

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 821

**Piping and Pressure vessel equipment specification
for Rotating Machines Packages**

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1. Scope

This specification relates to the packaging of rotating machinery and specifies the minimum design, fabrication and inspection requirements of piping and pressure vessel equipments installed on packaged equipment.

This specification covers the minimum technical requirements of materials for pipes, fittings, flanges, valves and other piping components used for process and utility piping systems inside the package.

This specification must be read in conjunction with **GS EP PVV 112**.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published at the effective date of this document.

Reference	Title
API SPEC 5L	Specification for Line Pipe
API SPEC 6D	Specification for Pipeline and Piping Valves
API SPEC 6FD	Specification for Fire Test for Check Valves
API STD 594	Check Valves: Flanged, Lug, Wafer, and Butt-welding
API STD 598	Valve Inspection and Testing
API STD 600	Steel Gate Valves - Flanged and Butt-welding Ends, Bolted Bonnets
API STD 602	Gate, Globe, and Check Valves for Sizes DN 100 (NPS 4) and Smaller for the Petroleum and Natural Gas Industries
API STD 609	Butterfly Valves: Double-flanged, Lug-and Wafer-type
API STD 623	Steel Globe Valves - Flanged and Buttwelding Ends, Bolted Bonnets
ASME B.1.20.1	Pipe Threads, General Purpose (Inch)
ASME B1.1	Unified Inch Screw Threads, UN and UNR Thread Form
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	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	Valves - Flanged, Threaded and Welding End

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Reference	Title
ASME B16.36	Orifice Flanges
ASME B16.47	Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch Standard
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
ASME B16.9	Factory-Made Wrought Buttwelding Fittings
ASME B18.2.1	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
ASME B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.3	Process Piping
ASME B36.10M	Welded and Seamless Wrought Steel Pipe
ASME B36.19M	Stainless Steel Pipe
ASME BPVC Section V	Non-Destructive Examination
ASME BPVC Section VIII	Rules for Construction of Pressure Vessels
ASNT SNT-TC-1A	Recommended Practice for Personal Qualification and Certification in Nondestructive Testing
ASTM A1016/A1016M	Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes
ASTM A182/A182M	Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High -Temperature Service
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194/A194M	Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A320/A320M	Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low -Temperature Service
ASTM A351/A351M	Standard Specification for Castings, Austenitic, for Pressure- Containing Parts
ASTM A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A380/A380M	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A388/A388M	Standard Practice for Ultrasonic Examination of Steel Forgings

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ASTM A453/A453M	Standard Specification for High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels
ASTM A578/A578M	Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
ASTM A703/A703M	Standard Specification for Steel Castings, General Requirements, for Pressure-Containing Parts
ASTM A705/A705M	Standard Specification for Age-Hardening Stainless Steel Forgings
ASTM A745/A745M	Standard Practice for Ultrasonic Examination of Austenitic Steel Forgings
ASTM A751	Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
ASTM A789/A789M	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM A790/A790M	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe
ASTM A815/A815M	Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings
ASTM A923	Standard Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic/Ferritic Stainless Steels
ASTM A928/A928M	Standard Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal
ASTM A960/A960M	Standard Specification for Common Requirements for Wrought Steel Piping Fittings
ASTM A991/A991M	Standard Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products
ASTM A995/A995M	Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts
ASTM A999/A999M	Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B733	Standard Specification for Autocatalytic (Electroless) Nickel-Phosphorus Coatings on Metal
ASTM D1418	Standard Practice for Rubber and Rubber Latices-Nomenclature
ASTM D3359	Standard Test Methods for Measuring Adhesion by Tape Test
ASTM E165/E165M	Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E213	Standard Practice for Ultrasonic Testing of Metal Pipe and Tubing

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Reference	Title
ASTM E309	Standard Practice for Eddy Current Examination of Steel Tubular Products Using Magnetic Saturation
ASTM E384	Standard Test Method for Microindentation Hardness of Materials
ASTM E562	Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count
ASTM F104	Standard Classification System for Nonmetallic Gasket Materials
ASTM F152	Standard Test Methods for Tension Testing of Nonmetallic Gasket Materials
ASTM F36	Standard Test Method for Compressibility and Recovery of Gasket Materials
ASTM G14	Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)
DIN 52913	Testing of static gaskets for flange connections - Compression creep testing of gaskets made from sheets
ISO 10497	Testing of valves - Fire type-testing requirements
ISO 15156-3	Petroleum and natural gas industries - Materials for use in H ₂ S-containing environments in oil and gas production - Part 3: Cracking-resistant CRAs (corrosion resistant alloys) and other alloys
ISO 15848-1	Industrial valves - Measurement, test and qualification procedures for fugitive emissions - Part 1: Classification system and qualification procedures for type testing of valves
ISO 4527	Metallic coatings - Autocatalytic (electroless) nickel-phosphorus alloy coatings - Specification and test methods
ISO 5208	Industrial valves - Pressure testing of metallic valves
ISO 9001	Quality management systems - Requirements
ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
MSS SP-42	Corrosion-Resistant Gate, Globe, Angle, and Check Valves with Flanged and Butt Weld Ends (Classes 150, 300, & 600)
MSS SP-43	Wrought and Fabricated Butt-Welding Fittings for Low Pressure, Corrosion Resistant Applications
MSS SP-45	Bypass and Drain Connections
MSS SP-55	Quality Standard for Steel Castings for Valves, Flanges, Fittings, and Other Piping Components - Visual Method for Evaluation of Surface Irregularities (ANSI-approved American National Standard)

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Reference	Title
MSS SP-6	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
MSS SP-9	Spot Facing for Bronze, Iron and Steel Flanges
MSS SP-95	Swage(d) Nipples and Bull Plugs
MSS SP-97	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded, and Buttwelding Ends

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

Reference	Title
GS EP COR 170	Materials for upstream sour service application - Specification for selection and design
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP COR 354	External protection of onshore structures and equipment by painting
GS EP INS 137	On/Off Valve Control Panels and Actuators
GS EP MEC 251	Supply of Axial and Centrifugal Compressors and Expander-compressors according to API Standard 617
GS EP PVV 102	Piping Hook-up Standards
GS EP PVV 112	Piping material classes
GS EP PVV 211	Design and fabrication of pressure vessels according to ASME VIII
GS EP PVV 412	Plate and frame heat exchanger
GS EP PVV 614	Welding of duplex and super-duplex stainless steel

3. Terms and definitions

3.1 Definitions

Managing Entity Entity identified on the front page of the document

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3.2 Terms

ASME	American Society of Mechanical Engineers
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
CPY	Company
CRA	Corrosion Resistant Alloy
DPI	Dye Penetrant Inspection
ENP	Electroless Nickel Plated
FB	Full Bore
FFKM	Perfluoroelastomer
GTAW	Gas Tungsten Arc Welding
HNBR	Hydrogenated Nitrile Butadiene Rubber
MSS	Manufacturers Standardization Society
MPI	Magnetic Particule Inspection
MT	Magnetic Particule Testing
NDE	Non Destructive Examination
NDT	Non Destructive Test
NPS	Nominal Pipe Size
NPT	National Pipe Taper
PCTFE	Polymonochlorotrifluoroethylene
PEEK	Polyetheretherketone
PFA	Perfluoroalkoxy
PT	Penetrant Testing
PTFE	Polytetrafluoroethylene
RB	Reduced Bore
RGD	Rapid gas Decompression
RT	Radiographic Testing
SMAW	Shielded Metal Arc Welding
UT	Ultrasonic Testing
VDS	Valve Data Sheet
VT	Visual Testing

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4. Material

Material designation to be used for all piping components (pipes, fittings, bolting and flanges) is specified in each piping class listed in [GS EP PVV 112](#).

4.1 Carbon steel

In case of welding, all carbon steel piping components, including normalized steels, used for the fabrication of pipes shall have a maximum carbon content of 0.23%.

The carbon equivalent of these materials, calculated using the formula:

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

shall be 0.42 maximum (ladle analysis).

If the content of alloying elements other than C or Mn is unknown, the formula to be used shall be: $C_E = C + \frac{Mn}{6}$ and, in this case, the carbon equivalent shall be less than 0.40 (ladle analysis).

All carbon steels materials shall be impact tested at minus 29°C (-20°F) in accordance with [ASME B31.3](#), unless more stringent requirements are already required in the product specification.

Carbon steel used for the fabrication of pipe, fittings, bolting and flanges shall be made by electric furnace or by basic oxygen process.

Fittings shall have sustained a Normalized or a normalized, quenched and tempered heat treatment.

Bolting shall undergo thermal hardness treatments in accordance with the requirements of the applicable codes and standards listed as reference documents.

4.2 Austenitic steel

Austenitic stainless steel pipes, fittings and flange shall undergo an annealing heat treatment in accordance with the corresponding ASTM standards.

Substitution of dual grade austenitic stainless steel material in lieu of low carbon grade is not acceptable without a written authorization from the managing Entity. Material Test Report is mandatory for dual grade materials and shall satisfy the chemistry requirements of "L" grade and the mechanical requirements of the regular grade.

4.3 Austenitic-ferritic stainless steel

Super Duplex stainless steel pipe shall be in accordance with Appendix 8.

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5. Pipes

5.1 Dimensions

Pipes for which schedules 10, 40, 80, etc. are specified must be in accordance with the standards [API SPEC 5L](#) or [ASME B36.10M](#).

Pipes for which schedules 10S, 40S and 80S are specified must be in accordance with the standard [ASME B36.19M](#).

Pipe wall thickness values shall be adequate for the full range of pressure/temperature combination.

Pipe sizes and pipe wall thickness values are specified in the [GS EP PVV 112](#).

Due to their vulnerability to damage and their limited mechanical strength NPS ½ and NPS ¾ should not be used except for short branch connections. NPS ½ and ¾ shall not be used for long-run piping.

5.2 Manufacture

5.2.1 General

Carbon steel pipe shall be of seamless fabrication for NPS up to 16 included and of SAW process exclusively for NPS 18 and above. Austenitic stainless steel pipes

Except otherwise agreed, seamless pipes shall be hot drawn.

Carbon steel pipes NPS 18 and above shall be produced by rolling and longitudinal welding. Welded pipes limitations shall comply with [GS EP PVV 112](#) requirements.

For Corrosion Resistant Alloy, selection of seamless or welded pipe shall be governed by manufacturing capabilities.

5.2.2 Fabrication of pipes

5.2.2.1 Seamless pipes

A seamless pipe shall be made in a single section.

5.2.2.2 Longitudinally-welded pipes

A longitudinally welded pipe shall be made in a single section.

For carbon steel, the SAW process shall be used exclusively.

For Austenitic stainless steel, the EFW shall be used.

For Austenitic ferritic stainless steel, acceptable welding processes are indicated in the [GS EP PVV 614](#).

Every pipe shall be made of one plate and one longitudinal welded joint.

The weld seams shall be subjected to full length (100%) radiographic inspection, in accordance with the requirements of [API SPEC 5L](#), by X-ray method onto radiographic films (Digital radiography inspection is subject to Company approval).

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5.3 End requirements

5.3.1 Jointing of small bore

As a general rule, small bore piping (NPS ½ and below) shall be joined together by socket welding with the limitations stated in [GS EP PVV 112](#).

6. Fittings

6.1 Dimensions

6.1.1 Bore

The bore diameter at the beveled end of butt-weld fittings according to [ASME B16.9](#) shall "Match Pipe" i.e. shall match the nominal inside diameter of connecting pipe based on the outside diameter and nominal wall thickness.

6.1.2 Carbon steels and low alloy steels

The thicknesses of fittings ends must be in accordance with the standards [API SPEC 5L](#) or [ASME B36.10M](#).

6.1.3 Corrosion Resistance Alloy steels

The thicknesses of fittings ends must comply with the standard [ASME B36.19M](#), except that tolerance only for fittings in schedule 10S shall be in accordance with [MSS SP-43](#).

6.1.4 Other dimensions

The dimensions of forged, threaded or socket-welding fittings shall comply with the standard [ASME B16.11](#).

The dimensions of butt-welding fittings shall be in accordance with the standard [ASME B16.9](#), except that tolerances for stainless steel fittings in schedule 10S shall be in accordance with [MSS SP-43](#).

The dimensions of swaged nipples shall comply with [MSS SP-95](#).

The dimensions of weldolet, sockolet, threadolet and similar fittings shall comply with [MSS SP697](#).

6.2 Manufacture

6.2.1 Fittings up to NPS 1½

All fittings up to NPS 1½, of the 3000 #, 6000 # and 9000 # series, shall be made of forged steel, of the socket welding type.

Threaded fittings may be allowed on water and service air piping, drains and vents up to NPS 2.

Forging ratio shall be 3:1 minimum. Fittings shall be forged shaped as close as possible to final dimensions and in such a manner that axial length of the part is parallel of the axial length of the fitting.

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Fittings formed and/or machined from bars are subject to Company approval, except for threaded couplings, caps and plugs.

Straight nipples (standard dimensions) is allowed to be machined from seamless pipe.

6.2.1.1 Elbows

In small bore welded piping, hot or cold-formed bends with a radius of 5D minimum may be used in lieu of elbows where authorized in the relevant piping material classes.

6.2.1.2 Tees

Equal or reducing tees shall be used as required by piping material classes.

6.2.2 Fittings NPS 2 and above

Wherever possible, welded fittings shall not be butt welded directly to another welded fitting in order to comply with requirements for offset of weld seams.

6.2.2.1 Seamless fittings

Seamless fittings shall be forged or extruded/expanded.

In case of forging, ratio shall be 3:1 minimum. Fittings shall be forged shaped as closed as possible to final dimensions and in such a manner that axial length of the part is parallel of the axial length of the fitting.

In case of fittings made from seamless pipes, section 4 of this specification shall be fully applicable to the starting material.

Machining from bars is not allowed. Fittings formed and/or machined from bars are subject to Company approval for NPS 4 and above.

6.2.2.2 Welded fittings

Welded fittings shall be made from forgings, plates or fusion welded tubular products with filler metal added (wrought material).

Cast material is not allowed.

In case of fittings made from welded pipes, section 4 of this specification shall be fully applicable to the mother pipe.

The welds shall be made by an approved process. The seams shall be back-welded if the welding process does not assure full penetration with, on the back, a weld reinforcement of uniform thickness, free of appreciable distortion.

Welding coefficient shall be 1.

For carbon steel and austenitic stainless steel, GMAW, FCAW and ERW are not acceptable welding processes.

6.2.2.3 Ends

As a general rule, the fittings used for piping NPS 2 and above shall be made of wrought steel with "butt-welding" prepared ends.

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When required by piping material classes, threaded fittings and socket welding fittings may be used for NPS 2.

6.2.2.4 Elbows

As a general rule, elbows shall have a long radius ($R = 1.5 \times \text{NPS}$).

Short radius elbows shall not be used without the approval of the Company.

If bends must be used for these sizes, they shall be cold-fabricated for NPS 2 and NPS 3 and hot-fabricated for NPS 4 and above. The bending radius shall be equal to five times the nominal pipe size.

6.2.2.5 Tees

Equal tees shall be used for all connections to piping of the same diameter. The limits within which they can be used shall be specified in the piping material classes specification.

Reduced tees shall be used as indicated in the piping materials classes.

6.2.2.6 Reducers

The use of concentric reducers shall be the general rule. The use of eccentric reducers shall be restricted in principle to piping in layers on pipe racks and to pump suction.

6.2.2.7 Other connections

Integrally reinforced forged branch outlet fittings (O'lets) shall be used for branch size less than half the header size only but shall be limited up to branch NPS 8.

7. Branch connections

Branch connections shall be made at 90° to the header run pipe; oblique connections shall be avoided.

Connections on elbows, tees and reducer are strictly forbidden.

Wherever possible, the longitudinal weld seam of welded pipe shall not be positioned on the top or bottom of the line so that the branch connections are located on the seam.

The types of connections which may be used in each case are shown in Appendix 3 of [GS EP PVV 112](#).

7.1 Small bore connections

Small bore connections should be designed taking into account the following practices:

- The fitting and unsupported length shall be as short as possible.
- The mass of valves and instrumentation shall be minimised.
- Any mass at the free end of a cantilever should be supported in both directions perpendicular to the axis of small bore.
- Connections shall not be located in high stress areas.
- Minimize the number of small bore connections / branches in piping.

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- Branches shall not be located in removable spools.
- Any small bore connection NPS 3 and below shall be systematically supported in both directions (braced for support) in the horizontal and vertical planes, when the branch is connected to large bore piping subjected to vibration whether it be process, equipment or acoustically induced. These supports shall be welded to the large bore piping. Where it is not practical because dismantling of the piping may be required or welding of the gusset material to the pipe is prohibited, a clamp type attachment shall be used.
- The minimum size of branch pipe shall be NPS ¾.
- Supports attachments shall be from the main pipe, to ensure that the small bore connection moves with the main pipe during transients movements and vibration.
- Any fastening shall be designed to be effective under vibration.

Small bore branches shall be avoided downstream of compressors, high rate depressurising valves and safety relief valves (acoustic fatigue). If it is not possible they shall be located well away from these sources of vibration. Special attention shall be paid to bracing these branches to the run-pipe.

8. Flange

8.1 Dimensions

8.1.1 Thicknesses

The end thicknesses of welding-neck flanges for which schedules 10, 40, 80, etc., are specified shall be in accordance with [ASME B36.10M](#).

The end thicknesses of welding-neck flanges for which schedules 10S, 40S or 80S are specified shall be in accordance with [ASME B36.19M](#).

8.1.2 Bore

The bore diameter at the beveled end of butt-weld flanges shall "Match Pipe" i.e. shall match the nominal inside diameter of connecting pipe based on the outside diameter and nominal wall thickness

8.1.3 Other dimensions

The other dimensions of slip-on flanges, lap-joint flanges, socket-welding flanges and welding-neck flanges shall comply with [ASME B16.5](#) for NPS up to 24.

The dimensions of welding-neck flanges and blind flanges NPS 26 and above shall be in accordance with [ASME B16.47](#) Series A.

8.2 Orifice flanges

Orifice Flanges shall be supplied:

- In pairs in accordance with [ASME B16.36](#)

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- With two ½" NPT threaded tapings and mating round plugs compliant with [ASME B16.11](#) for each orifice flange
- With jackscrews.

On piping ASME Class 150, ASME Class 300 flanges shall be used for orifice flanges.

The dimensions of orifice flanges shall comply with [ASME B16.36](#). The minimum size shall be NPS 2.

8.3 Connection between dissimilar flange material

In order to minimize galvanic corrosion when connecting carbon steel flange to a Corrosion Resistant Alloy (CRA) flange, the following rules shall be applied:

- The connection shall be located as far as possible on a vertical pipe
- On carbon steel side, weld overlay shall be applied only on the flange including seal joint contact surface, but with no overlap inside the flange. This requirement is only applicable for:
 - Flanges with RJ facing
 - Flanges ASME Class 150 and 300 if used with graphite flat gasket.
- CRA layer shall be 3 mm thick and shall be of the same chemical analysis as the CRA piping class material, i.e.:
 - SS309L + SS316L for connection with an austenitic stainless steel flange
 - Inconel 625 for connection with a duplex or superduplex flange.
- The bolting and gasket shall be as per CRA piping class
- For RJ flange, hardness of flange groove shall be at least 20 Brinell harder than the gasket.

8.4 Manufacture

8.4.1 Finishing of gasket contact faces

The gasket contact faces of the flanges may be of three main types:

- Flat face
- Raised face
- Grooved for ring joint.

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These contact faces shall undergo finishing machining in accordance with [MSS SP-6](#), as indicated by the table hereafter:

Flange facing designation (contact face)	Flange facing finish type	Roughness Ra
Flat Face (FF)	Spiral or concentric serrated "Smooth Finish"	3.2 μm to 6.3 μm (125 $\mu\text{in.}$ to 250 $\mu\text{in.}$)
Raised Face (RF) 1/16" (1.6 mm) and 1/4" (6.4 mm)	Spiral or concentric serrated "Smooth Finish"	3.2 μm to 6.3 μm (125 $\mu\text{in.}$ to 250 $\mu\text{in.}$)
Ring Joint Groove (RJ)	Extra smooth	1.6 μm (63 $\mu\text{in.}$) Ra max

8.4.2 Hardness of grooves of RJ flanges

Minimum Brinell hardness of the grooves for RJ flanges shall be:

- 110 HB for carbon steel flanges
- 180 HB for stainless steel flanges
- 190 HB for duplex stainless steel flanges.

In any case, the hardness of the groove shall be as a minimum 20 Brinell harder than the gasket.

8.4.3 Drilling

Bolt holes shall be made by multi-spindle drills. This drilling shall comply with [ASME B16.5](#) or [ASME B16.47](#) Series A, depending on the flange diameter (NPS 24 and below or NPS 26 and above).

The spot facing of the flanges at the bolt holes shall be in accordance with [MSS SP-9](#).

9. Gaskets

9.1 General

Asbestos containing gaskets are prohibited.

Graphite impregnated flat gasket shall not be used with CRA (Corrosion Resistant Alloy) material in conductive and aerated water (greater than 50 ppb oxygen).

Type of gaskets to be used (spiral wound, flat or metal ring joint) is specified in each piping class listed in [GS EP PVV 112](#).

9.2 Flat gaskets

9.2.1 Synthetic rubber gaskets

The gaskets shall be made from neoprene fabric or equivalent.

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9.2.2 Other flat gaskets

Only gaskets that have successfully passed the test protocol detailed in Appendix 1 of this specification are considered as qualified. Qualification is valid for 6 years from the laboratory report date.

In case of reported poor operational performance or quality issues, CPY reserves the right to immediately remove gasket qualification.

Any alternatives gasket material shall be submitted to CPY Technology Division for approval. Only material fulfilling all below preliminary parameters will be considered for potential qualification:

- Only fiber-based materials or flexible graphite materials are acceptable. PTFE or PTFE based materials shall be limited to particular applications and subject to a specific CPY approval process.
- Only 2 or 3 mm thickness gasket as mandated per relevant piping class are accepted.
- Flexible graphite material gaskets or sheets cut to size shall be one piece and without any weld.
- Flexible graphite or reinforced fiber based materials sheet cutting shall be carried out by water jet or flash cutter only.
- Gasket faces shall have an anti-sticking coating on both sides.
- For non-asbestos fiber gasket type material, [ASTM F104](#) classification to be F 702100 E03 M7.

In addition to the above, manufacturer shall provide the following information for material complete assessment:

- Gasket faces color coding and manufacturer marking
- Graphite material composition and quality
- Flexible graphite or fiber gasket metallic reinforcement material composition and mechanical properties
- Gasket tensile strength in accordance with [ASTM F152](#)
- Gasket compressibility and elastic recovery in accordance with [ASTM F36](#)
- Gasket stress relaxation in accordance with [DIN 52913](#)
- m and Y as per applicable standard.

9.2.3 Spiral-Wound gaskets

Only spiral-wound gaskets that have successfully passed the test protocol detailed in Appendix 2 are considered as qualified. Qualification is valid for 6 years from the laboratory report issuance date.

In case of reported poor operational performance or quality issues, CPY reserves the right to immediately remove qualification.

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Gaskets shall be in accordance with the standard [ASME B16.20](#) and their spiral-wound portion shall be made from type 316 stainless steel (or higher material grade if required on the relevant piping material specification) strip.

Prerequisites for qualification shall be as follows:

- PTFE or PTFE based fillers are acceptable
- GRAPHITE based fillers shall incorporate an adequate corrosion inhibitor (which shall itself receive the Technology Division of Company prior approval) in order to prevent potential galvanic corrosion.

Gaskets shall have an external centering ring and an inner ring. The two rings are made of either epoxy-polyester coated carbon steel or of stainless steel (i.e., made of the same metallic material as for the stainless steel strip spires). In case of epoxy-polyester coating, the painting quality shall satisfy the following criteria:

- The finished thickness shall be between 60 μ and 100 μ
- There shall be one coat only
- Testing shall be made on one test coupon per batch for the following:
 - Adhesion ([ASTM D3359](#))
 - Impact ([ASTM G14](#))
 - Corrosion (Salt spray test per [ASTM B117](#)).

9.2.4 Metal ring joints

Gaskets for [ASME B16.5](#) and [ASME B16.47](#) ring joint (RJ) shall be octagonal, type R in accordance with [ASME B16.20](#), including maximum hardness limits as stated below:

- Soft Iron: 90 HB
- Austenitic Stainless Steel: 160 HB

9.3 Dimensions

9.3.1 Flat gaskets

Gasket dimensions shall be in accordance with [ASME B16.21](#). Gasket thickness shall be in accordance with relevant piping class but not less than 2 mm.

The gasket inside diameter shall not extend beyond the inside diameter of the flange's bore i.e. gasket inside diameter shall match the bore of the flange and shall not restrict the flow of the process fluids.

9.3.2 Spiral-wound gaskets

The dimensions of spiral-wound gaskets used on raised contact faces shall be in accordance with the standard [ASME B16.20](#).

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9.3.3 Metal ring joints

Ring joints shall be octagonal. Ring joints dimensions shall be in accordance with the standard [ASME B16.20](#), and shall be specified to match with the associated flanges standard.

9.3.4 Special gaskets

For any other type of gaskets or for gaskets with dimensions greater than the limits defined by the relevant standards, the Manufacturer shall submit a dimensional drawing to Company and to the Package Vendor for approval.

10. Bolting

10.1 Dimensions

10.1.1 Stud bolts and screws

The diameters and lengths of stud bolts and Hex screws ("Heavy" series) shall comply with the standards [ASME B16.5](#) and [ASME B18.2.1](#) and shall conform to the dimensions shown on the materials requisitions.

Diameters shall be in inches, and lengths shall be in millimeters.

The lengths given on the requisitions are service lengths that do not include the dimensions of the end bevels.

Stud bolt lengths for the various sizes/classes of flanges shall not exceed those listed in [ASME B16.5](#) and [ASME B16.47](#) flange standards, unless required for bolt-tensioning equipment use.

The location of flanges and fittings should allow for the installation and removal of the bolts and nuts.

Bolts lengths shall be adjusted as necessary to provide a length that result in a maximum of two exposed threads.

10.1.2 Nuts

All nuts for bolts shall be of the hexagonal type ("Heavy" series) and shall be in accordance with the standard [ASME B18.2.2](#).

10.2 Fabrication

10.2.1 General

Stud bolts and nuts may be machined from treated steel rods. However, nuts may also be forged.

Screws shall be made by die-working the heads.

After these operations of forging and die-working, the bolting shall undergo the hardness treatments required by the reference codes and standards.

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10.2.2 Threading

Threading shall be in conformity with the following series of standard [ASME B1.1](#):

- "Coarse" series: for diameters less than or equal to 1"
- "8 threads" series: for diameters equal to or greater than 1" 1/8.

Stud bolts shall be threaded along their entire length. The machining and surface-condition tolerances applicable to the various threading shall be in conformity with the following classes:

- Class 2A of standard [ASME B1.1](#) for stud bolts and screws
- Class 2B of standard [ASME B18.2.2](#) for nuts.

10.3 Surface treatment

Bolting shall be protected against corrosion as stated in Table 1 below.

Table 1 - Fastener corrosion protection requirements

Application	Material grade	Corrosion Protection Paint systems as described in GS EP COR 350
Piping Equipment	CS/LAS uninsulated up to 80°C	HDG + P06 ¹
	CS/LAS uninsulated from 80°C to 200°C	P13 ¹
	CS/LAS uninsulated above 200°C	P11 ¹
	CS/LAS insulated up to 200°C	P13 ²
	CS/LAS insulated above 200°C	P11 2 nd ²
	SS uninsulated	Bare ³
	SS insulated up to 200°C	P13 ²
	SS insulated above 200°C	P11 2 nd ²
Notes ¹ The paint system (except the topcoat) shall be applied on all exposed parts of the bolt/nuts before assembly. The topcoat is applied after assembly. ² The paint system is applied after assembly on the exposed parts. ³ For SS and Nickel based alloy fasteners, "bare" means that the SS and Nickel based alloy are not delivered with any permanent corrosion protection but they may still require coating for other purposes, e.g. galling prevention.		

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11. General design rules

11.1 Layout of piping

The layout and routing of piping and the layout of equipment must:

- Provide sufficient clearance for overhead piping, operating access to the equipment, maintenance and removal of parts and instruments, equipment and machinery.
- Ensure the safety of personnel, with space and means for safe access for operation, maintenance, fire-fighting and evacuation.

The piping layout shall take into account the movement of the piping and the possible movement of the equipment and/or structures to which the piping is connected or by which it is supported.

Piping shall be supported to minimize mechanical stresses and vibrations and to allow for thermal, structural and mechanical movement.

Dead ends and pockets in lines are prohibited. Low or high points inducing gas or liquid pockets shall be avoided as far as possible. They shall be fitted with drains or vents.

Drain and vent valves shall be installed to facilitate hydro testing and purging.

Piping shall not prevent access to manholes, openings and inspection points.

Piping slope and drainage as well as other process requirements shall be taken into account for routing pipe and piping systems.

Piping with instrument connections and monitoring points shall be routed such that safe access to operate and maintain these is ensured; if necessary, platforms, walkways as a means of access shall be provided to allow for this.

Where expansion or contraction may occur, due to heating or cooling, clearance between adjacent pipes shall be large enough to allow for maximum expansion while maintaining minimum clearances as specified above.

11.2 Flexibility of piping

Piping systems are subjected to various loads such as internal pressure, weight of pipe, fittings, insulation and process fluids, wind loads, thermal expansion / contraction, PSV reaction, vessel motions, and deck and structural deflections. All loads shall be taken into account to ensure that piping and supports meet the requirements of the [ASME B31.3](#) code and also do not impose forces and moments in excess on equipments.

Piping system design must also account for vibration from various sources (e.g. acoustic vibration or vibration from compressors) and the environmental conditions.

The flexibility of the piping shall be assured by adequate routing (loops or changes of direction).

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Piping systems shall comply with [ASME B31.3](#) and shall have sufficient flexibility to allow for pipe thermal expansion or contraction and equipment or structural movements, so as to prevent:

- Failure of piping components due to overstress
- Leakage at joints
- Excessive loads on connected equipment, supports, anchor points, flanged connections, etc.

Expansion bellows, expansion joints or flexible hoses shall in no circumstances become the general rule for solving problems of thermal expansion, vibrations, or relative movements: furthermore, they shall only be used after written approval from the Company.

Piping systems shall be screened during the design stage to ensure that flow induced vibration, acoustic induced vibration or vibration from reciprocating machinery is reduced to acceptable levels. Small bore piping and fittings are particularly susceptible to this type of vibration fatigue and additional support may be required.

All small bore piping shall be braced for support in the horizontal and vertical planes when main branch is connected to large bore piping subjected to vibration whether it is process, equipment or acoustically induced. These support shall be welded or clamped to the large bore piping (refer to section 7.1). The design of those supports shall address the differential in thermal expansion between branch and header where needed.

CPY reserve the right to check the flexibility analysis done by the Package Vendor on all the critical lines.

11.3 Allowable forces and moments

11.3.1 Packaged units

The allowable loads at package units tie-in points shall be the same as the ones defined for the pressure vessels (refer to Appendix 1 of the specification [GS EP PVV 211](#)).

11.3.2 Centrifugal compressors

The piping loads shall be in compliance with the [GS EP MEC 251](#).

11.3.3 Centrifugal pumps

The piping loads shall be in compliance with the [GS EP MEC 251](#).

11.4 Installation of instruments

11.4.1 Accessibility and orientation

Instruments shall be located and oriented in such a way that they are directly accessible and readable from the existing fixed ladders and platforms or from the floor.

The vent location/orientation of the integral manifold valve and accessories shall be such that there shall be no risk for the Operator during the bleeding of the device.

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11.4.2 Other in-line instruments

The installation of other instruments in lines (control valves, orifice flanges, etc.) shall comply with the instrument specifications.

11.4.3 Instruments on equipment or piping

The installation of instruments on piping (temperature and pressure gauges, etc.) shall comply with the Piping Hook up standards ([GS EP PVV 102](#)).

Instrument connections on equipment or piping requiring either single block or double block and bleed facilities shall be made using a compact valve design.

This compact valve shall be ball type two or three pieces bolted together.

The side of this compact valve, which connects to the piping or the pressure vessel, must be flanged, whilst the instrument connection side may be flanged or ½" NPT female depending on instrument connection.

Compact valves shall be specified with flanged connections to piping and equipment. The instrument connection shall be threaded NPTF or flanged depending on the instruments types.

The bleed connection shall be ½" NPTF protected by a bleeder.

Bleeder shall include an anti-blow out design screwed bleed fitting allowing valve body cavity depressurization. The bleeder/body connection shall be NPT threaded, sealed with two elastomeric o-rings, located at top and bottom of the thread. ISO thread type is not acceptable instead.

The anti-blow out screwed bleed fitting shall be secured by an additional protective screw or screwed cap. The protective screw or screwed cap shall be securely locked to prevent loosening.

The both shall be protected to prevent accidental damages due to some eventual shock.

For lethal or toxic fluids, screwed bleed plug is not allowed and bleed outlet shall be directly connected to vent or drain network and routed to a safe location for collection and disposal.

NPS 2 flanged thermowells are the minimum size generally used.

Minimum pipe diameter for thermowell connection on straight run pipe shall be NPS 4.

11.5 Vents and drains

11.5.1 Vents and drains for normal operation

They shall include valves terminated by blind flanges, according to the piping hook up standards ([GS EP PVV 102](#)).

All piping shall have vents and drains to permit emptying the process line. Drain and vent connections shall be installed at all low and high points in the piping system. All pockets require drains. Vent and drain connections of valves shall not be used for that purpose.

11.6 Pipe supports

All piping shall be supported, guided and anchored taking into account their deflection, package movement (acceleration and displacement), as well as the differential movements generated by

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the equipment and the stresses, forces and moments on the equipment. Supports shall be installed so as to prevent the effects of vibration.

Particular attention shall be paid to the support of small bore branches to avoid overstress or fatigue failure in the branch area (refer to section 7.1).

Support points shall be adequately located and spaced for optimum load distribution and weight balance.

All support components to be welded on pipes and fittings shall be of the same material as the relevant pipe.

Supporting one line from another should be avoided as much as possible.

No piping support shall be done on flange assemblies.

The systems of anti-uprising of lines are not accepted.

The supports shall be designed to facilitate maintenance painting (no areas difficult to reach).

Supports shall be located as close as possible to changes of direction of the piping (lateral or vertical), taking into account flexibility requirements.

Dummy legs on elbow are prohibited. Their individual acceptance shall be subject to a specific derogation request.

11.6.1 Types of support

11.6.1.1 Clamped supports

Clamped supports are susceptible to corrosion because water may be trapped between the support and the pipe. If clamped supports are used in situations where corrosion may be expected, precautions shall be taken to protect the pipe and the supports against corrosion prior to clamping the pipe. To prevent galvanic corrosion, carbon steel clamps on pipes of other metallic materials shall be separated from the pipe by using a system as defined in section 11.6.3.2 for CRA piping in marine atmosphere.

Clamped supports require more maintenance than welded supports.

For piping systems where only small forces on supports can be expected (e.g. instrument air systems) the use of U-bolts may be considered. The use of U-bolts is allowed only for NPS up to 4. U-bolts shall be avoided for lines with vibration risks (i.e. reciprocating machines system, lines with risk of flow induced turbulence, etc), in that case Hold down Clamp supports with anti vibration washer and nuts shall be used.

11.6.1.2 Welded supports

Welded supports are less susceptible to corrosion than clamped supports.

Welded pipe supports shall be attached to the matching piece of pipe or fitting by means of a doubler plate in order to avoid direct welding of the piping component to its support.

Welded pipe shoe/saddle shall be avoided for lines that having a risk of acoustic induced vibration. Full encirclement pipe shoe/saddle shall be used instead to avoid asymmetric discontinuity between pipe and pipe shoe/saddle and to damp-out the level of shell vibration. Clamp shoe/saddle may be used as an alternative.

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11.6.1.3 Spring supports

At points of support subject to vertical movements, spring supports of suitable design shall be used to prevent excessive load variation.

11.6.1.4 Snubbers

Snubber is PROHIBITED.

11.6.2 Supports on non-insulated lines

The following pipes shall be supported on pipe shoes in order to avoid damaging the pipe wall:

- Pipes larger than 4" in marine atmosphere
- Carbon steel pipes with a wall thickness less than schedule 20
- Stainless steel pipes with a wall thickness less than schedule 10S.

When the pipes rest on supporting structures without pipe shoe, a protective sheet, as GRP sheet or neoprene sheet or Teflon, shall be inserted between the pipe and the supporting structure to avoid direct contact that can cause corrosion and fretting damage on pipe. The selection of the material for protective sheet shall be subject to the Company approval.

Supports for lines NPS 1½ and below shall be designed by the Package Vendor.

11.6.3 Supports in marine atmosphere

11.6.3.1 General

Supports in marine atmosphere shall be designed to avoid potential corrosion built-up. To this end metal to metal sliding contact which may damage the pipe coating shall be avoided as well as any potentiality of water accumulation between pipe and support.

Lines shall not directly rest on supporting structure. All lines shall be supported by cradles and shoes welded to the pipe to raise piping from supporting structure by a minimum of 100 mm to allow for inspection and paint maintenance.

However, for small bores pipes NPS up to 4, U-bolts may be used if polyethylene, polypropylene or PTFE sheets are inserted between U-bolt and Pipe, and between Pipe and Support. Polyolefin sheathed U-bolts may also be used.

11.6.3.2 Supports for corrosion resistant alloy (CRA) piping

To avoid potential crevice corrosion at supports, corrosion resistance alloy piping shall mandatorily have external surface protected by either:

- A doubler plate directly welded to the pipe wall by a continuous weld, the welding gas vent shall be plugged by screwed or welded metallic plug or plastic materials. The doubler plate shall be of the same material as the pipe onto which it is welded, the rest of the support being made of carbon steel.
- A stratified shell composed of laminated epoxy resin reinforced with fibreglass glued to the pipe.

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11.6.4 Supports on insulated lines

Pipe clamps of hanger assemblies shall have their rod attachment outside the insulation.

Insulated pipes shall not rest directly on their insulation but pipe shoes shall be used.

The clearance between the insulation and the supporting structure shall be at least 100 mm to enable for inspection and paint maintenance.

11.6.5 Fabrication and Material

11.6.5.1 Materials

All parts of support elements in contact or directly welded on the piping or supporting the gradient of temperature will have to be made of the same material as the supported line.

Doubler Plate, directly welded to the pipe wall (100% welding), shall be made from the same type of material as the pipe onto which it is welded and shall have a vent hole. The vent hole shall be plugged by screwed or welded metallic plug. The doubler plates shall be welded in the workshop.

11.7 Fabrication

11.7.1 Piping welded connection

11.7.1.1 General

Branch connections shall be made by fabricated set-on type, outlet fittings (weldolets, etc.) or tees, as indicated in Appendix 3 of the piping material classes of [GS EP PVV 112](#).

Connection made by welding set-on type branches onto the main header, with or without reinforcing pad (depending on calculation results) is allowed and shall comply with chapter 304.3 of [ASME B31.3](#). Such connection shall be supported by a calculation note and shall be reviewed by the managing entity.

All welded branch connections shall be joined to the header with full penetration welds.

11.7.1.2 Requirements for location of welds

Distance between two successive girth butt welds shall not be less than 50 mm or half a pipe diameter whichever is greater.

However this distance shall not be less than 50 mm or one pipe diameter whichever is greater when at least one of the following conditions applies:

- Non Carbon Steel material
- Any piping below 12".

The same requirements are applicable to the distance between a girth butt weld and an integral reinforced connection or any other branch connections.

Location of welds shall always permit to proceed with all applicable non destructive examinations.

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Shrinkage effect induced by welding shall not alter the tightness of pre-existing mechanical connections.

Two successive longitudinal weld seams shall be staggered by 30 degrees minimum.

11.7.1.3 Socket welds

When socket weld fittings or valves are used, the pipe face shall be spaced approximately 1 to 1.5 mm clear from the root face of socket to avoid "bottoming" which could result in excessive weld stresses and possible cracking. Socket welds shall be made with at least two passes.

11.7.1.4 O'lets

The bevel portion of the fitting marked by the "weld line" (mandatory information to be provided by manufacturer) shall be filled. Filling up to the rib of the skirt portion of the fitting is useless and may introduce unnecessary potential distortion.

It shall be verified that the weld profile is slightly concave all around the clock.

11.7.1.5 Sealing

Seal welds are generally prohibited on threaded assemblies.

The list of types of threaded connections subject to seal welding shall be submitted to Company for approval.

11.7.1.5.1 Hydrocarbon and non flammable service

Threaded plugs on hydrostatic vents not provided with a valve shall be seal welded after testing has been carried out. Caps shall not be seal welded.

11.7.1.5.2 Seal welding

Where seal welding of threaded joints is used, all following conditions shall be met:

- The materials shall be suitable for welding
- The joints shall be made up clean and without the use of any tape or compound
- The weld shall cover all exposed threads and shall be a continuous weld without surface defect
- Seal welds shall be done with GTAW or SMAW process with electrodes of 3.2 mm maximum exclusively
- Welding shall only be carried out by qualified welders
- No other satisfactory means of jointing are available.

11.7.2 Vents and tell-tale holes

Vent and tell-tale holes are intended to vent doubler-plate or support during welding and to they shall be tight plugged after the hydrostatic test of the equipment or line.

11.8 Welding Inspection and Non Destructive Examination

Welding inspection shall be made in accordance with [ASME B31.3](#) and the additional requirements defined herein.

11.8.1 Extent of NDT

11.8.1.1 Visual inspection

A 100% visual inspection of all welds shall be done after cleaning and prior to any subsequent NDT.

11.8.1.2 Other NDT requirements

The extent of NDT requirements other than visual inspection is defined in the Table 2 hereafter.

Table 2 - NDT Requirements

Service conditions	Fluid Cat 1 ⁽¹⁾ Standard extend control		Fluid Cat 2 ⁽¹⁾ Reinforced extend control	
	≤ 600	≥ 900	≤ 300	≥ 600
Pressure class				
Longitudinal welds	C	C	C	C
Girth welds	A	C E	B ⁽²⁾ E	C F
Socket welds (note 3)	None	E	E	F
Pressure-containing Tee welds such as pipe-to-pipe branch connections (including reinforcing pads) and branches made with "O-let" fittings, slip-on flange welds, pipe couplings, etc.	D	E	E	F
Non pressure-containing fillet welds (attachments welds to pressure-containing parts, supports)	None	D	D	E

(1) Fluid Category is defined in the Table 3 here after.

(2) 100% RT for lines subject to pneumatic tests.

(3) Ten percent of socket welds shall be radio graphed in order to check the gap between the male and female parts of the assembly. In no case this inspection is meant to be a weld imperfection (soundness) check.

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NDT and extent

- A = Minimum 5% of random radiographic testing (RT) i.e. one complete weld out of twenty for each welder or welding Operator, per WPS, or one weld minimum per prefabricated spool.
- B = Minimum 10% of random RT i.e. two complete welds out of twenty for each welder or welding Operator, per WPS, or two welds minimum per prefabricated spool.
- C = 100% RT.
- D = 5% Magnetic Particle (MPI) or Dye Penetrant (DPI) Inspection i.e. one complete weld out of twenty for each welder or welding Operator, per WPS.
- E = 10% Magnetic Particle (MPI) or Dye Penetrant (DPI) Inspection i.e. two complete welds out of twenty for each welder or welding Operator, per WPS.
- F = 100% Magnetic Particle (MPI) or Dye Penetrant (DPI) Inspection

Notes related to spot or random examination:

- Section 341.3.4 of the design code [ASME B31.3](#) applies in full for progressive sampling for examination when required spot or random examination reveals a defect or an indication of defect.
- Company reserves the right to choose the welds to be inspected.
- If the weld reject ratio (= number of defective welds divided by number of inspected welds) per welder or welding Operator exceeds 5%, extent of NDE shall be increased to 100% and shall stay at 100% until the reject rate per welder or welding Operator drops below 5% and stays there for five consecutive working days.
- Additional requirements shall also apply as expressed in below related sections.

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Table 3

CODE	FLUID	FLUID CATEGORY	CODE	FLUID	FLUID CATEGORY	CODE	FLUID	FLUID CATEGORY
AIR			PROCESS			CHEMICALS		
IA	Instrument Air	1	AG	Acid Gas	2	AF	Anti Foam	1
PA	Process Air	1	AM	Amine	2	AV	Volatile Amine	1
SA	Service air	1	BP	Butane Product	2	BI	Biocide	1
UA	Utility Air	1	CF	Fresh Caustic	2	CG	Coagulant	1
CLOSED DRAINS			DF	Disulfide Oil (DSO)	2	CI	Corrosion Inhibitor	1
AD	Amine drain	1	EP	Ethane product	2	DE	Demulsifier	1
CD	Closed Drain	1	HG	Hydrocarbon Gas	2	FE	Ferric Chloride	1
DC	Cold Drain	1	GD	Glycol (DEG)	2	HI	Hydrate Inhibitor	1
DD	Disulfide Drain	1	GM	Glycol (MEG)	2	HY	Sodium Hypochlorite	1
DS	Sour Water drain	1	GT	Glycol (TEG)	2	ME	Methanol	1
GD	Glycol Drain	1	HC	Hydrocarbon G/L (2 Phases)	2	MO	Morpholine	1
MD	Methanol Drain	1	HL	Hydrocarbon Liquid	2	OX	Oxygen Scavenger	1
STEAM CONDENSATES			LC	Lean Caustic	2	PD	Parafin dispersant/Wax inhibitor	1
CC	Cold Steam Condensates	2	LPG	LPG mixture	2	PC	Ph Controller	1
CL	LP Steam Condensates	2	LNG	Liquefied natural gas	2	PH	Phosphate	1
CH	HP Steam Condensates	2	MR	Mixte refrigerant	2	PPD	Pour Point Depressant	1
CM	MP Steam Condensates	2	NGL	NGL mixture	2	RE	Reverse demulsifier	1
CP	Polluted Steam Condensates	2	PP	Propane Product	2	SI	Scale inhibitor	1
FLARES/VENT			PR	Propane Refrigerant	2	SB	Sodium Bicarbonate	1
FA	Acid Flare	2	RC	Rich Caustic	2	SU	Sulphite	1
FC	Cold flare	2	SC	Spent Caustic	2	SY	Sodium Hydroxide	1
FH	High Pressure Flare	2	TG	Tail gas	2	MISCELLANEOUS		
FL	Low Pressure Flare	2	LS	Sulphur (Liquid)	2	ATM	Atmospheric Vent	1
VE	Vent	1	SS	Sulphur (Solid)	2	BB	Boiler Blowdown	1
SEWER			WATER			BR	Brine Reject	1
CS	Chemical Sewer	1	BW	Boiler Feed Water	1	CA	Catalyst	1
OD	Oily Water Sewer (Open Drain)	1	CW	Cooling Water	1	GI	Instrument Gas	1
WD	Domestic Sewer	1	DW	Drinking Water	1	HH	Hydraulic Fluid	1
STEAM			HW	Hot Water	1	HO	Hot Oil	2
SH	High Pressure Steam	2	FW	Fire Water	1	LO	Lube Oil	1
SL	Low Pressure Steam	2	PW	Produced Water (Oily Water)	1	SG	Seal Gas	1
SM	Medium Pressure Steam	2	RW	Desalinated Water	1	SO	Seal Oil	1
FUEL			SW	Sea Water	1	RF	Refrigerant	1
D	Liquid fuel	1	TW	Demineralised Water	1			
F	Fuel gas	1	UW	Utility Water	1			
FG	Fuel gas	1	WA	Foam Solution Water (Fire Fighting)	1			
DO	Diesel Oil	1	WI	Water Injection	1			
INERT GAS			WP	Spent or Waste Water	1			
HAL	Halon Gas	1	WT	Stripped Water	1			
IG	Inert Gas	1	WW	Water from Water Well	1			
NG	Nitrogen	1						
CDI	CO2	1						

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11.8.2 Particular case of welds of piping supports

11.8.2.1 All welds

All welds shall be 100% visual inspected.

11.8.2.2 Fillet welds

Welds between supports and main or secondary steel structure to which they are attached shall be subject to 100% MPI or DPI if they are supporting at least one line of NPS 10 or above.

Welds between supports and main or secondary steel structure to which they are attached shall be subject to 10% MPI or DPI if they are supporting lines NPS 10 and below.

Other welds shall be subject to MPI or DPI of one weld every 20 welds made by each welder or welder Operator.

11.8.2.3 Butt welds

Radiographic examination of one weld every 10 welds made by each welder or welder Operator.

11.9 Types and methods of examination

11.9.1 Visual examination

This shall be carried out before, during and after fabrication in accordance with [ASME BPVC Section V](#) article 9 and [ASME B31.3](#).

11.9.2 Radiographic inspection

Radiographic examination shall be in accordance with [ASME B31.3](#).

11.9.3 Magnetic particle inspection

When this method of examination is specified or required, it shall be carried out in accordance with [ASME BPVC Section V](#) article 7.

It is the preferred method of surface crack detection for carbon steel materials.

11.9.4 Liquid penetrant

When this method of examination is specified or required, it shall be carried out in accordance with [ASME BPVC Section V](#) article 6.

12. Valves

This chapter defines the minimum requirements for the design, fabrication and inspection of all the conventional valves designs (i.e. gate, butterfly, globe, ball, and check).

Compact valves comprising a combination of several valves shall also fully comply with this specification. Use of such compact valves shall be limited to instrument connections only.

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Integral manifolds that include two on line block valves are not addressed by the specification for on line application regardless of the line service. Such manifolds are subject to specific approval from Company.

This chapter shall apply to manual, On/Off valves and Control valves.

12.1 Valve data sheets

For all valve types and classes, valve data sheet shall be provided and shall clearly identify the service fluids and line design conditions as those will impact the valve design, manufacturing and testing requirements.

Valve data sheets shall be established from the template given in Appendix 3 of this specification. All information shall be filled out in order to provide the most accurate description of the product to be purchased.

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.

For each actuated valve tag, an instrument data sheet shall be provided in addition to the valve data sheet.

12.2 Definition of service classes for valves

Valves shall be classified as per Table 4 below depending on their service conditions.

Table 4 - Definition of service classes for valves

Valve Service Class	A	B	D
Fluids	Water - Air - Nitrogen Hydraulic oils	Hydrocarbons (liquid and gas)	Hydrocarbons (liquid and gas)
Service	Utility or non critical water injection	General process Production process Transport	General process or utility
Design Temperature Range	$T \leq 75^{\circ}\text{C}$ $T \geq \text{Ambient}$	$T \leq 200^{\circ}\text{C}$ $T \geq - 46^{\circ}\text{C}$	$T > 200^{\circ}\text{C}$

12.3 Materials

12.3.1 General requirements and limitation for casting material

Unless otherwise specified steel casting for pressure containing parts shall comply with general requirements of [ASTM A703/A703M](#) including all its supplementary requirements S1 to S34 as far as applicable.

The requirements of the full specification [ASTM A703/A703M](#) also applies to pressure controlling parts when casting is allowed by the present general specification.

Weld repairs shall be documented as soon as they come under section S20 of [ASTM A703/A703M](#) for any material or not by the standard.

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

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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.

Weld repairs are not allowed on seats and obturators.

Unless otherwise specified minimum requirements for impact test values are shown in Table 5 below.

Table 5 - Minimum impact requirements on casting material in delivery conditions

Material	Valve Minimum Design Temp.	Wall thickness. Valve component	Impact Test Temperature	Minimum Impact Test Value (unless otherwise specified)
Carbon Steel	T ≥ -29°C	< ½ inch	NA	Impact testing not required
Low alloy steel		≥ ½ inch	-29°C	min. 20 J average for 3 specimen min. 16 J for individual specimen
Duplex St. Steel Low alloy steel	T ≥ -46°C	All thickness	-46°C	according to API SPEC 6D section 6.6, except for pup pieces of valves with butt welding ends (see note here after)
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 . Local regulation or specific project conditions may ask for higher impact test values.				
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 .				

12.3.2 Toughness test requirements

Toughness test requirements shall comply with [API SPEC 6D](#) section 6.6 (except for casting defined on Table 5 here above).

12.3.3 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.