

WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION M-02-01

VALVES

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VALVES

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VALVES

1. GENERAL

This specification covers the requirements for gate valves, butterfly valves and reflux valves intended for installation in waterworks installations including pumping stations, water treatment works and service reservoirs or as specified otherwise.

All valves, with the exception of reflux valves, shall be provided with suitable gearboxes of self-locking design, if necessary, to enable the valve to be opened / closed against the specified maximum unbalanced pressure by one person only, including the emergency manual operation of an electrical valve. For manual operation, the effort required to operate the valve against maximum unbalanced pressure shall not exceed 250 N at the rim of handwheel or 125 Nm at the valve key.

Where specified in the Particular Specification, a headstock with an extension spindle shall be provided for operation of the gate valve or butterfly valve. For valves with vertical handwheel spindle, the rim of the handwheel shall be approximately 0.9 m above floor level. For valves with horizontal handwheel spindle, the height of the handwheel spindle axis shall be approximately 1 m above floor level.

For cast iron valves, all internal and external bare surfaces shall be coated with epoxy coating complied with the requirements of BS 6920 and Section 4 and 5 of WIS 4-52-01. The coating for fresh water and raw water applications shall be suitable for use in potable water and capable of meeting the full requirements of BS 6920. The minimum thickness of the coating shall be as specified below:

	Fusion Bonded Epoxy (μ m)	Airless Sprayed Application (μ m)
Flat and Pressurised Parts	250	400
Convex Outer Edges	150	300

Quality control tests on the coating applied to the valves shall include the following as a minimum requirement.

- Visual Inspection
- Thickness test
- Holiday detection
- Impact resistance test
- Adhesion test
- Cure test

The valve manufacturer may be requested to submit quality control or type test certificate on the coating applied to the valves for scrutiny or, if specified in the Particular Specification, conduct the quality control tests in the presence of an Independent Inspection Body.

2. GATE VALVES

Gate valves shall be of non-rising stem design constructed in accordance with BS 5163-1 and BS 5163-2 with flanged ends. The valves shall also comply with BS EN 1074-1 and BS EN 1074-2 and the flange ends shall be faced and drilled to BS EN 1092-1 and BS EN 1092-2 unless otherwise specified in the Particular Specification. To ensure smooth operation, valves of DN 350 mm and above shall be fitted with channel guides and gate shoes.

Depending on the types of applications and the valve seat arrangement as specified in the Particular Specification, gate valves shall be constructed of the following or other equivalent or superior materials:

Item	Materials of Construction			
	<u>Fresh Water & Raw Water Applications</u>		<u>Sea Water Application</u>	
	Resilient Seated with rubber-coated wedge	Metal Seated	Resilient Seated with rubber-coated wedge	Metal Seated (all stainless steel)
Body, Bonnet and Stuffing Box	Spheroidal Graphite Cast Iron to BS EN 1563	Spheroidal Graphite Cast Iron to BS EN 1563	Spheroidal Graphite Cast Iron to BS EN 1563	Stainless Steel 1.4401 to BS EN 10088-1:2005
Stem	Stainless Steel 1.4057 to BS EN 10088-1	Stainless Steel 1.4057 to BS EN 10088-1	Stainless Steel 1.4401 to BS EN 10088-1	Stainless Steel 1.4401 to BS EN 10088-1
Wedge	Spheroidal Graphite Cast Iron to BS EN 1563 fully vulcanized with EPDM, NBR or other equivalent material (Note 1). No ferrous part of the wedge shall be exposed.	Spheroidal Graphite Cast Iron to BS EN 1563.	Spheroidal Graphite Cast Iron to BS EN 1563 fully vulcanized with EPDM, NBR or other type of material with equivalent abrasion and resistance to chlorinated sea water. No ferrous part of the wedge shall be exposed.	Stainless Steel 1.4401 to BS EN 10088-1
Wedge Seat Rings	Not applicable	Aluminium Bronze to BS EN 1982 CC331G / CC333G	Not applicable	Not applicable
Body Seat Rings	Not applicable	Aluminium Bronze to BS EN 1982 CC331G / CC333G	Not applicable	Not applicable

Item	Materials of Construction
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	<u>Fresh Water & Raw Water Applications</u>		<u>Sea Water Application</u>	
	Resilient Seated with rubber-coated wedge	Metal Seated	Resilient Seated with rubber-coated wedge	Metal Seated (all stainless steel)
Gate / Wedge Shoes	Engineering plastic material such as polyamide or equivalent with low friction coefficient and high wear-resistance	Aluminium Bronze to BS EN 1982 Grade CC331G / CC333G	Engineering plastic material such as polyamide or equivalent with low friction coefficient and high wear-resistance	Not applicable
Channel Guides / Body Guides	Same as body material	Aluminium Bronze to BS EN 1982 Grade CC331G / CC333G	Same as body material	Not applicable
Stem nut	Aluminium Bronze to BS EN 1982 Grade CC333G		Stainless Steel 1.4401 to BS EN 10088-1 or Aluminium Bronze to BS EN 1982 CC333G	
Bolt	Stainless Steel to BS EN 3506-1 Grade A2			

Note 1 : The materials shall comply with BS EN 681-1 Type WA and the requirements stated in BS 6920 Parts 1 and 2 for use in potable water.

Gate valves of nominal size 300 mm and larger shall be provided with supporting feet.

Means of operation of gate valves shall be either manual or motorized as specified in the Particular Specification.

For manually operated gate valve, it shall be supplied with a hand wheel or stem cap for T-key operation as specified in the Particular Specification marked with arrow indicating closure of valve in a clockwise direction. The stem cap shall be replaceable and secured to the valve stem or gearbox spindle by a stainless steel socket head bolt. Except for valve operated by hand wheel mounted directly on valve stem or by valve key, valve position indicator shall be provided and fitted in such a position that it can be clearly viewed by the operator.

For electrically operated gate valves, the electric actuator fitted onto the valves shall comply with Water Supplies Department Standard Specification E-51-02 - Electric Actuator for Valve and Penstock. A hand wheel shall be provided for manual operation of the valve in case of power failure and shall close the valve when turned in the clockwise direction. For safety reason, the hand wheel operation shall be independent of the motor drive and gear, i.e. the motor operation shall not cause the hand wheel to rotate or vice versa.

Excessive Torque Protection Device

Stem caps shall be designed to be the first component of the valve to break under both of the following operation conditions: -

- (a) a gradually increasing closing torque is applied to the top end of the stem cap when the valve is in a fully open position; and
- (b) a gradually increasing opening torque is applied to the top end of the stem cap when the valve is in a fully closed position.

An easily replaceable shear device, as an alternative, to protect the stem or other valve components from damage due to excessive torque applied may be submitted to the Engineer for consideration. The device shall be replaceable with the valve under pressure.

Tests shall be conducted to verify compliance of the requirements by adopting the procedures described in the Annex A of BS EN 1074-2. When so tested, the valve stem cap or shear device shall fail between 0.8 and 1.0 of the nominal minimum strength torque (mST) of the size of valve concerned.

For stem caps or shear devices fitted to gearboxes on valves, their strength rating shall be reduced by the ratio of the respective gearbox to ensure that the torque applied to the stem through the gearbox shall not exceed the mST of the respective size of the valves.

Notwithstanding the above requirement, all parts of the valve excluding the stem cap or the shear device shall comply with the mST requirements as specified in Table B.1, Annex B of BS EN 1074-2:2000. The valve shall be tested in bare stem state without gearbox or stem cap fitted.

Test requirements for each stem cap in its delivery state shall conform to Clause 4.3 of BS 5163-2:2004 and test certificates shall be submitted to the Engineer for acceptance.

Report of appropriate testing issued by an approved independent laboratory to demonstrate the compliance with the above requirements shall be submitted to the Engineer for acceptance.

For key operated gate valves supplied with an extension spindle, the stem cap shall be fastened at the upper end of the spindle by a stainless steel socket head bolt for easy replacement when required.

3. BUTTERFLY VALVES

Butterfly valves shall be constructed in accordance with BS EN 593. The valves shall also comply with BS EN 1074-1 and BS EN 1074-2.

Butterfly valves shall be of double flanged type with flange ends faced and drilled to BS EN 1092-2. The face-to-face dimensions of the butterfly valves shall comply with BS EN 558 Table 4, Basic Series 13 for pressure rating of PN 25 and below, and Basic Series 14 for PN 40 unless otherwise specified in the Particular Specification.

Butterfly valves shall be designed for continuous operation of flow in either direction at any intermediate disk angles between fully opened and fully closed positions. The disk and seat shall be designed and profiled in such a way that it can reduce operating torque, provide bi-directional tight shut-off and ensure long service life. The disk shaft sealing shall be of replaceable ‘O’ rings and cup-seal design. The shaft seals and bearings shall be free from external lubrication.

Supporting feet shall be provided for butterfly valves of nominal size 600 mm and above.

Butterfly valves shall be constructed of the following or other equivalent or superior materials according to its application as specified in the Particular Specification:

Item	Materials of Construction		
	<u>Fresh Water & Raw Water Applications</u>		<u>Sea Water Application</u>
Body	Spheroidal Graphite Cast Iron to BS EN 1563. All wetted area shall be lined with rubber liner made from EPDM, NBR or equivalent material complied with BS EN 681-1 Type WA and satisfied with the requirements stated in BS 6920 Parts 1 and 2 for use in potable water quality. The full rubber lining should be vulcanized and bonded to the valve body.	Spheroidal Graphite Cast Iron to BS EN 1563	Spheroidal Graphite Cast Iron to BS EN 1563. All wetted area shall be lined with rubber liner made from EPDM, NBR or with equivalent abrasion and resistance to chlorinated sea water. The full rubber lining should be vulcanized and bonded to the valve body.
Disk	Spheroidal Graphite Cast Iron to BS EN 1563		Stainless Steel 1.4401 to BS EN 10088-1 or Copper alloy to BS EN 1982 Grade CC333G
Shaft	Stainless Steel 1.4057 to BS EN 10088-1		Stainless Steel 1.4401 to BS EN 10088-1
Rings bolted onto body or disk for seating or clamping purposes (If applicable)	Stainless Steel 1.4401 to BS EN 10088-1	Stainless Steel 1.4401 to BS EN 10088-1	Stainless Steel 1.4401 to BS EN 10088-1

Item	Materials of Construction	
	<u>Fresh Water & Raw Water Applications</u>	<u>Sea Water Application</u>
Resilient Seal (Not applicable to metal to metal seat)	Seal complied with BS EN 681-1 Type WA and satisfied with the requirements stated in BS 6920 Parts 1 and 2 for use in potable water quality.	Seal such as PTFE, EPDM or NBR Liner or other type of material with equivalent abrasion and resistance to chlorinated sea water.
Internal Fastenings (if applicable)	Corrosion-resistant and compatible materials i.e. Stainless Steel 1.4401 to BS EN 10088-1 or better.	

For valves of nominal size larger than 250mm, they shall be suitable for use with the disk shaft in horizontal position and provided with a handwheel for manual operation. The handwheel shall close the valve when turned in the clockwise direction and shall be marked clearly with the words “OPEN” and “CLOSE”, with arrows to indicate the direction of operation. Valve position indicator shall be provided and fitted in such a position that it can be legibly viewed by the person operating the valve.

For electrically operated butterfly valves, the electric actuator fitted onto the valves shall comply with the Water Supplies Department Standard Specification E-51-02 - Electric Actuator for Valve and Penstock. A handwheel shall be provided for manual operation of the valve in case of power failure. For safety, the handwheel operation shall be independent of the motor drive and gear, i.e. the motor operation shall not cause the handwheel to rotate or vice versa.

4. REFLUX VALVES

Unless otherwise specified in the Particular Specification, reflux valves shall be of wafer type or double flanged type suitable for mounting in between flanges of raised face and drilling to BS EN 1092:1 and BS EN 1092:2. The reflux valves shall be designed to effectively resist slam and water hammer.

The following designs of reflux valves are acceptable :

- (i) spring operated double flap type supported by a vertical hinge;
- (ii) spring operated nozzle type with annulus shaped waterways; and
- (iii) single or multi disk recoil type reflux valve.

Reflux valve with counter weights or springs fitted externally to the valve will not be accepted unless otherwise specified in the Particular Specification.

Suppliers shall provide a “head loss” curve and a dynamic characteristic curve for the same size of the valve to be offered. Reflux valves shall be selected in accordance with

the required dynamic response characteristic and other requirements as specified in the Particular Specification.

The reflux valve shall be constructed of the following or suitable superior materials:

Item	Materials of Construction	
	<u>Fresh Water & Raw Water Applications</u>	<u>Sea Water Application</u>
Double Flap Type		
Body	Spheroidal Graphite Cast Iron to BS EN 1563	Stainless Steel 1.4401 to BS EN 10088-1 or Copper alloy to BS EN 1982, designation CC333G.
Flap	Spheroidal Graphite Cast Iron to BS EN 1563	Stainless Steel 1.4401 to BS EN 10088-1 or Copper alloy to BS EN 1982, designation CC333G.
Seal	Seal complied with BS EN 681-1 Type WA and satisfied with the requirements stated in BS 6920 Parts 1 and 2 for use in potable water quality.	Seal, such as PTFE, RTFE, EPDM, etc. or with equivalent abrasion and resistance to chlorinated sea water.
Stop Pin, Hinge Pin, Spring and Pin Retainers	Stainless Steel 1.4401 to BS EN 10088-1	
Nozzle Type		
Body	Spheroidal Graphite Cast Iron to BS EN 1563	Spheroidal Graphite Cast Iron to BS EN 1563. All wetted area shall be lined with material such as natural rubber, EPDM, NBR or with equivalent abrasion and resistance to chlorinated sea water.
Seat Ring and Disk Ring	Stainless Steel 1.4401 to BS EN 10088-1	
Flow Diffusers (inner and outer)	Stainless Steel 1.4401 to BS EN 10088-1	
Guides	Stainless Steel 1.4401 to BS EN 10088-1	
Recoil Type		
Body and Door	Spheroidal Graphite Cast Iron to BS EN 1563	Spheroidal Graphite Cast Iron to BS EN 1563. All wetted area shall be lined with material such as natural rubber, EPDM, NBR or with equivalent abrasion and resistance to chlorinated sea water.
Seats and Faces	Stainless Steel 1.4401 to BS EN 10088-1	
Disk Hinge Pin	Stainless Steel 1.4401 to BS EN 10088-1	

5. VALVE TESTS

Valves shall be tested in accordance with BS EN 1074-1, BS EN 1074-2 for gate and butterfly valves, BS EN 1074-3 for reflux valves, and BS EN 12266-1&2 as appropriate for a duration of not less than 10 minutes.

The valve body shall be leak-tight with no visually detectable leakage for the duration of the test under an internal water pressure equal to 1.5 times the PN rating. The valve seat in the fully closed position shall be leak-tight with no visually detectable leakage for the duration of the test under a differential water pressure equal to 1.1 times the PN rating. All valve seats shall be tested in both directions except reflux valves for which the test pressure shall only be applied to the obturator in the flow direction of the valve.

For butterfly valves with metal to metal seals, a low leakage rate of not more than the figures given in the following table is acceptable in the valve seat tests :-

Maximum permissible seat test leakage rate for metal to metal seals of butterfly valves	
DN 1200 and below	above DN 1200
0.1 mm ³ /s x DN	As specified in the Particular Specification

The valve manufacturers may be requested to submit certificates of origin and test for the materials used in the construction of the valves and their component parts.

6. VALVE MARKING

Valve bodies shall be marked or on a plate of durable material securely fixed to the body of the valve with screws or bolts with the following information:

- (a) Name of manufacturer
- (b) Nominal pressure (PN)
- (c) Nominal size (DN)
- (d) Sealing material, e.g. RES for resilient seated valves
- (e) Direction of flow for reflux valves
- (f) The allowable differential pressure (Δp)
- (g) The weight of the valve in kg.

7. INFORMATION TO BE PROVIDED IN THE PARTICULAR SPECIFICATION

The following information, if required, shall be provided in the Particular Specification in addition to this Standard Specification.

Section of this Standard Specification	Requirement to be specified in the Particular Specification
Section 1 General	<ul style="list-style-type: none"> ● The need to provide a headstock with an extension spindle for operation of the gate valve or butterfly valve. ● Coating tests witnessed by IIB.
Section 2 Gate Valve	<ul style="list-style-type: none"> ● Operation of the valve (i.e. manual or motorized) ● Valve seat arrangement (i.e. resilient or metal seated) ● Pressure rating of the valve ● Maximum unbalance pressure across the valve ● Valve stroke time if motorized valve is required ● Alternative flange drillings ● For manually operated valve, to specify whether hand wheel or stem cap for operation by T-key shall be provided ● Provision of valve position indicator, if required, for hand wheel operated valve with hand wheel directly mounted on valve stem
Section 3 Butterfly Valve	<ul style="list-style-type: none"> ● Operation of the valve (manual or motorized) ● Pressure rating of the valve ● Maximum unbalance pressure across the valve ● Valve stroke time if motorized valve is required ● Alternative flange details
Section 4 Reflux Valve	<ul style="list-style-type: none"> ● Pressure rating of the valve ● Mounting method of the valves. (e.g. wafer type or flanged type) ● Acceptance of valve fitted externally with counter weights, damper or springs. ● Dynamic response of the valve, if required, in terms of system deceleration dv/dt (m/s^2) and maximum allowable reverse flow velocity V_R (m/s).
Section 5 Valve Tests	<ul style="list-style-type: none"> ● Maximum permissible seat test leakage rate for metal seated butterfly valves of size above DN 1200.