



Exploration & Production

GENERAL SPECIFICATION

SUBSEA SYSTEMS

GS SPS 024

**Subsea mechanical quarter turn actuator
(Manually operated gearbox)**

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1. Scope

This Technical Specification defines the minimum requirements for the design and manufacture of mechanical actuators for operating subsea ball valves, which will be used in high pressure subsea pipelines.

This specification relates specifically to the supply of the mechanical actuator, its mounting/interface with the subsea ball valve, which it will operate, and its interface with the operating power tool.

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.

Standards

Reference	Title
ASTM A 193	Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High Pressure/High Temperature Service
BS 1133 Part 6	Temporary protection of metal surfaces against corrosion (during transport and storage)
BS 3382	Cadmium Plating and Threaded Fittings
BS 4882	Bolting for Flanges and Pressure Containing Purposes
BS 5750	Quality Systems
DIN 500-49	Certificates on material testing

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
ASNT-TC-1A	Personnel Qualifications and Certification in Non Destructive Testing
ASME Section IX	Boiler and pressure vessel code – Welding and brazing qualifications

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS PVV 142	Valves
GS SPS 005	Subsea ball valves

3. Definitions

The following is a list of definitions of the terms, which apply to this specification:

- **Purchaser**

Means Total or approved representative.

- **VENDOR**

Means the person, firm or COMPANY who has been issued with the purchase order to supply the goods.

For full definitions and terminology refer to Total General Terms and Conditions of Purchase.

4. Actuator operational requirements

4.1 Environmental

See attached Data Sheet (Appendix 1) for project specific environmental information.

4.2 Valves

See Valve Specification and Data Sheet (Reference Section 2) for details on ball valves to be operated.

4.3 Mounting and installation

Provision shall be made such that the actuator is mounted on the ball valve to enable easy installation and replacement subsea by divers.



The valve will be installed such that the spindle is within 5 degrees of vertical.

The power tool interface shall be located such that it may be easily accessed by a diver.

4.4 Torque requirements

Maximum operational input torque shall be 250 Nm, the resulting minimum output torque shall be twice the maximum valve torque requirement at all points of the ball valve operation.

Actuator shall however be suitable for an overload input torque of 350 Nm when locked against its end stops or in an intermediate position.

4.5 Design life

The actuator shall be designed to operate for the design life of the field (Appendix 1) with maintenance as advised by VENDOR.

5. Actuator design and construction

5.1 Mechanism

VENDOR shall provide a detailed description of the actuator including a materials list.

The mechanism shall be entirely mechanical using gears and/or linkages. A worm and wheel gear system is preferred.

Maximum running speed transmitted by the power tool shall be one full opening or closing stroke of the ball valve in 30 seconds. Typical running speed to be advised by VENDOR.

The mechanism shall be entirely contained within and protected by the actuator body. There shall be no moving parts outside the body (Tactile indicators excepted, see section 5.4).

Adjustable end stops shall be fitted to the actuator to control each end of the stroke. They shall be capable of 3 degrees adjustment to either side of the nominal position of the output spindle.

5.2 Local position indicator

A local, mechanical, position indicator shall be fitted to the actuator to show the position of the ball within the valve.

The indicator may be one of two types:

- Visual
- Tactile.

A visual indicator shall consist of a pointer and a scale showing, at least, the fully open and closed positions. The pointer and scale markings shall have a high contrast with the background. Reflective or fluorescent finishes are preferred. The indicator shall be protected by a transparent cover. Armoured glass is preferred. The design shall resist impacts from small dropped objects and from divers and ROV's working nearby. The viewing window shall resist marine fouling and shall be cleanable by divers.

A tactile indicator shall consist of a pointer and a scale showing, at least, the fully open and closed positions. The pointer and scale markings shall be as large as possible and shall stand off from the actuator body so as to be distinguishable by a diver wearing gloves. They shall be painted in a contrasting colour to the actuator body. The indicator shall resist impact from small

dropped objects and from divers and ROV's working nearby. The indicator shall be strong enough to clear marine fouling, which may build up around it.

5.3 Body

The actuator body shall:

- Contain the mechanism
- Provide a suitable method for attachment to the valve
- Provide a suitable power tool interface and a support and reaction point for the power tool.

The body shall be filled with a suitable liquid medium to protect and lubricate the mechanism. A mineral based gear oil is preferred.

The body shall have suitable seals on all joints and on the input and output shafts to prevent ingress of seawater.

The body shall be pressure compensated to allow the internal and external pressures to equalise. A method shall be provided which will allow this pressure compensation while segregating the fill fluid from the seawater. An electrometric bladder is preferred which should be contained within the actuator body where possible.

A body relief valve shall be fitted to avoid damage caused by pipeline fluids leaking from the valve stem seal.

Provision shall be made on the body such that the actuator can be lifted and manipulated as necessary during transit and installation.

The actuator body shall be as small as possible with a smooth outline and have a minimal stand off from the valve.

5.4 Materials

Materials shall be selected for:

- Corrosion resistance in sea water
- Compatibility with fill and hydraulic fluids
- Wear resistance/hardness.

The body material shall resist external corrosion by seawater for the design life (see section 9.1 "Corrosion Protection").

Body and shaft seals shall be compatible with seawater and with the fill and hydraulic fluids.

The mechanism shall be designed to operate in lubricating oil but continue to function if the oil is displaced by seawater or pipeline fluid. In this case time to failure may be severely reduced.

Surface treatments may be specified to improve hardness and/or corrosion resistance. Chrome plating is not acceptable.

Studbolts and nuts shall be of a suitable grade from [ASTM A 193/194](#) or [BS 4882](#), and shall be cadmium plated with a PTFC coating applied to the cadmium.

A low resistance, electrical connection shall be provided between the actuator and the valve to ensure electrochemical compatibility.

The material of the operated subsea pipeline ball valve and the type of cathodic protection used shall be taken into consideration when selecting actuator materials.

5.5 Manufacturing procedures

The manufacturing, quality control and inspection procedures shall be agreed between Purchaser and VENDOR before manufacture commences and shall include all proposed operations, depending on the method of manufacture, in the correct sequence.

The procedures shall include details of:

- Steelmaking process
- Forging/Casting procedures
- Heat treatment procedures
- Surface treatment procedures
- Methods of temperature control
- Methods of chemical analysis and mechanical testing
- Welding procedures and qualification.

Note: All welding procedure and qualification tests shall be conducted in accordance with [ASME Section IX](#) and this specification. All welding procedures and qualification test results shall be approved by the Purchaser prior to production welding. All welders and welding operators shall be qualified in accordance with the Purchaser approved welding procedure and [ASME Section IX](#) prior to production welding.

- Non-destructive examination procedures
- Defect removal
- Weld repair.

Note: Weld repairs to castings shall only be carried out to a detailed procedure approved by the Purchaser. Repairs shall be carried out before any heat treatment of castings. Weld repairs to forgings are not permitted.

- Machining process.

6. Inspection and NDT requirements

The responsibility for quality control and inspection rests with VENDOR. The Purchaser however, reserves the right to:

- Inspect work in progress to ensure that materials and workmanship are in accordance with this specification
- Determine which items shall constitute hold points for witness by the Purchaser.

VENDOR's quality control and inspection procedures shall be in accordance with good engineering workshop practice.



7. Interfaces

7.1 Interface to valve

The ball valve MANUFACTURER will be responsible for the correct function of the actuator interface with the ball valve and will control all interface documentation.

The actuator shall be attached to the valve spindle and the valve bonnet in accordance with the interface drawings and information supplied. Actuators shall be interchangeable and shall allow fitting with the valve partially open.

The valve stem shall be designed such that the mating actuator can be located in only one orientation (e.g. the spline may have a unique locating key).

The method, bolts and mounting devices used to attach the actuator body to the ball valve shall be suitable for supporting the actuator and resisting the maximum operating torque.

The integration testing of valve with actuator mounted shall be carried out in accordance with Section 8.4 in this Specification.

Adequate provision shall be made to ensure that the actuator may be installed onto and removed from the ball valve after the valve has been installed subsea. The requirements shall include:

- Means to ensure that the valve and actuator stems are in line for any position of valve ball
- Means for diver, to handle and install actuator safely
- Means to easily and quickly fasten actuator to valve
- Means to flush out the space between the valve and the actuator to displace sea water with a protective liquid.

7.2 Interface to input drive tool

The actuator input shaft shall be suitable to be driven by a power tool, at the subsea location.

VENDOR shall be responsible for the design of the drive tool interface and shall control all interface documentation.

VENDOR shall ensure that the tool for which the drive shaft is designed is of a type readily available from diving CONTRACTORS, and shall consult with such CONTRACTORS as necessary to ensure that the tool can be easily engaged and operated by a diver.

A 1 ½ inch square shaft is suggested as a potentially suitable interface.

The interface shall be designed for quick and easy use by a diver or ROV, and shall have the following requirements:

- To accept the drive from the power tool
- To react against the torque applied by the power tool
- To support the weight of the power tool.

Where protective covers for the interface are specified they shall not be the main method for sealing the input shaft. Pressure caps shall be designed which shall be easily removable by a diver. Bleed ports shall be included in the caps. Caps may be oil or grease filled in which case provision shall be made for refilling the cap by a diver.

8. Testing

8.1 General

All actuators shall be tested prior to shipment from VENDORS works (Integration testing however shall be as Section 8.4). VENDOR shall provide a jig or test stand for both sizes of actuator.

The test procedures shall be as stated in Section 8.2 and 8.3. Final test procedures to be agreed between VENDOR and Purchaser.

All tests shall be witnessed at the discretion of Purchaser.

Actuators shall not be accepted until all tests stated are completed successfully and to the satisfaction of Purchaser.

8.2 Qualification tests

The following documented test results may be submitted as evidence of satisfactory performance in lieu of qualification tests on the model to be supplied to this Specification:

- Test report on actuators previously supplied to operate ball valves of same type, size and rating
- Test report on model larger than required (in this case, the required test shall be performed during the manufacture of the actuator to be supplied to this Specification).

Test results submitted in lieu of qualification testing shall be subject to Purchaser approval.

All materials shall be tested (or evidence provided) to show compatibility with the fluids with which they will be in contact.

The procedures required to install the actuator on the valve underwater by a diver shall be demonstrated.

The procedure to attach the power tool and operate the valve shall be demonstrated.

8.3 Factory acceptance test

The following factory acceptance test shall be performed on each actuator:

- Dimensions of interfaces shall be checked, for accuracy
- The relationship shall be determined between input and maximum output torque and the result shall be recorded
- The actuator shall be subject to an overload input torque of 350 Nm while locked against each end stop and at the centre of its stroke. There shall be no signs of damage on internal and external examination
- An oil leak test at 10 psi shall be performed on the actuator body (there shall be no leakage)
- The relief valve shall be calibrated and tested prior to mounting on the actuator body.

8.4 Valve to actuator integration testing

The integration testing of each actuator with the relevant ball valve may be conducted at either the valve or actuator VENDOR's works.

In either case it shall be the ball valve VENDOR's responsibility to inform Purchaser of the details for approval.

The actuator shall be assembled to the ball valve and the appropriate hydraulic filling procedures carried out (see Section 10).

A demonstration to confirm that the actuator and the space between the actuator and the ball valve has been properly filled shall be carried out.

The ball valve shall be opened by the actuator with full differential pipeline pressure across the valve. The actuator input torque required shall be less than 250 Nm. Torque throughout the stroke shall be recorded.

Electrical resistance between the actuator and the valve shall be measured and shown to be less than 1 ohm.

9. Corrosion protection and packing

9.1 Corrosion protection

After all tests are complete, the actuator shall be coated in accordance with the protective finish used on the ball valve. The position indicators must in no way be obscured during the coating operation.

Protection covers shall be fitted on the power tool connectors.

9.2 Packing

The actuator may be packed filled or empty at the discretion of the VENDOR. If empty, the actuator shall be protected by an internal corrosion resisting coating according to [BS 1133 part 6](#).

The actuator shall be protected by a purpose built wooden crate suitable for road carriage. The level of packing for the actuator will depend on the integration test location (See Section 8.4). VENDOR shall propose a packing procedure for Purchaser approval.

Provision shall be made to handle the crate by a fork lift truck.

10. Final assembly onto ball valve

The actuator VENDOR shall supervise the final assembly of the actuator to the valve including filling of the actuator and the space between the actuator and the valve (see also Section 8.4).

The actuator end stops shall be adjusted to stop the valve at the fully open and fully closed positions.

11. Documentation

The following documentation written in the English language shall be submitted to the Purchaser:

- Fabrication Drawings
- Design Calculations
- Certified Weight



- Spares Lists
- Special Tool Requirements
- Installation, Operation and Maintenance Manual.



Appendix 1 Data Sheets

Environment Data Sheets

Client:

Project:

Field/Location:

Water Depth (meters):

Temperature range (°C): Pipeline (minimum/maximum):

Seabed (minimum/maximum):

Design Life (years):



Subsea Mechanical Quarter Turn Actuator VENDOR Response Data Sheet

Client:

Project:

System:

Valve to be actuated

Nominal Bore:

Operating Pressure (barg):

ANSI class:

MANUFACTURER:

Model:

Maximum Operating Torque (Nm):

Actuator

MANUFACTURER:

Model:

Type of Mechanism:

Maximum Input Torque (Nm):

Maximum output Torque (Nm):

Materials

Body:

Mechanism:

Shafts:

Shaft seals:

Fill fluid:

Pressure compensation : Type :

Location:

Type of local position indicator:

Relief valve fitted (Yes/No):

Output travel range (degrees):

Number of turns of input for 90 degrees output:

End stop adjustment method:

End stop adjustment range (degrees):

Subsea Mechanical Quarter Turn Actuator
VENDOR Response Data Sheet (continued)



Valve Interface

Interface drawing number:

Output adaptor inside diameter:

Output drive type:

Method of Attachment to Valve:

Provision to fill space between valve and actuator:

Power Tool Interface

Interface drawing number:

Maximum output torque (Nm):

Maximum input torque (Nm):

Minimum output torque for 250 Nm input torque (Nm):

Maximum input torque with output locked (Nm):

Dimensions

Length (along axis of valve bore):

Width (across axis of valve bore):

Height (from valve bonnet):

Weight (kg):