



Exploration & Production

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS PVV 171

Steel piping fabrication

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1. Scope

This Specification applies to above ground process and utility piping lines, and those lines extending below ground in the same service using the same materials.

Requirements herein shall govern shop and field fabrication. Additional requirements, such as coating and wrapping, are not covered in this document.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Unless otherwise specifically indicated in writing, the Contractor shall work in accordance with the requirements of this specification and those of the latest editions at the time of call for tender of the documents listed hereafter.

Any divergence between any of the Contractual Reference Documents or between this specification and any other Contractual Reference Document, should 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.

Standards

Reference	Title
Not applicable	

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

In addition to the mentioned codes and their sub-references, other codes, such as National Codes, may govern some part of the piping. Drawings will indicate the applicable codes in such cases.

Construction Codes or Government regulations which may be listed in the Project Specifications, in the Requisition or in the Purchase Order, if any, shall have precedence except where this Specification is more stringent.

Reference	Title
ASME B 31.3	Process Piping
ASME B 1.20.1	Pipe Threads, General Purpose (Inch)
ASME B 16.25	Buttwelding Ends
ASME Section I	Power Boilers (For parts of piping systems associated with boilers and steam generating equipment, where that code applies: such parts will be indicated on drawings as boiler code piping)
ASME Section V	Non-Destructive Examination
ASME Section VIII	Pressure Vessels (where applicable)
ASME Section IX	Welding and Brazing Qualifications

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS COR 350	External protection of off-shore and coastal structures and equipment by painting
GS PVV 112	Piping material classes
GS PVV 173	Pneumatic testing of above-ground piping systems (where applicable)
GS PVV 175	Internal cleaning of piping and vessels
GS PVV 611	Welding of pressure containing piping and equipment
GS PVV 612	Piping and Equipment subject to severe sour service. Metallurgical and welding requirements (where applicable)
GS PVV 614	Welding of duplex stainless steel (where applicable)
GS PVV 615	Welding of UNS 31254 alloy (where applicable)
GS PVV 616	Welding of titanium pipes and fittings (where applicable)
GS PVV 617	Welding of 3 ½ nickel steel (impact tested at minus 101°C) (where applicable)
GS PVV 618	Fabrication of alloy UNS 06625 Grade 1 materials (where applicable)

Reference	Title
GS PVV 620	Specification for fabrication and welding of piping systems in cupronickel and associated materials (where applicable)
GS PVV 622	Piping and Equipment subject to intermediate sour service. Metallurgical and welding requirements (where applicable)

3. Information sources

3.1 Piping material classes

The Piping material classes Specification **GS PVV 112** shows the pipes, valves, flanges, fittings, branch connection, design details for vents, drains and instrument connections, and other specific material requirements for piping services. The specification includes the individual piping material classes and branch reinforcement requirements.

3.2 Drawings

3.2.1 Design drawings

3.2.1.1 General arrangement drawings

Complete design of the piping systems including description, sizes, dimensions, relative location of the various parts or components is generally shown on Piping General Arrangement drawings.

3.2.1.2 Isometric drawings

Complete and detailed information such as description, sizes, exact location, dimensions, joint details, are given in the isometric drawings. They shall clearly indicate the parts and/or components scheduled for assembly on the field. Welds and connections to be performed in the field shall be positioned in a manner requiring the least amount of field work and/or in order to facilitate field installation. A material take-off attached to the isometric drawing shall show details of all components of the isometric (list of materials, thickness, ratings, quantities, etc.).

3.2.2 Fabrication drawings

Shop drawings or sketches shall be prepared by the Contractor to facilitate the fabrication of parts or components of the Piping Systems. These drawings are intended to provide full information and instructions including typical shop details, weld preparation and procedures, etc., needed for that purpose. They must show the spool number, materials, dimensions, fabrication details, and the applicable code and procedures. Drawings must identify all equipment, lines or spools connecting to that spool. The General Arrangement or isometric drawing used as a reference shall be indicated. Spool pieces shall be identified by numbers indicating the isometric line number followed by suffix letters: A, B, C, etc.

Approval or review of shop drawings by the COMPANY does not relieve the Contractor of his responsibility to complete the work in accordance with the contract, the approved fabrication drawings and the Contractual Reference Documents.

3.3 Lines list

Mechanical data section of the lines list shows lines design pressures and temperatures as well as testing and insulation requirements. Additional information such as wall thickness is available in the relevant piping material classes.

3.4 Isometric index

This document is a list of all isometric drawings with their issue dates.

4. Extent of shop fabricated pipework

4.1 Carbon steel

Carbon steel of sizes 2 inches and larger shall be shop fabricated except for straight runs in pipe racks which are normally field run. 1 ½ inch sizes and smaller are normally field run, except if heat treatment is required.

4.2 Alloy

All alloy piping using butt-welded fittings shall be shop fabricated except for long straight runs in pipe racks which shall be field fabricated.

4.3 Branches

Branch connections on shop fabricated piping shall include appropriate couplings, fittings, or group of fittings (i.e. flanges thermowell connections), or stubs for small field-fabricated branch connections. 1 1/2 in. and smaller stubs shall not extend more than 300 mm from the outside of the header. Two inches and larger stubs and branches shall extend to the first flange or field weld point as indicated on the drawings or as required for reasonable piece size.

Reinforcement pads for field welded branches shall be fabricated and tack welded to the stub-in pipe by fabricator, and shall include vent and tell-tale hole.

4.4 Attachments

Attachments, such as supports, braces, lugs, and T-bars may normally be installed in the field. They shall be attached to the matching piece of pipe or fitting by means of an intermediate pad in order to avoid direct welding of the piping component to its support. Fabricated pipe requiring preheat or post weld heat treatment shall have shop welded pads or stubs, to which field welds can be made where attachments are required. In such a case, the pads or stubs welds to the pipe shall receive the required heat treatment in the shop.

4.5 Field runs

Field runs are designated on piping drawings.

5. Materials

5.1 Supply

All piping materials (pipes, fittings, valves, accessories, supports) shall conform to the relevant piping material class and to all the other related documents. Materials for non pressure parts



which are directly welded to pressure parts shall be of the same type and quality as the pressure parts.

5.1.1 Materials furnished by the COMPANY "free issue"

Materials possibly furnished by the COMPANY shall be as listed in the Contract documents. The Contractor shall be provided with a copy of Mill Certificates including chemical and physical properties for the materials furnished by the COMPANY.

The Contractor shall inspect all the materials (pipes, fittings, etc.) internally and externally. He shall agree or disagree with their condition at the time of delivery on site. A confirmatory inspection shall also be made by the Inspection Agency.

The Contractor shall declare all unacceptable defects and damages which are found on materials furnished by the COMPANY. Damaged material or materials found to have injurious defects shall not be used in the fabrication. The Inspection Agency shall decide if such materials may be repaired or must be replaced. Repairable defects or damages may be repaired by the Contractor on a cost plus basis to the COMPANY. Before a repair is made, it must be submitted to the COMPANY for approval. Non-repairable materials shall be replaced by the COMPANY.

The Contractor shall be considered responsible for defects or damages which will be detected after delivery on site. Repair or replacement of such defective materials shall be at the Contractor's expense.

The Contractor, on accepting the responsibility of the materials, shall keep a record on all related activities including date of inspection, designation and number of materials accepted or to be repaired or replaced, and any other pertinent information detailing material defects or damages. This record shall be signed by the Contractor and the Inspection Agency.

5.1.2 Materials supplied by the Contractor

The Contractor shall furnish all other materials necessary to perform the work. Materials furnished by the Contractor shall be new and shall be subject to prior approval by the COMPANY and the Inspection Agency. The Contractor shall not substitute any material specified in the contract documents without the prior written approval of the COMPANY and the Inspection Agency.

5.2 Identification

The Contractor shall ensure that the mill markings and identification on all materials shall be maintained throughout. The markings and identification, as proposed by the Contractor, shall be visibly clear and recognised as being correct by the Inspection Agency. An identification system for class of material shall be used by the Contractor.

5.3 Storage

All materials for the work, being the sole responsibility of the Contractor while in his custody, shall be stored in accordance with good practice, on pallets or timber blocking, off the ground and above the level of standing water. Materials shall be covered whenever possible. Materials shall not be stored near sites of operations such as blast cleaning or painting, that might leave undesirable deposits on the materials. The Contractor shall store all materials for the work in areas separate from surplus or scrap materials. Particular care shall be taken for valves. Ball valves shall be stored in a clean, covered area. Their plug shall be maintained in the open position at all time, with their original end-plugs on, until the last moment before their installation.

6. Fabrication

6.1 General

Prior to starting the work, the Contractor shall submit for the COMPANY approval sufficiently detailed documents pertaining to the proposed procedures and sequences he plans to use in the fabrication, assembling and joining of the various parts of the piping systems. Parts to be pre-fabricated shall be clearly indicated. Sequences in assembling piping components shall be established by the Contractor such that distortion and accumulation of residual joint stresses are minimised.

6.2 Execution of the work

The Contractor shall furnish qualified personnel and all equipment, tools, instruments, etc. necessary to carry out qualification of welding procedures and welders, handling, fabrication, welding, welding inspection, installation, testing, cleaning and painting of the piping components according to this Specification and the Contractual Reference Documents.

The furnished equipment shall be in first class operating condition and adequate replacement parts shall be available.

The Contractor shall have available on the fabrication site suitable ovens for drying and conservation of low-hydrogen electrodes and suitable equipment for preheating, post-heating and stress relieving where and when required (This equipment is subject to approval by the Inspection Agency).

The Contractor shall execute the work in a continuous and workmanlike manner, taking all necessary precautions to ensure that good work will result and that the approved completion schedule will be met.

The Contractor, at his own expense, shall provide the necessary weather protection to ensure that all work continues always as specified.

When conditions are or become unsafe to start or continue the work, the Contractor shall notify the Inspection Agency immediately.

6.3 Fabrication tolerances

Contractor is responsible for ensuring that fabricated piping conforms to applicable codes, specifications, drawings and purchase order requirements. He is responsible for fabricated dimensions that agree with piping drawings. Where not otherwise specified, dimensional tolerances shall conform to those shown in Appendix 1.

All angular dimensions of bends and branches shall be maintained within ± 1 degree.

6.4 Cutting

Cutting may be performed by machining, sawing, or by gas or plasma cutting guided torches. Any other process shall be submitted to the Inspection Agency for approval prior to use. Gas cutting is only accepted on non-galvanised carbon steel materials. In gas cutting, the cutting flame shall be so adjusted and manipulated as to avoid cutting beyond the prescribed lines. The roughness of gas cut surfaces and occasional notches on edges shall be removed by machining or grinding; cut surfaces and edges shall be left free of slag.

Cutting shall be performed perpendicularly to the piping component centreline unless otherwise indicated on the drawings. Cutting shall be made with suitable allowance taken into account for shape of connections and shrinkage due to cutting and welding.

After cutting, suitable identification markings, including at least grade of steel and heat number, shall be reproduced on each of the cut part of materials.

Special care shall be taken to remove internal burrs resulting from cutting, especially on pipes equal to or less than 2 inches in diameter.

6.5 Threading

Screwed connections shall only be used where permitted in the relevant piping material class.

Unless otherwise indicated on drawings, all threads shall be "taper" to NPT and concentric to the outside of the pipe, in accordance with the [ASME Code B.1.20](#). Normally, all threading shall be carried out after bending, forging, or heat treatment, but when this is not possible, suitable thread protection must be provided.

Screwed threads shall be clean cut with no burrs, no stripping. Ends shall be reamed to remove burrs. Threaded parts shall be fitted by progressive and tight screwing:

- By inserting an appropriate PTFE tape for design temperatures up to 140°C (except where seal-welding is required)
- Without inserting any foreign material above this temperature, unless suitable sealant product has been specially selected.

Excessive wrench marking on pipes or fittings shall be cause for rejection.

Seal welds are prohibited on threaded assemblies, except where specifically required by the Engineering Company. In that case, seal welds shall cover all exposed threads and shall be done with electrodes not in excess of 3.2 mm in diameter.

6.6 Alignment of components to be assembled

Piping components shall be adequately supported and accurately aligned by the means of jigs, clamps or other suitable devices as required in order to avoid deformation and minimise strains during tacking. Concentricity of adjacent parts and alignment of internal surfaces shall be within 1.5 mm. Where parts with internal diameters differing by more than 1.5 mm are joined concentrically, the inside of the smaller bore shall be tapered to match the larger bore within 1.5 mm. This tapering shall not result in a wall thickness less than the minimum design thickness plus corrosion allowance.

Relative positions of piping components, alignment, and spacing shall be checked by the Inspector before welding commences.

6.7 Requirements for location of welds

Distance between two successive girth butt welds shall not be less than one pipe diameter or 50 mm, whichever is greater, unless otherwise indicated on the drawings or approved by the Inspection Agency.

Attachments of non-pressure parts by welds which cross existing main welds or for which the minimum nominal distance between the toe of the attachment weld and the toe of the existing main welds or branch welds is less than the smaller of twice the thickness of the pressure parts or 40 mm, should be avoided.

All longitudinal weld seams shall preferably be located on the top side of pipe when the piping system is erected. Two successive longitudinal weld seams shall be staggered by 30 degrees minimum.

6.8 Specific requirements for stainless steel piping support

In all cases, a protection shall be applied to the pipe itself, even if the support is painted.

The following solutions are acceptable :

1. Pipe is coated at the support location with a vinyl-ester paint reinforced with glass flakes. Coating shall be applied in accordance with **GS COR 350**.
2. A stainless steel doubler plate is welded to the pipe (100% welding, the doubler plate shall be of the same material than the pipe, welding gas vent to be plugged).
3. Stratified shell composed of laminated epoxy resin reinforced with fibreglass is glued to the pipe.

6.9 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.

6.10 Threaded joints

6.10.1 Tightening of threaded connections

In piping systems employing threaded connections, all joints shall be tightened using a suitable wrench. For connections 2" and larger, joints shall be tightened using a "Ridgid" Compound Leverage Pipe Wrench, or equivalent.

6.10.2 Seal welding of threaded connections

6.10.2.1 Hydrocarbon service

Threaded plugs on hydrostatic vents not provided with a valve shall be seal welded after testing has been carried out. Valved vents, drains, and sample connections discharging to an open system shall only be seal welded upstream the first block valve. Caps shall not be seal welded. Threaded needle valves at sample connections shall not be seal welded. Galvanised piping shall not be seal welded.

6.10.2.2 Other services

All threaded connections shall be sealed as follows:

- 204°C and below: PTFE thread tape (i.e. no seal-welding)
- Above 204°C: seal weld wherever possible, otherwise use pipe jointing compound to Manufacturer's standard.

6.10.2.3 Seal welding

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

- The materials shall be weldable.

- The joints shall be made up clean and without the use of any tape or compound.
- The weld shall cover all exposed threads.
- The welding procedure shall not cause damage to the threaded fitting, e.g. valve soft seats.
- Welding shall only be carried out by qualified welders.
- No other satisfactory means of jointing are available.

6.11 Bends

Bending shall only be used if permitted in the relevant piping class. Bending is neither permitted on stainless steel materials nor on impact tested carbon steels.

Bending and forming shall comply with the procedure requirements defined in [ASME B 31.3](#) Code and the following requirements:

- Unless noted otherwise, the centreline radius of bends shall be five (5) nominal pipe diameter. Welds in bends are not permitted.
- Bends shall be produced only in seamless pipe. Cold bends shall be limited to diameters of 1 ½ inches and smaller, unless otherwise approved by the COMPANY. Elongation of outer layer shall not exceed 15%.
- Bending shall be made using suitable tools and procedures in order to obtain uniform arc surfaces free of cracks and buckles, without excessive out of roundness or thinning of the pipe material.
- The pipe wall thickness at the thinnest point after bending, less corrosion allowance, shall not be less than the calculated thickness required for pressure. Flattening of bends shall comply with the tolerances specified under clause 6.3 of this Specification. Weld repairs of defects in pipe bends are not acceptable.
- Galvanised pipes shall not be bent unless galvanising is made after bending.
- Bent pipes shall be subject to heat treatment in accordance with the requirements applying to each material and the recommendations defined by the code [ASME B 31.3](#).

6.12 Elbows

Elbows shall be long radius (1.5 diameter radius, as specified in the relevant piping material class) unless otherwise noted on drawings.

Mitered elbows are not allowed, except on lines open to the atmosphere such as safety valves open discharge or turbines exhaust lines.

6.13 Branch connections

Branch connections shall comply with the requirements of [ASME B 31.3](#) Code for Process Piping.

Branch connections shall be made by fabricated stub-in connections, couplings, outlet fittings (weldolets, etc.) or tees, as indicated on the piping material classes, and according to the material list of the relevant isometric drawings.

Oblique connections at 45° (when acceptable as per [GS PVV 111](#)) shall be prefabricated in shop. Site fabrication of such connections is not acceptable.

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

All instrument air, fuel gas, and steam connections shall be from the top of the header.

6.14 Orifice runs

Orifice runs shall not contain welds except at the flanges. Pipe ends at orifice flanges shall be machine-cut and perpendicular to the pipe axis.

Welds at the orifice flanges shall be ground smooth inside. Pipe-tap connections shall be drilled through the pipe wall and be smooth inside. Drawings will show the orientation of orifice flange taps and location of pipe taps. Orifice flanges shall be drilled and tapped for jack screws.

Pipe in orifice meter runs shall be in accordance with Instrument Specifications applicable to the Project.

6.15 Galvanised piping

Galvanised piping shall not be bent or welded. Piping required to be bent or welded shall be re-galvanised after fabrication and after having removed damaged galvanising.

6.16 Flange bolt holes

Where not shown otherwise, flange bolt holes shall straddle the vertical centreline of the pipe where the flange is installed vertically, and the north-south line where the flange is installed horizontally.

6.17 Cleaning

Fabricated pipe spools shall be cleaned free from weld spatter, scale, grease and dirt.

6.18 Extra length for site adjustment

Where the drawings indicate a "Field Weld" in the pipe, the relevant sections shall be supplied 200 mm longer with the ends left plain.

7. Welding

Welding shall be in accordance with the Welding Specification [GS PVV 611](#) which is fully applicable, together with one or several of the following additional specifications, as applicable: [GS PVV 612](#), [GS PVV 614](#), [GS PVV 615](#), [GS PVV 616](#), [GS PVV 617](#), [GS PVV 620](#), and [GS PVV 622](#), and the following additional requirements:

7.1 Welding Procedure Specifications (WPS)

The approved welding procedure specifications shall be made available on site for the whole duration of the fabrication.

7.2 Welding Procedure Qualifications (PQR)

Welding procedure qualification tests carried out on small diameter pipe may require execution of two welds if one does not permit all prescribed test specimens to be taken.

Welding procedure qualification for welded branch connections (especially angular), or welds of special configurations, may include special requirements and testing. In that case, qualification tests shall be as directed by the Inspection Agency.

For carbon steel materials, welding procedure qualification tests shall include those prescribed in **ASME Section IX** and the additional requirements here after:

7.2.1 Non-destructive examinations

Visual and radiographic or ultrasonic examinations shall be carried out according to this Specification prior to sampling the test specimens.

7.2.2 Macrosections

A specimen shall be extracted from the completed joint at two opposite locations (12 and 6 o'clock locations for the 5G position). The specimens shall be examined to ensure a good weld profile and freedom from unacceptable weld defects.

7.3 Welders and welding operators qualifications

Welders qualification shall be made on pipe either in the positions 2G + 5G, or in the 6G position. Welders qualified in the 2G + 5G or 6G positions shall be considered as qualified for all positions.

Welders and welding operators shall be qualified on the same P number material as for the work to be done.

Welder qualification for welded branch connections (especially angular) or for welds of special configurations shall include special requirements and testing as directed by the Inspection Agency. Only welders qualified for groove welds in the 6G (inclined, fixed) position may be submitted to particular qualification for welded branch connections.

Welders qualifications documents shall be stamped by recognised authorities such as: Lloyd's, D.N.V., T.U.V., Bureau Veritas, Institut de Soudure, Apave.

Welders and welding operators qualification tests based only on radiographic examination are not acceptable: qualification shall be based mechanical tests. Qualification test welds shall be subject to non-destructive inspection (visual + radiographic, and eventually ultrasonic) before any mechanical test specimen is removed from the test plate.

Only welders and welding operators successful in non-destructive inspection and destructive tests shall be permitted to perform any welding on the project in accordance with their qualification. However, at the discretion of the Inspection Agency, welders and welding operators are subject to re-qualification when the quality of their work, during fabrication, appears to be below the requirements of this Specification.

A record of the results of each test weld shall be jointly signed by the Contractor and the Inspection Agency. The record shall indicate the symbol or number given to the welder for identification of his work.

7.4 Welded connections

All butt welds shall be full penetration welds made using at least two passes.

No pass shall be commenced until the preceding pass has been completed.

Weld passes shall not start or stop at the same point.

Welding shall not be stopped before the second pass is completed, and until the thickness of the weld is at least equal to one third of the pipe wall thickness.

Where possible, butt welds may be made from both sides, in accordance with approved welding procedures. In that case, the back side of the root pass shall be ground or gouged-out to sound metal before welding on that side.

Welds joining components of different material thickness shall be made in such a manner that the slope through the transition zone does not exceed 1/4.

7.5 Post Weld Heat Treatment (PWHT)

PWHT, when required, may be carried out by either of the following means:

- Enclosed furnace
- In-situ furnace
- Local electric induction or resistance.

The PWHT procedure shall be submitted to the COMPANY for review and approval.

The surfaces of the pipe in the heat treatment zone shall be clean of all foreign matter.

The thermocouples shall be mechanically attached to the parts being heat treated, and within 40 mm from the outside surface of the weld metal.

When welds are locally heat treated, the pipes shall be adequately supported and the ends blanked off.

7.6 Field weld location

Piping drawings shall show limits of field run piping and locations of field welds required between spool pieces.

8. Assembly

8.1 Assembly of flanged piping

All flanged joints shall be properly assembled. Unusual measures such as the building-up of imperfect flanges by welding, re-facing of distorted flanges and heating and bending of pipe for proper alignment is not permitted.

Foreign material and protective grease shall be removed from flange faces prior to assembly. After cleaning, flange faces shall be inspected for pits and defects in the gasket contact face. Imperfections may not be repaired except by re-machining the flange facing on a lathe. RTJ flange grooves may be satisfactorily trued by hand lapping with an ORJ gasket.

After cleaning the flanges for make-up, dry gaskets shall be inserted. Flat gaskets shall be centred by the flange bolts. Centring rings of spiral wound type gaskets shall be properly centred.

All studs and nuts shall be thoroughly cleaned before assembling joints. Studs shall be long enough to show one and one-half threads after proper tightening.

When flanges are in alignment, both horizontally and vertically, and faces are parallel, studs shall be installed with the exception of one or two, and nuts hand tightened. In one of the holes left open, a pin wrench may be inserted to raise or lower either flange as required to ensure proper alignment. One stud shall then be tightened sufficiently to keep the gasket seated. The pin wrench shall then be removed and remaining stud tightened by gradually working around the flange until all studs are tight with equal tension on each stud.

For spiral wound type gasket joints, the bolting sequence shall consist of a series of uniform loading starting with the flange bolt in the 12 o'clock position, then transferring successively to the 6 o'clock, 9 o'clock, 3 o'clock, etc. bolt positions, increasing the load uniformly each time until the sequence is completed. Bolts shall be tightened until the flanges are uniformly seated on the gasket centring ring.

When flanges are in alignment but require a cold pull up to take care of expansion during operation, and if specified by the Engineering Company, bolting up shall be accomplished by use of special bolts or chain blocks. Special bolts shall be of a length great enough to engage the two flanges plus the cold pull. Use at least two bolts to provide equal tension on each side of the flange and by tightening up these bolts alternately, bring the flanges together. The correct length of studs shall be substituted for the special bolts.

In using chain blocks, the blocks shall be lashed to the pipe and the two flanges brought together and bolted up as prescribed previously.

Paint damaged during bolt-up procedures shall be repaired in accordance with the **GS COR 350**.

Bolt tensioners:

Hydraulic bolt tensioners shall be used on flange stud bolts 50 mm diameter and larger.

Bolting for use with bolt tensioners shall have the normal length increased by one bolt diameter. Bolt extensions beyond the nut shall be protected from corrosion by caps.

8.2 Assembly of piping to equipment

Piping shall be erected and supported in a manner that will not put undue strain on pumps, compressors, tanks, vessels or other equipment. Adjustment of piping by local heating is prohibited.

The procedure for connection of piping to equipment shall be as follows:

- After the equipment has been set, the pipe shall be connected to the equipment without making any tight connections to flanges.
- Full face gaskets shall be used on piping connecting to equipment with flat face flanges.
- Flanges shall be checked to assure that no strain is induced on the equipment. If pipe is not in correct alignment, it shall be removed and corrected. The correction in alignment shall not be made while the pipe is connected to the equipment.
- Scratched flange faces shall be repaired by re-machining in a workshop or shall be replaced.
- After alignment is found correct, the flanges shall be carefully "bolted up" with the stud bolt centred in the flanges and the nuts having equal threads showing.

9. Welding inspection

9.1 General

Welding inspection shall be made in accordance with **ASME B 31.3** and the additional requirements defined herein.

Inspection personnel and equipment shall be subject to prior approval by the Inspection Agency.

All fabrication shall be subject to inspection by the Contractor under the Inspection Agency's supervision and approval. All weld preparation, fit-up, and weld assemblies shall be visually inspected during all phases of fabrication. Where necessary, corrections shall be made in the weld preparation to assure that sound welds can be achieved by the welding process used. Cracks and undercuts or any evidence of poor workmanship shall be cause for rejection. Special care shall be taken in the inspection of branch welds.

The Contractor shall provide site access and reasonable aid to the Inspection Agency as required for the performance of their duty. The Contractor shall supply and operate at his own expense all equipment and materials necessary to inspect the welds according to this specification.

The Inspection Agency shall have the right to select the welds to be inspected.

Final inspection of welds shall be made after Post Weld Heat Treatment where such heat treatment is performed.

9.2 Extent of inspection

9.2.1 Visual inspection

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

9.2.2 Other NDT requirements

The extent of NDT requirements other than visual inspection is defined in the Table 1 hereafter.

Table 1 - NDT Requirements

Service conditions	Utilities lines		Hydrocarbons (liquid or gas)		Cryogenic Service		Severe Cyclic Conditions
	≤ 600	≥ 900	≤ 300	≥ 600	≤ 150	≥ 300	
Pressure class	≤ 600	≥ 900	≤ 300	≥ 600	≤ 150	≥ 300	≥ 150
Longitudinal welds	C	C	C	C	C	C	C
Girth welds	A	C E	B ⁽¹⁾ E	C F	B ⁽¹⁾ E	C F	C F
Socket welds	None	E	E	F	E	F	(See note 2)
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	E	F	F
Non pressure-containing fillet welds (attachments welds to pressure-containing parts).	None	D	D	E	D	E	F

(1) 100% RT for lines subject to pneumatic tests

(2) Socket welds are not permitted on severe cyclic conditions

9.2.3 General notes for Table 1

- A = Minimum 5% of random radiographic testing (RT). If the weld reject ratio per welder or welding operator exceeds 5%, RT 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
- B = Minimum 10% of random RT. If the weld reject ratio per welder or welding operator exceeds 5%, RT 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
- C = 100% RT
- D = 5% Magnetic Particle (MPI) or Dye Penetrant (DPI) Inspection
- E = 10% Magnetic Particle (MPI) or Dye Penetrant (DPI) Inspection
- F = 100% Magnetic Particle (MPI) or Dye Penetrant (DPI) Inspection

9.2.4 Particular case of welds of piping supports

9.2.4.1 All welds

100% visual inspection

9.2.4.2 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 inches or larger.

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 of NPS less than 10 inches.

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

9.2.4.3 Butt welds

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

9.2.5 Additional non-destructive inspections

Non-destructive inspection in addition to radiographic examination (ultrasonic, magnetic particle, liquid penetrant) may be required at the discretion of the Inspection Agency as additional inspection, or in the case of special weld configuration, or depending on the welding process used by the Contractor.

9.3 Types and methods of examination

9.3.1 Visual examination

This shall be carried out before, during and after fabrication in accordance with [ASME V article 9](#) and [ASME B 31.3](#).

Visual examination shall apply to all welds and shall include:

- Joint preparation and cleanliness

- Fit-up and internal alignment prior to welding
- Preheating
- Welding position, welding products and all other parameters defined in the applicable welding procedures
- Condition of the root pass after cleaning (external and internal where accessible)
- Slag removal and weld condition between passes
- Appearance of the finished weld.

9.3.2 Radiographic inspection

9.3.2.1 Applicable code

Radiographic examination shall be in accordance with [ASME B 31.3](#).

9.3.2.2 Film quality

Only ultra fine grain films of a quality equal or finer than Agfa Gevaert "D4", or Kodak "M", shall be used for radiographic inspection of piping welds.

9.3.2.3 Film size

Films size shall generally be 10 x 40 cm. Smaller width films for welds without intersections may be used provided a minimum width of 15 mm of base metal appears on each side of the weld on the radiograph.

9.3.2.4 Spot examination

When radiography is specified as a percentage (e.g., 10%), radiographic examination shall be carried out on the complete circumference (e.g., 1 in 10) of each size of piping butt welds.

As a minimum, at least one radiograph shall be taken on work performed in early stages of fabrication by each welder or welding operator.

The Inspection Agency may require radiographic inspection at a level above the percentage defined. In such a case, additional radiographs shall be at the COMPANY's expense if the welds are sound and at the Contractor's expense if they are unacceptable.

9.3.2.5 Socket welds

Ten percent of socket welds shall be radiographed 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.

9.3.3 Magnetic particle inspection

When this method of examination is specified or required by the Inspection Agency, it shall be carried out in accordance with [ASME V article 7](#). It is the preferred method of surface crack detection for carbon steel materials.

9.3.4 Liquid penetrant

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

9.3.5 Ultrasonic Testing (UT)

Ultrasonic testing may be used at the discretion of the Inspection Agency as additional inspection, or in the case of special weld configuration, or depending on the welding process used by the Contractor. In such a case, U.T. shall be carried out in accordance with [ASME V article 5](#).

9.4 Standards of acceptance

The following standards of acceptance shall be used for the visual and radiographic inspection for welding procedure qualification test welds, welder qualification and production welds, where applicable.

Standards of acceptance shall comply as a minimum with the limitations on defects defined in [ASME B 31.3](#) for normal fluid service, and with the additional requirements shown on the Table 2 hereafter.

The dimensional limitations of flaws subject to rejection specified in this clause are intended to ensure good quality welding. The effect of weld flaws on the service performance of a joint are influenced by their location and disposition, those located in the body of the weld being in general less serious than those in the root. This should be taken into account when considering the rejection of joints that appear to be border-line in quality as assessed by the limitations of flaws specified in this clause.

The Inspection Agency shall be the sole judge for the acceptability of welds and their decisions are final.

Table 2 - Standards of Acceptance

Type of defect	Limitation
Lack of penetration	No lack of penetration is permitted on process lines.
Cracks	Any form of crack or suspected crack ("linear indication") shall be considered as unacceptable.
Weld Reinforcement	Weld reinforcement shall be uniform. It shall merge smoothly with the parent material. Limitations of the ASME B 31.3 on weld reinforcement shall apply to internal surfaces as well as to external. No chipping of the weld reinforcement shall be permitted.
Concave root surface	The root bead shall fuse to both inside surfaces of joined materials. The depth of any root concavity shall not exceed 1.2 mm, but at no point shall the weld be thinner than the thickness of the thinner of the welded components.
Summation of all lengths of imperfections	The summation of all imperfections in a length of 300 mm of weld shall not exceed 50 mm. A summation of discontinuities having a total length of more than 8 percent of the total weld length shall be considered as unacceptable.

10. Contractor's documents

The Contractor shall prepare and keep up-to-date documents giving detailed technical information on welding operations.

These documents shall include, but not be limited to, the following information:

- Welding Procedures Specifications (WPS)
- Welding Procedures Qualification test Results (PQR)
- Welders qualification tests results
- Approved fabrication and shop drawings
- Sequence in assembling piping components
- Weld-logbook, giving for each part or component under fabrication:
 - Item number of the piping section containing the weld
 - Weld number
 - Welder identification
 - Date of welding
 - Welding procedure used
 - Type and date of non-destructive tests
 - Inspection results
 - Radiographic films (if weld was radiographed)
 - Date of heat treatment (if applicable)
 - Records of heat treatment parameters and heat treatment charts (if applicable)
 - Repairs.

Radiograph locations shall be carefully indicated on the isometric drawings.

These documents shall be jointly signed by the Contractor and the Inspection Agency.

The COMPANY shall be provided with these documents when the work is completed.

11. Testing

11.1 General

The Contractor shall perform the work necessary to successfully hydrostatically, or pneumatically and leak test the piping.

All lines shall be hydrostatically or pneumatically tested. Shop and field tests shall be performed in accordance with **ASME B 31.3** except that pneumatic testing shall be subject to the COMPANY prior approval.

Pneumatic testing shall comply with the **GS PVV 173**.

The Contractor shall submit all testing procedures for approval. All piping systems shall be tested, including those designed at 1 bar gage or less, regardless of design temperature. Shop hydrostatic test is required for piping on which field welding is not required.

All joints, including welds, are to be left un-insulated and unpainted for examination during testing. Vents, drains and relief valves shall be utilised to prevent damage to the piping system due to thermal expansion or other hazardous conditions during the test period.

Any test shall include a preliminary cleaning of the piping after fabrication, to be performed externally and internally, in order to remove all loose scale, weld spatter, sand and other foreign material. The cleaning shall be performed according to the **GS PVV 175**. Any test shall include a preliminary check at no more than 2 bars (g) to locate any major leak. Hydrostatic pressure testing shall only be carried-out on perfectly dry surfaces to allow for proper visual check for leaks.

The line list shall indicate the type of test and pressure to use on each line. The maximum operating pressure of each piece of equipment, including instruments, shall be checked against the test pressure of the piping system in which the piece of equipment is included. If the test pressure of the piping system is greater than the maximum operating pressure of the equipment, the equipment shall be blanked-off and tested separately.

The Contractor shall assign and designate a separate crew with suitable equipment for the testing operations. These shall be conducted diligently, thoroughly and in a safe and workmanlike manner in accordance with accepted piping testing practices.

No test shall be performed without witness of the COMPANY and/or Inspection Agency's representative(s).

11.2 Material, equipment and test fluid

The Contractor shall supply all necessary testing equipment (pumps, compressors, pressure indicators and recorders, etc.) and testing fluids.

The Contractor shall assume full responsibility for the disposal of testing fluids.

As water is normally used for pressure testing of process lines, special precautions shall be taken for draining and drying the lines. Test water shall be clean and free from minerals and suspended matter. Only water having a chloride content of 15 ppm or less shall be used in contact with stainless steel. sea water shall never be used.

If required, rust inhibitor and other chemical additives as oxygen scavenger, passivating agents shall be injected with the test water by the Contractor. Air for pneumatic testing shall be dried and filtered before use as a testing fluid.

11.3 Pressure testing

The minimum hydrostatic test pressure shall be 7 bars (g).

The pressure shall be maintained for an adequate time (not less than 30 minutes) to detect small seepage leaks and to permit a thorough inspection.

All piping which is pneumatically tested, such as process piping, instrument air, plant air and other low pressure piping, shall be tested at a pressure of 110 percent of design pressure.

Attention is drawn to the fact that some pneumatic tests, where high test pressures or large volumes, or both are involved, would introduce considerable hazard due to possible release of stored energy in the system. It is the Contractor's responsibility to select these cases and to propose alternative tests in line with **ASME B 31.3**, for the COMPANY approval.

11.4 Drying after testing

All piping shall be completely drained of all testing fluid. Special precautions should be taken to ensure the draining of all pockets where the testing fluid may be trapped.

All piping tested with water, in which water would be detrimental to the process operation, shall be thoroughly dried. This piping shall be blown-down with air, and air circulated through the piping until it has been determined that there are no trapped pockets of water and that the piping is dry. This in particular shall apply to all stainless steel piping.

12. Painting

Painting shall cover the whole piping system including bolting and accessories. Unless otherwise stated in a project specification painting shall be in accordance with **GS COR 350** including Colour Coding requirements.

13. Marking

13.1 During pre-fabrication

Fabricated parts requiring trial shop assembly shall be match-marked with paint to facilitate onshore erection.

Each piece shall be plainly marked with the piece number, using paint. After application of the primer, or rust preventer on carbon steel piping, permanent markings shall be stamped with steel stamps having rounded or U-shaped cross-section.

On carbon steel piping for low temperature and on stainless steel piping, no stamping is permitted and permanent marking (if required) shall be etched with an electric pencil.

On each element, the flow direction shall be marked so that there are no mistakes during the module assemblies for check valves, flowmeters, flow orifices, or globe valves.

13.2 Spool pieces for installation (hook-up)

Each spool piece to be installed shall be marked with an identifying number relating to the line number and position in the line.

Flanges indicated on the drawings as supplied loose for site welding shall be supplied either lightly tack-welded to the pipe or wired on.

14. Care and maintenance

14.1 Equipment

The Contractor shall be responsible for the care and maintenance of all equipment or material delivered on his site (installed, erected or stored). This care and maintenance must be done according to the Vendor specifications supplied by the Engineering Company, and must ensure the good working conditions of all materials until the start up time.

It must be clearly understood that all extra work which would occur during hook up or start up phases due to Contractor's lack of care shall be back-charged to him.

14.2 Valve operators

Valves handles, wrenches, etc. are to be issued from warehouse with valves and shall be fastened on the line as close as possible to the valve, as soon as the valve is erected. Fastening must be done using steel bands.

Valves supplied with packaged equipment are also subject to the above rules.

14.3 Temporary supports

It may be necessary to provide temporary supports for protecting the piping against shocks, vibrations, stresses, due to on-shore or off-shore handling until the final erection.

Temporary supports are particularly necessary for hanger supports and for large diameter piping.

14.4 Protection of piping spools and piping materials

Openings in piping spools shall be securely closed and flange faces and threaded connections shall be protected with suitable plugs, flange covers, and thread protectors. Small branches and flimsy parts shall be adequately braced or otherwise protected to prevent damage during handling and storage.

Flange gasket contact faces protection which becomes defective either after fabrication, handling or during storage must be re-protected immediately.

15. Priority lists

The Engineering Company may supply the Contractor with lists of line numbers showing the required fabrication priorities. These priorities would be based for the main part on expected equipment deliveries to site. When late, or out-of-sequence equipment deliveries occur, the Engineering Company's co-ordinator shall revise and up-date the priority list to reflect these changes.

16. Reporting

The Contractor shall be responsible for the preparation and distribution of all status reports, schedules, etc., pertaining to spools and materials as follows:

- Spool fabrication record
- Weekly fabrication status report
- Material summary report.

Appendix 1 Dimensional tolerances

- ① ± 3 mm max. from indicated dimensions for face to face, centre to face, location of branches, attachments, etc.

