrical continuity between the ball and the body and between the ball, stem and body of the valve.

f) Bearings

All bearings shall be of a self-lubricating design (anti-friction material is acceptable). For actuated valves installed with the stem in horizontal position, sizing of stem, stem extension and ball bearings shall consider the dead weight of the actuator and intermediate mounting kit (stem extension, etc.) and also the dynamic loading induced by the actuator action as far as necessary.

Regardless of the (actuated) valve position, the design of the bearing shall be verified for all static or dynamic loadings that would affect the valve mechanical performance for the valve as installed in-situ.

g) Upper stem

Sealant injection facility of the upper stem must be provided for all valves of service classes B and E in diameter 6 inches and over. The injection point on the stem must be located between primary and back-up seals or between two primary seals.

Ball valve stem retention shall not depend on the packing gland: a bottom entry shouldered stem is required. To achieve this, the upper stem shall be shouldered to the body of the valve and not to the bonnet nor to an intermediate piece bolted on the valve body. However, this is not required on integral trim, i.e., if stems are made in one piece with the ball. (In the case of top entry design, the bolted top cover that is required for pressure containment shall be considered part of the body).

Primary stem sealing barrier efficiency shall not depend upon a compressive action from the packing gland for ball valves in pressure class 300 and above. When allowed, cycling test shall be organized on valves of the supply to demonstrate the efficiency and reliability of the compressive action exerted on the primary sealing barrier in the long term. The extent of testing shall be agreed depending upon the valve requisition and packing gland arrangement. Valve testing shall be successfully completed prior to the release of the supply.

Extended spindle/stem assembly, when specified, shall have the stem within a tube and shall be to proven Manufacturer's Standard design. Design shall enable any necessary stem seal adjustment to be carried out at the top of the stem extension without removing any insulation. Any requirement for such valves will be indicated in the requisition. For flanged valves, the extended spindle length is measured from the top of an end-flange or body whatever the greater; for threaded or socket weld valves, it is measured from the top of the valve body. Stem/spindle extension lengths shall allow for assembly/dis-assembly operation in site condition and be as follows unless otherwise specified:

- For valves 2" in size and smaller: 100 mm, plus or minus 10 mm
- For valves larger than 2": 150 mm minimum.

Stem made of precipitation hardening material, typically UNS S17400, Inconel X718 etc., and whose finished section is more than 150 mm in its largest part shall be checked for tensile properties and microstructure on some appropriate extension of a stem of the supply. This extension shall go through the complete stem manufacturing process before testing. The extent of testing will be determined based on the service conditions as a minimum it shall consist of two cylindrical tensile specimen, two sets of ISO V-notch impact test specimen and three macrographs as a minimum.

h) Seats

Seats shall be of the simple piston effect design type.

The construction of the body seat rings or ring assemblies for trunnion mounted valves shall be such that body cavity relief is possible. A pressure relief hole in the ball is not allowed, whether on floating ball or on trunnion mounted valves.

Seat spring arrangement shall be preferred to a unique solid seat washer for high duty class E valves in pressure class 1500 where the fluid is expected to flow with significant sand quantity

On top entry valves, the seat design shall be such as to allow for easy trim removal; this shall be based on the use of split seats. Specific designs such as "seat push-back" devices are subject to the COMPANY prior approval. The seat design shall be such that the seat to ball tightness and the seat relief functionality can be easily recoverable after site re-assembly.

i) Ball position indicator

Positive means of indicating ball position shall be supplied by the Manufacturer for each valve, in accordance with the following:

- Manually operated ball valves:
  - Wrench operated valves: ball position indicator shall not be capable of incorrect fitting
  - Gear operated valves: when in place on valve, the gearbox valve position indicator shall be directly associated with actual stem/port position and shall be visible at all time under normal operation. When gear-operator is removed (i.e. for maintenance, etc.) the valve stem end shall incorporate positive indication of actual ball position. The refitting of the gearbox shall be capable of retaining the position so indicated
- Actuated ball valves:
  - These valves shall have similar positive indication as required for gear-operated valves as stated here above, and must incorporate one-way fitting of couplings, etc., to maintain external evidence of the actual ball position at all time, including under normal operation conditions.

For both types of ball valves (either manual or actuated) of NPS 36 and above in pressure class 900 and above the positive means shall give the indication of the ball position by adequate marking on the stem or on the stem extension for the two open and close positions. This marking shall be visible or reachable through the mounting kit when the valve is fully assembled with its actuator or gear box.

“Pointer” type attachment is not acceptable.

7.5.12.3 PLUG VALVES AND NEEDLE VALVES

Plug valves shall comply with ISO 14313 when allowed and are limited to specific applications. They shall not be used in high pressure gas service.

7.5.12.4 BUTTERFLY VALVES

Butterfly valves shall comply with API 609. Requisitions for butterfly valves shall state the outside diameter and wall thickness of the mating pipework. The Manufacturer shall confirm in his quotation that mating pipework bore will give adequate disc swing clearance.

All gear-operated butterfly valves are to be fitted with a disc position indicator.

On wrench operated butterfly valves, the wrench must be capable of being positively locked in the fully open and the fully closed positions.

When butterfly valves are of double or triple offset design butterfly valves shall comply with category B of API 609.

7.6 DIMENSIONS

7.6.1 FACE-TO-FACE OR END-TO-END DIMENSIONS

7.6.1.1 FLANGED AND BUTT-WELDING VALVES

Except as otherwise stated in the valve data sheets, the dimensions between the flanges or the welding ends of valves shall comply with ISO 14313. However, ASME B16.10 is applicable for all valves or sizes not listed in ISO 14313.

The dimensions between the flanges or the welding ends of ball valves shall be in accordance with "Long Pattern" dimensions. The "short pattern" may only be used if called for by the valve data sheet in order to solve layout clearance problems.

7.6.1.2 THREADED OR SOCKET-WELDING VALVES

The end-to-end dimension of threaded or socket-welding valves shall be indicated by equivalence to a Manufacturer’s catalogue.

7.6.1.3 VALVES INSTALLED BETWEEN FLANGES (WAFER TYPE VALVES)

The end-to-end dimensions of butterfly valves shall be in accordance with API 609. The outside dimensions of "wafer" type check valves shall be determined by API 594.

7.6.2 ENDS

7.6.2.1 FLANGED VALVES

The valve end flanges connecting the piping or pipeline flange shall be of the type required for the piping or pipeline material class to which the valve belongs.

The dimensions of the end flanges shall comply with ISO 14313 requirements.

All dimensional tolerances listed in ISO 14313 shall be fulfilled unless otherwise specified. Tapping of threaded flanges shall comply with ASME B1.20.1.

Screwed flanges added on to bronze valve bodies shall comply with ASME B16.24.

The body end flanges of all double flanged valves shall be drilled for through bolting. Except where otherwise specified, flanges that are drilled and tapped for studs are not acceptable unless approved by the Engineering Company. Where tapped holes are permitted, the depth of thread engagement shall conform to ASME B16.34 edition 2004.

7.6.2.2 BUTT-WELDING VALVES

Butt-welding ends of valves shall comply with ASME B16.25 unless otherwise specified, and their bores shall match those of the pipes to which they are connected.

All butt-welding end valves must be supplied with pup pieces and where necessary transition pieces to allow for transition between the valve body (material grade and thickness) and the adjacent pipe (material grade and thickness) to which the valve is intended to be connected. The total length of pup piece and transition piece, or pup piece alone (in case transition piece is not necessary) on each side of the valve, shall be equal to a minimum of twice the valve port diameter, with a maximum of 1 meter. The pup pieces and where necessary the transition pieces shall be supplied, welded and heat-treated if applicable by the valve manufacturer and under its responsibility prior to valve testing. Subject to special agreement prior to the Purchase Order award, pup pieces may be supplied free issue to the valve Manufacturer.

The wall thickness, length and material of the transition pieces will be also determined as to minimise the stress concentration at the two butt welds. Local stress evaluation may require development of finite element analysis, so as to run the verification under the various loading conditions. The transition piece shall be made preferably from a seamless forged tubular.

Transition / pup piece material shall be in accordance with the applicable Piping or Pipeline Material Class and shall conform to relevant COMPANY piping General Specifications in case of piping valves and to COMPANY pipeline General Specifications in case of pipeline valves. Longitudinal weld seams of transition piece and pup piece must be located in the top quadrant and staggered by 200 mm from each other except if otherwise specified.

The location of the two butt welds, i.e. body to transition or pup piece and transition piece to pup piece shall be such the welds are not exposed to high stressed concentration under any loading condition or combination of loadings the valve will be exposed to in operation or interim situation (line testing for example). The longitudinal weld of the transition piece and pup piece and also the connecting butt welds to these components shall be subjected to 100% radiographic examination and 100% ultrasonic examination. The NDT acceptance criteria shall confirm to ASME Section VIII Division 1

The detailed geometry of the valve body end and transition piece end shall allow for the full radiographic and ultrasonic examination of the welds before valve testing. Ultrasonic examination of the two butt welds shall be equally performed from each side of the welds whatever the line size.

The pup pieces and where necessary the transition pieces shall be ordered with the necessary extra length as to adapt the end cap or other means required for testing the valve with the full end thrust effect.

The sketch hereafter shows the principle of what is required.

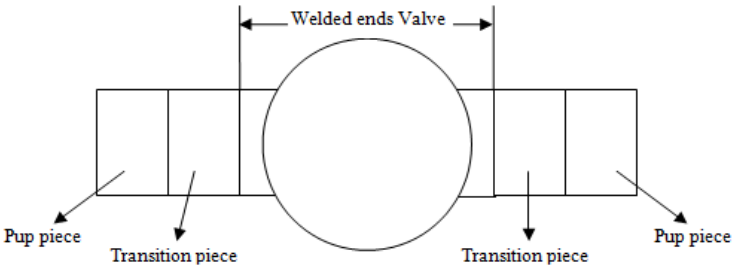


Figure 1 - Butt Welding Ends Valves: Detail of Transition and/ or Pup Pieces Requirements

Both pup pieces and transition pieces shall meet the internal bore requirement of the valve.

The thickness and material grade of the pup pieces must be the same as the adjacent pipe. The thickness and material grade of the transition pieces must be selected to meet the criteria of ASME B16.5 (Figure 14 "Bevel for combined thickness") or ASME B31.8 or ASME B31.4, or other pipeline code as applicable. Transition pieces may not be necessary, depending on adjacent pipe and valve end respective thickness and material grade. A typical assembly detail is shown on the sketch hereafter:

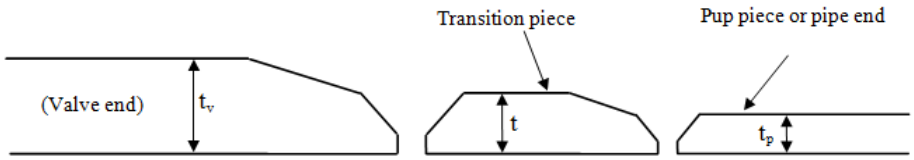


Figure 2 - Typical Assembly Detail (Valve Termination shall have a Minimum Thickness in accordance with ASME B16.34)

With reference to the above figure:

The slope of bevelled sections at the valve end and at the transition piece is 1 to 4 unless otherwise specified.

Valve body, transition pieces and pup pieces shall all be designed for the combinations of loading defined by the valve data sheet.

According to the codes, the following must be met: $t_v \leq 1.5\ t$, and $t \leq 1.5\ t_p$ (t_v, t, and t_p are determined by wall thickness calculations based on both the applicable codes and the respective material grades).

In case $t_v \leq 1.5\ t_p$, transition pieces are not necessary, but a pup piece shall nevertheless be supplied and welded to the valve end by the valve Manufacturer.

A practical example is given hereafter:

Table 9 - Practical Example

	Valve	Transition Piece	Pipe
Design Code	ASME B16.34	ASME B31.8	ASME B31.8
Material Grade	ASTM A350 LF2	ASTM A694 F52	API 5L X65
Wall Thickness	t_v = 42.9 mm	t = 31 mm	t_p = 21.4 mm

The weld filler metal of two dissimilar material grades must always match the highest grade material composition and characteristics. The complete assembly details must be submitted to the COMPANY for prior approval, together with the related welding procedures and qualification records (WPS/PQR).

In case of weld end valves, manufacturer shall guarantee that subsequent welding (and Post Weld Heat Treatment if applicable) with the connected pipe/ pipeline will not damage the sealing materials of the valve. Valve manufacturer shall also provide the maximum temperature that sealing material can withstand along with its location from the valve weld end. In certain cases, COMPANY may ask Contractor or company engaged in welding of valve with connected piping or pipeline to demonstrate that temperature at a distance recommended by valve manufacturer does not exceed the recommended temperature after welding and necessary PWHT as applicable.

7.6.2.3 VALVES ENDED WITH HUB CONNECTORS

The design of the hub connector will satisfy the rule of the minimum thickness required by the valve design code.

The vendor of the hub connector shall have clarified the maximum loading that can be accepted by the hub connectors in terms of normal load and moment, all information to be given in SI units.

The testing of these valves shall be performed using mating blind hub connectors and same sealing gaskets as the ones of the production supply.

7.6.2.4 THREADED OR SOCKET-WELDING VALVES

Threaded valve ends shall be tapped in accordance with ASME B1.20.1 and ASME B16.11. Socket-welding valve ends shall be bored in accordance with ASME B16.11.

Socket weld ball valves (soft seated valves only) shall be provided with 100 mm long plain end nipples (each side) made of an integral forged nipple schedule XXS (Carbon steel) or 80S (Stainless steel) or greater if specified in the relevant piping class. Nipple diameter shall be equal to the diameter of the connecting pipe. Materials shall comply with the relevant Piping Material Classes requirements, unless otherwise specified on the Valve Data Sheets.

Nipples shall be of integral forged type. Socket welded nipples are not allowed anymore.

7.6.2.5 VALVES INSTALLED BETWEEN FLANGES

The ends of "Wafer" type check valves shall comply with API 594 and the ends of butterfly valves shall comply with API 609.

The contact faces of check valves and the contact faces of butterfly valves for which separate gaskets are specified shall receive the same finish machining as the contact faces of the flanges between which these valves will be installed. This flange finish facing is specified in the relevant piping material class.

Flangeless valves, which have no connections as part of the valve body and are simply bolted or clamped between the adjoining line flanges, shall not be used for “Process Control” and “Isolation” purpose on piping in flammable or toxic services.

Flangeless lugged through drilled wafer check valve in piping for flammable or toxic service with size DN 50 – DN 200 (NPS 2 – NPS 8) shall also be avoided when possible. If it is unavoidable, due to process concern with COMPANY approval, possible joint leakage and bolts shall be shielded and properly protected against fire at all scenario.

Dual plate check valves in piping for flammable or toxic service with size larger than DN 200 (NPS 8) shall be double flanged type.

7.6.3 VALVE BORE

Full opening valves (full bore valves) are defined by ISO 14313 shall comply with table 1 of ISO 14313. Beyond the limits of the table 1 of ISO 14313 the minimum valve bore is defined by agreement with the COMPANY.

Unless otherwise specified in the datasheet, minimum bore for the reduced-opening valves with a circular opening through the obturators shall be as specified below:-

- NPS 24 and below – with a minimum bore in accordance with ISO 14313
- Above NPS 24 – with a minimum bore up to three sizes below nominal sizes of the valve with bore according to table 1 of ISO 14313

Valve installed on piggable line shall have the same bore all through the valve, including the transition piece and the pup piece as far as applicable. The bore shall match the pipeline internal diameter.

Valve data sheet shall specify the inside diameter. Tolerance for the inside diameter of valve full bore including transition piece and pup piece shall be within 0.005 in (0.13 mm).

Reduced opening of valves designed to ISO 10423 shall not be less than nominal size of valve according to ISO 10423.

7.6.4 OTHER DIMENSIONS

All other dimensions, such as: thickness of bodies and bonnets, attachment bolting, stem diameters, etc., shall be in accordance with standards specific to each type or group of valves.

7.7 DETAILS OF FABRICATION

7.7.1 GENERAL

Back faces of flanges shall be machined flat either as spot facings at the nut positions or machined over the entire back flange area. The nut seating area shall not present an as cast or as forged surface for the nuts. In addition, the valve end connections shall be designed to allow heavy series nuts to be used, (ASME B18.2.2) for the piping connections allowing for at least two threads to protrude above the nut without contacting other valve body parts or

bolting. Valve flanged ends shall be integral with valve body forging or casting. Weld on flanges shall not be permitted.

7.7.2 FLANGES OF FLANGED VALVES

The main machining operations performed on the flanges shall be the following:

7.7.2.1 CONTACT FACE FINISHING

Contact faces shall undergo finish machining in accordance with MSS SP 6. The Table 10 hereafter summarises the main recommendations of this standard:

Table 10 - Flange Facing Requirements

Flange Facing	Finish	Average Roughness (Maximum Value)
Flat Face or Raised Face 1/16" (with flat gasket)	"Stock finish"	(See note 1)
Raised Face 1/16" (with spiral wound gasket) or Raised Face 1/4"	Smooth finish	250 AARH (6.3 μ)
RTJ (2)	Groove: very smooth	63 AARH (1.6 μ)

Notes:

(1) The "Stock Finish" facing is not defined in MSS SP-6. For Flat Face or Raised Face (stock finish) facing, the roughness average range is 6.3 to 12.5 μ (AARH = 250 to 500 micro inches). Pitch and depth of machining groove shall be per MSS SP-6, table 1. However, roughness in excess of 12.5 μ (AARH greater than 500 micro inches) is acceptable to a maximum of 50 μ, provided groove parameters per MSS SP-6 table 1 are maintained

(2) Minimum hardness of RTJ flange grooves and maximum hardness of ring joints

The minimum BRINELL hardness of grooves of RTJ flanges shall be:

- 110 for carbon steel flanges
- 150 for alloy steel flanges
- 150 for stainless steel flanges
- 230 for Inconel 625 flanges.

The maximum BRINELL hardness of ring joints shall be:

- 90 for ARMCO mild steel
- 130 for Alloy Steel (4.6% Cr - 0.5% Mo)
- 135 for Stainless Steel (TP304/ TP316/ TP317)
- 210 for Inconel 625.

7.7.2.2 DRILLING

Bolt holes shall be made by multiple-spindle drill presses, or with a CNC drilling machine. The relationship between the drilling parameters and the flange diameters shall comply with ASME B16.5 or ASME B16.47 (Series A). The flanges shall be spot-faced at the bolt holes in accordance with MSS SP-9. The holes shall not be centred on the vertical or horizontal axis of the flanges.

7.7.3 WELDING AND WELD REPAIRS

Tack welds or non-continuous welds intended to be temporary or permanent features between internal components are strictly forbidden.

Welding and weld repairs are not authorised on valves in H_2S service (Refer 10008-STD-6-PIP-016,PEGS-12060-MMA-002 for more details).

All welding must comply with the COMPANY Specification 10008-STD-6-FAB-001,PEGS-12060-FAB-001.

Where the material specification requires impact tests, a spare test coupon shall be cast with each heat of castings whatever the valve pressure class. This shall be used if requested by the COMPANY to establish impact values for weld metal and heat affected zone, for a weld repair procedure qualification.

Defective steel valve bodies and bonnets may be repaired by welding in accordance with the provisions of their respective material standards with additional requirements as stated below.

The welding procedures and qualification of the welders for these repairs shall be in accordance with ASTM A488 for steel and Nickel alloys castings. The weld repair qualification procedures for castings shall cover all weld repair work irrespective of the stage in production at which weld repairing is carried out.

When allowed, major weld repairs of castings shall only be undertaken with the written approval of the COMPANY. Major repairs are defined in ASTM A995 with specific requirements specified in ASTM A703 and ASTM A488. Major repairs shall be identified on a welding map for each individual valve.

Depth of cavity for any major repair shall not exceed one half of the nominal local wall thickness after machining. Exceeding that depth the casting shall be put in hold for further investigation by the COMPANY.

Through thickness repairs in casting are strictly prohibited, One repair of that kind shall lead to the rejection of all identical valve parts of the same source whatever the material specification and heat charges corresponding to that production.

Repairs by welding or by impregnation with a metallic or non-metallic substance shall not be authorised on cast-iron valve bodies and bonnets.

Low temperature carbon steel, low alloy steel, austenitic stainless steel and other valve castings alloys that have been subjected to weld repairs shall be subjected to the heat treatment after repairs. The heat treatment delivery conditions are defined by the applicable material standards unless otherwise specified.

For valves of welded or fabricated construction, including valves with welded-on flanges or welded-in nipples, welded with pup piece etc., all welding shall be performed using weld procedures and welders/welding operators qualified according to 10008-STD-6-FAB-001,PEGS-12060-FAB-001 (for piping valves) and 10008-STD-6-PLR-025,PEGS-0710-PLR-012 (for pipeline valves) as applicable.

Where such valves are offered, this shall be highlighted in the quotation and all welding procedures, including repair procedures, shall be submitted to COMPANY for review and approval.

7.7.4 CLEANING

Seats, wedges, disc and seat ring threads shall be cleaned just prior to assembly, to ensure they are free from any dirt, grease or oil film; however, light grease or oil is permitted to allow for the installation of O-ring seals. (This requirement supersedes the requirement for light machine oil allowed by API 600).

However such products shall not drive to any misinterpretation of the valve test result. Finding of any adverse product shall lead to the rejection of the whole lot of valves presented for inspection and possibly to the rejection of the complete supply.

Contact surface of seat to obturator shall be dry before starting the valve test.

7.8 INSPECTION AND TESTS

In addition to the requirements specified herein, all inspection and tests shall comply with COMPANY General Specification 10008-STD-6-INT-001,PEGS-12060-INT-001 and 10008-STD-6-GEN-005,PEGS-12060-ADM-006.

7.8.1 QUALITY CONTROL

The inspection and tests necessary to confirm that the products meet the requirements of the standards, specifications and of the Purchase Order shall be carried out in the Manufacturer's plant by competent and qualified personnel independent of the production department.

If the Manufacturer does not have the necessary means of examination, these tests shall be carried out by an agency and at a place approved by the COMPANY.

The Inspection Agency shall conduct inspections in the Manufacturer's plant so as to make sure of the proper execution of the order and of the quality examination. It shall also witness final shop acceptance.

All inspection activities shall be listed in a quality plan per the forms attached in Appendix 1. This quality plan shall be submitted to the COMPANY for approval.

Each valve shall be identified by a unique serial number and shall be traceable to heat numbers of various components used in the valve.

For each valve purchase order and in each related valve assembly plant, COMPANY reserve the right to have one valve out of fifty completely dismantled for verification of the valve conformity in terms of valve design, valve component material, sealing arrangement, etc. This requirement shall be extended to more valves if obvious changes or non-conformities are identified. The verification can be requested and performed at time of valve testing or even at the time of valve final inspection.

7.8.2 VISUAL EXAMINATION

All valves must be 100% visually inspected as per API 598 and MSS SP-55. The visual examination shall take place before the valve test.

Before starting any valve test, the following shall be verified on the valve as settled in the test bunker or on the test bench.

- The valve is identified by a unique serial number on the valve body by means of a low stressed die-stamp
- The valve body, body closures, bonnet or cover are identified by a code number referring to the heat number of each of those parts. These identification marks shall be visible on the valve as assembled for testing
- Inlet and outlet hoses or tubing sections connecting the valve, the actuator and power sources are secured.
- The conditions of inlet and outlet connections to the valve
- Calibration and conditions of flowmeters, the connecting tubing or plastic hoses and all associated pressure gauges

During the valve Factory Acceptance Test, the COMPANY or its representative shall have free access to the valve in the bunker or on the test bench before and after each individual step of the valve test sequence, regardless of any remote monitoring system used to follow the test performance.

COMPANY representative shall be invited to attend any valve disassembly that will follow a valve test failure.

PTFE or any plastic material shall not be used on threaded connections during valve testing including on valve vent and drain plug connections.

7.8.3 PRESSURE TESTS

7.8.3.1 GENERAL

All valves (i.e., 100% of the supply) shall undergo pressure tests in accordance with the requirements of ISO 14313 and API 598 whichever is more stringent unless otherwise specified herein. ("Spot Testing" is not acceptable). Valves not covered by these standards shall be tested in accordance with MSS SP 61.

The Manufacturer shall submit for the COMPANY's approval its detailed testing procedure for each type of valves, including each pressure class and size. This procedure must be in full accordance with the present specification requirements and the applicable codes.

All valves in flammable fluids or toxic fluids require high pressure gas closure testing. The requirement applies to all types of valves including gate, globe, plug, check and butterfly valves as far as applicable.

For services other than the here above mentioned ones, high pressure gas closure test of gate, globe, plug check and butterfly valves shall be performed if specifically required by the valve data sheets.

Optional tests that are described in table 1, or table 2 of API 598 become mandatory irrespective of valve size and valve pressure class.

Back seat test of gate and globe valves used in gas service shall be performed with nitrogen at 110% of the pressure rating of the valve.

Test of actuated valves shall include the test of valves fully equipped with their own actuators and control panels. Testing with some template is not accepted.

Test of actuated valves shall be performed with the valve installed in the same position as it will be when installed in-situ. The in-situ valve position is defined by the valve data sheet.

When the valve is installed in the vertical position a trial fit of the actuator shall be organized at the manufacturer premises as to verify the actual connection of the actuator to the valve using the only lifting aids, lugs or others with which the valve and/ or the actuator are equipped by design.

Operation of the actuator shall be smooth at all times along the full stroke. Any kind of unexpected actuator movement during the valve stroke test shall be identified and reported.

For valves equipped with gear boxes, at least one gear box of each type of the requisition shall be verified by testing for the actual mechanical advantage. One identical gearbox, different from that one, may then be used as template to test each valve of the same design and the same size/ rating equipped with the same model of actuator.

All small valves designed to class 800 shall be considered as equivalent to valves of the same size in pressure class 600 for extent of testing and acceptance criteria.

Vertical multi-head test benches are restricted to manually operated valve in nominal size limited to NPS 4 and pressure class 600 maximum. Performance of such test bench is subject to evaluation and verification by the COMPANY anytime during testing.

Test of plugs, sealant injection accessories shall be as follows:

Seal weld of NPT threaded plugs and sealant accessories are tested by non-destructive examination, DPI or MPI, and air test.

Removable plugs and removable sealant injection accessories and associated check valves shall be tested when these ancillaries are installed on the valve. They shall be tight to gas at 110% of valve design pressure.

Specific tests required for valves in service classes C, D and subsea valves are not addressed by this specification.

7.8.3.2 TEST MEDIUM

a) Water tests

Testing medium shall be clean, inhibited, fresh water. Stainless steel valves shall be tested using inhibited fresh water having a maximum chloride content of 15 ppm. This also applies to valves fabricated with some parts made of stainless steel. The temperature of the test must be a minimum of +10°C. In case of non-impact tested body materials, the minimum temperature of the test medium shall be +16°C.

After testing with water, all valves shall be thoroughly dried to prevent possible corrosion from the water.

b) Gas tests

Gas tests shall be monitored using soap bubble method where zero leaks are either expected or requested. Where leak rates other than zero are specified, the leakage rate shall be measured using a flow meter calibrated with the gas used for testing.

7.8.3.3 ACCEPTANCE CRITERIA

Leakage rate related to the seat high pressure closure is based on the valve bore size, not on the nominal size.

High-pressure hydrostatic seat test leakage rates shall comply with ISO 14313.

The following criteria apply to gas tests only (including air, nitrogen, etc.):

- External leakage (maximum allowable leak rate from each source): 5 SCF/annum (0.27 SCC/min.)
- Seat leakage: according to the Table 11 hereafter.

Table 11 - Leakage Rates Acceptance Criteria for Closure Tests with Gas

(all values are in SCC/cm dia./min.)

Testing at Ambient Temperature			
		Low pressure tests (all valve nominal sizes)	**High pressure tests (all bore sizes)**
Soft seals	Valve pressure class ≤ 600	0 leakage	0.5
	Valve pressure class ≥ 900		1
Metallic seals	Valve pressure class ≤ 600		2
	Valve pressure class ≥900		4

Low Temperature: Cryogenic Tests (per 10008-STD-6-PIP-013,PEGS-12059-PIP-025)			
		Low pressure tests (all valve nominal sizes)	**High pressure tests (all boresizes)**
Soft Seals	Valve pressure class ≤ 600	60	60
	Valve pressure class ≥ 900	120	120
Metallic seals	Valve pressure class ≤ 600	120	180

	Valve pressure class ≥ 900	180	360

7.8.3.4 SPECIFIC REQUIREMENTS FOR BALL VALVES

a) All tests must comply with the procedure shown on Appendix 7. The testing certificate form to be used shall conform to the sample attached to Appendix 7.

b) Trunnion mounted ball valve tests shall include testing of the seat relief design effectiveness.

This test shall be made on at least one or 20% of manual valves of each size and pressure class, selected at random by the Inspection Agency. In case of failure, 50% of other valves of the same lot shall be tested. The extent of testing shall then be increased to 100% in case of two other failures.

The seat relief test shall be made on 100% of the actuated valves.

For the purpose of this test, nitrogen gas pressure shall be introduced in the valve body cavity, whilst both valve ends are to the atmospheric pressure. It must be verified that seat release occurs at a maximum pressure of 10% of the valve rating pressure (except for 150#: 8 bar, 300#: 10 bar and 600#: 15 bar).

c) Valves of sizes and pressure class according to the Table 12 hereafter, shall be pressure-tested with full end thrust effect. For this purpose, flanged-end valves shall be tested using end flanges (i.e., with blind flanges), and welded-ends valves shall be tested using temporary caps.

Table 12 - Size and Pressure Class Relationship for Test Requirements of Ball Valves with Full End Thrust

Pressure class	Minimum valve nominal size (inches)
150	Not required
300	24 (1)
600	16 (1)
900	16 (1)
1500	12
2500	12
API 6A 5000, 10000 and above	All sizes

Notes:

Up to 900# rating and for valves of nominal size up to 28", thrust effect may be evaluated on only one valve of each type (a type shall be understood as same valve design, same NPS, same rating and same part list - metallic and non-metallic - for each purchase order).

d) All valves ended with hub connectors shall be tested with full end thrust effect by means of mating blind hub connectors whatever the pressure class.

e) All ball valves shall pass an additional high pressure closure test according to the procedure described in API 598:

- For valves of service classes B, C, D and E, this high-pressure closure test must be done with nitrogen gas
- For valves of service class A, high pressure closure test shall be done with water.
- Subject to COMPANY approval, high pressure closure test of manually operated service class B ball valves to be used in liquid service, (excluding any multiphase service) may be done with water. These valves shall be subsequently marked and identified as being high pressure closure tested with water so as to prevent them from being used in a gas service.

7.8.4 HARDNESS TESTS

Hardness test shall be carried out on the valve pressure containing components for sour service application and hardness values shall be in accordance with 10008-STD-6-PIP-016,PEGS-0710-MMA-002.

7.8.5 NON-DESTRUCTIVE EXAMINATIONS (NDE)

Unless specified otherwise, NDE shall be carried out after completion of all repair works (if any) and heat treatment.

Magnetic Particle and Liquid Penetrant examination of pressure containing or pressure controlling parts shall be performed in their finished form (i.e. after completion of heat treatment and machining operation)

Non-destructive examination shall be conducted as per following:

- All valves shall be subjected to visual examination on the entire, visible internal and external surface area of the valve component. The acceptance criteria for visual examination of forgings shall be in accordance with applicable ASTM standard while acceptance criteria for visual examination of castings shall be in accordance with MSS-SP-55.
- Extent of NDT for valves shall be as per below table

Table 13 - Non-Destructive Examination Requirement with regard to Valve Size and Class

Valve Pressure Class	Valve Diameter (NPS)	NDT Requirements[1,2]
150#	≤6”	5% MPI or DP
	>6”	5% RT or UT and MPI or DP
300#	<6”	10% MPI or DP
	6”-14”	10% RT or UT and MPI or DP
	>14”	20% RT or UT and MPI or DP
600# 800#	<6”	20% MPI or DP
	6”-14”	20% RT or UT and MPI or DP
	>14”	100% RT or UT and MPI or DP
900#	<6”	100% MPI or DP
	≥6”	100% RT or UT and MPI or DP

Valve Pressure Class	Valve Diameter (NPS)	NDT Requirements[1,2]
1500#	≤4”	100% MPI or DP
	>4”	100% RT or UT and MPI or DP
2500# API 5000# API 10000#	≤2”	100% MPI or DP
	>2”	100% RT or UT and MPI or DP

Notes:

(1) Radiographic testing (RT) or Ultrasonic testing (UT) is applicable for pressure containing parts such as body, bonnet, cover, closure etc

Radiographic examination shall be performed for castings, however ultrasonic examination may be substituted for castings provided the surface finish permits the full examination of the part and manufacturer demonstrates that ultrasonic examination produces interpretable results Ultrasonic examination (UT) shall be performed for forgings, bars, plates and tubular products.

(2) For ferrous materials, magnetic particle (MP) examination shall be used in preference to dye penetrant (DP) examination. MP or DP shall be applicable for pressure containing parts, seats, stem and obturators.

- Non-destructive examination for valve components as per Table 13 above shall be performed in accordance with Section 8 of ASME B16.34 (Requirements for special class valves).
- The extent of radiographic examination of cast components shall also include location of abrupt change in geometry or thickness, location of risers, gates and feeders.
- In case of random NDT, selection of the components for NDT shall be based on lot comprising valves of same material, size and component manufacturing plant for each purchase order.
- In case of butt-weld end valves, bevelled ends shall be subjected to MP or DP examination in accordance with ASME Section V to ensure that area is free of any defects / linear indications.
- All butt welds in valves (including girth welds between valve and transition piece/pup piece or between transition piece and pup piece) shall be subjected to 100% radiographic and ultrasonic examination in accordance with ASME Section V with acceptance criteria conforming to ASME Section VIII Division 1.
- For weld overlays, all weld overlaid surfaces shall be 100% inspected by dye penetrant inspection. Linear defects or pin holes are not acceptable.
- Any seal welds or attachment welds on pressure containing parts shall be 100% examined by dye penetrant testing in accordance with ASME Section V with acceptance criteria stated in ASME Section VIII Division 1.

7.9 ACCEPTANCE

All valves shall be 100% tested by the Manufacturer in his shop and under his responsibility.

Factory Acceptance Test (FAT) of valves shall be notified by the Manufacturer only after successful internal (in-house) testing. The internal test reports shall be made available to the Inspection Agency prior to any further consideration for the related Notice of Inspection (NOI).

FAT of actuated valves shall be performed after assembly of the valve with its own gear box, actuator and control panel. Exception may be given to hydrostatic shell test and torque test which may be performed prior to installation of the actuator. Actuator and local control panel shall be tested at their manufactures premises prior to valve testing and complete test records including the values of the actuator output torques shall be available prior to starting the valve FAT.

The torque table, see Appendix 11, shall be fulfilled with the values recorded during the FAT of the actuated valve. This document shall be part of the manufacturer final documentation.

At the time of FAT or prior to FAT, all material test certificates, non-destructive examination reports, hardness test reports, AED reports, ENP coating reports shall be presented to the inspection agency for review. During FAT, inspector shall at least check the following:-

- Pressure tests
- Tightness tests
- Functional tests
- Dimensional check
- Visual inspection
- Valve marking / identification.
- Trim alignment and gear box or actuator end stop positions
- Internal cleaning
- Coating
- End protection and valve preservation

Any evidence of grit or sand blasting particles found inside the valve will require the valve to be stripped down, inspected and re-tested.

Inspection Agency shall not release the valve unless all above inspections has been satisfactorily completed. Inspection Agency shall issue release note upon satisfactory completion of all inspection stages as above.

7.9.1 EXTENT OF THE INSPECTION AGENCY INSPECTION AND WITNESSING

Each actuated valve shall be individually fully tested for mechanical, leakage and functional tests under witness of Inspection Agency.

The extent of witness inspection (FAT) by Inspection Agency for the manual valves shall be as follows:

Table 14 - Extent of the Inspection Agency Inspection and Testing for Manual Valves

Valve Nominal Size	Valve Type				
	All valve types and all valve service classes In pressure class ≥ API 10000	Gate, Globe, and Check valves	Ball valves		
			Valves Service Class E	Valves Service Class A, B, C, D	
		Valve pressure class as per ASME B16.34 or to API 5000			
		All pressure classes	All pressure classes	Pressure classes ≤ 600	Pressure classes > 600
≤ 1 ½"	100%	10%	100%	10%	10%
2" to 10"	100%	25%	100%	25%	50%
≥ 12"	100%	100%	100%	100%	100%

Notes:

(1) All small valves designed to class 800 are considered as equivalent to pressure class 600 for the extent of testing.

(2) The selection of valves to be tested shall be made by the inspector of the Inspection Agency and not by the Manufacturer. Higher inspection/witnessing rates may be requested for specific cases or upon failure in testing of the selected valves.

7.9.2 TEST FAILURE, RE-WORK, RE-TEST

In the event a valve test fails, the Manufacturer is permitted to reoffer the valve for inspection only once, and only after it has been properly re-worked and the reasons for failure has thoroughly been examined and explained by the Manufacturer to the Inspection Agency (who must report them). Should a given valve fail to pass a test for the second time, it shall be rejected and replaced by a new one.

7.9.3 TEST FAILURE ON SPOT CHECKS

For valve sizes which undergo Inspection Agency spot checks, the extent of sampling shall be increased by steps of at least 10% of the total valves number subject to spot checks, up to 100%, for each test failure. This increased sampling area shall first be related to valves of the same type and size as those having failed, and then, to larger sizes of the same type from the same manufacture.

7.10 DOCUMENTATION

7.10.1 CERTIFICATES OF CONFORMITY

The Manufacturer shall submit a certificate of conformity with the standards specified in the Purchase Order documents.

7.10.2 MATERIALS CERTIFICATES

For each valve, valve manufacturer shall provide inspection certificate demonstrating that it complies with all requirements of purchase specifications, applicable code and standards. Valve certificate shall summarize the materials of various parts along with corresponding heat number and shall also include the details of test conducted. Material test certificate for valve parts shall be issued by part manufacturer and shall be attached with valve certificate.

Test certificates shall be in accordance with EN 10204 and requirements of certification for various valve components shall be as per below table.

Table 15 - Type of Material Certificate Required for Each Valve Part

Nature Of Valve Part	Type of Certificate (Based on Valve Service Class)	
	Valve Service Class A	Valve Service Class B, C, D, E
Body	3.1	3.1
Flanges	3.1	3.1
Bonnet	3.1	3.1
Obturator	2.2	3.1
Stems	2.2	3.1
Bolting	2.2	2.2
Seats	2.2	2.2
Seals (1)	2.1	2.1

Notes:

(1) AED testing certification according to Appendix 8 shall be 3.1 type. Specific ED test may be required when the valve manufacturer cannot show evidence of its direct supply from the seal manufacturer or when lot identification cannot be established.

7.10.3 PRESSURE TEST CERTIFICATES

The Manufacturer shall submit a certificate of the pressure tests carried out on each valve in accordance with the codes and standards.

For ball valves, the form to be used is shown on Appendix 7. Test certificates must be supplied for each valve of the supply.

A test certificate refers to one valve or one integral bolted manifold only.

Valves and test certificates shall be traceable anytime during manufacturing through the production record system.

The valve test certificate shall include the table of Appendix 11 as fulfilled with the actual valve torque values and actual actuator output torque values.

7.10.4 OTHER TESTS CERTIFICATES

The Manufacturer shall submit all other test certificates showing results of tests as required in the present specification and appendices, for each valve.

7.10.5 TECHNICAL MANUAL

The Manufacturer shall submit a detailed and dimensioned drawing of each valve, with a list specifying the technical characteristics, the references of the parts, and the materials used (including material grades for all parts). He shall also submit a detailed operation and maintenance manual explaining:

- Understanding the functioning of the valve
- Operating the valve
- Maintenance and other work.

7.11 PREPARATION FOR SHIPMENT

7.11.1 MARKING

7.11.1.1 VALVE TAGGING

All valves shall be tagged by the Manufacturer with the Tag Number as stated on the requisition prefixed by the valve nominal size. This shall be clearly stamped on corrosion resistant metal tag permanently attached to the valve.

7.11.1.2 IDENTIFICATION OF MATERIALS AND MAIN CHARACTERISTICS

Marking on body and nameplate shall comply with table 12 of ISO 14313 or ISO 10423 and shall also include:

- The valve service class letter (i.e., A, B, C, D, or E)
- CRA overlay on dynamic seal pockets (if any)
- The high pressure gas closure test.

Soft seal valves shall be clearly marked by the Manufacturer with the soft seal material and maximum working temperature.

The marking shall remain legible for six months from the manufacturing plant ex-works as a minimum.

7.11.1.3 COLOUR CODING

If required, all valves shall be identified by an appropriate colour coding system specified in the order.

7.11.2 PROTECTION OF ENDS

All valve ends must be blanked off by wooden, metal or plastic plugs.

The threads of threaded valves shall be oiled or protected by a non-peel varnish.

The bevelled ends of valves with butt-welding ends and the contact faces of end flanges shall be protected by a peel-off varnish.

7.11.3 PAINTING

When paint is required for protection of the valve, it shall be applied only after all tests and examinations have been carried out by the Inspection Agency.

The interior surfaces, the threaded parts, the bevelled or socket-welding ends, the flange contact faces, and the various valve-identifying markings shall not be painted.

7.11.3.1 CARBON STEEL VALVES

The coating applied shall be as per 10008-STD-6-COR-010,PEGS-0842-COR-010 or 10008-STD-6-COR-011,PEGS-0842-COR-011.

7.11.3.2 AUSTENITIC STAINLESS STEEL VALVES

All stainless steel valves shall be protected against the risks of saline corrosion during cleaning, transport, fabrication, testing and/or storage.

The coating applied shall be as per 10008-STD-6-COR-010,PEGS-0842-COR-010 or 10008-STD-6-COR-011,PEGS-0842-COR-011.

7.11.3.3 NON-FERROUS VALVES

Non-ferrous (i.e. bronze and gunmetal) valves shall not be painted.

7.11.4 PREPARATION

The valves shall be closed for shipment, except for ball valves that shall be shipped in the fully open position. Specific protection shall apply as to avoid any damage to metal seated valves when shipped in closed position. Valve end protections do not suffice for that purpose. Gate and globe valves with soft seals shall have the wedge/disc backed off to relieve the pressure on the seals.

7.11.5 PACKING

The valves must be packed in sea packing, waterproof. Packing must be suitable for all stages of transport (rail, road, air, etc.).

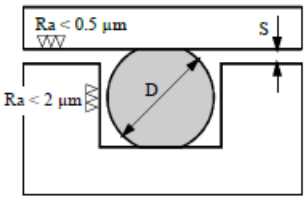
8.0 APPENDICES

Appendix 1. Minimum Requirements for Inspection & Test Plan (ITP)

Activity	Applicable procedures / specifications	Inspection involvement			Verifying Document	Notes
		Manufacturer	Inspection Agency	COMPANY		
1) Material properties Mechanical and chemical properties of body, closures, ball, seats, stem, trunnion, bolting and seals	ASTM Materials standards 10008-STD-6-PIP-012	H	R	R	Material certificate	
2) Visual and dimensional inspection 100% Rough Material 100% Machined components (including flange facings)	ISO 14313 ASME B16.5 ASME B16.10 ASME B16.34 MSS-SP-55 ASTM Material Standard	H	R	R	Report	
3) N.D.T Radiographic or Ultrasonic examination as applicable M.P.I. or DP as applicable	ASME B16.34 ASTM Sec V ASME Sec VIII Div 1	H	W/R	R	NDT Report	
4) Hardness test 100% on RTJ Groove flanges facing and gaskets	10008-STD-6-PIP-012	H	R	R	Hardness test report	
5) Electrodes nickel plating Thickness measurement Hardness checking Alloy composition Porosity Corrosion resistance Adhesion check	ASTM B 733 PEGS-12059-PIP-006 (Appendix 3)	H	R	R	ENP test report (Type 3.1)	
6) Weld overlays	10008-STD-6-PIP-012	H	R	R	Test report	
7) Tungsten carbide coatings	10008-STD-6-PIP-012 (Appendix 4)	H	R	R	Test report (Type 3.1)	
8) AED tests on “O-rings”	PEGS-12059-PIP-006	H	R	R	Test report (Type 3.1)	
9) Tests on assembled valve Pressure test Seat tests Torque test Functional test Seat relief test Cryogenic test (as applicable)	10008-STD-6-PIP-012 10008-STD-6-INS-011 10008-STD-6-PIP-013,	H	H	W	Test reports	
10) Painting Surface Preparation Dust level check Salt contamination check MEK rub test Correct paint system application WFT and DFT check Adhesion check	Project requirements 10008-STD-6-COR-010 10008-STD-6-COR-011,	H	W/R	R	Painting report	
11) Tagging, marking and final inspection	ISO 14313 Project requirements 10008-STD-6-PIP-012	H	R	R		
12) Fire safe certification	ISO 10497 or API Spec 6FA or API 607	H	R	R	Fire safe certificate	
13) Inspection Release Note issue		H	H	R	Release note	
R: Review of documentation W: Witness - To be notified H: Hold -Production stop	Signatures:				Date:	

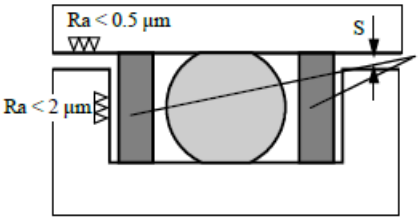
Appendix 2. Non Metallic Seals

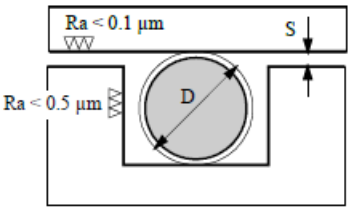
1) Elastomer Seals

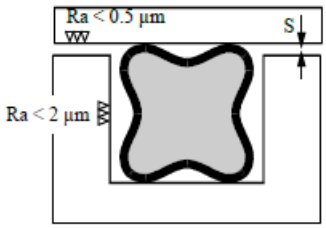
Material	θ range (°C)	"O"-rings	Pressure range (barg)	Hardness (Shore A)	Gap S (mm) D ≥ 5 mm
Nitril Rubber Hydrogenated Nitril VITON ® GLT CHEMRAZ ® 526 Silicone (70 Shore)	0 to +80 -40 to +150 -30 to +180 -20 to +220 -60 to +220		P < 150 150 ≤ P ≤ 200 P > 200	≥ 70 ≥ 75 ≥ 85	≤ 0.1 ≤ 0.07 ≤ 0.05

General Tolerance ISO H7-G6

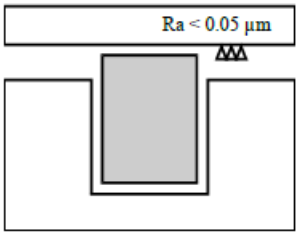
For gas hydrocarbons, O-rings must be certified resistant to explosive decompression

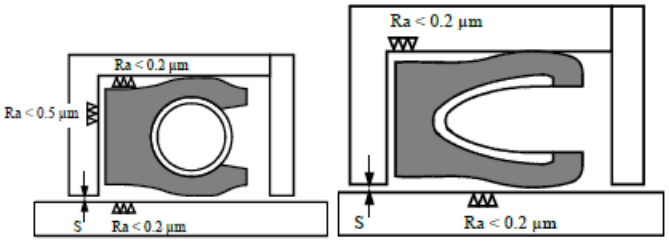
Material	Anti extrusion rings
PTFE + graphite (10 to 25%) Thickness 2.5 mm Assembly standard US AS568 A Extrusion gap S < 0.1 mm	 The groove filling shall never be less than70% and the initial compression set not less than 13% for any o-ring in dynamic situations, and those values shall always be significantly higher for static seal ring situations. The diameter of the o-ring shall always exceed the height of the aside back-up rings when parts are free in their groove, not compressed yet. For pressure classes 900 and over, 2 anti-extrusion rings must be installed, one each side of the elastomer "O"-rings. The requirement applies to each static or dynamic o-ring regardless the location and function in the valve assembly. These anti-extrusion rings may be split or not, depending on diameter and supplier.

Sheath Material	Body Material	θ range (°C)	Encapsulated "O"-rings (use of those products requires specific approval by Company)
FEP	Viton® Silicon	-40 to +140 -60 to +140	 Sheath thickness ≥ 0.5 mm and < 1.5 mm Extrusion gap S < 0.1 mm When "O"-Ring diameter is less than 25 D, groove shall be made in two parts for assembly
PFA	Viton® Silicon	-40 to +200 -60 to +200	

Quad rings (use of those products requires specific approval by Company)	
• Material and temperature range as for "O"-Rings • Pressure/Hardness as for "O"-Rings	 Extrusion gap S < 0.07 For high pressures (P > 200 barg) or high temperatures (θ > 100°C), anti-extrusion rings shall be used

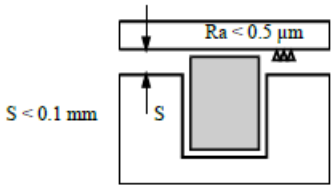
2) Thermoplastic seals

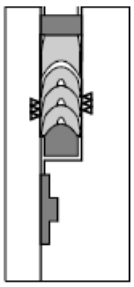
Material	θ range (°C)	Insert seals
PTFE + graphite (10 to 25%)	-80 to +200	 Material compressive strength at 23°C: $\sigma_c \geq 30$ N/mm²
KEL F ®	-150 to +100	
TURCITE ® 243	-200 to +250	
NYLON 12 ®	-20 to +100	
PEEK ®	-80 to +160	
VESPEL ® SP 21	-200 to +260	

Material	θ range (°C)	Lip seals (use of those products requires specific approval by Company)
PTFE (virgin)	-80 to +200	
PTFE + 25% graphite	-150 to +200	
PTFE +15% fibreglass +5% M_oS_2	-150 to +250	
TURCITE ® 243	-200 to +250	
VESPEL ® SP 21	-200 to +260	
PFA ®	-80 to +200	

Material flexural yield strength at 23°C: $\sigma_f \geq 100$ N/mm²

Extrusion gap S < 0.1 - Spring materials to be Nickel based alloys suitable for the operating conditions

Material	θ range (°C)	Fire safe back-up seals	Maximum pressure (barg)	Density (g/cm³)
Graphite + ash (small content) + corrosion inhibitor	-240 to +550	 The height of the fire safe barrier shall always exceed the groove depth.	150 200 350 > 350	> 1.6 > 1.7 > 1.8 > 2 to 2.2

Material	θ range (°C)	U or V shaped packing: ▭ Bearing guide and anti extrusion ring: ▬
Packing material:		 **Packing:** Ra < 0.5 µmm Material flexural strength at 23°C: σ_f > 100 N/mm² **Bearing guide/ anti-extrusion ring:** Ra < 0.5 µmm Material compressive strength at 23°C: σ_c >30 N/mm² After reinforcement fiberglass σ_c > 250 N/mm² Friction factor < 0.1
PTFE + graphite 10%	-200 to +200	
PEEK ®	-80 to +160	
PFA ®	-80 to +200	
Bearing guide and anti extrusion ring:		
PTFE + fiberglass 15% +10% M_o S_2	-200 to +240	
PEEK ® +graph. fiber 10%	-80 to +160	
VESPEL ® SP 21	-200 to +260	

Appendix 3. Electroless Nickel Plating Procedure

The coating facilities and the production flow systems shall be approved by the COMPANY prior to any supply.

1. Coating process

The ENP coatings shall be obtained by chemical reactions leading to a plating composed of 90% Nickel and 10% Phosphorus. This type of coating must comply with ASTM B733, with the following classification of this standard: SC4, Type V, Class 2, NiP 10 75 and with the following particular or additional requirements:

a) Surface preparation

The support surface shall be correctly prepared by abrasive blasting to SA 3. The roughness shall be:

- For round shape surfaces: Rt ≤ 2 µm and Ra ≤ 0.4 µm
- For other surfaces: Rt ≤ 60 µm and Ra ≤ 12.5 µm.

b) Diffusion heat treatment

The diffusion heat treatment specified in ASTM B733 after the ENP coating for class 2 shall be applied under a neutral atmosphere.

c) Additional testing

The coating hardness must be tested.

2. Testing

The following properties shall be tested in order to verify the quality of the deposits, and test certificates must be submitted to the COMPANY for approval:

2.1.Testing on samples (coupons)

The following testing shall be carried-out on one coupon for every batch or heat treatment:

a) Microhardness

The ENP hardness shall be checked according to ASTM B733. A minimum value of 850 HK100 shall be obtained.

b) Thickness

The ENP thickness shall be checked according to ASTM B733, paragraph 9.3.4 (micrometer method). No value below the specified thickness in Table 2, ASTM B733 shall be found.

c) Alloy composition

The ENP alloy composition shall be checked as specified in ASTM B733. The

Phosphorus content shall be within 9 and 11% in weight.

d) Porosity

The ENP porosity shall be checked as specified in ASTM B733, paragraph 9.6.1 (Ferroxyl test method).

e) Corrosion resistance

The ENP corrosion resistance shall be checked according to supplementary requirement S1.10 of ASTM B733.

2.2. Testing on components

The following testing shall be carried-out on components:

a) Appearance

The ENP appearance shall be checked as specified in ASTM B733, paragraph 7.2.1. Coating shall be smooth, adherent and free from visible blisters, pits, nodules, porosity and other defects. Slight discoloration resulting from heat treatment shall not be cause for rejection. 100% of the components shall be examined.

b) Adhesion

The ENP adhesion shall be checked according to ASTM B733, paragraph 9.4.2. The method used is based on impact test using a spring-loaded centre punch. No flaking or blistering shall be visible at a 10x magnification. Testing shall be made at random on components for each batch or heat treatment.

3. Material Certification and Traceability

All components shall be traceable for the details of the coating procedure, coating conditions and date of application.

The ENP coating applicator shall issue inspection certificates “Type 3.1” as per EN 10204 mentioning the results of all tests carried out as per Section 2 above. Each certificate shall identify the plant where the treatment is performed and the history of the process.

As a minimum a type 3.1 inspection certificate shall refer to a unique production batch identified by a serial number, the date of treatment, process main features and related production test records. Each certificate shall list the part serial numbers earlier defined by the valve manufacturer together with the material grades and the overall geometry of those parts. Part identifications and production batch serial number shall remain on parts all along the production flow till back to the receiving facilities at the valve manufacturer plant.

Appendix 4. Tungsten Carbide Coating Procedure

The coating facilities and the production flow systems shall be approved by the COMPANY prior to any supply.

1. Coating process

Coating process shall be HVOF (High Velocity Oxygen Fuel) process.

The coating of matching parts of each valve, i.e. seats and obturator, shall be performed by the same applicator using identified production lines.

Coating nominal composition shall be 86% WC - 10% Co - 4% Cr with density of 10.4 g/cm^3

2. Coating thickness

The thickness of the coating shall be minimum 400 µm after grinding and polishing.

3. Cleaning

The components shall be machined to achieve a surface roughness of 0.8 µm Ra. All edges shall be chamfered or radiused. Balls shall be spherical within 0.05 mm.

The components shall be cleaned for removal of oil by a cleaning agent (acetone or similar) before grit blasting.

The components may not be preheated before grit blasting or directly afterwards since clean dry air shall be used for the grit blasting operation.

4. Coating period

Small components shall be coated within four hours after grit blasting. Prior to start coating preheating of parts shall be carried out on large components or components whose thickness is a critical parameter such as balls. Humidity or condensation shall not be observed on the surface of the component when starting the coating process.

Large diameter components shall be supported firmly during the coating process as to minimize variations in thickness of coating around the clock.

5. Sealing

All coated surfaces, excluding parts used on pure oxygen service, shall be sealed after the spraying. The type of sealing shall be specified in the Manufacturer procedure. The sealing product shall be selected considering the valve operating temperature range.

6. After-coating treatment

All coated surfaces shall be ground and sealing area shall be polished or lapped.

The two seats shall be lapped with the corresponding ball surface to assure full tightness. Surface roughness shall be ≤ 0.10 µm Ra.

Surface Porosity Test: 100% of sealing area to be dye penetrant (DPI) examined. No visible defects are acceptable.

In case of final adaptation works being performed at valve manufacturer premises, first assembly or rework, a new DPI inspection shall be performed on all parts prior to the valve assembly

7. Coating Procedure Qualification testing

Coating procedure qualification shall be performed for qualifying the coating process used for the production coating of any of the valve components.

For same application plant, coating procedure shall be re-qualified whenever at least following essential variable are changed.

- HVOF equipment
- Powder grade
- Powder manufacturer
- Spray distance and Spray rate – Variation of more than 5%
- Fuel and gas flow rate - Variation of more than 5%

The base material used for testing shall be the same material as the one to be coated, i.e. a qualification run on carbon steel is not accepted for the application on stainless steel or any other corrosion resistant alloy.

The thickness of coating on all test samples shall not be less than 400 microns.

A specific qualification shall also be required in case of application of the tungsten carbide coating over a weld overlay made of stainless steel or Inconel 625 or Incoloy 825.

Following qualification tests shall be conducted on procedure qualification test coupon. The details of the below tests refers to the application on a carbon steel or stainless steel base material. The application over other material will require specific testing.

7.1. Bend test

A plate sample (approximate dimensions of 100 x 20 x 1.5 mm) shall be coated. The sample shall then be bent to 90° over a mandrel of 15 mm diameter.

Acceptance Criteria:- Cracking is acceptable but there shall be no peeling.

7.2. Bonding test

A test bar of 25 mm diameter shall be tungsten carbide coated and stuck to another bar having the same diameter as shown on the sketch hereafter. The whole sample shall then be submitted to a tensile test until complete separation of the two parts. The breaking shall occur on the glued side of the stuck bar. The applied stress shall be reported.

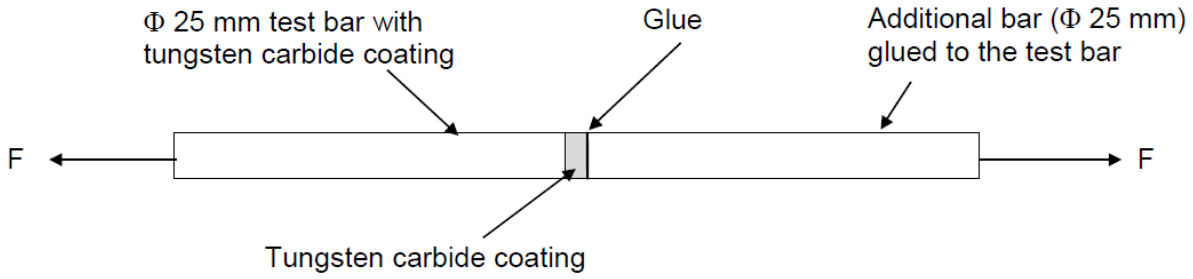


Figure 3 - Bonding test assembly

Acceptance criteria:-The test is accepted if the tensile force is greater than 10,000 psi and the break location shall be on the glue side.

7.3. Hardness

Hardness test shall be performed on a cross section for metallographic examination.

Acceptance criteria: - The hardness shall be minimum 1050 HV.

7.4. Porosity

Porosity test shall be performed on a cross section for metallographic examination.

Acceptance criteria:- The porosity shall be less than 1% by area.

8. Production testing

Following tests shall be conducted on production coating

8.1. Bend Test

One set of bend test specimen shall be coated with a seat and an obturator for each supply, for each one production week and for each batch of powder. Acceptance criteria shall be as specified in Section 7.1

8.2. Surface Porosity Test

100% of sealing area shall be examined with dye penetrant test in accordance with ASME Section V. No visible defects are acceptable.

8.3. Visual Examination

All the coated surfaces shall be 100% visually examined and shall be free of any surface defects.

8.4. Dimension

Coating thickness shall be measured on each component and shall not be less than 400 microns.

8.4. Hardness test

Hardness test shall be conducted for each 24hours production period, for each type of material and for each batch of powder. Acceptance criteria shall be as specified in Section 7.3.

9. Documentation

Following documentation shall be furnished for each supply

- Coating qualification test reports as per Section 7
- Coating test certificate to EN 10204 “Type 3.1” mentioning all tests as per Section 8

10. Material Traceability

All components shall be traceable for the details of the coating procedure, coating conditions and date of application.

The tungsten carbide coating applicator shall issue inspection certificates “type 3.1” certificates. Each certificate shall identify the plant where the treatment is performed and the history of the process.

- As a minimum a type 3.1 inspection certificate shall refer to a unique production batch identified by a serial number, the date of treatment, process main features and related production test records. Each certificate shall list the part serial numbers earlier defined by the valve manufacturer together with the material grades and the overall geometry of those parts. Part identifications and production batch serial number shall remain on parts all along the production flow till back to the receiving facilities at the valve manufacturer plant. A production batch is also limited to the parts coated with the same batch of powder and coated using the same HVOF equipment.
- Type 3.1 certificates of the powder shall also be available for review by the COMPANY before supply release.

Appendix 5. Inconel 625 or SS TP 316L – Weld Overlay Procedure for Seal Pockets and Seal Contact Surface on Obturators

1. Scope

This addendum covers requirements for weld overlay of Inconel 625 or stainless steel on steel or alloy substrate material of valve parts for corrosion protection purpose. It applies to sealing areas of valves exclusively.

This appendix does not apply to weld overlays of large valve surfaces such as internal surface of bodies, for which the COMPANY specification 10008-STD-6-FAB-001,PEGS-12060-FAB-001 remains however applicable.

2. Weld overlay requirements

2.1. Service conditions

a) Weld overlay shall provide corrosion protection on specified sealing areas of valves

b) Welded surfaces are in contact with the corrosive fluid

c) No surface defects are allowed on sealing surfaces.

2.2. Weld overlay description

a) Weld overlay shall be in accordance with ASME IX (Corrosion protection - Weld Metal Overlay)

b) Overlay thickness shall be sufficient in order to obtain a minimum of 3 mm thick protective layer in the final machined condition.

c) Areas to be welded and dimensional tolerances shall be shown on detailed drawings (overlay thickness included).

d) Maximum allowable hardness at any location on welded surface after final machining operation shall be less than 22 HRC for 316L and 35 HRC for Inconel 625 (NACE MR0175).

e) Dilution on welded surface shall not exceed 10% of base metal.

f) Heat Affected Zone (HAZ) thickness shall be minimised.

g) Overlay shall be performed in a minimum of two layers.

h) Welded surfaces are sealing areas in which any defect shall not be accepted.

3. Fabrication

3.1. General requirements

Automatic process with computerised monitoring system for the equipment positioning, equipment rotation and welding parameters shall be preferred.

SMAW and ESW processes are not allowed for the weld overlay on seal pocket or any sealing contact surface of obturators.

Welding procedure qualification shall be performed in accordance with ASME Section IX. Welding procedure qualification can also be performed in accordance with ISO 15614-7 subjected to COMPANY approval.

Welding qualification shall be performed using the same equipment as the one used for the production.

3.2. Welding consumables

Welding consumables used for fabrication shall conform to the description shown in the relevant WPS. A test certificate shall be provided for each lot used.

3.3. Welders qualification

Only qualified welders shall carry out production welding. Qualification shall be carried out in accordance with ASME Section IX.

3.4. Fabrication procedures

No fabrication shall start until the welding procedures are approved. These procedures shall cover at least the following:

- Storage, drying and handling of consumables
- Cleaning of base metal surfaces to be welded
- Welding method with operating mode and parameter description. The welding sequence shall minimise ‘stops and starts’.

The welding procedure qualification record (PQR) shall be documented and submitted together with the relevant WPS for approval by the COMPANY. Welding parameters, heat input, gas composition, gas flow etc. shall be recorded for each layer.

3.5. Defect removal and repair

a) Defects in excess of acceptance standard shall be removed by reducing weld overlay thickness and shall be repaired by re-welding.

b) All excavations shall be dye penetrant inspected prior to the start of repair welding in order to confirm the complete removal of defects.

c) Repair by re-welding shall be performed in accordance with a written procedure. The following information must be given in these procedures:

- Method of removing defects
- Requirements related to the shape of the excavation
- Inspection of repair prior to re-welding
- Applicable welding procedure and qualification tests
- Inspection after welding.

4. Qualification tests and acceptance criteria

4.1. Qualification test ring

Qualification test coupon shall be of the same material and grade as the production base material.

The qualification shall be run on a NPS 6 forged or cast ring with a seal pocket machined on its inside and its outside surface. The dimensions of the ring will be not less than 150x40 mm. The size of the two seal pockets will be 5x40 mm as finished after weld overlay machining.

The following examination shall be performed after weld overlay on the coupon:

a) Dimensional verification: Overlay thickness and conformity of dimensional tolerances (any change in dimensions after welding).

b) Visual inspection: Method as per MSS SP-55. No defects are allowed.

c) Dye penetrant inspection: Overlay shall be dye penetrant examined according to ASME VIII division 1, Appendix 8. No defects are allowed.

d) Chemical analysis: Spectrographic analysis of the weld metal surface shall be verified at the minimum overlay thickness as specified for finished components and also 1.0 mm below this finished surface. Chemical analysis results shall be within the nominal composition of the required type of overlay (i.e., SS TP316L or Inconel 625, as applicable).

e) Hardness testing: Testing shall include base material, Heat Affected Zone (HAZ) and weld metal. Three indentations minimum are required within each layer. The hardness survey shall be made at a maximum 0.5 mm distance between the indentations from the fusion line, through HAZ and into the unaffected base material. Hardness testing shall be the Vickers hardness test, 5 or 10 kg load.

f) Macrographic examination (x1.5): Three macro-sections specimens shall be extracted which shall be equally spaced around the circle. They shall be documented by coloured digital pictures attached to the test report.

g) Micrographic examination: The microstructure of the Heat Affected Zone (HAZ) shall be free of precipitations and intermetallic phases. The micro-examination of the etched specimens shall be performed at a magnification of x 400 and documented by photographs attached to the test report, which shall be submitted on request.

h) Bend test: Four guided side-bend test shall be performed in accordance with ASME Section IX.

4.2. Production weld overlay (100% extent of testing)

The following examination shall be performed after production weld overlay:

a) Dimensional verification: Overlay thickness to meet final machined condition requirement (as per drawings), and conformity of welded pieces.

b) Visual inspection: Method as per MSS SP-55. No inclusion, porosity, crack, slag, nor any visible defects are permitted.

c) Dye penetrant inspection: Dye penetrant examination shall be carried out on last layer in accordance with ASME Section VIII Div 1, Appendix 8 after any post-weld head treatment and final machining. No surface defects / indications are acceptable on sealing surfaces. If required, additional examination will be performed to ascertain the quality of the weld deposit underneath the machined surface. Any linear indication or rounded indications greater than 2.0 mm are not allowed. Any left embedded round defect shall be proven as not adverse to the sealing contact.

4.3. Documentation

The following document / reports shall be submitted for review:

- Welding procedures (WPS) and Procedure Qualification Records (PQR)
- Visual, Dimensional and Non-destructive examination reports for each overlay
- Welding consumable certificates.

Appendix 6. Stem Calculation Requirements

1. Scope

This addendum covers calculation requirements in order to determine the maximum allowable torque on a valve stem. Such calculation implies verification of all stem parts and attachments, whilst the following formula only relates to stem and stem key verification. The final maximum allowable value for stem torque shall be taken as the lowest result of all the related verifications, including the two calculations detailed hereafter.

2. Stem calculation

2.1. Von Mises formula

$$\sigma_e^2 = \sigma_t^2 + 3\sigma_c^2 \quad (1)$$

Where σ_t = tension stress (for instance, due to internal pressure)

σ_c = torsion stress

σ_e = equivalent stress.

2.2. Maximum equivalent stress

The maximum equivalent stress σe shall not exceed 90% of the nominal yield strength of the stem material: $\sigma_e \leq 0.90$ YS (where YS = the nominal yield strength of the stem material).

2.3. Maximum torsional stress

From the above, and taking into account a tension stress equal to zero (normal case), the following can be derived:

$$\sigma_c \leq \sqrt{\frac{(0.9YS)^2 - \sigma_t^2}{3}} \quad (2)$$

and since $\sigma_t = 0$ (normal case),

$$\sigma_c \leq \frac{0.9YS}{\sqrt{3}} \quad (3)$$

$$\boxed{\sigma_c \max = 0.52YS} \quad (4)$$

2.4. Maximum allowable torque for the stem

Section modulus of a round (solid) bar:

$$\frac{I_o}{v} = \frac{\pi D^3}{16} \quad (5)$$

(D = diameter of the bar, in mm)

Torsional stress of a round bar under a torsional torque:

$$\sigma_c = \frac{M_c}{(\frac{I_0}{v})} \times 1000 \quad (6)$$

With the following:

σ_c = torsion stress (N/mm²)

M_c = torsion torque (Nm)

$\frac{I_0}{v}$ = section modulus (mm³)

From equation (6), the torsional torque is given by:

$$M_c = \frac{\sigma_c (\frac{I_0}{v})}{1000} \quad (7)$$

or:

$$\boxed{M_c = \frac{\sigma_c \pi D^3}{16000}} \quad (8)$$

The maximum allowable torsion torque is derived from equations (4) and (8):

$$\boxed{M_c max = \frac{0.52 YS \pi .^3}{16000}} \quad (9)$$

3. Stem key calculation

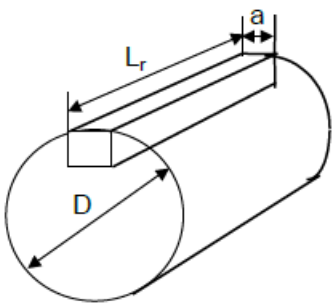
3.1. Force induced on the key by the torsional torque

$$F_{ck} = \frac{M_c}{r} \times 1000 \quad (10)$$

Where M_c = torsional torque (Nm)

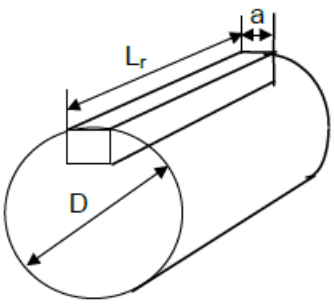
r = stem radius ($=\frac{D}{2}$) (mm)

F_{ck} = force induced on the key (N)



3.2. Shear stress induced in the key by the torsional torque

$$\sigma_{ck} = \frac{F_{ck}}{S_{ck}} \quad (11)$$



Where S_{ck} = contact area of the key (mm²) ($S_{ck} = a \times L_r$)

σ_{ck} = shear stress on the key (N/mm²)

From equations (10) and (11),

$$\sigma_{ck} = \frac{2M_c \times 1000}{D \times a \times L_r} \quad (12)$$

Where L_r = Length of the key (mm)

a = stem key width (mm)

3.3. Maximum shear stress value for the stem key

The shear stress in the key shall not exceed 90% of the nominal yield strength of the key material: $\sigma_{ck} \leq 0.90$ YS (where YS = the nominal yield strength of the key material).

3.4. Maximum allowable torque for the stem key

$$\sigma_{ck}\ \text{max.} = 0.90\ YS = \frac{2M_c \times 1000}{D \times a \times L_r}$$

$$\boxed{M_c max = \frac{0.90YS \times D \times a \times L_r}{2000}} \quad (13)$$

Appendix 7. Ball Valves Testing Procedure

1. Scope

This procedure applies to ball valves pressure testing. It describes testing procedures regarding tightness and performance of the valves.

Functional tests of actuated valves shall be carried-out only after having successfully passed all steps of the required pressure tests of this appendix.

2. Description of the tests

Pressure tests of valves shall be carried-out in the following sequence. All equipment used to monitor tests and pressure gauges must have current calibration certificates.

2.1. Filling of the valve

- Test fluid:
  - Water + corrosion inhibitor diluted at 3%
  - Maximum chloride content: 15 ppm
- Valve ends shall be blanked
- Ball in half open position
- Filling from the drain
- Vent (at highest point) in open air
- When valve is full, blank the vent
- Pressure measurements shall be made at not less than 25% nor more than 75% of gauge span.

2.2. Shell tests (with water)

- Ball in half open position (minimum 10 degrees opening)
- Apply pressure to the values shown on one of the applicable tables 1.a, 1.b, 1.c, 1.d (shell tests) here after.
- Isolate the valve from the pressure source
- Clean and dry the valve body
- Minimum duration of pressure test according to table 2
- Acceptance criteria: no visible leakage is acceptable.

2.3. High pressure closure tests (with water)

- Ball in half open position, valve at atmospheric pressure
- Close the valve

- Apply pressure on one seat to the values shown on one of the applicable table 1 (high pressure closure tests), the volume beyond this seat being at atmospheric pressure
- Duration of pressure test according to table 2
- Acceptance criteria: Maximum acceptable leakage rate according to table 3 (leakage to be measured in the valve body cavity)

2.4. Operational Torque testing

- Torque measurement shall be performed at the maximum differential pressure if specified in the valve data sheet or, without this information, at the nominal pressure of the valve pressure class (as shown on one of the applicable tables 1), on each seat
- The torque measurement shall be carried out until complete decompression of pressurised volume.
- The maximum torque required to operate the valve shall be measured for the following valve operations

  a) open to close with the bore pressurized and the cavity at atmospheric pressure;
  b) closed to open with both sides of the obturator pressurized and the cavity at atmospheric pressure;
  c) closed to open with one side of the obturator pressurized and the cavity at atmospheric pressure;
  d) as in (c) above but with the other side of the obturator pressurized.
- The above torque measurements shall be performed along the necessary angle of the valve stroke as to guarantee the selection of the gear box or the actuator for the required safety factor of 1.30 at minimum supply pressure.
- The measured torque shall be less than the valve design torque specified by the manufacturer.

2.5 Functional test (with water, actuated valve only)

- All connecting lines between valve and its local control panel shall be made of tubing of the same section as the one to be used on site. Flexible hose are not accepted for this purpose. In case of self-standing local control panels length of these shall not be less than 5 meters unless otherwise specified.
- The valve shall be fully equipped with the extension stem when it exists. The report of the actuator output torques shall be made available
- The actuator shall be pre-set for both the open and close position. The verification of opening and closing times shall be made after three cycles as a minimum

- The valve is then put in the close position and the shutoff pressure applied successively on each seat with the opposite seat and the cavity are at atmospheric pressure.
- The closing test shall start with the valve in the full open position, the bore being pressurized at the differential pressure (as per valve data sheet) whilst the cavity is at atmospheric pressure.
- The break to close is also required for manually operated valve equipped with a gear box.

  One valve of each size and rating shall be tested with its own gear box as to verify that the stroke can be performed. In case of failure the rule expressed in section 7.9.3 of this specification shall apply. Verification of the manoeuvrability of the valve and record of actuator and control panel performance are organised in conjunction with the instrument data sheet requirement.
- Verification of the actuator/ control panel checklist, see appendix of 10008-STD-6-INS-011,PEGS-12059-INS-036.

2.6. Gas tests

Gas tests are also required for valves in liquid hydrocarbon service except otherwise agreed. Gas tests shall only be carried-out after all water pressure tests have been passed satisfactorily. For safety reasons, gas tests shall be performed in an area especially dedicated to gas testing and specifically designed to resist a possible high-pressure gas explosion, such as a heavy wall concrete building or pit. No personnel may be allowed to approach the valve whilst it is under gas pressure.

All flexible hoses shall be securely tied.

Gas test shall start when the valve is completely dry.

The drain port shall be plugged with an adequate solid plug during all the gas tests activities. The drain port shall not be equipped with a valve during gas test except if that valve is part of the supply.

2.6.1. Low pressure closure tests, with air or nitrogen

This test shall be repeated after the high pressure closure test. The procedure is as follows:

- Ball in half open position, valve at atmospheric pressure
- Close the ball
- Put one seat under pressure (5.5 bars + 10% for all valve pressure classes and diameters), the volume beyond this seat being at atmospheric pressure. Only air or Nitrogen shall be used for this test

- Duration of pressure test according to table 2 (this test duration is meant to be measured after venting of the body cavity for the minimum stabilisation time also shown on table 2)
- Inspection on an outlet located between the two seats in the valve body cavity, using the bubble test method
- Acceptance criteria: no leaks are acceptable. The same test shall be carried out on the other seat.
- Soap solution shall be applied on all the joints such as body closure joint, body cover joint, body closure nut/bolts to ensure that there is no visible leakage.
- The same test shall be carried out on the other seat.

The test is then repeated at the end of the complete valve test sequence.

2.6.2. Seat relief test

The valve is put in the 'closed' position with both ends vented to the atmosphere. The pressure is increased in the cavity. A calibrated pressure gauge is connected in parallel on the cavity vent port as to allow for a direct reading of the cavity pressure at time of seat relief. When one seat releases the pressure the vent of that side is then 'closed' and the pressure of the cavity is still increased till release by the second seat.

2.6.3. High pressure closure tests

- Ball in half 'open' position, valve at atmospheric pressure
- Close the ball
- Apply pressure on one seat to the values shown on one of the applicable table 1 (high pressure closure tests), the volume beyond this seat being at atmospheric pressure
- Duration of pressure test according to table 2 (this test duration is meant to be measured after venting of the body cavity for the minimum stabilisation time also shown on table 2)
- Leakage rate measurement on an outlet located between the two seats in the valve body cavity, using a flow meter (the unit for leakage measurement is in cm^3/min
- Acceptance criteria: the maximum acceptable leakage rate shall be according to table 3.
- Soap solution shall be applied on all the joints such as body closure joint, body cover joint, body closure nut/bolts to ensure that there is no visible leakage.

The same test shall be carried out on the other seat.

After successful testing of the two seats, the valve shall be depressurized, and fully stroked before repeating the air test.

2.7. Test of drain, vent, plugs and accessories

Seal welds of NPT threaded plugs and sealant accessories shall be tested by gas test at 1.1 times the rated pressure.

Removable plugs and removable sealant injection accessories and associated check valves shall be tested when these ancillaries are installed on the valve. Tightness of Sealant injectors check valve shall be verified during shell tests and must be free of grease/sealant at that time. They shall be tight to gas at 110% of valve design pressure.

If provided, drain lines, vent lines and sealant injection lines shall be subjected to a hydrostatic test with valve at 1.5 times the rated pressure.

Table 1.a - Test Pressure in Relation to Valve Pressure Class
Carbon Steels to group 1.1 of ASME B16.34

Valve pressure class	Nominal pressure (bars)	Shell tests pressure (bars)	High pressure closure tests pressure (bars)
150	19.7	29.5	21.6
300	51	76.5	56.1
600	102	153.1	112.3
900	153.1	229.6	168.4
1500	255.5	383.2	281
2500	425.4	638.1	468
API 5000	345	517	345
API 10000	690	1034	690

Table 1.b - Test Pressure in Relation to Valve Pressure Class
316 Type Stainless Steels to group 2.2 of ASME B16.34

Valve pressure class	Nominal pressure (bars)	Shell tests pressure (bars)	High pressure closure tests pressure (bars)
150	19.0	28.5	20.9
300	49.6	74.4	54.9
600	99.3	149.0	109.2
900	148.9	223.4	163.8
1500	413.7	620.6	455.1
2500	744.6	1116.9	819.1

Table 1.c - Test Pressure in Relation to Valve Pressure Class
316L Type Stainless Steels to group 2.3 of ASME B16.34

Valve pressure class	Nominal pressure (bars)	Shell tests pressure (bars)	High pressure closure tests pressure (bars)
150	15.9	23.9	17.5
300	41.4	62.1	45.5
600	82.7	124.1	91
900	124.1	186.2	136.5
1500	206.9	310.4	227.6
2500	344.8	517.2	379.3

Table 1.d - Test Pressure in Relation to Valve Pressure Class 321 Type Stainless Steels to group 2.4 of ASME B16.34

Valve pressure class	Nominal pressure (bars)	Shell tests pressure (bars)	High pressure closure tests pressure (bars)
150	19	28.4	20.9
300	49.6	74.5	54.6
600	99.3	148.9	109.2
900	148.9	223.4	163.8
1500	248.2	372.3	273.0
2500	413.7	620.6	455.1

Table 1.e - Test Pressure in Relation to Valve Pressure Class S 31803 (F51) Type Duplex Stainless Steel to group 2.8 of ASME B16.34 and Inconel 625 group 3.8 of ASME B16.34

Valve pressure class	Nominal pressure (bars)	Shell tests pressure (bars)	High pressure closure tests pressure (bars)
150	20	30	22
300	51.7	77.6	56.9
600	103.4	155.1	113.8
900	155.1	232.7	170.7
1500	258.6	387.8	284.4
2500	430.9	646.4	474
API 5000	345	517	345
API 10000	690	1034	690

Table 2 - Minimum Duration of Tests in Relation to Valve Nominal Size

The below minimum durations can be extended to COMPANY or Inspection Agency requirement as long as the stabilisation is not achieved or because of unexpected behaviour of the valve. However individual testing time is not planned to exceed 30 minutes.

Valve nominal size or valve bore (inches)	Shell tests minimum duration (minutes)	Closure tests minimum duration (minutes)	
		Stabilisation time (for gas tests only)	Testing time
≤ 4	2	5	2
From 6 to 10	5	10	5
From 12 to 18	15	15	5
20 and above	30	15	5

Table 3 - Maximum Acceptable Leakage Rates for High Pressure Closure Tests

(Leakage Rates are in cm^3/min.)

Valve bore (inches)	DN	Tests with water	Tests with gas (see note 2)			
		Metallic seals (according to ISO 14313) (see note 1)	Soft seals		Metallic seals	
			Valve pressure Class ≤ 600	Valve pressure Class ≥ 900	Valve pressure class ≤ 600	Valve pressure class ≥ 900
≤ 2	50	0.31	2.5	5	10	20
2 ½	65	0.38	3.25	6.5	13	26
3	80	0.46	4	8	16	32
4	100	0.61	5	10	20	40
6	150	0.91	7.5	15	30	60
8	200	1.21	10	20	40	80
10	250	1.52	12.5	25	50	100
12	300	1.83	15	30	60	120
14	350	2.14	17.5	35	70	140
16	400	2.44	20	40	80	160
18	450	2.74	22.5	45	90	180
20	500	3.05	25	50	100	200
22	550	3.35	27.5	55	110	220
24	600	3.66	30	60	120	240
26	650	3.96	32.5	65	130	260
28	700	4.27	35	70	140	280
30	750	4.57	37.5	75	150	300
32	800	4.80	40	80	160	320
36	900	5.48	45	90	180	360
40	1000	6.00	50	100	200	400
42	1100	6.40	52.5	105	210	420
48	1200	7.30	60	120	240	480
54	1400	8.23	67.5	135	270	540
60	1500	9.14	75	150	300	600

Notes:

(1) No leaks are acceptable for soft seals under hydrostatic closure tests.

(2) No leaks are acceptable for low pressure closure tests with gas whether with soft seals or with metallic seals.

2.8. Cleaning after testing

- Blind test flange removed
- Ball in half ‘open’ position
- Interior of valve air-blown and dried.

After these operations, the ball must be left in fully ‘open’ position, the valve ends being then sealed-off with plastic caps.

2.9. Pressure test certificate

The below pressure test certificate is only an example that does not reflect a test sequence.

A complete test certificate shall report all test performed including the seat relief test when applicable. In case of the integral bolted manifolds, the test reports shall address tests performed on each of the two block valves and tests performed on the bleed valve.

Pressure Tests Certificate

MANUFACTURER			
PO N°	**MANUFACTURER REF:**		
CUSTOMER ITEM:	**VALVE DESCRIPTION:**		
TAG NO :	**SERIAL NO :**		
	DRAWING NO:		
Tests	**Acceptance Criteria**	**Test Results**	**Comments**
HYDROSTATIC SHELL TEST Pressure Duration Body leak Bonnet-cover leak Stem leak Drain lines, vent lines and sealant injection lines Full end thrust effect test condition: Yes / No	 Table 1 Table 2 No leakage No leakage No leakage No leakage	 P = ...barg t = ...min Leak: Yes/ No Leak: Yes/ No Leak: Yes/ No Leak: Yes/ No	
OPERATIONAL TORQUE TEST Valve differential pressure Close to Open : Side A pressurized Close to Open : Side B pressurized Close to open (both sides pressurized) Open to close (bore pressurized)	 ΔP = ... barg ..... Nm ..... Nm ..... Nm ..... Nm	 ΔP = ... barg ..... Nm ..... Nm ..... Nm ..... Nm	
HIGH PRESSURE CLOSURE TEST (WATER) Pressure Duration Side A Side B	 Table 1 Table 2 Table 3 Table 3	 P = ... bars t = ... min Leak rate : ..... Leak rate:	
LOW PRESSURE CLOSURE TEST (GAS or AIR) Pressure Stabilization time Duration Side A Side B	 5.5 -6 barg Table 2 ≥ 2 min No leaks No leaks	 P = ... barg t = ... min t = ... min Leak rate: ..... Leak rate:	
SEATS SELF RELIEF TEST (GAS) Side A Side B	8 bars for 150# 10 bars for 300# 15 bars for 600# 10% of rating for ≥ 900#	 Relief value: .....barg Relief value: .....barg	
HIGH PRESSURE CLOSURE TEST (GAS) Pressure Stabilization time Duration Side A Side B	 Table 1 Table 2 ≥ 2 min Table 3 Table 3	 P = ... bars t = ... min t = ... min Leak rate: ..... Leak rate:	
Test of welded plugs, removable plugs, accessories, etc	Section 2.7 (Appendix-7)	Leak : Yes / No	
LOW PRESSURE CLOSURE TEST (GAS or AIR) Pressure Stabilization time Duration Side A Side B	 5.5 bars Table 2 ≥ 2 min No leakage No leakage	 P = ... bars t = ... min t = ... min Leak rate: ..... Leak rate:	
RESULTS & COMMENTS: **SATISFACTORY: YES ☐ NO ☐ NON CONFORMITY REPORT N°**			

	NAME	**PLACE/DATE**	**SIGNATURE**
Manufacturer Inspection			
Inspection Agency			
Company Representative			

Appendix 8. Elastomer O – Ring Seals Explosion Decompression – Type Testing Procedure

1. Scope

This addendum covers requirements for testing the properties of resistance to explosion decompression of elastomer seals. These tests are type tests and are valid for all O-ring seals made of the same material, as long as their cross section size does not exceed the size of the test sample.

2. Testing principle

a) Purpose of the test: This type testing includes verification of mechanical properties of O-rings as well as testing of their anti-explosion decompression ("AED") properties.

b) Size of specimens to be tested: All specimens shall be made of O-rings of the maximum cross section diameter actually used in the valve supply with a minimum of 5 mm in diameter.

c) Nature and number of specimens: One run of tests shall be dedicated to only one O-ring material. Each test run shall include five O-rings specimens of the same material, same compound, and same batch, which shall have been subject to the same vulcanisation treatments. These five specimens shall be used as follows:

- All five O-rings are of either 5.33 or 6.99 mm nominal sections. Internal diameter of the two types of O-rings is fixed to 113.67 mm
- Three samples (samples 1 to 3) shall be subject to AED tests
- One sample (sample 4) shall be subject to tensile test
- And one sample (sample 5) shall be kept as a spare for any possible future investigation.

3. Mechanical testing

All tests to be performed shall comply with the following ASTM D297, ASTM D412, ASTM D1414, ASTM D1415 and ASTM D2240, where applicable.

All mechanical tests shall be performed at room temperature (i.e., 23°C ± 2°C). The following mechanical tests shall be carried-out for each test run:

a) O-rings cross section measurement: This measurement shall be done on all O-rings, including those subject to AED tests (in this case, measurements shall be made before and after the AED tests). The measurement method shall comply with ASTM D1414, section 7. The measurement points shall be a minimum of 4, equally spaced on the outer surface of each O-ring.

b) O-rings weight measurement: This measurement shall be done on all O-rings, including those subject to AED tests (in this case, measurements shall be made before and after the AED tests). Weight shall be measured using an analytical weighing apparatus, of a precision of + 0.1 mg maximum.

c) Rubber density: These measurements shall be made before and after the AED tests, according to ASTM D1414 and ASTM D297, using an hydrostatic weighing apparatus of a precision of + 0.1 mg maximum.

d) O-rings superficial hardness: These measurements shall be made before and after the AED tests, according to ASTM D1414 and ASTM D1415 (IRHD testing method) or ASTM D2240 (Shore A testing method). The measurement shall be made after 15 seconds following the indenter penetration.

e) O-rings tensile test: This test shall be made on both the sample 4 (i.e., on the O-ring not subject to AED tests), and on one O-ring which has been subject to AED tests, after these tests are completed (either sample 1, 2, or 3). Tensile and elongation tests shall be performed on an entire O-ring using an adequate dynamometer and load cell. The tensile modulus shall be calculated at 100% deformation. Testing method shall comply with ASTM D412.

4. Explosion decompression testing procedure

a) Test facilities: The testing facilities shall be approved by the COMPANY. All testing devices used for anti-explosion decompression testing shall be located in a safe area (ideally a locked room) dedicated to this purpose only, equipped with a proper outer vent system in order to cope with any gas leakage including those produced during the gas depressurisation phases of the tests. The complete test run shall be placed under the full responsibility of only one single operator.

b) Test equipment: The test equipment shall be made of a pressure vessel of a sufficient volume (3 litres minimum) with flanges of sufficient dimensions to receive the specimens to be tested. The devices used for decompression monitoring (i.e., needle valves or other type of valves) shall be calibrated prior to starting the tests. These devices shall be sized to allow for a full decompression all along the required 90 seconds in a linear mode all along the depressurisation.

c) Test medium: The test medium shall be a mixture of natural gas comprising 80% methane and 20% CO2. The gas mixture shall be obtained exclusively from bottles filled to the required nominal composition, i.e. loaded with the mixture of 80% methane and 20% CO2. A booster pump may be necessary in order to reach the required test pressure. The capacity of the bottles shall be of a sufficient volume in order to carry out the required testing cycles, and in any case replacement of bottles shall not be permitted during a soaking phase. Gas analysis shall be done at the inlet and outlet of the testing chamber.

d) Installation of the specimens in the test vessel: The specimens shall be installed on the pressure vessel as flange seals, exclusively in a groove, and shall be submitted to an axial compression and a groove filling limited to 13.5% and 73% maximum respectively. Actual groove size and compression rate shall be reported.

e) Procedure: The testing shall consist in five cycles. The duration of the first cycle shall be 78hours followed by four other ones of 48 hours each. The temperature is maintained at 75°C all along under a pressure of 190 bars minimum. After each soaking period, the pressure must be rapidly decreased to atmospheric pressure, in 90 seconds maximum. A one hour stand-by period is maintained between each cycle. The procedure shall include full monitoring and computerised record of both inlet and outlet pressures, as well as temperature of the test vessel during the five testing cycles (including decompression phases). The test temperature must be taken at the tested O-ring location or close to it. During the soaking periods, the variation of the inlet pressure shall be less than + 2 bars (g) and the variation of the test vessel temperature shall be less than + 2°C.

f) Test sequence: Tests shall be conducted in the following order:

- Clean the test vessel and housings
- Install test seals, clean
- Purge the test vessel with nitrogen
- Fill the test vessel by replacing the purged gas with the test gas
- Heat the test vessel to the specified temperature
- Increase the pressure to the test pressure value requirement
- Maintain test pressure and temperature for the specified duration
- Depressurise the equipment
- One hour stand-by at zero pressure
- Repeat this sequence five times
- Replace the test gas by nitrogen for purging, within 24 hours maximum
- Open the test vessel and perform an immediate visual examination of the seals.

5. Inspection and testing

Following the last decompression cycle, the specimens shall be removed from the test vessel within no more than 24 hours, this time being necessary for final inerting and cooling.

An optical macroscopic examination at a magnification of 10 and 20 of the specimens shall be made immediately after removal of the specimens. No visible cracks, splitting, blistering, swelling, or channelling shall be shown. Additionally, any changes in volume, weight, density, tensile strength, elongation, modulus and hardness shall be measured and reported.

Additionally each of three O-rings is cut in four segments and defects are rated according to NORSOK standard M710.

6. Reporting

Testing reports EN 10204 (type 3.1) must be sent to the COMPANY for approval and shall be attached to the Valve documentation.

The test reports shall include:

- A schematic diagram of the testing installation and main features of the testing apparatus
- The pressure and temperature cycles chart records with time scale for the complete five cycled tests
- The material data sheet issued by the O-rings Manufacturer
- Macro examination photographs for the three “AED” tested O-rings. The photographs shall be original coloured digital pictures or laser copies, and shall show the samples before and after “AED” tests at the two required magnifications of 10 and 20. The most significant areas shall be shown.
- The mechanical test report including details as required by the applicable standards, and conforming to the format attached hereafter
- The tensile test elongation chart record.

Mechanical tests results on elastomer O-rings

Material		**Date of tests**	
Batch identification number		Name and Signature of the Inspector	

a) Before AED tests

O-ring physical characteristics	**Sample 1**	**Sample 2**	**Sample 3**	**Mean value**
Cross-section (mm)				
Inside diameter (mm)				
Weight (g)				
Density (g/cm3)				
Shore A hardness after 15 sec.				
IRHD hardness after 15 sec.				

O-ring mechanical characteristics (on sample 4)	**Value**
Tensile strength (MPa)	
Ultimate elongation (%)	
Tensile strength at 100% elongation (MPa)	

b) After AED tests

O-ring physical characteristics	Sample 1	Sample 2	Sample 3	Mean value
Cross-section (mm)				
Inside diameter (mm)				
Weight (g)				
Density (g/cm3)				
Shore A hardness after 15 sec.				
IRHD hardness				

O-ring mechanical characteristics (on sample 1, 2 or 3)	Value
Tensile strength (MPa)	
Ultimate elongation (%)	
Tensile strength at 100% elongation (MPa)	

Appendix 9. Gate/ Globe Valve Data Sheet Form

COMMODITY CODE		**Criticality Rating** (per Doc. No. PEGS-12060-ADM-006)	
Option code Ends connection			
Valve type	**Gate ☐ Globe ☐**	**Valve tag number**	
ServiceClass	A ☐ B ☐ C ☐ D ☐ E ☐	PTTEP Piping Class/	
PEGS-12059-PIP-006		Piping class rating	
Pressure class		Corrosion allowance - mm	
(ASME B16.34/API 6A)		Corrosive Service (Y/N)	
Nominal Size		Class presure/temperature	
Bore (mm)			
Internal bore		Min/Max design pressure - bar	
Above ground/Underground		Min/Max design temperature°C	
Insulation		Min/Max operating temperature°C	
		Max differential pressure - bar	
Design		**Main Fluids**	
Construction standard		Solid particles in fluid	
		Note 6 of table 4, Section 5.4.7 of	
		PEGS-12059-PIP-006	
Construction type		H_2S/CO_2 max cotent (%) NACE	
Stem		Methanol max content	
Extended stem		Chemical treatment of line	
Operation (gear/wrench)		Flammable fluids or toxic fluids	
End connections			
End to end dimensions			
Flanges facing finish or		**Metallic materials**	
grooves facing finish		Body	
Stem position		Bonet	
(Vertical/Horizontal)		Obturator	
Flow axes (Vertical/Horizontal)		Stem	
grooves facing finish		Seat ring	
By Pass		Back seat	
Stem position		Gland flange	
(Vertical/Horizontal)		Bolting	
Flow axes (Vertical/Horizontal)		(section 5.5.7 PEGS-12059-PIP-006)	
Lifting Lugs		CSL	
Valve Support		(per API 20 Series)	
Lock Open/ Lock Close		FSL	
Drains, vents		(per API 20 Series)	
(table 6 of PEGS-12059-PIP-006			
Sealant Injection on Seats			
(table 6 of PEGS-12059-PIP-006		**Gaskets**	
Sealant Injection on Stem		Bonnet Gasket	
(table 6 of PEGS-12059-PIP-006		Gland packing	
Delivery requirements			
Non destructive test		Calulation note of body thickness	
Pressure test certificates		(section 5.5.1 of PEGS-12059-PIP-006)	
Material certificates		Bolting Calculation note	
Marking		(section 5.5.7.1 of PEGS-12059-PIP-006)	
		External coating	
		Colour code	
Notes:			

Appendix 10. Manual Operated Ball Valve Data Sheet Form

COMMODITY CODE		**Criticality Rating** (per Doc. No. PEGS-12060-ADM-006)	
Option code Ends connection			
Valve type	**Manual**	**Valve tag number**	
ServiceClass	A ☐ B ☐ C ☐ D ☐ E ☐	PTTEP Piping Class/	
PEGS-12060-PIP-006		Piping class rating	
Pressure class		Corrosion allowance - mm	
(ASME B16.34/API 6A)		Corrosive Service (Y/N)	
Nominal Size		Class presure/temperature	
Bore (mm)			
Internal bore		Min/Max design pressure - bar	
Above ground/Underground		Min/Max design temperature°C	
Insulation		Min/Max operating temperature°C	
		Min depressuisation temperature °C	
		Max differential pressure - bar	
Design		**Main Fluids**	
Construction standard		Solid particles in fluid	
		Note 6 of table 4, Section 5.4.7 of	
		PEGS-12059-PIP-006	
Construction type		H_2S/CO_2 max cotent (%)	
Fire safe		Methanol max content	
Floating or		Chemical treatment of line	
Trunnion mounted ball		Flammable fluids or toxic fluids	
Extended stem			
Operation (gear/wrench)		**Metallic materials**	
End connections:		Body	
Flanges		Ball	
Pup piece		Stem	
Transition piece		Seat spring/Seat washer	
Hub connecsion		Seat holder	
End to end dimensions		Bolting	
Flanges facing finish or		(section 5.5.7 PEGS-12059-PIP-006)	
grooves facing finish		Weld Overlay/Metallic Coating	
By Pass		CSL	
Stem position		(per API 20 Series)	
(Vertical/Horizontal)		FSL	
Flow axes (Vertical/Horizontal)		(per API 20 Series)	
Drains, vents			
(table 6 of PEGS-12059-PIP-006		**Internal seals materials** (as per table 4 of PEGS-12059-PIP-006)	
Sealant Injection on Seats		Seat Inserts (note 1)	
(table 6 of PEGS-12059-PIP-006		Dynamic seat seals	
Sealant Injection on Stem			
(table 6 of PEGS-12059-PIP-006		Dynamic stem seals	
Lifting Lugs			
Valve Support			
Lock Open/ Lock Close		Static seals	
		Fire safe graphite back-up seals	
Delivery requirements			
Non destructive test		Calulation note of body thickness	
Pressure test certificates		(section 5.5.1 of PEGS-12059-PIP-006)	
Material certificates		Bolting Calculation note	
Fire Safe certificate		(section 5.5.7.1 of PEGS-12059-PIP-006)	
Marking		External coating	
Quality Specification Level (QSL)		Colour code	
Notes:			
Note 1: Elastomeric material is prohibited			

Appendix 11. Actuated Valves Detailed Torque Table Form

The torque table shall be produced at bid and at FAT stages

Valve item/TAG number:	
Actuator model:	

Maximum valve differential pressure (bars)		Maximum actuator supply pressure (bars) (4)		Minimum actuator supply pressure (bars)		Safety factor (6)
Valve opening break torque (Nm)		Actuator opening break torque (Nm)		Actuator opening break torque (Nm)		
Valve opening running torque (Nm)		Actuator opening running torque (Nm)		Actuator opening running torque (Nm)		
Valve opening end torque (Nm)		Actuator opening end torque (Nm)		Actuator opening end torque (Nm)		
Valve closing break torque (7) (Nm)		Actuator closing break torque (Nm)		Actuator closing break torque (Nm)		
Valve closing running torque (Nm)		Actuator closing running torque (Nm)		Actuator closing running torque (Nm)		
Valve closing end torque (Nm)		Actuator closing end torque (Nm)		Actuator closing end torque (Nm)		
		Maximum actuator allowable pressure (bars) (5)				
Maximum allowable valve torque (Nm) (2)		Maximum actuator output (3)				

Notes:

(1) All torque values are subject to test checks in Manufacturers premises prior to acceptance of the related equipment. The values reported at FAT stage are the average of three measurements made in the same conditions

(2) This value must be justified by appropriate calculations and shall be submitted to Total for approval.

(3) This value corresponds to the actuator stall at the maximum air / hydraulic supply pressure.

(4) This value may be equal to the maximum regulated pressure on the actuator provided a safety valve is supplied on the related actuator.

(5) This is the maximum allowable working pressure of the actuator, i.e. the maximum pressure that can be applied to it without damage.

(6) The safety factor is the ratio of the actuator output torque at the minimum supply pressure over the valve required torque at the maximum differential pressure. This value must be a minimum of 1.30, unless larger values are specified in the requisition or in the valve data sheets.

(7) Atmospheric pressure in the cavity and maximum pressure differential in the valve bore.

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