

SOUTH AUSTRALIAN WATER CORPORATION

TECHNICAL GUIDELINE

**ALLOWABLE PIPE
SIZE, CLASS AND MATERIALS
FOR WATER MAINS**



Issued by: Manager Asset Management

Issue Date: September 2011

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MAJOR CHANGES INCORPORATED IN THE SEPTEMBER 2011 EDITION

The following lists the major changes to the April 2007 edition of TG 105, which have been incorporated in this edition:

1. First Edition.
2. Contact details amended September 2011.

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Section 1: Purpose

To ensure that all water supply pipes installed in SA Water's infrastructure achieve the required economic life span, of 100 years, it is critical that the materials and characteristics of the pipe types be appropriate to that aim.

To achieve this, a consistent methodology for pipeline design criteria should be adopted to ensure the appropriate pipe is selected for each application.

Section 2: General

SA Water has for operational and maintenance purposes determined all acceptable pipe material types and their minimum Allowable Pressure Rating (PN). In addition, the range of Allowable Pipe Diameters for pipes used in various water supply applications has also been specified.

This document overrides all other instructions issued on the use of pipe materials installed in SA Water's water supply networks and is the prime document regarding the selection and use of pipe material within the networks.

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

2.1 ADDITIONAL INFORMATION

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

Section 3: Background

3.1 ALLOWABLE PIPE SIZES

SA Water have standardised on the following nominal pipe sizes for new installations, DN 63 (Polyethylene pipe only), DN 100, DN 150, DN 200, DN 250, DN 300, DN 375, DN 450, DN 500, DN 600, DN 750 as they are readily available in one or more pipe systems. Above this size pipe design should be based on hydraulic requirements and matching them to MSCL pipe manufacturer's standard production schedules.

Polyethylene (PE) pipe (which is specified on the true outside diameter rather than a nominal inside diameter) has an equivalent size range as follows:

Standard Pipe Size	PE Pipe Equivalent
DN 100	125 mm OD
DN150	180 mm OD
DN200	250 mm OD
DN250	315 mm OD
DN300	400 mm OD

PE pipe is also available in 25 mm, 32 mm, 40 mm, 50 mm and 63 mm some of which are currently being used for property service connections plus 90 mm, 110 mm, and 160 mm sizes which may be considered for country supply situations where a size for size replacement option is required. (See Appendix B)

3.2 ALLOWABLE PIPE MATERIALS

The following pipe materials have been assessed as acceptable for use within SA Water's water supply network:

- Ductile Iron Cement Lined (DICL)
- Polyvinylchloride – Modified (PVC-M) Series 2
- Polyvinylchloride – Oriented (PVC-O) Series 2
- Polyvinylchloride – Unplastisised (PVC-U) Series 2
- Polyethylene – (PE) Material types 80 (PE80) and 100 (PE100)
- Mild Steel Cement Lined (MSCL) (Sintacote external coating)
- Copper

The preferred pipe material applications are as follows:

- Water Mains >DN100 PVC-M, PVC-O, DICL, PE and MSCL
- Water Mains <DN100 PE with Mechanical couplings
- Property Connections < DN100 PE with Mechanical couplings

Full details of allowable materials, pipe sizes and pressure ratings for specific applications are detailed in Appendix A.

3.3 ALLOWABLE PIPE PRESSURE RATING (PN)

SA Water has for operational and maintenance purposes determined the minimum Allowable Pressure Rating (PN) and the corresponding range of Allowable Pipe Diameters for pipes used in SA Water's water supply network.

The water industry typically require 100+ years from new mains. The type of material and pressure rating (PN) can have an effect on pipe life and while on the surface a lower class pipe may appear to meet the hydraulic requirements there are other factors which need to be considered to ensure the desired asset life is achieved.

The philosophy of using a class of pipe at or just above the operating pressures is one which is not adopted by SAW and most other water agencies. The reasons for this are based on the manufacturer's estimated

design life of the pipe and the methodology used to obtain this data. For example, the design life of all plastic pipes is based on the laboratory testing of pipe sections over extended periods of time to ensure the long term creep of the pipe will not cause the pipe to fail prematurely. This laboratory testing is carried out in ideal conditions with pipe which is in its optimum condition. While a design factor or safety factor is applied during the design of the pipe wall dimensions, (design factor can vary from 1.25 to 2.1 depending on the type of plastic) it does not necessarily take into account all of the other aspects which can impact on a pipe during its service life. Some of these aspects can include, damage to pipe during installation, soil loads through poor compaction, the influence of tapping bands etc.

As an example, SA Water installed PN6 PVC pipe as sewer rising mains, on the basis of the very low heads involved, about 15 years ago and these mains are now failing and have to be replaced as the design did not take into account the effects of fatigue.

Laying of PN9 and lower class pipes with their inherently thinner pipe wall requires additional care and supervision to prevent the pipe exceeding the allowable pipe ovality limits. Excessive ovality of the pipe creates the potential for pipe collapse as well as future maintenance problems when repairing/replacing sections of pipe. The cost of the extra work and testing involved in laying and compacting around the pipe would be equal to or greater than the savings made by purchasing lower class pipe. Class \leq PN 9 PVC pipe is generally not recommended for full vacuum situations especially where laying conditions may be less than optimal.

Because of these issues, SA Water requires the use of PN 16 in general main laying applications.. For larger project based applications where the Maximum Operating Pressure is low (<600 kPa) and there is a fixed supply pressure, SA Water Technical staff may, at their discretion, authorise the use of a lesser class of pipe.

One additional benefit of using the higher pressure pipe is that in the future, where the pipe capacity is insufficient the supply can be increased by pump boosting. This option can not be considered where the main is already operating at or near its recommended maximum allowable operating pressure.

Note:- PVC pipe manufacturers produce pipes in classes PN 6 and PN 9 primarily for the Irrigation Industry who only expect a pipe life of 25 years and purchase mainly on price. PVC pipes in this range are primarily manufactured as Series 1 (ISO size) pipe which is commonly solvent welded and not permitted for SA Water's water main infrastructure.

In the case of DICL pipe it is acknowledged that both PN 20 and PN 35 are manufactured. PN 20 is only manufactured in sizes DN225 and greater and has a thinner wall thickness than PN35 pipe. PN35 has however been specified for all DICL applications. This is not for pressure considerations but it is for long term resistance to corrosion due to the thicker wall of the pipe. PN 35 pipe is fully compatible with all standard fittings and unless there are specific pressure related requirements, standard PN 16 fittings and flanges complying with AS/NZS 2280 and AS 4087 are to be used with the PN 35 pipe except where a high pressure installation is adopted in which case PN35 fittings are to be used.

3.4 MINIMUM ALLOWABLE MAINS SIZES

WSAA Water Supply Code of Australia specifies a **minimum** diameter of DN100 for all water supply systems which incorporates a fire service (excluding cul-de-sacs) and allows DN63 PE for mains in cul-de-sacs serviced by fire hydrants on adjacent mains.

The draft WSAA Dual Water Supply Code of Australia specifies a **minimum** of DN100 for the water supply system which incorporates the fire service (excluding cul-de-sacs) and DN40 for the supply which does not include provision for the fire service.

Note :- *The DN values shown without reference to a pipe material (eg PE) refer to the inside diameters of the pipe while the DN marked PE etc are the external diameters. See comparison table in Appendix C.*

DN 25 PE pipe DN 40 PE pipe and DN 63 PE pipe are commonly used for property connections main to meter.

The following pipe sizes and materials have been assessed as the minimum acceptable for use within SA Water's water supply network:

Water Mains with Fire Fighting Capability

- DN100 equivalent pipe

Water Mains with no Fire Fighting Capability

- DN63 PE (or other DN50 equivalent) pipe in cul-de-sacs which must be able to be covered for fire emergencies by hydrants on adjacent mains.
- Small diameter country lands mains (eg DN63 or DN90 PE) are not considered to have fire fighting capability. Although fire plugs are provided on these mains they are primarily for filling emergency services water tankers and are not designed to be used for fighting fires directly from the main. The statutory obligation remains to fix fire plugs on these mains. They are also used for operational purposes eg releasing air from the main.

Section 4: Responsibilities

The personnel responsible for implementing these guidelines include:

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

SECTION 5: Further Information

For further information concerning this document, contact:

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SA Water Asset Management
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SECTION 6 – Referenced Documents

WSAA Codes

WSA 01 Polyethylene code of Australia
WSA 03 Water Supply Code of Australia

Australian Standards

AS 1432: Copper tubes for plumbing, gas fitting and drainage applications
AS/NZS 1477: PVC(-U) pipes and fittings for pressure applications
AS 1579: Arc-welded steel pipes and fittings for water and waste-water
AS/NZS 2280: Ductile iron pipes and fittings
AS/NZS 4130: Polyethylene (PE) pipes for pressure applications
AS/NZS 4131: Polyethylene (PE) compounds for pressure pipes and fittings
AS/NZS 4441(Int): Oriented PVC (PVC-O) pipes for pressure applications
AS/NZS 4765(Int): Modified PVC (PVC-M) pipes for pressure applications

SA Water References:

Water Supply Construction Manual – Authorised Items

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

Appendix A: Allowable Pipe Sizes and Pressure Rating for Water Supply Network

Pipe Material	Authorised Sizes DN #	Minimum Allowable Pressure (PN)		Remarks
		Standard Installations	Specific Project Areas *	
DICL	100 – 750	PN35	PN35	Rubber Ring Joint. Loose sleeve Polyethylene and backfill sand to TS 4 required for all applications. Use PN 16 fittings unless high pressure piping required
PVC-M	100 - 450	PN16	PN12	PVC-U being phased out Only Series 2, PVC pipe with Rubber Ring Joints are approved by SA Water. For PVC-O, material classes 400, 450 and 500 are authorised
PVC-O	100 – 375	PN16	PN16 DN 375 PN 12.5 class 400	
PVC-U	100 - 375	PN16	PN12	
PE (PE80/100) Note: Based on PE100 as this is becoming industry standard	25 - 110	PN16	PN12.5	Using mechanical couplings
	125 - 355	PN16	PN12.5	Using electro-fusion couplings or butt welding**
	400 - 800	PN16	PN12.5	Using butt welded connections**
MSCL	300 – 2 000	To suit design application		Welded or rubber ring joints (Sintakote)
Copper	20 - 80	Type A	Type B	Mechanical couplings

* Areas must be approved by SA Water.

** Only to be carried out by trained and accredited PE welders, approved by SA Water

*** Temperature and Cyclic loading de-rating needs to be considered for all plastic pipes

PE and MSCL diameters relate to the OD of the pipe. Other pipe diameters relate to the ID of the pipe

Appendix B: Preferred Size and Material for Mains & Meters

B1 MAINS

The following table indicates the current preferred replacement pipe size and material for mains replacement in SA Water's water infrastructure network. Note A hydraulic analysis of the current and future water system requirements must be undertaken prior to any main replacement.


Current size (ID) (any material)	Metro Area and Towns (DN)	Country Lands (DN)
50 mm	63 PE Mechanical Coupling	63 PE Mechanical Coupling**
80 mm	90 PE Mechanical Coupling** or 100 PVC* (where fire fighting capability is required)	90 PE Mechanical Coupling**
100 mm	100 PVC *	125 PE Electro-fusion Coupling * or 110 PE Mechanical Coupling ** or 100PVC
150 mm	150 PVC	180 PE Electro- fusion coupling or butt fusion welding, or 150 PVC
200 – 250 mm	200 – 250 PVC	200 – 250 PVC
300 – 750 mm	300 – 750 DICL	300 – 750 DICL
> 750 mm	Same diameter in MSCL	same diameter in MSCL

* provides minimum direct fire fighting requirements of 20 m head.

** provides water supply for tankers, but not necessarily enough for directly fighting fires

The following issues should be considered before commencing any replacement project:

- 50 – 90 mm pipes replaced with PE (PN12.5)
- 80 - 100 mm pipes in country lands may be replaced with 110 PE (PN 16) which will provide water for filling tankers for fire fighting purposes, but not necessarily enough for directly fighting fires
- 100 – 250 mm pipe replaced with PVC (O or M) – These materials are the new generation PVC pipe and have a similar cost structure.
- PVC-O is better in fatigue and cyclic loading situations (currently under review)
- 300 – 750 mm pipe replaced with DICL
- >750 mm pipe replaced with MSCL – RRJ pipe with “Sintacote” external coating.
- In some situations DICL or MSCL pipe in smaller diameters may be required for specific applications ie high pressure applications and where high traffic loads and low cover
- For large pipe purchases competitive tendering may change the pipe size - pipe material selection.
- Low cost PE installations eg narrow trench and plough-in are allowable for country mains applications provided the installation is in accordance with low cost mains guidelines.

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SERVICE CONNECTIONS

The following pipe material and sizes are to be used on main to meter service connections based on the maximum allowable flow through the respective meters:

- | | |
|--------------------------|---------------|
| • 20 mm and 25 mm meters | 25 mm PE pipe |
| • 40 mm meters | 40 mm PE pipe |
| • 50 mm meters | 63 mm PE pipe |

Copper has been used as a service connection material for many years, but it is no longer a preferred pipe material because of the potential for galvanic corrosion between the copper and CI and DI pipe and fittings.

Copper pipe may still be used for specific applications, but only where it has been specifically specified by the designer eg. for high pressures applications.

Appendix C: Equivalent Pipe Sizes for Commonly Used Pipe Materials

Pipe Size DN	COPPER, PVC and DICI Pipes		POLYETHYLENE Pipes			
	Commonly Specified Water Pipe Materials and Sizes		Equivalent PE Pipe Size, Pressure Class And Compound Type			
	Material and Pressure class Copper-Type A PVC-M-PN 12/16 DICI-PN 20/35	Mean ID mm	PE Pipe size (pipe OD) DN	Mean ID mm		Pressure class PN
				Compound PE80B	Compound PE100	
20	Copper	16	25	20	21	12.5
				19	20	16
25	Copper	22	32	26	27	12.5
				24	26	16
32	Copper	29	40	32	34	12.5
				30	33	16
40	Copper	35	50	41	42	12.5
				39	41	16
50	Copper	48	63	51	53	12.5
				48	51	16
65	Copper	60	90	73	76	12.5
				69	73	16
80	Copper	72	90	73	76	12.5
				69	73	16
	*		110	90	94	12.5
				85	90	16
100	PVC-O – PN16 (Classes 450/500)	114/115	125	101	106	12.5
	PVC-M - PN 12/16	113/110		96	101	16
	DICI – PN 35	102				
	*		160	130	136	12.5
				123	130	16
150	PVC-O – PN16 (Classes 450/500)	167/168	180	146	153	12.5
	PVC-M - PN 12/16	164/160		138	146	16
	DICI – PN 35	157				

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Pipe Size DN	COPPER, PVC and DICL Pipes		POLYETHYLENE Pipes			
	Commonly Specified Water Pipe Materials and Sizes		Equivalent PE Pipe Size, Pressure Class And Compound Type			
	Material and Pressure class Copper-Type A PVC-M-PN 12/16 DICL-PN 20/35	Mean ID mm	Pipe size (pipe OD) DN	Mean ID mm		Pressure class PN
				Compound PE80B	Compound PE100	
200	PVC-O – PN16 (Classes 450/500)	218/220	250	203	212	12.5
	PVC-M - PN 12/16	215/210		192	203	16
	DICL – PN 35	212				
250	PVC-O – PN16 (Classes 450/500)	269/271	315	256	268	12.5
	PVC-M - PN 12/16	265/259		242	256	16
	DICL – PN 35	265				
300	PVC-O – PN16 (Classes 450/500)	325/327	355	289	302	12.5
	PVC-M - PN 12/16	320/312		273	289	16
	DICL – PN 35	322				
375	PVC-O – PN16 (Classes 450/500)	401/404	450	366	382	12.5
	PVC-M - PN 12/16	395/386		346	366	16
	DICL – PN 35	401				

* No equivalent pipe size

PE pipe is available in coils for sizes DN 25 – DN 125