

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 119

**Design and fabrication of metallic piping supports -
Standard for piping supports**

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1. Scope

This General Specification covers the requirements for the design, fabrication of cryogenic and non-cryogenic pipe supports, including secondary structures fixed to main structures or concrete pipe-racks (see Figure 1).

It is applicable to onshore or offshore project development.

It does not rule the design of piping supports installed in process or utilities packages that are not under the responsibility of the managing entity identified on the front page.

This General Specification also gives schematics for typical supports in Appendix 4 to Appendix 12.

This General Specification application is mainly for metallic piping, not addressing non metallic piping of any kind.

The project specification shall follow requirements of this general specification, be limited to the related scope of work. It shall consider both the construction and operational environmental conditions, and also any potential effect of in-between long haul transportation.

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 completed 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.

Reference	Title
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A387	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
ASTM A516	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

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Reference	Title
ASTM B443	Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy(UNS N06625) and Nickel-Chromium-Molybdenum-SiliconAlloy (UNS N06219) Plate, Sheet, and Strip
Energy Institute 2008	Guidelines for the Avoidance of Vibration Induced Fatigue Failure in Process Pipework
MSS SP-58	Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

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.

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 351	External protection of structures and equipment by painting. Floating structures
GS EP COR 354	External protection of onshore structures and equipment by painting
GS EP COR 356	Corrosion Protection of Fasteners for Subsea and Topsides Applications
GS EP PVV 107	Piping Stress Analysis
GS EP PVV 112	Piping material classes
GS EP PVV 142	Valves
GS EP PVV 149	Spring hangers and supports
GS EP PVV 171	Steel piping fabrication
GS EP PVV 611	Welding of pressure containing piping and equipment
GS EP STR 301	Fabrication of offshore steel structures

3. List of Support Standards

Standard support drawings are given in Appendix 4 to Appendix 11 as listed in table below.

These standards do not represent finalised elements and are only schematic.

Contractors shall define in detail (calculation, finite element modelling, etc.) the supports according to the loads (operation, fabrication, transportation ...) and environmental conditions.

Summary of support standards		Appendix 3
Piping rested directly on supporting structure	Guide / U-Bolt / Flat collar	Appendix 4
Welded pipe shoes	- Free / Longitudinal guide / transverse guide / Fixed - Special design	Appendix 5
Clamped pipe shoes	- Pipe shoe with pipe clamps: Free / Longitudinal guide / Fixed - Special design for pipe shoe with pipe clamp	Appendix 6
Gussets on vertical piping	Free / Longitudinal guide / transverse guide	Appendix 7
Stanchions	- Free / Longitudinal guide / transverse guide / Fixed - With or without pipe clamps	Appendix 8
Brackets		Appendix 9
Hangers elements		Appendix 10
Trunnions		Appendix 11

4. Definitions

The definitions relating to pipe hangers and supports are as per [MSS SP-58](#).

In addition to the definitions selected from [MSS SP-58](#), some additional definitions are listed below:

Anchor	As per MSS SP-58
Clamp	As per MSS SP-58
Guide	As per MSS SP-58
Hanger or Pipe Hanger	As per MSS SP-58
Hanger rod	As per MSS SP-58
Jacket	As per MSS SP-58
Marine Atmosphere	As per GS EP COR 351
Pipe shoe	As per MSS SP-58
Pipe Support	As per MSS SP-58

Protection Shield or doubler plate	As per MSS SP-58
Restraint	As per MSS SP-58
Shear lug	As per MSS SP-58
Sliding Support	As per MSS SP-58
Snubber	As per MSS SP-58
Supporting Structure	Supporting structure is defined as the main structure of the installation.
Support - Standard	Standard supports are those commonly used, and which are defined and detailed on standard construction drawings.
Support - Special	Special supports cover all other supports not included in the standard supports and defined for specific cases, due to heavy loads or conceptual detail.
Support - Cryogenic	Cryogenic supports are categorised as supports for lines which the minimum operating range is in the range -196°C to -46°C and able to operate up to +66°C.
Support - Cold	Cold supports are categorised as supports for lines operating at temperatures between 0° and - 45°C.
Support - Hot	Hot supports are categorised as supports for lines operating at temperatures 0°C and above.
Support - Suspended	As per GS EP PVV 149 .
Spring hanger	As per MSS SP-58
Spring support	a spring loaded assembly or device, supporting the pipe from underneath.
Stanchion (or base support)	As per MSS SP-58
Trunnion (or dummy leg)	a tubular supporting device, branching-off horizontally from a vertical line, and resting on, or suspended from, the supporting structure.
U-bolt	As per MSS SP-58

5. General information

The piping supports study shall be carried out at the same time as the study of routing and piping stress analysis (as defined in [GS EP PVV 107](#)), at the very least for the position and type of support.

The Contractor shall prepare as minimum a specification for standard piping supports, a specification for special piping supports and a material take off.

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The specification for Standard piping supports shall contain:

- A description of the standard piping supports identification numbering system
- An index of the identification of the standard piping supports
- Dimensional sketches of the standard piping supports with materials of construction and surface protection
- The maximum distance allowable between two consecutive supports, consistent with the piping stress calculation
- The maximum allowable loading of the standard piping supports
- The criteria to define the split of work between piping support design by piping group and design by structure group (i.e. based on loads, based on frame height or cantilever length, etc.).

The specification for Special piping supports shall contain:

- Each support identified in accordance with the manufacturer catalogue at its last published edition
- A description of the special piping supports identification numbering system
- An index of the identification of the special piping supports
- Dimensional sketches of the special piping supports with materials of construction and surface protection
- The maximum distance allowable between two consecutive supports, consistent with the piping stress calculation
- The maximum allowable loading of the special piping supports.

The Material Take off for piping supports shall contain:

- A summary of the standard piping supports
- A summary of the special piping supports
- Material summary designation.

Supports shall be standardised as far as possible and shall bear an identification number. Special support identification numbers shall include line number, area location, etc.

A set of Standard Drawings is available in Appendix 3 of this General Specification which includes the most commonly applied piping supports. These Standard Drawings shall be considered as a guideline given for information. Other solution may be proposed by Contractor.

Common centre-to-centre distances of supports for straight steel pipes and for bent steel pipe are available in Appendix 1. However, these distances are indicative and shall not replace the piping stress study.

6. Design

6.1 General rules

Piping and accessories shall be adequately supported and provided with suitable anchorage to prevent excessive loads on connected equipment, and to prevent undue movements caused either by expansions or by vibrations.

Supports shall be designed so as to meet all static, operating and occasional loads (earthquake, surge, etc.) to which the piping may be subjected. The design shall be based on all concurrently acting loads transmitted into such supports. The concurrently acting loads are those derived from the relevant piping stress analysis of the related line.

For piping containing gas and not subject to a hydrostatic testing, weight of liquid shall not be considered provided that precautions against liquid entrance into the piping have been taken.

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

Guides and direction restraints shall be so as to allow lines to expand and contract freely relative to the anchor, and must be designed to be structurally suitable to withstand loads involved.

Piping entering vessels will preferably be supported from brackets attached to the vessel which shall be designed accordingly.

All support components to be welded on pipes and fittings shall be of the same material as the relevant pipe; welding shall be by qualified welders in accordance with qualified procedures and shall comply with the Company specification **GS EP PVV 611** for welding. Those welds shall be continuous, made of two runs minimum, and shall comply with **GS EP PVV 171** for minimum clearance against piping welds, welding process selection and non destructive examination.

Supporting one line from another should be avoided as much as possible and is forbidden for cryogenic lines.

Reinforcements to be welded to the pipe during prefabrication shall be shown on isometric drawings and positioned.

The loads applied onto supports shall be included in the structure's calculation or at least the structure has to be verified after the final supports sizing.

Where concrete or steel pipe-rack is not located immediately above the point of support, it will be necessary to provide supplementary secondary steel structures to obtain a point of support. These secondary steel structures shall be designed to cope with main structure design, and provision will be taken to eventually reinforce the main structure (gussets, etc.).

Loads (permanent and temporary) induced by these secondary structures shall be considered in main structure design.

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

The supports shall be designed to facilitate maintenance painting (no areas that are impossible or 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.

As far as possible, each layer of piping shall share a common support, regardless of the diameters of the piping making up the layer.

No piping support shall be done on flange assemblies.

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

Piping for anti surge lines, and those that are risk to flow induced vibration (FIV) and other form of vibrations shall be designed as stiff as possible together with the frame supports and structures to avoid resonance. Criteria of the stiffness shall be defined from the beginning of each projects; this will include the criteria of support span arrangements, maximum height of frame supports, and bracing requirements.

6.2 Selection of proper supports

The method of supporting depends on:

- Pipe Size
- Pipe movements
- Forces and loads at points of support
- Pipe insulation
- Existing structure.

6.3 Pipe movements

At points of support subject to vertical movements, spring supports of suitable design shall be used to prevent excessive load variation. All springs shall be provided with devices preventing misalignment, eccentric loading and excessive spring stresses.

When piping stress is critical, the use of constant load supports shall be imposed.

At points of support subject to horizontal movements, the displacements shall be taken by the use of sliding supports (with adequate length to take into account pipe displacements, etc.) or by the swing of long hanger rods (in any case, maximum angular displacement shall not exceed 5 degrees).

Selected pipe hangers shall be of an adjustable type.

Pipes installed with axial bellows shall be guided from each side in order to maintain correct alignment, and anchors for bellows shall be designed to withstand the pressure thrusts.

Piping installed with cold spring (only applicable for non-cryogenic lines) shall be shown on drawings in the pre-stressed cold position. Clearances shall be kept free for both construction and hot conditions.

Except otherwise stated, construction allowances shall be ± 2 mm.

6.4 Forces, loads and moments

For each support, the Contractor shall define a combination of loads and moments respectively for permanent loads and occasional loads not exceeding the allowable stresses of support components.

Other combinations of loads and moments shall be checked with the support design by the Contractor.

6.5 Allowable stresses

Allowable stresses for materials commonly used in the design of pipe hangers and supports are listed in Tables 2 and A1 of [MSS SP-58](#).

Allowable stresses for materials not listed in Tables 2 and A1 of [MSS SP-58](#), with known physical properties shall be determined as the lower of the following values:

- 1/4 of minimum tensile strength at service temperature
- 5/8 of minimum yield strength at service temperature.

Allowable stresses for castings shall be multiplied by a casting quality factor of 0.8.

7. Types of supports

Support piping can be classified according to different criteria:

- Their function (rigid, elastic)
- The conditions of use (hot, cold)
- The continuity of employment (temporary, permanent)
- The operability (clamped, welded).

7.1 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 7.8.2 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 pipe diameter up to 4 inches. 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.

7.2 Welded supports

Welded supports are less susceptible to corrosion than clamped supports.

Welded pipe supports shall not be used on the following piping (in this case clamp supports are applicable):

- Piping lined with glass, rubber, plastics, etc.
- High grade materials such as titanium, Hastelloy, monel, etc.

- Piping with corrosion-resistant coating (e.g. galvanised piping)
- Coated carbon steel (coating: PTFE, rubber, etc.).

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 (depend on the size of the pipe and loads that need to be validated by piping stress).

7.3 Hanger supports

Hanger supports shall not be used in systems with multiphase flow or where excessive vibration may be expected (e.g. near reciprocating compressors).

Suspending a line from another line is prohibited.

When a line is supported by pipe hangers, longitudinal guides shall be provided at regular intervals to absorb stresses due to the wind and to prevent vibration of the piping.

Hanger rods for lines subject to thermal displacement should be set out of plumb to an amount equal to one-half of the anticipated displacement of the pipe at the point of support.

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

7.4 Spring supports

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

When piping stress is critical, the use of constant load supports shall be imposed (i.e. designed such that the supporting effort is relatively constant over the total travel of the support).

GS EP PVV 149 provides more details about this type of supports.

7.5 Snubbers

Snubber is PROHIBITED.

7.6 Supports on non-insulated lines

Non-insulated pipes should rest on the supporting structure, except for the following which should be supported on pipe shoes in order to avoid damaging the pipe wall:

- Pipes with sizes larger than 24"; 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
- Surface condensation is likely (i.e. the operating temperature of the pipe is below ambient temperature) and therefore access will be needed for painting and repair

- The pipe may operate (even temporarily) at such a low temperature that this may cause Embrittlement of the supporting member
-
- When needed to avoid unacceptable pipe corrosion in corrosive atmospheres (e.g. due to coating damage caused by pipe movement and water collection on top of the supporting structure). Be careful, in these situations, pipe shoes do not alleviate corrosion problems of the supporting members themselves.

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 piping 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.

Hanger rods for lines subject to thermal displacement should be set out of plumb to an amount equal to one-half of the anticipated displacement of the pipe at the point of support.

On galvanised carbon steel pipes, a rubber sheet shall be placed between the clamp and the pipe. The selection of the material for rubber sheet shall be subject to the Company approval.

Supports for lines NPS 1"½ and smaller shall be designed by the Contractor.

7.6.1 Supporting of small bore piping

Supports for lines 1½" and smaller shall be designated on site during construction except the supports of any connecting line to equipment subject to vibrations or cyclic loading (reciprocating compressor, flow induced turbulence, acoustic induced turbulence...). The support for such lines shall be defined and detailed by study (i.e. based on [Energy Institute Guideline 2008](#)) by the Contractor.

Supports should be from the main pipe, to ensure that the small bore connection moves with the main pipe during transients and vibration.

7.6.2 Supporting of vertical lines

If the weight of a vertical pipe is supported by a clamp, it is recommended to prevent slippage that the clamp be located below a flange, fitting, or support lugs welded to the pipe.

7.7 Localized loads: Valves, filters, etc.

Localised concentrated loads (valves, filters, instruments mounted on piping, etc.) shall be studied separately.

Design and fabrication of the support structure shall be carried out in accordance with the following recommendations:

Supports in the vicinity of flanges shall not interfere with the tightening of bolting.

- Valve supports are not intended to be line support unless otherwise specified. More details are provided in [GS EP PVV 142](#)
- Supports shall be provided for sections left overhanging when valves, pipe sections, etc. are removed.

7.8 Supports in marine atmosphere

7.8.1 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 100mm to allow for inspection and paint maintenance.

However, exceptionally (typically for small bores pipes up to 4 inches), U-bolts may be used if polyethylene, polypropylene or PTFE sheets are inserted between U-bolt and Pipe, and between Pipe and Support. U-bolts shall be protected by coating in accordance with **GS EP COR 356**. Polyolefin sheathed U-bolts may also be used.

7.8.2 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
- A coating of a vinyl-ester paint reinforced with glass flakes. The coating shall be applied in accordance with **GS EP COR 350**.

7.9 PTFE sliding plates

The following lines shall be supported with special PTFE sliding plates in order to minimise horizontal forces caused by frictional resistance:

- All cryogenic lines
- All process lines NPS > 12"
- All cold insulated lines NPS > 3", when support clamps are tightened around insulation cradles.

PTFE sliding plates must be purchased from an experienced Manufacturer who can prove successful operation during five years minimum of devices supplied by him and fabricated according to the same procedure.

PTFE sliding plates shall be prefabricated and shall be embedded in steel substrate.

The best design shall be selected taking into account the actual working conditions, with the following particular emphasis:

- PTFE sliding on PTFE, or on stainless steel (polished), depending on vertical loads and on allowable axial friction loads

- With an insert in neoprene or not, depending on parallelism of surfaces
- The PTFE area shall be selected based on vertical loads and on maximum allowable contact pressure.

7.10 Supports on insulated lines

Weather jacketing on insulated piping and especially vapour barrier on cryogenic pipes shall be protected from damage at all support points. On hot insulated lines for personnel protection, the insulation may be interrupted.

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.

Supports designed with wooden blocks (as stops, etc.) shall have a good finish of its insulation. If the wooden block is outside the insulation, it shall be covered by a weather resistant mastic.

For clamp fastening on insulation cradles, a bolt tensioning torque procedure shall be defined by the Contractor for pre and after cool-down and submitted to the Company prior to any use.

At support location, insulation material shall be reinforced as follows:

- High density foam for resting and guide (160 kg/m³ or higher)
- Wooden blocks for stops.

A maximum deflection of 1% on insulation cradle shall be respected.

7.11 Supports on cryogenic lines

7.11.1 Forces, loads and moments

Allowable forces, loads and moments combination shall be defined in accordance with paragraph 6.4, for support components (plates, welds, etc.). Insulation cradles shall be high density foam with strength based on Ultimate Compressive Strength using a minimum safety factor of 5 or that which result in 1% deflection, whichever is less.

7.11.2 Design

Cryogenic supports shall be designed to minimise thermal conduction which could adversely affect the fluid in the pipe and/or the surrounding structure.

Cryogenic supports shall be designed taking into account warm-up and cool-down conditions. Adequate systems shall be used in order not to induce additional stresses on insulation material.

Clamps will be installed around insulation. Tolerances on clamps shall be compatible with insulation cradle tolerances to have the maximum contact between clamp and insulation for the best distribution of loads.

Clearances between upper and bottom part of clamps shall be sufficient taking into account warm-up/cool-down procedures and erection tolerances.

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For cryogenic anchor supports, trunnions design shall be preferred. Trunnions shall be of sufficient length to allow a minimum of 300 mm of bare metal between termination of insulation and support/structure.

Legs on trunnions to be welded to the product line shall be of the same material as the line.

In order to reinforce the trunnion, gussets shall be used and shall be welded to the pipe or to the base-plate.

Cryogenic anchor supports shall be adequately designed taking into account the following, where applicable:

- Resultant forces and moments
- Stress level in the weld between anchor and pipe
- Stress level in the anchor
- Rigidity of the anchor foundation
- Strength of the anchor foundation
- Strength of the load bearing insulation.

Differential movements between a pipe component and its welded-on anchor can produce high stresses in the pipe, leading to wall damage or failure (buckling).

For thin wall pipes, reinforcing saddles (where required) shall be avoided and shall be replaced with higher pipe schedule/thickness.

7.11.3 Welds on cryogenic supports

All welds shall be 100% radiographed (x-rays) or checked by calculation.

Allowable stresses in full penetration welds shall be same as for the plate material.

Allowable stresses in fillet welds shall be the allowable stress for the plate material multiplied by a joint factor of 0.8.

For fillet welds, the design throat thickness shall not be less than 0.7 nor greater than 0.8 times the leg length.

8. Fabrication, Material and welding

8.1 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.

Galvanised supports shall not be used on austenitic stainless steel, duplex stainless steel, nickel alloy, or 9% nickel steel piping.