

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 111

Piping design specification

11	10/2015	New revision
10	08/2012	Update following the EP reorganization, March 2011
09	01/2011	New revision
08	10/2009	Update of reference documents
00	03/2001	First issue
Rev.	Date	Purpose of the revision

Owning entity: DSO/TEC	Managing entity: DSO/TEC/PVV
------------------------	------------------------------

General Specification		GS EP PVV 111
Piping design specification		
Rev.: 11	Effective date: 10/2015	Page: 2 of 40

Contents

1. Scope	4
2. Reference documents	4
3. Materials.....	7
3.1 Tubes.....	7
3.2 Fittings	7
3.3 Branch connections	9
3.4 Flanges.....	10
3.5 Gaskets and bolts	12
3.6 Valves	12
3.7 Change of piping material class (pressure break only)	13
3.8 Blinds, Spectacle Blinds and Spacers	13
3.9 Special Piping Items (SP items)	14
3.10 Flexible Hoses	14
3.11 Non-Metallic material other than GRP used in chemical application.....	14
4. General design rules.....	15
4.1 Layout of piping.....	15
4.2 Flexibility of piping.....	17
4.3 Clearances and access.....	18
4.4 Installation of valves.....	22
4.5 Installation of instruments	23
4.6 Vents and drains	25
4.7 Isolation	25
4.8 Utility stations.....	26
4.9 Sample collection points	26
4.10 Thermal insulation and heat tracing	27
5. Special design rules.....	27
5.1 Vessels and columns	27
5.2 Storage tanks.....	28
5.3 Reactors	28

General Specification		GS EP PVV 111
Piping design specification		
Rev.: 11	Effective date: 10/2015	Page: 3 of 40

5.4	Heat Exchangers	28
5.5	Air coolers	29
5.6	Heaters	29
5.7	Pumps	30
5.8	Compressors	31
6.	Pipe supports	32
6.1	General	32
6.2	Identification of supports	32
6.3	Temporary supports	32
7.	Principle for the preparation of the main piping drawings, documents and models	32
7.1	General appearance of documents	32
7.2	Piping and Instrument Diagrams (P&ID's)	32
7.3	Line list	34
7.4	General drawings	34
7.5	Piping drawings	36
7.6	Isometric drawings	37
7.7	Piping supports	37
7.8	3D CAD Models	38
8.	List of equipment	38
8.1	Characteristics of equipment	38
8.2	Identification of equipment	39
	Bibliography	40

General Specification		GS EP PVV 111
Piping design specification		
Rev.: 11	Effective date: 10/2015	Page: 4 of 40

1. Scope

This document sets rules for the design of piping systems (process and utilities) of onshore and offshore petroleum installations.

This document shall be used in conjunction with [GS EP SAF 021](#), [GS EP ECP 103](#) and [GS EP PVV 112](#).

Offshore piping systems shall comply with [API RP 14E](#).

The scope is essentially the same as that of [ASME B31.3](#). The following are specifically excluded: onshore and offshore pipelines, furnaces and boilers tubes, building heating and ventilation piping.

The project particular specification shall consider this general specification for all systems and also shall define its application in various equipment packages.

For the lines within equipment packages that are not ruled out by the managing entity named on the front page of the present document, the application of this general specification shall be decided by the entity in charge on a case-by-case basis.

2. Reference documents

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

Any divergence between any of the Contractual Reference Documents, or between this specification and any other Contractual Reference Document, shall be reported to the Company for decision. In such a case, and unless otherwise agreed or decided by the 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 the Company. For this purpose, requests for substitutions or changes of any kind shall be complete with all pertinent information required for the Company assessment.

External Documents

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

If the country of installation has its own regulation, it must be applied wherever more stringent than the Basic Code.

Any Construction Code or Government Regulations, which may be listed in the Project Specifications or in the Contract, shall have precedence except where this Specification is more stringent.

Process and utilities piping shall comply with the requirements of [ASME B31.3](#).

The [ASME BPVC Section I](#) shall be applied for certain sections of piping connected to steam generators. The portions of piping to which this code is applied shall be clearly identified on the flow diagrams.

Piping design specification

Rev.: 11

Effective date: 10/2015

Page: 5 of 40

Reference	Title
API RP 14E	Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems
API SPEC 6A	Specification for Wellhead and Christmas Trees Equipment
API SPEC 6D	Specification for Pipeline and Piping Valves
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 B16.36	Orifice Flanges
ASME B16.47	Large diameter steel flanges NPS 26 through NPS 60
ASME B16.48	Line Blanks
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 B31.3	Process Piping
ASME B36.10M	Welded and Seamless Wrought Steel Pipe
ASME B36.19M	Stainless Steel Pipe
ASME BPVC Section I	Rules for Construction of Power Boilers
ASME BPVC Section VIII Div 1	Rules for Construction of Pressure Vessels
ASME BPVC Section VIII Div 2	Rules for Construction of Pressure Vessels - Alternative rules
BSI PD 5500	Specification for unfired fusion welded pressure vessels
MSS SP-6	Standard Finishes for Contact Faces of Pipes Flanges and Connecting-ends Flange of valves and fittings
MSS SP-97	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded, and Buttwelding Ends

Piping design specification

Rev.: 11

Effective date: 10/2015

Page: 6 of 40

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
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 771	Thermal insulation (hot and dual services)
GS EP COR 772	Thermal insulation (cold service)
GS EP ECP 103	Process sizing criteria
GS EP ECP 105	Process and Flow Assurance deliverables to be prepared by Contractor during engineering phase
GS EP EXP 501	Equipment and piping numbering
GS EP ICS 001	2D CAD Layouts
GS EP ICS 002	2D CAD Process Schematics
GS EP ICS 004	3D CAD Models
GS EP INS 125	Safety Relief Valves and Rupture Discs
GS EP PVV 102	Piping Hook-up Standards
GS EP PVV 107	Piping Stress Analysis
GS EP PVV 112	Piping material classes
GS EP PVV 119	Design and fabrication of metallic piping supports - Standard for piping supports
GS EP PVV 142	Valves
GS EP PVV 171	Steel piping fabrication
GS EP PVV 178	Design and erection of Glass Reinforced Plastic (GRP) with Epoxy resins piping system
GS EP PVV 211	Design and fabrication of pressure vessels according to ASME VIII
GS EP PVV 212	Design and fabrication of pressure vessels according to BSI PD 5500
GS EP SAF 021	Layout
GS EP SAF 261	Emergency Shutdown and Emergency De-Pressurisation (ESD & EDP)
GS EP SAF 351	Escape, evacuation and rescue from fixed installations

General Specification		GS EP PVV 111
Piping design specification		
Rev.: 11	Effective date: 10/2015	Page: 7 of 40

3. Materials

3.1 Tubes

3.1.1 Minimum diameter

The minimum nominal pipe size used shall be 1/2".

No pipe smaller than NPS 1/2" shall be used, except for instruments.

3.1.2 Pipe sizes

Nominal pipe sizes shall be chosen from the customary series:

1/2", 3/4", 1", 1 1/2", 2", 3", 4", 6", 8", 10", 12", 14", 16", 18", 20", and 24".

Nominal pipe sizes of 1"1/4, 2"1/2, 3"1/2, 5", 7", 9" and 22" shall not be used. Equipment supplied with connections of these sizes shall be adjusted to a standard size immediately adjacent to the equipment by means of a suitable reducing fitting. Bushings shall not be used.

For NPS above 24", nominal pipe sizes 26", 28", 30", 36", 42", 48", 56" and 60" are preferred dimensions.

Standard pipe dimensions and tolerances shall be in accordance with [ASME B36.10M](#) for carbon steel, low temperature carbon steel and low alloy steel and [ASME B36.19M](#) for stainless steel.

3.1.3 Threaded piping

The pipe wall thickness shall be, as a minimum Sch.80.

The following restrictions shall apply for threaded piping:

- Threaded joints are only authorized on utility lines if and where listed on the relevant piping material class.
- Threaded joints shall not be used on process service, with the exception of instrument connections that are located downstream an isolation valve and threaded plugs on test and vent drains where indicated on the piping hook-up standard.
- Threaded piping and joints shall not be used in lines subjected to vibrating.
- Threaded piping and connections shall be limited to 2" in NPS.

Threaded piping fittings shall have NPT thread in accordance with [ASME B1.20.1](#).

3.2 Fittings

Standard dimensions of metallic fittings shall be in accordance with [ASME B16.11](#) for threaded and socket welding fittings and [ASME B16.9](#) for butt welding fittings.

Dimensions for non-metallic fittings shall be in accordance with their respective manufacturer information.

The dimensions of weldolet, sockolet, threadolet and similar fittings shall comply with [MSS SP-97](#)

General Specification		GS EP PVV 111
Piping design specification		
Rev.: 11	Effective date: 10/2015	Page: 8 of 40

Wall thickness of butt welding fittings shall be the same nominal wall thickness as the attached pipe.

3.2.1 Fittings up to NPS 1"1/2

a) Ends

As a general rule, the fittings used for piping up to NPS 1"1/2 shall be made of forged steel, of the "socket welding" type, except:

- For [API SPEC 6A](#) 34.5 MPa and 69.0 MPa piping classes
- For any service where crevice corrosion or severe erosion may occur

where wrought butt welding fittings according to [ASME B16.9](#) shall be used.

Welded fittings made of malleable cast iron are prohibited.

Threaded fittings made of forged steel may be allowed on water and service air piping, drains and vents up to NPS 2". The threading shall be NPT, as per [ASME B1.20.1](#).

Threaded pipes or fittings shall not be used for buried pipe for any line service.

Reducing coupling shall be used for pipe size changes in line classes using screwed or socket weld construction.

b) Elbows

In small bore welded piping (NPS 1½" and smaller), 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 class.

c) Tees

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

3.2.2 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 of [GS EP PVV 171](#).

a) 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.

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

b) 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.

General Specification		GS EP PVV 111
Piping design specification		
Rev.: 11	Effective date: 10/2015	Page: 9 of 40

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

For piggable lines designed to the [ASME B31.3](#) code, radius of the bend shall be at least three times the outside pipe diameter.

c) Tees

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

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

d) 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.

e) 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.

For piping classes designated to [API SPEC 6A](#) 69.0 MPa and above, sockolet, threadolet and weldolet branch connection types are not allowed. Only sweepolet for branch less than NPS 2" is acceptable and reduced tees, equal tees or equal tee plus reducer for larger sizes are acceptable.

3.3 Branch connections

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

Oblique connections at 45° may be accepted only for flare, vent and drain piping systems with header above 4". Weld fabricated oblique connections are only acceptable for pressure rating up to 150#. They shall be designed and fabricated considering pipe wall thicknesses for a pressure rating of 300#.

For determination of Stress Intensification Factor (SIF) for oblique connections, refer to section 7.7 of [GS EP PVV 107](#).

Above the pressure rating limit of ASME Class 150#, oblique connections shall be shaped by hot extrusion or forging.

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 [GS EP PVV 112](#).

General Specification		GS EP PVV 111
Piping design specification		
Rev.: 11	Effective date: 10/2015	Page: 10 of 40

3.3.1 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.
- Branches shall not be located in removable spools.
- Any small bore connection below 3" 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 depressuring 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.

3.4 Flanges

3.4.1 Dimensions

Except as otherwise indicated, the dimensions of flanges shall comply with [ASME B16.5](#) for NPS up to 24" inclusive and with standard [ASME B16.47](#) Series "A" for above NPS 24".

Inside diameters of weld neck flanges shall be equal to those of connecting pipes.

Orifice flanges shall be supplied with flange taps and jackscrews and shall have NPS ½" NPT tapings in accordance with [ASME B16.36](#).

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

3.4.2 Ends

For NPS 2" and above, "welding neck" flanges shall be used exclusively. However, "slip-on" flanges may be used in accordance with the piping material classes for ratings 150 and 300.

3.4.3 Flange facing

Flange facing shall be one of the three main types:

- Flat face (FF) for connection to materials made of GRE (Glass Reinforced Epoxy); flat face flanges shall be provided with full-face gaskets
- Raised face (RF)
- Grooved, for ring joint (RJ).

The type of flange facing and its surface finish are specified in the piping materials classes ([GS EP PVV 112](#)).

For piping classes rating 1500# and 2500#, the use of Hub connector may be considered as an alternative to [ASME B16.5](#) or [ASME B16.47](#) Series A flanges for NPS 12" and above.

For piping classes [API SPEC 6A](#) 34.5 MPa and 69.0 MPa, the use of hub connector may be considered as an alternative to [API SPEC 6A](#) flanges for NPS 6" and above.

This shall not apply to equipment connections where ASME flanges shall be used.

Contact faces shall undergo finish machining in accordance with [MSS SP-6](#). The table hereafter summarizes the main recommendations of this standard.

Table 1 - Flange facing requirements

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 µin. to 250 µin.)
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 µin. to 250 µin.)
Ring Joint Groove (RJ) Type ASME B16.5 & ASME B16.47 Type 6B flanges API SPEC 6A (1)	Extra smooth	1.6 µm (63 µin.) Ra max
Ring Joint Groove (RJ) Type 6BX flanges API SPEC 6A (1)	Extra smooth	0.8 µm (32 µin.) Ra max

Note to Table 1:

- (1) Minimum hardness of ring joint grooves and maximum hardness of ring joints shall comply with [API SPEC 6A](#).

3.4.4 Connection between dissimilar material

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

- Flange shall be privileged as much as possible
- The connection shall be located as far as possible on a vertical pipe

General Specification		GS EP PVV 111
Piping design specification		
Rev.: 11	Effective date: 10/2015	Page: 12 of 40

- 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, superduplex or Inconel 625 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.

Carbon steel flange with CRA weld overlay shall be considered as Special Piping (SP) item and shall be clearly indicated on the P&ID where required. SP item data sheet shall be also issued.

3.5 Gaskets and bolts

The types to be used shall be specified in the project piping material class specification.

CAF (Compressed Asbestos Fiber) gaskets are prohibited.

Graphite impregnated flat gaskets shall not be used for any service with Corrosion Resistance Alloy (CRA) material when there is a risk of conductive and oxygenated water.

All spiral wound gaskets shall be of Low Stress type and shall have an external centering and inner ring.

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.

Bolt tensioners

Hydraulic bolt tensioners shall be used on flange stud bolts size 2" and above.

When hydraulic tensioning equipment is used, bolt lengths shall be increased at least by one bolt size minimum as to show the requested thread length free for equipment gripping.

3.6 Valves

3.6.1 Ends

As a general rule, valves up to size 1"1/2 inclusive shall have "socket welding" or NPT-tapped ends, except:

- For ball valves where 100 mm long plain end nipples (each side) shall be provided
- For [API SPEC 6A](#) 34.5 MPa and 69.0 MPa piping classes where joint connection type shall be "Butt Welding" end