



## Engineering Services

# Technical Standard TS 0230

## Gate and Butterfly Valve Requirements

Revision: 3.0  
Date: 06/03/17  
Status: Issued

Document ID: SAWS-ENG-0230

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Only the current revision of this Standard should be used which is available for download from the SA Water website.

## Significant/Major Changes Incorporated in This Edition

Substantial re-working of existing TS140.

## Document Controls

### Revision History

Revision	Date	Author	Comments
1	2010	G Rosser	TS140 issued for use
2	26/08/2016	M Stephens	Re-drafted and expanded – renamed TS 0230
3	17/02/2017	M Stephens	All review comments from SA Water and Allwater reviewers addressed

Template: Technical Standard Version 6.00, 10/05/2016

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# 1 Introduction

This introductory section describes the purpose and scope of SA Water Technical Standard (TS) 0230 and also contains a glossary of terms and references.

## 1.1 Purpose

This Technical Standard is intended to be referenced in the technical specification, procurement, testing and delivery of gate and butterfly valves (of all types and for all purposes) of all diameters. In the case of land development, and only for valves less than DN375mm, the application of this Technical Standard may be varied with reference to the scope and application of the SA Water Approved Products List provided the valves are used for isolation purposes only in gravity water reticulation systems. Gate and butterfly valves that are used for purposes other than isolation (e.g., control or other hydraulic regulation) are subject to the requirements of this document and not the SA Water Approved Products List (regardless of their diameter).

## 1.2 Glossary

The following glossary items are used in this document:

Term	Description
Actuation	One actuation is equal to the minimum of either the number of times the valve is fully closed (sealed) after opening, or fully opened from closed, or an accumulation of the percentage movements of a modulating valve up to the percentage required to fully stroke the valve from open to closed.
AS	Australian Standard
SA Water	South Australian Water Corporation
TS	SA Water Technical Standard
WSA	Water Services Association
Designer and/or contractor	The entities that undertake the design, specification, vendor negotiations, purchasing, construction installation and/or operational testing of the valves (can be either external or internal to SA Water)
Vendor	The supplier (re-seller) and/or factory manufacturer of the valves (not always the same entity) – the information required of the vendor under this Technical Standard must be obtained from the supplier (re-seller) and/or factory manufacturer as “vendors” as required

## 1.3 References

### 1.3.1 Australian and International

The following table identifies Australian and International standards and other similar documents referenced in this document:

Number	Title
AS 4680-2006	Hot-dip galvanised (zinc) coatings on fabricated ferrous articles
AS 1214-1983	Hot-dip galvanised coatings on threaded fasteners (ISO metric coarse thread series)
AS 2382-1981	Surface roughness comparison specimens
AS 2638.1-2011	Gate valves for waterworks purposes – Part 1: Metal seated
AS 2638.2-2011	Gate valves for waterworks purposes – Part 2: Resilient seated
AS 3894.1-2002	Site testing of protective coatings - non-conductive coatings - continuity testing - high voltage ('brush') method
AS 3894.3-2002	Site testing of protective coatings - determination of dry film thickness
AS/NZS 4020-2005	Testing of products for use in contact with drinking water
AS 4024.1601-2006	Safety of machinery - Design of controls, interlocks and guarding - Guards - General requirements for the design and construction of fixed and movable guards
AS 4024.1602-2006	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
AS 4024.1603-2006	Safety of machinery - Design of controls, interlocks and guards - Prevention of unexpected start-up
AS 4024.1604-2006	Safety of machinery - Design of controls, interlocks and guarding - Emergency stop - Principles for design
AS/NZS 4087-2011	Metallic flanges for waterworks purposes
AS 4795.1-2011	Butterfly valves for waterworks purposes – Part 1: Wafer and lugged
AS 4795.2-2011	Butterfly valves for waterworks purposes – Part 2: Double flanged
AS 5612-2013	Butterfly valves for general purposes
AS 6401-2003	Knife gate valves for waterworks purposes
AS 1646-2007	Elastomeric seals for waterworks purposes
WSA 03-2011 v3.1	Water Supply Code of Australia
WSA 04-2005 v2.1	Sewage Pumping Station Code of Australia
WSA 101-2008	Sewage Pumping Station Code of Australia

### 1.3.2 SA Water Documents

The following table identifies the SA Water standards and other similar documents referenced in this document:

Number	Title
TS 27 (new number TS 0202)	Bolt Tightening Procedure for Mechanical Plant
TS 59 (new number TS 0201)	Specification for EWS Departmental Flanges - 1983 (Reference Specification Only)
TS 15 (new number TS 0401)	Protection of Steelwork In Submersible Environments
TS 16 (new number TS 0400)	Protection of Steelwork In Atmospheric Environments
TS 18 (new number 0402)	Protection of Steelwork In Buried Environments
TS 98 (new number TS 0403)	Surface Preparation and Protection of Cast Iron Using Potable Water Approved Ceramic Filled Solventless High Build Epoxy
TS 147 (new number TS 0240)	Surge Mitigating Infrastructure
TS155 (new number TS 0101)	Safety in Design

### 1.4 Definitions

The following definitions are applicable to this document:

Term	Description
SA Water's Representative	The SA Water representative with delegated authority under a Contract or engagement, including (as applicable): <ul style="list-style-type: none"> <li>• Superintendent's Representative (e.g. AS 4300 &amp; AS 2124 etc.)</li> <li>• SA Water Project Manager</li> <li>• SA Water nominated contact person</li> </ul>
Responsible Discipline Lead	The engineering discipline expert responsible for TS 0230 defined on page 3 (via SA Water's Representative)

## 2 Scope

This Technical Standard must be applied in conjunction with all the requirements identified in the relevant Australian Standards for gate and butterfly valves as listed in clause 1.3.1. Valves supplied to SA Water must meet all of the requirements in the Australian Standards listed in clause 1.3.1. This Technical Standard is to be applied in addition to the requirements of the Australian Standards. In a number of areas, there is no overlap between the Australian Standards and this Technical Standard. In other areas, this Technical Standard provides direction in the event that the Australian Standards contain options. However, if a conflict between the requirements of this Technical Standard and those of the Australian Standards arises then SA Water must be supplied with a written description of the details of the conflict by the designer and/or contractor and SA Water will provide a clarification within 10 working days of receiving the notification of the conflict from the designer and/or contractor. No valve shall be procured if there is a potential conflict between the requirements of the Australian Standards and this Technical Standard.

## 3 Valve Applications

### 3.1 Gates and Knife Gate Valves

#### 3.1.1 Resilient Seated Gate Valves

Resilient seated gate valves can be used in water and wastewater systems where pressures are less than or equal to PN16.

Resilient seated gate valves, used for either isolation and/or control, should only be provided with an actuator when the designer and/or contractor has confirmed in writing, using a valve datasheet (refer to SA Water typical gate valve datasheet), the number of actuations and proposed functional operation for the resilient seated gate valve over its design life, and acceptance of these requirements by the vendor, before it is procured.

#### 3.1.2 Metal Seated Gate Valves

Metal seated gate valves are required in water and wastewater systems where pressures exceed PN16 or for specialist applications identified by SA Water.

Metal seated gate valves, used for either isolation and/or control, can be provided with an actuator when the designer and/or contractor has confirmed in writing, using a valve datasheet (refer to SA Water typical gate valve datasheet), the number of actuations and proposed functional operation for the metal seated gate valve over its design life, and acceptance of these requirements by the vendor, before it is procured.

#### 3.1.3 Knife Gate Valves

Knife gate isolation valves can be used for water and wastewater installations where pressures are less than or equal to PN10 and must seal with less than 10m of differential pressure across the valve gate.

Knife gate valves should not be used where the valves are required for isolation and are actuated more than once per month for maintenance work.

Where the number of actuations required to achieve the operational duty of the valve exceeds once per month and/or the pressures are greater than PN10 knife gate valves with specific features to enable the performance specifications to be met can be used provided the vendor contractually commits to an extended 5 year functional warranty for the valve from the date of first operation of the valve after installation (i.e., a warranty that covers the function of the valve under all operational

circumstances communicated to the vendor by the designer and/or contractor for the period of 5 years).

Knife gate valves must not be used as control valves unless the designer and/or contractor has obtained information from a valve vendor supporting the use of the valve as a control valve and the designer and/or contractor makes a written submission recommending the use of a knife gate valve as a control valve to SA Water.

## 3.2 Butterfly Valves

### 3.2.1 Concentric (Single Axis) Butterfly Valves

Concentric butterfly isolation valves are used for potable, raw or recycled water installations where pressures are less than or equal to PN16 and uni-directional sealing is required.

Concentric butterfly isolation valves should not be used where the valves are required for either isolation and/or control and are actuated more than once per three months for maintenance work unless specific seal on disc or seal on body features are offered by the vendor which enable actuation at more than once per three months without damage to the valve (seal, liner and/or any other component). The designer and/or contractor must confirm in writing, using a valve datasheet (refer to SA Water typical butterfly valve datasheet), the number of actuations and proposed functional operation for the concentric butterfly valve over its design life, and acceptance of these requirements by the vendor, before it is procured.

The specification of a vulcanised liner is required for valves which are actuated more than once per month. The frequency of actuation shall be determined by the designer and/or contractor based on the functional requirements agreed with SA Water in the case of new valves (including replacement of existing valves with a change in actuation frequency) and based on existing operational data in the case of replacement of existing valves with no change in actuation frequency.

The number of actuations required for maintenance work and/or operational purposes must be less than the maximum number of actuations nominated by the valve vendor over the design life referred to in clause 4.1 (or greater if required by the requirements of a project brief or known operational circumstances).

### 3.2.2 Single Offset Butterfly Valves

Single offset butterfly valves are configured such that the disc shaft is offset downstream of the valve seat plane (i.e., offset in the direction further into the valve body) to facilitate sealing contact around the circumference of the valve seal.

Single offset butterfly valves are used for potable, raw or recycled water installations where pressures are less than or equal to PN16 and uni-directional sealing is required.

Single offset butterfly isolation valves should not be used where the valves are required for either isolation and/or control and are actuated more than once per three months for maintenance work unless specific seal on disc or seal on body features are offered by the vendor which enable actuation at more than once per three months without damage to the valve (seal, liner and/or any other component). The designer and/or contractor must confirm in writing, using a valve datasheet (refer to SA Water typical butterfly valve datasheet), the number of actuations and proposed functional operation for the single offset butterfly valve over its design life, and acceptance of these requirements by the vendor, before it is procured.

The specification of a vulcanised liner for seal on body valves is required for valves which are actuated more than once per month.

The number of actuations required for maintenance work and/or operational purposes must be less than the maximum number of actuations nominated by the valve vendor over the design life referred to in clause 4.1 (or greater if required by the requirements of a project brief or known operational circumstance).

### 3.2.3 Double Offset Butterfly Valves

Double offset butterfly valves are configured such that the disc shaft is offset downstream of the valve seat plane and below the pipe and valve centreline such that interference is minimised on the opening and closing of the valve.

Double offset butterfly valves are used for potable, raw or recycled water installations where pressures are less than or equal to PN35 and/or bi-directional sealing is required.

Double offset butterfly isolation valves can be used where the valves are required for isolation and/or control and the number of actuations, for maintenance work and/or operational purposes, is less than the maximum number of actuations nominated by the valve vendor over the design life referred to in clause 4.1 (or greater if required by the requirements of a project brief or known operational circumstances). The designer and/or contractor must confirm in writing, using a valve datasheet (refer to SA Water typical butterfly valve datasheet), the number of actuations and proposed functional operation for the double offset butterfly valve over its design life, and acceptance of these requirements by the vendor, before it is procured.

### 3.2.4 Triple Offset Butterfly Valves

Triple offset butterfly valves are configured similarly to double offset butterfly valves, in terms of relative disc shaft location, with the addition of a seating cone surface and axis offset from the disc shaft centreline such that a seating ellipse results and friction is minimised on the opening and closing of the valve.

Triple offset butterfly valves can be used for potable, raw or recycled water installations where pressures are less than PN35 and/or bi-directional sealing is required.

Triple offset butterfly isolation valves can be used where the valves are required for isolation and/or control and the number of actuations, for maintenance work and/or operational purposes, is less than the maximum number of actuations nominated by the valve vendor over the design life referred to in clause 4.1 (or greater if required by the requirements of a project brief or known operational circumstance). The designer and/or contractor must confirm in writing, using a valve datasheet (refer to SA Water typical butterfly valve datasheet), the number of actuations and proposed functional operation for the double offset butterfly valve over its design life, and acceptance of these requirements by the vendor, before it is procured.

Triple offset butterfly valves are not generally used by SA Water.

## 4 Design Requirements

The word design, as used in TS 0230, refers to the specification of the configuration, selection and sizing of equipment to achieve required hydraulic and operational outcomes.

### 4.1 Design Life

The minimum design life of a gate or butterfly valve body (including welded overlay seats), flanges and other cast components shall be 50 years.

The minimum design life of components which are expected to require periodic maintenance or replacement, as notified by the designer and/or contractor to SA Water, before the procurement of any valve, shall be 25 years.

The designer and/or contractor must seek from the proposed valve vendor information regarding the design life of all parts of the valve and if there are departures from the design life identified in this clause for specific components then the shorter design life and maintenance or replacement period for the identified specific components shall be provided by the vendor to the designer and/or contractor for assessment. Any shorter design life identified for specific components must be communicated by the designer and/or contractor to SA Water for endorsement before any valve is procured. SA Water may require the designer and/or contractor to provide a detailed maintenance schedule with estimated present day costs before any valve is endorsed.

SA Water typical gate and butterfly valve datasheets may be used (and modified as required) by the designer and/or contractor preparing the specifications to identify valve components for which the vendor must provide information to assist in confirming the design life of the valve body, flanges and other cast components as well as components which require periodic maintenance or replacement.

### 4.2 Selection of Type of Valve

Valve selection considerations include but are not limited to:

- Type of water or wastewater

The type of valves the designer and/or contractor can specify may be restricted depending on the type of water or wastewater in which the valves must achieve full operational functionality over their design life without any more maintenance than identified by the valve vendor, in accordance with the requirements of this Technical Standard, prior to the procurement of the valves. The designer and/or contractor, or valve vendor, must obtain information on the physical and chemical characteristics of the water or wastewater from SA Water as stipulated in this Technical Standard. For example, a gate valve may be required instead of a butterfly valve for raw water applications and this gate valve may require a metal rather than resilient seat depending on the physical and chemical characteristics of the raw water. It is the responsibility of the designer and/or contractor to identify the correct type of valve for a particular application or to contractually transfer this responsibility to the valve vendor.

- Required design life

The minimum required design life for all valves is nominated under clause 4.1 above. However, the designer and/or contractor must obtain written confirmation from SA Water that there are no particular operational and/or maintenance circumstances, for a particular model or type of valve, that require the valves the designer and/or contractor is specifying and/or supplying to have a design life longer than the minimum periods identified in clause 4.1. The outcome of this assessment may restrict the type of valves the designer and/or contractor can specify that will meet the design life requirements.

- Operational requirements

The type of valves the designer and/or contractor can specify may be restricted depending on the operational requirements for the valves must fully perform over their design life without any more maintenance than identified by the valve vendor, in accordance with the requirements of this Technical Standard, prior to the procurement of the valves. The designer and/or contractor, or valve vendor, must obtain information regarding the operational requirements for the valves, including the criticality of the valve when it needs to be operated (and consequences if the valve fails to operate as required), from SA Water, and take this into account prior to the procurement of the valves. It is the responsibility of the designer and/or contractor to identify the correct type of valve for particular operational requirements (and criticality) or to contractually transfer this responsibility to the valve vendor.

- Maintenance requirements

The types of valves the designer and/or contractor can specify may be restricted depending on the maintenance requirements for the valves to fully perform over their design life. The designer and/or contractor must inform the valve vendor of all of the requirements of this Technical Standard, including information regarding the operational requirements and the environment in which the valves must operate, and then obtain information from the vendor regarding the maintenance requirements for the valves offered by the vendor. The designer and/or contractor is responsible for ensuring all operational and environmental information is transmitted to the vendor and that the maintenance requirements for any valves offered are transmitted from the vendor to SA Water prior to the procurement of any valves. The designer and/or contractor is responsible for ensuring that the valves procured do not have maintenance requirements that are unacceptable to SA Water.

- Safety requirements

The types of valves the designer and/or contractor can specify must account for the following non-exhaustive list of considerations:

- The physical space required for the size of valve nominated by the vendor, including all connected elements (e.g., bypasses), and whether the safe access can be achieved around the valve once installed in its intended location (e.g., building (new or existing) and/or chamber)
- The method for installation and removal of the valve (whether during construction and/or later maintenance) and the weight of the valve, lifting methods (requirements for crane or other lifting device) and whether safe manoeuvring of the valve is always practical
- The use of gearboxes to ensure that, in the case of manual actuation of the valve, excessive torque is not required (torque limits for manual actuation are specified in the SA Water typical gate and butterfly valve datasheets)

Requirements for single or double isolations using valves before work in spaces that may otherwise be inundated without the isolation are discussed in section 4.5.12 which relates to safe isolations.

Safety in Design and HAZOP workshops should be held, when the SA Water requirements for these workshops to be conducted are triggered under SA Water TS155, and the safety assessment of valves undertaken within these processes.

## 4.3 Materials Selection

The designer and/or contractor must confirm in writing, using a valve datasheet (refer to SA Water typical gate and butterfly valve datasheets), the materials proposed for all valve components before the purchase of any valve. In many instances, a general arrangement drawing from the vendor of the valve identifying each component and the material it is made of will be helpful and the designer and/or contractor must request this drawing from the vendor and provide a copy to SA Water. The SA Water typical gate and butterfly valve datasheets will, for some valve components (in particular critical performance and/or wetted components), request minimum grades of materials be provided in any supplied valve. These SA Water nominated materials should not be varied in the supplied valves unless the designer and/or contractor determines the technical reasons for the departure and specifically obtains from the vendor a statement that the alternative materials offered will meet the design life and warranty requirements of this Technical Standard. The designer and/or contractor must ensure that the vendor completes all responses, including material specification responses, required in the valve datasheet (returnable schedule) which forms part of the basis for entering into the contract to purchase the valve.

If there are functional performance implications (including operational failure through to excessive maintenance of or replacement of components) associated with the choice of one component material instead of another then the designer and/or contractor must determine what these are and fully inform SA Water before any valve is purchased. Minimum material hardness and nobility separations for components in direct contact must be specified by the designer and/or contractor and supplied by the vendor to avoiding galling (due to mechanical contact) or dissimilar metal corrosion. Minimum hardness and nobility separations for components in close physical proximity where there is risk of galling or dissimilar metal corrosion that will reduce the design life of the components must be identified by the designer and/or contractor and supplied by the vendor.

## 4.4 Pressure Rating

### 4.4.1 Typical Pressure Ratings

The typical pressure ratings to be considered by the designer and/or contractor are PN16, PN21 and PN35 in accordance with AS4087 (which relates to flanges).

Where valves are offered by vendors with alternative PN25 and PN40 pressure ratings these are acceptable provided the offered pressure rating is greater than the requirement for all possible design actions (loads, forces and other conditions) and operational configurations (including emergency contingency system requirements).

Flange drilling patterns for PN25 and PN40 valves will generally be at variance with those for connected pipe spools to AS 4087 and the designer and/or contractor must take this into account and specify appropriate custom connection details.

The designer and/or contractor must take account of the specific flange thickness of any valve offered by a vendor.

## 4.4.2 Minimum Pressure Rating

SA Water has established, for operational and maintenance purposes, a minimum pressure rating of PN16 for all gate and butterfly valves less than 375mm in diameter in SA Water's pressurised water supply networks.

SA Water has established, for operational and maintenance purposes, a minimum pressure rating of PN16 for all gate valves less than 200mm in diameter in SA Water's pressurised wastewater pumping mains.

For gate and butterfly valves in water systems greater than 375mm in diameter, and gate valves in wastewater pumping mains greater than 200mm in diameter, the designer and/or contractor may specify lower pressure ratings down to a limit of PN10 if it is demonstrated that the lower pressure rating is sufficient for all possible design actions (loads, forces and other conditions) and operational configurations (including emergency contingency system requirements).

## 4.5 Hydraulic and Operational Conditions

### 4.5.1 General Hydraulic Data

The complete range of operating conditions for the valve(s), including emergency contingency system requirements, must be identified by the designer and/or contractor and all hydraulic conditions identified including:

- Maximum flow (instantaneous and sustained/continuous)
- Minimum flow (instantaneous and sustained/continuous)
- Flow direction (one-way or two-way)
- Maximum pressure (under static, steady state and surge conditions)
- Minimum pressure (under static, steady state and surge conditions) and including negative pressure(s)
- Maximum differential pressure and the direction of application of this pressure (instantaneous and sustained/continuous)

The designer and/or contractor should confirm in writing, using a valve datasheet (refer to SA Water typical gate and butterfly valve datasheets), the hydraulic conditions to which any valve is proposed to be subject and the acceptance of these conditions by the vendor, before it is procured.

The range of operating conditions for any bypass valve(s) associated with the main valve, including emergency contingency system requirements, must also be identified by the designer and/or contractor.

### 4.5.2 Cavitation Data

The cavitation index for the valve(s), including the main valve and any bypass valve, under the following hydraulic and operational circumstances, must be determined by the designer and/or contractor:

- Maximum instantaneous (shorter than 180s) differential pressure across the valve (under any flow condition)
- Maximum sustained/continuous (longer than 180s) differential pressure across the valve (under any flow condition)

The cavitation index must be determined for the main and bypass valves, for the above hydraulic and operational circumstances, regardless of whether the valve is to be used for either isolation and/or control and is actuated (or not).

The cavitation index shall be calculated using the following equation for each hydraulic and operational circumstance:

$$\sigma = \frac{P_d - P_v}{P_u - P_d}$$

where  $\sigma$  = cavitation index,  $P_d$  = downstream pressure,  $P_v$  = vapour pressure and  $P_u$  = upstream pressure

Pressures, and not hydraulic grades, must be used with the same units and relative to the same level datum.

The designer and/or contractor should confirm in writing, preferably using a valve datasheet (refer to SA Water typical gate and butterfly valve datasheets), the calculated cavitation indices, and time of intended operation under each condition, and the acceptance of these conditions by the vendor (including confirmation by the vendor that design life requirements will be met for the valve operating under the specified conditions), before any valve is procured.

### 4.5.3 Number and Speed of Actuations

An actuation is defined as either one full stroke of a valve from closed to fully open (i.e., 100% open) or fully open to closed.

The number of actuations required of a valve over its design life must be identified by the designer and/or contractor and included in a valve datasheet (refer to SA Water typical gate and butterfly valve datasheets). The designer and/or contractor must confirm that the valve offered by a vendor can achieve the required number of actuations before any valve is procured.

If a valve vendor requires valve configuration and/or specific component changes to achieve a total number of actuations over the design life of the valve then the designer and/or contractor must inform SA Water of the changes required to achieve the total number of actuations.

If a valve is used for flow or pressure modulation (e.g., a water treatment plant control valve) and is only modulated through a proportion of the valve's full stroke per operation then the number of operations and percentage of the full stroke of the valve for each of these operations shall be used by the designer and/or contractor to determine the number of equivalent full stroke actuations required over the design life of the valve.

The designer and/or contractor must seek historical operational data from SA Water for any actuated valve that is a replacement for an existing valve and this data shall be interpreted and included in the datasheet provided to the vendor for a new replacement valve.

The speed of actuation is the time taken for the valve to operate from closed to fully open or fully open to closed if the rate of operation of the actuator is linear (i.e., the actuator rpm is constant). If the rate of operation of the actuator is non-linear, as the valve is operated from closed to fully open or fully open to closed, then the pattern of speed variation shall be documented by the designer and/or contractor and the purpose for varying the speed explained to SA Water before any valve or actuator is purchased and the non-linear rate of operation implemented.

### 4.5.4 Hydraulic Control Sensitivity and Losses

The relationship between the degree open (or position), differential head (or pressure) across and flow (or discharge) through a valve must be considered by the designer and/or contractor in the context of the functional (operational) requirements for the valve and the specification developed to ensure the functional requirements are met. SA Water typical valve datasheets require that valve vendors provide curves showing the degree open, differential head across and flow through valves. Curves showing the relationship between the Cv (or Kv) value plotted against the degree open for the

valve may be provided by valve vendors as part of satisfying the requirements under this curve (the method of derivation of Cv (or Kv) values and their units must be provided by the valve vendor to the designer and/or contractor) These curves must be calibrated based on actual valve tests and not solely theoretically developed by the vendor and should be requested by the designer and/or contractor for all isolation and/or control valves to be procured.

Curves for control valves must be assessed by the designer and/or contractor upon receipt from potential valve vendors to determine whether the sensitivity of the valve at different degrees open, with different differential heads and/or flows through the valve are appropriate for the functional requirements and use the curves to make comparisons between different valves that are offered during the procurement process. The designer and/or contractor must confirm that any valve to be procured meets the sensitivity requirements determined by the designer and/or contractor. Valves with more control sensitivity are preferred. The control valve curves shall be forwarded to SA Water for its records.

Curves for isolation valves should be assessed by the designer and/or contractor upon receipt from potential valve vendors to confirm functional requirements can be met. The isolation valve curves shall be forwarded to SA Water for its records.

The designer and/or vendor must use the curves supplied by the valve vendors to confirm the hydraulic losses across the valves when operated to their various degrees of opening as either control and/or isolation valves. The designer and/or contractor must confirm that the magnitude of loss across any valve will not prevent the operation of the system in which the valve is installed (e.g., loss will not exceed a magnitude at which minimum pressures and/or flows are not delivered in a system). Valves with the least hydraulic loss in the full open position may be preferred and this characteristic must be considered by the designer and/or contractor, in the context of other technical characteristics of the valves, before a technical selection is finalised.

#### 4.5.5 Straight Upstream and Downstream Pipe Lengths

The designer and/or contractor must provide valve vendors a complete description of the layout and functional requirements of a system (where available) in which new or replacement valves are proposed as part of the specification and/or datasheets issued for the purpose of procuring the valves. This description must ensure that the valve vendor is able to assess whether the hydraulic and/or other conditions associated with the installation will be suitable for the valve that is proposed (e.g., the vendor must have enough information such that the minimum upstream and downstream straight pipe lengths of the valve that are required can be confirmed). The designer and/or contractor is responsible for verifying the assessment undertaken by the valve vendor and ensuring that there are no hydraulic and/or other mechanisms which will invalidate the vendor's assessment.

Alternatively, the designer and/or contractor must request the hydraulic and/or other conditions that are required for the vendor's valves to meet the design life and functionality requirements of this Technical Standard. The designer and/or contractor must request this information using the specification and/or datasheets for the valves. The designer and/or contractor is then responsible for ensuring the hydraulic and/or other conditions specified by the valve vendors are satisfied and that the valve will not shorten the design life and/or impinge on the functionality of other physical elements (e.g., pumps, other valves, pipes and/or any other element forming part of the system).

#### 4.5.6 Time to Open/Close

The time to open and/or close any valve must be specifically determined by the designer and/or contractor over the entire range of operational conditions under which the valve needs to function throughout its design life. In making this determination, the designer and/or contractor must take into account:

- The hydraulic requirements of the system into which the valve is to be installed including, but not limited to, surge minimisation (consistent with SA Water TS147 and any other design practice that will avoid damage to either the system into which the valve is installed or the valve itself)
- The hydraulic, mechanical and/or any other requirements of the valve or associated gearbox and/or actuator (including timers for actuators) such that the equipment specified by the designer and/or contractor and supplied by the vendor is able to function over the required operating range throughout the design life (for the valve, gearbox, actuator and/or any other supplied equipment)

In the case of valves used for control, from pumps or otherwise, the designer and/or contractor must take into account the requirements of the pumps and/or equipment, other than the control valve, which interact with the control valve to achieve the desired hydraulic action of the system during start up, steady state operation and/or stopping. The designer and/or contractor must ensure that the valve vendor is informed of the intended use of the valve as a control valve and provide specific information regarding the flows, differential pressures, opening duration, closing duration, upstream/downstream straight lengths and any other relevant information that is required to ensure the valve vendor can specify a valve that will function operationally over the valve's entire design life. The designer and/or contractor must pass information regarding the technical details of intended control valve back to the pump and/or other equipment vendors (or SA Water Workshop maintenance group in the case of existing equipment) to ensure that all elements in the final operating system are compatible and will function operationally over each piece of equipment's respective design life.

#### 4.5.7 Gearboxes

Gearboxes shall be IP68 rated where direct buried and IP56 rated for other installation environments where the designer and/or contractor determines that an IP56 rating is sufficient to achieve the design life and functional operation requirements stipulated in this Technical Standard. The designer and/or contractor shall determine the requirement for and specification of additional protective wrappings for gearboxes in all installation environments.

Gearbox shall be specified and supplied in accordance with the applicable clauses within this Technical Standard including those relating to design life, maintenance requirements and safety (e.g., gearbox ratios to achieve permissible manual actuation torques).

#### 4.5.8 Seat Velocities, Wear and Sealing

The range of hydraulic and other functional conditions, including the durations throughout a valve's design life through which the valve will be operated at less than fully open positions, must be identified by the designer and/or contractor in the specification and/or datasheet for the valves. The vendor must provide curves for any proposed valve showing the degree open, differential head across and flow through valve (see clause 4.5.4 of this Technical Standard). The vendor must also provide specific information demonstrating the wear resistance of the seat of any valve that the vendor proposes in response to a specification and/or datasheet. The resistance that is required is against hydraulic erosion and/or mechanical wear of the metal, epoxy coating, rubber insert and/or any other valve seat component during the operation of the valve under any specified hydraulic condition and/or in any operating position for the durations identified in the specification. The required resistance must be sufficient for the operational requirements of the valve to be fulfilled over its entire design life. The designer and/or contractor must confirm that the information provided by a valve vendor confirms that the operational requirements of the valve will be fulfilled over its design life before any valve is procured.

The physical (e.g., erosion potential) and chemical characteristics of the relevant fluid in a system must be identified by the designer and/or contractor in accordance with the requirements of this Technical Standard and this information supplied to the valve vendor so that it can be taken into account in determining the valve seat configuration that will ensure the operational requirements of the valve are fulfilled over its entire design life. The information provided by the designer and/or contractor must be used by the vendor to confirm that physical and chemical characteristics of the relevant fluid will not adversely affect the valve sealing. The vendor must recommend valve seat configurations that will continue to seal over the design life of the valve taking into account the information provided by the designer and/or contractor.

Misalignment between the internal diameter of a valve and the internal diameter of the connected pipework (whether coated, lined and/or otherwise) upstream and/or downstream of the valve is not preferred as such misalignment can significantly increase the erosion potential in the valve seat and/or for the connecting flanges (i.e., both valve and pipe flanges). The designer and/or contractor must identify alternative options for avoiding the misalignment including the use of customised pipes spools in the event that a valve cannot be selected with an internal diameter that matches the internal diameter of the connected pipework. If a misalignment is unavoidable then the designer and/or contractor is to inform the valve vendor of the misalignment and obtain confirmation from the valve vendor that the misalignment will not impinge on the operational functionality of the valve and/or reduce its design life (e.g., the internal coating specification could be modified). The designer and/or contractor must ensure that the pipework connected to the valve is not damaged by any misalignment and inform SA Water of the reasons why a misalignment is unavoidable.

#### 4.5.9 Thrust – Through Body and Flanges or Other End Connections

Thermal stresses and displacements in a valve must be determined by the designer and/or contractor and this information must be provided to the valve vendor to ensure that the valve is able to meet its required design life. Thermal stresses and displacements in the pipework connected to the valve must also be determined by the designer and/or contractor and the pipework must be able to withstand these stresses and displacements, in addition to all other load actions, over the design life of the pipework. Thermal stresses and displacements must be determined by the designer and/or contractor using the range of conditions and temperatures identified in Table 4.1 based on the following installation temperature ranges:

- above ground installation temperature range: 12°C to 20°C
- below ground installation temperature range: 13°C to 27°C

The use of flexible and/or dismantling joints to accommodate thermal expansion and/or contraction in the bypass pipework and/or the effect of thermal expansion and/or contraction in the pipework connected to the valve must be considered by the designer and/or contractor. If flexible and/or dismantling joints are not specified by the designer and/or contractor then the reasons for this must be documented by the designer and/or contractor.

**Table 4.1 Installation Temperatures**

Valve (and Pipe) Location	Full or empty	Variation from Installation Temperature*
Above ground (full or part sun)	Empty	-20°C to +43°C
Above ground (full or part sun)	Full	-15°C to +31°C
Above ground (total shade)	Empty	-20°C to +35°C
Above ground (total shade)	Full	-15°C to +23°C
Below ground	Empty	-18°C to +18°C
Below ground	Full	-18°C to +18°C

\*based on historical SA Water guidelines and earlier technical practice documents

#### 4.5.10 Disc Orientation (Butterfly Valves Only)

Horizontal disc shafts are preferred to avoid accumulated sediment and debris potentially affecting the valve sealing or operation. Vertical disc shafts are permissible if a horizontal arrangement cannot be achieved provided a technical explanation for the need for the vertical orientation is provided by the designer and/or contractor to SA Water.

#### 4.5.11 Bypass Pipework and Valves – Requirements for and/or Control Sequence

The requirement for bypass pipework and valves around isolation valves greater than 375mm in diameter must be assessed by the designer and/or contractor and the determination made by the designer and/or contractor, and technical reasons for them, provided to SA Water for its records. The designer and/or contractor must confirm that any valve without a bypass valve will be fit for all required operational purposes in its technical documentation provided to SA Water.

One purpose of the bypass valve is to enable the differential pressure across the main isolation valve (i.e., the isolation valve around which the bypass pipework and valve is provided) to be temporarily reduced to enable the main isolation valve to be seated or unseated without undue stress on the main isolation valve components and/or avoid excessive manual torque input (if manual operation is required). Another purpose of a bypass valve is to facilitate the controlled re-filling of a pipe section that has been drained (or is otherwise empty) between two closed isolation valves. Bypass pipework and valves may be integral to the main isolation valve or installed independently around the main isolation valve by branched connection from a spool upstream to a spool downstream of the main isolation valve with the bypass valve located in the pipework formed by the branched connection.

The bypass pipework and valves must be selected and sized by the designer and/or contractor such that the pressure drop and flows in the bypass pipework and valves are not excessive and do not cause damage (e.g., loss of lining (if any), erosion or cavitation damage) to the bypass pipework and valves or the main isolation valve. The designer and/or contractor may use one or two bypass valves per main isolation valve (two bypass valves would be configured in parallel bypass pipework). The maximum flow velocity through the bypass pipework and valves must be confirmed by the designer and/or contractor and not exceed the limits for the pipework (and any lining) or the valves (including seat velocity limits) over the entire range of operating conditions. The designer and/or contractor must obtain the flow velocity limits through the bypass pipework and valves from the vendor before

procurement. The designer and/or contractor must inform the vendor of the cumulative time over which the bypass pipework and valves will be operated during main isolation valve seating or unseating operations (and the cavitation index during these operations) over the design life of the equipment. The designer and/or contractor may consult with SA Water to determine the typical time (based on re-fill rates or otherwise) and frequency of operation of a bypass valve and use this information to estimate the cumulative time over which the bypass pipework and valves will be operated. The design life of the bypass pipework and valves must match that of the main isolation valve. Lobster back bends are not preferred for bypass pipework.

Bypass valves for main isolation valves may be actuated for manual or automatic operation. In all cases (including non-actuated), the opening and closing sequence for the main isolation and bypass valves shall be as specified in Table 4.2 and Table 4.3 below:

**Table 4.2 Opening Sequence**

Opening Sequence – main valve initially closed		
Step	Action	Comment
1	Open bypass valve (if closed)*	Maximum velocity through bypass pipework and valves
2	Open main isolation valve	
3	Close bypass valve	Can only be left open if hydraulic measures prevent cavitation and/or any other form of damage

**Table 4.3 Closing Sequence**

Closing Sequence – main valve initially open		
Step	Action	Comment
1	Open bypass valve	Can only be already open if hydraulic measures prevent cavitation and/or any
2	Close main isolation valve	
3	Close bypass valve	Maximum velocity through bypass

\*if there is a relatively high pressure differential across the main valve when closed then the bypass valve should be normally closed to avoid high velocity flow (>4m/s) through the bypass valve. If there is a relatively low pressure differential across the main valve when closed, and lower flow velocity occurs through the bypass valve (<4m/s) then the bypass valve should be normally open to assist with water circulation

The bypass pipework and valves are also required for pipeline filling and draining operations. Hydraulic analysis of the pipeline system in which the isolation valve is to be installed must be conducted by the designer and/or contractor to determine the full range of hydraulic conditions (including pressure drops and flows) under which the bypass pipework and valves are required to operate without damage. The cumulative time over which the bypass pipework and valves are required to operate for pipeline filling and draining, and corresponding hydraulic conditions, must be identified by the designer and/or contractor, such that the vendor supplying the pipework and valves can correctly identify the operating conditions under which the bypass pipework and valves will be

required to operate over the design life of the bypass pipework and valves. The designer and/or contractor may consult with SA Water to determine the typical time (based on re-fill rates or otherwise) and frequency of operation of a bypass valve and use this information to estimate the cumulative time over which the bypass pipework and valves will be operated.

Bypass pipework and valves are typically provided for control valves but may not be installed subject to the designer and/or contractor providing a technical justification for not installing the bypass pipework and valves. Any technical justification for not installing bypass pipework and valves for control valves must be confirmed in writing, and the impact of this accepted by the vendor for the main valve, before any main valve is procured.

The bypass pipework incorporating the bypass valves shall include flexible and/or dismantling joints (or otherwise allow for movement and stress relief), as technically appropriate (e.g., if the bypass pipework spans over a main pipe dismantling joint), to accommodate thermal expansion and/or contraction in the bypass pipework and/or the effect of thermal expansion and/or contraction in the pipework connected to the main isolation or control valves. The amount of thermal expansion and/or contraction in the bypass and main valve pipework, allowing for movement at all flexible and/or dismantling joints, must be determined by the designer and/or contractor and the pipework and joints designed and specified to avoid any thermal stresses on the bypass or main valves while pressure thrusts are still restrained.

The relevant temperature changes to be used by the designer and/or contractor when determining thermal stresses and displacements are specified in Table 4.1 above.

#### **4.5.12 Safety – Isolations (Requirement for Double Isolation or not)**

There are number of circumstances under which the requirements for double isolations using valves must be considered. These circumstances are described below together with the approach to the risk assessment of the requirement for double isolation:

##### **4.5.12.1 Construction (e.g., Link-ins)**

In the case of the use of new and/or existing valves by contractors to provide isolations for new works delivered by the contractor (e.g., link-ins of new pipework), a risk assessment must be conducted by the designer and/or contractor that takes into account confirmed confined spaces or otherwise hazardous conditions and follow all applicable processes stipulated by Work Health and Safety and/or Safety in Design Legislation and Regulations.

If the new and/or existing valves are to be used for SA Water operation and maintenance in new and/or existing systems then these valves must be assessed as stipulated under clause 4.5.12.2 or 4.5.12.3 below.

##### **4.5.12.2 Operation and Maintenance of New Valves in Systems**

In the case of new valves installed in new or existing systems, where SA Water will take over the operation and maintenance of the completed works (including the new valves), a risk assessment must be conducted by the designer and/or contractor using the SA Water Risk Assessment Process (as stipulated at the time by the SA Water Risk Group) with SA Water personnel involved from SA Water Assets, SA Water Operations (including Allwater Operations where relevant) and SA Water Engineering. This risk assessment must determine whether the requirement for the on-going operation or maintenance of the system can be safely achieved by using a single isolation valve or whether more than one valve needs to be used to achieve an effective isolation. The nature of the on-going operation and maintenance activities must be fully described including (but not limited to):

- working with reliance on a valve isolation above ground with ready unrestricted escape route(s)

- working with reliance on a valve isolation in a trench or pit excavation below ground with restricted escape route(s)
- working with reliance on a valve isolation in an internal environment with restricted escape route(s)
- working inside a pipe downstream of an isolation valve with withdrawal from the pipe the only escape route
- all other possible working arrangements with reliance on a valve isolation

The risk assessment conducted by the designer and/or contractor must take into account confirmed confined spaces or otherwise hazardous conditions and follow all applicable processes stipulated by Work Health and Safety and/or Safety in Design Legislation and Regulations.

The use of a butterfly valve (for water systems) does not mean that double isolation (i.e., the closure of two valves (or a valve and another isolating device) in series) is automatically required for operations where the valve is used to isolate water from a work area. The specific mechanical configuration of the proposed butterfly valve must be obtained from the vendor by the designer and/or contractor and analysed from the disc through to shaft through to gearbox through to spindle/actuator, and through all other intermediate connections not listed, by the designer and/or contractor (prior to the risk assessment) to ensure that there is no possible mechanism for a sudden failure of any component and the rapid and unexpected opening of the disc. Fitted locking mechanisms on the spindle/actuator can be specified to ensure no possible inadvertent operation of the valve and/or otherwise prevent unintended/uncontrolled opening of the valve.

Butterfly valves with disc shafts that geometrically interfere with the disc shaft housing, including keyed connections, are preferred as they eliminate the risk of disconnection between the disc and shaft. Pinned connections between the disc shaft and disc may not eliminate the risk of disconnection between the disc and shaft (e.g., if the pins do not have interference fits and are not welded and/or deformed to hold) and, depending on the nature of the on-going operation and maintenance activities, double isolation may be required after risk assessment. In the case of keyed and pinned connections, the designer and/or contractor must confirm the minimum shear strength of the keyed connection is satisfactory, where maximum pressure occurs on one side of the valve and the other side is open to atmosphere, and present this information to SA Water at the risk assessment.

The use of a gate valve (for water or wastewater systems) does not automatically mean that a single isolation is satisfactory where the valve is used to isolate water or wastewater from a work area. As for the butterfly valve, the specific mechanical configuration of the proposed gate valve must be obtained from the vendor by the designer and/or contractor and analysed from the door (wedge) through to shaft through to gearbox through to spindle/actuator, and through all other intermediate connections not listed, by the designer and/or contractor (prior to the risk assessment) to ensure that there is no possible mechanism for a sudden failure of any component and the rapid and unexpected opening of the door (wedge). Fitted locking mechanisms on the spindle/actuator can be specified to ensure no possible inadvertent operation of the valve and/or otherwise prevent unintended/uncontrolled opening of the valve.

Knifegate valves must not be used as single(or double) isolations and additional isolation (using other valves or methods) is required to achieve an effective isolation.

The use of partial double isolations may be considered whereby two valves in series in a system are closed but the pipework is only drained of water or wastewater downstream of the first isolation point. This form of isolation is implemented by first closing two valves in series in a system to isolate from one direction (a further two valves in series may need to be closed to isolate from the other direction). The section of pipe to be worked on between the valves is then drained and the adjacent

section of pipe depressurised. Water or wastewater is retained in the section of pipe between the first and second isolations but is depressurised to a level matching the elevation difference between the first isolation valve and the highest level in the pipe between the first and second isolation valves. This reduces the potential for and impact of inundation of the work area protected by the first isolation while avoiding draining the pipe between the first and second isolations.

#### **4.5.12.3 Operation and Maintenance of Existing Valves in Systems**

In the case of existing valves installed in new or existing systems (e.g., the use of an existing valve to facilitate isolations), all the requirements identified in clause 4.5.12.2 with regard to the design, specification and risk assessment of new valves must be applied. The outcome from this risk assessment may require that other methods of isolation, or additional practical precautions, may be required to confirm a safe working environment can be established.

## 5 Specification Requirements

### 5.1 Gate Isolation and Control Valves (Water and Wastewater)

The minimum requirements identified in AS2638.1 and/or AS2638.2, in all regards, shall apply if not exceeded and/or added to in the following clauses and/or specification datasheet.

The following parameters are to be specifically identified in the valve specifications with items listed to be raised and closed out with valve vendors by the designer and/or contractor before any valve is procured:

#### 5.1.1 Water and/or Wastewater Quality Parameters

The following physical and chemical water quality parameters must be identified in all specifications and datasheets. Sensitivity to particulate matter in the water or wastewater must be addressed by the valve vendor in the specification and datasheet for all valves.

Characteristics of the water or wastewater including chemical composition and physical consistency (raw or treated water and raw or recycled wastewater):

- Physical composition:
  - Solids content (and size or grading of solids if applicable)
  - Temperature range
  - Water density
  - Wastewater density
  - Rheology of wastewater (sludge or other similar fluids)
  - Percentage of entrained air (if applicable)

Valves must be able to achieve the design life specified in this standard when exposed to, and operated in, the physical environment defined in the specification datasheet.

- Chemical composition:
  - pH
  - Conductivity
  - Total Dissolved Solids
  - Chlorides
  - Free chlorine
  - Free gases
  - Other chemicals

Valves must be able to achieve the design life specified in this standard when exposed to, and operated in, the chemical environment defined in the specification datasheet.

All components of valves that come into contact with potable water must comply with AS4020.

## 5.1.2 Configuration, Dimensional and Structural Considerations

The valve configuration and other details listed below must be identified by the designer and/or contractor in the specification and datasheet:

- The designer and/or contractor must identify the orientation of a valve to ensure, amongst other things, that the valve can be physically installed and removed for maintenance, that any gearbox can be fitted and operated and that the preferred operating direction of a valve door, disc, gate and/or wedge is achieved. All of the physical requirements listed in this clause must be able to be conducted in accordance with SA Water WHS requirements.
- The designer and/or contractor must confirm whether a bypass around the valve is required (in accordance with clause 4.5.11) and, if so, whether the bypass shall be integral or non-integral to the valve. The designer and/or contractor must ensure the requirements of section 4.5.11 are met with regard to valve bypasses.
- The designer and/or contractor must confirm, with both the vendor and SA Water, whether a valve is to be buried or not. Dismantling joints must not be direct buried and so in cases where a dismantling joint is specified with a valve by the designer and/or contractor the valve must be installed aboveground or in a chamber. However, in cases where a valve capable of withstanding thrust, and all other relevant forces exerted upon it over its design life, is specified by the designer and/or contractor this valve may be direct buried with installation closing collars.
- The environmental conditions in which the valve will be installed must be identified by the designer and/or contractor to ensure that appropriate protective mechanisms are also specified for the valve and to ensure that installation environment information is provided to the valve vendor. For example, above ground external and coastal, below ground aggressive groundwater and all other installation environments must be specifically specified and acknowledged by the vendor before any valve is procured. All relevant SA Water Technical Standards (and any other Australian Standards) relevant to the coatings to be applied to valves (whether buried or not) must be identified and followed by the designer and/or contractor (or valve vendor).
- The designer and/or contractor must confirm the minimum distance that is required between a valve and another other piece of equipment (e.g., a flowmeter or pump) in order to avoid causing either a problem in the installation and/or operation of the valve and/or other equipment. The designer and/or contractor may alter the type of valve specified if the minimum available distance between the valve and other equipment cannot be varied such that the operation of the valve is not compromised and/or to avoid increased maintenance requirements. A typical example might involve the selection of a full bore gate valve rather than butterfly valve to achieve minimum straight distances, in accordance with either the valve or pump manufacturers requirements, either side of a pump.
- The designer and/or contractor must confirm whether a valve will be installed in a chamber (above or below ground) and what the access arrangements are within this chamber. Any chamber, and its method of entry/exit, must comply with SA Water WHS requirements. The designer and/or contractor must also specify whether any chamber is used to support gravity, thrust (pressure and/or thermal) or any other type of load which would result in the failure of the valve (either physical or operational) if the chamber did not exist. The designer and/or contractor must confirm that all loads associated with the installation and/or operation of a valve in a chamber can be supported by the chamber (whether new or existing) and that the valve will not be detrimentally affected (in either a physical or operational sense).

- The designer and/or contractor must confirm how debris (e.g., grit) can be cleaned and/or flushed from the seating area of the valve (e.g., a cleaning port).

### 5.1.3 Bonnet

The designer and/or contractor shall specify whether a sealed (and pressure rated bonnet) is required for a gate valve or not. Where a gate valve bonnet is required to be pressure rated the pressure rating shall be equal to the maximum structural pressure rating of the valve. The designer and/or contractor shall specify a pressure rated bonnet where a valve is buried in all cases.

### 5.1.4 Wedge/Gate Encapsulation

For potable water systems, any wedge/gate encapsulation (or other internal component) must comply with the requirements of AS4020. The designer and/or contractor must request the certificate of compliance with AS4020 for the wedge/gate encapsulation material the valve vendor is proposing to use and the valve must not be procured until this certificate of compliance is provided by the vendor. The material type and chemical characteristics of the wedge/gate encapsulation must be confirmed by the designer and/or contractor before any valve is procured.

### 5.1.5 Stem (Shaft), Drive Nut and Seating

The designer and/or contractor shall explicitly obtain from the vendor, through the use of a returnable datasheet or otherwise, the stem material type, diameter and end thread classification and confirm that the stem material type, diameter and end thread classification will enable the valve to remain fully functional over the design life for the valve. The designer and/or contractor must confirm that the stem will maintain its relative position within the valve body (to all initial (before installation) tolerances).

The designer and/or contractor shall specify whether a rising or non-rising stem is required for a gate valve. The designer and/or contractor must take into account the available space for installation of the valve but also any increased maintenance requirements (or difficulties in achieving the required maintenance) in the case of either adopting a rising or non-rising stem. For example, the use of a rising stem may in one case result in problematic access to the top of the stem but reduce the maintenance challenges that would otherwise arise if a non-rising stem was used.

The designer and/or contractor shall explicitly obtain from the vendor, through the use of a returnable datasheet or otherwise, the drive nut material type and confirm what the functional life of the drive nut will be based on loading, actuation and/or any other relevant parameters in this Technical Standard. The designer and/or contractor shall confirm the vendor specified drive nut functional life with SA Water and provide options from the vendor for a longer drive nut functional life if SA Water informs the designer and/or contractor that the functional life of the drive nut, for the materials offered by the vendor, is insufficient.

The designer and/or contractor shall explicitly obtain from the vendor, through the use of a returnable datasheet or otherwise, the seating/unseating torque for the valve (under the operational condition that gives the maximum seating/unseating torque) and confirm the factor of safety for the stem strength during valve seating/unseating. The designer and/or contractor must inform SA Water if there is more than a 10% variation in the factors of safety for the different valve shafts, during valve seating/unseating, when valves that are being offered are technically assessed prior to the procurement of any valve.

### 5.1.6 Flanges

The valve flange thicknesses do not have to necessarily meet or exceed the requirements of AS4087 (pipeline flange standard). Depending on the structural characteristics of the materials comprising the valve body and flanges, and the interaction of the forces throughout the valve body and flanges for all load cases (including hydraulic), a designer and/or contractor may request a valve vendor provide test records, structural calculations and/or Finite Element Analysis (FEA) to confirm the adequacy of the thickness of a valves flanges for structural strength, fatigue and deflection. SA Water's recent experience has been that valves with more flexible structural characteristics are more vulnerable to failing pressure sealing tests as required under the Australian Standards referenced in clause 1.3.1and/or this Technical Standard. The designer and/or contractor must undertake and assessment of the technical risk of structural flexibility of a valve, including flanges, deflecting under pressure tests, bolt tightening during installation and/or under any other circumstances such that tests are failed and/or deflection limits are exceeded (see below).

The torques required to bolt a valve into adjoining pipe spools must be taken into consideration as one of the load cases for the valve flanges and the designer and/or contractor must specify the torques that will be applied in the installation of a valve in accordance with the tightening procedures described in TS27 and TS59. The valve vendor must quantify the maximum deflection of the valve flange that will occur under all load cases (including the installation torques) with less than 2mm deflection of the flange from its unstressed condition referred in all cases.

A designer and/or contractor can specify that a valve must have its flanges drilled to a pattern that matches those from AS4087 or can specify another pattern if required (e.g., to match PN25 or PN40 connecting pipework).

Raised or flat face (with O-ring) flanges must be specified with reference to the practices and preferences of SA Water Workshops if they are installing and/or maintaining the valves. Any designer and/or contractor that is involved in the specification of valve flanges that are to be installed by a SA Water Workshop must contact the relevant SA Water Workshop and confirm the requirement for either raised or flat face (with O-ring or gasket) flanges.

The specification for uncoated flanges (raised or flat face) prepared by the designer and/or contractor must include tolerances on the surface roughness of the flanges that are sufficient to enable sealing of the valve flanges with adjacent pipe spools upon installation, in cases where gaskets and/or O-rings are used, with tightening torques in the ranges prescribed in TS27 and TS59 (and WSA 104). If these tolerances are not met for the supplied valves then the specification by the designer and/or contractor must state that the valve surfaces will need to be flattened by the vendor until the required surface flatness is achieved before the valve can be shipped. The designer and/or contractor must identify additional surface finishes and/or protections that are required for uncoated valves to achieve sealing and the design life requirements identified in clause 4.1 of this Technical Standard (e.g., consideration of the specification of gramophone finishes for sealing and primers and/or corrosion inhibitors).

If flanges (raised or flat face) with coatings are proposed by a designer and/or contractor then the specification provided to the valve vendor by the designer and/or contractor must include tolerances on the surface roughness of the coated flanges that are sufficient to enable sealing of the valve flanges with adjacent pipe spools upon installation, in cases where gaskets and/or O-rings are used, with tightening torques in the ranges prescribed in TS27 and TS59 (and WSA 104). If these tolerances are not met for the supplied valves then the specification by the designer and/or contractor must state that the valve coating will need to be flattened by the vendor until the required surface flatness is achieved before the valve can be shipped.

Consideration may be given by the designer and/or contractor to specifying valves without coatings on the flange faces but this specification must be provided to the valve vendor, including water or wastewater quality parameters and internal dimensions of mating flanges, so that the vendor can state whether the use of uncoated flange face will lead to corrosion of the flange faces, bolts or any other component within the valve before the prescribed design life from clause 4.1 is achieved. This enquiry by the designer and/or contractor with the valve vendor must be made before the valve is procured.

Gaskets, where used, must be specified by the designer and/or contractor such that valve sealing can be achieved, for the test conditions stipulated in AS2638.1 and/or AS2638.2 and under this Technical Standard, with tightening torques in the ranges prescribed in TS27 and TS 59 (and WSA 104). SA Water experience has shown that the sealing tests can be successfully conducted with the correct gasket specification. Gaskets are to be in accordance with AS4020.

O-rings, where used, must be specified by the designer and/or contractor such that valve sealing can be achieved, for the test conditions stipulated in AS2638.1 and/or AS2638.2 and under this Technical Standard, with tightening procedure and torques as prescribed in TS27 and TS59 (and WSA 104). O-rings are to be in accordance with AS4020.

### 5.1.7 Vibration Performance

The designer and/or contractor must request vibration data from valve vendors for the most adverse conditions under which the valve will be operated (this data may or may not be available and may be based on testing in factories with custom restraint conditions and/or field data for operational valves). It is the responsibility of the designer and/or contractor to identify the most adverse conditions (hydraulic or otherwise) under which a valve will be operated (either intermittently and/or continuously) and include this information in the specification and datasheet as a compliance condition that the valve vendor must address before any valve is procured. The designer and/or contractor must confirm that under any operating condition the valve proposed by the vendor will not suffer damage from vibration to any components in any way that will reduce the operational use and/or life of the valve. Vibration that leads to more frequent maintenance than identified at the time of procuring the valve is deemed a reduction in the operational use and/or life of the valve.

Valves must not move from positions set using either an actuator or manually, have bolts come loose, incur damage to seats or in any other way develop faults or defects due to vibration when operated within the range of operational conditions defined by the designer and/or contractor in the specification and datasheet.

Designers and/or contractors must ensure that connected pipework (including extent of fixing as well as the structural and hydraulic effects of bends and/or any other equipment), supports and any other elements that can affect the vibration meet the requirements stipulated by the valve vendors to achieve anticipated vibration levels.

### 5.1.8 Noise Levels

If the valves to be procured are operated in a way that may result in problematic hydraulic noise levels in noise sensitive environments, then the designer and/or contractor shall request that the valve vendor provide the following noise level information (identified in Table 5.1), and identify the requested information in the specification and datasheet. Isolation valves are unlikely to be problematic in noise sensitive environments, even if noisy, provided the frequency of their operation is deemed sufficiently infrequent. Control valves may be more problematic and may generate greater levels of noise more frequently in noise sensitive environments. Designers and/or contractors must contact the SA Water to confirm whether a particular environment is noise sensitive and what level of noise, or frequency of occurrence of a noise, is considered problematic.

**Table 5.1 Sound Levels (Gate Isolation and Control Valves)**

	Overall	Octave band centre frequencies (dBA pressure) and (dB power)							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
<b>Sound pressure level (@1m)</b>	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>Sound power level</b>	✓	✓	✓	✓	✓	✓	✓	✓	✓

The information provided by the valve vendors shall be used by the designer and/or contractor to draw relative comparisons between the valves presented and to determine their suitability for a particular project. The designer and/or contractor shall inform SA Water if valve vendors are unable to provide the requested (or any) noise data.

### 5.1.9 Coatings

Fusion bonded epoxy (FBE) and/or ceramic (or other) epoxy internal coatings are required inside the body of cast iron, ductile iron and/or steel body valves. All FBE coatings are to be in accordance with AS4158.

In potable water applications, all coatings must be certified as AS4020 compliant and suitable for contact with drinking water. FBE internal coatings must be applied in accordance with the requirements of the coating manufacturer and are typically between 250-350µm thick. Ceramic (or other) epoxy internal coatings are to be specified by the designer and/or contractor in accordance with the requirements of SA Water TS0015, TS0016 and/or TS98, including required finished thickness of application, as applicable. The valve vendor is to confirm compliance with the requirement of TS0015, TS0016 and/or TS98 before the award of any supply contract.

In raw water, wastewater or other applications, coatings may not need to be certified as AS4020 compliant provided there is no direct or indirect risk to human health. FBE or ceramic (or other) epoxy internal coatings must be specified with explicit consideration of the physical and chemical characteristics of the fluid in contact with the internal surfaces within the valve. The designer and/or contractor must modify the specification to ensure that the internal coating specified will achieve the minimum required design life as stipulated in clause 4.1 above (or greater if required by the requirements of a project brief or known operational circumstances).

External coatings for valves vary considerably in terms of specification requirements depending on the physical and chemical characteristics of the location in which the valves are installed (internally, externally, aboveground, buried or other). Refer to TS0015, TS0016 and/or TS0018 for further requirements.

Valves within internal building or external environments that are not aggressive are typically coated with a FBE between 250-350µm thick. In internal or external environments that are aggressive the coating specification should be adjusted by the designer and/or contractor to achieve the minimum required design life as stipulated in clause 3.1 above (or greater if required by the requirements of a project brief or known operational circumstance).

Valves that are buried must be supplied with a customised FBE specification determined by the designer and/or contractor. The designer and/or contractor is responsible for determining whether wrapping is required to achieve the design life of the valves and ensuring compliance with TS0018.

The gate (or door/wedge) for the valve shall be encapsulated in accordance with AS1646 using EPDM for resilient seated gate valves.

It is common for valve coatings to be damaged after leaving the vendor factory. The designer and/or contractor shall obtain from the vendor the repair specification for the coating, including the type of material used, its method of application, its compliance with AS4020 (including relevant and current certificate of compliance with AS4020), its design life (to match that of the factory applied coating) and the time to obtain the coating repair material (if not readily available in South Australia). The valve is not to be procured before this information is obtained by the designer and/or contractor and it has been confirmed that the repair coating will be satisfactory and its acquisition and/or application will not cause additional project costs or delays in the event that damaged valve coatings need to be repaired. Spark testing of coating repairs is preferred.

It has also been common for valves to be supplied with coatings that do not meet the flatness tolerances specified in clause 5.1.6 of this Technical Standard. In SA Water's experience, this causes problems during installation and/or operation due to pressure test failures and/or leakage. The flatness of coated valve flanges must be confirmed before any valve is shipped in accordance with clause 5.1.6.

Internal coatings within valves must meet tolerances, defined by the designer and/or contractor in the specification for the valves, that enable all components of the valves to function as required, coatings to remain intact (not cracked, abraded, eroded and/or removed or lost), coatings to maintain their integrity and prevent corrosion and the valves to otherwise meet their operational requirements over the design life for the valves. The integrity of the internal coatings is critical where the coatings act to protect internal wetted valve components from corrosion and the designer and/or contractor must ensure that the specification for the valves communicates to the vendor the purpose of and design life required for the internal coatings.

### 5.1.10 Hydraulic Requirements

There are a number of hydraulic requirements and/or performance capabilities for valves which must be assessed by the designer and/or contractor, to ensure that the valve will operate as functionally required over its specified design life, as follows:

- The cavitation index of the valve installation must be determined by the designer and/or contractor for all instantaneous, intermittent and continuous operating hydraulic conditions (refer to clause 4.4.2) to confirm that the valve will not cavitate in a way, or for a duration, that is inconsistent with the vendor's knowledge at the time the valve was procured and/or is likely to cause damage
- If a mass production or special application valve is required then the designer and/or contractor must enquire with the vendor to determine whether any hydraulic testing and/or theoretical Computational Fluid Dynamics (CFD) analysis of the valve has been conducted by the vendor. If hydraulic testing and/or theoretical CFD analysis of the valve has been conducted then the designer and/or contractor must take this into account in technically assessing the valve before it is procured. Any hydraulic testing and/or theoretical CFD analysis of the valve obtained by the designer and/or contractor must be provided to SA Water for its records
- The method of resisting hydraulic forces (and force imbalances) within a valve shall be determined by the designer and/or contractor to ensure that thrusts are appropriately transferred to the body of the valve and that problems, such as excessive wedge/gate

resistance to operation, gear box slop and associated displacements and/or any other issue that may lead to more maintenance over the design life of the valve (than declared at the time of procurement of the valve), are avoided

- The hydraulic curves for any isolation and/or control valve must be obtained from the vendor and the relationships between the degree open, differential head across and flow through a valve considered by the designer and/or contractor to ensure that any valve selected will achieve the functional requirements of the system (including the valve in it) over the design life of the valve (refer to clause 4.5.4)

### 5.1.11 Maintenance Requirements

The maintenance requirements for a valve (including criteria identified in a datasheet or returnable schedule customised to suit specific application requirements by the designer and/or contractor) shall be considered by SA Water Procurement as potential weighted criteria in any Request for Tender process and/or market approach document and the evaluation of these criteria shall be such that valves are not procured which cannot be efficiently or safely maintained by SA Water Operations and Maintenance (or its contractor). The maintenance requirements for a valve are to be explicitly obtained in writing from the vendor by the designer and/or contractor and provided to SA Water for assessment before any order for a valve is finalised.

In circumstances where valves are directly purchased on a project with a supporting specification from a designer and/or contractor (including criteria identified in a datasheet or returnable schedule customised to suit specific application requirements by the designer and/or contractor), the specification used shall refer to this Technical Standard and the information regarding maintenance that is to be provided to SA Water before any valve order is finalised. This clause applies to valve purchases made by SA Water Workshops.

## 5.2 Butterfly Isolation and Control Valves (Water Only)

The minimum requirements identified in AS4795.1 and/or AS4795.2, in all regards, shall apply if not exceeded and/or added to in the following clauses and/or specification datasheet.

The following parameters are to be specifically identified in the valve specifications with items listed to be raised and closed out with valve vendors by the designer and/or contractor before any valve is procured.

### 5.2.1 Water Quality Parameters

The following physical and chemical water quality parameters must be identified in all specifications and datasheets. Sensitivity to particulate matter in the water must be addressed by the valve vendor in the specification and datasheet for all valves.

Characteristics of the water including chemical composition and physical consistency (raw or treated water):

- Physical composition:
  - Solids content (and size or grading of solids if applicable)
  - Temperature range
  - Water density
  - Percentage of entrained air (if applicable)

Valves must be able to achieve the design life specified in this standard when exposed to, and operated in, the physical environment defined in the specification datasheet.

- Chemical composition:
  - pH
  - Conductivity
  - Total Dissolved Solids
  - Chlorides
  - Free chlorine
  - Free gases
  - Other chemicals

Valves must be able to achieve the design life specified in this standard when exposed to, and operated in, the chemical environment defined in the specification datasheet.

All components of valves that come into contact with potable water must comply with AS4020.

## 5.2.2 Configuration, Dimensional and Structural Considerations

The requirements of clause 5.1.2 (for gate valves) must be applied by the designer and/or contractor for butterfly valves. In addition, the following additional requirements apply to butterfly valves:

Wafer butterfly valves must only be used where:

- the proposed installation is above ground
- the system pressure is less than or equal to PN16
- the valve diameter is less than 100mm
- the valve is not used for end of pipeline isolation

Lugged butterfly valves must only be used where:

- the proposed installation is above ground
- the system pressure is less than or equal to PN16 (unless explicitly guaranteed for a higher rating by a valve vendor)
- the valve is not used for end of pipeline isolation

Interference between any proposed wafer or lugged butterfly valve and the adjoining upstream and downstream pipework must be checked by the designer and/or contractor before the procurement of wafer or lugged valves and/or during the specification of the upstream and downstream pipework.

Flanged butterfly valves can be used where:

- the proposed installation is above or below ground
- the system pressure is less than or equal to PN35

### 5.2.3 Body

The valve body must pass all tests from AS4795.1 and AS4795.2 and as otherwise stipulated in this Technical Standard.

The valve body must either be constructed from a material that will not corrode or be coated to prevent corrosion over the design life for the valve.

### 5.2.4 Body Insert or Liner

Non-bonded EPDM liners may be considered by the designer and/or contractor where the valves are required for either isolation and/or control, are actuated less than once per three months for maintenance work and are aboveground and accessible for periodic replacement of the non-bonded rubber liners.

For potable water systems, any body insert or liner (or other internal rubber component) must comply with the requirements of AS4020. The designer and/or contractor must request the certificate of compliance with AS4020 for the body insert material the valve vendor is proposing to use and the valve must not be procured until this certificate of compliance is provided by the vendor. The material type and chemical characteristics of the body insert (including vulcanised liners) must be confirmed by the designer and/or contractor before any valve is procured.

The designer and/or contractor shall request a detailed Inspection Test Plan (ITP) for any vulcanised rubber liners where required under this Technical Standard. The ITP provided by the vendor shall, amongst other things, explicitly include the pre-heating, application and curing times and temperatures used in the manufacturing process for the valve and the liner material.

The designer and/or contractor must request from any vendor of a valve with a vulcanised EPDM liner the minimum adhesive bond strength and compression set (or memory) values required for the valve before any valve is procured. The designer and/or contractor shall include in the specifications for the valve the requirement for a bond strength and compression set test piece or tab such that the strength of the adhesive bond between the vulcanised liner and valve body wall can be confirmed for each valve supplied by the vendor. The compression set of the test piece shall also be confirmed for each valve supplied by the vendor. The tests for adhesive bond and compression set for any valve supplied shall be undertaken in accordance with all applicable Australian and/or International Standards and may need to be independently witnessed if SA Water requests. The designer and/or contractor must inform the valve vendor of the right for SA Water, or its representative, to witness the adhesive bond and compression set tests and provide SA Water of sufficient notice to organise witnessing of these tests.

SA Water recognises the following international standards for testing of adhesive bond and compression set:

- ASTM D429 - 14 Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates Test Method D Post Vulcanisation Bonding of Rubber to Metal
- ASTM D395 - 16 Standard Test Methods for Rubber Property - Compression Set

The Adhesive bonding and compression set testing is to be conducted to the methods documented in the ASTM standards. Other testing methods or standards will be considered (as required). The designer and/or contractor will need to demonstrate suitability of the alternate testing method(s) or standards to SA Water.

The designer and/or contractor must inform the valve vendor of the right for SA Water, or its representative, to witness the adhesive bond and compression set tests and provide SA Water of sufficient notice to organise witnessing of these tests.

SA Water may request a destructive test of a vulcanised liner (i.e. liner pull-off test) to demonstrate adhesion and consistency between standardised testing (during batch manufacture as per ASTM Standards) and actual manufactured product (ready for client delivery). Results of this testing shall be made available to SA Water.

The designer and/or contractor must confirm whether a valve vendor will utilise a third party factory (separate to the vendor) for the vulcanisation of a valve liner. If so, the designer and/or contractor must obtain the third party factory's ITP and all other manufacturing process details such that the information required under this clause can be confirmed as appropriate by the designer and/or contractor before any valve is procured.

### 5.2.5 Body Seat Ring

Stainless steel welded overlay seats for butterfly valves are not preferred when the valve bodies are cast or ductile iron because of the potential for carbon transfer during welding from the valve bodies to the welded overlay. The failure of butterfly valves due to the use of welded overlay seats and carbon transfer from the valve body has occurred in SA Water systems. If the options for the procurement of a butterfly valve are limited, or for other reasons a valve with a welded overlay seat is required, then the designer and/or contractor must obtain specific details of the materials and welding process proposed for valve seat and confirm that there will be no carbon transfer or other associated defect that reduces the design life of the valve. "Nickel buttering" layers are preferred in a valve when a welded overlay seat is required. Only specific stainless steel compositions can be considered for welded overlay seats and the composition proposed by a vendor must be identified by the designer and/or contractor and confirmed as appropriate for the required design life of the valve. The designer and/or contractor must submit detailed information from the valve vendor related to the welded overlay seat and valve body, including materials used and welding processes, to SA Water before the procurement of any butterfly valve with a cast or ductile iron body and welded overlay seat.

Welded overlay seats for butterfly valve may be used when the valve bodies are cast or fabricated steel because carbon transfer during welding from the valve bodies to or from the welded overlay can be controlled and the overall design life of the valve not affected. The designer and/or contractor must submit detailed information from the valve vendor related to the welded overlay seat and valve body, including materials used and welding processes, to SA Water before the procurement of any butterfly valve with a cast or fabricated steel body and welded overlay seat.

Push fit seat rings (including body seat and/or disc rings) can be used for butterfly valves provided the designer and/or contractor confirms the method of installation and removal (if any) of the seat ring, any fixing details, materials and that the required design life for the valve will be achieved. If pins are relied upon to hold a seat ring in place then the designer and/or contractor must obtain details of the pin material, the method of fixing (e.g., interference fit, welding and/or heat deformation) from the vendor and the designer and/or contractor must determine whether there is any potential for dissimilar metal or crevice corrosion and a reduction in the required design life (of the valve or components within it). The specification of coatings for wetted valve components susceptible to any form of corrosion shall be considered by the designer and/or contractor and reasons for the non-specification of such coatings shall be provided to SA Water. Any coatings specified shall be in accordance with the requirements of this Technical Standard.

Enamelled surfaces on the inside of the valve cast or fabricated body can be used in lieu of seat rings. A specification confirming the type, method of application, thickness, AS 4020 compliance and design life of the enamel used shall be prepared by the designer and/or contractor and no valve shall be procured until these details are provided by the vendor to the designer and/or contractor.

## 5.2.6 Disc and Shaft Connections

The valve disc must pass all tests from AS4795.1 or AS4795.2 and as otherwise stipulated in this Technical Standard.

The valve disc must either be constructed from a material that will not corrode or be coated (or encapsulated) to prevent corrosion over the design life for the valve.

The preferred method of connection between the valve disc and shaft is via disc shafts that geometrically interfere with the disc shaft housing (i.e., the use of non-circular shaft sections and disc housings). The use of a keyed connection between the valve disc and shaft is satisfactory provided the designer and/or contractor confirms the minimum shear strength of the keyed connection where maximum test or operational torque occurs and/or maximum pressure occurs on one side of the valve and the other side is open to atmosphere.

The use of a pinned connection between the valve disc and shaft is not preferred unless for high performance valves using taper pins which the designer and/or contractor confirms will meet all the requirements of this Technical Standard. If the options for the procurement of a butterfly valve are limited, or for other reasons a valve with a pinned connection between the valve disc and shaft is required, then the designer and/or contractor must confirm the minimum shear strength of the pinned connection where maximum test or operational torque occurs and/or the maximum pressure occur on one side of the valve and the other side in open to atmosphere. The designer and/or contractor must obtain specific details of the disc, shaft and connecting pins from the vendor and confirm that there will be no corrosion of the disc, shaft or connecting pin, or other defect, that reduces the design life of the valve (e.g., based on SA Water's experience, the use of disc pin connection to a shaft is unacceptable where dissimilar metal, crevice and/or any other form of corrosion may reduce the strength (or other functionality) of the connection over the design life for the valve). Where pins are used in combination with keyed connections there shall be no corrosion of any component that leads to a reduction in the initial (before installation) relative strengths or functionality of the pin and key components.

## 5.2.7 Shaft

The designer and/or contractor shall explicitly obtain from the vendor, through the use of a returnable datasheet or otherwise, the shaft material type and diameter and confirm that the shaft material type and diameter will enable the valve to remain fully functional over the design life for the valve. The designer and/or contractor must confirm that the shaft will maintain its relative position within the valve body, to all initial (before installation) tolerances, such that internal disc seals and any external seals remain fully functional over the design life for the valve.

The designer and/or contractor shall explicitly obtain from the vendor, through the use of a returnable datasheet or otherwise, the seating/unseating torque, maximum opening torque and maximum closing torque for the valve (under the operational condition that gives the maximum seating/unseating torque) and confirm the factor of safety for the shaft strength during valve seating/unseating. The designer and/or contractor must inform SA Water if there is more than a 10% variation in the factors of safety for the different valve shafts, during valve seating/unseating, when valves that are being offered are technically assessed prior to the procurement of any valve.

### 5.2.8 Shaft Bearings

Thrust bearings, if required, shall be specified that are able to resist all axial loads and radial loads.

Bearings shall be able to accommodate variations in shaft geometry with temperature.

The materials used in the bearings are to be identified by the valve vendor.

The maintenance requirements for the bearing systems are to be identified by the vendor in the returned datasheets prior to the procurement of the valve.

### 5.2.9 Seals and O-Rings

Particular operational and/or maintenance requirements for the seals must be identified by the valve vendor, including lubrication and access for maintenance requirements, in the returned datasheets prior to valve procurement.

### 5.2.10 Flanges

The valve flange thicknesses do not have to necessarily meet or exceed the requirements of AS4087 (pipeline flange standard). Depending on the structural characteristics of the materials comprising the valve body and flanges, and the interaction of the forces throughout the valve body and flanges for all load cases (including hydraulic), a designer and/or contractor may request a valve vendor provide test records, structural calculations and/or Finite Element Analysis (FEA) to confirm the adequacy of the thickness of a valves flanges for structural strength, fatigue and deflection. SA Water's recent experience has been that valves with more flexible structural characteristics are more vulnerable to failing pressure sealing tests as required under AS4795.1 and AS4795.2 or this Technical Standard. The designer and/or contractor must undertake an assessment of the technical risk of structural flexibility of a valve, including flanges, deflecting under pressure tests, bolt tightening during installation and/or under any other circumstances such that tests are failed and/or deflection limits are exceeded (see below).

The torques required to bolt a valve into adjoining pipe spools must be taken into consideration as one of the load cases for the valve flanges and the designer and/or contractor must specify the torques that will be applied in the installation of a valve in accordance with the tightening procedures described in TS27 and TS59. The valve vendor must quantify the maximum deflection of the valve flange that will occur under all load cases (including the installation torques) with less than 2mm deflection of the flange from its unstressed condition referred in all cases.

A designer and/or contractor can specify that a valve must have its flanges drilled to a pattern that matches those from AS4087 or can specify another pattern if required (e.g., to match PN25 or PN40 connecting pipework).

Raised or flat face (with O-ring) flanges must be specified with reference to the practices and preferences of SA Water Workshops if they are installing and/or maintaining the valves. Any designer and/or contractor that is involved in the specification of valve flanges that are to be installed by a SA Water Workshop must contact the relevant SA Water Workshop and confirm the requirement for either raised or flat face (with O-ring or gasket) flanges.

The specification for uncoated flanges (raised or flat face) prepared by the designer and/or contractor must include tolerances on the surface roughness of the flanges that are sufficient to enable sealing of the valve flanges with adjacent pipe spools upon installation, in cases where gaskets and/or O-rings are used, with tightening torques in the ranges prescribed in TS27 and TS59 (and WSA 104). If these tolerances are not met for the supplied valves then the specification by the

designer and/or contractor must state that the valve surfaces will need to be flattened by the vendor until the required surface flatness is achieved before the valve can be shipped. The designer and/or contractor must identify additional surface finishes and/or protections that are required for uncoated valves to achieve sealing and the design life requirements identified in clause 4.1 of this Technical Standard (e.g., consideration of the specification of gramophone finishes for sealing and primers and/or corrosion inhibitors).

If flanges (raised or flat face) with coatings are proposed by a designer and/or contractor then the specification provided to the valve vendor by the designer and/or contractor must include tolerances on the surface roughness of the coated flanges that are sufficient to enable sealing of the valve flanges with adjacent pipe spools upon installation, in cases where gaskets and/or O-rings are used, with tightening torques in the ranges prescribed in TS27 and TS59 (and WSA 104). If these tolerances are not met for the supplied valves then the specification by the designer and/or contractor must state that the valve coating will need to be flattened by the vendor until the required surface flatness is achieved before the valve can be shipped.

Consideration may be given by the designer and/or contractor to specifying valves without coatings on the flange faces but this specification must be provided to the valve vendor so that the vendor can state whether the use of uncoated flange face will lead to corrosion of the flange faces, bolts or any other component within the valve before the prescribed design life from clause 4.1 is achieved. This enquiry by the designer and/or contractor with the valve vendor must be made before the valve is procured.

Gaskets, where used, must be specified by the designer and/or contractor such that valve sealing can be achieved, for the test conditions stipulated in AS4795.1 and AS4795.2 and under this Technical Standard, with tightening torques in the ranges prescribed in TS27 and TS 59 (and WSA 104). SA Water experience has shown that the sealing tests can be successfully conducted with the correct gasket specification.

O-rings, where used, must be specified by the designer and/or contractor such that valve sealing can be achieved, for the test conditions stipulated in AS4795.1 and AS4795.2 and under this Technical Standard, with tightening torques in the ranges prescribed in TS27 and TS59 (and WSA 104).

### 5.2.11 Vibration Performance

The designer and/or contractor must request vibration data from valve vendors for the most adverse conditions under which the valve will be operated (this data may or may not be available and may be based on testing in factories with custom restraint conditions and/or field data for operational valves). It is the responsibility of the designer and/or contractor to identify the most adverse conditions (hydraulic or otherwise) under which a valve will be operated (either intermittently and/or continuously) and include this information in the specification and datasheet as a compliance condition that the valve vendor must address before any valve is procured. The designer and/or contractor must confirm that under any operating condition the valve proposed by the vendor will not suffer damage from vibration to any components in any way that will reduce the operational use and/or life of the valve. Vibration that leads to more frequent maintenance than identified at the time of procuring the valve is deemed a reduction in the operational use and/or life of the valve.

Valves must not move from positions set using either an actuator or manually, have bolts come loose, incur damage to seats or in any other way develop faults or defects due to vibration when operated within the range of operational conditions defined by the designer and/or contractor in the specification and datasheet.

Designers and/or contractors must ensure that connected pipework (including extent of fixing as well as the structural and hydraulic effects of bends and/or any other equipment), supports and any other elements that can affect the vibration meet the requirements stipulated by the valve vendors to achieve anticipated vibration levels.

### 5.2.12 Noise Levels

If the valves to be procured are operated in a way that may result in problematic hydraulic noise levels in noise sensitive environments, then the designer and/or contractor shall request that the valve vendor provide the following noise level information (identified in Table 5.2), and identify the requested information in the specification and datasheet. Isolation valves are unlikely to be problematic in noise sensitive environments, even if noisy, provided the frequency of their operation is deemed sufficiently infrequent. Control valves may be more problematic and may generate greater levels of noise more frequently in noise sensitive environments. Designers and/or contractors must contact the SA Water to confirm whether a particular environment is noise sensitive and what level of noise, or frequency of occurrence of a noise, is considered problematic.

**Table 5.2 Sound Levels (Butterfly Isolation and Control Valves)**

	Overall	Octave band centre frequencies (dBA pressure) and (dB power)							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Sound pressure level (@1m)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sound power level	✓	✓	✓	✓	✓	✓	✓	✓	✓

The information provided by the valve vendors shall be used by the designer and/or contractor to draw relative comparisons between the valves presented and to determine their suitability for a particular project. The designer and/or contractor shall inform SA Water if valve vendors are unable to provide the requested (or any) noise data.

### 5.2.13 Coatings

Fusion bonded epoxy (FBE) and/or ceramic (or other) epoxy internal coatings are required inside the body of cast iron, ductile iron and/or carbon steel body valves. All FBE coatings are to be in accordance with AS4158.

In potable water applications, all coatings must be certified as AS4020 compliant and suitable for contact with drinking water. FBE internal coatings must be applied in accordance with the requirements of the coating manufacturer and are typically between 250-350µm thick. Ceramic (or other) epoxy internal coatings are to be specified by the designer and/or contractor in accordance with the requirements of SA Water TS0015, TS0016 and/or TS98, including required finished thickness of application, as applicable. The valve vendor is to confirm compliance with the requirement of TS0015, TS0016 and/or TS98 before the award of any supply contract.

In raw water, wastewater or other applications, coatings may not need to be certified as AS4020 compliant provided there is no direct or indirect risk to human health. FBE or ceramic (or other) epoxy internal coatings must be specified with explicit consideration of the physical and chemical characteristics of the fluid in contact with the internal surfaces within the valve. The designer and/or contractor must modify the specification to ensure that the internal coating specified will achieve the minimum required design life as stipulated in clause 4.1 above (or greater if required by the requirements of a project brief or known operational circumstances).

External coatings for valves vary considerably in terms of specification requirements depending on the physical and chemical characteristics of the location in which the valves are installed (internally, externally, aboveground, buried or other). Refer to TS0015, TS0016 and/or TS0018 for further requirements.

Valves within internal building or external environments that are not aggressive are typically coated with a FBE between 250-350µm thick. In internal or external environments that are aggressive the coating specification should be adjusted by the designer and/or contractor to achieve the minimum required design life as stipulated in clause 4.1 above (or greater if required by the requirements of a project brief or known operational circumstance).

Valves that are buried must be supplied with a customised FBE specification determined by the designer and/or contractor. The designer and/or contractor is responsible for determining whether wrapping is required to achieve the design life of the valves and ensuring compliance with TS0018.

It is common for valve coatings to be damaged after leaving the vendor factory. The designer and/or contractor shall obtain from the vendor the repair specification for the coating, including the type of material used, its method of application, its compliance with AS4020 (including relevant and current certificate of compliance with AS4020), its design life (to match that of the factory applied coating) and the time to obtain the coating repair material (if not readily available in South Australia). The valve is not to be procured before this information is obtained by the designer and/or contractor and it has been confirmed that the repair coating will be satisfactory and its acquisition and/or application will not cause additional project costs or delays in the event that damaged valve coatings need to be repaired. Spark testing of coating repairs is preferred.

It has also been common for valves to be supplied with coatings that do not meet the flatness tolerances specified in clause 5.1.6 of this Technical Standard. In SA Water's experience, this causes problems during installation and/or operation due to pressure test failures and/or leakage. The flatness of coated valve flanges must be confirmed before any valve is shipped in accordance with clause 5.1.6.

Internal coatings within valves must meet tolerances, defined by the designer and/or contractor in the specification for the valves, that enable all components of the valves to function as required, coatings to remain intact (not cracked, abraded, eroded and/or removed or lost), coatings to maintain their integrity and prevent corrosion and the valves to otherwise meet their operational requirements over the design life for the valves. The integrity of the internal coatings is critical where the coatings act to protect internal wetted valve components from corrosion and the designer and/or contractor must ensure that the specification for the valves communicates to the vendor the purpose of and design life required for the internal coatings.

## 5.2.14 Hydraulic Requirements

There are a number of hydraulic requirements and/or performance capabilities for valves which must be assessed by the designer and/or contractor, to ensure that the valve will operate as functionally required over its specified design life, as follows:

- The cavitation index of the valve installation must be determined by the designer and/or contractor for all instantaneous, intermittent and continuous operating hydraulic conditions (refer to clause 4.5.2) to confirm that the valve will not cavitate in a way, or for a duration, that is inconsistent with the vendor's knowledge at the time the valve was procured and/or is likely to cause damage
- If a mass production or special application valve is required then the designer and/or contractor must enquire with the vendor to determine whether any hydraulic testing and/or theoretical Computational Fluid Dynamics (CFD) analysis of the valve has been conducted by the vendor. If hydraulic testing and/or theoretical CFD analysis of the valve has been

conducted then the designer and/or contractor must take this into account in technically assessing the valve before it is procured. Any hydraulic testing and/or theoretical CFD analysis of the valve obtained by the designer and/or contractor must be provided to SA Water for its records

- The method of resisting hydraulic forces (and force imbalances) within a valve shall be determined by the designer and/or contractor to ensure that thrusts are appropriately transferred to the body of the valve and that problems, such as excessive wedge/gate resistance to operation, disc fluttering, gear box slop and associated displacements and/or any other issue that may lead to more maintenance over the design life of the valve (than declared at the time of procurement of the valve) are avoided
- The hydraulic curves for any isolation and/or control valve must be obtained from the vendor and the relationships between the degree open, differential head across and flow through a valve considered by the designer and/or contractor to ensure that any valve selected will achieve the functional requirements of the system (including the valve in it) over the design life of the valve (refer to clause 4.5.4)

### 5.2.15 Maintenance Requirements

The maintenance requirements for a valve (including criteria identified in a datasheet or returnable schedule customised to suit specific application requirements by the designer and/or contractor) shall be considered by SA Water Procurement as potential weighted criteria in any Request for Tender process and/or market approach document and the evaluation of these criteria shall be such that valves are not procured which cannot be efficiently or safely maintained by SA Water Operations and Maintenance (or its contractor). The maintenance requirements for a valve are to be explicitly obtained in writing from the vendor by the designer and/or contractor and provided to SA Water for assessment before any order for a valve is finalised.

In circumstances where valves are directly purchased on a project with a supporting specification from a designer and/or contractor (including criteria identified in a datasheet or returnable schedule customised to suit specific application requirements by the designer and/or contractor), the specification used shall refer to this Technical Standard and the information regarding maintenance that is to be provided to SA Water before any valve order is finalised. This clause applies to valve purchases made by SA Water Workshops.

## 6 Testing

### 6.1 Factory Testing

All factory tests as stipulated in AS2638.1, AS2638.2, AS4795.1, AS4795.2 and AS6401, and as otherwise identified in this standard, must be requested of the valve vendor via the specification and datasheet prepared by the designer and/or contractor. Some tests are listed as optional or not mandatory in the Australian Standards in which case the requirements of this Technical Standard must be followed and SA Water contacted to determine which testing is required if it is unclear. Required tests shall be identified in the specification and datasheet prepared by the designer and/or contractor before the procurement of any valve. No valve shall be shipped from the factory until all required tests have been conducted, the results communicated to SA Water and SA Water has formally confirmed receipt of the test results. Depending on the contractual arrangements for the supply of the valve(s) and the terms of the specification and datasheet, SA Water may need to provide formal approval before any valves are shipped from the factory. Any such approval from SA Water will be based on independent third party witnessing and certification of the valves if required in accordance with this standard.

#### 6.1.1 Factory Testing (Unwitnessed)

Unwitnessed valve test results (factory test results), conducted in accordance with this standard, must be provided to SA Water in writing, and no valves shipped until SA Water has formally confirmed receipt of the test results, for all water and wastewater valves with a diameter above 375mm. Formal confirmation of the receipt of the test results by SA Water under this clause does not constitute an approval or acceptance of the valves. Approval and/or acceptance of the valves will be governed by the terms of the contract(s) for the supply of the valves.

Unwitnessed valve test results may be required under contracts referring to Australian Standards and/or SA Water Network Reticulation Standards for valves with a diameter less than or equal to 375mm. The requirements of this standard can be extended to valves with a diameter less than or equal to 375mm if the contract for the supply of the valves makes this standard applicable. All SA Water groups (including, but not limited to, SA Water Capital Delivery, Operations, Workshops, Assets and Procurement) involved in the delivery of valves with a diameter less than or equal to 375mm should explicitly confirm with the designer and/or contractor, and SA Water Procurement, whether this standard is to be applied or not.

#### 6.1.2 Factory Testing (Witnessed)

Witnessed valve test results (factory test results), conducted in accordance with this standard, must be provided to SA Water in writing, and no valves shipped until SA Water has formally confirmed receipt of the test results, for water and wastewater valves with a diameter above 375mm, when the relevant contracts for the supply of the valves stipulate that witnessed testing is required. Formal confirmation of the receipt of the test results by SA Water under this clause does not constitute an approval or acceptance of the valves. Approval and/or acceptance of the valves will be governed by the terms of the contract(s) for the supply of the valves.

If SA Water stipulate, based on an assessment of the criteria identified below, that the relevant contracts for the supply of the valves shall include witnessed valve testing then the designer and/or contractor, or any other party purchasing the valves, shall include the requirement for witnessed valve testing in accordance with this Technical Standard in all subsequent contracts and the specification and datasheet for the valve(s). The following non-exclusive list of considerations is to be taken into account in making the decision to witness the testing (or not):

- Criticality of the valve when installed and operational
- Ease or difficulty of maintenance (and repair or removal) of the valve once installed and operational
- Required design life of the valve(s) (body or components)
- SA Water technical knowledge of issues with the type of valve(s) which can be managed by witnessed testing
- Changes in the technical configuration and/or manufacturing process for the valve(s) relative to the valve(s) of similar type already installed and operational in SA Water systems
- Specific SA Water testing results and/or performance history for the type valve(s) to be purchased

Planning for witnessed tests must be coordinated through SA Water. The contractor (or any other party purchasing the valve(s)), and/or valve vendor intending to test the valve(s), must provide 30 working days of notice prior to factory testing so that arrangements can be made through SA Water for witnessing of the tests. Witnessing must be undertaken by SA Water or a suitably qualified third party witness. SA Water determines whether a third party witness is suitably qualified using its assessment criteria.

SA Water will assess the witnessed factory test results and approve or disapprove shipping within 10 working days.

## 6.2 Factory Valve Test Requirements

The designer and/or contractor must state in the valve specifications that detailed engineering drawings, specific to the valve to be procured, must be provided within two weeks of a contract for supply of the valve being entered into and these drawings must include for example, amongst other things, the dimensions and details of all valve elements, sections through the valve seat showing method of construction/assembly and shaft to disc connection details (for butterfly valves). The designer and/or contractor must include, in the specification, requests for any other detailed engineering drawings considered relevant to confirming the information provided by the vendor prior to procurement of the valve. The designer and/or contractor must also include mechanisms in the specification for holding the delivery of any valve where the detailed drawings do not comply with the pre-procurement information provided by the vendor and/or show details that mean the valve will not comply with the design life and/or operational and maintenance requirements of this Technical Standard.

The designer and/or contractor must state in the specification for the valves that Inspection Test Plans (ITPs) including the requirements identified in this Technical Standard be prepared by the valve vendor and issued for review and approval by the designer and/or contractor before any valves are shipped from factories (or other points of origin).

### 6.2.1 Type and Production Tests

Type and production tests must be carried out as required and described in AS2638.1, AS2638.2, AS4795.1 and AS4795.2 and as otherwise required and/or described in this Technical Standard. The results of the type testing must be requested, obtained and confirmed as satisfactory by the designer and/or contractor before any valve is procured.

## 6.2.2 Dimensional Measurements

All dimensions of the valves must be measured and recorded including overall length, width and height, internal diameter and flange dimensions (including pitch circle diameter, thickness and number of bolts).

## 6.2.3 Visual Checks

The position of all moving components must be checked with the valve in an open and closed position (including limit positions).

The free movement of all moving components from an open to closed to open position must be checked.

Internal and external coatings must be checked for any visually detectable defects.

## 6.2.4 Materials Certifications

Materials certificates for the valves including the body, wedge or disc, seats, shafts and all other components must be provided.

## 6.2.5 Pressure Tests

### 6.2.5.1 Metal Seated Gate Valve

Type testing of metal seated gate valves is acceptable when the pressure rating is less than or equal to PN16 and the criticality of the valves has been assessed in accordance with this Technical Standard (including clause 4.2) and the designer and/or contractor has confirmed with SA Water that the criticality is low and type testing of the valve type to be procured is sufficient.

Type testing must be conducted in accordance with AS2638.1. The results of the type pressure testing must be requested, obtained and confirmed as satisfactory by the designer and/or contractor before any valve is procured.

Production testing of metal seated gate valves is required when the pressure rating is greater than PN16 and/or the criticality of the valves has been assessed in accordance with this Technical Standard (including clause 4.2) and the designer and/or contractor has confirmed with SA Water that the criticality is sufficient to warrant production testing of the valve to be procured.

Production pressure testing of all metal seated gate valves must be conducted in accordance with AS2638.1, and witnessed and recorded, as follows (and in the order listed):

#### **Body Strength**

With reference to AS2638.1 Section 5.2.2, metal seated gate valves subject to production body strength pressure testing shall be arranged with blank flanges connected on both sides, the enclosed volume filled with water and the gate in the open position. Pressure testing must be conducted to 1.5 times the pressure rating for the valve and this pressure sustained for 5 minutes (for all valve sizes) with no detectable leakage through the valve spindle or any other part of the valve body. There shall be no plastic (permanent) deformation or distortion of the valve body or components.

### Sealing Tests

With reference to AS2638.1 Section 5.2.3, a blank flange must be fitted to one side of the valve only and the gate closed with the enclosed volume filled with water. If a second flange has been fitted for body strength test or any other reason, then this flange must be removed such that the gate is fully visible during the test. The valve must be supported and secured by the flange to which the blank has been applied (i.e., the upstream flange). Pressure testing must be conducted to 1.1 times the pressure rating for the valve and this pressure sustained for 5 minutes (for all valve sizes) with preferably no leakage (this is to be confirmed visually and by reference to connected pressure gauges). If there is leakage then the rate of leakage must not exceed the limits set in Table 5.2 of AS2638.1. The method of determining the rate of leakage must be requested from the vendor and confirmed as suitable by the designer and/or contractor.

#### 6.2.5.2 Resilient Seated Gate Valves

Type testing of resilient seated gate valves is acceptable when the criticality of the valves has been assessed in accordance with this Technical Standard (including clause 4.2) and the designer and/or contractor has confirmed with SA Water that the criticality is low and type testing of the valve type to be procured is sufficient.

Type testing must be conducted in accordance with AS2638.2. The results of the type pressure testing must be requested, obtained and confirmed as satisfactory by the designer and/or contractor before any valve is procured.

Production testing of resilient seated gate valves is required when the criticality of the valves has been assessed in accordance with this Technical Standard (including clause 4.2) and the designer and/or contractor has confirmed with SA Water that the criticality is sufficient to warrant production testing of the valve to be procured.

Production pressure testing of all resilient seated gate valves must be conducted in accordance with AS2638.2, and witnessed and recorded, as follows (and in the order listed):

#### Body Strength

With reference to AS2638.2 Section 5.2.2, resilient seated gate valves subject to production body strength pressure testing shall be arranged with blank flanges connected on both sides, the enclosed volume filled with water and the gate in the open position. Pressure testing must be conducted to 1.5 times the pressure rating for the valve and this pressure sustained for 5 minutes (for all valve sizes) with no detectable leakage through the valve spindle or any other part of the valve body. There shall be no plastic (permanent) deformation or distortion of the valve body or components.

#### Sealing Tests

With reference to AS2638.2 Section 5.2.3, a blank flange must be fitted to one side of the valve only and the gate closed with the enclosed volume filled with water. If a second flange has been fitted for body strength test or any other reason, then this flange must be removed such that the gate is fully visible during the test. The valve must be supported and secured by the flange to which the blank has been applied (i.e., the upstream flange). Pressure testing must be conducted to 1.1 times the pressure rating for the valve and this pressure sustained for 5 minutes (for all valve sizes) with no leakage (this is to be confirmed visually and by reference to connected pressure gauges). No leakage is permitted during the test.

### 6.2.5.3 Wafer and Lugged Butterfly Valves

Type testing of wafer and lugged butterfly valves is acceptable when the pressure rating is less than or equal to PN16 and the criticality of the valves has been assessed in accordance with this Technical Standard (including clause 4.2) and the designer and/or contractor has confirmed with SA Water that the criticality is low and type testing of the valve type to be procured is sufficient.

Type testing must be conducted in accordance with AS4795.1. The results of the type pressure testing must be requested, obtained and confirmed as satisfactory by the designer and/or contractor before any valve is procured.

Production testing of wafer and lugged butterfly valves is required when the pressure rating is greater than PN16 and/or the criticality of the valves has been assessed in accordance with this Technical Standard (including clause 4.2) and the designer and/or contractor has confirmed with SA Water that the criticality is sufficient to warrant production testing of the valve to be procured.

Production pressure testing of all wafer and lugged butterfly valves must be conducted in accordance with AS4795.1, and witnessed and recorded, and as described in clause 6.2.5.4 below except that “free-end” testing shall only be conducted for lugged (not wafer) butterfly valves. Sealing tests shall be conducted for wafer butterfly valves in accordance with AS4795.1 Section 5.3.4 such that the downstream disc face fully visible during the test (both valve flanges can be supported while still achieving a greater level of flange restraint than for a “free-end” test).

### 6.2.5.4 Double Flanged Butterfly Valves

Type testing of double flanged butterfly valves is acceptable when the pressure rating is less than or equal to PN16 and the criticality of the valves has been assessed in accordance with this Technical Standard (including clause 3.2) and the designer and/or contractor has confirmed with SA Water that the criticality is low and type testing of the valve type to be procured is sufficient.

Type testing must be conducted in accordance with AS4795.2. The results of the type pressure testing must be requested, obtained and confirmed as satisfactory by the designer and/or contractor before any valve is procured.

Production testing of double flanged butterfly valves is required when the pressure rating is greater than PN16 and/or the criticality of the valves has been assessed in accordance with this Technical Standard (including clause 4.2) and the designer and/or contractor has confirmed with SA Water that the criticality is sufficient to warrant production testing of the valve to be procured.

Production pressure testing of all double flanged butterfly valves must be conducted in accordance with AS4795.2, and witnessed and recorded, as follows (and in the order listed):

#### **Body Strength**

With reference to AS4795.2 Section 5.3.2, a blank flange can be fitted to both flanges of a valve and the enclosed volume filled with water. Alternatively, a single blank flange can be fitted to one side of the valve and tested with this process repeated for the other side of the valve. Pressure testing must be conducted to 1.5 times the pressure rating for the valve and this pressure sustained for 10 minutes (for all valve sizes) with no detectable leakage through the valve shaft seal or any other part of the valve body. There shall be no plastic (permanent) deformation or distortion of the valve body or components.

#### **Disc Strength Test**

With reference to AS4795.2 Section 5.3.5, a blank flange must be fitted to one side of the valve and the disc closed (to its mechanical limit stops) with the enclosed volume filled with water. Pressure testing must be conducted to 1.5 times the pressure rating for the valve and this pressure sustained

for 10 minutes (for all valve sizes) with no plastic (permanent) deformation or distortion of the valve body or components. Seat leakage is permissible during this test but must be determined and forwarded to the designer and/or contractor. For an eccentric valve that is required to seal bi-directionally this test must be repeated for the other side of the valve.

#### **Forward Sealing Test**

With reference to AS4795.2 Section 5.3.3, a blank flange must be fitted to one side of the valve only and the disc closed (to its mechanical limit stops) with the enclosed volume filled with water. If a second flange has been fitted for body strength test or any other reason, then this flange must be removed such that the disc is fully visible during the test. The valve must be supported and secured by the flange to which the blank has been applied (i.e., the upstream flange) in accordance with the "free-end" test requirements listed under AS4795.2 Section 5.3.6. Pressure testing must be conducted to 1.1 times the pressure rating for the valve, in the preferred sealing direction, and this pressure sustained for 10 minutes (for all valve sizes) with no leakage (this is to be confirmed visually and by reference to connected pressure gauges).

#### **Reverse Sealing Test**

For a valve that is required to seal bi-directionally the requirements of the forward sealing test identified above must be applied with the blank flange fitted to the other side of the valve. With reference to AS4795.2 Section 5.3.4, pressure testing must be conducted to 1.1 times the pressure rating for the valve, in the non-preferred sealing direction and opposite to the direction for the forward sealing test, and this pressure sustained for 10 minutes (for all valve sizes) with no leakage (this is to be confirmed visually and by reference to connected pressure gauges).

#### **Welded Overlay Seat**

If a body seat ring welded overlay is incorporated in a valve in accordance with clause 4.2.5 above, then the testing requirements identified in AS4795.2 Section 5.3.7 apply in addition to any other testing requirements identified by the designer and/or contractor that are required to comply with clause 4.2.5.

### **6.2.6 Noise Tests**

Noise tests are required for control valves greater than 375mm in diameter where the valves are being installed in noise sensitive installations such as where compliance with Environment Protection Agency (EPA) limits is required (if compliance with EPA limits is required then designers, contractors and/or valve vendors must make contact with the SA Water to determine whether lower noise restrictions than stipulated by the EPA apply).

Noise levels should be measured on the upstream and downstream side of the control valve when installed in a factory hydraulic test rig with the valve partially open and at the differential pressure and flow conditions which generate maximum noise emissions. The sound pressure level (@ 1m) and sound power levels must be measured with the valve partially open and the hydraulic conditions which generate maximum noise established.

### **6.2.7 Other Tests (including Coating Tests)**

If internal and/or external coatings have been applied then testing and then certification of the method of application, coverage and thickness (including spark testing) of the coating shall be provided to the designer and/or contractor for approval (and written notification of the results must be provided to SA Water confirming compliance with all SA Water Materials Group standards). If the testing or certification does not comply with SA water Standards or Australian Standards then SA Water may request third party testing and certification of the internal and/or external coatings.

All internal wetted coatings, for double flanged butterfly valves subject to production testing, must be tested in accordance with AS4795.2 Section 5.3.1.

All coatings for gate valves shall be tested in accordance with AS2638.1 Section 5.2.4 and AS2638.2.

### 6.2.8 Certified Drawings

Certified dimensional engineering drawings of valves must be provided within 4 weeks of entering into a contract for the procurement of the equipment unless otherwise negotiated in the contract (if a longer period is negotiated by a designer, contractor and/or valve vendor then SA Water shall be notified of this in writing). The designer and/or contractor must request any CAD and/or other electronic format certified drawings from the vendor (if available) and forward these drawings to SA Water.

Any specific pipe, spool or other device required to establish particular flow conditions approaching the suction side of a valve must be explicitly declared by valve vendors and certified dimensional engineering drawings of the pipe, spool or other device provided before valve procurement.

## 6.3 Pre-Shipping Documentation and Delivery Inspections and Testing

### 6.3.1 Pre-Shipping Documentation (Completed Inspection Test Plan)

Unwitnessed or witnessed factory tests provide results and/or a certificate(s) demonstrating that the valve complies with the specification and/or datasheet prepared by the designer and/or contractor and is defect free at the time the valve is released for shipping from the factory.

An Inspection Test (or Control) Plan (ITP) must be requested from the vendor by the designer and/or contractor, containing the factory test results and/or certificates, in the specification and/or datasheets for the valve. The ITP must be specifically updated for each valve by the designer and/or contractor, in co-operation with valve vendors as required, and a copy provided to SA Water (for its records) 10 working days prior to any procurement contract for a valve being finalised. Once factory testing is completed, and a valve is ready for shipping, the completed ITP must be forwarded by the vendor to the designer and/or contractor and the designer and/or contractor must ensure that all requirements of the specification and/or datasheets for the valve have been complied with based on the information contained within the ITP. The valve(s) may then be shipped. Examples of Inspection Test plans listing typical items that may be included and confirmed before any valve is shipped, including factory test results and material certificates) are included in Figure 6.1 and Figure 6.2 below:

Figure 6.1 Pre-Shipping Inspection Test Plan

Abnahme-Prüfplan / Inspection Control Plan								
Kunde / Client:								
Herstell.-Nr. / Works ser. No.:	Dok. Nr. / Doc. No.:	Komm.-Nr. / Our Order Ref. No.:	Prüfplan Nr. / Control plan No.:	Zeichnung Nr. / Drawing No.:	Blatt Nr. / Sheet No.:			
Lieferant / Supplier:	Dienststelle / Dept.:	Kennwort / Code:	Werk / Plant:	Kunden / customer No.:				
Benennung / Designation: Butterfly Valves								
Lfd. Nr./ Serial No.	Prüfgrundlage Test standard:	Prüfschritte / Testing phases – Beschreibung / Description:	Prüfbescheinigung / Inspection documents: DIN EN 10204	Prüfung durch / Inspection by:			Bemerkungen / Remarks:	
				H/M	K/C	SV/IN	B/CC	
1.		Maßprotokolle zur Baulänge, Flanschstärke, Flansch-Bohrungen und dem breitesten Punkt der Armatur stellen Measurement of all valves dimensions: flange face-to-face, flange drillings and thickness and widest point of the valve	Abnahmeprüfzeugnis 3.1/ Inspection Certificate 3.1 W	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
2.	DIN EN 12266-1/2 P 10 / P11	Festigkeits- / Dichtheitsprüfung des Gehäuses mit 1,5 x PN (Wasser) 100% Hydrostatic test on body with 1,5 x PN bar (water) 100%	Abnahmeprüfzeugnis 3.1/ Inspection Certificate 3.1 W	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Mindest-Prüfdauer, Tabelle A. 2 Annahmekriterien A.2.3 und A.3.3 Minimum duration table A.2 Acceptance criteria A. 2.3 and A.3.3
3.	DIN EN 12266-1/2 P 12 / P20	Festigkeits-/Dichtheitsprüfung des Abschlusses mit 1,1 x PN (Wasser) 100% Hydrostatic test on seal seat with 1,1 x PN (water) 100% (incl. seating correctly at valve close limit) – Test on both sides of the disc Any method of fixing or repairing a leak will be documented including photographs and quantitative measurements	Abnahmeprüfzeugnis 3.1/ Inspection Certificate 3.1 W	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Mindest-Prüfdauer, Tabelle A.4/A.3 Annahmekriterien A.4.3/A.2.3 Minimum duration table A.4/A.3 Acceptance criteria A.4.3/A.2.3
4.		Prüfung der Bauart, Bauform und Ausrüstung 100% Inspection of design and fittings 100%	Abnahmeprüfzeugnis 3.1/ Inspection Certificate 3.1 W	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
5.		Prüfung der internen und externen Beschichtung einschließlich Getriebe Perendurchschlagprüfung - 1,2 KV Check of external and internal coating for any defects including gear boxes checking of coating using high-voltage (brush) method – 1,2 KV	Abnahmeprüfzeugnis 3.1/ Inspection Certificate 3.1 W	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
6.		Prüfung der Kennzeichnung 100% Inspection of marking 100%	Abnahmeprüfzeugnis 3.1/ Inspection Certificate 3.1 W	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
7.	DIN EN 12266-2 F20	Prüfung der Betätigungsfunktion 100% Getriebeeinstellung überprüfen Functional test 100% Check of gear box settings	Abnahmeprüfzeugnis 3.1/ Inspection Certificate 3.1 W	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

30. DEZ. 2015

W = Witness    K / C = Kunde / Client    R = Review    B / CC = Beschichter / Coating Company  
H = Holdpoint    SV / IN = Sachverständiger / Inspector    H / M = Hersteller    manufacturer

Erstellungsdatum: 21.12.2015 16:06

Figure 6.2 Pre-Shipping Inspection Test Plan

Abnahme-Prüfplan / Inspection Control Plan								
Kunde / Client:								
Herstell.-Nr. / Works ser. No.:	Dok. Nr. / Doc. No.:	Komm.-Nr. / Our Order Ref. No.:	Prüfplan Nr. / Control plan No.:	Zeichnung Nr. / Drawing No.:	Blatt Nr. / Sheet No.:			
Lieferant / Supplier:	Dienststelle / Dept.:	Kennwort / Code:	Werk / Plant:	Kunden / customer No.:				
Benennung / Designation: Butterfly Valves								
Lfd. Nr./ Serial No.	Prüfgrundlage Test standard:	Prüfschritte / Testing phases – Beschreibung / Description:	Prüfbescheinigung / Inspection documents: DIN EN 10204	Prüfung durch / Inspection by:			Bemerkungen / Remarks:	
				H/M	K/C	SV/IN	B/CC	
8.	DIN EN 10204	Werkstoffzeugnis (einschließlich Klappenscheibe) Material Certificates (incl. Disc)	Abnahmeprüfzeugnis 3.1/ Inspection Certificate 3.1 W	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Body: EN-JS1025 Driving-Shaft, Trunnion: 1.4462 Reviewed by TPI
9.	DIN EN 10204	Überprüfung der Zeugnisse Check all Certificates	Abnahmeprüfzeugnis 3.1/ Inspection Certificate 3.1 W	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Reviewed by TPI
10.		Ohne Zeugnisablegung/ without report	W	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

30. DEZ. 2015

W = Witness    K / C = Kunde / Client    R = Review    B / CC = Beschichter / Coating Company  
H = Holdpoint    SV / IN = Sachverständiger / Inspector    H / M = Hersteller    manufacturer

Erstellungsdatum: 21.12.2015 16:05

SA Water may require additional delivery testing be undertaken after being added to the ITP in accordance with clause 6.3.2 below.

### 6.3.2 Delivery Inspections and Testing

All valves must be physically inspected upon delivery by contractors, SA Water Workshops and/or any other party taking receipt of the valves for defects including (but not limited to):

- Valve labelling errors
- External or internal coating (e.g., paint) defects
- Dimensional errors
- Valve seating defects (in the case of gate valves)
- Disc sealing errors (in the case of butterfly valves) – this could be due to inaccurately set mechanical stops, interference between the disc and body (through seals, liners or otherwise) or otherwise
- Excessive torque required to operate valve

Valve inspections must occur upon first receipt and acceptance of delivery of the valves and contractors, SA Water Workshops and/or any other party taking receipt of the valves must not do so unless subject to this inspection.

If defects are confirmed for the as-delivered valves then the vendor must be notified immediately and requested to rectify the defects in accordance with the terms of the contract(s) for the supply of the valves

SA Water Procurement may stipulate, based on an assessment of the criteria identified below, that delivered valves, which have already passed unwitnessed or witnessed factory tests, are to be re-tested in part or in full upon delivery to a designated point in Australia:

- Criticality of the valve when installed and operational
- Ease or difficulty of maintenance (and repair or removal) of the valve once installed and operational
- Required design life of the valve(s) (both components and body)
- SA Water technical knowledge of issues with the type of valve(s) which can be managed by witnessed testing
- Changes in the technical configuration and/or manufacturing process for the valve(s) relative to the valve(s) of similar type already installed and operational in SA Water systems
- Specific SA Water testing results and/or performance history for the type valve(s) to be purchased

Any such stipulation will be expressed in the relevant contracts with designers and/or contractors, or directly with a SA Water Workshop, prior to any supply contract with a vendor being entered into and the vendor will be notified of the intention to conduct post-delivery testing.

Re-testing of a valve upon delivery in Australia is required where the final gearbox and/or actuator (i.e., the gearbox and/or actuator to be permanently installed with the valve) for the valve is not fitted for the overseas factory testing. The designer and/or contractor must ensure this re-testing requirement is included in the valve specification and/or datasheets issued to vendors prior to the procurement of any valve. Re-testing of a valve may be required for other reasons as stipulated in the relevant contract, specification and/or datasheet developed by the designer and/or contractor and issued to the valve vendors prior to the procurement of any valve.

## 6.4 Workshop Testing for Valve Installations

This clause is applicable to cases where a new valve (or existing valve being re-furbished and re-installed) is assembled with accompanying pipe spools and/or other attachments in a workshop prior to be transported to an installation site.

When a risk assessment confirms that workshop testing is required, buried valves used for isolation and/or control, whether actuated or not, which are not directly connected flange to flange into an existing system, must be assembled with upstream and downstream pipework spools in a testing workshop, in the final valve and pipework configuration to be buried after installation (via closing collars or otherwise), and subject to testing in accordance with this Technical Standard. All SA Water groups (including, but not limited to, SA Water Capital Delivery, Operations, Workshops, Assets and Procurement) involved in the delivery of valves must participate in the risk assessment of buried valves and determine whether workshop testing is required (or not). Developers and/or contractors must inform themselves of any outcome from a risk assessment that has been undertaken by SA Water for a particular valve installation.

For valves used for isolation and/or control, whether actuated or not, which are not directly connected flange to flange into an existing system, the designer and/or contractor must obtain and provide information on each of the criteria identified below and provide this to SA Water to confirm whether workshop testing for valve installations is required after the delivery of a valve and preparations for its installation are complete:

- Criticality of the valve when installed and operational
- Ease or difficulty of maintenance (and repair or removal) of the valve once installed and operational
- Required design life of the valve(s) (both components and body)
- SA Water technical knowledge of issues with the type of valve(s) which can be managed by witnessed testing
- Changes in the technical configuration and/or manufacturing process for the valve(s) relative to the valve(s) of similar type already installed and operational in SA Water systems
- Specific SA Water testing results and/or performance history for the type valve(s) to be purchased

In the case of the direct installation of a valve (only), without any accompanying pipe spools and/or other attachments, this clause is not applicable.

An Inspection Test (or Control) Plan (ITP) must be prepared by the designer and/or contractor for workshops testing and certification of the valve and the assembly in which it is installed (e.g., connected upstream and downstream pipe spools). The ITP must be specifically updated for each valve by the designer and/or contractor, in co-operation with valve vendors as required, and a copy provided to SA Water (for its records) 10 working days prior to the finalisation of fabrication details for the valve and its associated assembly. The ITP must ensure that sufficient factory tests are repeated and/or other tests are conducted to ensure that all valve, pipework and/or any other elements comprising the totality of the valve installation will be fully operationally functional over the design life of all elements. Examples of Inspection Test Plans listing typical items that may be included and confirmed as part of workshop testing before valve and associated assembly installation are included in Figure 6.3, Figure 6.4 and Figure 6.5 below:

Figure 6.3 Workshop Inspection Test Plan

### INSPECTION & TESTING PLAN

Project: [Redacted] Client: [Redacted] ITP No.: 0364-H12 Version: 4  
 Date Issued: 1/05/2016 Principal: DIPTI / SA Water Prepared By: [Redacted]  
 Job Number: 6854 Location: [Redacted] Approved By: [Redacted]  
 Description: Hydro Testing Isolation Valve Assemblies (DN1200) Drawing No: Various

Inspection / Surveillance Legend	Summary of Requirements Process Qualifications	Principle Codes / Standards	Required MDR Records <i>(Yes or No field must be completed)</i>
<b>HOLD (H)</b> - nominated point beyond which work shall not be processed without verified acceptance by nominee  <b>WITNESS (W)</b> - nominated points at which the nominee shall be notified & invited to witness as activity but further work may proceed without the presence of the nominee  <b>REVIEW (R)</b> - verify by examination of documentary evidence that inspection / tests have been satisfactorily conducted.  <b>SURVEILLANCE (S)</b> - continuing evaluation of the status of methods, analysis of records & monitoring of activities on a (room basis to ensure quality requirements will be met  <b>VISUAL (V)</b> - 100% visual inspection of work / item to ensure compliance with code / specification  <b>DIMENSIONAL (D)</b> - measurement of critical dimensions to ensure work / item is within tolerance	<b>Traceability</b> Material <input checked="" type="checkbox"/> Consumables <input type="checkbox"/> Heat Treatment <input type="checkbox"/> Welder ID <input type="checkbox"/> Alloy Verification <input type="checkbox"/> NDT <input type="checkbox"/> Pressure Testing <input checked="" type="checkbox"/> WPS <input type="checkbox"/> Vacuum Testing <input type="checkbox"/>	AS 1210 : 2010 Pressure Vessels <input type="checkbox"/> AS 4041 : 2006 Pressure Piping <input checked="" type="checkbox"/> AS 4100 : 1998 Steel Structures <input type="checkbox"/> AS 4458 : 1997 Pressure Equipment - Manufacture <input type="checkbox"/> AS 4037 : 1999 Press. Equip. - Exam. & Testing <input checked="" type="checkbox"/> AS/NZS 3992 : 1998 Press. Equip. - Weld. & Braz. Qual. <input type="checkbox"/> AS 2885.2 : 2007 Pipelines - Gas & Liq. Pet. - Welding <input type="checkbox"/> AS/NZS 1554.1 : 20 Welding of Steel Structures <input type="checkbox"/> AS 1579 : 2001 Arc Welded Pipe & Fitting for Water & Waste Water <input type="checkbox"/> AS 1796 : 2001 Cert. of Welders & Weld. S'visors <input type="checkbox"/> ASME BPVC IX : 20 Welding & Brazing Qualifications <input type="checkbox"/> ASME B31.1 : 201 Power Piping <input type="checkbox"/> ASME B31.3 : 201 Process Piping <input type="checkbox"/> AS 4087 : 2011 Metallic Flanges for Waterworks Purposes <input checked="" type="checkbox"/> ASME/ANSI B16.20 : 1 Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral-Wound, & Jacketed <input type="checkbox"/>  <b>Client Specification</b> SA Water TS27 SA Water TS159b SA Water TS15 SA Water TS18 WSA 109-2011 AS 4087:2011 AS 4041 : 2006 AS 4037 : 1999 CSTR Division G	Yes No Inspection Release Certificate <input type="checkbox"/> <input checked="" type="checkbox"/> Material Traceability Register <input checked="" type="checkbox"/> <input type="checkbox"/> Material Certificate <input type="checkbox"/> <input type="checkbox"/> Consumable Certificate <input type="checkbox"/> <input checked="" type="checkbox"/> Conformance Certificate <input type="checkbox"/> <input checked="" type="checkbox"/> Deviations / Concessions <input type="checkbox"/> <input type="checkbox"/> Technical Queries / Request for information <input type="checkbox"/> <input checked="" type="checkbox"/> Welding Procedures (WPS) <input type="checkbox"/> <input checked="" type="checkbox"/> Welder Qualification Record (WQR) <input type="checkbox"/> <input checked="" type="checkbox"/> Weld Traceability Record (WTR) <input type="checkbox"/> <input checked="" type="checkbox"/> Weld Mapping Records (WMR) <input type="checkbox"/> <input checked="" type="checkbox"/> NDT Reports <input type="checkbox"/> <input checked="" type="checkbox"/> Heat Treatment Records <input type="checkbox"/> <input checked="" type="checkbox"/> Drawings / Dimensional Reports <input type="checkbox"/> <input checked="" type="checkbox"/> Non-Conformance Reports <input type="checkbox"/> <input type="checkbox"/> Pressure Test Records <input type="checkbox"/> <input checked="" type="checkbox"/> Coating Report Internal/external <input type="checkbox"/> <input checked="" type="checkbox"/> Mechanical & Performance Records <input type="checkbox"/> <input checked="" type="checkbox"/> Electrical Certificate & Reports <input type="checkbox"/> <input checked="" type="checkbox"/> Instrumental Certificates & Reports <input type="checkbox"/> <input checked="" type="checkbox"/> Statutory Approval & Compliance Plates <input type="checkbox"/> <input checked="" type="checkbox"/> Other <input type="checkbox"/> <input checked="" type="checkbox"/> <i>(specify in Summary of Requirements Notes)</i> <b>Responsibility / Nominee Legend</b> Works Coordinator WC Boilermaker B Project Manager PM Pipe Fitter P Welding Supervisor WS Supervisor S QA / QC Co-ordinator QA Welder W QC Officer QC Stores Rep ST Welding Inspector WI Subcontractor SC Workshop Manager WM Client C
<b>Comments:</b> [Redacted]			
Prepared by: [Redacted]	Company: [Redacted]	Signed: [Redacted]	Date: 01/05/16
Approved by: [Redacted]	Company: [Redacted]	Signed: [Redacted]	Date: 04/05/16

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Figure 6.4 Workshop Inspection Test Plan

### INSPECTION & TESTING PLAN

Project: [Redacted] Client: [Redacted] ITP No.: 0364-H12 Version: 4  
 Date Issued: 1/05/2016 Principal: DIPTI / SA Water Prepared By: [Redacted]  
 Job Number: 6854 Location: [Redacted] Approved By: [Redacted]  
 Description: Hydro Testing Isolation Valve Assemblies (DN1200) Drawing No: Various

CONTROL CATEGORIES: H = Inspection Hold Point (Work must not proceed to the next step until this activity is complete & a signature obtained from the column placing the HOLD, i.e. QA or Client), V = Verify, W = Witness Point (Notify to permit witness, work can proceed if witness does not attend at agreed time), S = Surveillance Point (Monitor operations), R = Review Documentation (Sign or Stamp to record review).

Item No.	Inspection / Test Activity (Spec / Drg. Ref)	Responsibility	Frequency	Inspection Requirements	Inspection / Test Method	Acceptance Criteria	CONTROL POINT			
							Action	Sign	Action	Sign
<b>THIS ITP IS TO BE READ IN CONJUNCTION WITH [Redacted]</b>										
1	Pipe spool released from shop	QC	Before Commencement	Signed off Fabrication check sheet	Visual	Green "Final Inspection" sticker on spool	H		W	W
2	Visual Inspection of valves	S	Before Commencement	Valve release form from SAW (sent via [Redacted])	Visual	Visual Inspection: free from holes, burrs, scale, cracks	W		W	W
3	Orientation OF Valve	S	Before Commencement	Direction of valve to be mark by [Redacted] Representative	Visual	ITP to be signed by [Redacted] Representative.	H		H	W
4	Equipment to be tested and calibrated in according to NATA standards/requirements	QC	Before Commencement	NATA	Visual	In date calibration: _____	H		W	W
5	Material (for potable water) DN100 - 400; 3mm EPDM Rubber DN450 - 1200; 3mm TESSNII BA-U (Compressed Fibre)	PM S	Before Commencement	Delivery docket Visual inspection of item	Visual	Visual Inspection: 3mm EPDM Rubber (for potable water) installed DN80-DN400. Visual Inspection: 3mm TESSNII BA-U Fibre (for potable water) installed DN450 - DN1200	W		W	W
6	Material (galvanized steel bolts) M12 - M20; min Grade 4.6 M24 - M33; min Grade 8.8	PM S	Before Commencement	WSA 109-2011, Table E2 & E4 AS4087:2011, Table C1	Visual	DN80 Flanges; M16 bolts min. Grade 4.6 DN100 Flanges; M16 bolts min. Grade 4.6 DN200 Flanges; M16 bolts min. Grade 4.6 DN900 Flanges; M33 bolts min. Grade 8.8 DN1200 Flanges; M33 bolts min. Grade 8.8	W		W	W
7	Insulation: Bolt insulation sleeves to be installed	[Redacted]	[Redacted]	[Redacted]	[Redacted]	[Redacted]	H		W	W
8	Bolt Tightening - Lubrication and sequence	[Redacted] / [Redacted]	Every Bolt	TS27 2.1 (Moycoat P74) WSA 109-2011, E7.1	Visual	Bolt lubrication applied; bolting sequence followed in according to TS27	S		W	W
9	Bolt Tightening - Torque	[Redacted] / [Redacted]	Every Bolt	TS27 WSA 109-2011, Table E2 & E8	Bolt Torque Sheet	Calibrated torque device used; Estimated torque DN80 Flange; M18 4.6, 65% Yield = 48Nm DN100 Flange; M16 4.6; 65% Yield = 48Nm DN200 Flange; M16 4.6; 65% Yield = 48Nm DN1200 Flange; M33 3.8, 65% Yield = 920Nm	H		W	W

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Figure 6.5 Workshop Inspection Test Plan

INSPECTION & TESTING PLAN

Project: [Redacted]  
 Date Issued: 1/05/2016  
 Job Number: 6854

Client: [Redacted]  
 Item No.: [Redacted]

ITP No.: 0384-H12 Version: 4  
 Prepared By: [Redacted]  
 Approved By: [Redacted]  
 Drawing No: Various

Description: Hydro Testing Isolation Valve Assemblies (DN1200)

CONTROL CATEGORIES: H = Inspector Hold Point (Work must not proceed to the next step until this activity is completed & a signature obtained from the column placing the HOLD; i.e. QA or Client); V = Verify; W = Witness Point (Notify to permit witness, work can proceed if witness does not attend at agreed time); S = Surveillance Point (Monitor operations); R = Review Documentation (Sign or Stamp to record review).

Item No.	Inspection / Test Activity (Spec / Drg. Ref)	Responsibility	Frequency	Inspection Requirements	Inspection / Test Method	Acceptance Criteria	CONTROL POINT					
							Action	Sign	Action	Sign	Action	Sign
10	Valves in open position	P	Before Hydro	N/A	Visual	No leakage or moisture	H		W		W	
11	Fill with water & leave for 24 hours	P	Before Hydro	N/A	Visual	N/A	W		W		W	
12	Valves in closed position, set gauges both ends	P	Before test	N/A	Visual	N/A	W		W		W	
13	By Pass Valve not to be installed for Sealing Test	P	Before Sealing Test	N/A	Visual	Blind flanges to be installed in place of By Pass valve	W		W		W	
14	Sealing Test - 1760 kPa test pressure for 10 minutes	P	Each test	AS 4795.2, Section 5.3.3 CSTR Part G, Section 12.2	Visual Inspection, no leaks. Pressure to be raised at 400kpa per 10min then target pressure.	0% leakage, moisture. Use 2 x Calibrated gauges (0-4000kPa) Test record SM-QF-05098 completed and signed.	H		W		H	
15	Release test pressure	P	After test	N/A	Visual	Pressure < 100kPa	W		W		W	
16	Sealing Test - 1760 kPa test pressure for 10 minutes	P	Each test	AS 4795.2, Section 5.3.3 CSTR Part G, Section 12.2	Visual Inspection, no leaks. Pressure to be raised at 400kpa per 10min then target pressure.	0% leakage, moisture. Use 2 x Calibrated gauges (0-4000kPa) Test record SM-QF-05098 completed and signed.	H		W		H	
17	Release test pressure	P	After test	N/A	Visual	Pressure < 100kPa	W		W		W	
18	By Pass Valve to be installed for Pressure Testing	P	Before Pressure Test	N/A	Visual	By Pass Valve Bolted lubrication applied; bolting sequence followed in according to TS27	S		W		W	
19	Pressure Testing - 1600 kPa test pressure for 30 minutes (client revised spec holding time)	P	Each test	AS 4041, Section 6.7 AS 4037, Section 17	Visual Inspection, no leaks or deformations. Pressure to be raised at 400kpa per 10min then target pressure.	0% leakage, moisture or deformations. Use 2 x Calibrated gauges (0-4000kPa) Test record SM-QF-05098 completed and signed.	H		W		H	
20	Release test pressure	P	After test	N/A	Visual	Pressure < 100kPa	W		W		W	

Signed by [Redacted] Representative: ..... Date: .....

Revision: 7, 5 July 2011  
 Printed: 29/06/2016

Signed by Client Representative: ..... Date: SM-QF-05038

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## 7 Warranty

In the case of project delivery through SA Water Capital delivery, with or without input from SA Water Procurement, and with project specific commercial terms and conditions, the warranty requirements of this technical standard must be included (in substance) in the project specific documentation (or alternatively directly referenced without modification).

In the case of valve procurement through SA Water that is not through the capital delivery process, the warranty requirements of this technical standard must be directly transmitted to valve vendors and complied with before any purchase is finalised.

### 7.1 General

The designer and/or contractor must include a requirement for a 2 year contractual warranty in the specification for the supply of all valves covered by this Technical Standard. This warranty is to begin on the first use of the valve in an operating SA Water system and is not to begin at any other time (including upon delivery of the valve). A 5 year contractual warranty is preferred and the designer and/or contractor must request this warranty period as an option from valve vendors. If a 5 year contractual warranty is not offered the designer and/or contractor must provide the written reasons for this to SA Water before any valve is procured.

The warranty provision in the specification for the valves must explicitly ensure that:

1. The warranty provides for the replacement of any valve found to be defective during the warranty period or the cost of replacing the valve with an appropriate alternative replacement valve. Any appropriate replacement valve proposed under a warranty claim must be approved for installation in writing by SA Water.
2. The warranty provides for the cost of removing the defective valve, including all SA Water operational, third party infrastructure and any other cost associated with works required to access the defective valve and/or the loss of operational utility resulting from the requirement to access and replace the defective valve.
3. The warranty provides for the cost of installing an alternate replacement valve approved by SA Water, including all SA Water operational, third party infrastructure and/or any other cost associated with the works required to install an alternate replacement valve and/or the loss of operational utility resulting from the requirement to install an alternate replacement valve.

A defect is defined as any change or deterioration in the valve that prevents the valve from meeting the testing requirements defined in section 5 of this Technical Standard. Such a defect may be detected as part of the normal course of use or operation of the valve and/or through specific testing of the valve by SA Water in accordance with section 7.2 below.

### 7.2 Inspection and Testing During Warranty Period

SA Water reserves the right to test any valve under warranty to confirm its operational performance against the test criteria stipulated in this Technical Standard.

SA Water may conduct passive monitoring of the performance and operation of the valve without physically engaging with or otherwise disturbing the valve in its installed conditions or changing its method of operation. Valve vendors will be notified by SA Water of the results of any passive monitoring of the performance and operation of the valve that confirms a defect. The warranty held by SA Water is unaffected by this passive testing and acceptance of this is to be confirmed by the valve vendor upon the initial supply of the valve and before any valve is procured.

SA Water may conduct active testing and monitoring of the performance and operation of the valve by changing its method of operation without physically engaging with or otherwise disturbing the valve in its installed conditions. Valve vendors will be notified by SA Water of any testing and monitoring of the performance and operation of the valve, involving a change to its method of operation, and given an opportunity to organise witnessing of any test. Valve vendors will be notified by SA Water of the results of any testing that confirms a defect. The warranty held by SA Water is unaffected by this active testing and acceptance of this is to be confirmed by the valve vendor upon the initial supply of the valve and before any valve is procured.

SA Water may conduct active testing and monitoring of the performance and operation of the valve by changing its method of operation and physically engaging with or otherwise disturbing the valve (e.g., by isolating the system containing the valve and physically removing the valve for testing in a workshop). Valve vendors will be notified by SA Water of any testing and monitoring of the performance and operation of the valve, involving a change to its method of operation and physically engaging with or otherwise disturbing the valve, and given an opportunity to organise witnessing of any test. Valve vendors will be notified by SA Water of the results of any testing that confirms a defect. The warranty held by SA Water is unaffected by this active testing unless the physical engagement with or disturbance of the valve results in new damage to the valve and acceptance of this is to be confirmed by the valve vendor upon the initial supply of the valve and before any valve is procured. The condition of removed valves will be documented upon removal from the system to establish a dilapidation baseline, which will be forwarded to the valve vendor, before any testing or transport of the valve by SA Water that could result in new damage.

If defect is discovered after any of the tests identified in this clause then the costs incurred by SA Water in conducting the tests will be paid by the valve vendor as part of any claim against the warranty.

The information contained in this clause must be explicitly transferred by the designer and/or contractor into all valve supply contracts.