

**ANNEXURE TO TENDER NO.DPS/MRPU/1/3/1488**

**Item: BELLOW SEALED VALVES FOR SODIUM SERVICE**

**1. SCOPE**

The scope of the tender is procurement of all materials and components, design, manufacturing, assembling, inspection, testing, packing and delivery of Y-type globe and straight type gate stainless steel bellow sealed valves with pneumatic actuator or motor operated for sodium system application to IGCAR Kalpakkam as per the detailed technical specifications given in the following paragraphs.

The details of sizes and types of valves with corresponding quantity are given in table

| <b>S. No.</b> | <b>Item details</b>                                                 | <b>Quantity (Nos.)</b> |
|---------------|---------------------------------------------------------------------|------------------------|
| 1             | DN15 Straight Gate valve of Pneumatic Type with manual override     | 4                      |
| 2             | DN25 Straight Gate valve of Pneumatic Type with manual override     | 2                      |
| 3             | DN15 Y type Globe valve of Pneumatic Type with manual override      | 5                      |
| 4             | DN25 Y type Globe valve of Pneumatic Type with manual override      | 5                      |
| 5             | DN15 Y type Globe valve of Motorized operation with manual override | 3                      |
| 6             | DN25 Y type Globe valve of Motorized operation with manual override | 3                      |

Valves with same nominal size and characteristics type (straight type gate / Y type globe) will be treated as a single lot irrespective of the mode of actuation. The evaluation of the commercial bid will be based on the lowest cost per lot of the valves. Split order will be processed based on lot and lowest offer, if necessary.

**2.A General description for items 3,4,5 and 6 ( Y type Globe Valves– Fig. 1):**

Bellows sealed valves are used in sodium system for flow control. The leak-tightness towards the exterior shall be assured mainly by means of SS bellows welded between the valve bonnet and valve stem of these valves. The valve stem shall not be allowed to have rotational movement in order to avoid any damage due to torque that might come on the bellows during such manipulation(i.e raising stem valves are required). A back-up leak-tightness (secondary seal) arrangement towards the exterior shall be provided by means of an easily accessible seal packing (stuffing box). It shall be possible to replace this packing without disconnect the valve from the line.

The construction of valves shall be of Y-pattern such that sodium gets drained easily. The angle of inclination for ‘Y’ shape with respect to horizontal axis shall be 45° maximum. Valve body shall be designed for zero or minimum volume hold up and should be fully drainable, with 3% slope in the line.

In order to detect failure of bellows, a hole closed with a plug of thread diameter M14 X 1.25 mm pitch X 20mm length shall be provided for introducing spark plug type

leak detector. The seal packing shall be graphite asbestos, which has good corrosion resistance against sodium. The stuffing box shall be fixed over the valve head by means of screws/ bolts.

The sealing between the valve body and the valve head shall be achieved by having the connected flange lip seal welded, the mechanical strength is achieved by bolting the two flanges. Valves shall be pneumatic or motor actuator type with manual override as per the table.

## **2.B General Description for items 1 & 2 (Straight Gate Valves - Fig. 2)**

The bellows sealed Gate valves are used in sodium system for draining or dumping. The leak-tightness towards the exterior shall be assured mainly by means of SS bellows welded between the valve bonnet and valve stem of these valves. Gate valves are primarily designed for 'ON-OFF' services in straight line of flow of sodium, where minimum restriction is desired.

## **OPERATING AND DESIGN CONDITIONS**

### **3.1. Operating Conditions**

- Fluid handled: Liquid sodium
- Fluid temperature: 600 °C (max)
- Pressure: Vacuum to 10 kg/cm<sup>2</sup>(g) at 600 °C (Class 300 as per ASME 16.34 )

### **3.2. Flow induced vibration (FIV)**

The valve shall not have detectable vibration during operation in sodium system in fully open condition corresponding to a flow velocity of 10 m/s. The supplier shall indicate in their offer that the above requirement will be met and shall furnish the supportive design document/test reports.

### **3.3. Leak Tightness Towards the Exterior**

The following condition must be proved:

- The leak of the valve body shall be less than 10<sup>-8</sup> pa.m<sup>3</sup>/s during helium leak test under vacuum at room temperature.
- No leakage shall be permitted during pressure test condition.
- No sodium leakage shall be permitted under operating condition.

### **3.4. Leak Tightness Across Valve Seat**

Leak tightness of the valve seat shall meet class IV as per standard ANSI/FCI 70-2.

### **3.5 Design Condition**

Design, fabrication, inspection and testing of the valves shall be as per ANSI B16.34 special class. The supplier shall select temperature and pressure rating of the valve as per clause 3.1 and accordingly meet all the requirements.

#### **4. APPLICABLE CODE, SPECIFICATIONS AND STANDARDS**

- ANSI B16.34 special class
- ANSI/FCI 70-2
- ASME section-VIII Div-1
- ASME Section IX
- ANSI B16.28
- EJMA Standard
- ASTM A 182 F316LN
- ASTM A 479/A 479M-3
- ASTM A 380
- ASTM E 165
- ASTM E 194
- ASTM E 142
- IS 9334
- IS 325

#### **5. MATERIAL, MANUFACTURE AND WELDING**

##### **5.1 Material**

Valve body shall be of SS 316LN (ASTM A 182 F316LN). Valves of size greater than 1 inch shall be of only forged construction while valves of sizes less than or equal to 1 inch may alternatively be made from bar stock (ASTM A 479/A 479M-3). It may be clearly mentioned in the quotation whether the body is forged or machined from bar stock. All other parts except handle and gland packing shall be of stainless steel or other suitable high temperature material. No casting is allowed. The material properties of the 316LN grade shall be taken same as that of 316 grade stainless steel for design calculations.

Graphited asbestos or Graphite impregnated with Inconel or other suitable high temperature packing shall be used for secondary packing.

##### **5.2 Welding**

All welding shall be carried out by TIG process. The welding procedure and welders performance qualifications for steel materials shall be as per ASME Sec IX. Procedure for welding must be approved by the purchaser before performing the qualifications test.

#### **6. DETAIL DESIGN, DRAWING AND MANUFACTURING DOCUMENTS**

The supplier shall submit the design documents and drawings for approval before the commencement of manufacturing.

All the manufacturing and quality assurance documents such as manufacturing process sheets, quality assurance plan, manufacturing procedure, welding procedures, weld data sheets, assembly procedure, inspection, testing and packing and

transportation procedure etc. shall be prepared by the manufacturer and shall be submitted to the purchaser for approval before commencement of manufacture.

## **7. GENERAL REQUIREMENTS**

### **7.1 Valve Body**

The valve body shall be of cylindrical section throughout. If tapped holes any in the valve body shall be clearly stated in the offer with the purpose of hole and its depth.

### **7.2. Valve Bonnet**

Body to bonnet shall be of welded construction. Crevices and threaded joints shall be avoided. Gaskets shall not be used. The bonnet shall be welded to the body for sizes up to one inch. A lip seal weld held together by bolted reinforcement flanges shall be provided for larger size valves. The valve has to be provided with a back seat to give a leak tight stem seal when the valve is in fully open condition.

### **7.3 Valve Seat**

Integral type seat shall be used. Profiled metal to metal seat shall be used. The seat, valve plug, stem and its guide bushing (the contact faces) shall be hard faced with satellite-6. Material deposited shall be machined and polished. The residual thickness of deposit shall be at least 2 mm throughout.

### **7.4 Stem**

Raising, non-rotating type stem shall be used. Stem should be restricted from rotation independently of the bellows. Valve shall be designed such that hand wheel, hand wheel guide sleeve, guide sleeve retainer and roller thrust bearing operate at room temperature.

### **7.5 Bellows**

The primary seal between valve body and valve stem shall be achieved by using hydroformed bellows made from SS316L/SS316Ti material. The permissible stress at 600° C shall be taken as 75.0 MPa as per ASME B31.3, Process piping code. Seamless or longitudinal butt-welded tube shall be used for forming bellows. The bellows after final forming shall be solution annealed. There shall be suitable provision to completely prevent transmission of torque onto bellows. The number of operating cycles considered for design is 1000 cycles (fully open to fully closing) of the valve at the rated temperature and pressure for all below sealed valves except smaller valves up to DN 25 shall be designed for 5000 cycles of operation. Bellows design and testing shall be carried out in accordance with EJMA Standard. All the bellows shall be subjected to helium leak test at sub-assembly stage and after complete fabrication of the valve as specified in clause 3.3.

### **7.6. End Connections**

The valve shall be butt welded on to the pipes. The valve end connection shall be of sufficient length so that its connection to the pipe by means of welding does not affect on its function and leak-tightness. The valve shall be supplied with their ends prepared for welding to schedule 40 pipe of same nominal size as per ANSI B16.28.

### **7.7 Surface Treatment**

The valve shall be delivered in perfectly clean, dry and degreased condition. All stainless steel parts shall be pickled and passivated (for machined portion pickling is not required) as per ASTM A 380. Cast iron items shall be treated (e.g. with phosphate). The supplier shall give the details of surface treatment.

### **7.8 Pressure Drop**

The valve design should be such that it offers minimum pressure drop ( $\Delta P$ ) to the system,

Where,  $\Delta P = K\rho V^2/2g$

In open position, flow resistance coefficient (K) with respect to sodium velocity (V) in the line shall not exceed 5 for globe valves. The supplier shall state the value of K in the offer for each size and type of the valve. The pressure drop coefficient shall be evaluated by performance type test in water. Supplier shall submit the test report to the purchaser.

### **7.9 Leak Detection**

In order to detect failure of bellows, a hole closed with thread diameter of M14 X 1.25 mm pitch X 20 mm length provided for introducing spark plug type detector. This will be placed as far as possible nearer to the bellows in order to reduce the time delay in detection.

### **7.10 Identification of the Valve**

The following indication must be permanently marked:

- Valve size, type, Rated class
- Valve body material (ASTM symbol)
- Flow direction of the valve
- Manufacturer's name

### **7.11 Operational requirements**

- Visual indicator for position of valve stem (partially open / closed condition) shall be available. Limit switches shall be provided for fully open and close conditions for all valves including manually operated valves.
- It should be possible to install and operate the valve with actuator in vertical or horizontal pipe section.

### **7.12 Painting and coatings**

All the metallic portions other than stainless steel, shall be given two layers of paints, which shall be withstand service temperature. The type of paint used shall be got approved by the purchaser.

## **8. VALVE ACTUATORS**

### **Pneumatic actuator**

- The pneumatic valves shall be supplied integral with the pneumatic actuator so that it can readily be used for ON-OFF service. Pneumatic actuator shall be double acting piston type and air to open and air to close mode of operation with override manual for operation.
- The pneumatic operation shall be effected by a combination of piston and cylinder. The valve shall operate at a pressure of 5 to 7 kg/cm<sup>2</sup> and the time for fully opening /fully closing the valve shall be within 5 seconds to 10 seconds.
- There should be provision for mechanical indication of position of valve stem.
- Limit switches shall be provided to indicate the extreme positions of valve stem. The contact rating of these limit switches shall be around 2 amperes at 230 volts.
- Data regarding pneumatic actuator, cylinder diameter, stroke volume available, stem force, stem travel, pressure at which valve closes, time for opening the valve fully under design operating conditions and other constructional features shall be furnished at the time of offer. The same data should be also be tested and furnished at the time of supply of each valve.
- Actuator leak test including tests to determine the air pressure and time required for opening/closing the valve shall be carried out.
- The pneumatic actuator construction should ensure long and trouble free operation without any leak across the piston/ cylinder. There should be diaphragm inlet and outlet for air to avoid sudden operation of stem.

### **Motor actuator**

- The valve shall be supplied integral with the motor and gear systems in assembled condition.
- The electric motor shall be 3 phase squirrel cage induction motor that can be connected star or delta on 415V, 50Hz power supply. The motor shall be designed for intermittent operation of closing, partially or fully opening the bellows sealed valve. The motor shall be provided with weather proof and flame proof enclosure. Primer coating and a coat of paint shall be applied on the casing.
- The motor operated valves shall conform to the following standard.  
IS 9334: Specifications for electric motor operated actuators.  
IS 325 : Specifications for three phase induction motors.
- It should have the following special provisions.
  - Design for operation in the ambient temperature range 15 °C to 60°C, up to 95 % relative humidity. Built in mechanical position indicator shall be provided.

- The valves shall have provisions for manual override. Hand wheel operation of valve shall be possible only after de-clutching the motor drive.
- Winding insulation shall be class- F.
- Two torque limit switches and two travel limit switches shall be provided for both the directions of rotation. Actuator shall be provided with sensitive and accurate torque limiting devices as well as travel limit device. There should be provision for varying the setting of these limits.
- The rating of motor shall provide a good margin over the torque required for closing/opening of the valve and other operations. One torque limit switch shall be provided to operate at the back seat when the valve is in fully open position. The other torque limit switch shall be provided to prevent excessive torque during closure of valve. The time for fully opening the valve from closed position shall be around 30 seconds. The actual value shall be provided after testing of the valve.
- The value of torque applied for operating the valve, closing and opening of the valve while conducting seat leakage and other tests shall be provided for information. The torque limits and travel limits shall be provided to suit these operations and the value of torque limits shall be given as a report.
- Following accessories shall be provided as part of the valve actuator.
  - The motor operated actuators shall have one built-in local position indicator for 1 to 100% travel and Potentiometer shall be provided for remote indication.
  - Over load protection relay for both motor and actuator against high current and short circuit.
  - Motors shall have a direct temperature sensing thermostat embedded in the stator windings for effective motor protection if winding temperature exceeds permissible temperature.
- The mechanical linkage between motor and valve stem shall be through a planetary gear system and a worm and wheel system so as to ensure a low inertia of output shaft thus enabling instant stopping. The gear design shall permit lifelong lubrication by grease. There should be a provision for measuring output torque by the lever deflection of the external crown of the planetary gear. Thus crown shall be maintained in position by springs which can be independently set to a different torque value for each direction of rotation. Whenever adjusted torque is reached, the torque limit switch is tripped. The inertia of motor shall be absorbed mainly by springs and not by the driven valve. The motor operation of valve shall be trouble free and smooth.
- The valve construction shall be such that the planetary gear assembly and motor will not be subjected to temperature above 60 °C during operation of the valve with 600 °C sodium.
- All the details of motor, the gear assembly, actuator, torque limiting device, time for fully opening the valve etc. as mentioned above shall be indicated in detail in the quotation.

## **9.0 BID ACCEPTANCE CRITERIA**

- Quotations from only **Original Valve Manufacturers** will be accepted. Quotations from dealers will not be accepted. The bidder should submit proof of in-house manufacturing capability.
- Quotations accompanied only with assembly drawing of valve will be considered.
- All inspection and testing charges shall be included in their budgetary offer. Quotations received only with inclusive of the above charges will be considered.
- Quotations containing the following additional documents only will be considered
  - Copies of purchase orders successfully executed or in execution in the last five years
  - List of clients to whom valves have been delivered in the last five years

## **10. BID EVALUATION CRITERIA**

- Budgetary offers will be evaluated as per the technical specification indicated in the indent.
- Valves with same nominal size and characteristics type (straight type gate / Y type globe) will be treated as a single lot irrespective of the mode of actuation. The evaluation of the commercial bid will be based on the lowest cost per lot of the valves. Split order will be processed based on lot and lowest offer (if necessary).

## **11. PRODUCT ACCEPTATION CRITERIA (Inspection and Testing)**

### **11.1 General**

Manufacturer shall prepare Quality Assurance Plan (QAP), inspection procedures for dimensional inspection, LPE, ultrasonic / radiography examinations, hydrostatic testing, pneumatic testing, helium leak testing and any other inspection and testing called for in the tender and shall submit the same for Purchaser's approval. These inspections shall be carried out as per approved procedures.

All the inspections are under the scope of supplier. The manufacturer shall provide the inspection and testing services and facilities for all the manufacturing works. The manufacturer shall maintain records of all inspection and tests, and these shall be made freely available to the purchaser's authorized representative. Radiographic films and all reports shall be stored for a minimum period of 10 years from the date of dispatch of component. Also the supplier shall supply a set of reports and x-ray images in electronic form by digitizing the same.

### **11.2 Material Test**

The supplier has to produce all the linkable certificate of the materials used for manufacturing of valves. In case the correlating test certificates are not available, the supplier, at no extra cost to the purchaser, shall get all the tests done to establish conformity of the material to its relevant code/specification.

### **11.3 Dimensional Inspection**



In addition to the inspection carried out during fabrication, the valve shall be subjected to the dimensional verification in the shop. The valves shall conform to the drawings submitted to and approved by the purchaser.

#### **11.4 Non Destructive Examination**

##### **11.4.1 Visual Examination**

Each & every part individually, subassembly of parts and final assembly shall be 100% visually examined to check the soundness of the part. The part shall be free from scratches, dents, tears or any other injurious defects particularly affecting the thickness of the part.

The entire formed surfaces shall be 100% visually examined to check the soundness of the part and shall be free from scratches, dents, tears or any other injurious defects particularly affecting the thickness of the formed part. All welds shall be examined visually after each pass.

##### **11.4.2 Liquid Penetrant Examination**

Lip seal welds and hard facing deposit shall be subjected to liquid Penetrant examination as per ASTM E 165 and the acceptance criteria shall be as per ANSI B 16.34.

##### **11.4.3 Ultrasonic / Radiographic Examinations**

Ultrasonic / Radiographic examination shall be carried out on all butt welds as per the relevant ASTM standard and the acceptance criteria shall be as per ANSI B 16.34.

##### **11.4.4 Pneumatic Test Pressure for Body**

The valve body shall be subjected to a pneumatic test at 18 bar (gauge) for minimum time of 20 minutes for pressure hold test. No leak shall be acceptable.

##### **11.4.5 Pneumatic Seat Test**

The test shall be performed on each valve in both direction and shall meet the requirement stated in clause 3.4. The valves shall be tested for seat leakage as per ANSI B 16.34. Class IV seat leakage as per standard ANSI/FCI 70-2 is acceptable for the valves.

##### **11.4.6 Helium Leak Test**

Each valve shall be subjected to helium leak test to check over all leak tightness towards the exterior. Leak tightness shall meet the requirement stated in clause 3.3

After surface treatment, helium leak test under vacuum shall be carried out using mass spectrometer to check the overall leak tightness of the valve towards the exterior. The valve will be operated during this test. The test shall be done after valve seat leak test. The leak across the bellows and valve body shall be less than  $10^{-8}$  pa. m<sup>3</sup>/s.

#### **11.5 Reports**

### 11.5.1 Instruction Manuals

Instruction manuals shall be submitted covering the following aspects:

Detailed instructions for unpacking, handling at site, storage for prolonged duration, erection, operation, maintenance procedure, preventive measures, list of spares, schedule of replacement of spares, greasing and / or lubricating schedules, operating procedure, catalogues of various components. Readable and convenient sized drawings shall be enclosed with the manual.

11.5.2. Following tests certificates shall be provided:

- Tests certificates of materials for manufacture of the following individual parts:
  - Valve body
  - Valve bonnet
  - Valve stem
  - Bellows
  - Body seat
  - Plug
  - Bolting
- Overall dimension inspection report
- Non-destructive examination test reports as defined in ANSI B 16.34.
- Valve seat leak test certificate.
- Helium leak test certificate.

The number of copies of different documents to be given by the supplier is given below:

| S. No. | Item                                         | No. of copies   |
|--------|----------------------------------------------|-----------------|
| 1.0    | Drawings and documents                       |                 |
| 1.1    | Initial submission (for each revision)       | 4               |
| 1.2    | Final submission                             | 6 + 1 soft copy |
| 2.0    | Inspection Reports, Performance Test Reports |                 |
| 2.1    | Initial submission (for each revision)       | 4               |
| 2.2    | Final submission                             | 6 + 1 soft copy |
| 3.0    | Instruction Manual                           |                 |
| 3.1    | Initial submission (for each revision)       | 4               |
| 3.2    | Final submission                             | 6+ 1 soft copy  |

## 12. PACKING AND TRANSPORTATION

### 12.1 Packing

The valves shall be perfectly cleaned, dried and individually packed. All opening such as leak port and end connection with edge preparations shall be suitably protected and closed before packing. Each valve with actuator shall be wrapped separately in polythene wrapper to prevent damage during transport. They shall be packed in weatherproof wooden crates. Relevant technical leaflets and operating instruction shall accompany the valves.

### 12.2 Transportation

This section covers transportation of equipment, receipt at site, unloading of material from carriers at site, transport to warehouses/stores, inspection of material. In case there is a time interval between receipt of material and erection, equipment will be stored in the stores/warehouses on temporary basis.

No material shall be despatched without prior consent in writing (shipping release) of the purchaser or his authorized representative. Transport of all items from supplier end to IGCAR, Kalpakkam and taking back to supplier end if any repair/replacement come, is under the scope of supplier.

It is the sole responsibility of supplier to insure all the equipment referred under purchase order during transit and all risks in transit being exclusively by the supplier.

### **13. GUARANTEE**

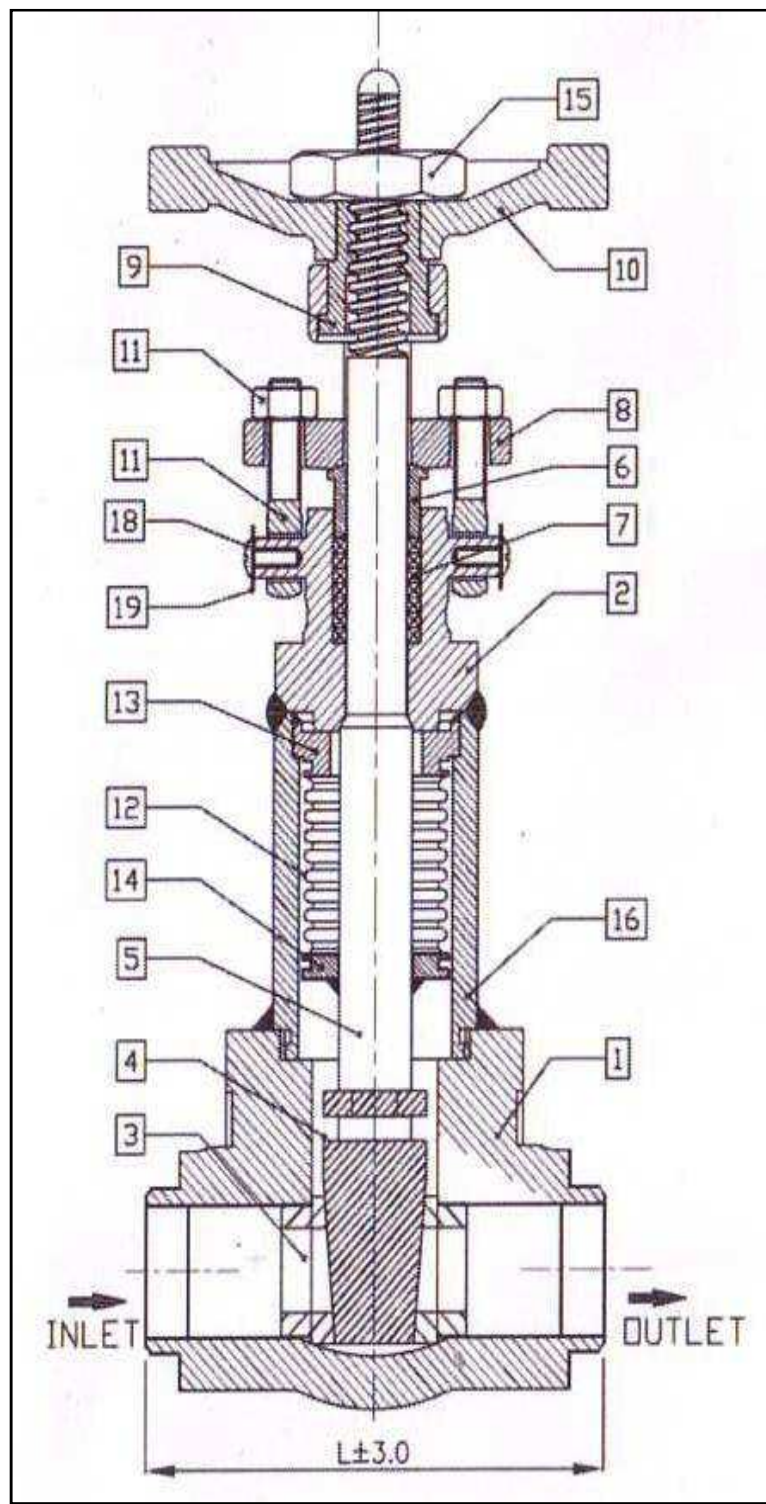
The component and the associated accessories / parts shall be guaranteed for a minimum period as specified in tender document from the date of receipt at site or from the date of completion of repairs. If any deficiency is noticed in performance of the component because of materials, manufacture, inspection & testing, the manufacturer upon notification by the purchaser and at purchaser's convenience shall forth with restore them to satisfactory condition by making good every defect, deficiency or failure by providing men, materials and equipment at purchaser's site without any extra cost to the purchaser.

### **14. PERFORMANCE GUARANTEE**

The supplier shall ensure that the valves and accessories supplied by him under this specification shall meet the guaranteed parameters as per the applicable codes and standards stated in the specification.

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FLOW DIRECTION

Fig.1 Y  
globe valve



type

Fig. 2 Straight type gate valve