

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 155

Gate, Globe and Check Valves

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1. Scope

This specification comes in addition to the definitions given in material requisitions and associated valve data sheets. It defines supplementary requirements for the fabrication, inspection and shipment of all conventional and proprietary metal seated gate, globe and check valve designs for onshore or offshore facilities.

This specification applies to all valves with body material made of ductile cast iron, carbon steel, alloy steel, corrosion resistant alloys, PVDF, bronze and other copper alloys. Specification shall also apply to all manual, on-off and control valves.

Potential use of gate, globe and check valve design for ESDV, SDV, BDV, HIPS, DBB or any other critical applications is not addressed in this document and shall be subject to supplementary requirements to be agreed with Managing Entity.

This specification applies to all process piping and pipeline valves regardless of the line design code.

The specification does not address any local regulation requirement.

In addition to the present specification, valves in cryogenic service (i.e. for use at continuous operating temperatures below -41°C) shall comply with **GS EP PVV 150**. Similarly, valves in high temperature service (i.e. with design temperature above 200°C) shall comply with **GS EP PVV 151**.

The specification does not intend to address all the safety concerns associated with its use. It is user responsibility to establish appropriate safety and health practices prior to product use.

2. Reference documents

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

Any conflicting requirements between this specification and any other relevant documents shall be reported to the Managing Entity for arbitration. In any case, and notwithstanding the final decision of the Company, the most stringent requirement is always first meant to govern.

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 6A	Specification for Wellhead and Christmas Tree Equipment
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

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Reference	Title
API STD 602	Gate, Globe, and Check Valves for Sizes DN 100 (NPS 4) and Smaller for the Petroleum and Natural Gas Industries
API STD 607	Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats
API STD 623	Steel Globe Valves - Flanged and Buttwelding Ends, Bolted Bonnets
API STD 624	Type Testing of Rising Stem Valves Equipped with Graphite Packing for Fugitive Emissions
API STD 6FA	Standard for Fire Test for Valves
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 B16.24	Cast Copper Alloy Pipe Flanges, Flanged Fittings and Valves: Classes 150, 300, 600, 900, 1500 and 2500
ASME B16.25	Buttwelding Ends
ASME B16.34	Valves - Flanged, Threaded and Welding End
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 B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME BPVC Section IX	ASME Boiler and Pressure Vessel Code (BPVC) - Section IX: Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators
ASME BPVC Section VIII Div 2	ASME Boiler and Pressure Vessel Code (BPVC) - Section VIII: Rules for Construction of Pressure Vessels - Division 2: Alternative Rules
ASNT SNT-TC-1A	Recommended practice for personal qualification and certification in nondestructive testing
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

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Reference	Title
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 A453/A453M	Standard Specification for High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels
ASTM A961/A961M	Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves and Parts for Piping Applications
ASTM B150/B150M	Standard Specification for Aluminum Bronze Rod, Bar, and Shapes
ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
EN 10204	Metallic products - Type of inspection documents
EN 12570	Industrial valves - Method for sizing the operating element
EN 60529	Degrees of protection provided by enclosures (IP Code)
ISO 10497	Testing of valves - Fire type-testing requirements
ISO 15156 (All parts)	Petroleum and natural gas industries - Materials for use in H ₂ S-containing environments in oil and gas production - All parts
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 5208	Industrial valves - Pressure testing of metallic valves
ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
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
MSS SP-6	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-Ends Flanges of Valves and Fittings

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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 COR 356	Corrosion Protection of Fasteners
GS EP INS 137	On/Off Valve Control Panels and Actuators
GS EP PVV 112	Piping material classes
GS EP PVV 141	Piping Material Data Sheets
GS EP PVV 147	Gaskets for piping and vessels
GS EP PVV 150	Valves in cryogenic service
GS EP PVV 151	Valves for high temperature service
GS EP PVV 158	Material and special process for valves (MDS & manufacturing processes)
GS EP PVV 611	Welding of pressure containing piping and equipment

3. Terms and Definitions

Technical terms, acronyms and abbreviations of the present specification follow the definitions given in [API SPEC 6D](#).

Additionally, the following list also applies:

Inspection Agency	The body in charge of product inspection of the products on behalf of purchaser at the manufacturer (or its subcontractor) premises.
Managing Entity	Entity identified on the front page of the document
PMC	Piping Material Class
ITP	Inspection Test Plan
NFI	Notification For Inspection
IOM	Installation and Operation Manual
MPD	Maximum Pressure Differential

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Each valve shall be given a service class depending on their service conditions as defined in below Table 1.

Table 1 - Definition of service classes for valves

Valve Service Class	A	B	C	D
Fluids	Water - Air - Nitrogen Hydraulic oils Chemicals (2)	Hydrocarbons Chemicals (2)	Hydrocarbons (1)	Hydrocarbons Steam
Service	Utilities Water systems	General process Production process Transport	General process (Cryogenic)	General process or utility
Design Temperature Range	$T \leq 85^{\circ}\text{C}$ $T \geq \text{Ambient}$	$T \leq 200^{\circ}\text{C}$ $T \geq -46^{\circ}\text{C}$	$T < -46^{\circ}\text{C}$	$T > 200^{\circ}\text{C}$

Note to Table 1:

- (1) Continuous operating temperature shall also be below minus 41°C for valves falling under service class C.
- (2) Chemical service ASME Class 300 and below shall be classified under Service Class A. For chemical service ASME Class 600 and higher, Service Class B shall be used.

Above defined service class along with valve size factor induces a criticality level that is translated into five manufacturing quality levels:

- **Quality Level 1:** Gate, Globe and Check valve service class A, ASME Class ≤ 600 .
- **Quality Level 2:** Gate, Globe and Check service class A, ASME Class > 600 .
- **Quality Level 3:** Gate, Globe and Check in non toxic or non lethal Hydrocarbon liquid service, ASME Class < 2500 . Gate, Globe and Check in chemical service, ASME Class ≥ 600 .
- **Quality Level 4:** Gate, Globe and Check in toxic or lethal Hydrocarbon liquid service, Hydrocarbon gas service, ASME Class < 2500 .
- **Quality Level 5:** Gate, Globe and Check, ASME Class ≥ 2500 and [API SPEC 6A](#) pressure rating ≥ 5000 psi.

4. Pressure Temperature Ratings

The valves shall be designed according to [ASME B16.34](#) standard class pressure rating or [API SPEC 6A](#) pressure rating as applicable. When allowed in the relevant piping class, valve below 2 inches can be designed to 800 intermediate pressure rating.

Paragraph 4 of [API STD 594](#), [API STD 600](#), [API STD 602](#) and [API STD 623](#) standards shall apply in full with the exception that all valves shall be rated for any pressure and temperature combinations allowed by the line rating. Pressure/temperature limitations imposed by special soft seats or trim materials shall be subject to specific Managing Entity approval.

In addition to that, for what concerns [API STD 600](#) paragraph 4.5; the word user shall be replaced by the word supplier, hence requesting manufacturer to provide the necessary means to prevent any potential cavity overpressure from occurring.

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5. Design

5.1 General Design Requirements

As a minimum, valve design shall be in full compliance with both [ASME B16.34](#) and paragraph 5 of relevant [API STD 594](#), [API STD 600](#), [API STD 602](#) and [API STD 623](#) Standards

Similarly, valve design according to [API SPEC 6D](#) or [API SPEC 6A](#) shall also be in full compliance with the standard.

In addition to the above, design supplementary requirements listed in this specification shall supersede any of the ones given by an international standard.

Gate and globe valves shall be rising stem design and suitable for re-packing under pressure in full open position.

Valve stems shall be designed such that the weakest link is outside of the pressure boundary.

For carbon steel valves in PMC with corrosion allowance 3 mm and higher, back seat shall be hard faced.

Globe valve seats for sizes NPS 2 and above shall be threaded and removable type. Welded seats are not acceptable. Gate, globe and check valves NPS 2 and above shall be field repairable.

Globe valve stellite coated plug shall be of the same material than the valve body.

Check valves in hydrocarbon service shall have a retainerless design.

Check valve disk shall be mechanically locked to the hinge arm.

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 than the valve trim.

Check valve spring shall be made out of a material grade suitable for service and operating conditions.

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

Weld-on flanges or hub are not allowed.

When the back seat is not integral with the bonnet, the back seat shall be secured in place using a positive mechanical lock. Locking by tack welding or metal upsetting (such as peening or staking) is not permitted.

5.2 Design Assessment

For each type of valve, Manufacturer shall submit a 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 the potential service external loads, tension and bending moments shall be taken into account. This analysis shall be performed in true service conditions, considering not only assembly orientation but also the actuator maximum possible torque or thrust.

Lifting lugs and valve support shall also be provided as part of the calculation notes.

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Stem and drive train components calculation shall comply with [API SPEC 6D](#) requirements.

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

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

(YS being the nominal yield strength of the material considered)

For actuated valves, bonnets, stems and stem extensions shall be designed and calculated to withstand the maximum torque/thrust delivered by the actuator at the maximum actuator output. For hand-operated valves, bonnets, stem and stem extensions shall also be designed to withstand the maximum anticipated torque that might be applied during the operation of the valve.

Except for valves designed according to [API SPEC 6A](#), all bolting calculations must meet [ASME B16.34](#) requirements. As a minimum, these stress value limitations shall address both the internal pressure loading as well as the gasket setting pressure when applicable.

In addition to the calculation note, FEA shall be provided for [API SPEC 6A](#) valve as well as for any valve above 12 inch in class 2500. The FEA shall then comply with the requirements of section 5.4.

5.3 Fire Safe Design

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

Gate and globe valve designs shall comply with [ISO 10497](#) or [API SPEC 6FD](#) for check valves. Qualifications performed in accordance to other recognized standards such as [API STD 607](#) or [API STD 6FA](#) can also be considered only if fully documented.

Test valve body bolting used shall be of the same material classification than the valve body.

To demonstrate that valves compliance with these requirements, Manufacturer shall supply with his quotation copies of Certification issued by a recognized Inspection Authority confirming that this requirement has been met for all items offered, and that appropriate testing has been carried out to demonstrate the "fire safe" 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 "fire safe" design of the supply. The validation of the qualification will be limited to valves of the same design, showing the same sealing material as identified by [ISO 10497](#) and sealing arrangement as the qualification valve. Only fire test certification with test date of less than 10 years shall be considered.

5.4 Specific Design Requirements for [API SPEC 6A](#) valves

Valve manufacturer shall have a valid license certificate to [API SPEC 6A](#) for the proposed range of products. Valve shall be designed and tested to the full rating unless otherwise specified.

Unless otherwise specified, material requirements shall meet PSL3 and quality control requirement PSL3, or PSL3G for valves in gas service.

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Bolt allowable stresses shall not exceed those established by [ASME BPVC Section VIII Div 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.

FEA shall include all pressure-containing parts and pressure-controlling parts.

FEA shall be conducted according to Part 5 of [ASME BPVC Section VIII Div 2](#) for the overall valve design and sizing of part for all significant loading and/or combination loadings at their respective design conditions.

Body bolting, top cover bolting or bonnet bolting shall additionally be verified by finite element analysis according to Part 5 of [ASME BPVC Section VIII Div 2](#) for the full loading sequence starting with the pre-tensioning of the bolts.

Pre-tensioning of the bolt shall never exceed 75% of the yield strength of the bolt material being understood that the yield strength is the mean value of three studs or fasteners of the same material, same source, same furnace batches and same section as the ones installed in the valves. Pre-tensioning of bolt obtained by a pure axial loading shall be preferred to other processes inducing transverse parasitic loading.

As a minimum, 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 successfully been qualified in accordance to [API SPEC 6A](#) Appendix F verification test procedure shall be considered.

PR1 and PR2 valves qualifications shall be presented (including pressure and temperature ranges, material class, qualification testing procedure, testing report, general and cross sectional drawings, approved final testing certificate...) to Managing Entity for a complete assessment.

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

FEA report shall provide all details related to meshing (elements characteristics, selection criteria...). It shall also include pressure containing and controlling parts stress and deformation outputs.

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

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

5.5 Body Dimensions

Valve face to face shall be in accordance with the relevant design standards. Globe valve design to [API STD 623](#) and gate valve design to [API STD 600](#) shall follow [ASME B16.10](#) face to face requirements. Non standard valve face to face shall be agreed between purchaser and valve manufacturer.

For sizes over DN 600 (NPS 24), body end flanges shall comply with the dimensional requirements of [ASME B16.47](#) Series A.

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Flanged ends 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.

Surface finish of flange faces shall be in accordance with [MSS SP-6](#) or [API SPEC 6A](#) as applicable.

Screwed flanges are only allowed for bronze valve bodies and 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 purchaser. Where tapped holes are permitted, the depth of thread engagement shall conform to [ASME B16.34](#).

Unless otherwise specified, valve butt-welding ends shall comply with [ASME B16.25](#). Ends IDs shall match the ones of the connecting pipe.

All butt-welding end valves shall be supplied with pup pieces to allow for transition between the valve body and the connecting pipe. Pup piece dimensional and material requirements as well as associated welding procedure shall be subject to Managing Entity approval.

Hub ends shall be designed considering:

- Valve body and pipe material.
- Hub rating shall comply with the valve nominal pressure class given in the relevant material group table of [ASME B16.34](#) or [API SPEC 6A](#) pressure rating.
- Hub rating shall be able to withstand the valve maximum test pressure (i.e. 1.5 times the nominal pressure class at ambient as defined in table 2 of [ASME B16.34](#) or [API SPEC 6A](#)).

Hub manufacturer shall supply the maximum allowable loads considering the maximum design pressure and temperature (axial force, bending moment, torsional moment and all the relative loading combinations). The same data shall be supplied for the ambient test conditions.

For valves NPS 24 and below, reduced port shall be one size below the valve nominal size with minimal bore according to the table 1 of [API SPEC 6D](#) or [API SPEC 6A](#).

Reduced valves openings for valves above NPS 24 shall not be less than two sizes below nominal size of valve with minimal bore according to the table 1 of [API SPEC 6D](#). Valve installed on piggable line shall have the same bore throughout the entire valve face to face as well as for the transition piece and pup piece if applicable. Bore shall match the pipeline internal diameter.

5.6 Bonnet to Body Joint

The gaskets of bolted bonnet or cover flange joints shall be suitable for the valve pressure class 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.