

SUB SECTION 7 : VALVES

1 VALVES AND OTHER ACCESSORIES

The details and specifications of various types of valves to be used in pumping plant and pumping main are as under:

1.1 GENERAL

Throughout erection, the valves shall be supported properly on wooden sleepers, etc. and shall be concreted immediately thereafter, as directed. Before the valves are actually fixed, they shall be cleaned and greased and it should be seen that all parts are in perfect working condition. In the case of air valves, the Contractor shall take special care of the dexine joints and the ebonite and /or vulcanite balls until they are fixed in position. They shall be kept immersed in water in suitable containers.

1.1.1 General and Operational Torque Requirement of Valves

Valves shall be as per internationally recognized standards. Valves shall be double flanged and the face shall be parallel to each other and flange face should be at right angles to the valve centerline. Backside of valve flanges shall be machined or spot faced for proper seating of the head and nut. Valve buried or installed in underground chamber, where access to a hand wheel would be impractical, shall be operated by means of extension spindle and/or keys. Valve shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position. The valve stem, thrust washers, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel. Valves shall be free from sharp projections. Butterfly and non-return valves shall be provided with bypass arrangement having rising spindle gate valves. Bypass may be integral with valve or connected between pipes. Minimum size of by pass for valves in transmission main is 150 mm and for valves in pump delivery is 65 mm.

The work of fixing appurtenances, i.e. butterfly valves, sluice valves, air valves, scour valves, etc. shall be carried out carefully so as not to damage them during handling, erection and fixing. The work shall be executed in a workmanlike manner under the direction of Employer's Representative.

All the butterfly valves and sluice valves for pumping plants and isolation valves on pumping main (except scour valves on pumping main and the isolation valves for air valves) shall be electrically operated. The valves shall have arrangement for manual operation also, operated through a suitable gearbox, by hand wheel. Operation must be possible by one man against maximum design working pressure. For butterfly valves the gearbox shall be provided with self locking devices. A locking facility shall be provided for the BF valve in either the fully open, fully closed or intermediate position. Gate valves and butterfly valves shall be provided with position indicators, to show whether the valve is in the open or close position.

Scour valves shall be provided with extension spindle with supports for operation from operating level / ground level.

1.1.2 Gaskets and Packings

Gaskets shall be of Nitrile rubber and ready made matching with respective flanges. Gaskets cut out from rubber sheets are not acceptable.

1.1.3 BUTTERFLY VALVES

1.1.3.1 Constructional Features

The valves shall be with integral body seat, suitable for ON-OFF and regulated operation. It shall be suitable for withstanding pressure from either side. Leakage rate shall not exceed 3.6cc/hr/cm nominal diameter of valve.

The valves shall be with double flanged ends.

The valves shall be electrically operated. Valves on raw water pumps delivery and transmission mains shall be with extension spindle. Extension spindle shall be with universal coupling and intermediate supports, if required. Operation of valves shall be with electric actuators mounted on floor stand at floor / top slab level.

Butterfly valves shall be of metal seated type generally as per BS EN 593. Valve shall be suitable for mounting in any position. The valve seat shall be of integrally cast or replaceable design. When the valve is fully closed, the seal shall seat firmly. The seat surfaces shall be machined smooth to provide a long life for the seal. All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve. Valve shall be suitable for throttling purpose. All valve spindles and hand wheels shall be positioned to give good access for operational personnel. Valve of diameter 450 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear shall be such that they can be opened and closed by one man against an unbalanced head of 1.15 times the specified rating. Valve and gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 200 N. All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

1.1.3.2 Materials of Construction

Item	PN 1.6 Valve	PN 1.0 Valves
Body	SGI IS 1865 Gr. 500/7	CI IS 210 Gr FG 260
Disc	SGI IS 1865 Gr. 500/7	CI IS 210 Gr FG 260
Shaft	Stainless steel BS 970, Gr 304 S15	Stainless steel BS 970, Gr 304 S15
Body and Disc Seat	Stainless steel AISI 316	Stainless steel AISI 316
Bearing	Steel backed PTFE (Teflon)	Steel backed PTFE (Teflon)
Internal Fasteners	Stainless steel SS316	Stainless steel SS316

1.1.4 SLUICE VALVES

1.1.4.1 Constructional Features

Sluice valve shall generally conform to BS: 5150 / IS 14846. They shall be of rising spindle type except for the valves for bypass. The gate face rings shall

non-be

securely pegged over the full circumference. Valve of 600 mm and above shall be furnished with a bushing arrangement for replacement of packing without leakage. They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5 mm. Valve of 700 mm and above shall be provided with thrust bearing arrangement for ease of operation. Valve of diameter 400 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 200 N. Valves spindles and hand wheels shall be positioned to give good access for operational personnel. Hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

Valves shall have two position marked at the shut end of the scale, first one corresponding to the position of the gate tangential to the bore of the seating and the second position below the first, corresponding to the position of the gate as it sits on the seating after moving a further distance equal to the depth of the seating.

All valves on pump suction and delivery piping shall be with electrical actuators. Valves on raw water pumps delivery and scour valve shall be with extension spindle. Extension spindle shall be with universal coupling and intermediate supports, if required. Operation of valves shall be with electric actuators mounted on floor stand at motor floor.

1.1.4.2 Materials of Construction

Body, Wedge, Dome	:For PN 1.0 CI IS 210 Gr. FG 260 For PN 1.6 SG Iron IS 1865 Gr. 500/7
Hand Wheel	:Cast Iron IS 210 Gr FG 200
Stem:	IS 6603, SS 4Cr17Ni 12 Mo2 / AISI 316
Body seat ring and Wedge Ring:	IS 318 Gr LTB 2
Shoe Channel and Stem Nut:	IS 318 Gr LTB 2
Back seat Bush:	IS 318 Gr LTB 2

1.1.5 AIR VALVES

1.1.5.1 General

The valve shall be capable of exhausting air from pipe work automatically when being filled. Air being released at a sufficiently higher rate to prevent the restriction of the Inflow rate. Similarly the valve shall be capable of ventilating pipe work automatically when being emptied, as the air inflow rate should be sufficiently high to prevent the development of vacuum in pipeline. The valve shall automatically released air accumulating in pipeline work during normal working condition.

Air valve shall be of Single chamber or Double acting type. For double acting type, a buoyant rigid ball (float) shall seal the large orifice and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged. A buoyant ball shall seal the small orifice at all pressures above atmospheric except when air accumulates in the valve chamber. Single chamber valve shall include a small orifice only, or large orifice only, operating in a manner identical with the small or large orifice in a

double acting valve. All air valves shall be provided with isolating valve and flanged end connection.

The aperture of valves must be properly designed for which the Contractor shall submit design calculations for necessary approvals before the procurement of valves.

All branched outlets including air valve tee's will be provided with one ½" BSP coupling duly plugged for measurement of pressure in due course. The closing plug shall be in Stainless Steel (AISI 304 or equivalent) with Hex. Head and shall be provided with copper washer for sealing.

1.1.5.2 Materials of Construction

Body and cover	CI IS 210 Gr FG 260
Float	Polycarbonate
Seat Ring	Dexine (Nitrile Rubber) on Bronze seat

1.1.6 ACCEPTABLE INDIGENOUS MAKES FOR VALVES AND BELLOWS

Butterfly Valves: Advance Valves Ltd./ Fouress Engg (I) Ltd./ Indian Valve (P) Ltd/ Kirloskar Brothers Ltd./ L & T or equivalent as approved by Employer's Representative.

Sluice Valves: Indian Valve (P) Ltd./ Kirloskar Brothers Ltd. or equivalent as approved by Employer's Representative.

Dual Plate Check Valves: Advance Valves Ltd./ Indian Valve (P) or equivalent as approved by Employer's Representative.

Kinetic Air Valves: Avcon Vales Ltd./ Indian Valve (P) Ltd./ Kirloskar Brothers Ltd or equivalent as approved by Employer's Representative.

Valve Actuators: Auma India Ltd./ Limitork Ltd./ Rotork or equivalent as approved by Employer's Representative.

Metallic Bellows: D Wren Industries (P) Ltd/ Flexatherm Expanllow (P) Ltd./ Lonestar Industries/ Metallic Bellows (I) Pvt. Ltd. or equivalent as approved by Employer's Representative.

1.1.7 DRAWINGS AND INFORMATION TO BE PROVIDED BY CONTRACTOR

- Cross-sectional drawing with materials of construction
- Outline dimensional drawings with valve parameters
- Torque calculation for selection of actuator
- Actuator data sheet and catalogues

1.1.8 ISOLATING COCKS

For isolation of small bore pipe work tapping for instrumentation equipment etc., and for individual component isolation, the cocks shall be stainless steel, 0.25 turn ball or plug valve with the operating handle arranged to indicate the open and closed positions.

1.1.9 NUT, BOLTS, WASHERS

The Contractor shall provide the jointing material such as nuts, bolts, washers, pig lead, rubber packing, etc.

Nuts and bolts shall be of the best quality bright steel, machined on the shank and under the head and nut. Studs, bolts and nuts shall be SS 304/316. Bolts shall be of accurate length so that only few threads show through the nut in the fully tightened conditions. Nuts and bolts shall conform to IS 1363 and IS 1367, unless specified otherwise.

Washers, locking devices and anti-vibration arrangements shall be provided where necessary.

Where there is a risk of corrosion, bolts, nuts and studs shall be designed so that the maximum stress does not exceed half the yield stress of the material under any conditions. All studs and screws shall be made of SS304/316.

The Contractor shall supply all holding down, alignment leveling bolts complete with anchorages, nuts washers and packing required to fix the plant to its foundations, bed plates, frames and other structural parts.

The Contractor shall procure and keep at site, reasonable excess quantities to cover wastage of those materials, which will be normally subject to waste during erection, commissioning and setting to work.

1.1.10 VALVE ACTUATORS

1.1.10.1 Codes and Standards

This specification covers the general requirements of Electric Motor Actuators for valves. All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards except when stated otherwise here in or in valve specification.

1.1.10.2 Design Requirements

The actuator shall be suitable for operation in hot, humid, dusty and tropical atmosphere. Type of actuator offered should be in satisfactory operation under similar conditions. For isolating service, the actuator shall be rated for three successive open-close operations of the valve or 15 minutes, whichever is longer. For regulating service, the actuator shall be suitably time rated for the duty cycle involved with necessary number of starts per hour.

The actuator shall open and close the valve completely and make leak tight valve closure without jamming. The actuator shall attain full speed operation before valve load is encountered and impact an unseating blow to start the valve in motion (hammer blow effect). The actuator shall operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

The actuator motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energized and prevent drift from torque switch spring pressure. The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

1.1.10.3 Features of Construction

- i. The actuator shall essentially comprise integral starter, drive motor, torque/limit switches, gear train, clutch, hand wheel for manual operation, position indicator/ transmitter, space heater thermal overload protector and internal wiring. The actuator enclosure shall be dust tight, weather-proof suitable for outdoor use

- without necessity of any canopy. The weather protection class of actuator shall be IP 65 for indoor and IP 68 for out door installations.
- ii. All electrical equipment accessories and wiring shall be provided with tropical finish to prevent fungus growth. The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.
 - iii. The actuator motor shall be three phase, squirrel cage, induction motor with class B insulation and IP 68 protection, designed for high torque and reversing service.
 - iv. The motor shall be designed for full voltage direct on-line start with starting current limited to 6 times full-load current.
 - v. The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each. Earthing terminals shall be provided on either side of the motor.
 - vi. Each actuator shall be provided with following limit switches.
 - 2 torque limit switches, one for each direction of travel, self locking, and adjustable torque type.
 - 4 end-of-travel limit switches, two for each direction of travel.
 - 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve.
 - vii. Each limit switch shall have 1 NO + 1 NC potential free contacts. Contact rating shall be 5A at 240 VAC.
 - viii. Each actuator shall be provided with relay for monitoring the availability of valve for remote operation. The contact rating shall be 5A, 240 VAC. The available signal shall comprise of the following:
 - Actuator mounted Local-Off-Remote. Selector switch set to remote.
 - No power failure at starter.
 - Emergency stop not operated.
 - No drive fault.
 - ix. The torque switch shall have a minimum accuracy of 3% of set value. The torque switch shall be provided with calibrated knobs for setting desired torque and separate knobs shall be provided for open and close torque switches.
 - x. The torque and limit switches shall be housed in a separate enclosure with protection class as that of actuators.
 - xi. Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall de-clutch automatically when the motor is energised.
 - xii. The actuator shall have:
 - One (1) built-in local position indicator for 0 100% travel.
 - Two (2) position transmitters, potentiometer type of 100 ohm rating for remote indication.
 - xiii. All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 mm² copper. All wiring shall be identified at both ends with ferrules.

- xiv. The terminal box shall be weather proof with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 mm² copper conductor.
- xv. The terminals, terminal boards, terminal boxes, winding tails and associated equipment shall be suitable for connection to supply system having 'adequate short-circuit capacity and clearance time determined by associated fuses'. The terminal boxes shall be totally enclosed.
- xvi. All terminals of limit and torque switches, space heater, position transmitters, shall be brought to a common terminal box. There shall be at least five (5) terminals spare to terminate spare cores of cable.
- xvii. The actuator shall be painted with epoxy paint. The colour shall be got approved from Employer's Representative.
- xviii. The nameplate shall be provided on the actuators as per relevant IS. In addition, the following shall also be marked:
- Tag number
 - Torque rating
 - Full travel time
- xix. Local controls shall be protected by a lockable cover.
- xx. Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The gearbox shall be grease filled, and capable of installation in any position. All operating spindles, gears and head stocks shall be provided with adequate points for lubrication.
- xxi. The valve actuator shall be capable of producing not less than 1½ times the required valve torque and shall be suitable for at least 15 minutes continuous operation.
- xxii. The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions.
- xxiii. The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall also be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase operation. The heaters shall be switched "ON" when the starters are "OFF" and shall be switched "OFF" when the starters are "ON".
- xxiv. The following shall be included as standard feature for valve actuators
- (a) Two (2) DC interposing relays for matching the low voltage of remote commands with the control voltage.
 - (b) The motor shall be specially designed for valve operation, combining low inertia with a high torque and with linear characteristics.
 - (c) Each electric-motor operator shall be provided with a hand-wheel with handle for manual operation. The hand-wheel shall be automatically de-clutched when the electric motor is operating, but shall be capable of being engaged at other times by positioning the clutch lever. The electric operation shall override the manual operation.
 - (d) All motor operators shall be provided with visible local valve position indicators mounted on the operator assembly itself.
 - (e) The torque switch shall function to stop the motor on closing or opening of the valve, or upon actuation by the torque when

the valve disc is restricted in its attempt to open or close. A minimum of two (2) torque switches, one for closing direction and one for opening direction shall be provided.

- (f) The non-adjustable limit switches shall stop the motor and give indication when the disc has attained the fully open or close position.
- (g) All wiring connections from the various switches shall be brought out on to separate terminal box mounted on the valve, having liberal space for wiring and making connections.
- (h) The terminal box shall be suitable for outdoor use and shall be weatherproof and dust tight.

xxv. Reversing starters

- (a) The reversing starters shall comprise forward and reverse contactors, electrically interlocked with each other.
- (b) The terminal overload relays provided with the reversing starters shall be three elements, positive acting, ambient temperature compensated, time lagged thermal overload relay with adjustable settings. The setting range shall be properly selected in accordance with the rating of the motor.
- (c) Thermal overload relays shall be hardest type.
- (d) 'STOP' push button of the starter and hand-reset device shall be separate from each other.
- (e) Overload relay reset push button shall be brought out to the front and made easily accessible.
- (f) Overload relay shall be provided with at least one 'NO' and one 'NC' or one change-over contact.
- (g) The minimum continuous current rating of the Contractors shall be 16Amps for all actuator valve motors up to 6 kW.

1.1.11 GEARBOX FOR VALVES

Gearbox must be self- locking type, with a continuous indicator. Traveling nut and screw type of gearboxes are not acceptable

The gearbox must conform to the provisions of AWWA C-504. The rated torque capability of each operator shall be sufficient to seat, unseat and rigidly hold in any intermediate position the valve disc it controls under the operating conditions specified. Operating torque must be as per requirements given in clause 4.5.10.2 and 4.5.10.3.

The operator must essentially be of worm and worm wheel design, self-locking type with or without additional spur gear arrangement to ensure that the effort on hand wheel is limited to the pull specified.

All valve operators shall be equipped with adjustable mechanical stop-limiting devices to prevent over-travel of the valve disc in the open and closed positions. Either end of the worm shaft must be provided with needle roller bearing to take on the lateral thrust.

The housing for the gearing must be enclosed and sealed in such a way that there is no leakage of oil / grease even after long period of un-use and there is no ingress of rainwater. Operator for valves, which are likely to be submerged in water for long period during the rainy season, must be watertight.

The hand wheels may be provided with extension for easy grip. The hand wheels must have a provision for locking with a chain and pad lock. All operators when fitted to the valve shaft must ensure clockwise closing and this must be indicated on the housing. A mechanical indicator is to be provided to show disc travel and end of travel.

1.1.12 INSPECTION

During testing there shall be no visible evidence of structural damage to any of the valve component.

Motorized valves shall be tested with their actuators, with a differential head equivalent to their maximum working pressure, to prove that the actuators are capable of opening and closing the valves under maximum unbalanced head condition within the specified opening or closing period.

(a) Butterfly valves:

Seat leakage test at rated pressure

Body hydrostatic test at 1.5 times the rated pressure

Disc strength test at body test pressure Valve operation with and without actuator

(b) Sluice valves:

Seat leakage test at rated pressure

Body hydrostatic test at 1.5 times the rated pressure

Valve operation

(c) Non-return valves:

Seat leakage test at rated pressure

Body hydrostatic test at 1.5 times rated pressure

(d) Kinetic air valves:

Seat leakage test at rated pressure

Body hydrostatic test at 1.5 times rated pressure

(e) Metallic bellows:

Body hydrostatic test at 1.5 times rated pressure