WATER SERVICES
ASSOCIATION OF AUSTRALIA

WSA 403 PRODUCT AND MATERIAL INFORMATION AND GUIDANCE

Supplement to the Water Supply Code of Australia WSA 03—2011

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WSAA Project Working Group

Carl Radford, Water Services Association of Australia

Peter Pittard, PAMAJ Consulting Pty Ltd

Participating WSAA Member water utilities

TBA

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About WSAA

The Water Services Association of Australia (WSAA) is the peak industry body representing the urban water industry. Our members provide water and sewerage services to over 24 million customers in Australia and New Zealand and many of Australia's largest industrial and commercial enterprises.

ACKNOWLEDGEMENT OF COUNTRY

The Water Services Association of Australia acknowledges and pays respect to the past, present and future Traditional Custodians and Elders of this nation. We recognise their continuing connection to land and waters and thank them for protecting our waterways and environment since time immemorial.

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PRODUCTS AND MATERIALS OVERVIEW

Purpose

Water Agencies typically expect water supply infrastructure to have a life of at least 100 years. This requirement reflects community expectations of Agencies' operational and financial performance. The performance of a sewer system significantly depends on the attributes of the materials and products used in its construction. The appropriate selection of pipeline system products and materials is paramount to achieving life expectancies.

Unless otherwise specified by the Water Agency, products should comply with recognised national or industry standards. The involvement of third party certification bodies to independently verify conformance is stipulated for many products.

The purpose of Part 1 is to:

(a) provide information on the principal pipeline system attributes and some details of ancillary products used in the construction of water supply networks and referenced in Water Supply Code of Australia WSA 03.

(b) outline aspects such as product specifications, product descriptions and classifications, joint types, water industry experience and recommendations on use.

NOTE:

It does not provide instructions on life expectancy for pipeline systems as this is dependent upon design, manufacture, transport, handling, installation, operation, protection from third party damage and other external factors.

The purpose of Part 2 is to

(i) provide information on standards and product specifications for products commonly used in water main construction and listed on the WSAA website www.wsaa.asn.au.

(ii) provide information regarding the applicability and limitations of the various conformity assessment options.

WATER SERVICES
ASSOCIATION OF AUSTRALIA

PART: 1 PRINCIPAL PIPELINE SYSTEM ATTRIBUTES

Product and Materials Information and Guidance
Supplement to the Water Supply Code of Australia
WSA 03–2011

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1 DUCTILE IRON PIPES FOR PRESSURE APPLICATIONS – WATER SUPPLY

1.1 PRODUCT SPECIFICATION

WSA PS – 200 (pipe); WSA – 201 (fittings); WSA – 202 (ISO pipe and fittings).

1.2 PIPES AND FITTINGS

Ductile iron pipes and fittings to AS/NZS 2280 have dimensions based on imperial sizing. The nominal diameter, DN, approximates the internal diameter of the pipe after cement mortar lining.

PN20, PN35 and Flange Class are the standard classifications for DI pipes. Flange Class has a thicker wall and is specified for flanged (screwed) pipe or where additional structural strength is required.

Minimum wall thicknesses for fittings with pressure classifications of PN16, PN20 and PN35 are specified in AS/NZS 2280.

Typical effective laying lengths of pipes are 5.5 m or 5.7 m. The minimum length for AS/NZS 2280 pipes is 5 m.

Ductile iron pipe to EN 545 has dimensions based on metric (ISO) sizing and are not compatible with AS/NZS 2280 pipe and fittings. Pipe of Class C40 to the EN standard, when cement mortar lined, has an internal diameter closely matching nominal sizes. The internal diameters of cement mortar lined AS/NZS 2280 and EN 545 pipe and fittings are different in most cases with the EN 545 bores being 4 to 6% less than AS/NZS 2280 dimensions. This results in AS/NZS 2280 pipe bores delivering 10 to 15% more flow for a given head loss.

1.3 SUPERSEDED K CLASS

The classification of the superseded K class pipe and fittings was not related to pressure rating but instead a parameter that specifies the minimum wall thickness for various nominal diameters.

1.4 JOINTS

1.4.1 Flexible

Elastomeric seal spigot and socket joints with flexible elastomeric sealing rings are generally used for joining ductile iron mains. The joint can accommodate limited longitudinal displacement and angular deflection (approximately 1 to 3½ degrees, depending on pipe size) and can therefore be used in areas liable to minor ground movement e.g. subsidence.

Flexible joints permit minor changes in pipeline direction and grade and may reduce the need for bends (fittings).

Witness marks applied to the spigot end show insertion depth for the maximum angular deflection and zero angular deflection. Elastomeric seals are provided with the pipe.

Joint seals are manufactured from elastomeric polymers (complying with AS 1646 and AS 681.1. EPDM has replaced natural rubber as the default material although SBR might also be used. (See Ancillary Products – Jointing components for more information on joint seal material options).

Joint lubricants, consisting of water based emulsions and a bactericide provide lubrication during the making of the joint and prevent damage to joint seals. Jointing lubricants and elastomeric seals are required to meet the performance requirements of AS/NZS 4020.

1.4.2 Flanged

Flanged pipe joints made to AS/NZS 2280 are manufactured by threading the ends of Flange Class pipe and screwing on a flange. An epoxy thread sealant is used. The greater wall thickness of Flange Class pipe is used to compensate for the pipe wall lost in thread cutting.

Integrally cast flanges, complying with AS 4087, are produced on cast fittings. PN 16 is the standard pressure rating but PN 35 flanged fittings are available.

1.5 INTERNAL LINING

1.5.1 Pipes

1.5.1.1 Cement mortar lining

AS/NZS 2280 ductile iron pipe has internal corrosion protection in the form of cement mortar lining. The performance of cement mortar lining to protect ferrous pipes from internal corrosion is well documented locally and internationally. The unlined ductile iron jointing surfaces are coated with epoxy.

A bituminous seal coat may be specified for cement mortars. The intended purpose of the seal coat is to reduce the contact between the cement mortar lining and the contents of the water main, thereby restricting lime leaching and consequent high pH levels in supply when conveying soft (i.e., low carbonate alkalinity) water, especially where flow rates are low and residence times are lengthy.

Consideration should be given to the use of seal coatings where the total alkalinity of the water being conveyed is less than 30 mg/L.

Many Australian water utilities specify seal coatings as mandatory for pipes up to and including DN 300

Nominal cement mortar lining thicknesses in pipes manufactured to the EN 545 are approximately 25% less than pipe manufactured to AS/NZS 2280, while EN 545 minimum cement mortar lining thicknesses are typically half those of AS/NZS 2280.

Cement mortar lining thicknesses to AS/NZS 2280 can be supplied in EN 545 pipes.

1.5.1.2 Alternative lining options

Alternative internal linings include:

(a) Polyurethane to EN 15655.

(b) Fusion bonded epoxy or liquid 2-pack epoxy to EN 14901

These linings have been used overseas in some areas for 30–55 years and reports suggest good performance. Only limited local experience of the performance of these linings is available.

1.5.2 Fittings

The standard internal linings for AS/NZS 2280 fittings are thermal bonded polymeric coating to AS/NZS 4158.

Other internal options include:

(a) Polyurethane to EN 15655.1.

(b) Liquid 2-pack epoxy to EN 14901.

1.6 EXTERNAL CORROSION PROTECTION

1.6.1 Pipes

The standard external coating for ductile iron pipes is metallic zinc coating in accordance with ISO 8179-1, with a finishing liquid-applied black coloured coating.

Other coating options include:

(a) Polyurethane coatings to EN 15189

(b) Fusion bonded epoxy or liquid 2-pack epoxy to EN 14901.

The majority of Australian Water Agencies have adopted a policy of specifying loose polyethylene sleeving (LPS) for all ductile iron pipes as a corrosion protection measure, unless specialised coatings such as polyurethane or polyethylene, for example, are

employed. Properly installed LPS provides a high degree of corrosion protection by creating a passive uniform environment around the pipe and limiting oxygen exposure. LPS should be installed in accordance with AS 3681 and only accredited pipe layers trained in the application of sleeving should be utilised.

The need for LPS depends on the type of soil and the required service life of the pipeline. Ductile iron pipes may be buried without extra external protection in soils that are not aggressive. In soils that are aggressive, and where either the time or the cost of soil assessment is prohibitive, LPS is the recommended solution.

The application of zinc coatings was not historically utilised on ductile iron pipes in Australia, although they have been used in Europe for more than 60 years. Zinc coatings are now provided in Australia as a standard offering with 200 g/m^2 thickness complete with a finishing layer and are considered to enhance the external corrosion benefits of pipe in buried applications. In some soil applications it is considered acceptable to install zinc coated pipes without polyethylene sleeving.

Enhancements to zinc coatings are also available where 85/15 Zinc-Aluminium alloy, copper enhanced Zinc-Aluminium alloy and rare earth element enhanced Zinc-Aluminium alloys are offered with 400 g/m^2 thickness complete with a finishing layer. It is reported that these coatings provide improved corrosion protection over standard zinc coating and allows for installation in a wider range of soils, without the need for sleeving.

EN 545 nominates that DI pipes with zinc coating of 200 g/m^2 thickness and min 100mm thick finishing layer or enhanced zinc alloy coating with 400 g/m^2 thickness and min 100mm thick finishing layer can be buried without sleeving except:

(i) For Zinc coatings

- (A) soils with a resistivity less than 1500 Ω cm when laid above the water table, or less than 2500 Ω cm when laid below the water table
- (B) mixed soils i.e. comprising two or more soil natures
- (C) soils with a pH below 6 and a high reserve of acidity
- (D) soils containing refuse, cinders, slags or polluted by wastes or industrial effluents
- (E) areas where there is stray current

(ii) For Zinc-Aluminium or enhanced Zinc-Aluminium alloys

- (A) acidic peaty soils
- (B) soils containing refuse, cinders, slag or polluted by wastes or industrial effluents
- (C) soils below the marine water table with a resistivity lower than 500 Ω cm,
- (D) areas where there is stray current

EN 545 also advises that evidence of the long-term performance of the above-mentioned solution (e.g. tests and references) should be provided by the manufacturer.

Manufacturers should be consulted for life expectancy estimates.

It should be noted however that there has been no proven experience or data to support the extrapolation of European experience to Australian conditions and environments. It is considered imperative that testing be undertaken to ensure that the soil environment meets any necessary pre-conditions.

1.6.2 Fittings

The standard coating for AS/NZS 2280 ductile iron fittings is thermal bonded polymeric coatings.

Other coating options include:

(a) Polyurethane to EN 15655.

(b) Liquid 2-pack epoxy to EN 14901.

1.7 SERVICE CONNECTIONS

The preferred option for service connections is pre-tapped connectors, comprising a fitting into which a pre-drilled connection has been made. Pre-tapped connectors are used to make a pre-laid service connection (dry tapping) during construction.

Tapping bands are utilised for retrospective service connections where live tapping is necessary and may also be used for dry tapping.

Service connections to ductile iron pipe may be made by tapping directly into the pipe and can be done with the main under pressure. The high stiffness of reticulation sized pipe caters for tapping connectors attached by clamping mechanisms.

1.8 STORAGE

Pipes should be supported on dunnage to keep pipes off the ground. If pipes are to be stored on timbers, the ends of pipes should be chocked to prevent movement. Pipe supports should be located approximately 900 mm from each end.

For pipes being strung along the trench, the socket end should be leading in the direction of laying. For pyramid stacking refer to the manufacturer's instructions.

Fittings should be stored on pallets or other means to keep them off the ground.

Polyethylene sleeving is subject to degradation when exposed to UV radiation and should be sheltered from direct sunlight when stored prior to use. Polyethylene sleeving and sleeved pipes can be stored outside for up to 2 months (Refer to AS 3680). Rolls of polyethylene sleeving may be stored for longer periods if protected (e.g. warehouse or under hessian).

1.9 DESIGN AND INSTALLATION

Design of ductile iron pipeline systems is based on "flexible" pipe theory and should be in accordance with AS/NZS 2566.1

Care should be taken during handling and installing pipes and fittings to prevent damage to protective coatings.

The material properties of ductile iron make it unnecessary to derate the system for temperature surge or fatigue.

1.10 WATER INDUSTRY EXPERIENCE

Cement lined ductile iron pipelines have been widely used for reticulation and distribution water mains since 1978 when ductile iron was introduced as a replacement for cast grey iron pipe. Ductile iron pipelines have generally performed well when appropriate corrosion control measures were implemented, particularly at the point of connection with the customer service. Limited experience is available for the performance of imported ductile iron pipes (metric size, internally and externally coated and lined with polymeric materials).

1.11 RECOMMENDATIONS ON USE

As the sleeving is the primary corrosion barrier, care needs to be exercised during installation to prevent damage. Only accredited pipe layers trained in the application of sleeving should be used. Electrical insulation of copper water service pipes and fire services to ductile iron is recommended to prevent galvanic corrosion.

Loose fit polyethylene sleeving is not recommended where anaerobic estuarine soils are encountered.

Seal coatings or alternative lining systems may be required for cement mortar lined pipes conveying soft unbuffered water. Where there are low flows resulting in long retention times in the system, particularly in the earlier stages of a planned development, lime leaching of unsealed cement mortar linings may occur leading to elevated pH levels. These concerns are generally limited to pipes of DN <300.

Ductile iron pipelines may be used for installations that run parallel to high voltage electricity transmission lines as the rubber ring joints render the pipeline electrically discontinuous.

1.12 FURTHER INFORMATION

http://www.dipra.org/

AWWA M41 Ductile-Iron Pipe and Fittings

http://www.wsaa.asn.au

WSA – TN3 Ring bending stiffness and allowable deflection of ductile iron pipe and steel pipe

2 STEEL PIPES FOR PRESSURE APPLICATIONS – WATER MAINS

2.1 PRODUCT SPECIFICATION

WSA PS – 203 (Pipe); WSA – 204 (Fittings).

2.2 PIPES AND FITTINGS

Steel pipe is manufactured from plate or strip that is formed to shape and joined by spiral welding, longitudinal welding, circumferential welding or combinations of these. Fittings are fabricated, lined and coated in similar materials as pipe. Standard drawings are available from the manufacturer.

Preferred size ranges are listed in AS 1579, including a mix of imperial and ISO sizes. The availability of a range of steel grades and thicknesses enables the manufacture of an almost unlimited range of sizes and pressure classes.

Constraints on size of the manufacturing or coating plant or on transport determine the length of pipe available. The current maximum available length is 12 m with 6 m and 9 m being common.

2.3 PRESSURE CLASS

There are no standard pressure classes for steel pipe. Each pipeline is individually designed.

2.4 JOINTS

A range of joints is used including slip-in, spherical spigot and socket, rubber ring, welding collar, butt welded or flanged. Flanged or welded joints may be used for all sizes. Rubber ring joints are available for sizes DN 300 to DN 1200 and allow joint deflection of approximately 3° for DN ≤500 and approximately 1° for DN >500. Slip-in and spherical spigot and socket joints allow deflection of approximately 3°. Mechanical joints, couplings and dismantling joints are available for steel pipe.

2.5 INTERNAL LINING

2.5.1 Pipes

Steel pipes should be internally lined, the standard options being cement mortar lining or fusion bonded polyethylene. Cement mortar linings conforming to AS 1281 are suitable for all sizes and cement mortar lining is the default option for sizes less than DN 300 (due to non-availability of fusion bonded polymeric lining).

Leaching of lime from the cement mortar lining, raising pH, will occur in many Australian waters, being most evident in soft unbuffered waters. Seal coating of the lining with bitumen seal coats reduces leaching by 99%, thereby mitigating the issue associated with increasing pH.

2.5.2 Fittings

Steel fittings should be internally lined, the default option being cement mortar lining. Specialised polymeric coatings are available but generally not required for potable water supply applications.

2.6 EXTERNAL CORROSION PROTECTION

For pipelines that will be buried, the preferred external protection of pipes and fittings is fusion-bonded polyethylene. For rubber ring jointed, cement-lined pipes and fittings, the polyethylene extends over the end of the pipe to provide coverage of the socket. Subsequent cement lining overlaps the polyethylene lining. This system is particularly effective since it achieves complete internal and external corrosion protection and overcomes the need for field applied protection (as required for welded joints). Factory applied tape wrapping systems are also available for external protection but do not effectively integrate with internal cement lining, as does the fusion bonded polyethylene coating system.

Cathodic protection may be required in some instances, particularly long electrically continuous welded pipelines – all will require specialist advice on a project by project basis. Rubber ring jointed pipelines are not generally cathodically protected.

For pipelines that will be laid above ground, coating systems (for aesthetic and protective objectives) may be used. WSAA Materials Fact Sheet 1, Protective Coatings provides guidance on selection of a suitable system.

External protective coating is not required for steel pipes that will be concrete encased (e.g. road crossings).

2.7 SERVICE CONNECTIONS

Steel pipelines are generally not used for reticulation mains. Service connections are not normally made to steel pipelines.

2.8 STORAGE

Steel pipes are flexible and care should be taken to avoid deformation. They should be supported clear of the ground so as to prevent excessive longitudinal bending. Coated pipes should not be stored in the open (UV exposure) for more than 12 months. Storage of rubber seals should be in accordance with AS 1646 and the manufacturer's recommendations.

2.9 PIPELINE DESIGN

Steel pipelines are classified as "flexible" and should be designed in accordance with AS/NZS 2566.1.

Care should be taken during handling and installing pipes and fittings to prevent damage to protective coatings. Welded joints require restoration of external and internal coating / lining.

2.10 WATER INDUSTRY EXPERIENCE

Steel pipes have been used by Australian Water Agencies since the early 1900s. Initially riveted pipe barrels were used, which were replaced by welded pipes. Early steel pipes were installed unlined and coated externally with coal-tar or bituminous coatings, often in conjunction with hessian wraps. Factory applied cement mortar linings and external gunnite cement mortar coatings were introduced in the mid 1930s. Fusion-bonded external polyethylene (low density) coating was introduced in the 1970s. Medium-density polyethylene coating was introduced in mid-1990s. Factory applied tape wrapping systems have been used in some installations.

Polyethylene lined and coated rubber ring jointed pipe is generally regarded as providing superior corrosion resistance and ease of installation (available in sizes DN 300 – DN 1200).

Welded steel pipelines are most commonly specified for trunk mains. However, welded steel pipelines are used for specialised water reticulation applications e.g. in contaminated ground, for bridge/creek crossings where thrust support of fittings is not feasible, in very soft or unstable ground, in very steep ground and for vertical connections.

Steel mains have high structural and fatigue strength.

2.11 RECOMMENDATIONS ON USE

Where welded joints are necessary, qualified welders with specialised equipment should be engaged and restoration of internal lining and external coating requirements specified.

Particular attention should be given to transportation and handling as steel mains are susceptible to corrosion if the coating is damaged.

Precautions need to be taken where significant lengths of electrically continuous steel pipeline are laid parallel to high voltage electricity lines due to the risks of induced currents.

Steel mains are not generally suited for reticulation mains, except for specialized applications.

2.12 FURTHER INFORMATION

www.americanlifelinesalliance.com/Products.htm

AWWA M11 Steel Pipe—A Guide for Design and Installation

http://www.awwa.org/bookstore

WSA – TN3 Ring bending stiffness and allowable deflection of ductile iron pipe and steel pipe

http://www.wsaa.asn.au

3 POLYVINYCHLORIDE (PVC) PIPES FOR PRESSURE APPLICATIONS – WATER SUPPLY

3.1 MATERIAL

PVC covers four variants:

(a) Unplasticised PVC or PVC-U
(b) Modified PVC or PVC-M
(c) Oriented PVC or PVC-O
(d) Fusible PVC

Until 2000, PVC-U was the default PVC pressure pipe material. Since then PVC-O and PVC-M have progressively displaced PVC-U and these are now the preferred materials.

PVC-M and PVC-O have better fracture toughness than PVC-U and offer better hydraulic performance in equivalent sizes and pressure classes. Repetitive, high pressure waves can cause cyclic fatigue in PVC. However, the fatigue characteristics of the materials have been systematically studied and it is possible to design pipelines to avoid fatigue altogether. That is, if the pipeline system can be designed to operate beneath the fatigue threshold, fatigue failure will not occur.

PVC-O has higher fatigue resistance than PVC-M and PVC-U but all three materials can be used in pressure sewers, provided the conditions are within the appropriate design envelope. Water Agency asset management practices may require authorisation to mix and match variants of PVC, although there are no technical reasons to prohibit mix and matching.

PVC polymer resin is compounded with calcium-zinc, organic or tin stabiliser to prevent thermal degradation of the polymer during the extrusion process by which pipe is manufactured or by the moulding process by which fittings are manufactured. Other additives are added to improve processing, inhibit degradation by ultraviolet light and to add colour.

Fusible PVC is intended for rehabilitation and horizontal directional drilling applications and is joined using a butt-welding technique similar to polyethylene pipes. This product is not yet readily available in Australia.

FURTHER INFORMATION

Plastics Industry Pipe Association (PIPA) - download from http://www.pipa.com.au

POP201	1.1	May, 2013	Resistance of Plastics Pipes and Fittings to Water and Wastewater Chemicals
POP202	2.1	Nov 2016	PVC, PP and PE Pressure Pipe Installation on Curved Alignments
POP203	1.0	Dec 2007	Identification Of Buried Pipe Systems
POP204	1.0	Feb 2004	Expected Service Life Of Elastomeric Pipe Seals
POP207	1.0	Jun 2012	Installation of Potable Watermains in Contaminated Ground
POP101	1.3	Feb 2009	PVC Pressure Pipes Design for Dynamic Stresses
POP103	2.0	Jul 2010	Depth of Engagement for PVC Pipes
TN002	1.0	Sep 2009	PVC Pressure Pipe System Maintenance Guide
TN003	1.0	Jan 2005	Temperature Derating of PVC Pipes for Pressure Applications
TN006	1.0	Apr 2010	Weathering of PVC Pipes and Fittings
TP006	1.0	Aug 2012	Long Term Performance of PVC Pressure Pipe

Water Services Association of Australia (WSAA) download from http://www.wsaa.asn.au

WSA - TN2	Guidelines for the use of non-metallic pipes with ductile iron elastomeric joint fittings and spread sheet calculation

PVC Pipe Association (USA) (http://www.uni-bell.org)

AWWA (USA) http://wwww.org/bookstore

3.2 UNPLASTICISED PVC (PVC-U) PIPES FOR PRESSURE APPLICATIONS – WATER SUPPLY

3.2.1 Product Specification

WSA PS – 211.

3.2.2 PIPES

Unplasticised PVC (PVC-U) pressure pipes have been commonly used by Australian urban water agencies for reticulation since the 1980's.

PVC-U pipes are manufactured to AS/NZS 1477 and available in both imperial (Series 2, DIOD) and metric sizes conforming to ISO standards (Series 1). The Water Supply Code of Australia WSA 03 deems Series 2 to be the default option

PVC-U Series 2 pipes are available in sizes from DN 100 to DN 375 and pressure classes PN12 to PN20, depending on size.

PVC-U Series 1 pipes are available in sizes from DN 80 to DN 450 and pressure classes from PN4.5 to PN18, depending on size.

Relative to overseas, Australian Water Agencies were slow to adopt PVC-U as an option for pressure sewers. Some concerns about the notch-sensitivity and fatigue strength of PVC-U have been expressed but these have been addressed by setting a minimum fracture toughness and by establishing an appropriate design against cyclic loading

Guidelines for the use of plastics pipes with duction iron fittings specified in WSA:03 are given in the Water Services Association of Australia Information and Guideline Note WSA TN2 Guidelines for the use of ductile iron elastomeric joint fittings with plastics pipes, available from https://www.wsaa.asn.au.

Relative to overseas, Australian Water Agencies were slow to adopt PVC-U as an option for pressure sewers. Some concerns about the notch-sensitivity and fatigue strength of PVC-U have been expressed but these have been addressed by setting a minimum fracture toughness and by establishing an appropriate design against cyclic loading

3.3. MODIFIED PVC (PVC-M) PIPE FOR PRESSURE APPLICATIONS – WATER SUPPLY

3.3.1 Product Specification

WSA PS – 209.

3.3.2 PIPES

Modified PVC (PVC-M) was introduced to the Australian market in 1998. PVC-M differs from the traditional PVC-U by way of special additives that greatly improve the toughness whilst retaining the strength similar to PVC-U. The design factor for PVC-M is 1.4 (compared to 2.1 for PVC-U). Consequently, the wall thickness of PVC-M is proportionally less for the same PN rating.

PVC-M is manufactured to comply with AS/NZS 4765 and are available in both imperial (Series 2 DIOD) and metric sizes conforming to ISO standards (Series 1). The Water Supply Code of Australia WSA 03 deems Series 2 to be the default option

PVC-M Series 2 pipes are available in sizes from DN 100 to DN 450 and pressure classes from PN6 to PN20, depending on size.

PVC-M Series 1 pipes are available in sizes from DN 100 to DN 575 and pressure classes from PN6 to PN18, depending on size.

3.4 ORIENTED PVC (PVC-O) PIPE FOR PRESSURE APPLICATION – WATER SUPPLY

3.4.1 Product Specification

WSA PS – 210.

3.4.2 PIPES

Molecular oriented PVC (PVC-O) was introduced to the Australian market in 1974 but was not widely promoted due to limitations on manufacturing capacity and cost. Technological advances have enabled PVC-O to be produced more efficiently. PVC-O is produced from PVC-U formulations but differs from the traditional PVC-U by way of a special manufacturing process that converts a random orientation of the molecular structure to a more ordered alignment, resulting in improved physical properties including higher strength, greater resistance to cyclic fatigue and greater impact resistance.

The design factor for PVC-O is 1.6 but the higher strength relative to PVC-M results in a reduction in wall thickness for an equivalent pressure rating.

AS/NZS 4441 classifies PVC-O pipes according to the Minimum Required Strength (MRS) of the material which is based on the degree of orientation. Manufacturers generally select a material strength, either MRS400, MRS450 or MRS500, for a particular PN rating, which then determines the standard specified minimum wall thickness and corresponding pipe stiffness. Some manufacturers manufacture pipes with wall thicknesses greater than the standard specified wall thicknesses for a particular MRS to ensure minimum pipe stiffnesses greater than SN10 are achieved.

PVC-O pipes are manufactured to AS/NZS 4441 and are available in imperial (Series 2 DIOD) sizes only.

PVC-O pipes are available in sizes from DN 100 to DN 450 and pressure classes from PN 12.5 to PN 20, depending on size.

3.5 EFFECTIVE LENGTHS

The standard effective length of PVC pipes is 6 m, however shorter pipe lengths may be available for unstable ground such as filled, mine subsidence and slip areas.

3.6 PRESSURE CLASS

Pipe wall thicknesses are dependent on the pressure rating, diameter and design stress.

The hydrostatic design stress for PVC-U pipes for diameters ≤ DN150 is 11 MPa and for larger diameters is 12.3 MPa.

The hydrostatic design stress for PVC-M pipes is 17.5 MPa.

The hydrostatic design stress for PVC-O pipes is dependent on the material MRS. A design co-efficient of 1.6 provides for 25 MPa for MRS400, 28 MPa for MRS450 and 32MPa for MRS500.

De-rating of the nominal pressure class is required for PVC pipes when temperatures exceed 20°C and possibly when subjected to cyclic loading. De-rating requirements for fatigue and temperature are specified in WSA 03 Part 1.

3.7 PIPE STIFFNESS

Designers should be aware that the reduced wall thickness of PVC pipes with higher material strengths for the same pressure rating, particularly PVC-O, will result in lower pipe stiffness ratings.

The 2008 publication of AS/NZS 4441 stated “In order to take full advantage of the economics and performance of PVC-O pipes, it is essential that application designers are cognisant of the limitations of thin-walled pipes and information is presented in this Standard on lateral stiffness, negative pressure resistance and aspects of joint performance. Users should refer to AS/NZS 2566 for further advice.”

By way of example, approximate stiffness calculations for the various types of PVC-O pipes are included below for commonly used pressure ratings, using standard mean wall thicknesses.

	Initial Ring Stiffness SN				
PN	PVC-U	PVC-M	PVC-O 400	PVC-O 450	PVC-O 500
12	49.5	14.1	6.3	4.7	3.3
16	11.9	32.5	13.1	9.4	6.4
20				18.0	13.1

Many water agencies have specified that PVC-O pipe is required to have a minimum stiffness rating of SN10. Some manufacturers provide an increased wall thickness for PVC-O MRS450 PN16 pipes to ensure a minimum of SN 10 is achieved.

3.8 JOINTS

3.8.1 Flexible

Push fit spigot and socket elastomeric seal joints are the most common jointing method for PVC pipes used in the water industry. However, the joint design, including both the seal and socket, is unlikely to be the same for the variants of PVC from the same manufacturer or from different manufacturers. This does not prevent PVC pipes from the same manufacturer or from different manufacturers being joined together but it is essential to use the correct socket – seal combination.

The elastomeric seal joint can accommodate some longitudinal displacement and angular deflection. Angular deflection at a joint is typically limited to approximately 1 degree. This is sufficient to accommodate minor changes in direction and grade and may reduce the need for bends (fittings).

Witness marks applied to the spigot end by the manufacturer show the insertion depth. Spigots should be inserted into the socket up to the witness mark and not beyond it.

Joint seals provided with the pipe are manufactured from elastomers complying with AS 1646 and AS681.1. SBR (Styrene Butadiene Rubber) and EPDM (Ethylene Propylene Diene Rubber) seals are acceptable. Seals may be locked in place during production of the socket or supplied separately. Except in the case of locked-in seals, the ring groove must be cleaned and the seal inserted prior to jointing.

Joint lubricants, consisting of water-based emulsions and a bactericide, provide lubrication during the making of the joint to prevent damage to joint seals during assembly.

Jointing lubricants and seals are required to meet the performance requirements of AS/NZS 4020.

Socket depths are designed to accommodate a number of factors including thermal movement, Poisson contraction and angular deflection. PVC pipes with elastomeric seal joints can withstand some ground movement but in locations such as mine subsidence areas longer sockets, possibly in conjunction with shorter pipe lengths, might be required. For filled, mine subsidence and slip areas the Designer should refer to individual manufacturers and specify the type, length and manufacturer(s) of PVC pipe to be used.

3.8.2 Flanged

Flanged PVC pipes are not available. The preferred method of joining PVC pipes to a flanged valve or fitting is by means of a ductile iron flange/socket fitting (Note that a PVC socket should not be connected to a ductile iron spigot due to the potential for creep in the PVC socket).

3.9 CORROSION PROTECTION

3.9.1 PIPES

Not applicable for PVC-U pipes or fittings. PVC-U pipe is resistant to corrosion attack in naturally occurring soils and waters and is immune to stray current corrosion..

3.9.2 FITTINGS

Ductile iron fittings are coated and lined with a thermal bonded polymeric coating in accordance with AS/NZS 4158

3.10 FITTINGS

Ductile iron fittings are compatible with Series 2 PVC pipes and are nominated as the default option for fittings. Series 1 pipes can also be accommodated for some sizes using adaptor seals in the fitting sockets. Long-radius post- formed bends (i.e. a pipe segment is bent over a mandrel to form a bend) are also available.

AS/NZS 2280 nominates the minimum depth of entry beyond the elastomeric seal for socketted fittings intended for use with plastics pipes. The minimum entry depths are proposed to accommodate axial movement of the pipe due to the combined effects of thermal contraction, Poisson contraction together with an allowance for joint angular deflection, spigot chamfer length, spigot end squareness and soil friction effects.

Guidelines for the use of plastics pipes with duction iron fittings are also given in the Water Services Association of Australia Information and Guideline Note WSA TN2 Guidelines for the use of ductile iron elastomeric joint fittings with plastics pipes, available from https://www.wsaa.asn.au.

Property services should be installed at the time of main laying, utilising pre-tapped connectors wherever possible. Where tapping bands are utilised, only Type F tapping bands incorporating a full circle design and positive stop should be used, particularly for pipes with low pipe stiffnesses such as PVC-O.

Only Type F repair and off-take clamps with a full circle design and positive stop should be used with PVC pipes, particularly for pipes with low pipe stiffnesses such as PVC-O.

3.11 STORAGE

PVC pipes are subject to surface degradation when exposed to UV radiation for extended periods. PVC pipes can be stored outside for 12 to 24 months depending upon location and longer if protected (e.g. warehouse or under hessian).

3.12 SERVICE CONNECTIONS

Direct tapping of PVC pipes is not acceptable. Only approved tapping bands, which are designed to prevent ovalisation of the pipe when the band is tightened, should be used. Pre-tapped ductile iron fittings may be used to make a pre-laid service connection (dry tapping) during construction. Service tappings should be at least 0.5 m between centres and preferably 5 times the outside diameter of the pipe. Sharpened cutters specifically designed for PVC pipe should be used.

3.13 PIPELINE DESIGN AND INSTALLATION

Buried pipe structural design should be performed in accordance with AS/NZS 2566.1. The pressure class of pipe, which is based on the maximum operating pressure with appropriate de-rating for the effects of temperature, positive and negative surge and fatigue, should be nominated on the design drawings.

Buried pipes cannot be readily located unless tracer tapes or wires are installed over the pipe during installation.

Pipes can be cut to length and chamfered on site. Specialised equipment is available to cut the chamfers on site. Care should be taken to ensure the ends of the pipes are cut square and are not “scored” during this process. A witness mark indicating the insertion depth must be drawn on the spigot end of a cut pipe.

3.14 WATER INDUSTRY EXPERIENCE

PVC-U pressure pipe has been used by Australian Water Agencies since about 1970, albeit the growth occurred mainly in the 1980s and 1990s. Overall the performance has been

excellent, but some early failures were reported due to unsatisfactory design, particularly with respect to cyclic fatigue. The adoption of a fracture toughness test in 1996 led to greater consistency in quality and performance. The increased acceptance of PVC-U occurred due to its ease of installation and sound performance.

PVC-M and PVC-O pipe has now been used successfully in Australia for multiple decades and have largely displaced PVC-U pipes for pressure applications.

3.15 RECOMMENDATIONS ON USE

PVC drinking water systems should not be used where the ground is, or there is a high likelihood that it could be, contaminated by chemicals, especially ketones such as acetone and halogenated organic solvents such as dichloromethane. Even though PVC itself is not very permeable to many chemicals, consideration also has to be given to contamination of water by chemicals entering the pipe via the joints. Note this is equally true of all pipe systems jointed with elastomeric seals.

Where PVC pipeline systems are intended to be used in pumped mains or where the temperature of the reticulated water exceeds 20°C, design analysis should be conducted to determine de-rating factors.

As with pipe of all materials, PVC pipelines should be installed in a manner that avoids point loading and mechanical surface damage. Pipes should be handled carefully and pipes containing scratches or scores deeper than 10 per cent (upper limit of 0.5 mm) should not be used.

3.16 FURTHER INFORMATION

Plastics Industry Pipe Association (PIPA) - download from http://www.pipa.com.au

POP201	1.1	May, 2013	Resistance of Plastics Pipes and Fittings to Water and Wastewater Chemicals
POP202	2.1	Nov 2016	PVC, PP and PE Pressure Pipe Installation on Curved Alignments
POP203	1.0	Dec 2007	Identification Of Buried Pipe Systems
POP204	1.0	Feb 2004	Expected Service Life Of Elastomeric Pipe Seals
POP207	1.0	Jun 2012	Installation of Potable Watermains in Contaminated Ground
POP101	1.3	Feb 2009	PVC Pressure Pipes Design for Dynamic Stresses
POP103	2.0	Jul 2010	Depth of Engagement for PVC Pipes
TN002	1.0	Sep 2009	PVC Pressure Pipe System Maintenance Guide
TN003	1.0	Jan 2005	Temperature Derating of PVC Pipes for Pressure Applications
TN006	1.0	Apr 2010	Weathering of PVC Pipes and Fittings
TP006	1.0	Aug 2012	Long Term Performance of PVC Pressure Pipe

Water Services Association of Australia (WSAA) download from http:wsaa.asn.au

WSA-TN2	Guidelines for the use of non-metallic pipes with ductile iron elastomeric joint fittings and spread sheet calculation

PVC Pipe Association (USA) (http://www.uni-bell.org)

AWWA (USA) http://wwww.org/bookstore

4 POLYETHYLENE PIPES FOR PRESSURE APPLICATIONS - WATER SUPPLY

4.1 PRODUCT SPECIFICATION

WSA PS – 207 (Pipe), WSA PS– 208 (fittings).

4.2 PIPES

Polyethylene pressure pipes are manufactured to AS/NZS 4130 (Series 1) from a pre-compounded PE 100 base resin material that has been assessed for conformity with AS/NZS 4131 and listed in PIPA Guideline POP004 and PIPA Guideline POP004a, respectively.

PE100 pipes to AS/NZS 4130 shall be minimum SDR 11 PN 16 corresponding to a maximum static pressure rating of 1.6 MPa. Pressure classes PN 20 and PN 25 are available for applications requiring higher pressures.

For straight pipes in all diameters, the standard length is typically 12 m but 6, 15 and 20 m lengths can be supplied.

For pipe sizes up to and including DN 140, pipe can be supplied in coils. Some manufacturers might be able to supply coils in even larger diameters. The length of pipe in a coil will depend on both the pipe and core diameter and the size of the drum upon which the coil is wound.

4.3 FITTINGS

Fittings manufactured to AS/NZS 4129 for use with polyethylene pipe include:

(a) Electrofusion fittings manufactured from PE100 compounds.

(b) Mechanical compression fittings manufactured from various plastics, e.g. polypropylene, ABS, polyethylene,

(c) Mechanical compression fittings manufactured from various metals, e.g. ductile iron, dezincification resistant copper alloys, Grade 316 stainless steels.

PE fittings may be fabricated or moulded.

Fabricated fittings with junctions shall be type tested to ISO 13264 to demonstrate adequate mechanical strength and flexibility. The tests shall be conducted on one sample for each DN combination. e.g. 110 x 110, 160 x 160, 160 x 110 etc

4.4 SIZING

PE pipe sizing is to international standards (metric) with nominal sizes based on the actual outside diameter.

Sizing of PE pipe varies from that of copper, PVC and DICL manufactured to Australian Standards. Equivalent internal diameters cannot be gauged by comparing DNs of PE to DNs of these other pipes. For example, DN 450 PE pipe has an internal diameter similar to series 2 DN 375 PVC and DICL pipes. The exact comparison will depend upon the PVC variant, whether PVC-U, PVC-M or PVC-O.

Pipe from PE 100 compound has a thinner wall than pipe from PE 80 compounds when comparing the same pressure ratings and hence has a larger internal diameter.

Available sizes relevant for reticulation mains are DN 63, 110, 125, 160, 180, 225, 250, 280, 315, 355, 400 and 450. For larger mains, pipe is available in Australia in diameters up to DN 2000.

4.5 PRESSURE CLASS

Pressure rating is a function of the pipe diameter to wall thickness ratio (SDR) and the MRS.

The PE material classification is related to the minimum required strength (MRS) of the compound by a factor of 10. i.e. PE100 has an MRS of 10 MPa. Defining of PE pipe material by its density only, i.e. Medium Density Polyethylene (MDPE) and High Density Polyethylene (HDPE), is no longer appropriate.

The MRS is the minimum allowable value of hoop stress at the 97.5% lower prediction limit at 20°C extrapolated to 50 years. The 50 years is a convention for establishing the material classification and is not intended to suggest a maximum service life.

De-rating the nominal pressure class is required where PE pipe or fittings will be subjected to cyclic pressures or where temperatures exceed 20°C. WSA 03 Part 1 specifies de-rating requirements.

4.6 JOINTS

Electrofusion or butt fusion joints are normally used for DN 90 and above with butt welding being the preferred choice for very large diameters.

Welded joints require trained and certified welders.

Mechanical compression joints are generally specified in sizes up to DN 110 for temporary services and where welding is impractical.

Flanged PE stubs to join to PE pipe by electrofusion or butt fusion are available in sizes DN 90 to > DN 450. Flanged PE stubs to join to PE pipe by mechanical compression are available in sizes up to DN 160. The flange requires a corrosion resistant backing plate of 316 stainless steel (below ground) or hot dipped galvanised steel (above ground). Bolts, nuts and washers should be the same material as the backing plates. 316 stainless steel bolts and nuts should be marked A4.

Flange gaskets are required to comply with WSA 109.

Hydrant installations require full-face flanges with bolting details to AS 4087.

4.7 EXTERNAL CORROSION PROTECTION

PE pipe is resistant to corrosion attack in naturally occurring soils and waters and is immune to stray current corrosion.

4.8 TRANSPORTATION, HANDLING AND STORAGE

4.8.1 General

Pipe and fittings should be transported, handled and stored in accordance with the relevant requirements of AS/NZS 2033 and with POP 005 guidelines.

All pipe should be stacked in a manner to minimise pipe ovalisation.

For black pipe with blue or lilac stripes or jackets outside storage should be limited to a maximum of two years from the date of pipe manufacture prior to installation. Black pipes with blue or lilac stripes or jackets can be stored outside for longer periods if protected from UV and stored in a manner that maximises ventilation (e.g. ventilated warehouse or under hessian).

Fittings, and sealing materials should be left in the original sealed cartons until immediately before use and stored in secure areas away from direct sunlight. Black fittings conforming to AS/NZS 4129 have a storage life at least equal to black PE pipe.

For solid black pipe outside storage can be unlimited, although it would be good practice to cover black pipes e.g. with hessian where an extended period of storage (>2 years) was envisaged. Elevating the pipe material temperature can result in pipe distortion and pipe length increase, which can cause installation problems. Therefore it is beneficial to shield pipe from direct sunlight and to store in a manner that maximises ventilation.

4.9 SERVICE CONNECTIONS

Service tapping sizes should be DN 25, DN 32, DN 40 and DN 50.

Electrofusion welded tapping saddles should be used at all times with new installations of PE pipe.

Where the use of electrofusion tapping saddles is determined impractical by the project manager, mechanical tapping saddles complying with AS/NZS 4129 can be used for:

(a) tapping PE minor mains (<DN 63).

(b) rehabilitation installations using PE in sizes up to and including DN 180; and

(c) connections to existing PE mains and above-ground PE mains.

Where mechanical tapping saddles are used, a minimum spacing of 0.5m between tappings should be maintained and tapping should not be performed closer than 0.5 m from the termination of the PE pipeline.

Tapping of curved PE pipe should take place only at the top of the pipe to minimise stress around the tapping hole. Where dry tapping is performed, a plug cutter should be used, and all swarf removed. Under pressure tapping should only be used with systems that utilise plug cutters that retain the PE pipe wall plug within the cutter. Where welded tapping systems are used, the assembly should be allowed to fully cool naturally before cutting the mainline PE plug.

4.10 PIPELINE DESIGN AND INSTALLATION

Buried pipe structural design should be performed in accordance with AS/NZS 2566.1.

Buried pipes cannot be readily located unless tracer tapes or wires are installed over the pipe during installation.

Hydraulic design requires consideration of the expected pressure regime to enable selection of appropriate pressure class of pipe. Pressure class should be based on the maximum operating pressure with appropriate de-rating for the effects of temperature, surge (positive and negative) and fatigue.

For specific installation information relating to PE pressure pipelines refer to AS/NZS 2033 *Installation of polyethylene pipe systems.* Install single length pipe or pipe with fully welded joints under roads and railways.

Where warm ambient temperatures exist to substantially elevate pipe temperature above a buried service temperature, allow pipe to approximately achieve the service temperature before final connection and backfill.

4.11 WATER INDUSTRY EXPERIENCE

The use of small diameter polyethylene pipe for water service connections was widely taken up by Australia's water agencies throughout the 1990s. The use of PE for water reticulation is becoming more popular.

The experience with PE for pumped pressure sewers, especially in larger sizes, is limited, despite the excellent fatigue and corrosion resistance of PE, although PE is being specified as the default system for low-pressure sewerage that is currently being adopted throughout Australia.

PE pipe is preferred over other water main materials where substantial longitudinal flexibility (tighter radius of curvature), fewer joints, self-restraining pipelines (i.e. using welded PE pipelines) are required.

4.12 RECOMMENDATIONS ON USE

PE systems should not be used where the ground is or will be contaminated by chemicals, especially low molecular weight hydrocarbons and organic solvents.

Where PE is intended to be used in a pressure main and the operating temperature exceeds 20°C, the published de-rating factors should be applied (Refer to AS 2033).

Fabricated PE fittings can require substantial derating and should only be used with considerable caution. The PIPA Industry Guidance Note POP 006 provides information on the pressure derating requirements for plain pipe fabricated into fitting configurations.

Pipes should be handled carefully and pipe containing scratches or scores deeper than 10% should not be used. Installation should be in accordance with AS/NZS 2033:2008

Blue striping is predominantly used to identify PE pipe used for drinking water applications.

Fusion jointing should be conducted and managed in accordance with WSA 03.

4.13 FURTHER INFORMATION

http://www.pipa.asn.au/

http://www.plasticpipe.org

5 GLASS REINFORCED PLASTIC (GRP) PIPES FOR PRESSURE APPLICATION – WATER SUPPLY

5.1 PRODUCT SPECIFICATION

WSA PS – 219, WSA PS– 205J and WSA PS – 205J

5.2 PIPES

Glass reinforced plastics (GRP) pipes are manufactured for the Australian market to ISO 23856 using the filament wound (FW) or centrifugally cast (CC) process. GRP jacking pipe is manufactured to ISO 25780.

GRP nominal sizes range from DN 300 to DN 4000. See 4.4 for more details.

GRP pipes are defined by the nominal stiffness SN, which is the initial ring stiffness in units of Newtons /metre/metre. See 4.5 for more details.

Nominal pressures ratings are from PN1 to PN32. GRP jacking pipe intended for use in non-pressure applications can be supplied with a nominal pressure rating ranging from PN 1 to PN 2.5.

When specifying the use of ductile iron fittings with GRP pipes, care should be taken to ensure compatibility with the GRP pipe OD.

The nominal length for GRP pipe is 6m. Pipes can be supplied in lengths down to 1 m. The total length of each standard 6m pipe is equal to the specified nominal length with a tolerance of +0/-60 mm. Other tolerances in length are possible with respect to short pipes.

Glass reinforced plastic (GRP) is an engineering composite material. GRP pipe is typically comprised of layers of thermosetting resin, glass fibre reinforcing and sand.

Filament wound GRP pipes are produced by winding continuous glass fibre rovings onto a mandrel resulting in a pipe with controlled internal dimensions.

Centrifugally cast GRP pipes are produced by feeding raw materials into a rotating mould using a fully automated and electronically controlled process.

The mechanical properties of GRP pipes can be varied by adjusting the quantity, proportions and orientation of the various laminates in the pipe wall. The flexibility of this system enables pipes to be designed to meet a wide range of pressure applications. The types of resin may also be varied in order to meet the many duties and environments to which the pipes may be subjected. The inner layer is designed to provide corrosion resistance, abrasion resistance and a smooth flow surface.

The wall construction of non-pressure pipe differs from pressure pipe in that it contains less glass fibre reinforcement.

5.3 FITTINGS

GRP pipe fittings are fabricated from sections of straight pipe, cut to length, joint wrapped externally and internally with additional fibre reinforcement. Fittings are usually supplied with spigot ends and joined using standard pipe couplings.

The standard range of fittings include:

(a) Pipe couplings.
(b) Elbows 11°, 22.5°, 45°, and 90° (available angle range from 1° to 90°) with spigot, socket or flanged ends.
(c) Tees, either equal or reduced with spigot, socket or flanged ends.
(d) Reducers, concentric or eccentric spigot, socket or flanged ends.
(e) Wye’s with spigot, socket or flanged ends.
(f) Other fittings can be manufactured to order.
(g) Flanges, slip-on or plain.

Ductile iron and steel fittings with elastomeric seals can be used in GRP pipelines. Ductile iron and steel fittings should have compatible performance capability and should be appropriately protected against internal and external corrosion.

GRP fittings used with GRP jacking pipes are fabricated from sections of straight pipe, cut to length, joint wrapped externally and internally with additional fibre reinforcement in accordance with ISO 10467. GRP fittings are supplied with spigot ends suitable for connection to the GRP jacking pipe stainless steel or GRP couplings.

5.4 SIZING

Pipes manufactured by the filament wound method offers DN 300 to DN 750 pipes with spigot outside diameters complying with Australian preferred outside diameters (WSA PS 219) and DN 900 to DN 4000 pipes with spigot outside diameters complying with ISO 23856 Series B1 (Table 5).

Pipes manufactured by the centrifugally cast method offers DN 300 to DN 600 pipes with spigot outside diameters complying with ISO 23856 Series B2 (Table 6) and DN 700 to DN 1400 pipes with spigot outside diameters complying with ISO 23856 Series B1 (Table 5). The external diameters do not align with Australian Standard pipes.

GRP jacking pipe is manufactured in nominal sizes ranging from DN 300 to DN 3000. The declared external and internal pipe diameters are required to be specified by the manufacturers.

5.5 PRESSURE CLASSES

GRP pressure pipes are defined by both a pressure class and stiffness. For centrifugally cast GRP pressure pipe, the GRP composite through the wall is varied to increase the pressure rating while the wall thickness is increased to increase the ring-bending stiffness (wall thickness increase is not used to increase the pressure rating).

Pressure classes PN 12.5, PN 16 and PN 20 are recommended for water supply. Pipes of pressure class PN 12.5 and less are available in stiffness classes SN5000 and SN10000. Pipes of pressure class PN 16 and PN 20 are only available in stiffness class SN10000.

5.6 JACKING LOAD AND NOMINAL STIFFNESS

ISO 25780 requires a minimum pipe stiffness of SN 20,000 N/m/m. GRP jacking pipes can be supplied with jacking loads in the range of 50 to 1000 Tonnes and nominal stiffness ≥ SN 20,000 N/m/m

5.7 JOINTS

5.7.1 Flexible

Plain-ended GRP pipes are joined with a sleeve coupling that is factory fitted to one end of the pipe.

The standard ‘FWC’ couplings comprise a filament wound GRP outer shell and inner elastomeric gasket for the full width of the coupling.

An additional special purpose rubber ring joint with a flush external diameter is available for microtunnelling and pipe jacking.

Standard couplings accommodate angular deflection of 1 to 3° depending on pipe size. Witness marks on the spigot identify insertion depth. Spigots should be inserted to but not beyond the witness mark.

Ductile iron fittings can be joined to GRP non-pressure pipe by means of:

(a) Ductile iron socket to GRP spigot.

(b) Ductile iron flange to GRP flange.

(c) Ductile iron spigot (machined to GRP outside dimensions) to GRP spigot with a standard coupling.

GRP pipes (marked Adjustable) can be cut anywhere along the pipe barrel and rejoined using a standard GRP coupling, mechanical gibault type coupling, DI socket or other approved mechanical compression seal joint.

Flange socket/spigot metal (or GRP where permitted) fittings are required to connect pipes to flanged fittings. Dimensions and drilling patterns should comply with AS 4087.

GRP pipe couplings have an outside diameter equal to the pipe external diameter. Couplings are available in different types and pressure classes depending on the application.

5.8 INTERNAL LINING

5.8.1 Pipes

CC-GRP pipes are finished internally with a resin rich corrosion barrier that is resistant to attack by the conveyed water. The corrosion barrier acts as protection against degradation of the pipe wall structure.

5.8.2 Metal fittings

Ductile iron fittings lined and coated to AS/NZS 4158 will provide the best combination of internal and external corrosion resistance.

5.9 EXTERNAL CORROSION PROTECTION

5.9.1 Pipes

Standard GRP pipes manufactured from polyester (thermosetting) resins are resistant to corrosion by soil, water and sewage, and are unaffected by stray or induced currents.

Where it is considered there is potential for permeation and degradation of GRP pressure pipe or their EPDM gaskets/rings by organic contaminants specialist advice should be sought. In some instances the use of vinyl ester resins may be warranted.

GRP fittings do not require any special protection.

5.9.2 Metal fittings

Ductile iron fittings lined and coated to AS/NZS 4158 will provide the best combination of internal and external corrosion resistance.

Steel fittings complying with AS 1579 should be externally coated using an approved factory applied PE tape wrap systems or APAS listed solventless epoxy coating.

5.10 SERVICE CONNECTIONS

Special requirements apply for the tapping of GRP pipe, either for under pressure connection of a new reticulation main or for providing customer services. For customer service or live tapped main connections, it is essential to use approved types of full circumference metal bands and cutting tools such as diamond tipped drills, hole saws and trepanners. Pre-tapped connectors such as socketed DI or elongated couplings can be used where dry tappings are to be made during the installation of the main. Narrow band tapping saddles should not be used in such situations.

5.11 PIPELINE DESIGN AND INSTALLATION

When installed to the requirements given in the Standard Drawings in WSA 03, and for the usual shallow cover installations for water supply, GRP pressure pipe at the minimum available stiffness of SN5000 is predicted to provide satisfactory performance for most native soil conditions encountered. However, in trafficked areas with shallow covers SN10000 is usually required. For an overall soil stiffness (deformation modulus) E’ <3 MPa, it is recommended that structural design to AS/NZS 2566.1 be undertaken.

Structural design may show that SN10000 should be used for lower stiffness native soils. For very low stiffness native soils with a deformation modulus of 1 MPa or less e.g. soft clays, swelling soils, soils containing organic materials, the use of the widened trench

required by a design to AS/NZS 2566.1 may not be feasible. Where the buried flexible pipe design process given by this Standard indicates marginal conditions with respect to deflection, ring strain or buckling it is usually more cost effective to improve the soil characteristics than use higher pipe stiffness. See AS/NZS 2566.2 for various options for improving embedment performance. Pipe stiffness is only a minor part (about 15%) of the combined pipe-soil stiffness resisting external loading and an increase of the pipe stiffness from SN5000 to SN10000 (or higher) will only provide a relatively small decrease in predicted deflection. Unlike the more ductile thermoplastic pipe (PVC, PE and ABS), where joint performance generally limits the deflection CC-GRP is sometimes strain limited.

All plastics pipes undergo creep and in the case of GRP pressure pipe, this results in the long term (50 year) stiffness being approximately 0.4 of the initial (3 minute) stiffness. The increase in loading due to backfill settlement requires that the initial allowable deflection for GRP pipe be less than the long-term limit. Typically short-term deflection should not exceed 4%.

GRP pipes have a limited resistance to bending and shear. It is therefore critical that the foundation and bedding offers a continuous and uniform support to the pipe barrel. Attention needs to be given to the possibility of point loads applying to the pipe barrel such as from an uneven native rock foundation beneath the bedding. Such a condition can be a cause of pipe failure. Standard Drawings in WSA 03 show minimum bedding thicknesses. However, it may be prudent to increase the bedding thickness in extreme conditions.

Appropriate care should be taken with GRP pipes to avoid impact damage or point loads.

5.12 WATER INDUSTRY EXPERIENCE

GRP pipelines have performed well where installation conditions have been correctly managed.

There have been a few instances of GRP pipeline failure. Some failure analyses indicate the cause as high impact loading due to rough handling initiating failure. Other failures have occurred at tapping points where non full circumferential clamps were used or associated with operating pressures much higher than the pipe pressure rating.

The liner resin type may have to be modified from polyester to vinyl ester to ensure it is suitable for the required environment e.g. water at temperatures of over 35°C.

The Australasian Society Trenchless Technology has developed Trenchless Guidelines, Standards and Specifications to assist industry users in Australia and New Zealand in utilising these technologies. These documents are not intended to replace any existing relevant manuals or standards. It remains the user's responsibility to ensure that all relevant laws, standards and specifications are adhered to during the course of a Works with use of these trenchless technologies.

These Guidelines, Standards and Technical specifications are available from the Australasian Society Trenchless Technology (ASTT) website. (http://astt.com.au).

5.13 RECOMMENDATIONS ON USE

GRP pipeline systems might not be suitable for use in the following situations:

(a) where there is a high likelihood of future excavation in the immediate vicinity of the pipeline e.g. congested CBD pipe corridors.

(b) above ground where there is risk of vandalism.

(c) In ground contaminated with certain organic compounds in concentrations that could lead to attack of the EPDM elastomeric gasket or permeation through the joint and into the water supply.

5.14 FURTHER INFORMATION

AWWA M45 Fiberglass Pipe Design

http://www.awwa.org/bookstore

http://www.hobas.com/

http://www.superlit.eu/

http://www.futurepipe.com/en/

https://www.rpcpipesystems.com/

Zhejiang Eastern Haobo Pipes Co Ltd (DFHB)

http://astt.com.au

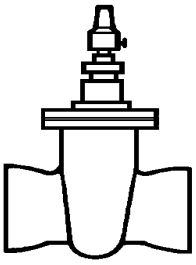
6 GATE VALVES

6.1 RESILIENT SEATED GATE VALVES

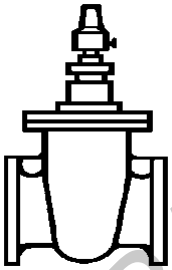
6.1.1 Product Specification

WSA PS – 260.

6.1.2 Description



Double socket RSV



Double flange RSV

A resilient seated gate valve (RSV) typically consists of:

(a) A ductile iron polymeric fusion coated body

(b) A ductile iron polymeric fusion coated bonnet.

(c) A metal gate (wedge) fully encapsulated with bonded resilient (rubber) seal. Unlike metal seated gate valves, RSVs do not have any seat rings, either on the body or on the gate

(d) A stainless steel non-rising spindle

(e) O-ring type stem seals.

(f) A gun metal gate nut

The fully guided rubber coated gate can be opened fully to give an unobstructed flow or closed to stop flow with drip-tight sealing. RSVs are usually operated by a Tee-key or in above ground situations with a handwheel. RSVs are typically double flanged or double socketed but may have a combination of ends including spigots. The stem seal can be replaced in service by opening the gate fully while the pipeline is under pressure. If damaged, however, the resilient seal on the gate cannot be replaced and should be discarded. RSVs are used mainly as stop valves or isolating valves and are not designed for throttling purposes.

RSV's are rated at PN16 or PN25.

The surfaces of the valve requiring corrosion protection are coated with polymeric fusion coating to AS/NZS 4158. For high-pressure applications (i.e. >250m head) or for sizes above DN 750, metal seated valves should be used.

6.1.3 Water Agency experience

RSVs were first introduced into Australia in the late 1970's. Australian water utilities have now almost universally adopted the resilient-seated gate valve for use within its reticulation systems.

The Australian Standard has progressively adopted many inclusions to address early concerns when RSV's were first introduced into Australia, including:

(a) Specification of minimum material requirements to ensure appropriate strength and corrosion resistance of the valve components.

(b) Full rubber encapsulation of the gate to avoid possible corrosion sites.

(c) A Type Test regime to prove sufficient strength in order to meet normal torque operating requirements of a reticulation valve.

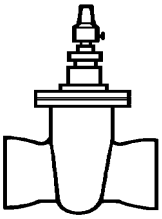
(d) Cyclic flow Type Tests to demonstrate the ability of an RSV to meet design performance requirements.

6.2 METAL SEATED GATE VALVES

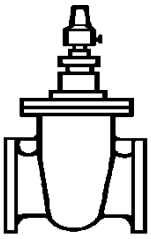
6.2.1 Product Specification

WSA PS – 261.

6.2.2 Description



Double socket MSV



Double flange MSV

A metal seated gate valve typically consists of:

(a) A ductile iron polymeric fusion coated body.
(b) A ductile iron polymeric fusion coated bonnet.
(c) A metal gate (wedge).
(d) A stainless steel non-rising spindle.
(e) O-ring type stem seals.
(f) Sealing ring on the gate either integral with the gate (for bronze gate) or separate ring fixed on the face of the gate (ductile iron gate).
(g) A separate seating ring on the body.
(h) A Gunmetal gate nut.

The design of the valves should conform to AS 2638.1 for sizes up to DN 900. The purchaser should specify requirements for sizes larger than DN 900.

The fully guided gate (wedge) can be opened fully to give an unobstructed flow or closed to stop flow. Some leakage is permissible as per AS 2638.1. These valves are normally operated by a Tee-key with or without an actuator, depending on size and application. In above ground situations a hand wheel operation is usual. The valves are generally double flanged or double socketed. The stem seals can be replaced in service by opening the gate fully while the pipeline is under pressure. MSV's are used mainly as stop valves or isolating valves and are not designed for throttling purposes.

MSV's up to DN 1800 have been manufactured in Australia. MSV's can be rated to PN35. The rotation of the input shaft to close a valve is optionally clockwise or anti-clockwise. The purchaser must specify the required direction of rotation.

The surfaces of the valve requiring corrosion protection are coated with a polymeric fusion coating to AS/NZS 4158.

6.2.3 Installation

Valves can be installed with stem horizontal or vertical depending on the need at the installation location. Where valves are required to be installed horizontally, the guides should be designed to support the weight of the gate in its horizontal position. The valves can be buried or installed above ground.

6.2.4 Recommendations on use

The use of MSV's is now largely redundant given their replacement with RSV's, except for high-pressure applications (i.e. >250m head) and sizes >DN 750. While MSV's and RSV's are generally deemed to provide equivalent functional performance and are interchangeable

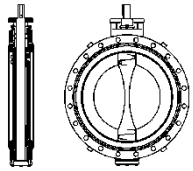
in most instances, RSV's have become the default stop valve throughout the water industry internationally. However, substitution of one for another should not be made without consultation with the designer and the Water Agency. Some Agencies may limit the size of approved RSV's.

7 BUTTERFLY VALVES

7.1 PRODUCT SPECIFICATION

WSA PS – 263.

7.2 DESCRIPTION



The main components of a butterfly valve (BFV) are:

(a) Body
(b) Blade
(c) Shaft(s)
(d) Bearings
(e) Seat/seal
(f) Operating gears

BFV shafts can be a one-piece unit extending completely through the valve blade or stub–shaft type, where two separate shafts are inserted into the blade hubs. All shafts are of stainless steel.

The valves may have:

(i) Resilient rubber seal on the body (bonded or loose).

(ii) Resilient rubber seal in the body.

(iii) Resilient seal on the blade.

The resilient seal on the blade for larger valves can be replaced on site in-situ. The seal on the body cannot be replaced on site without the removal of the valve from the pipeline. The seal on body can be replaced conveniently in a suitable workshop only. The shaft seal could be O-ring type with additional lip type seal at shaft drive end. The lip seal can be replaced on site by removing the gear operator only.

The BFV body may be cast or ductile iron. The blade may be of cast iron, ductile iron, aluminium-bronze, cast steel or fabricated steel. Purchasers should specify their needs in the specification.

BFV's are available in flange-flange, lugged or wafer designs.

7.3 APPLICATION

BFV's may be used for maximum normal flow velocity of 5 m/sec but can withstand up to 7.5 m/sec for "emergency" operation.

BFVs can be used as an isolating valve, stop valve or as a control valve. Exact needs should be carefully determined and specified to get the suitable valve for the desired purpose.

7.4 INSTALLATION

BFV's are normally installed with the shaft horizontal though could be installed with the shaft vertical or in an inclined position. BFV's should preferably be installed in a chamber for below ground installation, though they can be buried.

7.5 ADVANTAGES / DISADVANTAGES

BFV's have the advantages of being:

(a) Light.

(b) Cheaper than gate valves of similar sizes, especially in larger sizes. However, other associated costs, such as, valve chamber, gear operator, input stop if required, position indicator if considered necessary etc. should be considered to determine the overall cost of the installed valves.

(c) Needing shorter face-to-face distance.

BFV's have the following disadvantages:

(i) In the fully opened condition the blade remains in the flow path causing some obstruction and hence some head loss.

(ii) Pipelines that employ BFV's cannot be cleaned using traditional methods employed by the water industry. Future renovation of the pipeline may also be limited by use of BFV's.

7.6 OPERATION

BFV's can be operated by:

(a) Hand wheel fitted on a manual gear operator.

(b) An electric actuator.

(c) Hydraulic actuator.

(d) Pneumatic.

(e) A combination of hydraulic actuator and drop weight where the valve is opened hydraulically and closed by drop weight.

(f) Tee-key from the spindle cap.

Smaller BFV's could also be operated with a hand operated lever.

7.7 FURTHER INFORMATION

AWWA M44 Distribution Valves: Selection, Installation, Field Testing, and Maintenance

AWWA M49 Butterfly valves: Torque, Head Loss, and Cavitation Analysis

http://www.awwa.org/bookstore

8 NON-RETURN (REFLUX) VALVES

8.1 GENERAL

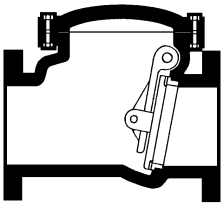
Non-return valves (NRV's) allow flow in one direction only. NRV's are used to stop any reversal of flow in a pumped main when pumps stop. Two principal NRV designs are the swing check and tilting disc.

8.2 SWING CHECK VALVES

8.2.1 Product Specification

WSA PS – 264.

8.2.2 Description



Swing check valves are of very simple construction with a long body and a disc. A cover is also provided on top of the body to facilitate cleaning. The hinged disc opens in the direction of flow only to allow flow and closes fully when flow reversal occurs. The disc remains fully within the body during the opening and closing of the valve. Desired flow velocity is about 2 m/sec to keep the disc fully open.

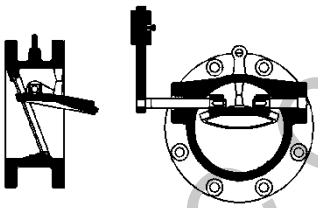
The design of swing check non-return valves should comply with the requirements of AS 4794. However, the purchaser should specify the flow rate, working pressure, flange drillings, materials, position indicators and other desired requirements, such as, anti-slamming, noise, vibration characteristics.

8.3 TILTING DISC VALVES

8.3.1 Product Specification

WSA PS – 264.

8.3.2 Description



A tilting disc non-return valve works much the same way as a swing check valve. The main differences are that the flange to flange distance in a tilting disc valve is shorter than that in a swing check valve. Also, the disc extends outside the body of the tilting disc valve when fully open, whereas for a swing check, the disc remains fully within the body.

While counterweight can be used to reduce the closing time, it can also increase the slamming and vibration. The need for a counterweight should therefore be assessed carefully to achieve the desired outcome.

The design of tilting disc non-return valves should comply with the requirements of AS 4794.

9 PRESSURE REDUCING VALVES

9.1 GENERAL

Pressure reducing valves (PRV) are used to reduce the upstream pressure of the PRV to a desired lower downstream pressure irrespective of the upstream pressure or flow conditions or both.

9.2 PRODUCT SPECIFICATION

WSA PS – 268.

The following should normally be specified when procurement of a PRV is required:

(a) Type of valve (Globe or electrically operated eccentric plug or butterfly etc).
(b) Maximum upstream pressure when the valve is closed.
(c) Upstream pressure corresponding to maximum flow.
(d) Upstream pressure corresponding to minimum flow (Note: minimum flow is not the zero flow. It is the minimum flow greater than zero that will be encountered during the operation of the valve).
(e) Required downstream pressure of the valve.
(f) Flange drillings if the valve is flanged.
(g) Materials of construction.
(h) Need for an opening/closing speed controller.
(i) Required noise level etc.

9.3 DESCRIPTION

A PRV is generally a hydraulically operated globe valve. However, electrically operated and suitably designed eccentric plug valves or butterflies valves could also be used. The valve should be designed and selected carefully to ensure that it does not cavitate within the specified flow ranges and pressure differential. The PRV works automatically to maintain the desired downstream set pressure to protect the integrity of the downstream pipelines.

The basic components of a hydraulically operated PRV are:

(a) Main body of the valve.
(b) Diaphragm.
(c) Shaft and the sealing disc.
(d) Pilot.

Other small fittings, such as filters, hydraulic connections from the valve to the pilot, isolators, speed control etc.

The PRV maintains the downstream set pressure by changing the flow rates through the valve. In operation, the pilot senses the downstream pressure through a hydraulic connection at the outlet of the valve. The pilot then reacts to change the pressure above the diaphragm, causing a movement of the diaphragm. This in turn causes a movement of the sealing disc and thus brings changes to the valve opening positions. The flow rate through the valve changes when the valve opening position is changed. When the downstream pressure tends to exceed the desired set pressure, the valve closes more and when the pressure falls below the set pressure the valve opens more. The valve closes drip-tight when the downstream pressure exceeds the set pressure. The pressure control circuit may also be fitted with a needle valve type speed control to control the opening/closing speeds of the valve if required. Fast opening/closing of the valve might result in pressure surges in the pipeline.

In electrically operated eccentric plug or butterfly valves, a pressure sensing device is fitted downstream of the valves. The valve opens/closes depending on the pressure downstream of the valve.

If the required pressure reduction is very high, it may require the installation of more than one valve in series to achieve the desired reduction in steps. Large pressure reduction in one step may cause cavitation, noise and damage to the valve.

In some installations, a smaller PRV in parallel with a large PRV may be required to control a wide range of flow rates. Some PRV manufacturers supply PRV with a direct acting integral bypass PRV to control low flows. The use of such valve could save installation space and make the installation and maintenance easier.

9.4 INSTALLATION

The PRV should always be installed in a chamber (if the pipeline is buried) and provided with a manual bypass to ensure continuation of water supply in case of PRV malfunction. It should also be provided with isolating valves upstream and downstream, which would allow its isolation and maintenance.

9.5 NOISE

PRVs are inherently noisy. In some installations, especially in installations near residential areas, noise control could be very important. In noise sensitive areas, PRV should be designed, selected and installed to reduce noise to a desired level. In some installations, noise-attenuating treatment may be required.

9.6 FURTHER INFORMATION

AWWA M44 Distribution Valves: Selection, Installation, Field Testing, and Maintenance

http://www.awwa.org/bookstore

10 VALVE EXTENSION SPINDLES

10.1 PRODUCT SPECIFICATION

WSA PS – 262.

10.2 RECOMMENDATIONS ON USE

In some cases, valves are often buried at a greater depth than normal and conventional valve keys will not reach. To accommodate this, valve extension spindles are used to extend the height of the valve spindle thereby allowing access from the operating level. Considerable torque is often required to operate valves so it is important to ensure these items are manufactured to meet the performance requirements of the WSA Purchase specification and AS/NZS 2638.

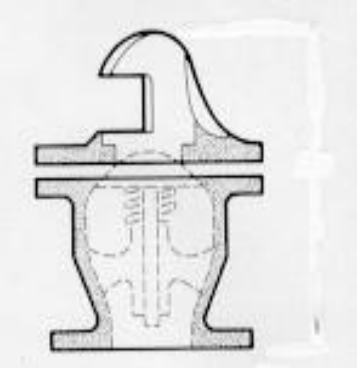
11 HYDRANTS

11.1 SPRING HYDRANTS

11.1.1 Product Specification

WSA PS – 267.

11.1.2 Description



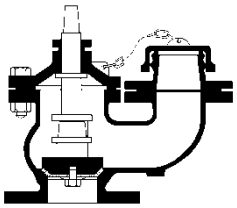
The spring hydrant valve to AS 3952 is installed underground in the vertical position. The hydrant is controlled by a hydrant standpipe which, when installed on the hydrant, activates a domed seat. The domed seat incorporates a spring seal that shuts off the flow when the standpipe is removed. The domed seat seals on a resilient seat in the valve. The hydrant cover, which has integral lugs to allow the standpipe to be installed, is bolted on to the body. All materials that are not inherently corrosion resistant are coated with a polymeric fusion bonded coating to AS/NZS 4158.

11.2 SCREW-DOWN HYDRANTS

11.2.1 Product Specification

WSA PS – 267.

11.2.2 Description



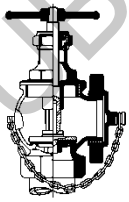
The screw down hydrant is installed underground and is controlled by an internal screw rising stem. The outlet may be threaded to suit local agency specifications or a spring hydrant incorporated onto the outlet flange.

11.3 RIGHT ANGLE SCREW-DOWN HYDRANTS

11.3.1 Product Specification

WSA PS – 267.

11.3.2 Description



The right angle screw down (millcock type) hydrant valve is installed above ground, attached to a standpipe. The outlet of the hydrant is at right angles to the inlet and is controlled by an internal screw rising stem.

12 AIR VALVES

12.1 PRODUCT SPECIFICATION

WSA PS – 265.

12.2 APPLICATION

Air valves are used in water systems for various purposes, including:

(a) Continuous release of accumulated air from a pipeline while the pipeline is in operation and under pressure. Air, if not released continuously, accumulates at high points, reducing the flow capacity of the pipeline and ultimately causing air binding (total stoppage of flow).

(b) Releasing air during filling of a pipeline. Air release, however, if too fast can force the valve float to close prematurely, especially towards the end of the filling period, causing an instantaneous halt of incoming liquid. This can result in a pressure surge in the pipeline that can potentially cause a pipe burst.

(c) Allowing air inflow during draining a pipeline to avoid the creation of large vacuum that can reduce draining efficiency and in worst case, result in a pipe collapse. This is particularly important during uncontrolled draining such as a pipe burst situation.

(d) Allowing air to enter freely into a pipeline during column separation and restricting air outflow when the column re-joins. This type of anti-vacuum valve is used to reduce the water hammer effect that can result in a pressure (rising) main when failure of power to a running pump occurs.

12.3 DESCRIPTION

The design and function of air valves varies very widely. Valves may be described primarily by their principal function i.e.:

(a) Air release valves (release of air during filling of main).

(b) Air release and vacuum valves (combine the functions of air release and preventing a vacuum from forming in the pipeline).

Valves may also be described in terms of their design i.e.:

(i) Large orifice.

(ii) Small orifice.

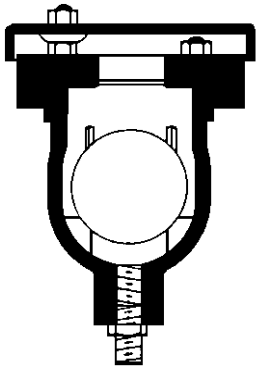
(iii) Double orifice (or combination) valve.

Air valves may be automatic or manual types. The automatic air valves open/close automatically to release air from or allow airflow into the pipeline automatically. On the other hand, manual air valves open automatically when the pressure inside the valve chamber falls to atmospheric level during dewatering but during filling of the main, the valve must be kept open by depressing the float manually with a depressor bar to prevent the float from closing the valve prematurely. When charging of the main is complete, the float is released by manually screwing up the depressor bar against water sprays to close the valve.

12.4 TYPES

12.4.1 Air release and vacuum valves – large orifice

12.4.1.1 Description



These valves allow the release of large quantities of air during the filling of a main and air inflow to the main during its dewatering.

A large-orifice air valve has an orifice nominally the same size as the inlet of the valve, which allows automatic air intake into a pipeline during draining and releases air to atmosphere from the pipeline during filling.

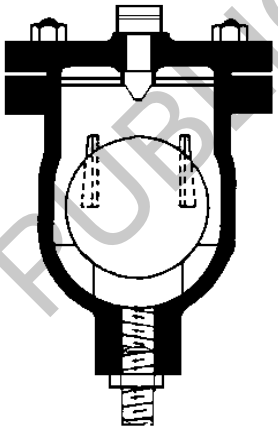
12.4.1.2 Operation and features

When the pipeline is filling, air is exhausted. When emptying, air is admitted. During pipeline filling, exhausting air or spray unseats the float (ball) from the bottom seat but does not force the float against the top seal. The valve remains open while air continues to discharge. When all air has been discharged, pressurised water fills the valve chamber and forces the float against the seal at the top of the valve. The valve should be drip-tight at a pipeline internal pressure of 80 kPa. The valve remains closed until the pipeline pressure falls below atmospheric. During pipeline draining, the float drops and breaks the seal, allowing air to enter. The air enters the pipeline via airways around the float seat.

A mechanically operated device is generally fitted to the air valve to enable the float to be depressed and held down during emptying or filling operations. The float and seal are designed avoid impact damage or creep deformation. A cover plate is fixed above the orifice to prevent dirt or other material falling onto the float and seal area and to shield the float from direct sunlight. Seals, seats and floats should be replaceable in the field without special tools.

12.4.2 Air release valves – small orifice

12.4.2.1 Description



The small-orifice air valve automatically releases air that has accumulated in the high points of the pipeline during normal operation of a pressure pipeline.

12.4.2.2 Operation and features

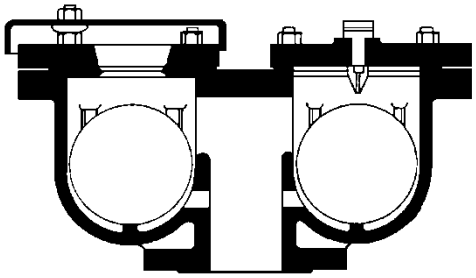
The specific gravity of the ball (float) is such that it floats when the chamber is full of water but will not close by air pressure alone. The buoyancy of the ball causes it to seal a small orifice, approximately 2 mm in diameter.

As air accumulates in the top of the chamber, the water level is depressed. Ultimately, loss of buoyancy causes the ball to drop and break the orifice seal. Air then escapes and the consequent rise in water level brings the ball up to reseal the orifice. The cycle continues as air accumulates.

The orifice outlet is protected from outside contamination by means of a cover plate. The float material withstands impact, without deformation, arising from sudden closure.

12.4.3 Air release and vacuum valve – Combination or double air valve

12.4.3.1 Description

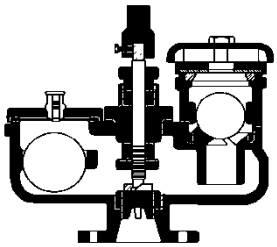


These valves combine the function of an air release valve and large orifice air and vacuum valve. The air release valve is manufactured as an integral part of the large orifice valve.

A combination valve combines the large orifice and small orifice functions in one valve. The small-orifice air valve releases accumulates air during normal operation of a pressure pipeline. The large orifice air valve ventilates the pipeline during emptying and filling.

12.4.4 Combination or double air valve with integral isolating valve

12.4.4.1 Description



These valves are the same as a combination (double) orifice valve but fitted with an integral isolator to facilitate the maintenance of the valve while the pipeline is under pressure. The valves are normally installed on buried pipelines in a chamber.

The valve includes an isolating valve in addition to a small orifice air valve and a large orifice air valve. The small orifice air valve releases accumulated air during normal operation of a pressure pipeline, the large orifice air valve ventilates the pipeline during emptying and during filling and the isolating valve allows inspection and maintenance to be undertaken without the need to dewater the pipeline.

12.4.5 Specially designed anti-vacuum valves

12.4.5.1 Description

These valves are specially designed to allow large air inflow when there is column separation in a pipeline and to allow restricted air outflow when the column re-joins. This helps to reduce or eliminate water hammer effect in the pipeline.

12.4.6 Anti-shock or anti-surge air valves

12.4.6.1 Description

Anti-shock or anti-surge air valves incorporate three orifices:

(a) The large orifice allows the large inflow/outflow of air during pipe draining/filling.

(b) The small orifice releases any accumulated air from the pipeline when the pipeline is in operation.

(c) The anti-shock or anti-surge orifice is provided with a mechanism which comes into operation automatically when pressure inside the pipeline tends to increase suddenly due to sudden closure of the float, which in turn causes an almost instantaneous stoppage of the incoming liquid flow.

12.5 INSTALLATION

Air valve selection, sizing and installation is very important for proper functioning of a main.

Air valves should be installed at each high point of a main and at every point where a change of gradient occurs. Air valve sizing programs are now-days available from the manufacturers to determine the number and sizes of air valves required. Consultation with a valve specialist is advisable before placing an order.

12.6 CHAMBER DESIGN

Air valves should be installed in a valve chamber e.g. Special care should be taken in the design and installation of air valves in chambers. Often it is found that the air valve chambers are provided with no or insufficient opening for air inflow/outflow, which may severely affect the performance of the valves. Chamber drainage is another aspect often neglected. In many locations, air valve chambers are found flooded with the air valve(s) submerged under water. In this situation, air valves cannot perform their desired functions, so endangering the integrity of the pipeline and safety of operation.

Proper design of chambers is therefore vital.

12.7 FURTHER INFORMATION

AWWA M51 Air Release, Air/Vacuum, and Combination Air valves

http://www.awwa.org/bookstore

13 MECHANICAL TAPPING BANDS

13.1 PRODUCT SPECIFICATION

WSA PS – 310.

13.2 DESCRIPTION

A tapping band, supplied in two parts and incorporating a threaded boss for connecting a main-tap (ferrule or ball valve) to the drilled main, encircles the main and is typically fastened by tightening two bolts, each positioned on wings at either side of the band. Tapping bands should be manufactured to AS/NZS 4793 and are available in various materials including stainless steel, ductile iron, gunmetal and reinforced plastic. Pre-tapped connectors are preferred for use in new DI or PVC pipeline installations.

It is recommended that the tapping band / main-tap joint be wrapped after installation to isolate it from the surrounding soil.

13.3 APPLICATION

13.3.1 Ductile iron pipes

Metallic (including gunmetal) tapping bands for ductile iron mains (Type R) should be coated with a thermal-bonded polymeric coating to prevent potential galvanic corrosion. Where a copper service connection is used suitable insulation should also be installed to prevent corrosion at the ferrule / tapping band connection.

13.3.2 PVC pipes

Tapping bands for use with PVC pipes (Type F) should be full circle design to prevent diametrical deflection of the pipe by more than 5%.

13.3.3 GRP pipes

Narrow banded tapping bands should not be used on GRP pipe as this can induce high stresses that can cause failure of the pipe. For these applications, stainless steel wrap around clamps with the appropriate size off take are recommended (Refer to Clause 4.10 for further guidance).

13.3.4 PE pipes

Mechanical tapping bands should not be used on PE pipe if at all practicable (Refer to Clause 4.8 for further guidance).

14 OFF-TAKE CLAMPS FOR UNDERPRESSURE CONNECTIONS

14.1 PRODUCT SPECIFICATION

WSA PS – 313.

14.2 DESCRIPTION

Off-take clamps are manufactured to AS 4181 for under pressure connection of a new main to an existing main. They may be manufactured from stainless steel or polymeric coated ductile iron or steel. The clamp is provided in a “tee” configuration. The nominal major diameter of the clamp is compatible with the OD of the existing main to which the new main will be connected. The minor diameter (off-take) has a flanged end to which a gate valve is connected, after the clamp has been fitted to the existing main. A rubber seal provides a watertight joint and electrical insulation between the existing main and the clamp body. AS 4181 nominates Type R clamps for application to rigid pipes such as ductile or grey iron, steel, asbestos cement, copper and reinforced concrete. Type F clamps are for application to flexible pipes such as PVC and glass reinforced thermoplastics (GRP).

15 SURFACE FITTINGS

15.1 PRODUCT SPECIFICATION

WSA PS – 290, WS PS – 291 and WSA PS – 292

15.2 APPLICATION

(a) Access covers and frames for valve pits.

(b) Access covers and frames for stop valves and hydrants.

15.3 DESCRIPTION

Access covers and frames provide access to operate below-ground stop valve spindles and to allow connection of a standpipe to a hydrant. Two types are available depending on location and loading. Class B are for installation in non-trafficable areas and Class D are for installation in roadways. The frame and cover is typically manufactured from ductile or grey cast iron. Class B covers are also provided with an integral frame manufactured from moulded plastic with a ductile iron, or plastic top.

16 JOINTING COMPONENTS

16.1 JOINT SEALS

The long-term performance of joint seals is vital. Seals must retain their dimensional and physical properties, resist microbiological attack and resist degradation by chemically contaminated ground. Elastomeric seals should comply with AS 1646/AS 681.1 and specified as EPDM or SBR. The selection of the elastomeric compound is generally the responsibility of the pipe manufacturer. However, depending on specific environmental conditions, the designer in consultation with the Water Agency may specify the type of elastomeric compound.

AS 1646/ AS 681.1 specifies physical properties as well as methods of test to verify their conformance to the standard.

The synthetic rubbers EPDM and SBR have now almost entirely replaced natural rubber as the preferred seal materials for use in water supply applications.

The design (dimensions, shape, hardness) of the seal is also the pipe or fitting manufacturer's responsibility, subject to the joint conforming to the performance requirements of the product (pipe, valve etc) specification.

Joint seals are usually supplied with the system components and as such do not have a specific product specification. The Water Agency has the option to specify particular types of elastomeric compounds in the purchase specifications for the various pipe materials.

Each joint seal is marked clearly and durably with the nominal size, manufacturer's identification, number of the standard with the type of application and hardness category as a suffix, e.g. AS681-1/WA/50, 3rd party certification mark, quarter and year of manufacturer, and abbreviation of the elastomer type e.g. EDPM. In addition, the purchaser may request additional colour marking. Where this is requested the elastomer type EPDM can be easily identified by a green markings on the face of the seal. For SBR joint seal a blue markings is applied on the face of the seal.

16.2 JOINTING LUBRICANT

Jointing lubricant is required to provide sufficient lubrication to prevent damage to joint seals or surfaces on jointing. There is no specific standard for a jointing lubricant but it is required to have the following characteristics:

(a) Comply with AS/NZS 4020.
(b) Be safe for handling by pipe installers.
(c) Not affect the elastomer or pipe or fitting materials.
(d) Remain an effective lubricant under wet conditions.
(e) Not be hazardous to handle and be able to be applied by hand.
(f) Be completely soluble in water.
(g) Be able to be removed under standard flushing arrangements for commissioning.

Jointing lubricants are supplied with the pipe and pipe seals and are nominated as a specific requirement in the pipeline purchase specifications.

Jointing lubricants should be used by the nominated use-by dates and stored in accordance with the manufacturer's instructions.

16.3 FLANGE GASKETS AND O-RINGS

16.3.1 Product Specification

WSA PS – 312.

16.3.2 Application

Flange gaskets and O-rings should comply with WSA 109.

WSA 109 provides gasket material options together with minimum property requirements and dimensions for both PN16 and PN35 flange gaskets and O-rings. Guidelines for flange assembly are also included.

Appendix C of AS/NZS 4087 Metallic Flanges for Waterworks Purposes provides guidance for the selection of correct jointing requirements for flanges including flange face type, gasket type, gasket thickness and minimum property class of fasteners.

Recommended torques should be sourced from the component manufacturer.

The industry predominantly specifies 3mm thick EPDM flange gaskets for PN16 applications and 1.5mm thick compressed fibre gaskets for PN 35 applications.

There is a wide range of compressed fibre materials available in the market, however not many are suitable for flange gaskets in water supply applications. It is particularly important that PN35 compressed fibre gasket materials meet the material properties specified in WSA 109. A minimum compressibility of 15MPa is considered essential for high pressure applications.

O-rings are generally used with steel flanges.

Grey cast iron flat face flanges should only be jointed to another flat face flange. When jointing to a raised-faced flange the introduction of bending stress into the grey cast iron flange could result in over stressing and brittle fracture

17 UNRESTRAINED MECHANICAL COUPLINGS

17.1 PRODUCT SPECIFICATION

WSA PS – 311.

17.2 DESCRIPTION

A typical unrestrained coupling for variable pipe materials and diameters of the same nominal size rating, refer to Figure 1. For a typical traditional unrestrained “Gibault” type coupling refer to Figure 2.

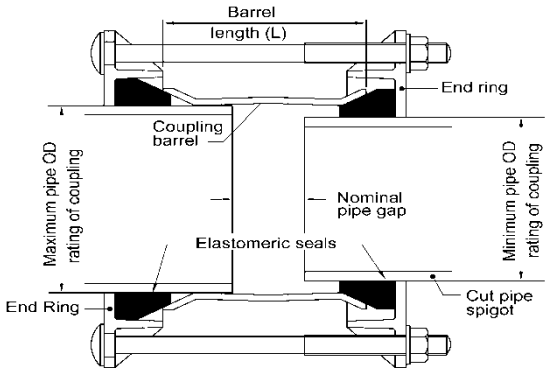


FIGURE 1

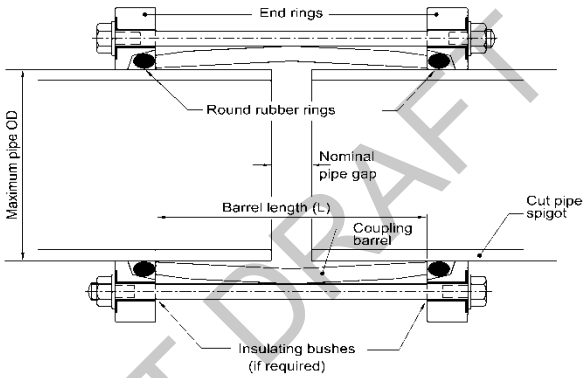


FIGURE 2

A typical bolted unrestrained stepped coupling for same or variable pipe materials of different nominal sizes is shown in Figure 3. A typical bolted unrestrained flange adaptor is shown in Figure 4.

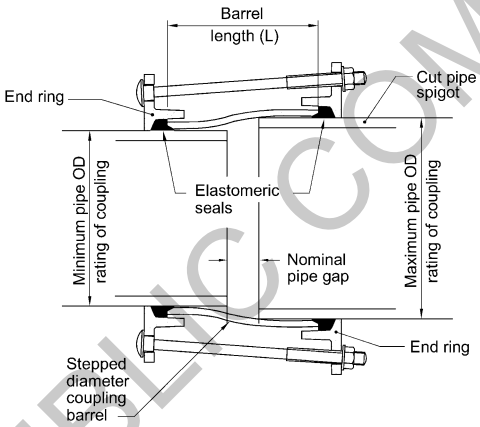


FIGURE 3

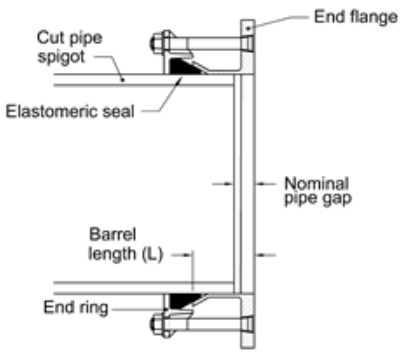


FIGURE 4

Mechanical couplings should conform to AS/NZS 4998 and may be made from a variety of materials but most commonly fusion bonded ductile cast iron or stainless steel with stainless steel bolts. Elastomeric seals are generally EPDM to meet the requirements of AS 1646 in conjunction with AS 681.1 (equivalent to EN 681.1).

Mechanical couplings are generally available for operating pressures up to 1.6 MPa and 3.5 MPa. The majority of these mechanical couplings provides no end restraint and should not be used where this is required. Some stepped couplings can also induce longitudinal forces on the fitting, which can cause movement along the pipe.

17.3 RECOMMENDATIONS ON USE

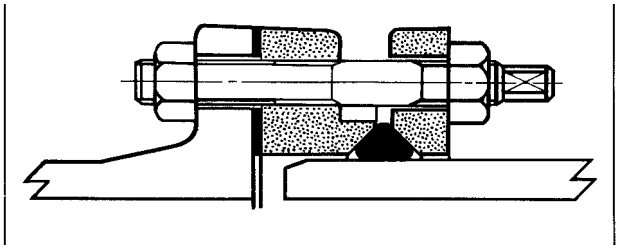
Mechanical couplings may be used to joint pipes and spigots of fittings or valves. They are most commonly used in maintenance applications but may also be used in new installations. The traditional “gibault’ type coupling was widely used to join pipes and spigots of the same diameter. These fittings have now largely been superseded by a range of mechanical couplings that are adaptable to variable mating pipe and spigot diameters. These “variable” couplings are more versatile and can be used to join diameters varying by up to 22 mm.

18 DISMANTLING JOINTS

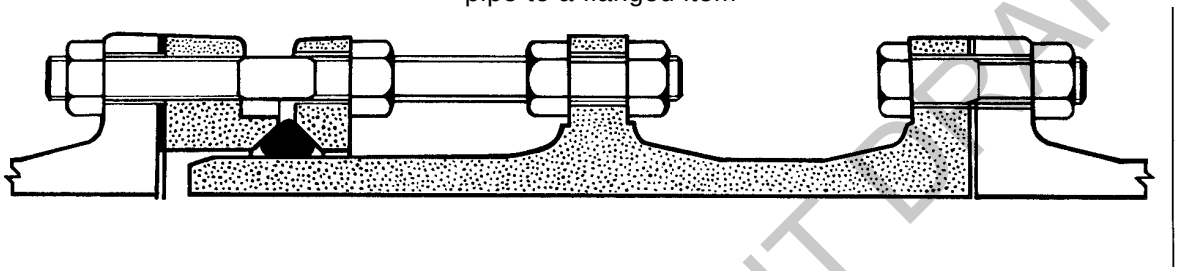
18.1 PRODUCT SPECIFICATION

WSA PS – 284

18.2 DESCRIPTION



Non-thrust type dismantling joint – for use to join a flange-spigot fitting or a flange/spigot length of pipe to a flanged item



Thrust type dismantling joint – for use where axial thrust forces may be present

Dismantling joints (DJ) are generally available in sizes DN 100 – DN 750 and are intended to provide a means to enable a flanged valve, or other critical flanged component, to be easily removed from a pipeline for repair or replacement.

Dismantling joints are designed either to resist thrust or for non-thrust applications at maximum operating pressures of 1.6 MPa and 3.5 MPa.

A non-thrust type DJ consists of two special flanges, a rubber O-ring seal and stainless steel studs and nuts. The two flanges slip over the spigot of an adjoining fitting, usually a flange - spigot connector, which is located approximately 12 mm from the valve flange. The rubber seal is positioned between the two DJ flanges and the studs pass through all three flanges. When the studs are tightened, seals are activated between the DJ and valve flange, then between the two DJ flanges.

Dismantling is carried out by removing or loosening the nuts to allow the DJ flanges to slide along the spigot, so providing a gap between the spigot end and the valve flange.

A thrust type DJ operates in a similar manner except the adjoining fitting, a flange - spigot connector with an integrally cast central flange, is provided. The studs also pass through the central flange to provide thrust restraint in both directions.

DJs for ductile iron pipelines are generally manufactured from polymeric fusion coated ductile iron while dismantling joints for steel pipelines are manufactured from structural or mechanically tested grades of steel with carbon equivalents ≤0.40 and cement mortar lined.

Hot dipped galvanised or stainless steel studs, bolts and nuts are used generally with EPDM elastomeric sealing rings that meet the requirements of AS 1646.

18.3 RECOMMENDATIONS ON USE

Dismantling joints should be installed to provide access to critical flanged pipeline components such as valves, which may need to be replaced or removed for maintenance.

The thrust type design is preferred.

19 CORROSION PROTECTION

19.1 LOOSE FIT POLYETHYLENE SLEEVING

19.1.1 Product Specification

WSA PS – 320.

19.1.2 Description

Polyethylene film was first used as a corrosion protection device for buried cast iron pipes in the USA in the early 1950s; it has proved to be an effective method of controlling corrosion in aggressive soils. The purpose of loose polyethylene sleeving is to prevent contact between the pipeline and adjacent soils, thus providing a non-aggressive environment for the pipeline and minimising corrosion. Moisture may form between the sleeving and the pipe and the free flow of ground water within sleeving is not acceptable. The effectiveness of the sleeving is not impaired by the presence of condensate or small amounts of water that may be trapped within the sleeve.

Polyethylene sleeving is supplied as a “layflat tube” i.e. a tubular form of polyethylene film which has been flattened for handling and storage. Nominal sizing of the layflat tube (DN) relates to the size of pipe for which it will be used. The sleeving is coloured green so as to provide good contrast relative to the (black) external surface of ductile iron so as to facilitate the detection of tears or other damage to in sleeving applied to a pipe or fitting. The specification for polyethylene requires a minimum film thickness of 200 micrometres and covers UV resistance and tear resistance. However, it should not be stored in direct sunlight and requires care during installation to avoid damage. Sleeving should be applied in accordance with AS 3681.

19.1.3 Application

The need for polyethylene sleeving depends on the type of soil, class and diameter of ductile iron pipe, and the required service life of a pipeline. In soils that are aggressive and where either the time or the cost of soil assessment is prohibitive, polyethylene sleeving is the quick and cost effective solution, giving assurance of long term performance. Use of the Linear Polarisation Resistance (LPR) method – a special electro-chemical soil testing technique, quickly determines the aggressivity of the soil by measuring its polarisation resistance.

19.2 TAPE WRAP SYSTEMS

19.2.1 Product Specification

WSA PS 335

WSA PS 336

19.2.2 Description

There is a wide range of tape wrap systems available for the external corrosion protection of metallic components.

Polymeric tapes are typically shop applied to steel pipe fittings and are used for steel pipeline field joints. Petrolatum tapes are typically applied to valves and appurtenances. may be field or shop applied.

Heat-shrinkable coatings are typically applied to steel pipeline field joints or are shop applied to steel pipe fittings.

19.2.3 Reference Standards

These reference Standards apply equally to pipework used in pressure sewers, pumping stations and buried applications in treatment works.

AS 4822 *External field joint coatings for steel pipelines*

Type 1A *Petrolatum tapes for valves and Type 1B Polymeric tapes for field joints).*

Type *1B for Polymeric tapes includes tests for indentation, impact strength, lap shear strength and adhesion between layers*

Type 2A-1 *Heat-shrinkable, cross-linked coatings*

http://www.awwa.org/bookstore

19.2.4 Petrolatum tape systems

Petrolatum tape systems consist of a primer, the petrolatum tape and an over wrap. A mastic filler is also often required to obtain a smooth profile to enable optimum wrapping. These systems when applied correctly provide good protection where limited surface preparation is possible and where complex shapes are involved as it is readily moulded in to the desired configuration.

Petrolatum tape systems are not recommended where cathodic protection is to applied due to their limited dielectric properties when compared to pipe coating materials.

19.2.5 Synthetic tape systems

Synthetic tape systems consist of a wide range of materials form bitumen mastics to butyl mastic with various backing materials. These tape systems require a high level of surface preparation prior to the application of a primer. Profiling mastic or tape is also required to provide a regular surface profile prior to wrapping.

Synthetic tape systems are recommended for pipe joint reinstatement rather than more complex fittings and are suitable for use on cathodically protected pipelines.

19.2.6 Heat shrink sleeves

Heat shrink sleeves are used to provide corrosion protection to pipe joints. They have limited scope to accommodate any changes in geometry and are limited to use on welded steel pipe joints. A high level of surface preparation followed by preheating and priming is required for optimum performance.

The use of any tape systems is generally not recommended in conjunction with stainless steel fittings.

19.3 FURTHER INFORMATION

AWWA M11 *Steel Pipe—A Guide for Design and Installation*

AWWA M27 *External Corrosion—Introduction to Chemistry and Control*

AWWA M41 *Ductile-Iron Pipe and Fittings*

http://www.awwa.org/bookstore

WATER SERVICES
ASSOCIATION OF AUSTRALIA

PART: 2 CONFORMITY ASSESSMENT OF PRODUCTS - OPTIONS AND SELECTION FOR THE WATER INDUSTRY

Product and Materials Information and Guidance
Supplement to the Water Supply Code of Australia
WSA 03–2011

CONTENTS

20 STANDARDS AND CONFORMITY ASSESSMENT

20.1 PURPOSE

The purpose of this Part is to

(a) provide additional information on product standards and specifications for products and materials.

(b) provide information regarding.

20.2 PRODUCT AND MATERIAL STANDARDS AND SPECIFICATIONS

20.2.1 Product Standard

A product Standard is a document prepared nationally, or internationally by a recognised Standards body (e.g Standards Australia, International Organisation for Standardisation (ISO), European Committee for Standardisation (CEN) or a recognised water industry body such as PIPA, WRc (UK) or AWWA (USA)). A product standard typically specifies attributes such as dimensions, materials of construction, performance requirements, production and factory quality control and testing requirements and serves as the basis for the manufacture and third-party certification of a product.

The long-term performance of pipeline systems is critical to the operating efficiency of water agencies. Product Standards play a crucial role in helping water agencies to ensure that assets are appropriately designed, constructed, maintained and rehabilitated in accordance with good risk management practices.

Most products used in the water industry are covered by an appropriate Standard. Standards may be purchased from a variety of sources including Standards Australia, Techstreet or SAI Global.

Where a suitable product standard is not available for a particular product WSAA may prepare and publish a WSAA Water Industry Standard pending publication of a suitable Australian Standard. Water Industry product standards are available from the WSAA website.

In some cases, more than one product Standard may be available for a particular product type. It is the responsibility of the Water Agency to nominate the appropriate and acceptable Standard for all products.

20.2.2 Product specifications

The purpose of product specifications is to allow purchasers to define their requirements to suppliers. A product specification generally references the applicable product Standard together with quality assurance, conformance requirements and options provided by the product standard e.g. protective coatings, pressure class, stiffness class, joint type etc.

WSAA maintains a suite of product specifications for water industry strategic products that are freely available from the WSAA website.

As specifications are subject to change, WSAA product specifications contain a document history section to allow users to ensure that the status of the specification is current before use.

In some cases, more than one WSAA product specification is available for a particular product type. e.g. Australian Standard vs ISO ductile iron pipes. It is the responsibility of the Water Agency to nominate the appropriate and acceptable product specification.

WSAA product standards and product specifications are published by the Water Services Association of Australia Inc. on the understanding that:

The Water Services Association of Australia Inc. and individual contributors are not responsible for the results of any action taken on the basis of information in the WSAA product standards and/or purchase specifications, nor any errors or omissions.

The Water Services Association of Australia Inc. and individual contributors disclaim all and any liability to any person in respect of anything, and the consequences of anything, done or omitted to be done by a person in reliance upon the whole or any part of a WSAA Water Industry Standard or Product Specification.

It should also be noted that WSAA Product Specifications have no reference to any contractual requirements or general terms and conditions that may be required by purchasers. Such contract details are the responsibility of the individual purchaser.

20.3 CONFORMITY ASSESSMENT

Conformity assessment is the process undertaken to demonstrate conformance to a product Standard. The means for demonstrating conformance involves completion of type tests and adherence to an ongoing minimum sampling and testing frequency plan. These requirements are defined in the Standard.

Assessment methods include ISO 9001 Quality Management System Certification, Product Certification, Second Party Verification, Supplier Declaration of Conformance and WSAA Appraisal. One or more of these methods may be selected.

The objective of conformity assessment is to reduce the consequences and associated costs of non-conforming product. However, the cost of conformity assessment should be balanced against the tangible and other benefits arising from its adoption.

Historically, Australian Standards included an Appendix that specified the use of a product certification scheme to demonstrate conformity with the Standard. Standards Australia has now determined that the choice of using product certification rests with the purchaser and revised Standards no longer include those requirements. Accordingly, it is now imperative that water agencies product specifications and procurement contracts clearly specify how product conformity is to be demonstrated.

20.3.1 Assessment Methods

There are a number of methods to undertake conformity assessment:

20.3.1.1 Quality Management System certification

ISO 9001 sets out the criteria for a manufacturer to maintain a Quality Management System. To enable the system to be certified a Conformity Assessment Body (CAB) audits the manufacturers quality systems on an annual basis to ensure compliance.

ISO 9001 certification is intended to provide confidence in a manufacturers quality system in relation to its specific manufacturing capability however does provide assurance of conformity of a particular product to a Standard.

ISO 9001 certification is generally specified by purchasers as a pre-requisite for product manufacturers.

20.3.1.2 Product Certification

Product certification is an impartial third-party attestation (See Clause 20.3.1.3) of product conformance to nominated Standard(s).

There are different levels of product certification from Type 1 to Type 6 defined in ISO IEC 17067. Type 5 is the most specified product certification requirement for the Australian water industry, although Type 1 and Type 3 is also sometimes specified, depending on the assessed risk of product non-conformance. Risk = consequence of failure x likelihood of failure

Type 1 requires type testing only. Type 3 requires type testing followed by periodic testing of samples from the factory. Type 5 requires type testing followed by periodic testing of samples from the factory and annual factory surveillance audits of the manufacturing process and management system.

Product certification is undertaken by a Conformity Assessment Body (CAB) accredited by a signatory member of the International Accreditation Forum (IAF) Multilateral Arrangement (MLA). In Australia, the appropriate signatory member of the IAF MLA is the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

See WSAA Technical Note WSA TN-08 for more details relating to product certification requirements. WSA TN-08 may be referenced by water agencies in regulatory and contractual agreements that involve the supply of products.

20.3.1.3 Third-party Verification

Third-party verification means that an independent organisation has reviewed the manufacturing process of a product and has independently determined that the final product complies with specific standards

20.3.1.4 Second Party Verification

Second party verification involves the purchaser, or its agent, auditing the supplier's manufacturing operations or inspecting finished product prior to release. For complex products, a hold point in manufacture may be specified whereby the purchaser audits or inspects the product prior to authorising continuation.

20.3.1.5 Supplier's Declaration of Conformance

A supplier's declaration of conformance states that the product or material complies with the specification quoted in the order or alternatively document any variations. The "supplier" may be the manufacturer or retailer of the product, depending on the distribution chain and purchasing transaction.

The Competition and Consumer Act 2010 provides that a manufacturer's promotion or response to a purchaser's enquiry must not give false or misleading information.

Product certification does not permit a manufacturer or supplier to abrogate those obligations.

20.3.1.6 WSAA Appraisal

The WSAA Product Appraisal program is a voluntary scheme that provides a single coordinated appraisal of a product's conformity to the relevant specification. The Appraisal includes an assessment of design, attributes, performance and suitability of a product and verifies compliance with product certification and quality assurance requirements.

A WSAA Appraisal is not a product approval. Each water agency is responsible for authorisation of products for use within their area.

20.3.2 Testing Laboratories

Where tests are completed to demonstrate product conformity testing and calibration laboratories are required to be accredited to AS/NZS ISO/IEC 17025 by a signatory member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). The scope of the laboratory accreditation shall include the competencies and capabilities required to execute the product testing and calibration work to be undertaken. In Australia, the appropriate signatory member of ILAC MRA is the National Association of Testing Authorities (NATA).

APPENDIX A

ADDITIONAL INFORMATION AND DEFINITIONS

(Informative)

A1 BEST ENVIRONMENTAL PRACTICE FOR PVC PIPES AND FITTINGS

In 2010, following an extensive review by an Expert Reference Panel, the Green Building Council of Australia (GBCA) published Green Star PVC materials credits in the Green Star rating tool. This established the criteria defining BEP PVC manufacturing from raw materials and production through use to end-of-life, recycling, and disposal.

At the time, the BEP requirements were included in the relevant Australian and New Zealand PVC product Standards. This allowed for both product certification and consistent BEP identification marking on PVC pipe and fittings products.

The requirements for BEP PVC have been consolidated in AS/NZS 5395, which can be referenced by the Australian Standards for PVC pipes and fittings.

Product/manufacturer declarations are necessary elements of the compliance process for BEP PVC. Whilst some requirements can be met by testing, there are others that are supported by supplier statements of compliance - for example, confirming the type of chlorine or vinyl chloride monomer manufacturing process employed.

Some organisations may require BEP PVC certification by an accredited third-party Conformity Assessment Body (CAB) registered with and accredited by the Joint Accreditation System of Australia and New Zealand.

AS/NZS 5395 may be used for demonstrating conformity to enable this certification.

NOTE : The background of the development of the Best Practice Guidelines for Life Cycle of PVC Building Products is given in PIPA POP106 Verification Guidance for Best Environmental Practice PVC Pipe and Fittings.

A2 FACTORS INFLUENCING SELECTION OF CONFORMITY ASSESSMENT OPTIONS

In determining the default conformity assessment requirement for a specific product, the following issues are relevant:

(a) Likelihood of manufacturing process causing a product non-conformance.

(b) Likelihood of failure of the pipeline system from a product non-conformance.

(c) Consequences of product failure.

(d) The product specification.

(e) Project magnitude / management.

(f) Innovation

RISK = CONSEQUENCE OF FAILURE x LIKELIHOOD OF FAILURE

A2.1 Likelihood of manufacturing non-conformance

Variability of product quality and the reliability of conformity assessment options are influenced by the means of production.

Where the volume of production is high, sampling plans to AS 1199 or AS 2490 may be used. Statistical sampling may not be applicable to low volume production processes or jobbing fabrications, in which case focus on process and /or personnel qualification, together with type testing, may be appropriate.

A2.2 Likelihood of failure of pipeline system from a product non-conformance

The likelihood of failure of a pipeline system from a product non-conformance depends on the nature of the non-conformance. A non-conformance of a pipe to a specified internal diameter would have little likelihood of causing to failure of a pipeline system. A non-conformance to a strength or stiffness requirement of a pipe could cause failure with low to high consequence depending on how close the particular loading was to the failure limit for the pipe / support selection i.e. standard stiffness small diameter PVC would have excess loading capacity for most installations. A non-conformance to a specified external diameter could affect joint sealing and may have a moderate to high likelihood of causing failure.

A2.3 Consequences of failure

A higher level of assurance of product compliance is required where the expected detrimental consequences of failure resulting from any non-conformance are high. The objective of conformity assessment is to reduce the likelihood of non-conformance and subsequent failure due to product design and/or manufacturing deficiency.

A2.4 Product specification

The product specification must be written such that it clearly specifies essential performance requirements, attributes and test methods. These must be specified in a manner that can be measured and objectively verified by the manufacturer and certification body.

A2.5 Project magnitude / management

For contractual and other reasons, a major or special project may require specific quality assurance provisions in lieu of the default conformity assessment options stipulated in this WSA 03 and WSAA product specifications.

A2.6 Innovative products

WSA 03 does not nominate specifications for innovative products, even though they may have existing certification to a national or industry standard. For products undergoing trial evaluations, a Water Agency may be prepared to accept or manage a (temporary) higher level of risk.

Each agency should be responsible for stating its own conformity assessment requirements for innovative products.

A3 SELECTING THE CONFORMITY ASSESSMENT OPTION

Selection of the appropriate conformity assessment option for products is made after considering the factors outlined above.

A3.1 Type 1

Type 1 product certification should be nominated where:

(a) the likelihood of the manufacturing process causing a non-conformance is low, e.g. fully automated manufacturing and control, and manufacturing quantity is small; and/or

(b) the consequences of failure are low; and/or

(c) the likelihood of failure is low.

Examples of products for which Type 1 product certification is applicable are non-detectable marking tapes and maintenance hole covers in non-trafficable areas.

For a product normally used in situations where failure would result in moderate consequences of failure or where the likelihood of failure is moderate, Type 1 may be specified in conjunction with an ISO 9001 quality management system certification if Type 3 is not practicable.

A3.2 Type 3

Type 3 product certification should be nominated where:

(a) the likelihood of manufacturing processes causing a non-conformance is moderate to high and statistical sampling plans are not practicable e.g. a minor degree of manual input to manufacturing; and/or

(b) the consequences of failure are moderate; and/or

(c) the likelihood of failure is moderate.

Examples of products for which Type 3 product certification is applicable are valve chambers and maintenance hole covers in trafficable areas.

The frequency of CAB surveillance audits should be increased to match an increase in the likelihood of manufacturing non-conformances or increased risk of failure. Type 3 may be specified in conjunction with an ISO 9001 quality management system certification if Type 5 is not practicable.

A3.3 Type 5

Type 5 product certification should be nominated where:

(a) the likelihood of manufacturing processes causing non-conformance on a large scale and with consistent repetition is high, i.e. mass produced product; and /or

(b) the consequences of failure are high; and/or

(c) the likelihood of failure is high.

Examples of products for which Type 5 product certification is applicable are certain flow control valves and buried pipes and fittings (excepting special low volume products).

For pipes made by batch processes or complex or speciality products, Types 1 or 3 plus ISO 9001 quality management system certification may alternatively be specified.

Type 5 is specified where the risk of failure is high. It is commonly adopted for mass-produced, critical products such as pipes, fittings and valves. However, it may not be practicable for batch processes or complex or speciality products; for these, Types 1 or 3 plus ISO 9001 quality management system certification may be more appropriate.

A3.4 ISO 9001 quality management system certification

ISO 9001 quality management system certification is generally nominated where the expected consequence and likelihood of non-conformance is moderate or, for high risk products, where product certification is not practicable. This is typically where there may be many design changes (e.g. concrete) or for low volume, speciality products (e.g. fabricated GRP fittings) or where the specification does not adequately specify objective performance criteria.

Where WSAA Product Specifications mandates an ISO 9001 quality management system certification as a means of assuring product quality, the scope of the certification is required to be focused and relevant to the product. Typically this requires the certificate issued by the CAB to specifically state the product type or process by which the product is produced (e.g. manufacture and supply of concrete, to AS 1379.)

An ISO 9001 management system certification generally does not reference a product standard or specification; however, for the above example, reference to AS 1379 in the scope is appropriate since AS 1379 is process oriented.

Purchasers are expected to seek the supplier's declaration that product supplied against a purchase order complies with the nominated specification.

A3.6 Second party verification

A salient objective of third party (CABs) system or product certification is to minimise the intervention of second parties (purchasers) in the supplier's production operations. Second party auditing at the suppliers works may, however, be appropriate for low volume fabricated items and may be used in conjunction with ISO 9001 management system certification. This option may be an overriding option for the purchaser should product quality problems be identified during the supply. The Water Agency or Designer may determine the need for second party verification and specify this in the project contract documentation.

A4 THE STANDARDS AND CONFORMANCE INFRASTRUCTURE OF AUSTRALIA

In Australia, the following bodies make up the standards and conformance infrastructure:

(a) The National Measurement Institute (NMI), which maintains and disseminates the national standard of physical measurement and ensures Australia's measurement standards are at a level comparable to those of its major trading partners.

(b) Standards Australia, an independent, not-for-profit national standards development body.

(c) The National Association of Testing Authorities (NATA), an independent, not-for-profit national accreditor of laboratories and testing facilities and inspection bodies.

(d) The Joint Accreditation System of Australia and New Zealand (JAS-ANZ), a bi-national government accreditation authority for certification and inspection bodies and other related bodies.

Each component of Australia's standards and conformance infrastructure has a key role to play, and the resulting enhancement will contribute to greater economic prosperity for Australia and the health, safety, and wellbeing of all Australians.

For further information on Australian standards an conformance infrastructure in the regional and international framework refer to https://www.industry.gov.au/trade/australias-standards-and-conformance-infrastructure.

A4.2 National Measurement Institute

The NMI is responsible for Australia's national infrastructure in terms of physical, chemical, biological, and legal measurements. Under the National Measurement Act 1960, the NMI is responsible for coordinating Australia's national measurement system and for establishing, maintaining, and realising Australia's units and standards of measurement which, in turn, provide measurement traceability.

More information about the NMI is available on the following website: www.measurement.gov.au

A4.3 Standards Australia

Standards Australia is recognised by governments as Australia's peak voluntary standards body. It coordinates standards development activities (referred to as 'standardisation'), develops internationally – aligned Australian Standards for public benefit and in the national interest, and facilitates the accreditation of other standards development organisations.

From the perspective of the construction industry, conformity assessment and the standards and conformance infrastructure bodies that underpin it – provide a high degree of confidence in the products used and the services delivered.

More information about SA is available on the following website: www.standards.org.au

A4.4 Joint Accreditation System of Australia and New Zealand

JAS–ANZ is the government–appointed accreditation body for Australia and New Zealand, which is responsible and inspections. JAS–ANZ accreditation is built upon a competency-based assessment process and provides confidence in CAB's capability to deliver reliable certification and inspection services.

More information about JAS-ANZ is available on the following website: www.jas–anz.org

A4.5 National Association of Testing Authorities

NATA is recognised by governments as Australia's national authority for the accreditation of laboratories and reference material producers. NATA is also recognised as a peak body for the accreditation of inspection bodies and proficiency testing scheme providers. NATA accreditation is based on a process for peer assessment of a facility's competence and its capability to produce reliable data from tests, measurements, inspections and related services.

NATA provides specific guidance on working with NATA accredited building product laboratories in the form of Industry User Guide No 4 for building products.

More information about NATA is available on the following website: www.nata.com.au.

A5 INNOVATIVE PRODUCTS AND MATERIALS

Innovative products are deemed to be those for which a recorded history of successful performance under a range of Australian installation and operating conditions is not available and for which a default or alternative specification is not included in WSAA Codes.

A6 RESPONSBILITIES

A6.1 Water Agency

Each Water Agency should be responsible for nominating variations to the default product specifications and conformity assessment requirements.

A6.2 Designer

Except where a project or Agency agreement or specification states otherwise, the Designer should be deemed responsible for selecting the most appropriate / suitable products. In some cases, products may have to be authorised by the Water Agency.

Product requirements, including attributes such as protective coating, pressure and/or stiffness class, joint type etc should be stated in the Design Drawings and/or Specification.

A6.3 Constructor

Constructors should use only such products that are nominated in the Specification and Design Drawings.

A6.4 Purchaser

Unless otherwise specified by the Water Agency, the default product specifications listed on the WSAA website should be used for specifying product requirements.

The purchaser should be responsible for obtaining the supplier's declaration that products conform to purchase specifications.

The Constructor is frequently the “purchaser” of products.

Where third party certification is specified, the conformity assessment body is deemed to be responsible for licensing the manufacturer (or the Licensee) to use the certification body’s mark and ensuring correct use of the mark.

The supplier may or may not be the manufacturer of the product.

Melbourne Office
Wurundjeri Country
Level 8, Suite 8.02
401 Docklands Drive
Docklands VIC 3008

Sydney Office
Gadigal Country
Level 6 75 Elizabeth Street
Sydney NSW 2000
GPO Box 915
Sydney NSW 2001

P +61 (0) 3 8605 7600
email: info@wsaa.asn.au

www.wsaa.asn.au