



Exploration & Production

GENERAL SPECIFICATION

SUBSEA SYSTEMS

GS SPS 004

Subsea Manifold System Gate Valves

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1. Introduction

1.1 Scope

The purpose of this specification is to define the functional, design and testing requirements of subsea manifold isolation gate valves. The requirements are applicable to all gate valves except the service valves. This specification covers both Remotely Operated Vehicle (ROV) operated valves and hydraulically operated valves with ROV override.

1.2 Responsibility

It is the responsibility of anyone who supplies equipment to this specification to ensure and document compliance with the requirements defined by this specification, and other relevant standards and statutory requirements.

Deviations from any of the requirements defined herein shall be treated as non-conformance in accordance with relevant Total procedures.

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.

This technical specification is complementary to documents **GS SPS 001** and **GS PVV 142**, and shall therefore be read in conjunction with said documents and the other Total specifications and standards identified herein.

The specification for gate valves shall furthermore comply with all relevant statutory requirements and specifications as well as all referenced ISO and other standards unless otherwise stated by Total.

Standards

Applicable industry standards and specifications are defined in **GS SPS 001** and **GS PVV 142**.

In addition, reference is made to the latest revision of the following codes and applicable standards:

Reference	Title
ANSI B16.5	Pipe flanges and flanged fittings
ISO 14313	Specification for Pipeline Valves. Gate, Plug, Ball, and Check Valves (replaces API 6D)
ISO 10423	Specification for Wellhead and Christmas Tree Equipment (replaces API 6A)
ISO 10433	Specification for Wellhead Surface Safety Valves and underwater Safety Valves for Offshore Service (replaces API 14D)
ISO 13628	Specification for Subsea Wellhead and Christmas Tree Equipment
ASME B16.34	Valves - Flanged, Threaded, and Welding End



Reference	Title
ASME V	Boiler and Pressure Vessel Code Section V - Non Destructive Examination
ASME VIII	Boiler and Pressure Vessel Code Section VIII - Rules for Construction of Pressure Vessels - Division 1
ASME VIII	Boiler and Pressure Vessel Code Section VIII - Rules for Construction of Pressure Vessels - Division 2 - Alternative Rules
ASME B31.3	Chemical plant and petroleum refinery piping
EN 10204	Metallic Products - Types of Inspection Documents
NAS 1638	National Aerospace Standard for flushing and cleaning

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS COR 100	Design of cathodic protection of offshore structures
GS PVV 142	Valves
GS SPS 001	Design philosophy and requirements for Subsea Stations
GS SPS 002	Design of Subsea Structures
GS SPS 005	Subsea Ball Valves

Reference	Title
GS SPS 006	Service Valves in Subsea Stations
GS SPS 009	Corrosion Protection of Subsea equipment
GS SPS 010	Preservation Requirements for Subsea Packages
GS SPS 011	Mechanical Completion Requirements for subsea Equipment
GS SPS 023	Cleaning and Flushing of Hydraulic Systems

3. Requirements

The gate valves covered by this specification consist of the following main components:

- Valve assembly
- ROV Interface facility

The valve assembly consists of:

- Valve body
- Valve Stem w/Actuator (Hydraulic or manual ROV).

3.1 General requirements

General requirements for the valve are:

1. The valve shall have butt weld pipe ends to fit the adjoining pipe system.
2. All valves shall be full bore design with bi-directional flow and sealing.
3. The valve shall be designed with due consideration to erosion and corrosion, and damage or blocking caused by possible sand or other particle deposition or hydrate formation. For gate valves mounted such that the gate moves in the vertical plane, special consideration shall be given to the possibility for sand accumulation or hydrate formation in valve cavity.
4. The valves shall be prepared for ROV operation and shall have visual position indicator showing full travel. The valves shall be designed for ROV operation either by a standard or dedicated gate valve tool.
5. The override shall have direct drive with extended shaft and visual position indication on the receptacle showing full travel.
6. Mechanical actuator spindle and override spindle shall rotate clockwise to close, counter clockwise to open.
7. Valve performance shall not be affected by any combination of operational and design loads acting on it. Performance limitations shall be identified.
8. The design life for the valve assembly shall be as defined in the Project specific documentation.
9. The valves shall be suitable for running pigs in both directions.
10. The internal profile of the valve shall prevent snagging of pig and minimise accumulation of debris and loose objects.
11. The valve/tool interface shall comply with API 17H or [ISO 13628.8](#).

3.2 Valve assembly

All valve assemblies shall be designed for the field conditions defined in the Project specific documentation.

The design shall be identified by design life, external and internal design pressures and temperatures, material compatibility with produced media, injected chemicals such as methanol, inhibitors and other relevant chemical substances.

Design requirements:

The listed design requirements shall be implemented in the valve assembly:

1. The design of the valves shall be in accordance with the requirements contained within this specification and GS PVV 142, and the referred design code [ISO 14313](#) (API 6D)
2. The ROV torque tool shall break open the valve safely and reliably at max. valve differential pressure
3. The required brake out torque shall be minimum 30% below the torque tool capacity
4. The stem drive mechanism shall be designed for a torque/thrust force 2,5 times higher than the estimated torque to operate a new valve with full differential pressure under the most severe load condition
5. The actuator or ROV torque tool interface shall have a capacity of twice the same torque/thrust force at max. actuator hydraulic pressure
6. The weakest point of the valve actuation system shall be outside the stem seal area
7. For torque calculations, the friction factor between hard face surfaces shall be 0,2 or higher, unless otherwise documented and agreed
8. Sensitive components such as position indicator arrangements close to the ROV receptacle shall be protected against ROV impact (1000 kg at 0,5 m/s)
9. Valves shall be designed and tested to take a bending moment of minimum 3000 Nm and an axial force of 3000 N at the ROV interface and still be operable within the specified torque values
10. Valves shall be designed and tested for an external hydrostatic pressure to be at least equal to the Project specific water depth
11. Pipeline pressure in the cavity shall act in the valve closing direction

3.3 Sealing requirements

The following sealing requirements shall be followed:

1. Body/bonnet seal shall be bi-directional metal to metal or welded. A metal-to metal seal shall have pre-tensioning as the main sealing force
2. The floating seat ring shall be single piece with simple piston effect
3. Seats shall be preloaded to provide a contact load in order to limit ingress of debris and to achieve stability at low pressure
4. The stem seal shall as a minimum consist of two separate sealing systems. When specified for a particular field application, one system shall be metal-to-metal seal with pre-tensioning as the main sealing force. Consequently, a metal to metal seal design shall be available and fully qualified for field application.

5. The valve main seal, between the gate and the seats shall be metal-to-metal
6. Non metallic stem seal:
The sealing systems shall be compatible with the production and injection fluids, as well as with the external and internal pressures. CONTRACTOR shall demonstrate the adequacy and suitability of the sealing systems, particularly in case of local gas decompression, through a thorough analysis and verification test programme for Total agreement.
7. For valves with rising stem the non metallic seals shall be protected from fluid contamination.
8. The stem seal arrangement shall be fitted with back seat facilities with the stem in upper/withdrawn position. The back seat shall be considered as an end stop only and not a seal.
9. Stem leakage shall be vented without causing any pressurising of actuator housing. A bleed port with a check valve shall be fitted to prevent seawater intrusion into the stem housing.
10. The stem seal shall be designed to prevent ingress of seawater at the design water depth with minimum internal pressure. Minimum internal pressure is 0.05 bar.

3.4 External connections/Body penetrations

Penetrations in valve body and bonnet shall be avoided. Any ports used for testing and flushing shall be plugged and seal welded after use.

As applicable, vent and drain valves/ports shall be provided at the highest possible and at the lowest possible position of the valve, respectively.

3.5 Actuator

3.5.1 General requirements

The design of subsea actuators shall comply with [ISO 13628](#). General requirements are:

1. The actuator shall be double acting hydraulic operated with “fail as is mode” or single acting with spring return “fail safe close” mode
2. The hydraulic cylinders and lines shall be delivered with verified cleanliness level NAS 1638 class 6
3. The hydraulic cylinders shall have independent flushing ports. The flushing port shall be positioned in the highest practical level to ensure proper air bleed off possibilities
4. Positioning of limit switches if required
5. The hydraulic connection points for the hydraulic supply shall be fitted with pup pieces prepared for butt weld end connections to the supply lines
6. The actuator design pressure shall be 1.1 times the actuator operating pressure

3.5.2 Functional requirements

The following functional requirements shall be implemented in the design:

1. The actuator design shall be of a direct drive
2. The actuator housing shall be volume compensated for volume changes caused by valve stroke and by temperature variations. The pressure compensating system shall be a passive

system without use of accumulators. The compensating system shall be based on use of a pressure balanced system filled with a suitable fluid with density higher (1,1) than seawater.

3. The hydraulic piston and piston rod seal arrangement shall prevent ingress of fluid from the volume compensating system into the hydraulic system or hydraulic fluid to enter into the volume compensating fluid.
4. The hydraulic piston seal arrangement shall be designed to withstand peak pressure when overriding the valve against blocked by pass in the hydraulic system
5. The hydraulic actuator shall have visual position indicator showing full travel, to be observed from a ROV in a docked position.

3.6 Materials requirements

For general material requirements reference is made to **GS SPS 009** and the following.

Design limitation on materials:

For submerged parts that may be exposed to cathodic protection¹, the following shall apply:

- For carbon and low alloy steels, SMYS shall not exceed **700 MPa** (725 MPa for bolts). The actual yield strength shall not exceed **950 MPa**. Alternatively, it may be verified that the actual hardness in base materials does not exceed **295 HB**
- For carbon steel welds a maximum of **300 HV5** applies
- For stainless steels and non-ferrous materials, resistance against hydrogen embrittlement shall be controlled by the actual hardness of the material which shall be in accordance with NACE MR 01.75.

3.7 Coating

Surface preparation and protective coating shall be in accordance with **GS SPS 009**.

3.8 Test program

The FAT (Factory Acceptance Testing) shall ensure and demonstrate that equipment and functions are in accordance with purchase order and contract requirements. The FAT program and procedure shall be prepared by the SUPPLIER and approved by Total.

The Factory Acceptance Testing program shall consider:

For the valve:

- Testing according to **ISO 10423**, PSL 3 (API 6A)
- Dimensional control
- Seat tests (low and high pressure, hydraulic and gas test), the FAT procedure and program shall specify the admissible leakage for each seat test
- Torque measurement on various situations (particularly open with full differential pressure on the seat).

¹ Material which would be coated shall be considered as exposed to cathodic protection unless it is demonstrated that the coating will remain tight for the specified design life.

For the actuator:

- Hydraulic piston and cylinder leak test, according to API 14D
- Cleanliness level of test fluid for hydraulic actuator shall meet [NAS 1638](#) class 6.

For the valve and actuator assembly:

- Functional test to verify design requirements shall include torque measurement of opening and closing sequences. The valve shall be operated with field specific differential pressures
- Interface check of ROV torque tool
- Number of turn to operate by ROV from fully closed shall be verified
- Marking for fully closed and open shall be verified.

3.8.1 Qualification testing

New valve designs shall be qualified in accordance with [GS SPS 001](#) and with [ISO 10423](#) (API 6A), PR2 performance testing. In addition to the requirements defined in the relevant industry standards, the following requirements shall be adhered to:

1. The operational torque at normal operating pressure and design differential pressure shall be recorded
2. A life endurance test of minimum 1200 cycles shall be performed to reflect the life time operation of the actuator and valve
3. The valve assembly (housing and stem seal) shall be tested with external pressure corresponding to the specified water depth
4. Where the design includes more than one seal, each seal shall be proven by individual tests
5. Stepwise seat test shall be performed to demonstrate that the valve seals adequately with moderate pressure increments and at all pressure levels
6. The qualification tests shall demonstrate that galling does not occur
7. The test shall verify torque for operation of valves at zero and maximum differential pressure
8. Resistance measurements shall be performed to verify electrical continuity between components to be connected to the cathodic protection system. Valve stem, valve closing element, and other relevant parts of the valve internals shall be included in the cathodic protection system
9. Number of turns to operate by ROV from fully closed to fully open shall be verified. Where drive interface units and/or position indicator units are employed, these shall be included in the tests to confirm these are suitable for the applied loads and that they do not limit the valve stroke
10. Material/fluid compatibility shall be established

For previously qualified valves: if the design has been subjected to a change that affects the performance of the valves, a qualification test shall be performed.

3.9 Mechanical completion

Reference is made to [GS SPS 011](#).



3.10 Marking

3.10.1 Valve tagging

All valves shall be tagged with the tag number as stated on the requisition. This shall be clearly stamped on non-corrosive metal tag permanently attached to the valve.

3.10.2 Identification of materials and main characteristics

In addition to the markings required by MSS standard SP25, the following information shall be marked by cold stamping on each valve:

- The type of valve (gate)
- The specification and grade of body and trim materials
- The casting number
- The batch number
- The valve pressure class
- The diameter.

3.11 Packaging and preservation

Reference is made to **GS SPS 010**.



Appendix 1 List of information required on drawings and/or data sheets

Valve type
Pressure class
Service conditions
Location/water depth
Design life
Nominal size
Bore diameter
Design Code
Design standard
Design temperature, Flow Medium
Design temperature, Environment
Maximum differential pressure
Port design
Corrosion allowance
End connections
Process fluid
Body construction
Trim construction
Seat construction
Main seal type and material
Body/bonnet seal, types and material
Stem seal, types and material
Seawater ingress seal, type and material
Seat ring/body seal, type and material
Body material
Bonnet material
Stem material
Ball material
Seat material
External bolt, material
External nut, material
Vent and drain valves
Sealant injection valves
Surface protection
Type of operator
Valve tag number
Max seat test pressure
Torque at max seat differential pressure
Maximum load from pipe (bending moment)