



**SPECIFICATION  
FOR  
SUBSEA BALL VALVES  
(SOUR SERVICE)**

**OIL AND NATURAL GAS CORPORATION LTD.  
INDIA**

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## 1.0 SCOPE

1.1 This Specification covers the minimum requirements for Design, Manufacture and supply of Carbon Steel –NACE Ball Valves of size 2" and above and ANSI class upto 2500# for use in submarine pipeline systems handling sour hydrocarbons in liquid or gaseous phase in compliance with the requirements of API 6DSS, NACE Standard MR-01-75 and special requirements as described in this specification.

## 2.0 REFERENCE DOCUMENTS

2.1 All valves shall be manufactured and supplied with API monogram in accordance with the American Petroleum Institute (API) Specification 6DSS, Latest Edition, with additional requirements as indicated in the following sections of this specification.

2.2 Reference has also been made in this specification to the latest edition of the following Codes, Standards & Specifications:

- a. ASME B-31.8 : Gas Transmission and Distribution piping Systems
- b. ASME B-31.4 : Liquid Petroleum Transportation Piping Systems.
- c. ASME B-16.5 : Steel Pipe Flanges and Flanged Fittings.
- d. ASME B-16.25 : Butt-welding Ends
- e. ANSI 16.34 : Steel Valves
- f. API 1104 : Specification for Welding Pipeline and Related Facilities.
- g. ASME-Sec. VIII : Boilers & Pressure Vessel Code  
ASME-Sec. IX
- h. ASTM-A-370 : Mechanical Testing of Steel Products.



- i. MSS-SP-6 : Standard Finishes for Contact Faces of Pipe Flange and Connecting-end Flanges of Valves and Fittings.
- j. MSS-SP-44 : Steel Pipeline Flanges
- k. NACE MR- 01-75 : Material requirements Sulphide Stress Cracking Resistant Metallic Materials for Oil Field Equipments.
- l. NACE TM-02-84 : Test Method Evaluation of Pipeline Stress for Resistance to Stepwise Cracking.
- m. NACE-TM-01-77 : Laboratory testing of metals for resistance to sulphide stress cracking and stress corrosion cracking.
- n. SSPC-VIS-1 : Steel Structures Painting Council-Visual Standard.
- o. DNV-1981 : Det Norske Veritas Rules for submarine pipeline.
- p. ASME B 31.3 : Chemical Plant and Petroleum Refinery Piping.

### 3.0 MATERIALS

3.1 All Materials used for various valve components exposed to sour environment shall comply to the requirements of NACE Standard MR – 01- 75 and Cl.8.7 of API6DSS. All sour service material shall meet special testing viz. HIC and inclusion count check (as per ASTM E 45). Material for major components of the valves shall be as indicated in Valve Data Sheet. Other components shall be as per relevant Codes & Standards. Company's written approval shall be taken in this regard.



- 3.2 Unless specified otherwise, Charpy V-notch test on each heat of base material shall be conducted as per API 6DSS, for all pressure containing parts such as body, end flanges, welding ends as well as the bolting material for pressure containing parts. Unless specified otherwise, the Charpy impact test shall be conducted at 0°C .

The Impact requirements shall be as per API 6DSS.

- 3.3 Seal material if provided shall be resistant to amine based corrosion inhibitors.

#### 4.0 DESIGN AND CONSTRUCTION

- 4.1 Valves shall be designed for permanent subsea installation in water depths and service conditions as indicated in the Data Sheet. In addition corrosion allowance indicated in Valve Data Sheet shall be considered in valve design.

- 4.2 Valve design shall meet the requirements of API Specification 6DSS and shall be suitable for the service conditions indicated in the Valve Data Sheet. The ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 shall be used to design the valve body. Allowable stress requirements shall comply the provisions of ANSI B31.3.

- 4.3 Valve body shall be fully welded type design. Split body designs and body joints with threads are not permitted.

- 4.4 Valves shall be Full Bore (FB) or Reduced Bore (RB) as indicated in the Valve Data Sheet. Full bore valves shall be suitable for the passage of all types of pipeline scraper and inspection pigs on a regular basis without causing damage to either the valve components or the pig. The valve bore shall provide an unobstructed profile for pigging operations in either direction. Full bore valves shall be designed to minimize accumulation of debris in the seat ring region to ensure that valve movement is not impeded. The bore size of reduced bore valves shall conform to API 6DSS.



- 4.5 Ball mounting shall be trunnion type only. Valve design shall minimize the possibility of debris ingress into the trunnion as far as practicable.
- 4.6 Valve seats shall be primary metal to metal contact type. Non-metallic elastomeric O-rings or other seals for drip-tight sealing shall be encased in a suitable groove in such a manner that it cannot be removed from seat ring and there is no extrusion during opening or closing operation at maximum differential pressure corresponding to valve class rating. The seat rings shall be spring energised to ensure sealing at low differential pressure. For sealing at higher pressure, the seat rings shall be line pressure energised. Internal surface of valve body in contact with valve seats shall be provided with minimum 3.0 mm thick overlay (deposited by welding) of corrosion resistant material.
- 4.7 Where necessary, seals shall be provided on the valve body to prevent leakage from the valve to the environment and to prevent sea water leakage into the valve under as installed conditions. The external hydrostatic pressure considered in design shall correspond to a pressure of 1.5 times the hydrostatic head at the installation location.
- 4.8 Body cavity over-pressure shall be prevented by self relieving seat rings/assemblies. A pressure relief hole in the ball is not permitted.
- 4.9 Valve design shall avoid bimetallic corrosion between carbon steel and high alloy components used in the assembly. Suitable insulation shall be provided as required.
- 4.10 Valves shall be designed to withstand a sustained internal vacuum in both open and closed positions.



- 4.11 Valves of size 8" NB and above shall have the provision for secondary sealant injection under full line pressure for seat and stem seals suitable for sub-sea environment and operation by diver. Sealant injection points shall be provided with a needle valve accommodating a sealant fitting.
- 4.12 Valve design shall ensure repair of gland packing under full line pressure.
- 4.13 a. Valve ends shall be either flanged or butt welded or one end flanged and one end butt welded as indicated in the Valve Data Sheet. Flanges of the flanged end cast body valves shall be integrally cast with the body of the valve. Face to face/end to end dimensions shall conform to API 6DSS.
- b. Flanged end shall have dimensions as per ANSI B 16.5 for sizes upto 24" NB (excluding 22" NB) and as per MSS-SP-44 for sizes 22" NB and 26" NB and above. Flange face shall be either raised face or ring joint type as indicated in purchase requisition. Flange face finish shall be serrated or smooth as indicated in the Valve Data Sheet. Smooth finish when specified shall be 125 to 200 AARH.
- c. Butt weld end preparation shall be as per ANSI B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. Valves shall be without transition pups. In case difference exists between thickness of valve neck end and connecting pipe, the bevel end of valve shall be prepared as per ANSI B 31.8 or ANSI B 31.4 as applicable.
- 4.14 Design of weld end valves shall be such that during field welding operations, the soft seals are not liable to be damaged.
- 4.15 Valves shall be provided with ball position indicator and stops of rugged construction at the fully open and fully closed positions.



- 4.16 Valves of size > 8" NB shall be equipped with support foot and lifting lugs. Tapped holes and eye bolts shall not be used for lifting lugs. Height of support foot shall be kept minimum.
- 4.17 Valves shall have locking devices to be locked either in full open (LO) or full close (LC) position when indicated in the Valve Data Sheet. Locking devices shall be designed for operation by diver with minimal effort and shall be permanently attached to the valve operator and shall not interfere with operation of the valve.
- 4.18 Valves shall be provided with antistatic devices to ensure electrical continuity between stem and valve body.
- 4.19 **Operating Devices**
- a. Valves shall have a power actuator or manual operator as indicated in the Valve Data Sheet. In case of manual operator, valve sizes upto and including 4" NB shall be wrench operated and valve sizes > 6" shall be gear operated. Valves design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and that damaged parts can be replaced without the valve cover being removed.
  - b. The power actuator shall be in accordance with the Company specification issued for the purpose.
  - c. Operating devices shall be designed for easy operation of valve under maximum differential pressure corresponding to the valve rating.
  - d. Manual operator shall be configured such that operation of the valve by the diver is possible. Manufacturer shall demonstrate that diver operation is readily achievable.





- e. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 35 kg. Manufacturer shall also indicate the number of turns of hand wheel (in case of gear operators) required for operating the valve from full open to full close position.
- f. Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- g. Gear operators, if specified, shall have a self locking provision and shall be fully encased in water proof/splash proof enclosure and shall be filled with suitable grease.

4.20 All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The procedure qualification shall include impact test, hardness test and HIC test.

4.21 Repair by Welding is not allowed for fabricated and forged body valves. Repair by welding is permitted for cast body valves subject to written approval by Company and shall be carried out as per ANSI B 16.34. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall include impact test, hardness test and HIC test.

## 5.0 INSPECTION AND TESTS

5.1 The Manufacturer shall perform all inspection and tests as per the requirements of this specification and the relevant codes, prior to shipment, at his works. Such inspection and tests shall be, but not limited to, the following:

5.1.1 All valves shall be visually inspected.



- 5.1.2 Dimensional check shall be carried out as per the Company approved drawings.
- 5.1.3 Chemical composition and mechanical properties including hardness and corrosion properties shall be checked as per relevant material standards and this specification, for each heat of steel used.
- 5.1.4 a. Non-Destructive examination of individual valve material and components consisting of but not limited to castings, forgings, plate and assembly welds shall be carried out by the Manufacturer.
- b. Valve body castings of all valves shall be radiographically examined on 100% of the surface of critical areas as per ANSI B 16.34. Procedure and acceptance criteria shall be as per ANSI B16.34.
- c. Valve forgings and valve bodies fabricated from plates shall be ultrasonically examined in accordance with the procedure and acceptance standard of Annexure E of ANSI B16.34
- d. Bodies and bonnets made by welded assembly of segments of castings, forgings, plates or combinations thereof shall be examined, as applicable, by methods of 5.1.4 b) for cast components or 5.1.4 c) for forged components and plates.
- 5.1.5 Full inspection by radiography shall be carried out on all welds of pressure containing parts. Acceptance criteria shall be as per ANSI B 31.8 or ANSI B 31.4 as applicable and API 1104.
- 5.1.6 Welds which in Company's opinion cannot be inspected by radiographic methods, shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Sec. VIII Appendix U and Appendix VI respectively.



- 5.1.7 a. All finished wrought weld ends shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the end.  
Laminations shall not be acceptable.
- b. Weld ends of all cast valves shall be 100% radiographically examined and acceptance criteria shall be as per ANSI B16.34.
- c. After final machining all bevel surfaces shall be inspected by dye penetrant or wet magnetic particle methods. All defects longer than 6.35 mm shall be rejected. Further, the defects measuring between 6.35 mm and 1.59 mm which are separated by a distance less than 50 times their greatest length shall be rejected. Rejectable defects must be removed.  
Weld repair of bevel surface is not permitted.
- 5.1.8 All valves shall be tested in compliance with the requirements of API 6DSS.
- 5.1.9 A supplementary low pressure gas seat test as per Annexure B, Cl.B.3 of API 6DSS shall be carried out.
- 5.1.10 A Check shall be carried out to demonstrate that the dissimilar metals used in the valves are successfully insulated as per the requirement of Cl. 4.9 of the specification.
- 5.1.11 Hyperbaric qualification testing as per Annexure B, B.5 of API 6DSS for each size and pressure rating shall be carried out.
- 5.1.12 Cathodic protection continuity test is to be carried out as per the requirement of Annexure B, Cl.B.6 API 6DSS.
- 5.1.13 Seal type test is to be carried out as per the requirement of Annexure B, Cl.B.7 API 6DSS.



5.1.14 Cavity relief Testing as per Annexure B, Cl.B.13 of API 6DSS is to be carried out.

5.1.15 Valves shall be subjected to Operational Torque Test as per Annexure B, Cl.B.11 of pressure corresponding to the valve rating. The maximum hand wheel force shall not exceed 35 Kg.

5.1.16 Power actuator shall be tested after assembly at the valve Manufacturer's Works. Actuator shall be capable of allowing minimum five consecutive "opening" and "closing" cycles. To achieve this, the Manufacturer shall provide a reverse automatic control gear for uninterrupted "closing" and "opening" operations.

This test shall be conducted on all valves. In case the test does not meet the requirement, re-testing/rejection of the lot shall be as decided by Company's Inspector.

The actuator shall be adjusted to ensure that the opening and closing time is within the limits stated in Actuator Data Sheet issued for the purpose.

The manual over ride provided on the actuator shall also be checked.

It shall be demonstrated that there is no internal leakage when the valve is subjected to an external pressure equivalent to that at 1.5 times the depth indicated in the Valve Data Sheet. The valve internal pressure shall be ambient during the demonstration.

For power actuated valves, the torque required to open and close the valve shall be measured. The measurements shall produce curves of torque vs. valve position for at least three opening and three closing cycles without internal pressure and three opening and three closing cycles with maximum differential pressure, Data measurement shall be measured at 15 degree intervals minimum including 0 and



90 degrees. Valve shall be opened and closed through total of 100 cycles with maximum differential pressure. The torque test shall be repeated. The torque change after 100 cycles shall not prevent the valve from meeting the specified performance requirements.

- 5.2 Company reserves the right to perform stagewise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Company's Inspector.

Company reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

In no case shall any action of Company or his Inspector relieve the Manufacturer of his responsibility for material, design, quality or operation of valves.

Inspection and tests performed/witnessed by the Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

## 6.0 EXTENT OF INSPECTION AND TESTING

Company or its representatives reserve the right to witness all the tests like hydrostatic testing and functional testing of the valves.



## 7.0 TEST CERTIFICATES

Manufacturer shall submit the following certificates:

- a. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the valve construction as per the relevant standards.
- b. Test certificates of hydrostatic and pneumatic tests complete with records of timing and pressure of each test.
- c. Test reports of radiograph and ultrasonic inspection.
- d. Test report of valves confirming to clause 5.1.8 to 5.1.16 of this specification.
- e. Certificate regarding the maximum bending moment permissible for each type, size and rating of the valves.
- f. Certificate regarding the maximum hydrostatic head for which the valve is suitable for installation.
- g. All other test reports and certificates as required by API 6DSS and this specification.

The certificates shall be valid only when signed by Company's Inspector. Only those valves which have been certified by Company's Inspector shall be dispatched from Manufacturer's works.



## 8.0 PAINTING, MARKING AND SHIPMENT

- 8.1 Painting shall be done in accordance to the “Functional specification for Installation of sub-marine pipelines and related facilities Spec. No. 2015”.
- 8.2 In addition to the corrosion resistant paint for long time subsea application, entire valve surface shall be provided with suitable antifouling coating to overcome rapid growth of fouling organisms / marine growth during the operational life of the valve. Special attention shall be paid to the valve position indicator and the outlets/connections requiring access during diver operation. Points requiring access during diver operation shall be coated with radium/phosphorescent materials which can absorb the light and retain the glow, so that these points can be easily identified before valve operation.
- 8.3 All bolting and nuts exposed to the sea water environment shall be coated with PTFE or shall be plated with Zinc as per ASTM B 633 Type II SC3.
- 8.4 All valves shall be marked as per API 6DSS. The units of marking shall be metric except nominal diameter which shall be in inches. In addition to the API marking, water depth to which the valve has been designed to be installed shall also be indicated clearly.
- 8.5 Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.
- 8.6 All sealant lines and other cavities of the valve shall be filled with sealant before shipment.



8.7 Packaging and shipping instructions shall be as per API 6DSS.

8.8 On packages, the following shall be marked legibly with suitable marking ink:

- a. Order Number
- b. Manufacturer's Name
- c. Valve size and rating
- d. Tag Number.

#### 9.0 SPARES AND ACCESSORIES

9.1 Contractor shall provide spare parts needed for start up and commissioning.

9.2 Contractor shall also recommend a list of tools & spare parts (with prices) needed for two year normal operation maintenance.

#### 10.0 DOCUMENTATION

10.1 At the time of bidding, Manufacturer shall submit the following documents:

- a. General arrangement drawings showing all features and relative positions and sizes of vents, drains, gear operator/actuator and other external parts together with overall dimensions.
- b. Sectional drawing showing major parts with reference numbers and material specification.
- c. Referenced list of similar supplies of ball valves shall be furnished. In case of full bore ball valves, manufacturer shall furnish all relevant details including Project, Year, Client, Location, Size, Rating, Service, Water depth, etc. wherein the ball valves have been installed in piggable pipelines in the last five years.





- d. Details of corrosion resistant paint, anti-fouling coating and radium/phosphorescent coating proposed to be applied on the valve surface as per the requirements of clause 8.2 of this specification.
- e. Clausewise list of deviations from this specification, if any.

10.2 Within three weeks of placement of order, the Manufacturer shall submit four copies of, but not limited to, the following drawings, documents and specifications for Company's approval:

- a. Detailed sectional drawings showing all parts with reference numbers and materials specification.
- b. Assembly drawings with overall dimensions and features.
- c. Fabrication details of all valves.
- d. Welding Procedures, Heat treatment procedures and Testing procedures.

Manufacturer of valves shall commence only after approval of the above documents. Once the approval has been given by Company, any changes in design, material and method of manufacture shall be notified to Company whose approval in writing of all changes shall be obtained before the valve is manufactured.

10.3 Within 30 days from the approval date, Manufacturer shall submit to Company one reproducible and six copies of all approved drawings, documents and specifications as listed in clause 10.2 above.

10.4 Prior to shipment, Manufacturer shall submit to Company one reproducible and six copies of the following:

- a. Test certificates as listed in clause 7.0 of this specification.



- b. Manual for installation, erection instructions, maintenance and operation instructions including a list of recommended spares for the valves.

10.5 All documents shall be in English only.

#### 11.0 MANUFACTURER'S QUALIFICATION

Manufacturer who intends bidding for sub-sea ball valves must submit along with the Bid, the relevant information and details as mentioned in clause 10.1 (c) of this specification, to establish that the type of valve offered are field proven for permanent sub-sea installation in similar service and are functioning satisfactorily.