SA Water

SOUTH AUSTRALIAN WATER CORPORATION

TS 140

TECHNICAL SPECIFICATION

STOP VALVE SELECTION CRITERIA FOR WATER MAINS

Issued by: Manager Asset Management

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Government of South Australia

MAJOR CHANGES INCORPORATED IN THE XXXX EDITION

The following lists the major changes to the XXXX edition of TS 140, which have been incorporated in this edition:

1. First Edition

Contents

NOTE:

Wording shown as normal text is an SA Water requirement.

Wording shown as italic text is for information only.

Section 1: Purpose

To ensure that the most suitable and effective stop valves are installed in SA Water's water supply network a series of selection criteria have been specified. Correct selection will result in ease of operation and maintenance and ensure the valves achieve the required economic life span of 50 years.

To achieve this, a consistent methodology for valve selection should be adopted to ensure the appropriate valve is selected for each application.

This document has been produced to specify acceptable types of stop valves, size (DN), pressure ratings (PN) and materials. In addition, preferred installation systems (buried, chamber, anchors etc) have also been specified.

This document overrides all other instructions issued on the use of stop valves installed in SA Water's water supply networks and is the prime document regarding the use of stop valves within the network.

The document has been produced by the Asset Management and Engineering staff and is based on Water Services Association of Australia (WSAA) and Australian Standards valve usage recommendations. The document will be revised on a two yearly basis and be signed off by the Manager Asset Management. Minor technical amendments may be added in the intervening period and these will be signed off by the Infrastructure Standards Manager

Section 2: General

SA Water has for operational and maintenance purposes identified Gate valves and Butterfly valves as the preferred stop (isolation) valve options within their water supply network. Stop valves are not designed for use as flow control valves and must not be used for flow control (throttling) purposes.

2.1 PURCHASE OF VALVES

2.1.1 SA Water Staff (incl contractors operating under authority)

SA Water has entered into a Period Contract for the exclusive purchase of valves and only the valves listed on the contract are to be ordered and used by SA Water staff involved with ordering of valves. Where the required valves are not on the Period Contract or the contract valves do not meet some special valve requirement SA Water Technical Specialists should be contacted to identify suitable alternate valves.
Contact Procurement or local SA Water store for list of Period Contract Valves or alternatively SA Water's Water Supply Construction Manual (WSCM)- Authorised Items List - Mains (pages 36-49). See below for internet site access.

2.1.2 External Contractors

For valves not purchased by SA Water, but where the valves are to be used in SA Water's infrastructure the only valves to be used are those

listed in SA Water's Water Supply Construction Manual - Authorised Items List - Mains (see pages 36-49).
See SA Water Internet Site
http://www.sawater.com.au/NR/rdonlyres/A5B496D6-4766-48E6-B9F3-F90A4D6F9069/0/WMainsIss3R2.pdf

2.2 DIRECTION OF CLOSURE

All valves used in SA Water's infrastructure network must be ordered and supplied as CLOCKWISE CLOSING.

Care must be taken because AS2638 allows the manufacture of both clockwise and anti-clockwise closing valves. If a supplier requests valves from an interstate supplier they may supply valves with the wrong direction of closure. Clockwise closing valves can be easily identified by a red mark on the top of the spindle cap and the word 'CLOSE' with an arrow to indicate the direction of closure.

2.3 ADDITIONAL INFORMATION

All enquiries regarding this document shall be referred to the Infrastructure Standards Manager.

Section 3: Basic Valve Information

While there are a number of types of stop valves on the market, SA Water have standardised on Gate valves and Butterfly valves as the preferred types of valve. Other types of stop valve may be utilised in SA Water's infrastructure network with project specific approval from SA Water's Asset Management group.

3.1 GATE VALVES

Gate valves, also known as sluice valves, are valves that open by lifting a round or rectangular gate/wedge out of the path of the liquid. The gate faces can be wedge shaped or parallel. Gate valves are designed to be fully opened or closed. When fully open, gate valves have no obstruction in the flow path, resulting in a very low headloss.

Gate valves have either a rising or a non-rising stem. Only non-rising stems are used for buried applications.

Gate valves are available in 2 types as follows:

- resilient seated valves (AS 2638.2)
- metal seated valves (AS 2638.1)

Resilient seated gate valves are the most common stop valve currently being installed. They are available in sizes DN80 to DN750 with an allowable pressure rating of up to PN25 and are operated by a removable key and are suitable for buried applications. The larger sizes can be fitted with a gearbox and are available with an inbuilt bypass.

Metal seated gate valves are much more expensive than resilient seated valves. The Australian Standard covers valves in the size range DN80 to DN900, but they can be purchased in larger sizes up to 2 400 mm diameter. They can have an allowable pressure rating of up to PN35 and are operated by a removable key and are suitable for buried applications. The larger sizes can be fitted with a gearbox.

Gate valves are available with 3 jointing configurations as follows:

- Double Flange
- Double Socket
- Flange/Socket combination

Because of SA Water's requirement for anchoring all stop valves, flanged is the normal option and combination valves are used in limited applications.

3.2 BUTTERFLY VALVES

Butterfly valves are quarter-turn valves. The "butterfly" is a metal disc mounted on a shaft. When the valve is closed, the disc is turned so that it completely blocks off the passageway. To fully open the valve, the disc is rotated through 90° (a quarter turn) to allow passage of the fluid, but with a greater headloss through the valve than is experienced with a gate valve.

When replacing a gate valve with a butterfly valve, Engineering and Hydraulics approval must be obtained.

Butterfly valves are available in a range of configurations for a variety of installations. Their use is becoming more popular particularly in the larger sizes because they are cheaper and with the correct selection of materials and gearbox, they can now also be used in buried applications.

All buried butterfly valves are to be fitted with a torque limiting device

The variations of butterfly valve design include:

- Bolting configurations
    - Wafer
    - Lugged (tapped)
    - Double Flanged

- Sealing systems
    - Seal on Disc (High pressure applications)
    - Seal in body (Bonded) (Low pressure applications)
    - Seal on body (Clamped) (Low pressure applications)
    - Metal on metal (High pressure applications)

- Disc Arrangement
    - Concentric
    - Single offset } (Low pressure applications)
    - Double offset
    - Triple offset (High pressure applications)

3.2.1 Bolting configurations

Wafer - Wafer style valves are designed to be used for low cost, above ground valve installations. The valve outside diameter is smaller than the inside diameter of the mating flange bolt holes which allows the valve to be placed between the two adjacent pipework flanges and long bolts hold the valve assembly in place. The disadvantage is that the downstream pipework can't be removed while the upstream section is pressurised.

Lugged (tapped) - Lugged and tapped valves are similar in appearance to wafer style valves except that tapped lugs are provided to match the flange bolt holes. These are also normally used in above-ground valve installation. The valve is placed between the two adjacent pipework flanges and bolts screwed into the tapped lugs hold the valve in place. This has the advantage of allowing the downstream pipework to be removed while the upstream section remains pressurised.

Double Flanged - These valves have conventional flanges, are much more robust valves and can be ordered with special coatings and gearbox which make them suitable for buried applications.

3.2.2 Sealing Systems

Seal on Disc – for this type, the resilient seal is fixed to the disc and held in place by a clamp ring and retaining screws.

Seal in body (lining only) – for this type, the resilient seat is fixed in the body of the valve and held in place by a clamp ring and retaining screws or retained by a groove in the body and epoxy bonded in the groove behind the seat.

Seal on body (fully encased) – for this type, the resilient seat is physically retained and of the envelope type (covers the entire wetted surface of the bore and wraps around the flange faces) creating an integral gasket for sealing against mating flanges. Liners can be loose in the body and clamped by the adjoining flanges or bonded or vulcanized to the body.

Metal to metal – These are specialist valves and are manufactured to highest engineering tolerances to obtain a drip proof seal. They are generally double flanged valves and are used for high pressure and, with the correct selection of materials, high velocity flow applications.

3.2.3 Disc Arrangement

The standard "concentric" butterfly valve has no offset: The shaft and vane are coincident with the centreline of the pipe. Single and double-offset butterfly valves have the shaft offset back from the centreline of the seating surface, ie offset to one side of the centreline. This helps the disc "cam" into the seat, but the seat must still be resilient to accept the edge of the vane in the last degrees of seating.

The triple-offset valve is like a double-offset, with the addition that the edge of the seating surface is generated as the surface of a cone, which itself is offset so that one of its sides is parallel to the wall of the pipe. This makes

the seating surface slightly elliptical, but it meets the seat without needing to be distorted hence metal seats are possible, eliminating the limitations of elastomeric seats. A slightly flexible laminated stainless/graphite seat seal is used to conform to the small irregularities in the seating surfaces, but the seating torque is necessarily high. Triple offset butterfly-style valve can survive higher temperatures and higher pressures than other types.

Section 4: Valve Selection

4.1 ALLOWABLE MATERIALS

The basic materials requirements are as detailed in AS 2638 and AS 4795 and these are the minimum requirement for materials and have been assessed as acceptable for use within SA Water's infrastructure supply network:

The most common materials are as follows:

Body

- Ductile Iron with FBE coating

Disc (Butterfly Valve)

- Grade 316 Stainless Steel, Aluminium bronze
  (Note: tapered pin connections between shaft and disc are not acceptable to SA Water)

Wedge (Metal Seated Gate Valves)

- Ductile Iron with Bronze or 316 Stainless Steel sealing rings

Elastomeric Items

- EPDM

Full details of allowable materials, pipe sizes and pressure ratings for specific applications are detailed in "Authorised Products for Water Reticulation Systems"

4.2 ALLOWABLE VALVE SIZES

SA Water has standardised on a range of sizes for valves (as available).

The range is as follows:

DN80	DN100	DN150	DN200	DN250
DN300	DN350	DN400	DN450	DN500
DN550	DN600	DN650	DN700	DN750
DN800	DN900	DN1000	DN1200	DN1400
DN1600	DN1800	DN2000	DN2200	DN2400

Not all these valves sizes are covered in the relevant Australian Standard and choice may be limited to the available range of valves.

For butterfly valves, care should be taken to ensure that the internal diameter of adjacent pipework (particularly cement lined pipe) is the same size or larger than the outside diameter of the disc to ensure the disc is not prevented from opening fully during operation.

4.3 ALLOWABLE PRESSURE RATING (PN)

SA Water has, for operational and maintenance purposes, established a minimum pressure rating of PN16 for all products used in SA Water's water supply network. For larger project specific applications, where the Maximum Operating Pressure is low (<600 kPa) and there is a fixed supply pressure, SA Water Technical staff may, at their discretion, authorise the use of a lesser class of system.

Valves with the following Pressure Ratings (PN) are generally available:

PN10	PN16	PN21	PN25	PN35

The reason for specifying a minimum pressure rating is that in the future, where the system capacity is insufficient, the supply can be increased by pump boosting. This option can not be considered where the system is already operating at or near its recommended maximum allowable operating pressure.

4.3.1 Gate Valves

For operational and availability reasons gate valves should be used as follows:

- ≤ PN25 Resilient seated valves (to AS 2638.2)
- > PN25 Metal seated valves (to AS 2638.1)

Where operational requirements dictate a change to these criteria, the specific valve requirements will be shown on the design drawings or specification.

Gate valves normally have a spindle thread ratio of 2 turns per 25 mm of valve diameter.

4.3.2 Butterfly Valves

Australian Standards exist for butterfly valves for 2 different applications:

- general purposes
- waterworks purposes

Only valves in accordance with Australian Standards and designed for Waterworks purposes are to be used in SA Water's infrastructure network.

4.4 FLANGE SELECTION

Historically, flanges were selected using the "EWS Tables Series" *(based on BS10 - the British Standard for Flanges)* and for water supply the most commonly used "Tables" were as follows:

Table	Maximum Pressure Rating (PSI)	Equivalent Max. Pressure Rating (MPa)
EWS Table-C	Up to 200 psi	Up to 1.4 MPa
EWS Table-F	200 to 300 psi	1.4 to 2.0 MPa
EWS Table-H	300 to 500 psi	2.0 to 3.5 MPa

The British Standard was copied and introduced into Australia as AS2129 - Flanges for general purpose.

These classifications are still referred today by maintenance staff even though Table C no longer exists and manufacturers no longer manufacture Table F valves and fittings.

Tables F and H were classed as the higher pressure systems and have the same number of holes, hole diameters and pitch circle diameter (PCD) which has allowed manufacturers to standardise on Table H.

The principal Australian Standard for flanges used in the water industry is:

AS 4087 Metallic flanges for waterworks purposes

When ordering valves this standard should be the reference. For example:

AS 4087 Figure 5 –dimensions for DI - PN16 (compatible with Table C)

AS 4087 Figure 7 –dimensions for DI – PN35 (compatible with Tables F & H)

This standard was introduced as an alternative to AS 2129, because the DI fittings used in the water Industry were rated as 1.6 MPa and there was no suitable flange Table in AS 2129 without going to Table F. This obviously was impractical because it had a different number of bolt holes, PCD etc.

When ordering valves, the type of flange face also needs to be considered. There are three common flange face configurations available and the selection may be limited to what the manufacturer can/will provide. The common types include:

- Flat face
- Raised face, and
- Flat with O-ring Groove

TS59- Specification for EWS Departmental Flanges - 1983 provides historical information on flange arrangements, gasket selection and compatibility.

4.5 GEARBOX SELECTION

Gearboxes are required on valves as follows:

Gate Valves all valves > DN500

Butterfly valves all valves > DN80, - *this is to prevent rapid closure causing water hammer. Lever operated valves may be used up to DN300 provided the system will not be effected by rapid closure*.

Gearboxes shall be suitable for operation by using a portable power actuator applied to the operating spindle and have a torque limiting device as part of the operating spindle mechanism. Gearboxes shall have a ratio of between 3:1 (minimum) and 6:1 (maximum).

Gearboxes shall be:

- grease lubricated;
- provided with seals on input and output shafts to prevent ingress of foreign matter and water in the event of flooding;
- suitable for continuous immersion to a depth of 5 m above the base;
- constructed to enclosure rating IP68; and
- sized such that the input torque required to operate the valve under the worst conditions of differential head, unseating force, or emergency flow shall be a maximum of 100 Nm.

Primary manual gearbox actuators may utilise spur gears, worm, worm and wheel operating systems.

Manual actuators shall be self-locking in all positions.

Mounting flanges for manual actuators or direct-drive actuators shall comply with ISO 5211 using an adaptor piece if necessary.

Manual actuators and gearboxes for buried installation shall be suitable for key operation via an extended spindle assembly.

Section 5: Installation

5.1 TYPES OF WATER MAINS

Because of the different pipe materials used for water mains and their different laying requirements, the pipework (mains) system can be divided into two types:

- Rigid mains
- Non-rigid mains

5.1.1 Rigid Mains

Rigid mains are fully welded or flange jointed mains and include steel mains (MSCL) and Polyethylene (PE). Because of the effects of temperature related expansion and contraction within rigid mains, extreme forces can be applied to flanged valves, fittings and the main itself. Without proper precautions these forces can distort or damage valves to such an extent that they will not seal or operate properly.

Precautions can include the use of specially designed valve chambers containing an expansion joint which isolate these forces from the valves, and link-in the pipes at times of median temperatures.

5.1.2 Non-rigid Mains

Non-rigid mains are mains which incorporate rubber ring joints (RRJ) or expansion joints which “absorb” the expansion and contraction of the main. Valves need to be restrained against hydrostatic forces when the valve is closed and this is normally done by the use of a concrete anchor blocks, which encase a thrust collar fixed to the adjacent section of pipe (which is bolted to the valve flange).

5.2 THRUST BLOCK/ANCHORS

All Stop Valves must be anchored.

In RRJ buried applications there is a requirement for the installation of a thrust block adjacent to each stop valve (See Water Supply Construction Manual Drawings Section B).

For rigid pipelines, where the valves are installed in valve (anchor) chambers the valve must be bolted to the flange of an anchor pipe cast into the wall of the chamber. An unrestrained dismantling joint must be provided at the flange on the other side of the valve to allow removal of the valve if required. This also provides suitable compensation for temperature related forces acting on the valve.

5.3 ACCESS TO VALVES

The modern generation of valves are designed to require minimum maintenance and for this reason most inline valves installed in non-rigid mains are now being buried. Valves installed in rigid mains still normally require chambers to provide sufficient restraint for the pipeline and prevent damage to the valve body from inline pipe stresses. Where doubt exists the final decision should be made by SA Water technical staff.

All valves shall incorporate the Australian Standard key operated spindle cap and an extended spindle assembly (if required). For buried applications, extended spindles shall be inside a sleeve or pipe extending to the surface and have an authorised metal cover and frame at surface level to provide access for operation of the valve.

5.4 POSITION OF OPERATING SPINDLE/SHAFT

5.4.1 Gate valves

The spindle is normally placed in the vertical position, but for larger valves it is possible for the spindle to be laid in the horizontal position. If this requirement

is specified, the valve must be ordered with a bevel gearbox (90°) and special wedge guides to reduce friction and wear.

Horizontal spindles are employed where there is insufficient depth for the spindle to sit vertically.

Project specific approval is required before valves are permitted to be laid horizontal.

5.4.2 Butterfly Valves

The operating shaft of butterfly valves can be placed in either the vertical or horizontal position. All valves > DN500 should have their operating shaft in the horizontal position and the valve should be installed so that the bottom edge of the disc opens in the downstream direction (to allow flushing of any silt build-up when the valve is opened without scouring of the disc or lining).

When gearboxes are ordered details of the orientation of the operating spindle/shaft must be provided.

5.5 BYPASS VALVES

Bypass valves are installed on larger diameter valves to facilitate the transfer of water from the upstream side of a closed valve to the downstream side to reduce the operating force required to open the valve.

Some valves are manufactured with an integral bypass valve and these should be used where possible.

Bypass valves should be used as follows:

Gate valves	< PN 10	Valves ≥DN450
	≥ PN 10	Valves ≥DN300
Butterfly valves		Valves ≥ DN 500

5.6 DISMANTLING JOINTS

Dismantling joints (unrestrained) are to be installed on the unrestrained side of all valves installed in chambers to facilitate easy removal of valves for repairs or replacement.

Buried valves do not require dismantling joints.

Section 6: Responsibilities

The personnel responsible for implementing these guidelines include:

- All Water Services managers and staff
- Regional Operations Managers
- Local managers
- Project Managers involved in SA Water infrastructure projects
- All SA Water employees involved in installing and maintaining the water supply network
- Contractors and constructors installing and maintaining the water supply network

SECTION 7: Further Information

For further information concerning this document, contact:

Infrastructure Standards Manager
Telephone (08) 7424 2009
Facsimile (08) 7003 2009
SA Water Infrastructure Division
Level 7, SA Water house, 250 Victoria Square, ADELAIDE, SA 5000
ivor.ebdell@sawater.com.au

SECTION 8 – Referenced Documents

WSAA Codes

WSA 03 Water Supply Code of Australia

Australian Standards

AS 2638.1	Metal seated gate valves for waterworks purposes
AS 2638.2	Resilient seated gate valves for waterworks purposes
AS 4087	Metallic flanges for waterworks purposes
AS 4795:2006	Butterfly valves for water works purposes
DR 05377	Butterfly valves for general purpose

SA Water References:

TS59- Specification for EWS Departmental Flanges - 1983 (Obsolete - for historical reference only)

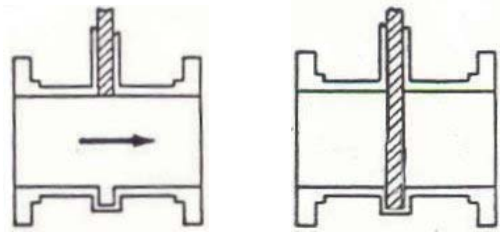
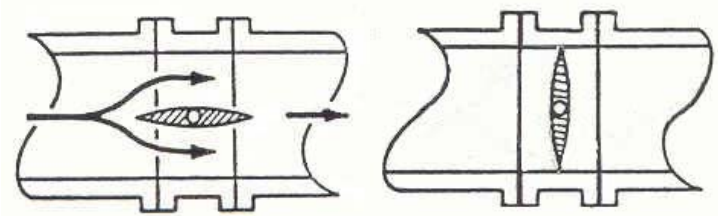
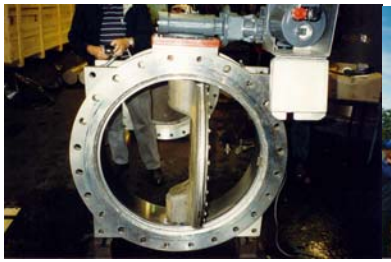
Water Supply Construction Manual – Authorised Items

(http://www.sawater.com.au/SAWater/DevelopersBuilders/NetworkInfrastructureStandards/Water+Supply+Manual.htm)

Appendix A: Stop (Isolating) Valves Information

Purpose: Stop Valve for on/off use. - Not suitable for flow control.

Applications:
- Isolating network zones
- Shutoff area for bursts / maintenance
- Isolating equipment (pumps, PRVs etc)

Type	Method of Operation	Typical Arrangement	Typical Usage
Gate (also called Sluice)	 Open Closed	 	Water Supply Can also be used for Recycled Water and Sewage Effluent
Butterfly	 Open Closed	 	Water Supply Can also be used for Recycled Water