

GENERAL SPECIFICATION

INSTRUMENTATION

GS EP INS 125

Safety Relief Valves and Rupture Discs

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1. Scope

This specification describes the minimum requirements for the design, sizing, selection and installation of:

- Pressure Relief Valves
- Thermal Relief Valves
- Rupture Discs
- Tank pressure / Vacuum systems
- Valves/Discs Maintenance Facilities.

This specification shall be applied in conjunction with:

- [GS EP PVV 112](#)
- [GS EP PVV 142](#).

The Piping Valves Vessels (PVV) General Specifications (GS) as referenced throughout this specification provide the mandatory requirements related to metallurgy, casting, welding, machining and material examinations. This specification provides additional requirements to the referenced PVV specifications.

2. Reference documents

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

External Documents

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

Reference	Title
AISI	American Iron and Steel Institute
API 6D / ISO 14313	Specification for Pipeline Valves
API RP 520	Recommended Practice for the Design and Installation of Pressure Relieving Systems
API Std 2000	Venting Atmospheric and Low-pressure Storage Tanks: Non refrigerated and Refrigerated
API Std 526	Flanged Steel Pressure Relief Valves
ASME B16.34	Valves - Flanged, Threaded and Welded End
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME Section VIII div. 1	Pressure Vessels
ASTM A 352	Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service

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Reference	Title
ASTM A 703	Steel Castings, General Requirements for Pressure Containing Parts
Class Society Rules	Particular design rules as per selected Class Society may be applicable for equipment installed on the hull of floating facilities and may require Class Society type approval
EN 10204	Metallic Products - Type of Inspection Documents
European Directive 97/23/EC dated 29 May 1997	Directive of the European Parliament and of the Council on the approximation of the Laws of Member States concerning pressure equipment (PED)
ISO 15156	Material for use in H ₂ S containing environments in oil & gas production - Cracking-resistant CRAs (corrosion resistant alloys) and other alloys
MSS SP-54	Quality Standard for Steel Castings – Radiographic inspection for Valves, Flanges and fittings and Other Piping Components
MSS SP-55	Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Visual Method for Evaluation of Surface Irregularities
NACE MR0175/ISO 15156	International Standard NACE MR0175/ISO 15156 - Petroleum and Natural Gas Industries - Materials for use in H ₂ S-containing Environments in Oil and Gas Production
UNS	Unified Numbering System code

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 ECP 103	Process sizing criteria
GS EP EXP 203	Maintenance and inspection documentation preparation during project phase
GS EP EXP 217	Requirements to Vendors, Suppliers and EPC's for spare parts

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Reference	Title
GS EP INS 101	Instrumentation engineering, supply and construction general requirements
GS EP INS 107	Design and installation of instrumentation links
GS EP PVV 112	Piping material classes
GS EP PVV 142	Valves
GS EP PVV 611	Welding of pressure containing piping and equipment
GS EP PVV 612	Metallurgical and equipment subject to severe sour service. Metallurgical and welding requirements
GS EP PVV 613	Valves materials requirements for use in sour service
GS EP PVV 622	Piping and equipment subject to intermediate sour service. Metallurgical and welding requirements
GS EP SAF 262	Pressure protection relief and hydrocarbon disposal systems

3. Definitions

The following terms and abbreviations will be used in the present document:

Company: TOTAL E&P or any TOTAL E&P subsidiary.

Contractor: Any party TOTAL E&P has signed a contract with, for the Engineering, Procurement, Construction and Installation of a part of a project or maintenance contract.

Manufacturer: The party having received a Purchase Order from Company, Contractor or Package Vendor for the manufacturing and supply of safety relief valves or rupture discs.

Package or Package Unit: Prefabricated process or utility self-contained unit, generally able to operate on its own, supplied fully tested and ready for immediate installation, being supplied by a designated Package Vendor.

FAT	Factory Acceptance Test
NDE	Non-Destructive Examination
NPS	Nominal Pipe Section
PID	Piping & Instrumentation Diagram
PSV	Pressure Safety Valve
TSV	Thermal Safety Valve

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4. General Requirements

Safety relief valves and rupture discs design shall be based on the requirements of the process application, operating and design conditions, piping specification (material, class) and environmental conditions.

As mentioned in [GS EP INS 101](#), the final selection of the Manufacturer upon tender and bid evaluation shall be subject to standardization for each application type. Therefore, the Contractor shall ensure throughout the facility and subcontracted packages that the number of valve brands and models is reduced to the lowest minimum possible, i.e. preferably to one Manufacturer for each application only. The Contractor shall equally coordinate his selection of valve brand and model with all Package Vendors accordingly, in order to avoid a large diversity of valves, accessories, spare parts, etc.

5. Data Sheets

An approved dedicated engineering data sheet shall be the basis for procuring the relief valves or rupture discs. Standard sizing and product data sheets provided by the Manufacturer shall not be used as a substitute for the engineering data sheets.

Engineering data sheets are a collection of specific data provided by multiple disciplines (process, safety, instrumentation, piping, valves, mechanical, etc.).

Engineering data sheets shall be segregated documents for the following types:

- Conventional relief valve
- Pilot-Operated relief valve
- Thermal relief valve
- Rupture disk
- Other applications as may be the case.

Contractors and Package Vendors shall issue an as-built revision of all engineering data sheets upon installation & commissioning with all Vendor specific details completed, in the proper electronic format, as per Contract.

6. Safety Relief Valves Technical Requirements

Safety relief valves shall meet the requirements of [API 526](#).

Safety relief valves shall be of conventional direct-acting angle pattern, spring loaded, pilot operated and high-capacity type.

- Conventional spring-loaded safety valves shall be used in services where there is no back- pressure or where the constant back-pressure does not exceed 10% of the set pressure and also usually for steam service.
- Balanced bellows safety valves shall be used for variable back pressures or for back pressures ranging from 10% to 50% of the set pressure or when the fluid is corrosive, toxic or fouling.

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- Pilot operated valves shall be considered on services such as light gases at high set pressure, on clean gas in pulsating service, when the set point is less than 10% above the operating pressure or for very high capacities.

Refer to **GS EP ECP 103** for set point tolerances.

Safety relief valves, except for the thermal relief of liquids, shall be adjustable blow-down type, designed in accordance with **API RP 520** and **ASME Boiler and Pressure Vessel Code, section VIII** and where applicable, **section I**.

Safety relief valves on cryogenic services shall be supplied with extended bonnet. Material for the extended bonnet and temperature transfer fins shall be suitable for the minimum design temperature of the PSV.

An atmospheric, open vented bonnet shall be provided for steam or air.

Use of diaphragm type pilot operated valve is not allowed.

Weight loaded relief valves shall be used only for low-pressure safety valves (**API Std 2000**).

The use of aluminum, instruments containing mercury (Hg), and instruments containing asbestos is strictly prohibited.

The use of **AISI 304** or **304L SS** is not allowed for any parts in contact with the atmosphere.

Lifting levers shall be provided on all safety valves used on steam and air service.

In case of dangerous gas (e.g. H_2S), vents shall be collected and hooked up so as to lead a safe location.

Thermal safety valve shall be conventional spring loaded type, as per **GS EP SAF 262**. The discharge of liquid expansion valves shall be hooked up so as to lead a safe location.

6.1 Origin of Materials and Manufacturing

The Manufacturer shall submit during tender a "Declaration of Materials and Manufacturing Origin", clearly listing:

- All casting companies for the supply of cast and forged components
- All companies for welding and examination of cast and forged components
- All companies for machining, assembling and testing

which may be used for the fabrication of any pressure or non pressure-containing or process-wetted valve component, including Manufacturer himself. This list shall be set up for each valve component, per valve model, size and pressure range.

The Manufacturer shall clearly list which of his own factory/factories (names and addresses) is/are proposed. In case the Manufacturer will use more than one of his own factories at different geographic locations, then the Manufacturer shall clearly list which factory will be used for each valve and/or each valve component.

It shall be noted that Company approval of a Manufacturer is related to a specific factory at a specific geographic location.

Casting companies are subject to Company approval. The fact that a Manufacturer is listed on Company's approved vendor list does not imply a general approval for any casting Company or

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steel mill possible used by the Manufacturer. The Manufacturer may only order valve components casting companies approved prior by Company.

Non-approved casting companies shall have obtained Company approval before Purchase Order.

The casting Company identification and heat number shall both be clearly visible at the final product by means of embossed or stamped numbers.

6.1 Valve body design

Material selection for all body components shall be in strict accordance with [GS EP PVV 142](#) and [GS EP PVV 112](#). The material pressure-temperature ratings for the valve body shall be in accordance with the associated piping class and not as a function of the operating pressure-temperature limits. However, internals (trim) and non-metallic components may be subject to the operating pressure-temperature limits on a case-by-case basis.

All valves shall have a service class (A thru D) assigned as per [GS EP PVV 142](#), clearly identified on the engineering data sheets, to identify particular requirements on material selection, design, examination and testing. Class A may not be used for process, flammable and chemical fluids.

Relief valve bodies shall be a one-piece cast body with integral end connections (refer to section 6.3).

Manufacturer shall provide the detailed ASTM, [AISI](#) or [UNS](#) material code, also clarifying generic trademark names, for all body, bonnet, bolting or trim components, including material details for non-metallic components such as seals, gaskets, etc.

Even when better quality or grade materials are proposed, then the Manufacturer shall include this in the mandatory List of Deviations during tender for review and approval by Company.

Cast components shall be free from injurious blowholes, porosity, shrinkage faults, cracks or other defects in accordance with [MSS SP-54](#) & [MSS SP-55](#). Refer to [GS EP PVV 142](#) for mandatory requirements on materials, fabrication and examination. Any welding or weld repair shall comply with [GS EP PVV 611](#), and major welding as defined in [ASTM A 703](#) shall only be undertaken with the written approval of Company.

Unused threaded holes in pressure containing parts of valve body shall be avoided. If a blind plug is installed, then it shall be seal welded.

For valves in sour service, [NACE MR01-75](#) / [ISO 15156](#) shall comply with [GS EP PVV 612](#), [GS EP PVV 613](#) and [GS EP PVV 622](#). Welding and weld repairs are not allowed for valves in sour service.

6.2 Bonnets, Top Plates and Bolting

Bonnets and top plates shall be the same material as the valve body.

Bonnets and top plates for pressure relief valves shall be a bolted design with fully retained gaskets. Screwed bonnets and union bonnets are not permitted.

Bonnets for thermal relief valves up to and including NPS 2 inch may be screwed bonnets.

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Caps covering the top of the adjustment bolt are usually screwed to the bonnet, equipped with an integral locking screw.

Pressure-containing bolting for bonnets and top plates shall be in strict compliance with Table 7 of [GS EP PVV 142](#).

6.3 End Connections

Thermal and pressure relief valve bodies for service class C thru D shall be a one-piece cast body with integral flanges. Other type of flanged end connections (e.g. weld neck, slip-on, threaded, lap joint or socket weld) and threaded end connections are strictly not permitted.

The relief valve body for service class A may have a threaded end connection for valves up to and including NPS 2 inch.

Flanged connections shall be [ASME B16.5](#) type (RF, FF, RTJ) as defined by the applicable piping class, and which shall be clearly mentioned on the engineering data sheet. Therefore, the piping class shall also be clearly mentioned on the engineering data sheet.

The allowable end connection sizes for pressure relief valves are: ASME NPS 2, 3, 4, 6, 8, 10, 12, 14 inch and larger. Intermediate sizes may not be used or selected. The use of end connections smaller than 2 inch is not permitted. Therefore, the upstream process tapping/piping shall always be minimum NPS 2 inch.

The allowable end connection sizes for thermal relief valves are: ASME NPS 3/4, 1, 1.5, 2, 3, 4, 6, 8, 10, 12, 14 inch and larger, of which the end connections might be threaded for service class A valves up to and including NPS 2 inch.

The Manufacturer may assume that short-length concentric reducers will be installed to match the selected valve size, unless stated differently on the data sheet.

The flange rating for any given relief valve shall be:

- Minimum ASME Class 150 for GRP and PVDF piping
- Minimum ASME Class 300 for metallic piping.

For flange face roughness and hardness, refer to [GS EP PVV 142](#).

For reasons of Manufacturer interchangeability, any relief valve having Manufacturer specific dimensions shall be avoided.

6.4 Internal Components

All internal components (including spring and adjustment assembly) shall be corrosion resistant materials, with a minimum of AISI 316.

In case of seawater service, all process-wetted internal components shall be made of Monel-400 ®, Hastelloy-C ® or Duplex ®, while non-wetted internal components shall be minimum AISI 316.

6.5 Pilot Valves and Associated Tubing

The complete pilot valve assembly, including supports, shall be minimum AISI 316. In case of seawater service, all process-wetted components shall be made of Monel-400 ®, Hastelloy-C ® or Duplex ®.

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As per **GS EP INS 107**:

- Tubing shall be minimum AISI 904L
- Compression fittings shall be minimum AISI 316L
- All tubing and fittings in seawater service shall be Monel-400 ® or Hastelloy-C ®
- All threaded connections shall be made using sealant paste; tape is not allowed
- Any other link component (e.g. tee, valve) shall be fully minimum AISI 316 or 316L (or Monel-400 ® or Hastelloy-C ® for seawater service).

As per **GS EP INS 101**, the brand and sizing system shall be standardised throughout the whole facility, including package units. The sizing system, i.e. metric or imperial sizes, and brand shall therefore be clearly stated on the engineering data sheets before tender.

6.6 Gaskets, Seals and Bellows

Metallic gaskets, seals, and bellows shall be at least AISI 316, unless stated differently on the engineering data sheets. Non-metallic seals shall be selected in accordance with Table 4 of **GS EP PVV 142** and the notes there-under.

Metallic gaskets, seals and bellows for seawater service shall be made of Monel-400 ®, Hastelloy-C ® or Duplex ®.

The engineering data sheets shall clearly mention the presence of any naturally present (e.g. H₂S) or added chemical fluid component (e.g. methanol, corrosion inhibitor) to enable an assessment of non-metallic process wetted parts.

The use of FKM (e.g. Viton ®) and Polyamide (e.g. Nylon ®, Vespel ®) is strictly prohibited for process wetted parts in hydrocarbon and chemical service.

Pressure-containing parts non-metallic seals shall have mechanical properties in compliance with Appendix 2 of **GS EP PVV 142**.

Any elastomeric seal material shall be anti-explosive decompression (AED) certified according to a procedure complying with the requirements of **GS EP PVV 142** Appendix 8; all AED seals shall be of "O" ring circular cross section type only.

Bellow seals are prone to fatigue failure. Their application is limited to specific applications where no stem leakage is allowed such as acid, toxic and lethal process fluids. A pressure gauge with isolation manifold shall be provided to detect bellow leakage.

6.7 Lifting Devices

Removable lifting devices shall be provided for all valves heavier than 50 kg. The lifting devices shall be positioned in such a way that the completely assembled valve is in a straight position for mounting it in the adjacent piping, and in such a way that lifting slings cannot touch or damage any component.

All lifting locations on valve shall be provided with an AISI 316 text plate stating for which purpose they can be used.

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7. Safety Relief Valve Selection

Specific operating conditions and requirements shall determine the selection of a certain valve (type) for a given service.

Such operating conditions and requirements may be created by one or more of (but not necessarily be limited to) the below-mentioned circumstances:

- Applicable relief case(s)
- Media, blow off to atmosphere/relief system-flare
- Pressure/temperature rating.

Except for special service, on process requirement, safety relief valves shall be selected from the standard sizes listed in [API 526](#).

For standardization purposes, and to reduce the quantity of spares, the Company may require the number of standard sizes at the site to be restricted. The Contractor shall submit the proposed valve sizes for the approval of the Company.

The type of valve selected for each application shall be submitted for approval.

Specific attention shall be given to the selection of pilot-operated valves:

- Only types with non-flowing pilots shall be used
- Due to a requirement to minimize emissions to atmosphere, modulating-action type pilots (whereby the pilot opens the PSV enough to satisfy the required relieving capacity) shall be given preference over pop-action type pilots (whereby the pilot causes the safety valve to open fully).

The set pressure of a pressure safety valve shall never exceed the maximum allowable working pressure of the vessel it protects as specified in [ASME section VIII](#).

7.1 Valve Sizing

Manufacturer shall indicate the blow down and the typical tight closing pressure of each valve.

Manufacturer computer program used for sizing pressure safety valves shall be approved.

Manufacturer shall provide detailed printouts for each valve containing original data, calculated results and formulas for approval.

A calculation sheet (using [API RP 520](#) formulas) shall be provided by Manufacturer for each safety relief valve in accordance with process values defined on the individual engineering data sheets.

Note:

- For conventional valves, set pressure is the difference between relieving pressure and constant back pressure.
- For balanced valves, relieving pressure and set pressure are the same.
- For conventional valves, the variation of superimposed back pressure cannot exceed 10% of the set pressure.

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The valve size shall be calculated on the basis of the worst credible case that might cause the valve to blow.

Relieving capacity, due to fire exposure, shall be determined as per [API RP 520](#), latest edition for the process area pressure vessels, taking into account possible equipment insulation.

Sizes shall be identified in accordance with [API RP 526](#) showing inlet size - orifice area- outlet size (e.g. 1D2, 2H3...).

The initial valve size selection shall be based upon the valve's suitability for the given case.

Concurrently, the selected orifice (area) will be the next larger standard area as defined in [API RP 526](#). Orifice area will be expressed in mm².

When instances are not clearly covered, the proposed solutions shall be submitted to Company/ Contractor for approval.

The final selection of all pressure relief valves shall be subject to Company/Contractor approval.

7.2 Noise and Vibration

Noise and vibration calculations shall be made by Manufacturer, as per [GS EP SAF 262](#) definition and shall be submitted with the quotation for approval by Company.

The maximum vibrations shall not exceed the thresholds figures set in [GS EP ECP 103](#).

The maximum allowable noise exposure and sound pressure levels on facilities operated by Company are defined by legislation (European Directives and local regulations) as well as by Company HSE Directives and GS specifications.

The engineering data sheets shall clearly mention if the maximum allowable noise levels are at continuous or intermittent service

The sound pressure level measured at one meter distance, at any position, shall not exceed the specified value throughout the operating range.

8. Rupture Discs

8.1 General Requirement

The design, construction and material shall be in accordance with the process specification, piping classes and requirement of [API Std 526](#) and [ASME section VIII division 1](#).

Rupture discs shall be delivered equipped with two discs holder rings suited for assembly in between pairs of line flanges.

The disc holder ring shall have on the outlet side a DN15 (1/2") NPT hole with a plug for connection of device for the detection of disc ruptures as per [GS EP ECP 103](#).

For each rupture disc, two spare discs shall be supplied for commissioning and start-up.

Manufacturer shall deliver a calculation sheet for each rupture disc.

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8.2 Rupture Discs Selection

The use of rupture discs shall be limited to the cases listed below and avoided in all other cases (refer to [GS EP SAF 262](#)):

- Fast response is required, e.g. protection of the water side of a gas cooler in case of tube rupture, protection against surge effects of loading/unloading buoys, in parallel of fast opening valve in closed flare design.
- Downstream relief system must be protected from a corrosive fluid (in this case, particular attention should be paid to prevent any debris from damaging or plugging a downstream relief valve).

8.3 Disc Sizing

The Manufacturer shall provide detailed printouts for each rupture disc containing original data, calculated results and formulas for approval.

The rupture disc calculations shall be in accordance with sizing formula contained in [API RP 520](#), last edition.

8.4 Construction

Rupture disc shall be designed according to [ASME Section VIII div. 1](#).

The material of the wetted parts shall be compatible with the fluid in accordance with the piping class or better and as a minimum AISI 316L SS.

The disc holder ring shall be of minimum AISI 316 SS and will include a plug of the same material.

9. Buckling Pin Valves

The use of buckling pin valves shall be subject to specific Company approval.

10. Tank Pressure/ Vacuum (Breather) Systems

Tank pressure/vacuum valve for storage tanks shall be of the weight-loaded type and designed in accordance with [API Std 2000](#). All vents shall be suitable for mounting on a vertical stub connection from the tank and shall be furnished with the specified flange. Deviations shall not be considered.

Vacuum break or inlets shall be included vertically upwards and shall be protected by a weatherproof cover and screen.

Pressure relief outlets for local discharge duty shall be protected by a weatherproof cover and screen.

Inlet and outlet flanges where specified on the individual engineering data sheets will be in accordance with [ANSI B16.5](#).

Relieving capacity due to fire exposure for storage tanks containing flammable or combustible liquids, shall be determined as per [API Std 2000](#).

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11. Identification and Marking

11.1 Safety Relief Valves

Each safety relief valve shall be provided with a permanently engraved AISI 316L stainless steel name plate. This plate shall be riveted or screwed.

The following information as a minimum shall be provided:

- Tag number
- Manufacturer s name, Model
- Valve type and serial number
- Set pressure (in units specified on engineering data sheet)
- Valve, orifice size and flange rating
- Spring type and range
- Valve spring, disc, disc holder, material
- Rated capacity (in units specified on engineering data sheet).

Safety relief valves shall be marked in accordance with [ASME B16.34](#).

A permanent mark cast may indicate body rating and body material.

11.2 Rupture Discs

Rupture discs shall be provided with a permanently engraved AISI 316L stainless steel name plate. This plate shall be riveted or screwed.

The following information as a minimum shall be provided:

- Tag number
- Manufacturer s name, Model
- Valve type and serial number
- Holder size, rating, material
- Rupture pressure at the operating temperature
- Pressure rating
- Lot number.

11.3 Special Marking

Special marking such as "METHANOL SERVICE" shall be provided when indicated in the engineering data sheets.

Marking shall be chosen such, that confusion with other similar components is avoided.

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12. Painting

All safety relief valves and any carbon steel accessory shall be painted as per:

- **GS EP COR 350** for valves located at coastal and offshore process facilities
- **GS EP COR 351** for valves located at offshore floating structures (hulls)
- **GS EP COR 354** for valves located at onshore process facilities
- Or according to the particular project specification(s).

The applicable painting system and final painting colour shall be clearly indicated on the engineering data sheets by Contractor or Package Vendor. In case the valve body does not require painting, any carbon steel accessory shall be painted as per painting system P01 (refer to **GS EP COR 350**).

Painting shall only be applied after all mechanical tests and inspections have been performed, but the installation of any accessory (and functional testing therefore) is preferably done after final painting. Under no condition may any accessory, tubing or accessory brackets & bolting, nor the packing flange and bolting, be painted.

Tag plates and name plates shall be installed after final painting.

13. Inspection and Testing

13.1 General

The minimum rules and requirements related to inspection and testing of valve manufacturing are laid out in **GS EP PVV 142**. This complementary section provides more detailed requirements adapted to the manufacturing of relief valves.

The required inspection and testing plan (ITP) for valve manufacturing is divided into:

- Standard ITP: to be provided by default for 100% of the supplied valves
- Optional ITP: to be provided when specified by the purchase order, project specification or engineering data sheet, possibly per individual valve.

The standard tests are to be executed for 100% of the supplied valves by the Manufacturer. Any test performed by his sub-suppliers may not be considered as a substitute for the tests and inspections listed here-after.

The Manufacturer shall provide, free of charge, factory access and all necessary means to Company, or his representative, and to Contractor or Package Vendor, or their representative, for the witnessing of all tests and inspections described here-after. The 'representative' may be a designated Inspection Agency.

The minimum witness rate (excluding individual audits) for inspection and testing shall be as listed here after:

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Table 1 - Extent of witnessing rate for inspection and testing

Valve size (inlet flange)	All pressure classes	Pressure classes ≤ 600	Pressure classes > 600
≤ NPS 10"	100%	25%	50%
≥ NPS 12"	100%	100%	100%
		with a minimum of 1 valve per: - valve model - pressure class - valve size	

An individual test report shall be supplied for each supplied valve, and which shall accordingly be identified by an appropriate fabrication numbering system. A test report addresses one assembled valve only. All test reports and test certificates by third parties shall be collected and adequately organised in the Manufacturer Documentation books supplied with delivery and being available during inspections.

13.2 Material certificates

The Manufacturer shall submit material certificates giving the results of the chemical analysis and of the mechanical tests carried out in accordance with the requirements of the reference codes and standards for all metallic and non-metallic process wetted and pressure containing materials.

Cast and forged components shall only be accepted when they meet the requirements of the impact test at the given test temperature as per Table 2 here-after. Any component failing the impact test shall be rejected. Impact test results, including the specimen test temperature, shall be clearly stated on the material certificates.

Important note:

Table 2 here-after applies to ASME/ASTM codes and standards. Different and more restrictive criteria may apply when the supply must comply with the [European Pressure Equipment Directive \(PED\) 97/23/EC](#). In case of conflict, the most restrictive criteria shall apply.

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Table 2 - Impact test criteria for pressure-containing cast and forged components

Material	Design Temp.	W. T.	T Test	Impact Test Value
Carbon Steel	$T \geq -29^{\circ}\text{C}$	$< \frac{1}{2}$ inch	n.a.	Impact testing not required
Low-Alloy Steel		$\geq \frac{1}{2}$ inch	-29°C	min. 20 J average for 3 specimen min. 16 J for individual specimen unless otherwise specified
L.T. Carbon Steel Low-Alloy Steel	$-29^{\circ}\text{C} > T \geq -46^{\circ}\text{C}$	All	-46°C	As per ASTM A 352 or: min. 20 J average for 3 specimen min. 16 J for individual specimen, whichever is greater, unless otherwise specified
SS 300 series (316, CF8M, etc.) SS 400 series (Monel 400 etc.)	All	All	Ambient	Impact testing not required, but in case of sour service subject to hardness test with HRC 22 max. or according ISO 15156-3
Duplex St. Steel	$T \geq -29^{\circ}\text{C}$ $T \geq -46^{\circ}\text{C}$	All	-46°C	min. 27 J average for 3 specimen min. 20 J for individual specimen unless otherwise specified
Nickel-Alloy Steel Stainless Steel	$-46^{\circ}\text{C} > T \geq -101^{\circ}\text{C}$	All	-101°C	As per applicable ASTM standard
9% Nickel-Alloy Stainless Steel	$T < -101^{\circ}\text{C}$	All	-101°C	As per applicable ASTM standard
For all materials: the minimum impact test values are related to tests performed on full-section impact test specimen (10x10mm). Values for sub-sized specimen (when required) shall be agreed on by Company. Impact testing shall be performed per ladle (furnace) charge.				

- **For bar stock and non-metallic components:** the steel mill or component Manufacturer shall be clearly visible at the final product by means of embossed, stamped or laser engraved number (printing is only allowed for non-metallic parts), as per material certificate.
- **For cast or forged components:** the casting company identification and heat number shall both be clearly visible at the final product by means of embossed or stamped number, as per material certificate and/or heat number.

The material test report (certificate) shall clearly indicate/identify:

- Testing laboratory
- Foundry / Steel mill
- Heating numbers
- Chemical composition analyses

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- Impact test temperature
- Impact and hardness test results.

Material certificates shall be provided for any valve as follows, as per [EN 10204](#):

Table 3 - Type of material certificate required for each valve part

Valve Component	Minimum type of Material Certificate	
	service class A	service class B, C, D
Body	3.1	3.1
Bonnets and top plates	3.1	3.1
Bolting (for pressure containing parts)	2.2	3.1
Spring & pressure containing trim parts	2.2	3.1
Other trim parts pressurised	2.1	3.1
Other trim parts non pressurised	2.1	2.2
Bellows	2.1	3.1
Seals & Gaskets	2.1	2.1
Pilot valve body	2.1	3.1
All other pilot valve components	2.1	2.2
Tubing and compression fittings	2.1	2.2
Rupture disc	3.1	3.1

13.3 Pressure testing

Hydrostatic shell tests shall be executed for 100% of the supplied valves by the Manufacturer in accordance with [ASME B16.34](#).

Hydrostatic shell tests shall be applied to all final machined pressure-containing components at 1.5 times of their ASME Class rating, either individually or assembled. Hydrostatic pressure testing of non-final machined pressure containing parts is not permitted, it can only be considered as an early foundry quality test.

Hydrostatic tests shall be performed in-house by the Manufacturer.

Testing water quality is selected according to the type of valve material. After testing, appropriate cleaning and drying shall be done.

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Regardless the type of valve and to which standard it has been designed, the minimum duration for hydrostatic shell tests for both internal and for witnessed tests shall be as per [API 6D](#) (and not as per ISA, ISO, ASME, IEC, or other standard):

Table 4 - Minimum duration of hydrostatic shell tests

Valve Size (inlet flange)	Duration (minutes)
≤ NPS 4"	2
6" ≤ NPS ≤ 10"	5
12" ≤ NPS ≤ 18"	15
≥ NPS 20"	30

Extended pressure tests up to 30 minutes can be requested by Company, or his representative, as long as stabilisation is not achieved, or because of unsuspected behavior of the valve, or when a particular casting quality assessment is requested.

Bellows shall be tested separately at 1.1 times the maximum shut-off pressure.

The set pressure test shall be performed with air or Nitrogen. The maximum tolerance will be ± 0.1 bar for a setting pressure below 5 bar, and ± 3% for higher set pressure in accordance with [ASME Section 1](#).

The test set pressure shall take into account the back pressure (if any) indicated on data sheet and shall be compensated accordingly.

Rupture discs shall be tested by lot. The Manufacturer shall test a percentage of the rupture discs from the same heat number lot, for each rupture disc size, duty, and rating. These rupture tests shall be conducted in-house by the Manufacturer on an ASME accredited test bench and witnessed.

Note: A lot of rupture discs is those discs manufactured of a material at the same time, of the same size, thickness, type, heat, and manufacturing process including heat treatment.

The Manufacturer shall test and provide a test report for each individual valve.

Cryogenic service relief valves shall be hydrostatic tested for all pressure containing parts as here-above prior to cleaning, drying and final assembling, followed by a dedicated thermal cycle testing program as specified in section here below.

13.4 Post-delivery inspection

After delivery and before start up, the setting pressures and the valves seal shall be checked on a test bench.

14. Thermal Cycle Tests for Cryogenic Service Valves

The Manufacturer shall develop a detailed test procedure based on this section, including the cool down method, test equipment and test set-up; subject to Company review and approval

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prior to testing. Detailed test reports per test, including calibration certificates of test equipment shall be included in the final test report.

The Manufacturer's test procedure shall clearly illustrate the test rig, valve supports, temperature/pressure/flow sensors, purge schematic with gas supply, purge valves, etc. The valves shall be equipped with blind flanges provided with purge connections and passages for temperature sensors.

The inlet connection of the relief valve shall be submerged into the coolant bath (cold box), while the outlet connection shall not be submerged into the coolant. The outlet connection might be thermally insulated during the test only if the final installation is with thermal insulation.

Temperature sensors and recording shall be provided for at least:

- Room temperature
- Body outside temperature on inlet connection
- Nozzle or disc
- Bonnet (at body connection location)
- Coolant (inside cold box).

The seat leakage test shall be measured by an adequate flow meter. The leakage to the outside of the valve shall be measured using a helium mass spectrometer with a sniffer probe; the test procedure shall define the acceptance value as a function of each valve size/design.

The test/purge gas shall be either pure helium or a helium/nitrogen mixture (min. 2% helium). Its dew point shall be constantly measured, and always remain 5°C below test temperature.

Attention and precautions shall be made due to the fact that most of the testing in this section is based on gas testing. As such, dedicated test areas, protecting personnel by means of concrete walls/bunkers shall be provided, including protection against liquid nitrogen projection occurring from a failing valve submerged in liquid nitrogen. The cold box is not considered a safe barrier. Therefore, monitoring of pressures, temperatures and flow rates from a safe location is required. The use of electronic sensors is therefore recommended.

The relief valve shall be actuated (popped) by increasing the gas pressure remotely.

Each cryogenic relief valve shall be subject to the following tests and assembling sequence. The purpose is to demonstrate that the valve remains functional and leak tight throughout a full thermal cycle.

Therefore, each individual relief valve shall be subject to a thermal cycle test, demonstrating and recording the set pressure at ambient and at coldest working temperature.

NOP means Normal Operating Pressure of the process.

1. Pre-assembling tests
 - Hydrostatic testing of pressure-containing valve parts as per section 13.3.
2. Valve assembling and functional tests
 - Thorough cleaning and drying of all valve parts, then final valve assembling

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- Final valve assembling (no temporary parts)
- Final set pressure adjustment.
- 3. Pre-cryogenic tests (at ambient temperature)
 - Valve purged and pressurized at NOP with test gas (at inlet only)
 - Perform body tightness leak test, for 15 minutes at NOP
 - Perform seat leakage test, for 15 minutes at NOP
 - Perform set pressure test.
- 4. Cryogenic tests (at minimum design temperature)
 - Cool down the valve inlet connection to minimum design temperature
 - Valve shall be kept purged at 2 barg with test gas
 - Perform seat leakage test, for 15 minutes at NOP
 - Perform set pressure test.
- 5. Post-cryogenic tests (at ambient temperature)
 - Valve purged and pressurized at NOP with test gas (at inlet only)
 - Perform body tightness leak test, for 15 minutes at NOP
 - Perform seat leakage test, for 15 minutes at NOP
 - Perform set pressure test.

The valve shall be rejected in case the pop pressure during or after cryogenic tests differs more than $\pm 5\%$ from the pre-cryogenic tests. Rejected valves may be resubmitted for retesting only after the cause or part has been identified and be corrected or replaced.

All rejections and corrections shall be noted in the test report part of the manufacturing data book for Company.

15. Packing and Preservation

After testing, safety relief valves shall be cleaned, dried and prepared for shipment.

All safety relief valves shall be packed based on the project specification.

All safety relief valves shall be protected and sealed with special package such as vacuum packing so as to prevent condensation. Care shall be taken not to open or damage this packing during shipping.

Each item shall be suitably packed so as to be protected from damage during shipment, long term storage and particularly in summer or winter extreme.

These precautions shall comprise, but not be limited to the following:

- Before leaving the factory, all openings in the valve body or accessories shall be provided with temporary closures to prevent entry of dirt.

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- During transport and storage, the valve ends shall be protected with suitable close fitting protectors (e.g. plastic caps) or covers of at least 3 mm thick and securely fastened by an adequate number of bolts.
- Connections of accessories shall be protected by thread protectors.
- The crate materials shall have a fumigation treatment.

Each item shall be identified with the complete purchase order number. Additionally, they shall be marked with the item numbers of the contents according to Contractor drawings.

Spare parts shall be separately packed.

Manufacturer will indicate the storage conditions and transportation recommendations that apply to their equipment.

16. Spare parts

Spare parts for commissioning, start-up and 2 years operation are normally defined by the project specification included in the Purchase Order. In the absence of a project specification, the Manufacturer shall by default prepare and complete the spare part lists, for all safety relief valves supplied and rupture discs, as defined by **GS EP EXP 203** and **GS EP EXP 217**.

17. Permanent Maintenance Facility

In order to maintain and retest relief valves then maintenance and testing tools shall be provided. They shall contain:

- Adequate tools and benches for disassembling/assembling pressures relief valves.
- Adequate tools and machines for valves cleaning One or more calibrated test bench for testing relief valves. The test benches shall cover all relief valves types/sizes/pressure ratings present on the production facility including small pneumatic relief valves for pneumatic actuators.

Maintenance and testing tools shall be permanently installed in the maintenance workshop.

All the equipments and tools part of the permanent maintenance facility are included in the Contractor's scope of supply.

18. Documentation

18.1 Documentation to be provided during tender

The Manufacturer shall supply 100% of the following statements, calculations, documentation and certificates with bid.

1. Statement of Compliance

With **GS EP INS 125** + **GS EP PVV 142** + applicable project specifications and data sheets.

2. List of Deviations

From applicable GS, project data sheets and specifications.

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3. Declaration of Materials and Manufacturing Origin

- All casting companies for the supply of cast and forged components
- All steel mills for the supply of bar stock materials
- All companies for welding and examination of cast and forged components
- All companies for machining, assembling and testing
- Manufacturer's factory(s) location(s) used for the order concerned.

4. Calculations

Min/max % opening, noise prediction, etc.

5. Valve body

Model, size, dimensions, end connections, materials for all individual components.

9. Accessories

Type, model, materials, datasheet for each accessory.

10. Certification

11. General

Overall dimensions and weight of full assembly.

18.2 List of Deviations

All deviations, as listed in the mandatory "List of Deviations", attached the technical proposal, shall be reviewed, clarified, approved or rejected one by one for Company final approval before Purchase Order.

18.3 Documentation to be provided after Purchase Order

Before manufacturing commences, the Manufacturer shall re-issue all design and calculations provided during tender. Contractor and Package Vendor shall duly verify and correct any erroneous data before Company review and approval.

Manufacturing may only commence after Company approval of these documents, including:

- Inspection and test plan (ITP), including welder and inspector qualifications
 - Manufacturing plan (selected casting companies, steel mills and other sub-vendors)
- During manufacturing, the Manufacturer shall issue for Company and Contractor review and approval Inspection and testing procedures for all applicable items in section 13
- Name plates and tag plate drawings.

18.4 Final documentation

Final documentation, also called Vendor Data Book (VDR) or Manufacturer Data Book (MDR) shall include as a minimum:

- All documents updated as-built/as-supplied as listed in section 18.1

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- Test report and test certificates as per Inspection and Test Plan (ITP), in accordance with section 13 and the Purchase Order instructions
- Material certificates, NDE results/photos, (repair) welding examinations, etc.
- Digital valve footprint curve and overshoot graph for anti-surge and recycle valves
- Calibration certificates
- Any project document/correspondence where particular technical explanations and agreements have been established (e.g. Minutes of Meeting, Derogation Requests, etc.)
- Type approval(s) & reports by [Class Society](#) (when applicable)
- Spare parts list in accordance with section 16 and/or the Purchase Order instructions
- Product bulletin and data sheet for any supplied item
- Installation, Operation and Maintenance (IOM) manuals (including maintenance tools and test benches).

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Bibliography

Reference

Title of the publication

API Std 521	Pressure Relieving and Depressuring Systems
API Std 527	Seat Tightness of Pressure Relief Valves
ASME B1.20.1	Pipe Threads, General Purpose
ASME B16.10	Face-to-Face and End-to-End Dimensions of Valves
ASME B31.3	Process Piping
ASME V	Non-destructive Examination
IEC 60079	Electrical Apparatus for Explosive Gas atmospheres - Part 0 to 14
IEC 60529	Degrees of Protection Provided by enclosure (IP code)
European Directive 2003/10/EC dated 06 February 2003	Directive of the European Parliament and of the Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (Noise)
European Directive 94/9/EC dated 23 March 1994	Directive of the European Parliament and of the Council on the approximation of the Laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres (ATEX)
IECEX	IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres (IECEX System)
MSS-SP-6- 2012	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
USP-NF	United States Pharmacopeia - National Formulary (approved materials for sanitary service equipment)
GS EP INS 137	On/off valve control panels and actuators functional and construction requirements
GS EP INS 900	Instrument hook-up diagrams