

**OMAN WASTEWATER
SERVICES COMPANY S.A.O.C**




**الشركة العمانية
لخدمات الصرف الصحي ش.م.ع.م**

SECTION 04

VALVES, PENSTOCKS AND ACTUATORS

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4 Valves, Penstocks and Actuators

4.1 General

All valves shall be suitable for the service conditions under which they are required to operate. The design, construction and choice of materials shall take into account all operational deviations including pressure surge and thermal shock.

All valves shall have platform for operation and maintenance. Necessary handling facility shall be available for each valve.

Gate valves should be such that the bore of the fully open valve is unobstructed by any part of the gate. Where the blade of a butterfly valve requires significant thickening to provide adequate stiffness a through-flow (low loss) design is preferred.

Penstocks should be preferable designed as rectangular cross section with a 3-side NBR round cord sealing. Operation has to be done by electrical actuators and emergency manual actuation with a hand wheel.

Diaphragm valves shall be used for services carrying chemicals or aggressive fluids.

Valves for lubricating oil services shall be flanged, having steel bodies with stainless trim.


Any valve which is designed for uni-directional flow shall have an arrow embossed or cast on the valve body clearly indicating the required flow direction.

All valves, unless otherwise approved or specified, shall be of the external rising spindle type. Where desirable to protect the spindle against ingress of dirt, or where the position of the valve may create a hazard to operators when the spindle is extended, suitable spindle covers shall be provided. The spindles and operating gear of all valves for use outdoors shall have weather and dust proof protection.

Any gear or bevel wheels used to transmit motion shall be of cast steel or approved quality cast iron with machine cut teeth. No thrust from the valve shall be transmitted to the extension spindles and valve pedestals shall not be mounted directly on floor plating. Any floor steel work trimmers for supporting pedestals shall be provided by the Contractor.

Special attention shall be given to the operating mechanism and correct lubrication of all valves to ensure a minimum of maintenance and ease of operation.

All valves shall be positioned so as to be readily accessible for operation and maintenance from permanent floors, galleries or access platforms.

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As far as practicable any maintenance or replacement of wearing parts shall be possible with the valves in situation, but for valves with connecting branches of less than 50 mm nominal bore full access to moving components only will be accepted.

Eyebolts or similar facilities shall be provided, where necessary, to facilitate the handling of heavy valves or components.

No valve shall be installed with its operating spindle gland below the horizontal centre line so as to avoid dirt entering the gland and to ensure complete drainage.

When valves are required to be locked in position for operation they shall be provided with an approved locking system on the spindle (no chain) and with a master key system.

The internal diameter of all valves at the ends adjacent to the pipes shall be the same as the internal diameter of the pipe to which they are joined.


All valves shall be provided with labels or nameplates. These labels shall include in the inscription a valve "name", or abbreviated description of the valve duty, and a unique plant reference number for the valve.

Within 2 months of award of Contract, a valve numbering scheme to cover the complete Contract Works shall be agreed. After approval of the numbering scheme, the Contractor shall draw up a valve schedule to cover the Contract Works. The scheduled details of each valve shall include the valve number, its title as it appears on the valve label, the nominal size of the valve, its design pressure and temperature, the Manufacturer's name and model number and a brief description of the valve materials. The valve schedule shall be subject to the Engineer's approval. The finalized valve schedule shall be included in the operating and maintenance manuals, provided under the Contract.

4.1.1 Hand operation requirements

Where required, valve spindles shall be lengthened so that the hand wheel shall be at a height approximately one meter above the level of the floor or platform from which the valve is to be operated and where necessary they shall be provided with headstocks and pedestals of rigid construction. All thrusts when opening or closing the valve shall be taken directly on the valve body. Pedestal hand wheels or valve tables shall be provided at a convenient operating floor or intermediate floor level. Such pedestals and valve tables shall be mounted direct on floors or steel members and not on floor grills or plating.

All valve hand operating mechanisms shall be easily operable by one man. The mechanisms shall be such that the total force at the rim of the hand wheel or other point of application of manual action shall not need to

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exceed 400N (normally 200N pull plus 200N push) to exercise any valve. Special attention shall be given to the operating mechanism for large size valves with a view to ensuring that a minimum of maintenance is required and to obtaining quick and easy operation.

All gate, globe and screw down non-return valves shall be of the non-rising hand wheel pattern unless specifically approved by the Engineer.

All valves shall be closed by rotating the hand wheels in a clockwise direction when looking at the face of the hand wheel. In cases where the hand wheel is not directly attached to the valve spindle suitable gearing shall be introduced to ensure clockwise closing. The face of each hand wheel shall be clearly marked "open" and "shut" or "closed" with arrows indicating the direction of rotation to which they refer.

Plastic valve hand wheels will not be accepted. All valve spindles shall be fitted with indicators so that the valve opening can be readily determined. In the case of valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.

4.2 Wedge Gate Valves

All valves of nominal sizes DN 50 to DN 600 shall comply with BS 5163 type B.

Valves of nominal size greater than DN 600 shall be constructed in accordance with BS5150, but are appropriate for wastewater purposes.

Waterworks valves of nominal size DN 50 to DN 300 shall be of resilient seal design. Waterworks valves of nominal size DN 350 and greater and any wastewater gate valves in locations where debris could damage resilient seals shall be copper alloy seated.


All valves of nominal size DN 350 and greater, which may be potentially used for charging up or emptying of mains, shall be fitted with an integral bypass valve.

Surfaces of all valve components shall be protected from corrosion either by the nature of their material of construction or shall be suitably coated depending on application.

All fasteners involved in the assembly of valves shall be protected from corrosion by the application of zinc and a polymeric barrier coating.

Valve stems shall be constructed from aluminium, bronze or stainless steel with chromium content of not less than 15%.

All valves shall be pressure tested by the manufacturer in accordance with Section 19 of BS 5163. For all valves greater than nominal size DN 300, the manufacturer shall provide a test certificate. Valves of nominal size

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greater than DN 600 shall be pressure tested in accordance with Section 19 of BS 5163 even though these are outside the scope of that standard.

4.3 Knife Gate Valves

Knife gate valves should be used in all circumstances where sludge or solids in the medium are likely to affect the operation of other types of valves over time.

Knife valves shall be capable of being mounted between flanges to BS4504 in the form of one of the types listed in BS 5155. If lugged, the width of material round the holes shall be at least equal to the whole radius.

The gate shall be of stainless steel, and shall open to allow unrestricted passage of the medium. The geometry of the seal face area shall discourage residence of solids. The valve shall be bi-directional in operation.

4.4 Eccentric Plug Valves

Plug valves shall be in accordance with British Standard BS 5158.


The interior design shall be streamlined to give high capacity straight through flow in the full open position, reducing turbulence, pressure drop and the affect of erosive media.

The supplier shall specify at tender stage any installation/orientation requirements. The plug shall be firmly supported to provide a tight shut off. The plug coating shall be suitable for the fluid, be abrasion resistant and shall form a perfect seal with both 'on' and 'off' seating pressures. The eccentric support of the plug shall allow the plug to rotate away from the seal for instant opening and shall reduce seat wear and operating torque.

Seats shall be chosen for corrosion and erosion resistance to the medium. Seats shall be either welded or screwed to the valve body by corrosion resistant screws. The seats shall be specifically profiled for low torque opening and extended seat life. The seals shall give trouble free service at all operating pressures and shall be easily replaceable.

Bearings shall be permanently lubricated sleeve type to prevent entry of abrasive materials, and shall be easily replaceable.

Valves shall be supported such that they do not move when operated under the most onerous of conditions, including potential seizure in the closed position.

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4.5 Butterfly Valves

Butterfly valves shall be in accordance with BS EN 593 and shall have or be capable of being mounted between flanges to BS 4504. If lugged, the width of material round the holes shall be at least equal to the whole radius.

Valves shall be tight shut off, unless specified for regulating applications.

As a minimum specification the body shall be cast iron, unless the valve is subject to pressure surges, when ductile iron shall be used.

The discs shall have a convex streamlined shape designed to achieve low head loss characteristic.

Butterfly valves shall not be permitted in applications where solids or rags are possible in the pipeline.

Metallic valve seals shall be of the replaceable type and shall be secured to the valve body by corrosion resistant screws. Resilient seals shall be of high quality nitrile rubber or other acceptable material to BS EN 681 that provides resilience, tensile strength and elongation and long flex life.

Double flanged butterfly valves shall have the seal secured to the valve disc edge by the means of a sectional retaining ring. The ring and seal shall form a resilient and durable seal.

For wafer butterfly valves the seal material shall be of an elastomer proven for the application, and shall be secured to inside of the valve body, extending over the flange surface mating with the pipe on each side. The method of attachment shall allow the seal to be replaceable.

Valve shafts shall be stainless steel. Discs shall be fixed to the shaft by stainless steel dead end screw connection or stainless steel taper pins.


Valve bushings shall be of PTFE or other suitable elastomer, designed to provide service for 10 years for the application, excepting regulating operation, when the life shall be 5 years. They shall be replaceable.

Butterfly valves intended for flow control or modulating operation shall be of the “high performance” type with metal to metal seating.

4.6 Ball Valves

Ball valves shall be permitted on pipeline diameters of 50mm or less e.g. air/gas dosing lines etc. Ball valves shall be in accordance with BS 5159 or equivalent and be fitted with limit stops.

Valve bodies shall be stainless steel. Cast iron bodies are permitted provided they are fitted with a stainless steel liner or are rubber lined. The ball and stem shall be stainless steel and seats shall be PTFE. The valve

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stem shall be designed such that thrust is taken by the shaft and not via the ball and seats.

Non-metallic ball valves of UPVC or ABS are permitted in association with pipework of the same material.

Both metallic and non-metallic valves shall be full diameter, three-piece pattern to facilitate replacement of the ball, seat, backing ring etc. without dismantling of the pipe work.

4.7 Diaphragm Valves

Diaphragm valves shall comply with BS 5156 or equivalent and be of the straight through wireless type on all slurry and sampling lines. The diaphragm shall be a reinforced, flexible moulding directly fixed to the valve spindle compressor. Provision shall be made for the replacement of the diaphragm which shall be carried out without the need to remove the valve from the line.

4.8 Air Valves

The air valves shall be either of the "dual" large orifice type having a float operated large discharge orifice and a lever operated small discharge orifice, or of the small orifice type having a float operated small discharge orifice.


The air valve float chamber and float chamber cover shall be of cast iron and all other parts shall be non-corrodible materials. All orifices shall be located well clear of the liquid level in the float chambers. The valves shall have flanged bases.

The air valves shall be provided with separate isolating valves and drain plugs. Air valves with a 'built-in' isolation facility are not permitted. Air release valves used for sewage pumping applications shall be piped to an adjacent wet well or sewer.

4.9 Pressure reducing valves

Reducing valves shall be of approved type and shall be perfectly stable, quiet and vibration less in operation when pressure-reducing at any throughput up to the maximum flow and shall be suitable for continuous use at the operating conditions.

Where electrical or hydraulic valve operation is included the operating mechanism shall be remote controlled. On failure of the operating mechanism the valve shall neither close nor open automatically but shall be readily adjustable by hand.

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A pressure relief valve shall be provided on the outlet side of each reducing valve, capable of exhausting to atmosphere the maximum discharge of the reducing valve without undue build-up of pressure on the LP side. The discharge from the relief valve shall be led to safe approved target. Pressure gauges and thermometers shall be provided upstream and downstream of the reducing valve.

4.10 Non return valves

All non-return valves shall be provided with means of draining and depressuring the space between the valve and its adjacent isolating valve. The design shall preclude the possibility of the valve jamming in the open position; the effect of solid particles settling-out in dead spaces within the valve should be recognized in this respect.

Unless stated to the contrary, non-return valves should be rapid-closing. Power-assisted closing is acceptable where necessary for rapid shut-off. For large non-return valves on air and water services, consideration shall be given to the consequences of valve slam and the possible requirements for a hydraulic snubber to minimize slam effects.

4.10.1 Ball Check Valves

Ball check valves shall be suitable for high debris or thick sludge applications where required.

The valve shall be a reliable low maintenance method of preventing reverse flow and shall be suitable for mounting in horizontal and vertical pipelines.

The valve type shall be specifically designed to reduce shock, keeping the hydraulic head loss through the valve to a minimum.

The ball check valve shall be robust and suitable for arduous duties. The interior design shall ensure that high flow capacity with minimum pressure drop is available.


The valve shall have a removable top cover to facilitate the inspection of the ball and removal of debris.

4.10.2 Swing Check Valves

Swing check valves shall be in accordance with BS EN 12334.

An external weighted lever shall be fitted where necessary to assist fast closing, particularly on sewage and sludge applications where any part of the external lever system presents a hazard, it shall be suitably guarded.

Where the orientation of the valve is not horizontal, manufacturer's advice on permissible angle and the application of weighting shall be obtained.

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For pump discharge duties, the non-return valves shall be slam resistant recoil type.

The valve shall have a removable top cover to facilitate the inspection of bearings and movement of the valve door unless stated otherwise. The cover shall be tapped ½” BSP.

The end bearings and glands shall ensure that the valve operates efficiently whilst requiring minimum maintenance. Bearings shall be of the self lubricating type and be designed to ensure good performance at maximum hydraulic load. The bearings shall be constructed of corrosion free material.

4.10.3 Flap valves

Flaps should be plastic, stainless steel or cast iron. Mating surfaces of flaps and frames shall be of a non-ferrous metal (excluding aluminium) machined to ensure a watertight fit in the closed position or shall be an elastomer adequately supported to ensure positive sealing. The flap is to be designed for the highest differential pressure anticipated including for surge.

Hinge pins shall be stainless steel in bronze bushes. All flaps shall be double link hung. Hinge pins and mating surfaces shall be smeared with DWI approved lubricant grease.


4.11 Penstocks

Penstocks shall comply with BS 7775.

Channel penstocks in their open position shall present no restriction to channel width unless approved.

The open dimensions of wall penstocks shall not be smaller than the wall apertures, thus giving full opening in the fully open position. Where the aperture is taken to a base, the penstock shall be flush to the invert incorporating a proven embedded elastomer.

Unless otherwise specified, wall penstocks shall mount on the side of the wall allowing the best opportunity for maintenance access with minimum process disruption. Where there is no significant difference in access either side, penstocks should be mounted for ‘face on’ seating, such that the best sealing is achieved in the desired circumstances.

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Penstock leakage rates will comply with AWWA C501, as detailed below:

Litres / minute/ metre of perimeter

On seat	1.25
Off seat to 6m water head	2.5
Off seat to 9m water head	3.0
Off seat to 12m water head	3.75
Off seat to 15m water head	4.5

Penstock designs and materials offered shall be proven. Machinery components of manual penstocks shall be capable of at least 10 years service without attention under the specified duty. The rest of the penstock shall be capable of 30 years service unless agreed otherwise. All wearable components shall be removable in situ.

Penstocks shall have rising stems unless otherwise specified. They shall have graduated transparent protection tubes to indicate percent opening. Where non-rising stems are required, mechanical visual indication of position shall be provided.

Weir penstocks shall be constructed such that no part of the spindle which passes through the nut shall be in the water flow for potable water service. For other services, the spindle will be entirely clear of the flow path.

Penstock frames shall not be distorted during installation. The Contractor is entirely responsible for the successful performance of installed penstocks in terms of leakage rates, smooth operation (particularly for actuated ones), and for the final condition, particularly with regard to surface protection. In view of the critical nature of installation programmes, failure to rectify a problem immediately may result in the Contractor being required to replace a penstock regardless of the suspected fault.

Penstock headgear, hand or electrical, shall be located to allow ease of operation and maintenance. Adequate access shall be provided. Hand wheels shall be no lower than 1m above operating floors. Tees shall be located just beneath operating floor level beneath a screwed access cover and a key with support hook for which storage is to be provided.

All penstocks shall move downwards on clockwise turning.

Extension spindles shall be galvanised or coated mild steel as a minimum specification. They shall be connected by muff couplings, each employing four fitted bolts. Care is to be taken that galvanic action is avoided, preferably by choice of materials.

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Extension shafts are to be stayed every 2 metres.

It is essential that headgear and penstocks are accurately aligned. Before connection of a shaft to an actuator, alignment shall be satisfactorily demonstrated.

Where there are high off seat loads, wall thimbles or spigots shall be used.

Frames may be constructed from cast iron or stainless steel. Doors may be constructed from cast iron, stainless steel, or stainless steel reinforced plastic. Grade 304 stainless steel is the minimum standard acceptable.

For low differential heads, gate seals may be elastomer type. The supplier is to demonstrate proven service.

The stem is to be stainless steel Grade 304 minimum. Fasteners are to be stainless steel.

Wedges for steel gates, actuated gates and larger gates shall be faced with non-ferrous metal.


The following data is required to be submitted with the tender:

Materials:

- Frame
- Door
- Stem
- Nut
- Seals
- Invert seal
- Adjusters
- Fixings

Functions:

- Channel/wall/weir
- On/off seat
- Rising /non-rising
- Universal joints
- Closing direction
- Actuation
- Thimble/spigot

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4.12 Power operated valves (general requirements)

Valves, dampers and similar devices requiring abnormal physical effort to operate or high speed operation, shall be provided with powered actuation. Hand operating equipment shall also be fitted for closing and opening, which is effectively decoupled during power operation.

The following criteria are preferred in the selection of the power source for the servo mechanism: -

- Isolation and other duties not subject to operation more than once in 10 minutes - electrical, compressed air.
- Continuous or intermittent modulation - compressed air, or hydraulic fluid. Modulating electrical actuators shall be to the Engineer's approval.
- Continuous or intermittent modulation involving heavy control forces hydraulic fluid.
- Emergency control or isolating duties - spring loaded backed up by compressed air or hydraulic fluid.

Electric actuators for on/off duties shall be fitted with travel limiting devices capable of accurate and positive adjustment. Torque limiting or other devices shall be provided to prevent damage to the mechanism in the event of jamming of the driven device.


All powered valve or damper mechanisms shall be provided with accurate indication of the position of the driven device.

Electrically operated devices may be provided with integral or separate switch/ control equipment in accordance with the requirements of the control and instrumentation specification. Provision shall be made for the inclusion of interposing relays and volt free contacts to suit modern control systems, including digital control systems.

Power supply shall be in conjunction to the particular requirements of the control and instrumentation specification.

Direct solenoid operation of valves shall comply with the control and instrumentation section of the specification.

Reversing contactors and limit switches, used to control electric power driven mechanisms, shall be robust and of proven reliability by both type test and commercial operation. Solid state switching may be accepted when temperature conditions permit.

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Appendix A

Valve Selection Matrix

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		Knife Gate Valve	Wedgagate Valve	Reflux Valves	Butterfly Valves	Air relief valves	Pressure & Flow Control Valves	Ball Float Valves	Ball plug diaphragm pinch and globe valves
Valves body (See Note 1)		Cast Iron grade 200 316L Stainless Steel	Cast Iron grade 220 Cast Steel grade 621	Cast Iron grade 220	Cast Iron grade 220 Spheroidal Graphite Cast iron 425/12	Cast Iron grade 220	Cast Iron grade 220	Cast Iron grade 220	See Note 1
Valve bonnet/cover		Cast Iron grade 220		Cast Iron grade 220		Cast Iron grade 220	Cast Iron grade 220	Cast Iron grade 220	
Body sealing face		Rubber/plastic	Gunmetal LG2	Gunmetal LG2	Gunmetal LG2	Nitrile rubber/plastic	Nitrile rubber/plastic/leather	Gunmetal LG2/nitrile rubber	
Gate/disc		316L Stainless Steel	Cast Iron grade 220	Cast Iron grade 220	Cast Iron grade 220 Spheroidal Graphite Cast iron 425/12		Cast Iron grade 220 Gunmetal LG2	Cast Iron grade 220 Gunmetal LG2	
Gate/disc sealing face			Gunmetal LG2	Gunmetal LG2	Nitrile rubber		Gunmetal LG2	Nitrile rubber/plastic	
Disc seal retaining ring									
Gate/disc securing pins		316L Stainless Steel	316L Stainless Steel	316L Stainless Steel	316L Stainless Steel				
Hinge pins/shafts/spindles		316L Stainless Steel	See Note 1	316L Stainless Steel	316L Stainless Steel	316L Stainless Steel		See Note 1	
Hinge pin/shaft spindle bearings		Phosphor Bronze PB102	See Note 1	Phosphor Bronze PB102	PTFE/Phosphor Bronze PB102	PTFE/Phosphor Bronze		See Note 1	
Hinge pin/shaft gatebody leak seals		Nitrile rubber/plastic	Nitrile rubber/plastic	Nitrile rubber/plastic	Nitrile rubber/plastic			See Note 1	
Pistons/cylinders						Gunmetal LG2	Gunmetal LG2 Phosfor Bronze PB102	Gunmetal LG2	
Diaphragms							Nitrile Rubber/Plastic		
Float						316L stainless Steel / Plastic		Tinner Copper C101 / Plastic / 316L Stainless Steel	
Internal fittings and misc. trim		316L Stainless Steel or plastic	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	
Notes	1	Manufactured Standard Material is acceptable.							
	2	Manufactured from suitable corrosion resistant materials.							
	3	Cast iron Grade220 is only to be used for valves installed inside buildings with no risk of freezing. Where installations are subject to freezing conditions, valve bodies and bonnets/covers shall be manufactured in ductile iron (spheroidal graphite cast iron 25/12) only							
General		The contractor and/or manufacturer shall be responsible for ensuring that all materials used in the construction of valves are suitable for the duty and application for which they are intended							

	Knife Gate Valve	Wedgegate Valve	Butterfly Valves Standard Pattern	Butterfly Valves High Performance Pattern	Ball valves	Diaphragm Valve. Wier pattern	Diaphragm Valve. Straight through pattern	Eccentric Plug Valve
Potable water, final effluent, service water		X	X		X	X		
Raw sewage	X							X
Flow control (air, water)				X				X
Abrasive liquids and slurries.	X						X	X
Chemicals					X	X		
Compressed air (< 1 Barg)			X					
Compressed air (> 1 Barg)		X						

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