

TWEED SHIRE COUNCIL

**MECHANICAL
DESIGN
SPECIFICATION**

ME03

PIPEWORK

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PIPEWORK

ABBREVIATION	INTERPRETATION
ABS	Acrylonitrile Butadiene Styrene
AOP	Allowable Operating Pressure
AS/NZS	Australian / New Zealand Standard
DA	Development Approval
DICL	Ductile Iron Cement Lined
DIEL	Ductile Iron Epoxy Lined
DN	Nominal Diameter
FRC	Fibre Reinforced Concrete
FRP	Fibre Reinforced Plastic
GRP	Glass Reinforced Plastic
KPA	Kilopascal
L/S	Litres per second
MAOP	Maximum Allowable Operating Pressure
MPA	Megapascal
PN	Nominal Pressure Class
PVC	Polyvinylchloride
PVC-M	Polyvinylchloride modified
PVC-O	Polyvinylchloride orientated
PVC-U	Polyvinylchloride unplasticised
RCP	Reinforced Concrete Pipe
RRJ	Rubber Ring Joint

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ABBREVIATION	INTERPRETATION
SCL	Steel Cement Lined
SEL	Steel Epoxy Lined
SN	Nominal Stiffness
SS	Stainless Steel
VC	Vitrified Clay
WSAA	Water Services Association of Australia
WS-SPEC	Water Services Specification

1 CITATION

This document is named “Tweed Shire Council, Mechanical Design Specification ME03 - Pipework”

This document has the following functions:

- To relate to and comply with Tweed Shire Council’s Land Development Specifications D11, D12, C401 and C402.
- To nominate the Water Services Association of Australia (WSAA) Codes and associated documents as the general requirements to be met for the Asset Creation process within the Tweed Shire Council Area of jurisdiction.
- To specify parameters, requirements and functions contained within the Codes that Council is to nominate or to amend.
- To specify additional technical and/or administrative matters (that are not otherwise specified within Australian Codes or Standards) pertaining to NSW Government Department of Planning.
- To specify any technical requirements not covered by the Codes.
- To identify materials, solutions and methods permitted by the Codes that are not acceptable to Council.
- To specify preferred options where the Codes provide for several methods to deal with a particular issue.

This document, as a Specification, is based upon compliance with the Sewerage Code of Australia (WSA-02), Water Supply Code of Australia (WSA-03), the Sewage Pumping Station Code of Australia (WSA-04), Vacuum Sewerage Code (WSA 06) and Pressure Sewerage Code of Australia (WSA 07)) and is complimented by the strategic product specifications and technical requirements contained within WS-SPEC National Water Industry Specifications.

WSA-02, WSA-03, WSA-04, WSA-06 and WSA-07 are available from the Water Supply Association of Australia (WSAA), email: info@wsaa.asn.au,

WS-SPEC and Australian Standards are available from the Saiglobal webshop at www.saiglobal.com/shop.

For all design and construction contracts, all alternatives to these specifications will require specific approval by Tweed Shire Council.

2 ORIGIN OF DOCUMENT, COPYRIGHT

This document was originally produced for Tweed Shire Council. This document is copyright to Tweed Shire Council.

3 VERSIONS

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Engineering Services
1.1	Draft for review		10-Sept-2007	
1.2	Draft with upgrades for review	All	18-Aug-2008	

4 DEFINITIONS

In this document:

“**Standard**” shall mean and include a Standard Specification, Standard Code of Practice or other Standard issued by a recognised association or body set up for the purpose.

“**Australian Standard**” or the abbreviation “AS” shall mean a Standard issued by the Standards Association of Australia.

“**Draft Report**” or the abbreviation “DR” shall mean a draft of an Australian Standard issued by the Standards Association of Australia.

“**British Standard**” or the abbreviation “BS” shall mean a Standard issued by the British Standards Association.

“**International Standard**” or the abbreviation “ISO” shall mean a Standard issued by the International Standards Organisation.

“**Principal**” – The Principal is as defined in GC21 and is Tweed Shire Council.

“**Principals’ Authorised Person**” - is as defined in GC21

“**Contractor**” denotes the person or corporation bound to execute construction and related work on behalf of the Principal.

“**Designer**” means a company, consultant or Professional Engineer who is qualified and is competent to perform the engineering works required for the Asset Creation process on behalf of a Developer.

“**The Code**” means the Water Services Association Codes (Sewerage Code of Australia (WSA-02) and the Sewage Pumping Station Code of Australia (WSA-04) and Water Supply Code of Australia (WSA-03), Vacuum Sewerage Code (WSA 06) and Pressure Sewerage Code of Australia (WSA 07))

“**WS-SPEC**” means the national standard water industry specifications.

5 SCOPE

5.1 Inclusions

The scope of work shall include but not be limited to the following:

- Design and supply of all pipework, fittings and other appurtenances
- Testing and commissioning of all pipelines,
- Cleaning and disinfection of potable water pipelines,
- Corrosion protection systems, ,
- Connections to proposed mechanical equipment,
- Connections to existing and proposed structures,
- Provision of pipe supports, anchorage and/or thrust blocks,
- Provision for expansion and contraction,
- Temporary diversion pipework required to construct the works
- Provision of pipe systems to penetrate structural elements
- Rectification of defects during the defects liability period.
- Preparation and supply of 3 hard copies and 3 electronic copy of operating and maintenance manuals.
- Supply of detailed installation drawings, installation instructions and commissioning procedures.

5.2 Reference Documentation

The documents listed below form part of this specification. They are listed in order of precedence.

Items marked with ‘*’ are provided with this specification:

- This document *
- Equipment Schedules (Datasheets) *
- General Mechanical Specification ME01*
- Relevant Australian Standards
- Relevant International Standards
- WSAA guidelines

6 ORDER OF PRECEDENCE

Where discrepancy or contradiction in documentation may occur, the order of precedence for documents specifying the works to be undertaken (from highest to lowest order of precedence) shall be as follows:

- (a) Tweed Shire Council Land Development Specifications D11, D12, C401 and C402.
- (b) This specification.
- (c) Water Services Association Codes (Sewerage Code of Australia (WSA-02) and the Sewage Pumping Station Code of Australia (WSA-04) and Water Supply Code of Australia (WSA-03), Vacuum Sewerage Code (WSA 06) and Pressure Sewerage Code of Australia (WSA 07))
- (d) WS-SPEC

7 STANDARDS

In addition to standards listed under ME-01, pipework shall be in accordance with the following Australian Standards.

AS 1074	Steel tubes and tubulars for ordinary service
AS 1111.1	ISO metric hexagon bolts and screws - Product grade C - Bolts
AS 1111.2	ISO metric hexagon bolts and screws - Product grade C - Screws
AS 1237	Plain washers for metric bolts, screws and nuts for general purposes - General plan
AS 1260	PVC-U pipes and fittings for drain, waste and vent application
AS 1281	Cement mortar lining of steel pipes and fittings
AS 1345	Identification of the contents of pipes, conduits and ducts.
AS 1349	Bourdon tube pressure and vacuum gauges.
AS 1432	Copper tubes for plumbing, gasfitting and drainage applications
AS 1477	PVC pipes and fittings for pressure applications
AS 1565	Copper and copper alloys - Ingots and castings
AS 1579	Arc-welded steel pipes and fittings for water and waste-water
AS 1646.1	Elastomeric seals for waterworks purposes - General requirements
AS 1646.2	Elastomeric seals for waterworks purposes - Material requirements for pipe joint seals used in water and wastewater applications - Specifies by prescription formulation
AS 1646.3	Elastomeric seals for waterworks purposes - Material requirements for pipe joints seals used in water and wastewater applications with the exception of natural rubber and polyisoprene compounds
AS 1646.4	Elastomeric seals for waterworks purposes - Material requirements for pipe joint seals used in water and wastewater applications - Thermoplastic elastomers and vulcanizates
AS 1722.1	Pipe threads of Whitworth form - Sealing pipe threads
AS 1722.2	Pipe threads of Whitworth form - Fastening pipe threads
AS 1741	Vitrified clay pipes and fittings with flexible joints - Sewer quality
AS 1830	Grey cast iron
AS 1831	Ductile cast iron
AS 2032	Installation of PVC pipe systems
AS 2074	Cast steels
AS 2129	Flanges for pipes, valves and fittings
AS 2518	Fusion-bonded low-density polyethylene coating for pipes and fittings
AS 2566	Buried flexible pipelines - Structural design
AS 2700	Colour standards for general purposes
AS2280	Ductile Iron Pipes and Fittings
AS 3518	Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications

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AS 3571	Glass filament reinforced thermosetting plastics (GRP) pipes - Polyester based - Water supply, sewerage and drainage applications
AS 3680	Polyethylene sleeving for ductile iron pipelines
AS 3681	Guidelines for the application of polyethylene sleeving to ductile iron pipelines and fittings
AS 3688	Water supply - Metallic fittings and end connectors
AS 3690	Installation of ABS pipe systems
AS 3690	Installation of ABS pipe systems
AS 3691	Solvent cement and priming (cleaning) fluids for use with ABS pipes and fittings
AS 4020	Testing of products for use in contact with drinking water
AS 4041	Pressure Piping
AS 4058	Precast Concrete Pipes (Pressure and non-pressure)
AS 4087	Metallic flanges for waterworks purposes
AS 4089	Copper pipe and fittings - Installation and commissioning
AS 4129	Fittings for polyethylene (PE) pipes for pressure applications
AS 4130	Polyethylene (PE) pipes for pressure applications
AS 4131	Polyethylene (PE) compounds for pressure pipes and fittings
AS 4139	Fibre reinforced concrete pipes and fittings
AS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS 4321	Fusion-bonded medium density polyethylene coating and lining for pipes and fittings
AS 4441	Oriented PVC (PVC-O) pipes for pressure applications
AS 4765	Modified PVC (PVC-M) pipes for pressure applications
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
BS 3974	Specification for pipe supports- Pipe hangers, slider and roller type supports
I.S. EN 681-1	Elastomeric Seals - Materials Requirements For Pipe Joint Seals Used In Water And Drainage Applications - Part 1: Vulcanized Rubber

8 GENERAL

The pipework shall be rigidly and safely supported at intervals not exceeding manufacturer's recommendations.

The pipework shall be arranged in such a way that access to machinery and controls are not impeded.

Adequate supporting and anchoring arrangements for all pipes shall be provided and particular care shall be taken to ensure that any imposed loading is, as far as possible, is not transmitted to machinery or other associated plant.

Pipework shall be arranged to allow easy disconnection of all components, including pumps, valves, instruments and equipment.

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Pipework carrying fluids likely to cause blockages shall be fitted with adequate facilities such as blank flanges or flanged pipe bends, which can be easily removed for cleaning and rodding of pipework.

All pipes of 80 mm diameter or above connected to items of plant shall have flanged connections.

Where used for water supply, pipes, joint seals, flange gaskets, o-rings and jointing lubricant shall comply with AS 4020. Where pipe does not comply with AS4020, the pipe shall be marked "not suitable for drinking water".

Generally for buried applications rubber ringed joints (RRJ) will be required for the majority of pipe materials listed below i.e DI, MS, GRP, PVC, RCP, FRC, and VC.

Principal's minimum requirements for sewerage gravity main pipe materials are as follows:

- (a) mPVC, uPVC or oPVC: rubber ring jointed, SN8/SN10. Ultra rib pipe is acceptable for pipes greater than DN150mm.
- (b) PE: electrofusion or butt fusion, minimum SDR 17
- (c) DI: rubber ring jointed, polyethylene sleeved, cement or epoxy lined, minimum PN20.
- (d) GRP : rubber ring jointed couplings, minimum SN10000 stiffness, minimum PN10 pressure class
- (e) VC: spigot and socket type using roll on rubber ring (elastomeric) joints.

All products and materials used for the creation of infrastructure shall comply with the relevant sections of WS-SPEC as applicable for the respective pipe materials.

Principal's minimum requirements for pressure main pipe materials are as follows:

- (a) mPVC, uPVC or oPVC : rubber ring jointed, minimum Class 16 Series 2
- (b) PE : electrofusion or butt fusion, minimum PN16 pressure class
- (c) DI: rubber ring jointed or flanged, PE sleeved, cement or epoxy lined, minimum PN20.
- (d) Steel : rubber ring jointed, flanged or welded, FBPE coated, cement or epoxy lined, minimum steel barrel wall thickness of 6mm or diameter/120 whichever is the greater,
- (e) GRP: rubber ring jointed couplings, minimum PN16 pressure class SN10000 pipe stiffness.

9 PIPE MATERIALS

9.1 Material selection

Where pipe materials are not specified in the Contract documents they shall be determined by the Contractor and submitted to the Principal's authorised person for approval.

Unless noted otherwise, fitting material and class shall be the same as or higher than the adjacent pipe.

Pipe materials shall be selected to suit the process fluid and the operating environment.

Ductile iron fittings to AS2280 shall be the default option for use with PVC, GRP and ABS pressure pipes. The use of moulded PVC-U fittings with PVC-M, PVC-O and other plastic pressure pipes requires approval from the Client.

Pipe materials to be used are given in tables below. The use of materials other than those specified shall be subject to the approval of the Principal's Authorised Person.

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PIPE SERVICE	PIPE MATERIAL CODE					
	Exposed			Buried/Embedded/Encased		
	Up to 50mm	65mm to 80mm	100mm and larger	Up to 50mm	65mm to 80mm	100mm and larger
Aeration Pipework	B1	B3/B5	B3/D5	B1	B3	B3
Caustic Soda	D1/D3/B6	D1/D3/B6	-	D1/D3/B6	D1/D3/B6	-
Compressed Air	A2/B4/D3	B1/B4/D3	-	A2	B1/B4/D3	B1/B4/D3
Chlorine Gas (dry)	B3	-	-	-	-	-
Chlorine Solution	D1	D1	-	D1	D1	-
Chlorine Gas under Vacuum	D1	-	-	-	-	-
Digested Sludge	-	B4/D3	C4/B4/D3	-	B4/D3	C3/B4/D3
Digester Gas	-	B5	B5	-	B5	B5
Domestic Water (potable)	A2/B5	A2	C5	A1	A1	C1
Fire Main	A2	A2	B2	A1	A1	C1
Grit	-	B5/D3	B5/D3	-	B4/D3	B4/D3
Industrial Water	A2	A2/B5/D3	A2/C5/D3	A1	A1/D3	C1/D3
Methanol	B4	B4	-	B4	B4	-
Mixed Liquor	-	D3	C4/D3	-	D3	C3/D3
Overflow and drainage	A1/D1/D3	A1/D1/D3	C5/D1/D3	A1/D1/D3	A1/D1/D3	C1/D1/D3
Pumped Drainage Return	-	-	C5/D3	-	-	C1/D3
Raw Sludge	-	B4/D3	C4/B4/D3	-	B4/D3	C3/B4/D3
Reclaimed Effluent	A2	A2/D3	A2/D3	A1	A1/D3	C1/D3
Secondary Effluent	-	-	C5/E1	-	-	C1/E1
Sewage	-	D1/D3	C5/E1	-	D1/D3	C1/E1
Scour Air	B1	B1	B1	B1	B1	B1
Scum	-	D3	B2/D3	-	D3	C1/D3
Sodium Hypochlorite	D1	D1	-	D1	D1	-
Subnatant	A2	A2/D3	A2/D3	A1	A1/D3	C1/D3
Acids	D1	D1	-	D1	D1	-
Tank Drain	D1/D3	D1/D3	B2/D3	D1/D3	D3	C1/D3/E2
Tertiary Effluent	-	E1	C5/E1	-	E1	C1/E1
Thickened Sludge	-	D3	C4/D3	-	D3	C3/D3
WAS	-	D3	C4/D3	-	D3	C3/D3

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CODE	PIPE
A1	Copper, AS1432, Type B, annealed tempered.
A2	Copper, AS1432, Type B, as drawn tempered.
B1	Steel, to AS1074, medium galvanised. (limited use)
B2	Steel, to AS1579, welded and or flanged. (limited use) Hot dip galvanised and/or cement lined where indicated.
B3	Steel. Hot dip galvanised. All flanged or welded. (limited use)
B4	Stainless Steel, grade 316, seam welded, Scheduled to suit application.
B5	Stainless Steel, grade 316, spiral welded, minimum thickness =2 mm
B6	Carbon Steel scheduled to suit application.
C1	Ductile iron, rubber ring joint AS2280 Class K9. Cement lined (heavy) and bitumen coated. TytonXcel Ductile iron, tyton rubber ring joint class PN20. Cement Lined (heavy) and bitumen coated.
C2	Not Used
C3	Ductile iron, rubber ring joint AS2280 Class K12. Epoxy coated internally. TytonXtreme Ductile iron, tyton rubber ring joint class PN20. Epoxy coated internally.
C4	Ductile iron flanged joint, AS2280 Class K12. Epoxy coated internally. TytonXtreme Ductile iron, rubber ring joint class PN35. Epoxy coated internally.
C5	Ductile iron flanged joint, AS2280 Flange Class PN 16 or PN 35 with Screw on flanges.
D1	UPVC, AS1477
D2	Not Used
D3	Plastic ABS, AS3518
D4	GRP polyester based, AS2634 & AS3571.
D5	UPVC AS1254, storm water pipes.
E1	Reinforced concrete pipe to AS4058 or FRC pipe to AS4139. Rubber ring joints.
E2	Reinforced concrete pipe to AS4058 or FRC pipe to AS4139.
E3	Reinforced concrete pipe to AS4058 PVC lined.

9.2 Ductile iron pipes and fittings (Gravity and Pressure)

Ductile iron pipes and fittings for water and sewerage applications shall be compliant with Section SP2 of WS-SPEC.

For specific Principal's requirements for water supply applications, refer to clause D11.12 and C401.07 of Development Design and Construction Specification for Water Supply-D11 and C401. For

specific Principal's requirements for Sewerage applications, refer to clause D12.15 and C402.07 of Development Design and Construction Specifications for Sewerage-D12 and C402.

Pipes cast into concrete shall be power-tool cleaned to AS 1627.

9.3 Steel pipes and fittings (Pressure)

Steel pipes and fittings for water and sewerage applications shall be compliant with Section SP1 of WS-SPEC.

Steel pipes shall be provided with cathodic protection if required in accordance with geotechnical recommendations.

The Designer shall take account of congested service corridors, poor soil conditions and the need for additional security for strategic mains with regard to the provision of restrained joints.

The Designer shall avoid the positioning of continuously welded steel pipelines in parallel with high voltage power lines.

Steel pipes shall be FBPE (Sintakote) coated and lined with cement mortar type SR or epoxy.

For specific Principal's requirements for water supply applications, refer to clause D11.13 and C401.08 of Development Design and Construction Specification for Water Supply-D11 and C401. For specific Principal's requirements for Sewerage applications, refer to clause D12.17 and C402.08 of Development Design and Construction Specifications for Sewerage-D12 and C402.

Steel pipe and fittings shall be manufactured in accordance with AS1579.

Unless otherwise specified steel pipes and fittings shall be cement mortar lined in accordance with AS 1281. For applications where the wastewater being conveyed has a sulphate content greater than 500 mg/L, Type SR cement shall be used.

Buried steel pipes and fittings shall be externally coated with medium density, fusion bonded polyethylene complying with AS4321.

Elastomeric ring joint seals shall comply with AS1646 or EN 681-1 (EPDM).

Steel pipe, joint seals, flange gaskets, flange o-rings and jointing lubricant shall comply with AS4020.

If specified fully welded steel pipes shall be provided with cathodic protection.

9.4 Stainless Steel Piping

Stainless Steel piping shall be grade 316 unless otherwise approved by the Principal's authorised Person.

Spiral wound stainless steel tube used shall be manufactured in accordance with the requirements set out in AS4041 for class 3 piping or other agreed manufacturers standards.

All stainless steel welding shall be carried out using approved welding techniques and appropriate procedures. Post weld cleaning and passivation shall be carried out to remove any defects and heat tint arising from the welding process.

9.5 Copper pipes and fittings

Copper tube for water supply applications shall be specified to be manufactured in accordance with AS 1432 in the range of DN6 to DN200 for Type A or Type B. The Designer shall take into account the requirements of AS 3500.

Capillary and compression fittings shall be specified to comply with AS 3688 and de-zincification resistant. Capillary fittings shall have silver brazed joints or solder insert capillary joints.

For specific Principal's requirements for water supply applications, refer to clause D11.16 and C401.09 of Development Design and Construction Specification for Water Supply-D11 and C401.

Copper and copper alloy fittings shall comply with AS 3688.

Copper pipes and fittings shall be installed and commissioned in accordance with AS4089.

All above ground copper pipe shall be protected against corrosion by painting. Painting shall be by a system that effectively primes to the copper and prevents peeling of the paint.

Copper pipes for potable water reticulation shall be naturally coloured or sheathed blue. Copper pipes for recycled water reticulation shall be sheathed purple Lilac.

Copper pipes shall be insulated from aluminium, mild steel or galvanized surfaces by plastic sleeving or neoprene tape bonded to the piping. Connections to steel or cast iron piping shall be insulated with Dielectric unions.

9.6 Polyethylene (PE) pipes and fittings (Pressure and Gravity)

PE Pipes and Fittings for water supply and sewerage applications shall be compliant with WS-SPEC section SP6.

PE pipes shall be manufactured in either PE80B or PE100 polymer material.

Selection of pipe class shall take into account cyclic loading and fatigue

PE pipes for pressure applications shall be in accordance with AS4130, PE80 or PE100.

Fittings for PE pipes for pressure applications shall be in accordance with AS4129.

Material requirements for PE pipes and fittings for pressure applications shall be in accordance with AS4131.

Colour coding for PE pipes shall be according to AS4130. Series 1 pipes are for general pressure applications and are compatible with the ISO 11922-1 size series dimensions. Series 2 and 3 are used for fuel gas applications. PE pipes for potable water supply shall be blue or black with blue stripes Series 1. PE pipes for sewerage shall be black with cream stripes Series 1. PE pipe for recycled water shall be lilac or black with purple Lilac stripes Series 1.

Series 2 and 3 pipes (gas pipes) shall be yellow or black with yellow stripes.

Mechanical joint elastomeric seals shall comply with AS1646 or EN 681-1, EPDM.

For specific Principal's requirements for water supply applications, refer to clause D11.14 and C401.10 of Development Design and Construction Specification for Water Supply-D11 and C401. For specific Principal's requirements for Sewerage applications, refer to clause D12.18 and C402.05 of Development Design and Construction Specifications for Sewerage-D12 and C402.

9.7 PVC pipes and fittings (Pressure and Gravity)

PVC gravity pipes and fittings for water supply and sewerage applications shall be compliant with Section SP4 of WS-SPEC.

The Designer shall ensure that PVC pipe specified is compatible with ductile iron (DI) pipe where necessary.

Pipe shall have smooth external wall for DN150mm to AS1260. Ultra rib is acceptable for pipes greater than DN150mm.

Pipes and fittings shall be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of cover. All exposed uPVC pipework shall be painted to protect it from UV light using a water based acrylic paint.

Selection of pipe class shall take into account cyclic loading and fatigue.

All types of PVC pipes and fittings shall only be used for below ground and internal building applications and shall be installed in accordance with AS 2032 and AS 2566.1 unless otherwise stated in this specification. In instances where any type of PVC will be exposed to direct sunlight only UV stabilised PVC shall be used, or a protective system approved by the Principal's authorised person. The Contractor shall take account of the time for storage and type of cover.

All types of PVC pipe and fittings shall be manufactured using lead free stabilisers.

PVC pipes and fittings for pressure applications shall comply with AS 1477.

Unplasticised PVC (PVC-U) pipes and fittings for gravity sewers, drain, waste and vent applications shall comply with AS 1260.

Modified PVC (PVC-M) pipes and fittings for pressure applications shall comply with AS 4765. Dimensions for PVC pipes and fittings for pressure applications shall comply with AS1477.

Oriented PVC (PVC-O) pipes for pressure applications shall comply with AS 4441. Stiffness of the pipe shall not be less than 10,000.

Elastomeric joint seals for PVC pipes shall comply with AS1646 or EN 681-1, EPDM or SBR.

Series 1 PVC pipes are a metric pipe size and Series 2 pipes have dimensions that are compatible with cast iron pressure pipe and fittings. As per AS1477, Series 1 PVC pipes for drinking water applications shall be white, Series 2 PVC pipes for drinking water applications shall be light blue, Series 1 and Series 2 PVC pipes for recycled water shall be purple, and PVC pipes for pressure sewerage applications shall be cream.

Other colours may be supplied by agreement between the purchaser and manufacturer.

For specific Principal's requirements for water supply applications, refer to clause D11.10 and C401.04 of Development Design and Construction Specification for Water Supply-D11 and C401. For specific Principal's requirements for Sewerage applications, refer to clause D12.13, D12.14 and C402.04 of Development Design and Construction Specifications for Sewerage-D12 and C402.

9.8 ABS Pipes and Fittings

ABS pipes and fittings for water supply and sewerage applications shall be compliant with Section SP12 of WS-SPEC.

ABS pipe and fittings shall comply with AS 3518.

ABS piping and fittings shall be solvent welded and installed in accordance with AS 3690 and AS 3691 and the manufacturer's instructions.

Elastomeric joint seals shall comply with AS1646 or EN 681-1, EPDM or SBR.

For specific Principal's requirements for water supply applications, refer to clause D11.11 and C401.05 of Development Design and Construction Specification for Water Supply-D11 and C401.

9.9 Glass reinforced plastic (GRP) pipes and fittings (Pressure and Gravity)

GRP pipes and fittings shall only be used with prior approval of Principal's authorised person.

If approved, GRP pipes and fittings for water supply and sewerage applications shall be compliant with Section SP5 of WS-SPEC.

In instances where GRP is exposed to direct sunlight a protective system approved by the Principal's authorised person shall be provided. The Contractor shall take account of the time for storage and type of cover. GRP pipes and fittings shall be lined with a suitable resin liner. Where GRP pipes are cast into concrete, the coupling shall be treated by the manufacturer to ensure a watertight joint is attained.

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Elastomeric joint seals shall comply with AS1646 or EN 681-1, EPDM.

For specific Principal's requirements for water supply applications, refer to clause D11.15 and C401.06 of Development Design and Construction Specification for Water Supply-D11 and C401. For specific Principal's requirements for Sewerage applications, refer to clause D12.19 and C402.06 of Development Design and Construction Specifications for Sewerage-D12 and C402.

9.10 Reinforced Concrete Pipes and Fibre Reinforced Concrete Pipes

Reinforced concrete pipes shall comply with section SP8 of WS-SPEC.

Fibre reinforced concrete pipes (FRP) shall conform to requirements of Section SP11 of WS-SPEC.

Rubber ring joints shall be resistant to the penetration of tree roots.

Elastomeric joint seals shall comply with AS1646 or EN 681-1, EPDM.

9.11 Vitrified clay pipes and fittings

VC pipes and fittings shall be compliant with WS-SPEC, section SP7.

Pipe and fitting shall be spigot and socket type using roll on rubber ring (elastomeric) joints.

Natural rubber shall not be used in rubber ring joints.

For specific Principal's requirements for Sewerage applications, refer to clause D12.16 and C402.09 of Development Design and Construction Specifications for Sewerage-D12 and C402.

9.12 Concrete Works for Pipelines

All concrete work shall be compliant with WS SPEC Sections SP43, 44 & 45 and TR10. Classes of concrete used for the construction of the works shall be as follows:

Application	Grade (F'c at 28 days)	Min cement content (kg.m3)	Max w/c ratio
Blinding concrete, mass concrete	N15	-	-
Surface footpaths and driveways	N25	-	-
Unreinforced thrust blocks, anchor blocks, bulkheads, and conc. encasement in all environments	N25	-	-
Reinforced thrust blocks, anchor blocks, bulkheads, and conc. encasement in all environments	N32	-	-
Valve chambers and flowmeter pits in non-aggressive environments	N32	-	-
Valve chambers and flowmeter pits in aggressive soil and groundwater environments	S40	380	0.50
Underground booster pump stations, building foundations, in non-aggressive environments.	N32	-	-
Underground booster pump stations, building foundations, in aggressive soil and groundwater environments.	S40	380	0.50

10 CONNECTIONS

10.1 Couplings

10.1.1 Gibault joints and compression type couplings

Mechanical pipe couplings not intended to take tension and couplings for connecting steel pipe to cast or ductile iron pipe shall be "Gibault" joints or epoxy-coated steel rubber-ring compression type couplings.

10.1.2 Victaulic couplings

Mechanical pipe couplings intended to take tension may be of the "Victaulic" type. Victaulic couplings shall be installed so that a minimum of 3mm gap is left between adjacent pipe ends to allow for expansion. The seals shall be selected for the service required. Victaulic couplings on mild steel pipe may be of the rolled grooved type, as manufactured by Tyco, or approved equivalent.

10.1.3 Flexible rubber couplings

Where necessary, flexible couplings shall be fitted on connections to equipment to prevent transmission of vibration to the adjacent pipework systems.

Couplings shall be selected to match pipeline and/or equipment connection size and meet the operating conditions with pressure rating equivalent to adjacent pipe work.

Proprietary joining system for gravity pipes shall be used such as Fernco or other approved equivalent.

10.2 Expansion joints

Where pipework is subject to temperature variations, the installation shall include expansion loops, bellows joints or another approved device that shall accommodate thermal expansion and contraction of the pipework.

Particular care shall be taken of plastic pipes (ABS, PVC, PE) which have a high co-efficient of expansion.

Expansion calculations shall allow for the pipe empty condition which often gives the greatest range of temperature variations.

11 AIR AND SCOUR VALVES

11.1 Air Valves

Refer to clause 15 of ME-04 Valve Specifications.

Automatic air valves shall be installed at the high points of all pipework containing any pressure, which cannot be vented through service connections, hydrants or vent cocks furnished with equipment.

Manual air valves shall be installed at the high points of all liquid lines. Automatic air vents shall be provided at locations subject to frequent air accumulation or sharp vertical crests.

PIPEWORK

11.2 Scour Valves

Scour valves shall be according to Section 6.6 of WSA 03-2005 for Water Supply Applications and clause 10.9.5 and 9.2.3 of WSA 04-2005 for Sewerage Applications.

Manual Scour Valves shall be provided at the low points of all fluid lines.

Automatic drain valves shall be provided at all low points of compressed air lines with an integral strainer or approved equivalent. The discharge shall be directed towards a drain.

12 PIPE SUPPORTS

Piping shall be adequately supported on racks or by anchor brackets, saddles or supports. In no case shall support spacing exceed that recommended by the pipe manufacturer to adequately support the pipework for the service intended.

Pipe supports shall be in accordance with BS3974

Hangers, supports or pipe racks shall be provided in each direction at each change in direction can be in conflict with some expansion requirements. All hangers, racks, saddles and supports shall be of standard manufacture for that purpose.

Pipe supports in the floor trenches, drains, or similar conditions shall be of stainless steel construction.

All pipework with joints not designed to withstand tensile forces tending to separate the joint when the pipeline is subjected to an internal gas or liquid pressure shall be fitted with thrust and anchor blocks at all intersections, branches, changes of direction, valves and dead ends.

Anchorage of pipework shall be provided where there is the possibility of joint separation or subjecting pipework to excessive stresses.

Thrust supports for buried application will be in accordance with WSA Codes also refer to refer to D11, D12, C401 & C402 The design of the supports shall be the responsibility of the Contractor. The design calculations shall be submitted to the Principal's authorised person if requested.

13 PIPEWORK PENETRATING STRUCTURAL ELEMENTS

Pipework penetration through concrete structures shall be such as to prevent seepage and maintain the integrity of water retaining structures. Puddle flanges shall be used where resistance to thrust is required. Other proprietary systems such as "Link-Seal" may be used where thrust support is not required. Approval by the Principal's authorised person of the Contractors proposals for location and details of pipe penetrations is required.

14 IDENTIFICATION OF PIPEWORK

Unless specified otherwise, pipes, conduits and ducts shall be identified in accordance with AS 1345.

All pipes and conduits shall be marked except those cast into concrete or buried without ducts in the earth in this case refer to D11, D12, C401 & C402. For example, pipes shall be marked if they are openly exposed, undercover, concealed in ducts, false ceilings or behind panelling. Where a pipe is lagged, the marking shall be applied on the outside of the lagging. Complex networks of piping shall be marked with additional markers or colour bands.

All non-metallic pipes buried underground shall be provided with detectable marking tape along their complete buried length so that they can be identified with a pipe locator.

15 TESTING

All piping and pressure pipelines shall be subject to acceptance tests.

Testing of pipes shall be in accordance with C401 and C402.

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