Eskom	Standard	Asset Management

Title: **Standard for Procurement of Large Bore Metal Seated Butterfly Valves for use as Cooling Water Isolation Valves**

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1. INTRODUCTION

This specification serves as the *Employer* standard for requirements and quality control measures for the procurement of triple off-set metal seated butterfly valves, used in cooling water systems in the *Employer's* fleet. The document specifies the minimum requirements and criteria that these valves are to comply with during design, manufacturing, installation and maintenance.

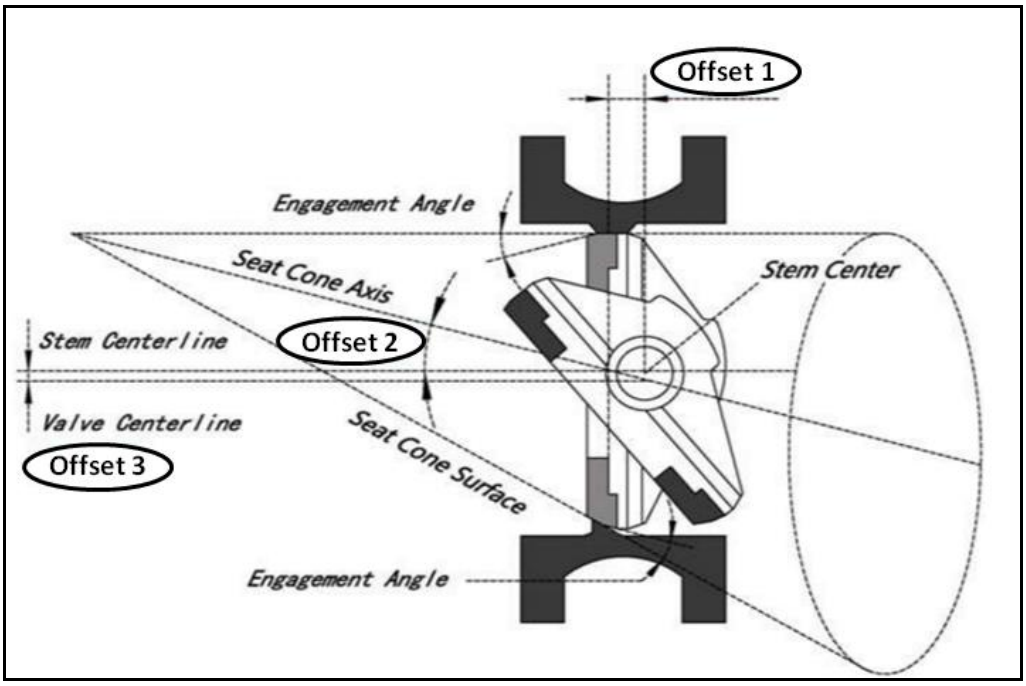

Figure 1: Typical illustration of Triple Off-set Metal seated valve

2. SUPPORTING CLAUSES

2.1 SCOPE

This specification covers the minimum requirements for the design, manufacture, inspection, testing, supply and refurbishment of triple off-set metal seated butterfly valves to be used as cooling water isolation valves at the *Employer's* power stations. Metal seated valves should only be used in applications where sediment will not collect that might have a damaging effect on the sealing arrangements. Typical applications are on Condenser cooling water inlet and outlet ducts, specifically in vertical pipelines. Resilient seated valves are recommended for main CW ducts and where abrasive sediment could be present.

This specification covers new installations, replacements and refurbishment applications applicable to triple off-set metal seated designs.

This document provides guidance to the System Engineer to assist in compiling a detailed scope of work specific to the respective site and compliance to these minimum requirements.

This standard will form the basis for fair and accurate tender evaluations by the technical tender evaluation team.

This standard will also provide information and guidance to a maintenance team/refurbishment *Contractor* during valve refurbishment.

2.1.1 Purpose

This specification clarifies the *Employer's* requirements for large bore metal seated valves to ensure consistent quality and technical design.

2.1.2 Applicability

This document is applicable to the *Employer's* generation fleet, for the specification and procurement of triple off-set large bore metal seated butterfly valves as installed in cooling water systems.

2.2 NORMATIVE/INFORMATIVE REFERENCES

2.2.1 Normative

[1]	ISO 9001	Quality Management Systems.
[2]	EN 10204	Metallic Products - Type Of Inspection Documents
[3]	EN 1092-1/2	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 1; Steel Flanges
[4]	OHSACT	Occupational Health and Safety Act of 1993
[5]	PER	Pressure Equipment Regulation 2009
[6]	240-101712128	Standard for Internal Corrosion Protection of Water Systems, Chemical Tanks
[7]	240-55864767	Chemistry and Microbiology Standard for Condenser Cooling Water
[8]	240-83539994	Standard for Non-Destructive Testing (NDT) on Eskom Plant
[9]	240-14558157	Standard for the Identification of the Contents of Pipelines.
[10]	240-48929482	Tender Technical Evaluation Procedure

2.2.2 Informative

[11]	EN 593	Standard for design and manufacture of butterfly valves.
[12]	BS10	British standard for flanges referenced in various tables such "A", "D" etc.
[13]	EN1092-1	Flanges and their joints Circular flanges for pipes, valves fittings and accessories (PN designated * replaces BS 4504)
[14]	PED 97/23/EC	Pressure Equipment Directive
[15]	SANS 347	Standard Specification for the Categorization and Conformity Assessment Criteria for All Pressure Equipment
[16]	SANS/ISO 3834 - 2	Quality Requirements for Fusion Welding of Metallic Materials
[17]	MSS SP68	Standard Practise Developed and Approved by the Valve and Fitting Industry for High pressure butterfly valve with off-set design.
[18]	EN 1563	Material designation and material properties
[19]	EN 10028-1	Flat products made of steel for pressure purposes
[20]	EN 10213	Steel castings for pressure purposes
[21]	EN 10028	Non Alloy and Alloy steels flat products for pressure purposes
[22]	EN 12516	Industrial valves – shell design strength
[23]	EN 10088	Stainless steel grades

[24] ANSI B16.47 Large Diameter Steel Flanges NPS26 Thru NPS 60 metric/inch standard

[25] ASME B16.34 Valves, Flanged, Threaded and Welded ends

2.3 DEFINITIONS

Condenser T1	Condenser cooling water inlet side
Condenser T2	Condenser cooling water outlet side
Cooling water duct	Main cooling water pipework, also referred to as cooling water duct, that transports cooling water from the cooling water pumps to the condensers and back to the cooling towers
PER	Pressure Equipment Regulations as defined in the Occupational Health and Safety Act.
PED	Pressure Equipment Directive 97/23/EC

2.4 CLASSIFICATION

Public Domain: Published in any public forum without constraints (either enforced by law, or discretionary).

2.5 ABBREVIATIONS

Abbreviation	Description
AMME	Asset Management Mechanical Engineering
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
BS	British standard
BSPT	British Standard Pipe Thread
CAD	Computer Aided Drafting or Computer Aided Design
CW	Cooling Water
DE	Drive end
DN	Diameter nominal
EN	European Norm
EPDM	Ethylene Propylene Diene Monomer
FEA	Finite Element analysis
ISO	International Standards Organisation
ITP	Inspection and Test Plan
MPI	Magnetic Particle Inspection
MSDS	Material safety data sheet
NB	Nominal Bore
NCR	Non-Conformance Report
NDE	Non drive end
NDT	Non-Destructive Testing

Abbreviation	Description
OD	Outside Diameter
PCD	Pitch Circle Diameter
PN	Pressure nominal
PT	Dye Penetrant test
QCP	Quality Control Plan
RT	Radiographic testing
SG	Spheroidal Graphite
T1	Condenser cooling water inlet
T2	Condenser cooling water outlet
UT	Ultrasonic test
VJ	Viking Johnson
WPQR	Weld Procedure Qualification Record
WPS	Weld Procedure Specification

2.6 ROLES AND RESPONSIBILITIES

The System Engineer is to ensure that this specification is utilised for compiling an enquiry for all metal seated butterfly valves for use in CW systems.

The System Engineer and *Contractor* will have a clear understanding of the installation and operational requirements of these valves.

Although the face-to-face is quoted in the technical specification, it remains the *Contractor*'s responsibility to confirm the face-to-face dimensions and flange drilling on site in the case of replacement valves.

The system engineer must ensure that the relevant site flange specification for specific valve position is made available when the scope of work is compiled.

3. DESIGN REQUIREMENTS

3.1 VALVE BODY

3.1.1 General requirements

The valve body will be designed to the stipulated design pressure as per the scope of work or to the existing valve design pressure. In no circumstances will valve pressure rating be less than maximum close valve head delivered by Cooling water pumps times a safety factor of 1.5. The system engineer will specify the required design pressure in the enquiry document. The valve integral flanges will however be to the same flange drilling standard and code as the existing valve.

The body material selection will be as indicated in Section 4 (Materials of construction), and can be from either single piece casting or fabricated by means of assemblies.

Items that need to be integral part of valve body:

- Flanges
- Lifting lugs
- Support feet for valves installed in a horizontal pipeline.

- Spindle bearing hubs
- An ISO 5211 gearbox mounting platform, with same drilling as the free issue gearbox from the specific site – or new gearbox in event that *Contractor* is to supply valve with a new gearbox.

Where valves are required for current installations as a replacement, the face-to-face dimension must, where possible, be the same as that of the valve on site.

In the event that the new valve face-to-face dimension conforms to latest standards (e.g. ISO 5752), and the site valve face-to-face dimension cannot be met, the criteria per section 3.1.2 and 3.1.3 will apply.

3.1.2 Condenser isolation valves

The existing valve is usually fitted complete with a double flanged expansion compensator up-stream or down-stream of the valve. One of two scenarios can then occur, namely:

- **The valve face-to-face dimension is larger than the installed valve**. In this case the Contractor may deviate from the face-to-face dimension provided that the valve is supplied with a replacement double flanged expansion compensator. The combination will then be required to have the same dimensions as the combined expansion compensator and valve dimensions of the site installation.

- **The valve face-to-face dimension is smaller than the installed valve.** The *Contractor* can either supply a replacement expansion compensator to take up the difference in face-to-face dimension if dimensions differ by more than 50mm. If the variance in the old face-to-face dimension compared to the new face-to-face dimension is less than 50mm, a spool piece manufactured from plate (EN 10028–2 grade P235GH as a minimum) may be installed as a wafer pattern. In this case the spool piece will have the same flange drilling as that of the valve and site flanges. The internal diameter of this spool piece shall be coated with the same corrosion protection process as used for the wetted parts of the valve. The *Contractor* will also supply longer bolts and studs to accommodate this variance.

3.1.3 Main CW duct isolation valves

On main CW duct isolation valves such as interconnector valves or auto closing valves, one or both flanges are typically flexible couplings complete with a flange (VJ or Johnson couplings). For these valves the following two options are acceptable:

- The new valve face-to-face dimension is larger than that of the installed valve. In this case the *Contractor* may deviate from the face-to-face dimension but must make provision during installation to cut the main CW duct back and re-fit the flanged flexible coupling.
- The new valve face-to-face dimension is shorter than that of the installed valve. The *Contractor* has to supply a matching flange welded to a spool piece of the same dimensions as per the site duct. This can be fitted by using the flexible coupling. The internal surface of the flange and spool piece must be coated with the same corrosion protection process as used for the wetted parts of the valve.

3.2 FLANGES

For valves where the bodies are castings, the flanges will be cast integral with the valve body.

In the case of fabricated valves, the flanges must be welded to the body and thus form an integral part of the valve body.

Flange drilling will be to the same specification and standard as per the currently installed valve or pipe flanges.

All valve flanges will be of flat face design with serrated gramophone finish, regardless of body material.

Typical existing flange standards on site are BS10, BS4504, SABS 1123, or EN 1092-1. For new installations/pipelines the flanges will comply to the relevant pressure rating as determined by the plant designer but will comply to the respective EN 1092 standard suitable for the design pressure requirements.

Where bolt holes have to be blind holes due to the valve configuration, these are to be tapped to a minimum depth of 1.5 times the bolt diameter.

The *Contractor* must ensure that sufficient space is left between the valve body and flange to tighten the bolt nut. Spot facing to the back of the flange is allowed.

3.3 DISCS

The disc shall be of a continuous casting or manufactured by means of fabrication. All discs will have a smooth profile with no open cavities or exposed ribs or strengthening webs. Should the disc design incorporate webs or ribs to minimise weight, these will be covered with a cover plate suitable to withstand the line pressure * 1.5 safety factor without deformation. The plate will also be fitted in such a manner that the cavities below are sealed from the media. Where such cover plate is fitted the rib areas and areas below cover plate will also be coated as per coating requirements contained in section 10 of this document.

Should the media corrosiveness require materials other than EN 10028-7 X2CrNiMo17-12-2 (1.4404), the *Contractor* may suggest alternatives after studying the water chemistry data records that will be supplied from site history as part of the enquiry.

Discs will be manufactured from materials listed in Section 4 (Materials of construction). The leading edges of the disc from below the seal ring/seat shall be overlaid with stainless steel 316L and be machined back to the required tolerances. Should the media corrosiveness require materials other than 316L, the *Contractor* may suggest alternatives after studying the water chemistry data records that will be supplied from site history.

If the discs are manufactured from plate, no welded joints will be allowed on the actual disc diameter. The spindle boss will not be welded by a standard fillet weld. This spindle boss to disc weld will be done by machining a single V profile on both longitudinal sides of the boss and the weld will thus be done as a single V profile as a minimum. Designer will provide proof by calculation or FEA that this weld will withstand at least 1.5 times the valve rated unbalance pressure when applied on the valve disc.

The body will be designed to ensure that stresses under no circumstance of normal isolation or operation, will exceed the requirements of EN 12516. The *Contractor* will also supply a proof design test in accordance with EN 12516 for the body. For spindle and disc the designer will provide design calculations for mechanical integrity based on maximum shut of pressure of the valve to the *Employer* for review

The spindle to disc connection can be such that there are stub spindles or a full-length spindle.

The disc spindle boss, regardless of whether two short spindles or one full length spindle are used, will be such that the minimum length is not less than 1.25 times the spindle maximum diameter. For single shafts this is applicable to both disc-to-shaft connection points (DE and NDE). In the event of a stub shaft design, the bosses will be closed so that no media can penetrate to the spindle. The side where the shaft penetrates the disc shall be sealed as described in Section 3.4.

3.4 SPINDLES

Spindle material will be as per the Materials of Construction in Section 4.

In the event that the *Contractor* wants to offer an alternative, a full detailed engineering motivation is to be provided for acceptance or rejection.

In all designs, regardless of whether stub spindles or solid shafts are offered, the spindle to boss interface will be sealed by means of “O” rings or similar seals.

For bosses where the one side is blind (closed from the media), the shaft to boss connection needs to be sealed by “O” rings. If the boss is an open design, both entry and exit sides of the shaft must be sealed with “O” rings or similar seals.

As this is not possible when keyways are used for disc-to-shaft connections, the *Contractor* must advise how this interface will be sealed if a keyway connection is offered.

The indicator must be such that if removed the valve spindle to gearbox quarter segment connection integrity must not be affected.

For keyway orientation kindly refer to section 7.1 of this document.

3.5 DISC TO SPINDLE CONNECTION

3.5.1 General requirements relating to all pin designs

Pins will always be an interference fit.

During refurbishment, all pins will be replaced and will comply with the requirements of each pin design as detailed below.

The disc and spindle will be connected by means of at least two taper pins on the DE spindle half, and at least one pin on the NDE spindle half.

Pin entry and exits will be isolated from the media by means of threaded plugs (see Figure 2.)

Shafts will be assembled into the disc boss before the pilot hole is drilled for the pin.

There are 3 acceptable designs regarding disc-to-shaft connection by pins. Each design will be discussed in section 3.5.1.1 thru to 3.5.1.4

3.5.1.1 Blind taper pin design

For this design the disc and spindle are connected by means of at least two taper pins on the DE side shaft. The taper pin holes are blind taper holes. On the NDE spindle half and at least one pin is fitted. The pin ends will be isolated from the media by means of mechanical plugs.

After the pilot hole is drilled (the disc and shaft already assembled), the taper hole for the pin will be drilled through the one side of the shaft boss, all the way through the spindle and at least to 2/3 depth at the opposite side of the boss.

A taper reamer will then be used to machine a perfect taper from the pin entry side, through the side of the boss, through the spindle and to at least to 2/3 of the thickness of the opposite side of the boss. The taper will match the taper pin exactly.

Before the pin is fitted, the hole will be cleaned to ensure all burrs and longitudinal scratch marks are removed. The taper pin will be machined to the same taper angle as that of the reamer.

The boss at the pin’s small end will have a hole drilled through the boss (opposite side of boss from where the pin is inserted). This will then be threaded and plugged by a solid plug of maximum ½ inch BSPT to seal any cavity below the pin. During dismantling of the valve this pug can be removed to allow for the pins to be driven out (see Figure 2).

On the large diameter end, where the pin is inserted into the disc, the pin is prevented from coming undone by means of a full bore threaded cap that is screwed down onto the top of the pin. No clearance will exist between the pin and the end cap. This encapsulates the pin completely from the media, as the mechanical threaded cap isolates the pin from the entry point and locks the pin in place.

As final protection the cap and plug are filled with an epoxy coating, (same as for the valve wetted parts), thus completely isolating the pin and cap from the media. Under no circumstances will the pin be held in place by a single grub screw that is drilled and tapped on the periphery interface of the pin and the disc boss. All mechanical locking mechanisms will be the same OD as that of the pin end.

During refurbishment of existing valves, where the pin is held in place by a single grub screw as explained above, the refurbishment company will provide a method statement detailing how it will be corrected so that the pin is held in place as explained above i.e. a method how to remove the grub screw and provide full sealing of the pins from the media.

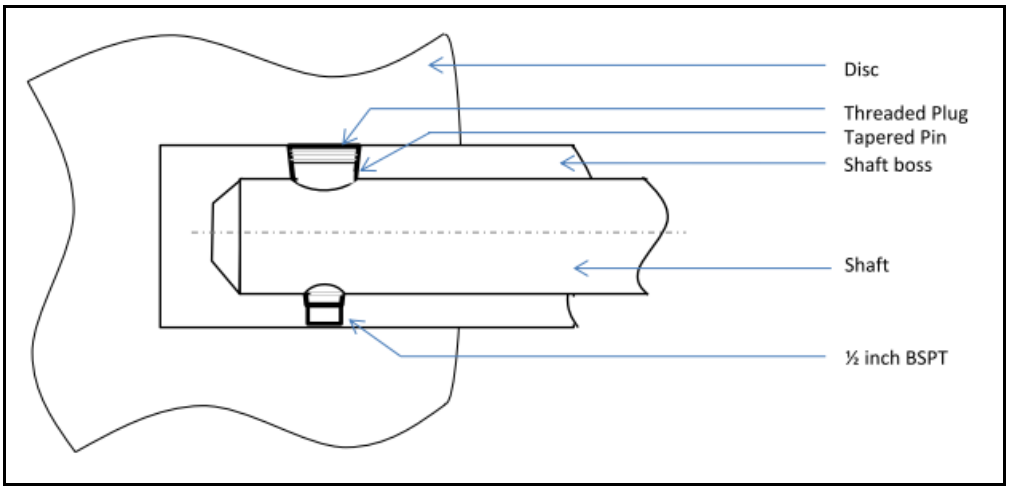

Figure 2: Blind Taper Pin

3.5.1.2 Full length taper pins with full bore mechanical plugging devices

The requirements will be as per section3.5.1.1, with the only difference that the pin's small end does not stop blind at the exit point.

The small end on the pin must be at least 2-3mm below the outer surface of the boss, to allow for coating to seal the pin from the line media (see Figure 3).

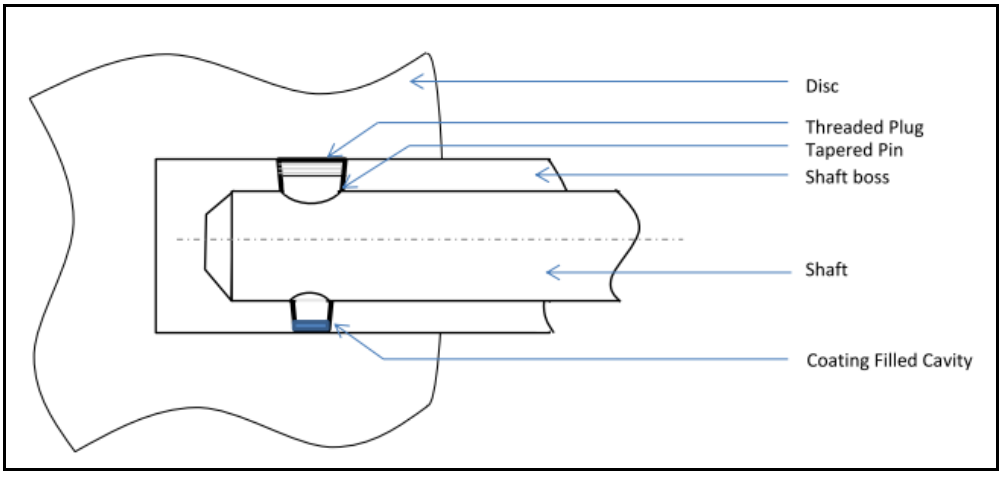

Figure 3: Full Length Taper pin

3.5.1.3 Non taper pins with full bore mechanical plugging devices

Should the parallel-sided (non-taper) pin design be offered, the holes will be drilled such that they pass through the center of the spindle. The hole for the pin will be drilled through the disc spindle boss all the way through the spindle. No design will be accepted where the pins are fitted off-center to the spindle center line (see Figure 4).

The hole for the pin will be drilled through the disc spindle boss, all the way through the spindle.

Each pin location hole (entry and exit sides) will have a threaded plug of at least the same OD as the pin screwed into the hole and will contact the pin. Thus, the pin shall be shorter than the pin location hole and of the thickness of the two plugs to allow for these threaded plugs to be fitted on either side. The plugs are not to stand proud of the disc boss.

Under no circumstance will the pin be welded to the disc.

Under no circumstance will the pin be held in place by a single grub screw that is drilled and tapped on the periphery interface of the pin and disc.

During valve refurbishment the pin bore will be machined by reamer (or suitable tool) to be perfectly parallel. Consequently, new pins will be fitted to suit the new pin hole diameter.

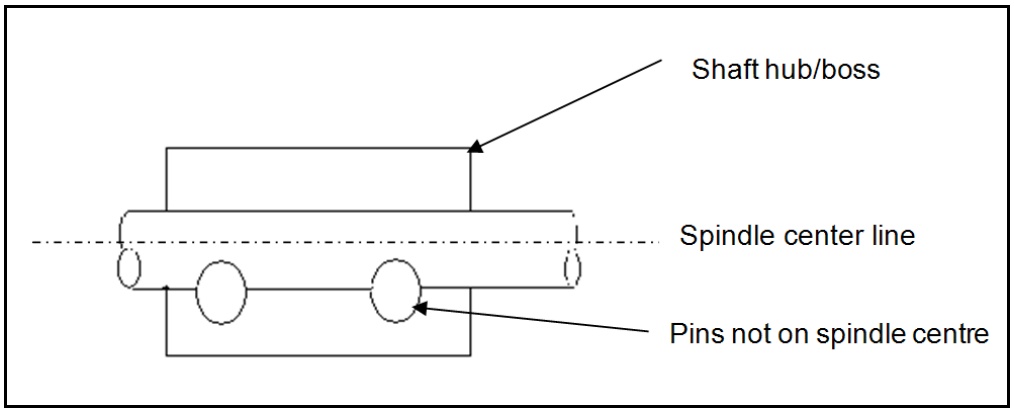

Figure 4: Pins off-set from centreline of spindle – not allowed

3.5.1.4 Integral drives

Integral drive can be achieved by having the spindle end machined square, splined, hexagonal, octagonal, or with an internal keyway and matching female connection in the disc itself. These connections are preferred as they minimise hysteresis, and the connection is removed from submersion in the wetted part of the valve.

If keyways are used to lock the disc and spindle, the keyway will be designed in such a manner that under full pressure closure (and maximum torque) the stress around the disc or spindle keyway area will not exceed 30% of the yield stress of the weaker component (disc, spindle or Key). The *Contractor* shall provide design calculations as proof. The keyway should be fitted in the lowest stress concentration area of the disc hub.

3.6 SPINDLE BEARINGS

On both DE and NDE sides of the spindle, end bearings will be fitted. Bearing bushes may be of one or two-piece design.

Bearings will be of proven self-lubricating design.

Where required thrust bearings will also be fitted, and these will also be self-lubricating.

Thrust bearings will not be re-adjustable on site (after being adjusted by the manufacturer), to prevent disc movement that will affect the integrity of the seat and seal arrangement. Thrust bearings must only be adjusted during full dismantling of the valve or on re-assembling after maintenance.

Bearings will be located in bearing bosses that are integral with the body of the valve, , cartridge type bearing / seal arrangement is preferred see 3.6.1

Material of construction will be as per section 4.

3.6.1 Spindle bearing seals

Bearings on both DE and NDE will be sealed from the media flowing through the valve.

The seal material selection will be done after evaluating the chemistry of the media flowing through the valve. Seals can be of “O” ring, cup seal or lip seal design.

Cartridge type bearings on both NDE and DE will be preferred. These bearings will also have integral “O” rings fitted to act as a seal for media leakage to atmosphere.

Low maintenance gland packing or sealing such as “O” rings will be preferred, and then with at least a double “O” ring at the open connection to atmosphere.

The seal material selection will be done after evaluating the chemistry of the media flowing through the valve. Seals can be of “O” ring, cup seal or lip seal design, or a combination of these.

The *Contractor* may offer gland packing type sealing. The gland packing and stuffing box will be of live loaded design. Both packing and stuffing boxes will be designed in such a manner as to allow for packing replacement with the valve installed in line. The gland packing will be of asbestos free design, and a full MSDS will be included in the final data pack of the valve.

The wetted side of the bearings will also be sealed against the media by “O” ring seals or similar proven design as described above, if cartridge type bearings are not used.

The sealing shall be designed as a dry shaft system, meaning that no media must be present between the “O” Rings in the body spindle boss area.

3.7 SEAT AND SEAL (VALVE TRIM)

3.7.1 General:

The selected seal/seat (valve trim) will allow for the valve to be opened and closed at full differential line design pressure.

In the material selection of all weld trim due consideration shall be given to avoiding the introduction of galvanic couples such as coupling materials with large galvanic potentials such as graphite and mild steel.

3.7.1.1 Uni and bi-directional valves:

The *Employer* makes use of both Bi- and Uni-directional valves. Due to the design of triple off-set metal seated valves, these are normally only Uni- directional. The valve will be tested in the preferred direction in accordance with the EN 12266 Leak Rate A (No visible leaks).

Irrespective of whether Bi-directional or Uni-directional, the valve body shall be clearly marked with an

marking indicating the high pressure and low-pressure sides on the flanges. For T1 and T2 the one flange will be marked Duct side and the other Condenser side. During isolation the higher pressure is on the T1 duct side but for the T2 it is also to the duct side because when the condenser is drained, the only pressure that the valve is subjected to is the resident pressure in the ducts.

To illustrate what is meant above for the T1 and T2, by the preferred direction of isolation versus direction of flow, consider the following:

- The normal flow of a condenser T2 valve is from the condenser to the hot duct and eventually the cooling tower. However, when the condenser is isolated, the T2 valve must isolate the condenser from the hot duct. The isolation direction for the T2 valve is therefore directly opposing the normal direction of flow.

The *Contractor* will liaise with the *Employer's* site personnel as to which side is normally the pressure side of the valve.

3.7.2 Seals

The seal ring will be of laminated design and be constructed from stainless steel in accordance to EN 10028 part 7 X5CrNiMo17-12-2 (UNS 1.4402 / ASME A240 316)) with a graphite bonding layer between the stainless steel laminations. The seal can be mounted either in the disc or in the body. The *Contractor* may propose an alternative material to the *Employer's* Engineering for acceptance.

The seal ring will be of replaceable design.

In the event of the design allowing for a stainless-steel intermediate ring to be mounted on the disc below the seal ring, an "O" ring will also be installed between this ring and the disc casting.

Bolts shall be countersunk.

As the seat and seal ring are a matched set, the seal and seat ring must be marked in such a manner as to allow for inspection after maintenance to confirm that the seal and seat ring have been correctly aligned.

3.7.3 Seal clamping ring

The seal clamping ring will be of bolted design, materials as per Section 4, unless otherwise stipulated (as a result of water quality). Seal clamping rings will be fully coated after installation. If clamping rings are manufactured from stainless steel a water analysis might indicate the seal to be coated as well.

Bolt heads shall be countersunk i.e. will not protrude above the clamping ring surface.

The clamping ring bolts will be designed such that they can be locked in place and cannot loosen during operation. This can be achieved by applying Loctite to the bolts during final tightening phase. Countersunk screws will be of Allen key design.

The clamping ring edge will be profiled to minimize turbulence on the edge of the ring whilst the valve is operated.

3.7.4 Valve body seats

The seat shall be located in the body.

The seat shall have a smooth step-less profile to minimize turbulence. The seat ring shall be of a replaceable type.

Bolts shall be countersunk and will not stand proud of the seat. The bolts and seat ring shall be of stainless steel as per Section 4. Bolting will always be from a grade of stainless steel different from the parent material to prevent galling when bolts are tightened or removed.

Bolts will be designed to prevent loosening during service i.e. peening the bolt head and countersunk bolt hole.

Only bolt-on type seats will be allowed. Designs where the seat is formed by welding onto the body will not be accepted.

Seat rings will be of uniform material. Hard faced overlay by welding, plasma spray etc., will not be accepted unless agreed to by the *Employer's* Engineering.

4. MATERIALS OF CONSTRUCTION

Table 1: Materials selection

COMPONENT	MATERIAL TYPE	EN MATERIALS
Cast Bodies	SG Iron	EN 1563 grade 400/15 or 18
	Cast Steel	EN10213 grade GP240GH
Fabricated Bodies	Carbon steel (Minimum Tensile strength grade)	EN 10028 -2 grade P235GH
Cast discs	SG Iron	EN 1563 grade EN-GJS 400/15 or EN-GJS 400/18
	Cast steel	EN10213-2 grade 240GH
	Stainless steel	EN 10213 GX2CrNi19-11 (1.4309), EN 10213 GX5CrNiMo19-11 (1.4409)
Fabricated Discs	Carbon steel (Minimum Tensile strength grade)	EN 10028 -2 grade P235GH
Body seat and laminated graphite / seal ring	Stainless steel variants	**OPTION 1** Stainless steel to EN 10028-7 X2CrNiN18.9 if seal is X5CrNiMo17-12-2 **OPTION 2** Stainless steel to EN 10028-7 X2CrNiN18.9 if seal is X2CrNiMo17-12-2 **OPTION 3** Stainless steel to EN 10028-7 X2CrNiMo17-12-3 if seal is X5CrNi18-10 **OPTION 4** Stainless steel to EN 10028-7 X2CrNiMo17-12-3 if seal is X2CrNiN18-9
	Duplex stainless steel	**OPTION 5** Duplex Stainless steel to EN 10028-7 X2CrNiMoN22-5-3 applicable all stainless seal ring options
Seal clamping ring	Stainless steel	**OPTION 1** EN 10028-7 X5CrNi18-10

		OPTION 2 EN 10028-7 is X5CrNiMo17-12-2
	Duplex stainless steel	**OPTION 3** Duplex Stainless steel to EN 10028-7 X2CrNiMoN22-5-3
Spindles	Stainless steel	Minimum grade EN10088-3 X6CrNiMoTi17-12-2
Pins and internal fasteners	Stainless steel	EN 10250-4 X2CrNiMoN22-5-3
Internal spindle seals	Radial lip seal/cup seal/o ring	FPM/Nitrile/EPDM
Spindle bearings/Bushes	Self-lubricating aluminum bronze	BS 1400 PB1C or EN 1982 CC 483-k, with self-lubrication qualities
Thrust bearing	Self-lubricating aluminum bronze	BS 1400 PB1C or EN 1982 CC 483-k, with self-lubrication qualities

5. QUALITY REQUIREMENTS

The *Contractor* shall prepare a detailed Inspection and Test Plan (ITP) detailing the inspection and testing to be applied to all stages of valve manufacture. All manufacturing will be done in accordance with the agreed ITP. The ITP shall be subject to the *Employer's* approval and shall indicate all inspection and test points, the methods and procedures to be used, and the acceptance criteria to be applied. Following review by the *Employer*, agreed quality surveillance requirements such as witness points and hold points shall be indicated on the ITP.

6. NON-DESTRUCTIVE TESTING

In order to prove the integrity of certain items of the valve parts, the following non-destructive testing acceptance standards will be applicable and will be in line with *Employers* NDT standards 240-83539994

Acceptance NDT standards will be as follows:

a) PT to EN ISO 23277 (for weld seams)

b) PT to BS ISO 1371 (for castings)

c) MPI to EN ISO 17638 and EN ISO 23278

d) RT to BS EN 1435 (RT)

e) UT to EN ISO11666, EN ISO 23279 and EN ISO 17640

f) UT for thickness above 8mm to EN ISO 17640

All NDT reports will form part of the final data book.

6.1 CAST BODIES OR DISCS IN SPHEROIDAL GRAPHITE (SG) IRON

The as-received casting will be tested on both internal and external surfaces by means of Dye Penetrant testing (PT) for linear indications in the "as received condition" from the foundry. Any linear indications in excess of the acceptance criteria as detailed in BS EN 1371 will cause the casting to be rejected.

Dye penetrant testing will not be used to quantify SG iron castings for porosity.

Where machining is done on the SG iron casting - on completion of the machining process, the newly exposed areas will be tested by PT.

During valve refurbishment, both the entire body (internal and external) and disc will be tested for indications by means of PT.

6.2 BODIES OR DISCS CAST IN CARBON STEEL

a) Bodies will be tested on both internal and external surfaces by means of PT, or MT inspection, for linear indications and porosity in the "as received condition" from the foundry, before any machining commences. Any defects larger than what is allowed in BS EN 1289 will be reported by the *Contractor* and a repair procedure will be submitted to the *Employer's* Engineering for acceptance.

b) After final machining is complete, all machined areas will be inspected, and all defects will be reported to the *Employer*'s Engineering for acceptance.

c) The *Contractor* will not perform weld repairs on defects found during NDE on castings (Bodies or discs), unless allowed by the *Employers* Engineering and Welding department.

6.3 BODIES OR DISCS FABRICATED FROM PLATE MATERIAL

The plate edges intended to be used for the fabrication process will be 100% ultrasonically tested (UT) for laminations. Plate with laminations will not be used.

After cutting to size for rolling or forming of plate, the edges will again be tested by means of UT for laminations. Any defect will render the plate liable to be rejected.

All accessible welding will be UT or RT tested for imperfections of the weld and will be repaired before final assembly. Should an RT or UT not be practical then those welds will be subjected to PT/MPI

6.4 SOLID BAR FOR SPINDLES

All solid bars will be 100% UT tested for indications, and material will only be used if defect free, Bars with any lamination or porosity will not be utilised.

7. GEARBOX AND ACTUATORS

Different methods of actuation can be required and will be stipulated in the enquiry document. Actuation can be by means of electrically or hydraulically operated actuators.

7.1 ELECTRIC ACTUATOR AND GEARBOX

Valves will be fitted with a gearbox before pressure testing. The stops on the gearboxes will be set during the seat/seal leakage tests. On successful pressure test the stops will be sealed to prevent tampering.

Valves will close on torque, but end stops on gearboxes are to be set as back-up in the event that torque switches fail.

Gearboxes will be rated to at least an IP68 in accordance with EN 60529 ingress protection.

Gearbox design will be such that the lubrication will not require replacement or replenishing earlier than valve normal service intervals. During unit GO the gearbox can be opened for inspection, provided that system is depressurized or that the mechanical lock out as per section 8 is in place. With valve locked out, the gearbox may be removed whilst line is pressurized for emergency repairs, should any maintenance be required see section 8.

Gearboxes can be of “rack and pinion” or “travelling nut and worm gear” design.

Gearboxes will not be of the “Scotch Yoke” or travelling nut design. Neither will gearboxes be allowed that makes use of an intermediate sleeve between the valve DE shaft and gearbox shaft boss, because if the sleeve is removed then the self-locking of the gearbox and valve shaft is lost.

Gearbox design will be of “self-locking principle”, this means that under no circumstance must any unbalanced force exerted on the disc, cause the valve disc to move from the current position. Disc position can thus only be altered by external input to the valve shaft.

The gearbox must not be removed from the valve after pressure and leak tests.

Gearbox and actuator combination to be selected such that when operating the actuator hand wheel in a clockwise direction; it will move the valve to the closed position.

A minimum of 50% safety factor will be used for the gearbox and 30% for the actuator. The ratings of the gearbox and actuator shall be matched to the valve torque requirements including safety factors as mentioned. The *Contractor* will provide the *Employer* with the power and torque calculations.

If a key is used to link the gearbox to the valve spindle, the keyway shall be in line with the valve disc position, this lead to say that when valve is open the keyway will be in line of the flow direction, and when valve is closed the shaft will be rotated so that the keyway direction from the centre of the shaft will be perpendicular to the flow direction. Actuator feedback options must be same as the current installation unless a new C&I upgrade requires any additional interfaces. The feedback will include a combination of items below. The scope of work document must clearly indicate which of the items below are required:

- Potential free change-over contacts for ‘open’ and ‘close’ positions.
- Potential free torque switches for ‘open’ and ‘close’ directions.
- A 4-20 mA four wire signal proportional to position feedback.
- Torque ‘open’ and torque ‘close’ contacts.
- Motor temperature and switchgear contacts.
- Feedback ‘open’ and feedback ‘closed’ contacts.
- Feedback ‘not open’ and feedback ‘not closed’ contacts.
- Command ‘open’ and command ‘close’ contacts.
- Common supply and common contacts.

Actuator torque switches to be set during the leak test. A functional test will be performed on the assembly before the leak test.

Actuators may be removed from the gearbox after pressure testing to prevent damage during transport, but the gearbox will remain fitted to the valve.

The gearbox will have an adjustable end stop for both open and closed positions, but this will be sealed after successful leak testing.

The gearbox will be fitted with a clear and fixed position indicator. This position indicator must be aligned during the leak testing of the valve. The indicator must be a permanent marking or feature and must be tamper proof after it has been fitted. A scale from 0° to 90° is to be fitted to this indicator and must be divided into a minimum of 10° increments from open to close. For fully closed to 10% open, the markings will be 1° increments.

7.2 HYDRAULIC ACTUATION

Due to the number of variants used on site such as with or without counterweight, integral power pack, stand-alone power pack, etc., this requirement will be described in the enquiry document as a site specific requirement.

The product offered by the *Contractor* shall have a direct interface with the existing plant, more modernized designs maybe offered, provided it can be fully integrated.

8. MECHANICAL LOCK-OUT FACILITY OR ACCIDENT PREVENTION SYSTEM

As a minimum, a system similar to one of the following shall be fitted to all new valves, including the CW pump Auto closing valves. The reason for installing the lockout on the Auto Closing valve is that except for the actuation method the CW Pump Auto Closing valve and CW pump back up isolation valves are the same and they can be used interchangeably by changing the actuation mechanism.

Option 1

For safe access to work, as part of the standard isolation and permit to work to be issued, the valve has to be fitted with a manual lock-out device. This manual lock-out device is to be completely separate from the gearbox or actuator and may not be interlocked to the gearbox. The lock-out device is required for both the closed and open positions of the valve.

This lock-out facility shall be designed (and proof of calculations will be provided by the *Contractor*), to withstand a torque of 130% that of the maximum torque rating of the gearbox/actuator combination. A typical example of a locking device is shown in Figure 5

Figure 5: Typical mechanical lockout device

Option 2

In the event that a mechanical lockout as described in Section 8, Option 1 is not fitted, an accident prevention system as described below shall be fitted.

To provide safe access to the pipeline when the isolation valve is closed, the isolation valve shall be equipped as per the example given in Figure 6. This will provide safe access for workers into the pipeline, while the system is still pressurized. It shall enable maintenance downstream of the pipeline whilst the upstream side is fully pressurized.

The lock-out system shall lock the disc of the isolation valve in its closed position, by means of anchors (e.g. fixed and manual), and shall be independent of the valve

The manual anchor shall be equipped with a lockable hand wheel and an indicator will be supplied to indicate if the hand wheel is in the open or closed position.

The system shall be of proven design and design calculations will be provided to demonstrate that the device can withstand all actuator forces and the maximum differential line pressure. The spindles of the manual anchor where it enters the valve body will be of a live loaded gland packing design.

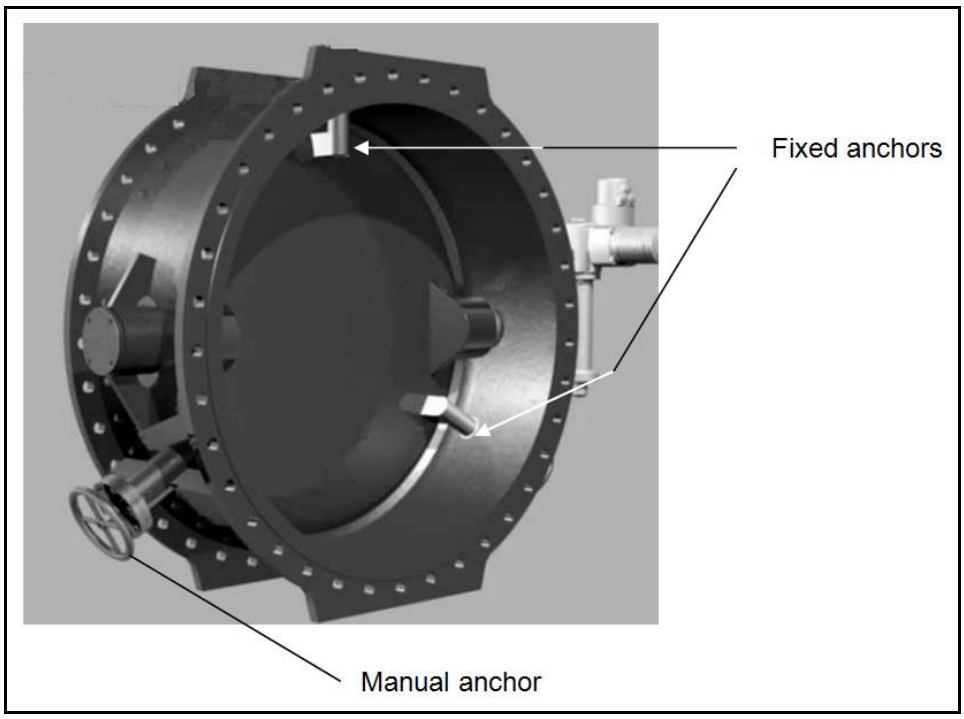

Figure 6: Accident prevention system

9. HYDRAULIC PRESSURE TEST AND LEAK TEST

Although an initial body pressure test can be done before machining of the casting commences, a final body hydrostatic test will be done on the assembled valve. For the body hydraulic pressure test the valve disc will be opened partially to subject the complete body to hydraulic pressure.

Should the body pass the pressure test, the valve disc is then closed, and a seat leakage test is performed. After the seat leakage test is successfully completed, the gearbox end stops, as well as the actuator torque and limit switches, are set to at the closed position,

Note: Valves will not be supplied bare shaft, as this will affect the sealing integrity as gearbox end stops might not be set to the optimum position as achieved during seat leakage tests.

For all new valves, the body hydrostatic test will be done at 1.5 times the design pressure. The seat leakage test will be done at 1.1 times the maximum system pressure (specified by The *Employer's* Engineering department) and in BS EN 12266 Parts 1 and 2. After the test has been completed the valve will be depressurised and cycled at least once from the closed position to approximately 5% open and then reclosed. The valve seal will then be subjected to a follow up pressure test and be pressurised to at least the maximum system pressure for 10 minutes. During this follow-up test the valve will also seal to EN 12266 rate "A" or "B" depending on seal design. Rate B will only be allowed if a solid seal ring is used and not a laminated seal ring.

10. COATING SPECIFICATION

All valves must be coated according to the requirements given below.

The *Contractor* may propose an alternative coating system, this is however subject to approval of the *Employer's* RT&D corrosion department representative. The requirements described below must be submitted as a main offer. Failure to submit this main offer may lead to disqualification of the tender.

Thus, if an alternative coating process is offered it can be done as an alternative, but main offer must include the requirements as mentioned below.

The following table provide coating requirements:

Table 2: Coating Requirements

This table to be considered as Annexure D of 240-101712128: "Specification for the Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings"	
Basic Requirements:	
Environment - External	External valve surfaces exposed to inland atmospheric conditions.
Material - External	Ferrous substrate.
Surface Preparation - External	Abrasive blast clean to Grade Sa 2.5 Surface profile as specified by the coating manufacturer
Generic System - External	Primer: Two component re-coatable epoxy zinc phosphate primer (75 – 100 micron). Finishing: Two component polyurethane acrylic finishing coat (50 – 75 micron).
Environment - Internal	Immersed, cooling water, pH 8,1 to 8,6, temperature range 25°C to 45°C, flow rates of up to 2,0 metres per second.
Material - Internal	Ferrous substrate.
Surface Preparation - Internal	Abrasive blast clean to Grade Sa 3 Surface profile as specified by the coating manufacturer
Generic System - Internal	(Optional) holding primer as specified by applicator and coating manufacturer
	Two component solvent free amine cured epoxy coating 2 coats @ 300 micron per coat NDFT (nominal dry film thickness) Total dry film thickness of the coating system: 675 to 850 micron (with the use of a primer). Total dry film thickness of the coating system: 600 to 750 micron (without the use of a primer).

Special Requirements:

1. Corrosion Protection shall only proceed once all mechanical, fabrication, manufacturing activities i.e. cutting and welding have been completed and released in terms of the manufacturing/fabrication Quality Control Plan (QCP).

2. Rounded edges are required in order to be able to apply the corrosion protection system uniformly and to attain adequate coating DFTs on sharp edges, refer to ISO 12944-3 should more detail be required. All sharp edges from the original fabrication shall be rounded or chamfered and burrs around holes and along other cut edges shall be removed. All edges to be rounded off with a grinder to a radius of 3mm or more.

3. Weld beads with a surface irregularity exceeding 3mm or with sharp crests having a radius less than 3mm shall be ground.

4. All welds shall be free of slag, slag inclusions and pinholes. Adjacent areas shall be free of weld spatter, which shall be removed by grinding or scraping.

5. The contractor shall be wholly responsible for the surface preparation and corrosion protection system application. Coated surfaces shall meet the DFT as required by this specification sheet and aspects thereof in referenced documents.

6. All materials, i.e. paint, primers, adhesives, rubber liner, solvents, cleaning agents for a specific corrosion protection system shall be supplied by the same manufacturer. The solvents used shall be those recommended and manufactured by the manufacturer.

7. Prior to final surface preparation all substrates shall be tested for chloride contamination, according to ISO 8502-6. Casting substrates which may be pitted and/or rough and porous are inherently susceptible to soluble salt contamination.

8. Soluble salt testing shall be performed by the Bresle soluble salt test method. If not within acceptable limits (as per the manufacturer requirement but not exceeding 100mg/m2), the surfaces shall then be washed/decontaminated by High Pressure (HP) water washing using fresh/clean water (with a conductivity reading of maximum 100 µS/cm) at a minimum pressure of 300 bar. A salt decontamination chemical additive with demonstrated capability of removing salts may be used in conjunction with HP cleaning.

9. Soluble salt testing shall be repeated on representative test patches which shall be blast cleaned to Grade Sa 3 (ISO 8501-1) for internal surfaces and Sa 2.5 for external surfaces. If acceptable then proceed with blasting and application steps – if not then repeat HP washing until the salt contamination has been removed to within acceptable limits.

10. Prior to any surface preparation all surfaces that are, or are likely to be contaminated with oil or grease as a result of the fabrication/manufacturing process shall be solvent cleaned with a suitable water-soluble biodegradable alkaline cleaner/detergent or with appropriate organic solvents.

11. Cleaning may be performed by using rags for small areas, or a spray gun for large areas. The detergent/solvent-cleaned surfaces shall then be thoroughly washed down with fresh/clean water ensuring that the oil-water emulsion formed is completely removed from the metal.

12. Degreased and water washed surfaces shall be checked for residual oil and grease using the atomized water spray test as per ASTM F21 and further degreasing shall be carried out if residual oil or grease is found to be present. A black light test shall be used to check for oil contamination. Zero oil and grease contamination is the acceptable limit. Washing with fresh/clean water containing a suitable degreasing agent of partially painted components shall take place between coats, if surfaces are found to be contaminated.

13. Surface preparation by abrasive blasting shall be performed by means of conventional handheld blasting equipment capable of removing mill scale and suitably preparing the substrate to the required cleanliness.

14. The requirement for surface preparation of surfaces for immersion condition or internal surfaces is strictly Grade Sa 3 (ISO 8501-1), in which case the surfaces shall be blast cleaned to white metal where all traces of rust, mill scale and other foreign matter are removed.

15. In general, Grade Sa 2 ½ (ISO 8501-1), i.e. very thorough blast cleaning where at least 95% of the mill scale, rust and other matter is removed, is specified in the case of most external protective coating systems for atmospheric exposure.

16. All compressed air for blasting activities shall be free from entrained moisture and oil. All traps shall be in a functional condition. The compressed air shall be tested at regular intervals using clean white clothes to assess cleanliness and dryness. This requirement shall be included in the QCP.

17. After surface preparation, all dust, grit blasting media or any other deleterious matter shall be removed from the surfaces by vacuuming. The process shall be repeated until the required level of dust and debris removal is achieved. It is imperative that all surface dirt and contaminants are completely removed before coating or the adhesion of the coating shall be impaired.

18. Immediately before coating or rubber lining activities, blast cleaned steel shall not exhibit more than “dust quantity rating” 2 when tested in accordance with ISO 8502-3.

19. Power and hand tool cleaning is only applicable to very localised touch ups or patch repairs. Specific requirements for patch repairing a coating system are defined in section 4.8.6 of 240-101712128 and 240-106365693. Hand-tool cleaning for isolated/localised areas may be utilised provided the required standard of finish is achieved. For all immersion applications final mechanical cleaning shall be by bristle blaster in order to create a required or specified surface profile.

20. Cleaning by means of hand or power-tools, i.e. wire brushes, chipping hammers, scrapers, grinders, sanders, needle descalers, bristle blasters etc. may only be used where accepted by the Eskom engineer and where the position and condition of the substrate metal is such that efficient cleaning and surface profile can be achieved and where the protective coating system is designed for application to brushed or ground surfaces i.e. specifically formulated surface tolerant coatings.

21. Oil and grease deposits shall be removed prior to cleaning as detailed earlier in this specification. Special attention shall be paid to drillings, bolt holes, etc.

22. Different grades and types of blasting media exist. It is important that the correct abrasive be used in combination with a specific coating system to achieve the specified surface profile. The required blast profile height should be carefully considered. The contractor shall select an appropriate abrasive type and mesh size to attain the specified surface profile.

23. Only inert mineral grit or steel grit abrasives shall be used. Sand or silica-based abrasives shall not be used. Abrasive material for blast cleaning shall be used in accordance with the manufacturer’s specifications and in line with local environmental regulations. The abrasive shall be clean, sound, hard particles free from foreign substances such as dirt, oil, grease, toxic substances, organic matter and water-soluble salts.

24. It is important that good quality abrasives are used in order to minimize the amount of waste grit and dust generated and contamination of the surfaces.

25. At all times care shall be taken to ensure adequate protection of any surfaces and parts not requiring blast cleaning and coating.

26. Equipment name plates and identification plates shall be protected from coatings. No coatings shall be applied over any surfaces where these will adversely affect the performance of the item or component.

27. The use of re-cycled blasting media for the final blast is strictly prohibited.

28. All abrasive media shall be stored in an area that is completely dry, covered and protected from weather.

29. The profile height of the blasted surfaces should be within the range of the specified coating system or primer coat in the case of rubber lining. Refer to the manufacturers Product Data Sheets. Unless otherwise specified by the coating/rubber lining manufacturer, a profile height of 25 microns to 90 microns is recommended for most coatings systems.

30. It is important that the blast profile does not exceed the specified DFT of the primer or first coat. Blast cleaning of rough, severely pitted or corroded surfaces may result in high profiles i.e. > than 100 microns. In these cases, the primer or first coat shall be applied by brush/roller to ensure complete wet-out of the pitted/jagged surface. In addition, a different primer or first coat may be required. However, agreement should be reached between the contractor and coating/rubber lining manufacturer as to the most suitable profile range, with due consideration of the application method, for a specific coating system.

31. The contractor shall consider and detail these potential scenarios or eventualities in the required Method Statement which shall be reviewed by Eskom for acceptance/rejection prior to any work. Ultimately, the contractor shall be responsible for any risk that could arise or be attributed to this choice.

32. The contractor shall ensure that during surface preparation and coating/rubber lining activities the relative humidity (RH) in open, undercover shop environments is less than 80% RH. Ambient temperatures shall be between 15°C and 30°C or as per the manufacturer recommendations, whichever is the more stringent. The maximum/minimum substrate temperature at the time of coating/rubber application shall be strictly in accordance with the product data sheet.

33. During stable weather conditions environmental parameters shall be measured and recorded at least 4 times per shift. During periods of inclement or cold weather conditions the environmental parameters shall be measured and recorded hourly. In the event that the latest two readings of any of the parameters indicate a deteriorating trend which would likely exceed parameter/s or limits then no final surface preparation or application shall be permitted. All measurements shall be recorded at the steel surface. Dew point requirements shall be as per the Product Datasheet or 240-101712128.

34. For all inspections of all surface preparation and coating/rubber lining activities the surfaces shall be clean allowing unhindered visual access to the surface. The contractor shall provide sufficient and adequate lighting (Cool White) to enable inspections. Cell phone lighting is not acceptable.

35. In order to avoid recontamination and flash rusting of the surfaces, the primer or first coat shall be applied within 8 hours after final surface preparation of the steel surfaces. Under no circumstances shall the blast be permitted to stand overnight.

36. Many modern organic coatings can be applied without the use of a primer. However, should a primer coat be required for holding of the blast, or otherwise, the contractor shall indicate/describe the reasoning for the need of such a primer i.e. as a holding primer or as a means of enhancing adhesion of the system. Details shall be provided in the Method Statement for the type of primer, generic resin, solvent borne or free, maximum DFT and compatibility with subsequent coats.

37. The detailed Method Statement shall be submitted and reviewed by Eskom for acceptance/rejection prior to any work. Ultimately, the contractor shall be responsible for any risk that could arise or be attributed to the system selection.

38. The spray operator shall be equipped with a “wet comb” and frequently monitor the wet film thickness to prevent/reduce a wide spread of DFT’s.

39. In the case of coatings, after allowing sufficient time for the first coat to cure, all edges, weld seams, bolts and nuts, and other crucial areas shall be given an additional stripe coat, by brush application, with the same material as the following coat. Should the use of a primer be omitted, stripe coating shall be carried out between applications of the first coat and the subsequent coat.

40. As instructed in the table above and to reiterate, immediately prior to coating all pitting, omega cavities, honey combing, voids or any other surface defects shall be stripe coated by brush in a stippling manner to ensure complete wetting out of the surface defect.

41. For coating systems multiple coats shall be applied as per the table at the top of this specification sheet. Single coat systems are not permissible.

42. In the case of coatings where more than one coat is applied, the colour of each coat shall be different from the previous coat. In the case where aesthetic requirements are secondary, repairs after final testing shall be carried out using a different colour. In other cases, two finishing coats of the same colour may be applied to achieve complete colour uniformity.

43. All finishing colours for external surfaces shall be in accordance with the Eskom requirements; 240-145581571: Standard for the Identification of the Contents of Pipelines.

44. Where more than one coat is being applied in an open exposed yard environment, surface preparation and washing shall be carried out between coats.

45. Where the coating has completely cured or allowed to age before finishing, before application of a subsequent coat the surface shall be prepared by light sanding, scrubbing with potable water using a bristle brush and drying before over-coating.

46. Application of subsequent coats shall be in accordance with the specified system. The required over-coating intervals as mentioned in the latest Product Data Sheet shall be observed and adhered to.

47. The number of coats and DFT per coat required to achieve the total film DFT shall be agreed between the contractor and coating manufacturer and will be dependent upon the method of application chosen.

48. The total DFT of the applied coating system shall comply with the recommended minimum and maximum DFT limits as recommended in the latest Product System Data Sheet and this specification.

49. The range of DFTs of each coat shall be as follows; 90% of random readings shall be equal to or greater than the minimum specified DFT. No individual reading shall be less than 80% of the specified DFT. In the case of solvent borne coatings no individual reading shall be greater than 150% of the manufacturer's maximum specified DFT. All deficient film DFTs shall be rectified prior to release of components.

50. The coating shall be evenly applied to form a smooth, continuous, unbroken layer free from misses, sags, runs, tears and other defects that could affect the integrity of the coating.

51. Flange faces will be coated with a single primer layer as in point 30 above.

52. The contractor shall perform pinhole detection using appropriate "spark" testing equipment at a voltage setting as per the coating/rubber lining manufacturer's requirements. Wet sponge testing shall not be acceptable.

53. With the exception of access limitations or as instructed by the Eskom engineer all areas of coating damage shall be patch repaired in a different or contrasting colour and by brush application. The extent of the damage shall be carefully inspected to assess which coats in the system have been damaged and which surface preparation methods are most suitable and appropriate. The Eskom engineer shall accept/reject the contractor's recommended method of surface preparation i.e. mechanical power and hand tool cleaning.

54. When more widespread repairs are required and when the damage extends to the steel substrate abrasive blast cleaning to Grade Sa 3 (ISO 8501-1) is required.

55. All coats in the system shall be re-instated. Areas to be primed shall be cleaned of dust, dirt, grease, salts or other deleterious matter and all edges of existing paint shall be feathered back to a hard edge. The patch primer used shall be in accordance with the requirements of the relevant coating system. The over-coating onto an existing coating by subsequent intermediate and finishing coats (where applicable) shall be stepped at 25 mm intervals to produce a feathered edge. Specifics of such instances shall be assessed on a case-by-case basis.

56. All shop coated or rubber lined surfaces shall be inspected and examined for coating damage on arrival at site. If the damage is excessive, it may be preferable to repair the transport damage before installation/assembly/erection whilst access is easier.

57. Provision shall also be made for the repair of handling damage to the coating or rubber lining after installation/assembly/erection/scaffolding removal. For coatings spot repairs shall reinstate each of the previous coats and shall commence directly after the localised surface preparation. In the case of rubber lining the contractor shall include a specific section in the method statement proposing patch repair procedures for acceptance/rejection by Eskom.

58. All immersed surfaces shall again be pinhole tested (only after completion of all handling, moving and equipment and scaffolding removal) to ensure the coating or rubber lining is pinhole free and if required additional repairs shall be performed and once cured then the repair areas shall be retested. The process to be repeated until a pinhole free coating is achieved. In the case of rubber linings and depending on the nature, extent and concentration of damage larger sections of rubber lining may be required as instructed by Eskom.

59. After completion of the coating activities sufficient curing time of the coating system shall be given prior to immersion as per the requirements of the Product Data Sheet.

60. Accelerated curing is not permitted. All coated surfaces shall be adequately ventilated until full cure has been achieved. At the end of the curing period and before immersion the full cure of the applied coating shall be verified by the contractor and/or coating manufacturer.

61.

11. ACCESS FOR INSPECTION

a) The *Employer's* quality surveillance representative and/or the *Employer's* representative shall have free access, based on mutual agreement, to the *Contractor*'s and its sub-contractor's facilities for the purpose of inspecting the work performed and/or witnessing testing/inspection performed by the *Contractor* during the fabrication process.
b) All manufacturing and test procedures as well as all inspection and test reports shall be made available in the *Contractor*'s manufacturing facility to the *Employer* or the *Employer's* quality representative for review.
c) The *Employer's* quality surveillance representative and/or the *Employer's* representative shall be informed in advance of a scheduled witness or hold point event. If work identified as a witness or hold point is assembled and rendered inaccessible without approval from *Employer* or without the *Employer's* quality surveillance representative having been given the opportunity to inspect the work, then such work shall be disassembled and made accessible for inspection. If hold and witness points are not adhered to an NCR will be raised for correction at the contractor's expense and time

12. NAME PLATES

The following minimum information will be on the valve name plate:

a) The design code.
b) Manufacturer's name.
c) Line pressure (seal pressure)
d) Design temperature (minimum and maximum)

e) Maximum allowable operating pressure (MPOP)
f) Serial number
g) Operating running Torque.
h) Closing torque
i) Flange specification
j) Body material
k) Disc material.
l) Valve type – Triple off-set Metal seated
m) Uni- or Bidirectional

13. PREPARATION FOR TRANSPORT

Valves will be supplied adequately packaged and/or crated so that no damage can occur during transport or off-loading by means of a forklift or slings and overhead cranes. Special care should be taken with coated areas.

Each valve will be individually wrapped in a durable protective packaging such as a re-enforced PVC or re-enforced Nylon wrapping.

The wrapping will be sealed to prevent environmental conditions such as rain or dust to settle on the valve sealing faces. Furthermore, the wrapping will be UV resistant as these valves are normally not stored under roof.

Both the up and downstream flange will be covered with a solid cover (plywood or galvanised sheeting) before the wrapping is applied.

The complete wrapped and packaged valve will be inspected at the Contractor's works before it is transported to the Power Station to the acceptance of the *Employer*, this to be included on QCP as an Employer's hold point.

As the gearbox is to remain on the valve during transport, the transport crate/palette will be such that adequate support is provided at all times to the gearbox to prevent any damage to the gearbox. The palette/crate will be marked so as to prevent accidental lifting or rigging of the valve at the gearbox.

The requirements above apply to both new and also refurbished valves.

14. DELIVERY TO SITE

The *Contractor* is responsible for the co-ordination and execution of the various functions involved in delivery to site. Such functions include the following:

- Valves will not be transported bare shaft, in event that order state bare shaft; *the Employer* must supply the free issue gearbox for each valve.
- Transport.
- Delivery.
- Off-loading. (System engineer to be present)

15. DOCUMENTATION

15.1 MANDATORY DOCUMENTATION TO BE SUBMITTED WITH TENDER:

During the enquiry the items listed below will be considered mandatory, to be supplied with the tender. Failure to supply the required documents will cause the tender to be rejected.

a) Years of experience in triple off-set valve design.

b) Years of experience in manufacturing of triple off-set butterfly valves.
c) Reference list of similar valves supplied in the last 10 years, specifically in South Africa to either the *Employer* or to Water Reticulation systems for ≥ 600mm.
d) Organizational chart clearly indicating personnel responsible for Design, Manufacturing and Quality Assurance.
e) Outline drawing for each valve. The minimum information to be indicated on the drawing will include:

i. Outline dimensions
ii. Weight
iii. Flange drilling,
iv. Actuator mounting platform/hand wheel data
v. Materials of construction of main components.
vi. Details of mechanical lock-out facility
vii. Torque values (Running and Closing torque)

f) Typical Program for the complete project
g) Typical Quality Control Plan (QCP) or ITP (inspection and test plan)
h) Clear statement defining which contractor's entity will perform the surface preparation and coating activity - is it in-house or sub-contracted?
i) Coating procedure.
j) Complete catalogue/brochure of the intended valve.
k) Any exclusions or qualifications or deviations to this specification or site specific scope of work must be listed as part of the tender; else the tender will be rejected. Should there be no exclusions or deviations then a letter to be included in the tender stating full compliance.

15.2 DOCUMENTS TO BE SUBMITTED WITHIN 1 WEEK AFTER AWARD OF CONTRACT

a) Method Statement to explain in sufficient detail the following:

i. Specific detail of the required mechanical work on the valve. The interface between coating and mechanical work will be clearly defined, with respect to integration of activities.

ii. Information with respect to interfaces with activities (as in point above) performed by other *Contractor*s/sub-contractors.

b) Explanation of sequence/order of work areas to minimize unnecessary handling of valve after coating has been applied, and to prevent mechanical damage during manufacturing process.

c) The valve *Contractor*/manufacturer, in consultation with the applicator and coating manufacturer, shall compile a detailed application procedure for the works. This detailed procedure shall be submitted to the *Employer* for review and approval.

d) The valve *Contractor*/manufacturer and applicator shall submit a detailed program showing how the works will be carried out and completed.

e) Detailed program for the complete project (bar chart), to include each step of coating process.

f) Detailed drawings that will be used for manufacturing.

g) Coating application procedure including latest revisions of specified coating Material Product Data Sheets and Material Safety Data sheets

h) Actual QCP's and ITP's to allow the *Employer* to add the required intervention points. A section for coating to be included. Individual QCPs and ITPs must be kept for each valve.

i) All relevant welding documents WPS and WPQR.

j) Pressure testing procedure.

k) List of sub-contractors that will be used – only *Employer* approved coating applicators will be considered.

15.3 DOCUMENTS TO BE SUBMITTED ON DELIVERY

a) Valve Material Certificates in accordance with EN 10204 (of 2004) 3.1 as a minimum for major items such as body, disc, spindles, pins, seat ring, seal, and clamping rings.

b) Valve body hydrostatic test certificate.

c) Seat leakage test certificate (EN 12266 parts 1 and 2).

d) List indicating and identifying all valve spares, with all material certificates.

e) In event that any part is from a forging process, the heat treatment certificate to be included.

f) Valve, gearbox and actuator maintenance, Installation and operating manuals.

g) Certificates of coating material.

h) Coating integrity check sheet indicating the dry film thickness test report and pinhole test.

i) An Electronic copy of valve outline drawing and bill of materials in CAD or AUTOCAD format for record keeping at the *Employer*.

j) Heat treatment records.

k) Official copies of material test certificates, and pressure test reports (1 hard copy and one soft copy).

l) Welder qualification certificates.

m) Non-destructive test reports.

n) Test equipment calibration certificates.

o) All NCR's and proof of rectifications.

16. REFURBISHMENT

16.1 REPAIR AT *CONTRACTOR'S* WORKS:

Due to the design of the valve the valve seal cannot be replaced with the valve installed, and thus need to be removed from the line. During tender phase the contractor has to provide proof of experience in refurbishment of triple off-set metal seated valves The Contractor also has to provide proof to the Employer that he can obtain the OEM seal/seat arrangement from the OEM of the valve.

The *Contractor* will provide a method statement on proposed repair activity, specifically highlighting the critical activities, such as seal replacement, body seat repair and modification/repair of shaft to disc connections.

16.1.1 Valve body:

Valve body external will be inspected visually for mechanical damage.

For internally lined/coated valves, the coating will be removed by means of abrasive grit blast.

After the valve body has been dismantled/grit blasted and cleaned the following areas will undergo surface NDT for crack-like indications, any indications found must be highlighted to the *Employer* Engineering for agreement on repair action:

a) Casted bodies: Flange to body sectional changes both on outside and inside of valve body.

b) Fabricated bodies: All flange to body weld interfaces.

c) Gearbox/actuator mounting platform and sectional change from body to platform base.

d) Shaft/bearing bosses.

e) On Fabricated valve bodies all long and seam welds on body pressure envelope.

f) All corrosion pits depth/profiles to be recorded and photos to be taken and be included in the databook. Under no circumstances will coating be used to restore mechanical integrity damage, unless specifically agreed to by *Employer's* corrosion department representative. Pits with a depth of 3-5 mm depth can be filled with epoxy during the coating process, provided the pit/crevice does not affect the mechanical integrity of the valve body.

g) All welding on the wetted parts and all external stiffening webs will undergo surface NDT for indications (PT/MPI), before any welding repairs commence a weld repair map will be compiled, and all welding procedures WPS, etc be reviewed by the *Employer's* welding specialist.

16.1.2 Valve disc:

a) Remove any coating by means of abrasive grit blasting.

b) Casted discs: NDT (PT) the spindle boss to disc sectional change.

c) Fabricated discs: Surface NDT all welded areas (Spindle boss to disc) as well as any other welding on the disc.

d) Inspect disc for mechanical damage and corrosion damage.

e) On disassembly the shaft bore in the disc must be measured for ovality, ovality should not exceed 0.25mm on any axis of measurement, in event that this is exceeded the *Contractor* must propose a repair action to the *Employers* Engineering for approval. Repair may include the installation of a sleeve or installation oversize bearing, after the bore has been rectified.

f) On Fabricated discs inspect disc surface for any deformation.

g) Inspect shaft/bearing bosses ID for any corrosion or mechanical damage.

h) In some instances, the disc seal landing surface could be badly corroded due to the crevice or galvanic corrosion. Provided that the disc leading edge is still intact, the corrosion pits below the seal area can be filled with Epoxy as will be used for the coating of the disc, (see Figure 7). This coating repair to be agreed to by the *Employer's* corrosion department representative

i) In cases where the disc leading edge is badly affected by corrosion (see Figure 8), the following scope will apply:

   i. The disc has to be machined down to remove the corrosion damage to a depth of at least 10mm.

   ii. The width of the machined back area should at least be the same as original seal surface landing area diameter (See Figure 9). A backing ring will be manufactured as one solid piece, and not in segments to prevent corrosion between the segmented slots and the blade surface, material to be of same material type / grade as that of the disc material. In event of cast iron or ductile iron discs the spacer ring can be fabricated from Carbon steel similar to EN10028 P235GH or similar. The backing ring must be machine on the edge to conform to the off-set and off-set profile of the original disc design, to ensure that the disc angle is suitable for the triple off-set disc angle of attack.

   iii. The ring will be fastened to the disc by countersunk screws.

   iv. The back side of the backing ring will be equipped with an "O"-ring groove machined and a suitable "O"-ring will be fitted, to prevent any media to get trapped between the bottom of the ring and the disc.

v. After fitting the ring, the crevice between ring ID of the ring and OD of the disc step will be filled with coating to ensure that no open crevices exist between ring and disc interface.

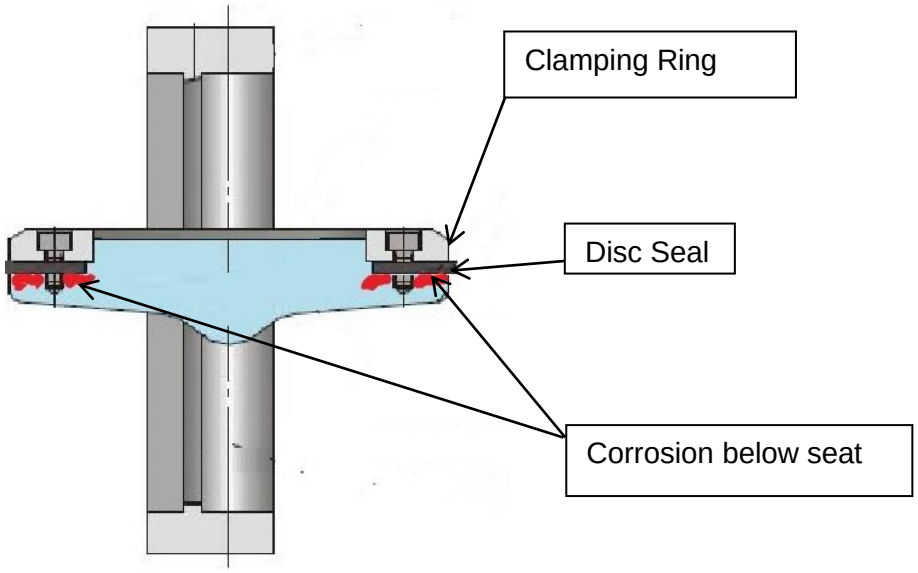

Figure 7: Disc corrosion below seal

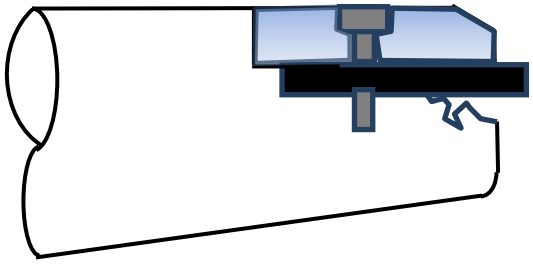

Figure 8: Disc leading edge corroded

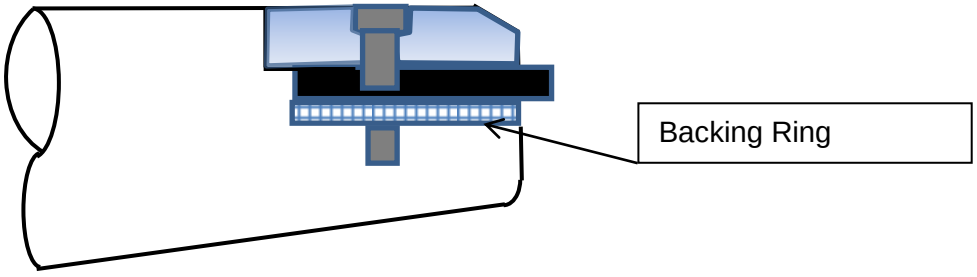

Figure 9: Disc leading edge repaired with insert

16.1.3 Disc to spindle connection

16.1.3.1 Pinned connections:

It is not common for triple off-set valves to have both shafts fixed by means of pins; however there are some designs that does not use the pin design, but uses a keyed design. Where disc to spindle connection is achieved via taper pin principle, the disc and spindle should be fitted together before the disc is assembled in the body. The taper bores have to be cleaned by reamer to ensure a perfect smooth taper, if disc and shaft is to be re-used.

New taper pins have to be fitted that match the taper pin bore exactly (slight interference). The pin's large end must be lower than the top of the disc so that a plug such as in Figure 3 can be fitted. This is to protect the pin from corrosion and to mechanically lock the pin.

On final assembly, no part of the pin must be bare. The top and bottom must be fully encapsulated in the coating.

16.1.3.2 Integral drive connections:

Both the male and female parts need to be inspected for damage of the drive splines and drive, mating areas. Should any damage be noted, the integral drive should be repaired so that no hysteresis (free play) exists between drive and disc.

On assembly this interface must be protected from the media in order to prevent corrosion.

16.1.4 Seal clamping ring:

In event that any corrosion or mechanical damage is noted on the clamping ring during dismantling of the valve, the clamping ring should then be replaced. The clamping ring will fulfil the requirements of section 3.7.3 of this document. This document only deals with the typical design where the seal is fitted in the disc, as for these low-pressure applications it is seldom that the laminated seal ring is fitted in the body.

16.1.5 Seal ring:

The seal ring can be a solid piece design or of laminated design. Due to the specific and unique leading edge angle profiles, it is imperative to obtain this seal ring from the OEM, as changing the angle of either seal ring or body seat will compromise the sealing capabilities of the valve. It is strongly advised that seat ring and seal ring are replaced in a matched set.

During refurbishment, should the seal ring be re-usable, and be of laminated design then the lamination bonding layer needs to be carefully inspected to ensure that the separate rings of the laminated seal ring are still intact. In event of any sign of delamination the seal ring must be replaced.

During installation of seal ring, it is imperative to ensure that the unique markings of the seal ring and body seat ring do align, as they are normally a matched set.

In some cases/designs seal rings can be solid and not laminated, please note that with solid rings a "bubble tight" seal cannot be guaranteed, and at best will provide a seal to EN 12266 Rate B (allowing certain a leakage).

16.1.6 Hydraulic and leakage testing after assembly

The hydraulic and leak tests after refurbishment will comply with all requirements of Section 9 of this standard, with the only exception that the hydraulic body test can be reduced to 1.1 times the design pressure.

16.1.7 Additional requirements during refurbishment

All criteria as per Section 10 through to Section 15 will apply to refurbished valves as well.

All replacement parts will comply with materials of construction as listed in Section 4

16.2 IN SITU REPAIR:

As a seal replacement is not possible with the valve installed, in situ repairs will mostly be to repair leaks on glands and flanges.

Provided the pipeline is drained and depressurized to prevent water hammer, gearbox maintenance can be performed with the valve installed. Care must be taken that the end-stop and torque limit switches on the actuator is then correctly set to ensure proper seating of valve seat and seal arrangement.

If valve is equipped with a mechanical lockout as in section 8, gearbox maintenance can be achieved with valve installed and line pressurized, however a proper risk assessment must be conducted, involving the subject matter expert from AMME.

17. TENDER EVALUATION CRITERIA

For technical Evaluation criteria the principles of section 3.4.2.2 of document 240-48929482 will be adhered to as illustrated in Table 3 below

Table 3: Qualitative evaluation criteria

Score	(%)	Definition
5	100	**COMPLIANT** • Meet technical requirement(s) AND; • No foreseen technical risk(s) in meeting technical requirements.
4	80	**COMPLIANT WITH ASSOCIATED QUALIFICATIONS** Meet technical requirement(s) with. • Acceptable technical risk(s) AND/OR; • Acceptable exceptions AND/OR; • Acceptable conditions.
2	40	**NON-COMPLIANT** • Does not meet technical requirement(s) AND/OR; • Unacceptable technical risk(s) AND/OR; • Unacceptable exceptions AND/OR; • Unacceptable conditions.
0	0	**TOTALLY DEFICIENT OR NON-RESPONSIVE**
Note 1: The scoring table does not allow for scoring of 1 and 3. **Note 2:** Foreseen acceptable and unacceptable risk(s), exceptions and conditions shall be unambiguously defined in the relevant Tender Technical Evaluation Strategy.		

Table 4: Mandatory requirements for new valves

Section	Criteria	Yes / No
15.1 & 3.2	Flange drilling as per site requirements	
15.1 & 3.3	Valve disc/blade one piece design (fabricate or casted)	
15.1 & 8	Mechanical lock out offered (if requested in scope)	

15.1	Proof with references of experience in manufacturing/refurbishment of triple off-set metal seated butterfly valves ≥ 600mm	
15.1	Basic drawing included indicating : • Outline dimensions • Weight • Material of main components • Flange drilling • Running and closing Torque	

Note: In Table 5 and Table 7, below the column for Weight is left to the discretion of the system engineer to complete. Based on the scope and specific criteria certain of the evaluation criteria might be left out or be deemed more important than others based on the actual valve condition. The system Engineer must ensure that the accumulative total of all the weights totals 100%

Table 5: Qualitative Criteria for new valves

Scope Section	Criteria	Weight	0	2	4	5
3.1.1	Face to face		Different with no adjustment adaptor		Different but spool piece / adaptor supplied	Exactly as per site
3.3	Spindle boss length		< 0.9 * shaft diameter	≥ 0.9 * shaft diameter < 1.1	≥ 1.1* shaft diameter < 1.25	≥ 1.25 * shaft diameter
3.5	Disc to shaft connection		Pins off-set to centerline of shaft / pins located with grub screw		Pins – exposed and not encapsulated	Integral drive /Pins as per scope section
3.6	Bearings seals		Non self-lubricating and with no seals	Self-lubricating without integral seals	Self-lubricating but only with seals on one end of bearing	Self-lubricating cartridge type with integral seals
3.7.2	Disc Seal (trim)		No Statement of seal design	Non laminated - solid seal design	In Disc – non - Solid seal	In Disc – laminated stainless steel
3.7.3	Seal clamping ring		Completely non-compliant	Un acceptable deviance	Acceptable deviance	Fully compliant
3.7.4	Body seat		Completely non-compliant	Un acceptable deviance	Acceptable deviance	
4	Materials of construction		No material spec given	Body or disc = grey cast iron	1 deviance & disc and body non grey cast iron	Fully compliant
7.1	Electrical actuators		No Detail given	Deviance un-acceptable	Deviance acceptable	Fully compliant
15.1	Organogram indicating Design / manufacture and QC/QA		No Organogram	Both mech and coating supplied – key persons not indicated	Both mech and coating side with minor omissions	Fully compliant
15.1	Typical QCP		No QCP	Very high level	Some minor	Detailed QCP for both

				and not detailed QCP	Omissions	mechanical and coating
10& 15	Coating procedure		No procedure	Deviances un-acceptable risk	Slight deviance but acceptable risk	Comply with requirements

Table 6: Mandatory Requirements (Refurbishment)

Section	Criteria	Yes / No
16.1.1& 16.1.2	Is NDT included on both body and disc	
16.1& 16.1.7	Proof with references of experience in refurbishment of triple off-set metal seated butterfly valves ≥ 600mm	

Table 7: Qualitative Criteria for refurbished valves

Scope Section	Criteria	Weight	0	2	4	5
	Exclusions from Scope of work		No procedure	Deviances un-acceptable risk	Slight deviance but acceptable risk	Comply with requirements
3.7& 16.1.5	Replacement seal ring & body seat		No procedure	Deviances un-acceptable risk	Slight deviance but acceptable risk	Comply with requirements
15.1& 16.1.7	Typical QCP		No QCP	Very high level and not detailed QCP	Some minor Omissions	Detailed QCP for both mechanical and coating
10& 16.1.7	Coating procedure		No procedure	Deviances un-acceptable risk	Slight deviance but acceptable risk	Comply with requirements
15.1& 16.1.7	Organogram indicating Design / manufacture and QC/QA		No QCP	Very high level and not detailed QCP	Some minor Omissions	Detailed QCP for both mechanical and coating

18. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Turbine Plant Study Committee	
Nicolaas Hallatt	Chief Engineer, Duvha Power Station Member of Turbine Plant Study Committee Member of Feedheating and Condensers Care Group
Gary de Klerk	Chief Engineer, Asset Management Mechanical Engineering Member of Turbine Plant Study Committee Member of Feedheating and Condensers Care Group
Duduzile Ramasimong	Corporate Specialist, Asset Management Mechanical Engineering Member of Turbine Plant Study Committee
Joe Roy-Aikins	Chief Engineer, Kusile Power Station Member of Turbine Plant Study Committee
Francois du Preez	Corporate Consultant, Asset Management Mechanical Engineering Member of Turbine Plant Study Committee Member of Feedheating and Condensers Care Group Member of ACC's and Cooling Towers Care Group
Noel Lecordier	Senior Consultant, Asset Management Mechanical Engineering Member of Turbine Plant Study Committee
Phuti Ngoetjana	Senior Advisor, Asset Management Maintenance Member of Turbine Plant Study Committee
Kapil Sukhnandan	Middle Manager, Asset Management Maintenance Member of Turbine Plant Study Committee
Felicia Ramela	Chief Engineer, Asset Management - Physical Metallurgy & Structural Integrity Member of Turbine Plant Study Committee
Sydney Mhlana	Chief Technologist, Matla Power Station Member of Turbine Plant Study Committee
Gugu Ngcobo	Corporate Specialist, Asset Management Mechanical Engineering Member of Turbine Plant Study Committee
Daniel van Tonder	Senior Engineer, Duvha Power Station Member of Turbine Plant Study Committee
Senamile Nzama	Engineer, Asset Management Mechanical Engineering Member of Turbine Plant Study Committee
Reinaldo da Veiga	Engineering Manager, Rotek, Turbo Gen Services Member of Turbine Plant Study Committee
Herman van Niekerk	Senior Consultant, Asset Management Mechanical Engineering Member of Turbine Plant Study Committee Member of Feedheating and Condensers Care Group
Dave Johnson	Chief Engineer, Mechanical, Asset Management Peaking

	Member of Turbine Plant Study Committee
Wynand Cilliers	Senior Engineer, Peaking Turbine Systems Engineering Member of Turbine Plant Study Committee
Abel Rudman	Senior Engineer, Camden Power Station Member of Feedheating and Condensers Care Group
Stefan Erasmus	Chief Technologist, Duvha Power Station Member of Feedheating and Condensers Care Group
Krishnee Ramalingum	Senior Technologist, Lethabo Power Station Member of Feedheating and Condensers Care Group
Mike Amir	Senior Consultant, Asset Management Mechanical Engineering Member of Feedheating and Condensers Care Group
Takalane Tose	Technician, Arnot Power Station Member of Feedheating and Condensers Care Group
Keith Northcott	Senior Consultant, RT&D Member of Feedheating and Condensers Care Group
Preetha Sewlall	Snr Process Engineer, Duvha Power Station Member of ACC's and Cooling Towers Care Group
Gontse Mathibedi	Senior Engineer Condenser and CW system, Kriel Power Station Member of ACC's and Cooling Towers Care Group
Nathi Mabaso	Auxiliary System Engineer, Tutuka Power Station Member of ACC's and Cooling Towers Care Group
Zain Karodia	Turbine Systems Engineer, Matla Power Station Member of ACC's and Cooling Towers Care Group
Carl Kohrs	Condensate System Engineer, Arnot Power Station Member of ACC's and Cooling Towers Care Group
Katlego Mathibedi	LPS System Engineer, Medupi Power Station Member of ACC's and Cooling Towers Care Group
Thandekani Ngcobo	CW System Engineer, Arnot Power Station Member of ACC's and Cooling Towers Care Group

19. REVISIONS

Date	Rev.	Compiler	Remarks
May 2013	0	HC van Niekerk	New document drafted for review
July 2013	1	HC van Niekerk	Released for Approval
June 2017	1.1	HC van Niekerk	Review to revision 2.
September 2017	1.2	HC van Niekerk	Final Draft Document for Comments Review
October 2017	1.3	HC van Niekerk	Updated Final Draft after Comments Review Process
October 2017	2	HC van Niekerk	Final Rev 2 Document for Authorisation and Publication
June 2022	2.1	HC van Niekerk	Update to rev 3. International standards were reviewed and reference to those made in this standard, Eskom does require specific details not covered by international

Date	Rev.	Compiler	Remarks
			generic butterfly valve standards, and thus it is not possible to adopt an international standard to replace this Eskom standard
June 2022	2.2	HC van Niekerk	Final Draft after Comments Review Process
June 2022	3	HC van Niekerk	Final Rev 3 Document for Authorisation and Publication

20. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- HC v Niekerk
- AF du Preez
- KP Northcott

21. ACKNOWLEGEMENTS

None