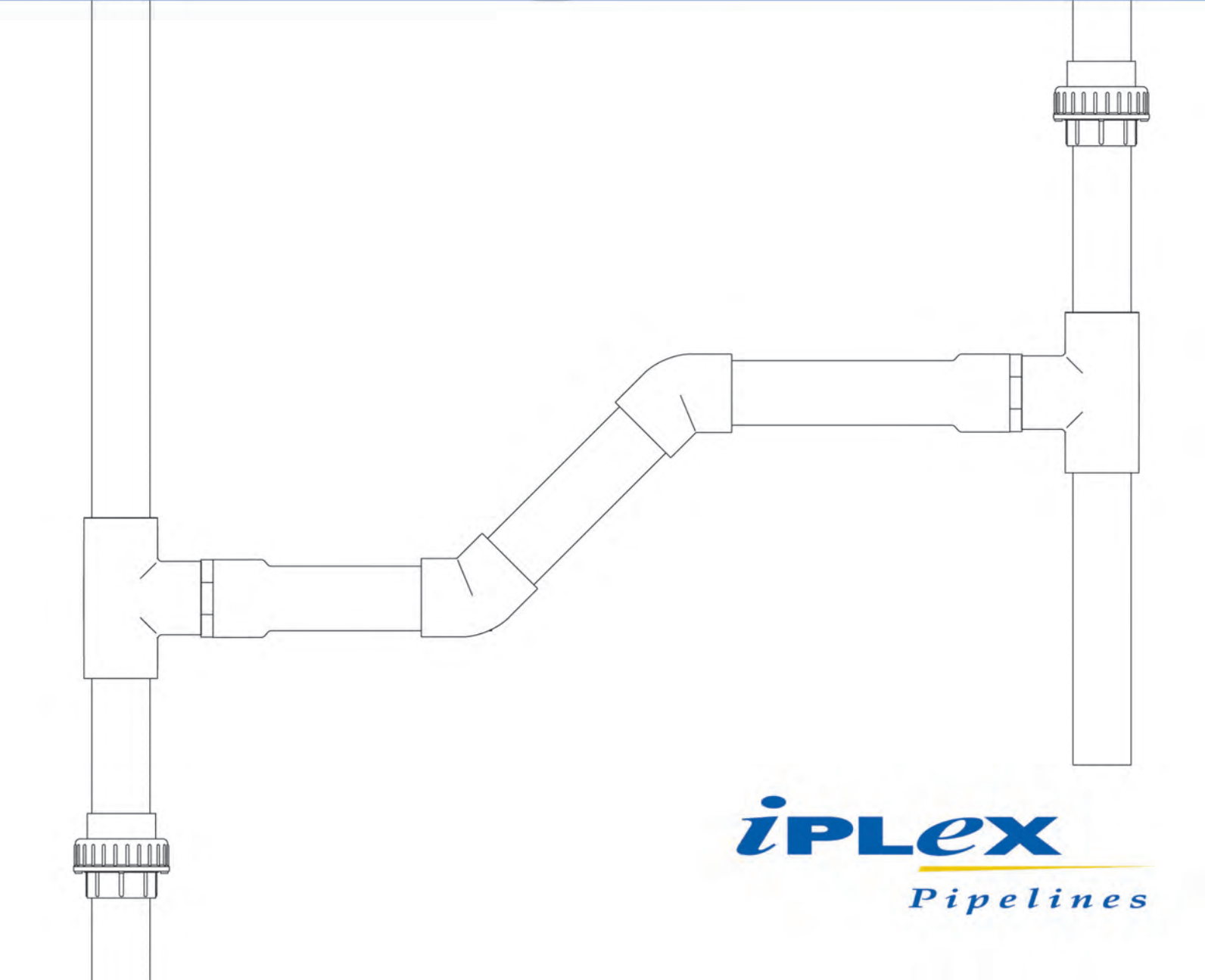


ENGINEERING DESIGN AND INSTALLATION GUIDE

PVC-U Pressure Pipes and Fittings



Important Disclaimer

The information, opinions, advice and recommendations contained in this publication are offered only with the object of providing a better understanding of technical matters associated with pipeline design etc, with Iplex Pipelines assuming no duty of care in respect of them. This design and installation guide should not be used as the sole source of information. As it does not refer to all relevant sources of information, reference should also be made to established textbooks and other published material. Readers should not act or rely upon any information contained in this publication without taking appropriate professional advice, which relates to their particular circumstances. Iplex Pipelines disclaims all liability to any party who acts or fails to act as a consequence of reliance upon the whole or any part of this guide. So far as it may be lawful to do so, Iplex Pipelines supplies this guide on the condition that it will incur no liability whatsoever in respect to any loss or damage of any kind claimed to arise either directly or indirectly as a result of reliance on any statement herein or in respect of any act, cause or matter or thing alleged to arise directly or indirectly as a result of the contents of this publication. It excludes all warranties and conditions statutory or otherwise as to quality or fitness of the products for any purpose and excludes all liability of itself its servants and agents for all loss or damage in relation to the use of the products or reliance on this information. Pipes and fittings are shown as typical configurations, however in some cases product dimensions may vary or be changed without notice. Where these matters are critical please contact Iplex Pipelines ON-LINE for clarification.

Copyright © 2010 Iplex Pipelines Australia Pty Ltd. No part of this catalogue may be reproduced, stored in a retrieval system or transmitted in any form, electronic, mechanical recording or otherwise without the consent of Iplex Pipelines Australia Pty Ltd.



	page
Section 1 - General	03
1.1 Introduction.....	03
1.2 Applications.....	03
1.3 Features and benefits.....	03
Section 2 - Material properties	04
2.1 Material properties.....	04
2.2 Sustainability.....	05
2.3 Temperature effect on pressure rating.....	05
2.4 Chemical resistance.....	05
Section 3 - Product data	06
3.1 Standards and testing.....	06
3.2 Rubber ring seals.....	06
3.3 Certification.....	06
3.4 Colour and Markings.....	06
3.5 Product codes.....	06
Section 4 - Product range	08
4.1 PVC-U pressure pipe dimensions.....	08
4.2 Fittings.....	09
4.3 PVC-U fittings.....	09
4.3.1 PVC solvent weld joint pressure fittings.....	09
4.4 Ductile iron fittings.....	19
Section 5 - Hydraulic design	20
5.1 Flow capacity determination.....	20
5.2 Pressure class selection.....	20
5.3 Water hammer surges and cyclical effects.....	20
Section 6 - Structural design	25
6.1 Flexible pipe design.....	25
6.2 Minimum cover heights - AS/NZS 2566.....	25
6.3 Thrust block design for fittings.....	25



	page
Section 7 - Installation	28
7.1 Handling and storage.....	28
7.2 Trenching.....	28
7.3 Embedment and backfilling.....	28
7.4 Joining instructions - Solvent weld joint (DN15-DN150).....	29
7.5 How solvent cement works.....	29
7.6 Importance of priming fluids.....	29
7.7 Iplex solvent cement - Type P.....	30
7.8 Iplex solvent cement - Type N.....	30
7.9 Iplex priming fluid.....	30
7.10 Solvent weld jointing instructions.....	30
7.10.1 Cut spigot square and deburr.....	30
7.10.2 Check alignment.....	30
7.10.3 Mark clearly.....	30
7.10.4 Dry fit the joint.....	30
7.10.5 Clean and soften the surface.....	30
7.10.6 Coat the socket first, then the spigot.....	31
7.10.7 Assemble - hold for 30 seconds.....	31
7.10.8 A vital 5 minutes.....	31
7.10.9 Curing and testing.....	31
7.11 Safety precautions for solvent weld procedures.....	31
7.12 Joining instructions - Rubber ring joint (DN80-DN375).....	31
7.12.1 Cutting pipes.....	31
7.12.2 Cleaning.....	31
7.12.3 Lubricate.....	32
7.12.4 Assembly.....	32
7.13 Ductile iron socket joints.....	32
7.14 Jointing fluids (lubricants).....	32
7.15 Expansion and contraction.....	33
7.16 Installing on a curved alignment.....	33
7.17 Concrete encasement.....	33
7.18 Tapped service connections.....	33
7.19 Above ground suspended pipelines.....	34
Section 8 - Testing	35
8.1 Field testing.....	35
Section 9 - Frequently asked questions	37

1.1 Introduction

PVC pressure pipes are manufactured from unplasticised polyvinyl chloride polymer (a thermoplastic material) using the extrusion process. PVC (also known as uPVC and PVC-U) pipes were introduced into Australia in the early 1960's and are now widely accepted for use in water supply, irrigation and sewerage rising mains.

Their high strength to weight ratio together with exceptional resistance to corrosion or chemical attack make these pipes ideal for major infrastructure applications.

A report has been published by PIPA (PVC Pipelines Industry Association of Australia) on an investigation of 600 km of PVC pipes laid in the early 1970s as part of the Millewa Waterworks District Scheme. It involved the exhumation and testing of numerous pipe specimens and confirmed the long-term durability and serviceability of PVC-U pressure pipes.

Iplex PVC-U pressure pipes meet the requirements of AS/NZS 1477 "PVC pipes and fittings for pressure applications" and the Water Services Association of Australia (WSAA) Reticulation Code WSA 03.



Figure 1.1 - PVC irrigation pipe installation

1.2 Applications

Iplex PVC-U pipes are recognised for their advantages and have been used extensively since the 1970's in the following applications,

- Major potable water supply trunk and reticulation mains
- Irrigation and turf watering systems
- Industrial process pipelines
- Effluent pipelines for pumped sewage, industrial and rural wastes
- Slurry pipelines carrying abrasive and corrosive mine or quarry materials

1.3 Features and benefits

PVC plastic pipe systems offer major advantages over traditional materials including corrosion resistance, installation economics, operating efficiencies and significant reductions in maintenance costs. The following outlines some of the features and benefits of PVC pipes.

Table 1.1: Features and benefits

Features	Benefits
Excellent internal/external corrosion resistance	Long service life
Electrically non conductive	Do not suffer from electrolytic corrosion
Reiber rubber ring	Reduced jointing effort and improved reliability
Light weight	Ease of handling and reduced laying costs



Figure 1.2 – Potable water PVC-U pipeline installed in roadway.



Figure 1.3 – The light weight nature of PVC pipes allows ease of handling during installation.

2.1 Material properties

The general physical properties of PVC-M are provided in Table 2.1.

Table 2.1 – Typical material properties

Property	Value
Physical and mechanical	
Specific gravity	1.43 to 1.5
Effect on potable water - AS/NZS 4020	Complies
Hydrostatic design stress – AS/NZS 1477	≤DN150=11.0 MPa >DN150=12.3 MPa
Mean hoop stress at 20°C extrapolated to 50 years - AS/NZS 1462.6	≤DN150=23.6 MPa >DN150=26.0 MPa
Fracture toughness - AS/NZS 1462.19	4.14 MPa m ^{0.5}
Flexural modulus - ISO 9969	3200 MPa
Poisson's ratio	0.38 – 0.40
Thermal	
Coefficient of linear thermal expansion	70 x 10 ⁻⁶ /° C
Thermal conductivity	0.138 x 10 ⁻³ W/m.K
Specific heat	1045 J/kg.K
Maximum practicable working temperature	50°C
Fire resistance	
Flammability	Will not support combustion
Ignitability - AS 1530*	7
Smoke development - AS 1530*	9
Spread of flame - AS 1530*	0
Heat evolved - AS 1530*	2
* AWTA Product Testing, test report number 7-558788-CV	
Electrical	
Volume resistivity	10 ¹⁶ ohm.cm (60% RH)
Surface resistivity	10 ¹³ - 10 ¹⁴ ohm
Power factor	0.015 - 0.020 at 20°C
Dielectric constant	3.4 - 3.6 at 25°C (60 Hz)

2.2 Sustainability

Iplex PVC-U pressure pipe is a sustainable infrastructure pressure pipeline. It has low embodied energy, can utilise re-processible PVC from its manufacture and is fully recyclable at the end of its service life.

Iplex PVC-U pressure pipes are lightweight and as result require less non-renewable energy (e.g. diesel) during transportation. Lightweight PVC-U pressure pipe also allows the production of more lengths of pipe per tonne of raw material, compared with almost any other pressure pipe of similar diameter and pressure class.

Iplex PVC-U pressure pipes do not contain any compounds based on lead, cadmium or mercury. This actively prevents more of these compounds from entering the environment and positively reduces industry demand for these compounds upstream of the manufacturing process.

Iplex PVC-U pressure pipe is chemically inert. There is no corrosion or chemical or gas emissions during its normal service life as a public water main or sewer.

Iplex PVC-U pressure pipe does not require any further application of protective coatings or sealing compounds, which are known to liberate volatile organic compounds to atmosphere.

Iplex PVC-U pressure pipe is also very durable enabling a one off energy consumption in the manufacture of the pipe asset. This is only required once in its 100 year service life, if installed and operated to the relevant codes and standards.

For further information refer to the PIPA website, www.pipa.com.au/environment.

2.3 Temperature effect on pressure rating

PVC pipes are suitable for service temperatures between 0°C and 50°C. For temperatures above 20°C, provision must be made for pressure re-rating in accordance with Table 2.2.

Table 2.2: Thermal re-rating factors*

Maximum service temperature (°C)	Multiplication factor for pressure re-rating
20	1.00
25	0.94
30	0.87
35	0.78
40	0.70
45	0.64
50	0.58

*Based on ISO 4422-2 Pipes and fittings made of un-plasticized polyvinyl chloride (PVC-U) for water supply Part 2: Pipes (with or without integral sockets)

2.4 Chemical resistance

Resistance of PVC pipe and elastomeric seals to reaction with or attack by the chemical agents listed in the "Chemical Resistance Guide" has been determined by research, investigation and reference to data from international and local sources.

Information provided is intended as a guide only. Due to the complexity of some organochemical reactions, it is suggested that in critical applications, additional long-term testing be performed.

Data provided should not necessarily be regarded as applicable to all exposure durations, concentrations and working conditions likely to be encountered.

PVC has exceptional resistance to attack from high concentrations of alkalis and acids, except for strong oxidising agents at maximum or near maximum concentrations. The material is not recommended for use with aromatic and chlorinated hydrocarbons, ketenes, esters and ethers.

For further information please visit the Iplex Chemical Resistance Guide at www.iplex.com.au in design tools.

3.1 Standards and testing

Iplex PVC-U pipes and associated materials are manufactured to relevant Australian Standards under third party accredited quality assurance programs complying with AS/NZS ISO 9001

PVC-U pressure pipes and fittings are manufactured in accordance with Australia/New Zealand Standard AS/NZS 1477 "PVC pipes and fittings for pressure applications".

3.2 Rubber ring seals

Iplex Rieber sealing rings comply with AS1646 'Elastomeric seals for waterworks purposes'. They are manufactured from SBR or EPDM polymer.

3.3 Certification

Iplex PVC-U pressure pipes are StandardsMark licensed to AS/NZS 1477.



SAI Global licence numbers,
SMK1304
SMK1058
SMK1173
SMK1531

3.4 Colour and Markings

Iplex PVC-U pipes are colour coded in accordance with AS/NZS 1477 and WSAA product specification WSA PS211, to readily distinguish between the different types of pipe applications. The following is a summary of the colours used for common applications.

- PVC-U (Series 1) pipes for drinking water applications are white in colour
- PVC-U (Series 1) pipes specified for recycled water applications are purple in colour
- PVC-U (Series 1) Pipes intended for pressure sewerage applications are cream in colour



Figure 3.1 - Iplex PVC-U Series 1 Pressure Pipe. PPSO1225, DN25 PN12 SWJ PVC-U pressure pipe x 6m

3.5 Product codes

The computer identification codes used by Iplex Pipelines are given in the Table 3.1 and are in the form,

'AAAA (A) BBCCC (D)' – the brackets indicate the symbol is used only where required.

Table 3.1 Pipe product codes

Product description	Product code AAAA (A)	Pressure class		Nominal diameter		Pipe effective length	
		PN	Code BB	DN	Code CCC	(m)	Code (D)
PVC-U Pressure Series 1 SWJ	PPSO	4.5	04	100	100	1	A
PVC-U Pressure Series 1 RRJ	PPHO	6	06	150	150	2	B
Purple PVC-U Series 1 RRJ	PPHL	9	09	200	200	3	C
Cream PVC-U Series 1 RRJ	PPHC	12	12	225	225	4	D
		15	15	300	300	5	E
		16	16	375	375	6	-
		18	18				

Examples

The product code for RRJ DN200 PN16 (Series 1) PVC-U Pipe in 6m length is:

“PPHO16200”

The product code for SWJ DN100 PN9 (Series 1) PVC-U Pipe in 6m length is:

“PPSO09100”

Table 3.2 - Product codes for lubricants

Container size (grams)	Product code	
	Iplex standard lubricant	Iplex Plus* (Bactericidal)
500	JLO10500	JLB10500
1000	JLO11000	JLB11000
4000	JLO14000	JLB14000

* This product is accredited under the WaterMark Scheme to technical specification ATS 5200.014, licence No: WMKA00103.

Table 3.3 - Solvent cement - Type P

Container size (grams)	Product code	Colour
125	JPG0125	Green
250	JPG0250	Green
500	JPG0500	Green
4000	JPG04000	Green
500	JPC0500	Clear

Table 3.4 - Priming fluid

Container size (ml)	Product code	Colour
250	JR0250	Red
500	JR0500	Red
1000	JR1000	Red
4000	JR4000	Red
250	JC0250	Clear
500	JC0500	Clear

4.1 PVC-U pressure pipe dimensions

PVC-U pressure pipes are available in both solvent weld joint (SWJ) and rubber ring joint (RRJ). DN15 up to and including DN150 pipes are available in solvent weld joint and DN80 up to and including DN375 pipes are available in rubber ring joint. Typical pipe dimensions are shown in Table 4.1 and Table 4.2.

Table 4.1 – Series 1 PVC-U (SWJ) pressure pipe dimensions

Nominal diameter DN	Mean outside diameter	PN4.5		PN6		PN9		PN12(PN15*)		PN18	
		T	ID	T	ID	T	ID	T	ID	T	ID
15	21.4	-	-	-	-	-	-	1.5 *	18.3 *	1.8	17.8
20	26.8	-	-	-	-	-	-	1.5	23.7	2.2	22.4
25	33.6	-	-	-	-	1.5	30.5	1.9	29.8	2.7	28.1
32	42.3	-	-	-	-	1.9	38.5	2.4	37.5	3.4	35.4
40	48.3	-	-	1.5	45.2	2.1	44.1	2.7	42.8	3.9	40.5
50	60.4	-	-	1.8	56.8	2.6	55.2	3.3	53.7	4.9	50.5
65	75.4	1.7	72.0	2.2	71.0	3.2	68.9	4.2	67.0	6.1	63.2
80	88.9	2.0	84.9	2.6	83.7	3.8	81.3	4.9	79.0	7.1	74.6
100	114.3	2.5	109.3	3.2	107.8	4.8	104.6	6.3	101.7	9.1	96.0
125	140.2	3.0	134.1	4.0	132.2	5.9	128.4	7.6	124.9	-	-
150	160.3	3.4	153.4	4.5	151.3	6.7	146.9	8.8	142.7	12.8	134.7

Table 4.2 – Series 1 PVC-U (RRJ) pressure pipe dimensions

Nominal diameter DN	Mean outside diameter	PN4.5		PN6		PN9		PN12(PN15*)		PN18	
		T	ID	T	ID	T	ID	T	ID	T	ID
80	88.9	2.0	84.9	2.6	83.7	3.8	81.3	4.9	79.0	7.1	74.6
100	114.3	2.5	109.3	3.2	107.8	4.8	104.6	6.3	101.7	9.1	96.0
125	140.2	3.0	134.1	4.0	132.2	5.9	128.4	7.6	124.9	-	-
150	160.3	3.4	153.4	4.5	151.3	6.7	146.9	8.8	142.7	12.8	134.7
200	225.3	-	-	5.7	213.8	8.4	208.5	11.1	203.1	16.2	192.9
225	250.4	4.8	240.8	6.3	237.7	9.3	231.7	12.3	225.8	18.0	214.4
250	280.4	-	-	7.1	266.2	10.5	259.4	13.7	252.9	20.1	239.9
300	315.5	6.0	303.4	8.0	299.5	11.7	292.0	15.5	284.5	22.6	270.2
375	400.5	7.7	385.1	10.1	380.3	14.9	370.7	19.6	363.3	-	-

Note:

All dimensions are in millimetres.

T = average mean wall thickness

ID = average mean inside diameter

The standard effective length for all pipes is 6m + 50mm, -0mm

Some sizes and classes are subject to minimum order quantities and availability at time of order

4.2 Fittings

A full range of bends, tees, reducers, and valve connectors are available for Iplex PVC-U Series 1 pressure pipes with appropriate socketed joints.

4.3 PVC-U fittings

The Iplex solvent weld joint (SWJ) PVC pressure fitting range is compatible with Series 1 pipes and is available for pipe sizes DN15 to DN150.

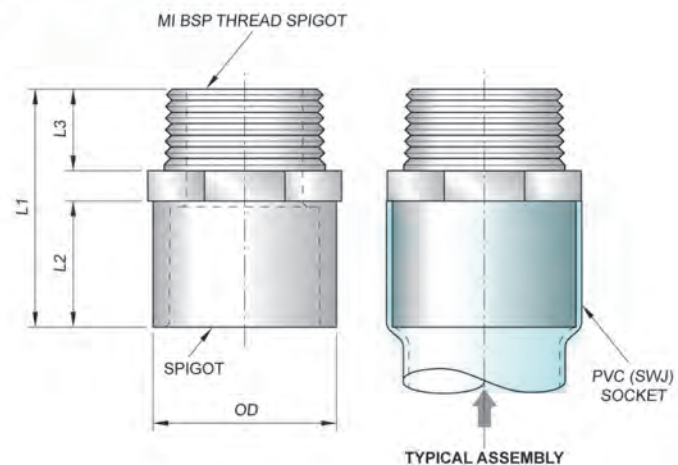
Note: The use of imported solvent welded PVC-U fittings with parallel sockets will require gap filling solvent complying with ASTM D-2564. Failure to use the appropriate solvent and cleaner will result in joint failure.

All PVC fittings are electrically non conductive and do not require corrosion protection in aggressive environments.

4.3.1 PVC solvent weld joint pressure fittings

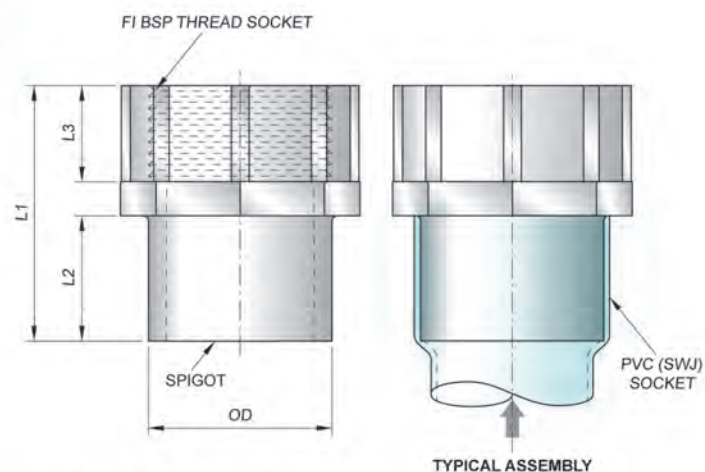
P002 (CAT 2) PVC pressure (Valve) adaptor - Spigot (SWJ) x MI BSP thread.

Product code	DN x BSP	PN (bar)	OD	L1	L2	L3
P0021515	15 x 1/2"	18	21	48	25	17
P0022015	20 x 1/2"	18	27	49	22	20
P0022020	20 x 3/4"	18	27	46	21	16
P0022515	25 x 1/2"	18	33	52	25	20
P0022525	25 x 1"	18	33	54	24	23
P0023232	32 x 1 1/4"	18	42	63	30	23
P0024020	40 x 3/4"	18	48	56	33	16
P0024025	40 x 1"	18	48	59	33	19
P0024032	40 x 1 1/4"	18	48	63	33	22
P0024040	40 x 1 1/2"	18	48	67	33	23
P0025025	50 x 1"	18	60	63	37	19
P0025040	50 x 1 1/2"	18	60	67	37	21
P0025050	50 x 2"	18	60	79	38	27
P0028075	80 x 3"	18	89	106	51	35
P002100100	100 x 4"	18	114	180	69	40



P003 (CAT 3) PVC pressure (Faucet) adaptor - Spigot (SWJ) x FI BSP thread.

Product code	DN x BSP	PN (bar)	OD	L1	L2	L3
P0031515	15 x 1/2"	18	21	44	19	18
P0032020	20 x 3/4"	18	27	47	21	18
P0032515	25 x 1/2"	18	33	50	25	17
P0032525	25 x 1"	18	33	55	24	22
P0033232	32 x 1 1/4"	18	42	62	29	24
P0034025	40 x 1"	18	48	62	33	23
P0034040	40 x 1 1/2"	18	48	67	33	25
P0035025	50 x 1"	18	60	66	37	23
P0035040	50 x 1 1/2"	18	60	71	37	25
P0035050	50 x 2"	18	60	75	37	29



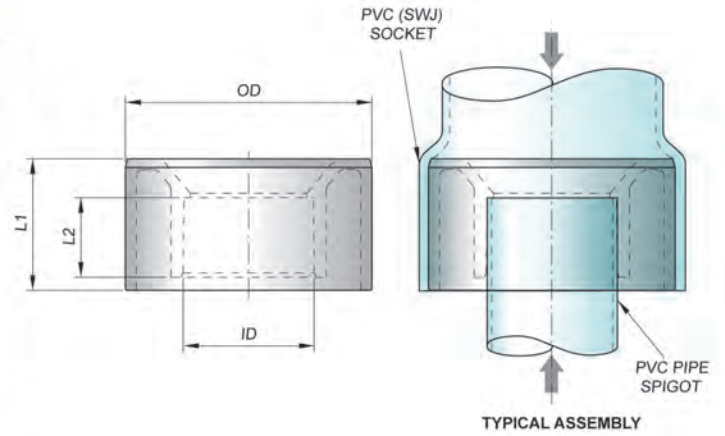
Note: All illustrations are not to scale.

All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.3.1 PVC solvent weld joint pressure fittings

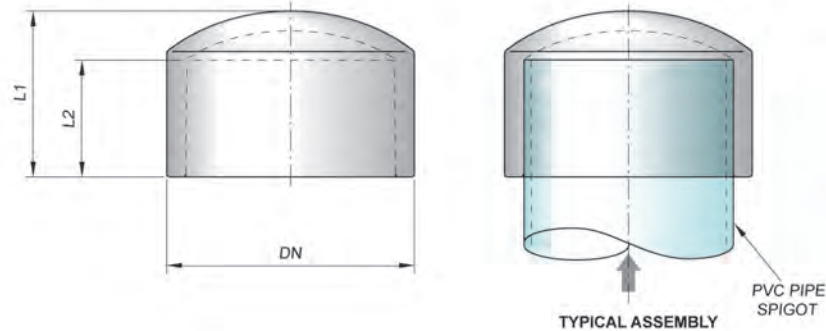
P005 (CAT 5) PVC pressure reducing bush - SWJ

Product code	DN x dn	PN (bar)	OD	ID	L1	L2
P0052015	20 x 15	18	27	21	20	18
P0052515	25 x 15	18	33	21	23	20
P0052520	25 x 20	18	33	27	23	20
P0053225	32 x 25	18	42	33	28	23
P0054025	40 x 25	18	48	33	30	27
P0054032	40 x 32	18	48	42	30	27
P0055025	50 x 25	18	60	33	37	28
P0055040	50 x 40	18	60	48	37	34
P0056550	65 x 50	18	75	60	44	37
P0058050	80 x 50	18	89	60	52	37
P00510050	100 x 50	18	114	60	61	37
P00510080	100 x 80	18	114	89	63	50
P005150100	150 x 100	18	160	114	88	61



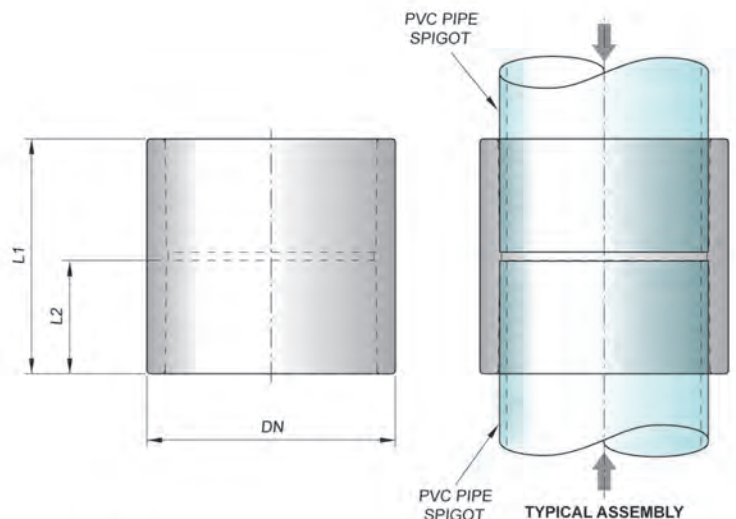
P006 (CAT 6) PVC pressure end cap - SWJ

Product code	DN	PN (bar)	L1	L2
P00615	15	18	38	25
P00620	20	18	32	20
P00625	25	18	25	23
P00632	32	18	35	28
P00640	40	18	38	31
P00650	50	18	52	37
P00665	65	18	75	48
P00680	80	18	73	54
P006100	100	18	91	64
P006150	150	18	126	88



P007 (CAT 7) PVC pressure coupling - SWJ

Product code	DN	PN (bar)	L1	L2
P00715	15	18	56	26
P00720	20	18	43	20
P00725	25	18	49	23
P00732	32	18	58	28
P00740	40	18	66	31
P00750	50	18	76	36
P00765	65	18	103	48
P00780	80	18	108	51
P007100	100	18	128	62
P007150	150	18	184	88

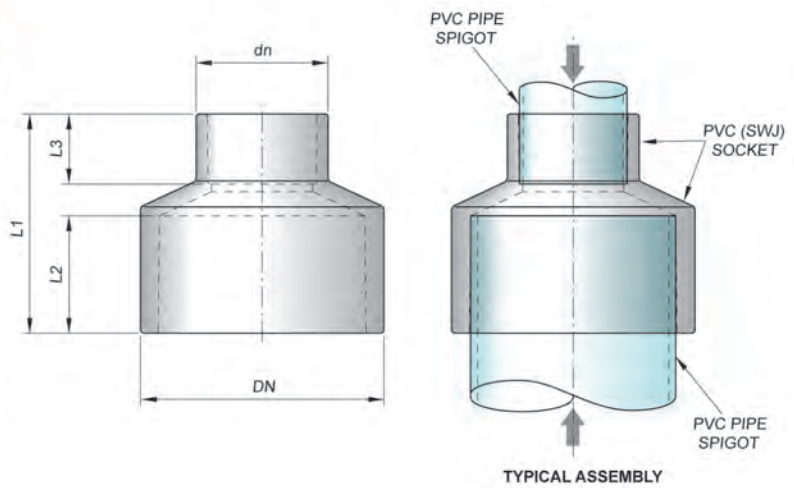


Note: All Illustrations are not to scale.
All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.3.1 PVC solvent weld joint pressure fittings

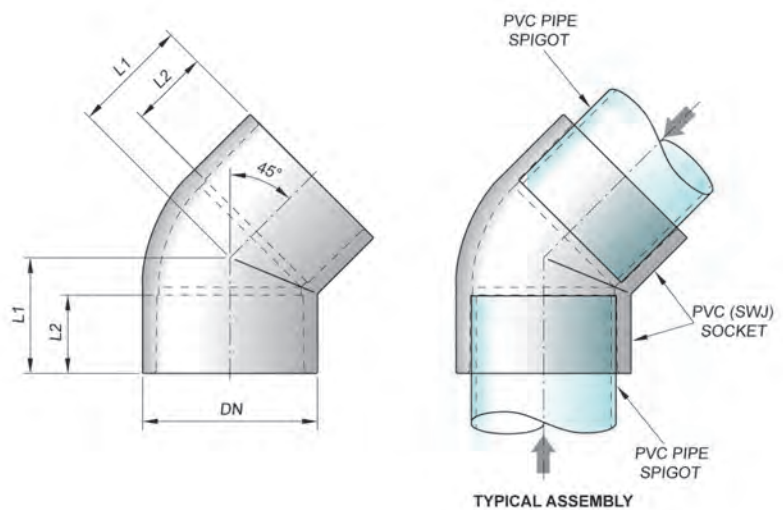
P008 (CAT 8) PVC pressure reducing coupling - SWJ

Product code	DN x dn	PN (bar)	L1	L2	L3
P0082015	20 x 15	18	46	22	20
P0082515	25 x 15	18	48	23	20
P0082520	25 x 20	18	51	24	21
P0083225	32 x 25	18	70	33	30
P0084020	40 x 20	18	64	33	26
P0084025	40 x 25	18	65	32	24
P0084032	40 x 32	18	74	36	33
P0085025	50 x 25	18	71	37	28
P0085040	50 x 40	18	78	38	32
P0086550	65 x 50	18	94	48	40
P0088050	80 x 50	18	107	54	38
P0088065	80 x 65	18	115	54	46
P00810050	100 x 50	18	122	65	39
P00810080	100 x 80	18	117	64	52
P008125100	125 x 100	15	165	92	63
P008150100	150 x 100	12	175	103	61



P010 (CAT 10) PVC pressure elbow x 45° - SWJ

Product code	DN	PN (bar)	L1	L2
P01015	15	18	28	20
P01020	20	18	30	23
P01025	25	18	35	24
P01032	32	18	45	35
P01040	40	18	52	40
P01050	50	18	60	45
P01080	80	18	80	53
P010100	100	15	90	61
P010150	150	15	126	88

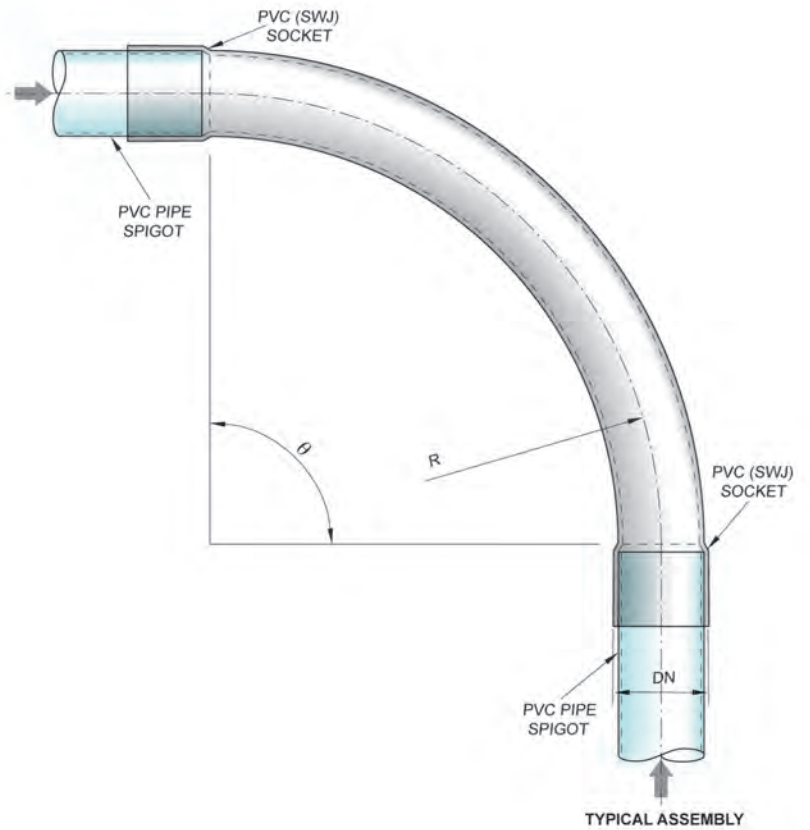


Note: All illustrations are not to scale.
All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.3.1 PVC solvent weld joint pressure fittings

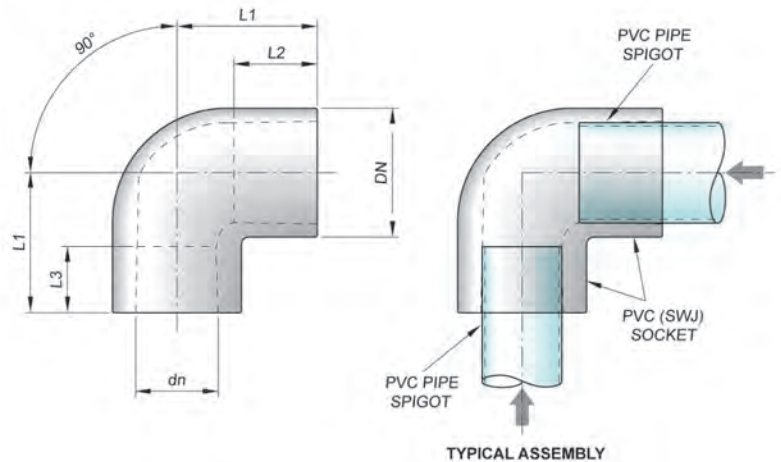
P012 (CAT 12) PVC pressure long radius bend - SWJ

Product code	DN	θ	PN (bar)	R
P0122090	20	90°	18	245
P0122590	25	90°	18	245
P0123290	32	90°	18	245
P0124045	40	45°	18	245
P0124090	40	90°	18	245
P0125022	50	22½°	12	245
P0125045	50	45°	12	245
P0125090	50	90°	12	300
P0126545	65	45°	12	300
P0126590	65	90°	12	300
P0128011	80	11¼°	12	600
P0128022	80	22½°	12	600
P0128045	80	45°	12	600
P0128090	80	90°	12	600
P01210011	100	11¼°	12	600
P01210022	100	22½°	12	600
P01210045	100	45°	12	600
P01210090	100	90°	12	600
P01215022	150	22½°	12	800
P01215045	150	45°	12	800
P01215090	150	90°	12	800
P01220090	200	90°	9	900



P013 (CAT 13) PVC pressure elbow x 90° - SWJ

Product code	DN x dn	PN (bar)	L1	L2	L3
P0131515	15	18	28	17	-
P0132015	20 x 15	18	37	22	18
P0132020	20	18	36	20	-
P0132520	25 x 20	18	44	25	25
P0132525	25	18	42	23	-
P0133232	32	18	48	27	-
P0134040	40	18	54	30	-
P0135050	50	18	70	37	-
P0136565	65	15	87	48	-
P0138080	80	15	110	63	-
P013100100	100	15	124	64	-
P013150150	150	15	175	88	-

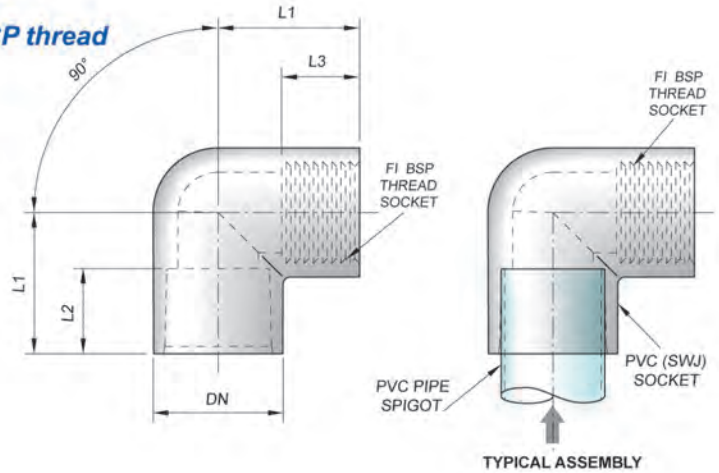


Note: All Illustrations are not to scale.
All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.3.1 PVC solvent weld joint pressure fittings

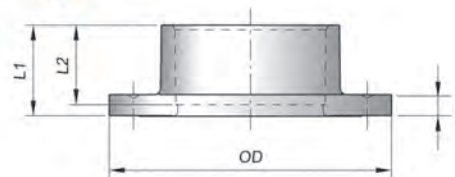
P015 (CAT 15) PVC pressure elbow - SWJ x FI BSP thread

Product code	DN x BSP	PN (bar)	L1	L2	L3
P0151515	15 x 1/2"	18	29	18	16
P0152015	20 x 1/2"	18	36	20	18
P0152020	20 x 3/4"	18	36	20	19
P0152515	25 x 1/2"	18	36	22	18
P0152520	25 x 3/4"	18	41	24	24
P0152525	25 x 1"	18	44	24	24
P0153232	32 x 1 1/4"	18	54	32	31
P0154040	40 x 1 1/2"	18	58	33	33



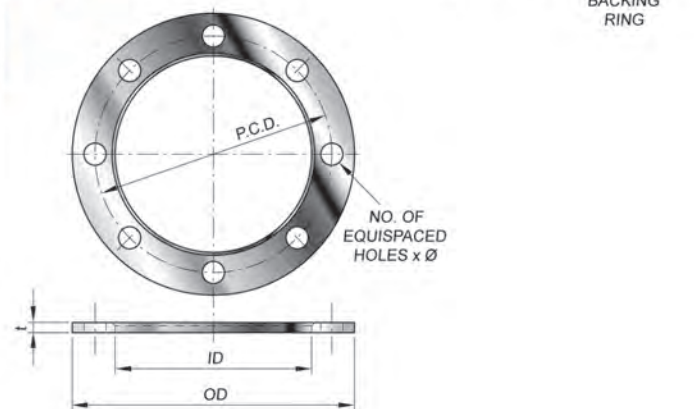
P016 (CAT 16) PVC pressure full face flange - SWJ x Flange

Product code	DN	PN (bar)	OD	L1	L2	t
P01650	50	18	150	43	37	12
P01665	65	15	165	54	48	12
P01680	80	15	185	68	60	13
P016100	100	18	215	69	61	14
P016150	150	18	280	98	88	20



P016 (CAT 16R) Galvanised steel backing ring - Drilled table E

Product code	DN	OD	ID	PCD	t	No. of holes x dia
P01650R	50	150	75	114	6	4 x 18
P01665R	65	165	93	127	6	4 x 18
P01680R	80	185	110	146	8	4 x 18
P016100R	100	215	138	178	10	8 x 18
P016150R	150	280	195	235	10	8 x 22

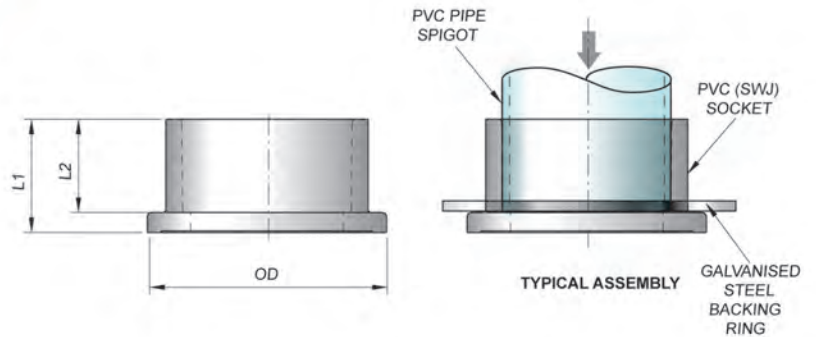


Note: All Illustrations are not to scale.
All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.3.1 PVC solvent weld joint pressure fittings

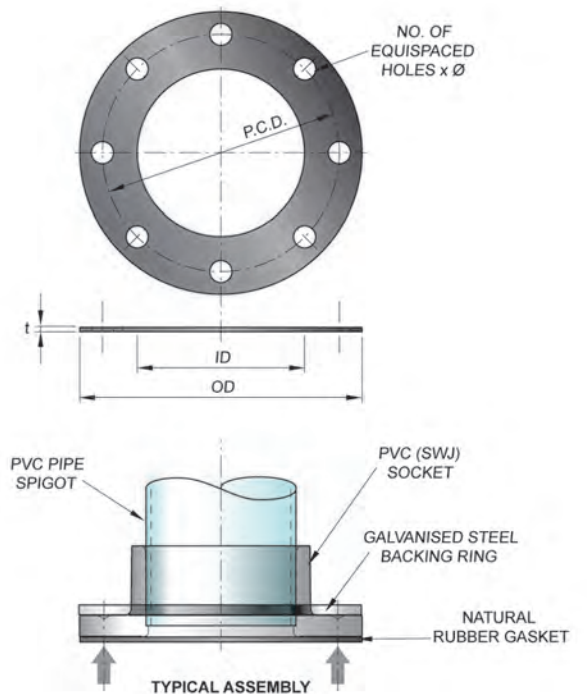
P016 (CAT 16S) PVC pressure stub flange - SWJ x Flange

Product code	DN	PN (bar)	OD	L1	L2
P01650S	50	15	97	43	31
P01665S	65	15	106	55	48
P01680S	80	15	129	69	60
P016100S	100	15	160	77	63
P016150S	150	15	215	98	88



P016 (CAT 16G) Full face natural rubber gasket. Table E

Product code	DN	OD	ID	PCD	t	No. of holes x dia
P01650G	50	150	60	114	3	4 x 18
P01665G	65	165	70	127	3	4 x 18
P01680G	80	185	88	146	3	4 x 18
P016100G	100	215	114	178	3	8 x 18
P016150G	150	280	168	235	3	8 x 22



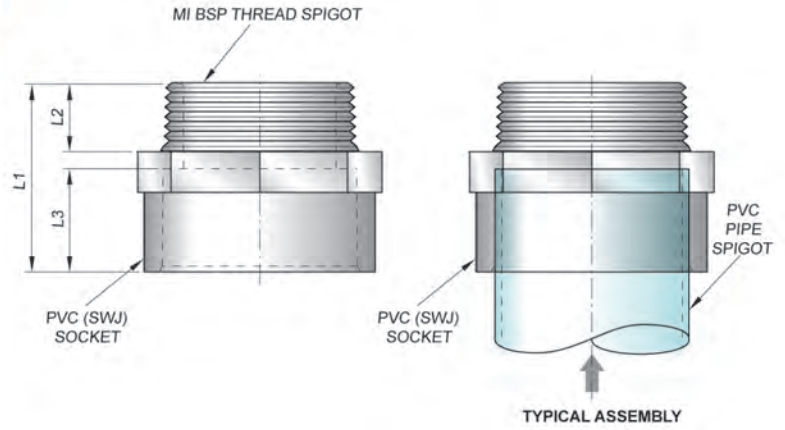
Note: All Illustrations are not to scale.

All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.3.1 PVC solvent weld joint pressure fittings

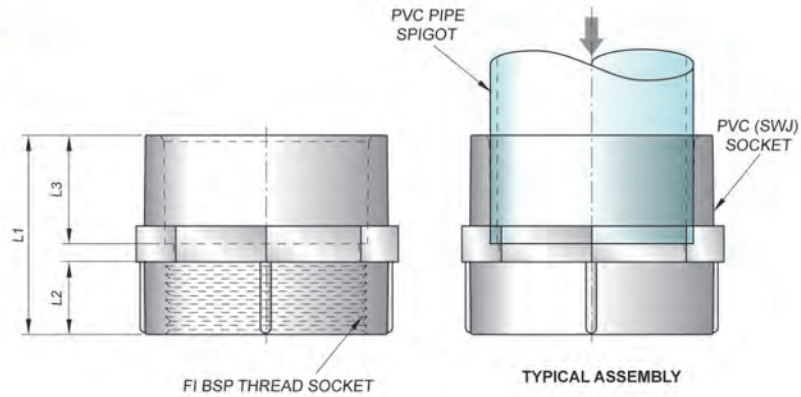
P017 (CAT 17) PVC pressure socket adaptor - SWJ Socket x MI BSP thread

Product code	DN x BSP	PN (bar)	L1	L2	L3
P0171515	15 x ½"	18	49	17	25
P0172020	20 x ¾"	18	47	18	25
P0172525	25 x 1"	18	50	21	23
P0173232	32 x 1¼"	18	63	23	29
P0174040	40 x 1½"	18	67	23	32
P0175050	50 x 2"	18	78	27	39
P0176565	65 x 2½"	18	91	28	52
P0178075	80 x 3"	18	94	35	51
P017100100	100 x 4"	18	111	40	61



P018 (CAT 18) PVC pressure socket adaptor - SWJ Socket x FI BSP thread

Product code	DN x BSP	PN (bar)	L1	L2	L3
P0181515	15 x ½"	18	46	19	25
P0182020	20 x ¾"	18	48	19	26
P0182525	25 x 1"	18	58	26	30
P0183232	32 x 1¼"	18	59	26	31
P0184040	40 x 1½"	18	67	27	37
P0185050	50 x 2"	18	71	27	40
P0188075	80 x 3"	18	94	36	51
P018100100	100 x 4"	18	112	41	61

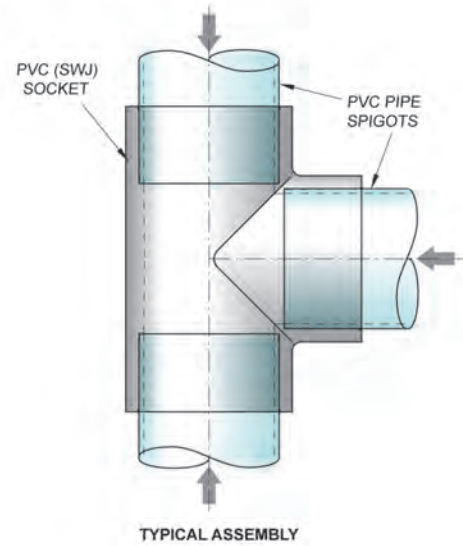
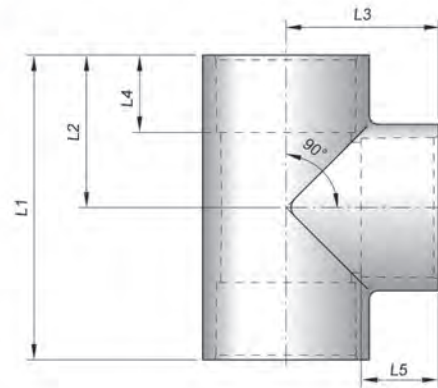


Note: All illustrations are not to scale.
All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.3.1 PVC solvent weld joint pressure fittings

P019 (CAT 19) PVC pressure tee - SWJ

Product code	DN x dn	PN (bar)	L1	L2	L3	L4	L5
P0191515	15 x 15	18	56	28	28	17	17
P0192015	20 x 15	18	75	37	37	23	23
P0192020	20 x 20	18	72	36	36	20	20
P0192515	25 x 15	18	76	38	36	24	28
P0192520	25 x 20	18	87	43	43	27	28
P0192525	25 x 25	18	84	42	42	23	23
P0193220	32 x 20	18	100	50	47	29	22
P0193225	32 x 25	18	100	50	50	29	25
P0193232	32 x 32	18	96	48	48	27	27
P0194015	40 x 15	18	99	49	49	32	19
P0194020	40 x 20	18	99	49	51	32	22
P0194025	40 x 25	18	96	48	57	33	29
P0194040	40 x 40	18	108	54	54	30	30
P0195020	50 x 20	18	120	60	60	38	22
P0195025	50 x 25	18	120	60	60	38	24
P0195032	50 x 32	18	119	59	63	37	28
P0195040	50 x 40	18	125	62	64	37	31
P0195050	50 x 50	18	140	70	70	37	37
P0196565	65 x 65	15	178	89	89	48	48
P0198040	80 x 40	18	200	100	81	53	33
P0198050	80 x 50	18	200	100	87	53	38
P0198080	80 x 80	18	200	100	98	53	51
P01910050	100 x 50	18	250	125	125	63	37
P01910080	100 x 80	18	250	125	125	63	51
P019100100	100 x 100	15	250	125	125	63	64
P019150100	150 x 100	12	350	175	145	88	61
P019150150	150 x 150	12	350	175	175	88	88

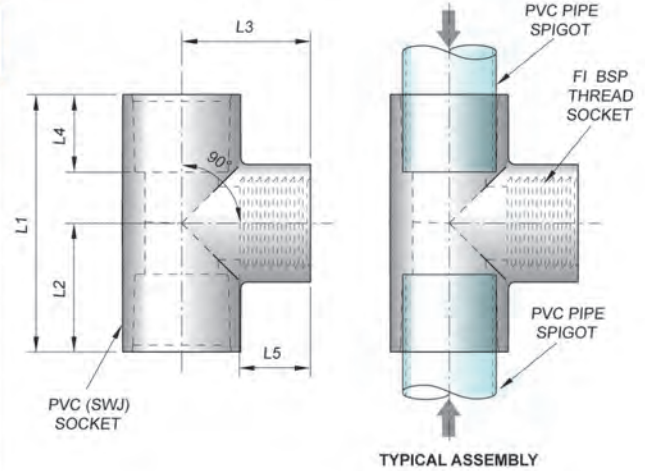


Note: All illustrations are not to scale.
All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.3.1 PVC solvent weld joint pressure fittings

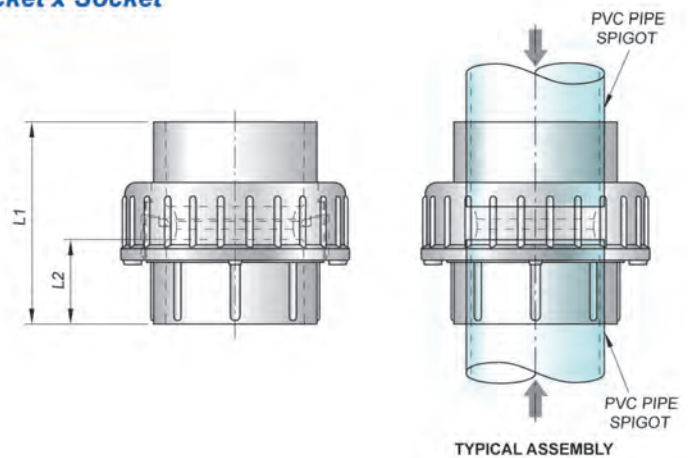
P021 (CAT 21) PVC pressure tee - SWJ Socket x FI BSP thread

Product code	DN x BSP	PN (bar)	L1	L2	L3	L4	L5
P0211515	15 x 1/2"	18	58	29	29	18	16
P0212015	20 x 1/2"	18	72	36	36	20	19
P0212020	20 x 3/4"	18	72	36	36	20	19
P0212515	25 x 1/2"	18	72	36	36	23	19
P0212520	25 x 3/4"	18	87	44	44	29	20
P0212525	25 x 1"	18	94	47	47	29	23
P0213215	32 x 1/2"	18	87	44	42	31	16
P0213220	32 x 3/4"	18	93	47	48	32	20
P0213225	32 x 1"	18	100	50	51	32	22
P0214015	40 x 1/2"	18	99	49	49	32	19
P0214020	40 x 3/4"	18	99	49	51	32	22
P0214025	40 x 1"	18	103	52	54	33	23
P0215015	50 x 1/2"	18	98	49	52	37	16
P0215020	50 x 3/4"	18	104	52	56	37	19
P0215025	50 x 1"	18	111	56	60	37	22



P022 (CAT 22) PVC pressure barrel union - SWJ Socket x Socket

Product code	DN	PN (bar)	L1	L2
P02215	15	18	69	27
P02220	20	18	68	27
P02225	25	18	72	28
P02232	32	18	77	32
P02240	40	18	81	33
P02250	50	18	89	37

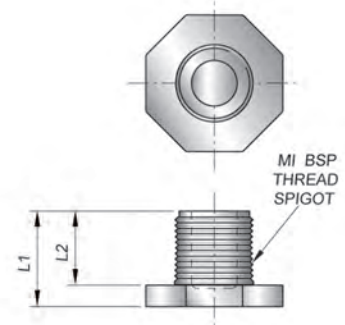


Note: All Illustrations are not to scale.
All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.3.1 PVC solvent weld joint pressure fittings

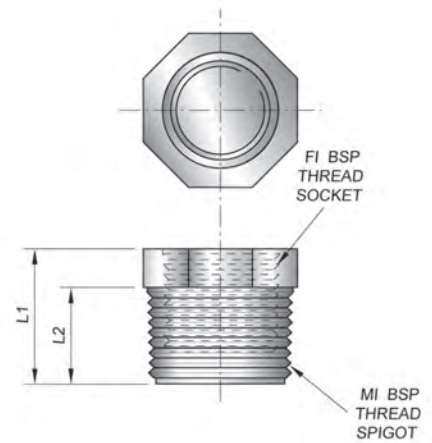
P023 (CAT 23) PVC pressure plug - MI BSP

Product code	BSP	L1	L2
P02315	1/2"	25	20
P02320	3/4"	25	20
P02325	1"	25	19



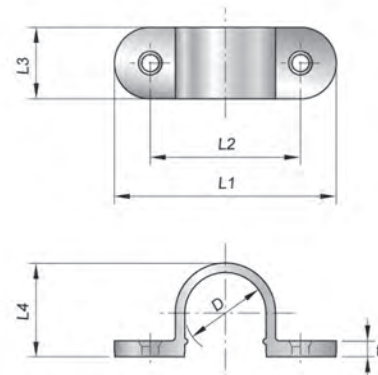
P024 (CAT 24) PVC pressure screwed bush - FI BSP

Product code	BSP	PN (bar)	L1	L2
P0242015	3/4" x 1/2"	18	25	18
P0242520	1" x 3/4"	18	34	24



P053 (CAT 53) PVC Saddle

Product code	DN	D	L1	L2	L3	L4	t
P05315	15	21	58	40	19	25	4
P05320	20	27	67	43	24	30	5



Note: All Illustrations are not to scale.

All dimensions are approximate only. If critical please contact Iplex Pipelines for confirmation.

4.4 Ductile iron fittings

Conventional socketed fittings complying with AS/NZS 2280 – “Ductile Iron Pressure Pipes and Fittings” are generally suitable for use with Iplex PVC-U Series 1 pressure pipes.

A complete range of bends, tees reducers and flange-spigot pieces are available with rubber ring sockets in sizes DN100 to DN375.

Reference should be made to the Water Services Association of Australia WSAW TN2 ‘Guidelines for the use of non-metallic pipes with ductile iron elastomeric joint fittings’. If in doubt, contact Iplex Pipelines to confirm the suitability of any particular range of fittings.

Ductile iron fittings can be protected from corrosion with the following:

- Polymeric coated (preferred)
- Cement lining and polyethylene wrap
- Epoxy coating



Figure 4.1 - Example of a polymeric coated ductile iron socketed bend.

5.1 Flow capacity determination

The hydraulic capacity of a pipeline can vary due to various factors, which include:

- Growth of slime, which will vary with the age of the pipeline and available nutrient in the water.
- Roughening, due to wear by abrasive solids.
- Siltation or settlement of suspended particulate matter.
- Joint imperfections and fittings

To assist the designer in selecting the appropriate pipe diameter, flow calculation software is available from Iplex Pipelines which allows variation in fluid temperature and pipe roughness to suit site conditions. The flow calculator is available at www.iple.com.au in the Design Tools section.

Alternatively flow resistance charts are shown in Figures 5.2 and 5.3. The flow resistance charts relate friction loss to discharge and velocity for pipes running full and have been calculated using the Colebrook-White transition equation in the form:

$$V = -2\sqrt{2gdS} \log\left(\frac{k}{3.7d} + \frac{2.51v}{d\sqrt{2gdS}}\right)$$

where:

- V = mean velocity (m/s)
- g = acceleration due to gravity (m/s²)
- d = pipe internal diameter (m)
- S = hydraulic gradient (m/m)
- k = equivalent hydraulic roughness (m)
- v = kinematic viscosity (m²/s)

The Colebrook-White transition equation takes into account the variation in viscosity with temperature and pipe roughness and is recognised as being one of the most accurate in general use but requires an iterative solution.

The flow resistance charts shown in Figures 5.2 and 5.3 have been prepared based on a temperature of 20°C which corresponds to a kinematic viscosity for water $v = 1.01 \times 10^{-6} \text{ m}^2/\text{s}$ and equivalent pipe wall roughness co-efficient, $k = 0.003 \text{ mm}$.

This value of the equivalent roughness coefficient “k” assumes the PVC-U pipeline is straight, clean and concentrically jointed without fittings. Possible values ranging between 0.003 to 0.015 mm are given in AS 2200 “Design Charts for Water Supply and Sewerage” for PVC. An approximate allowance for the effect of variation in water temperature can be made by increasing the chart value of the head loss by 1% for each 3°C below 20°C and

decreasing it by 1% for each 3°C in excess of 20°C.

The hydraulic performance of a pipeline may be adversely affected if combined air release and anti-vacuum valves are not installed at local high points in each section of a pipeline, with a maximum spacing not exceeding 500m. These are required to maintain full bore flow and limit the occurrence of sub atmospheric conditions.

5.2 Pressure class selection

The nominal pressure rating in kilopascals of a PVC pressure pipe is equal to PN multiplied by 100. This rated pressure should not be exceeded at any location in the pipeline by the maximum operating pressure including water hammer pressure surcharges.

When designing a pipeline, Class PN6 should not be used for vacuum conditions unless pipes have been embedded and surrounded in very good, well-compacted non-cohesive material (such as sand or gravel). Above ground pipelines subject to full vacuum should be a minimum of PN9.

Where the pipeline will be operating at elevated temperatures, for example greater than 20° C, the nominal rating should be multiplied by the re-rating factor given in Table 2.2.

Fatigue and structural considerations should also be considered when selecting the pipe class. For example surge pressures commonly known as ‘water hammer’ must be considered when selecting the pipe class.

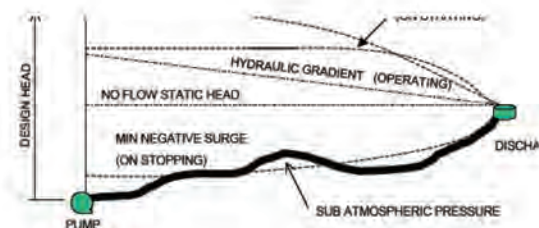
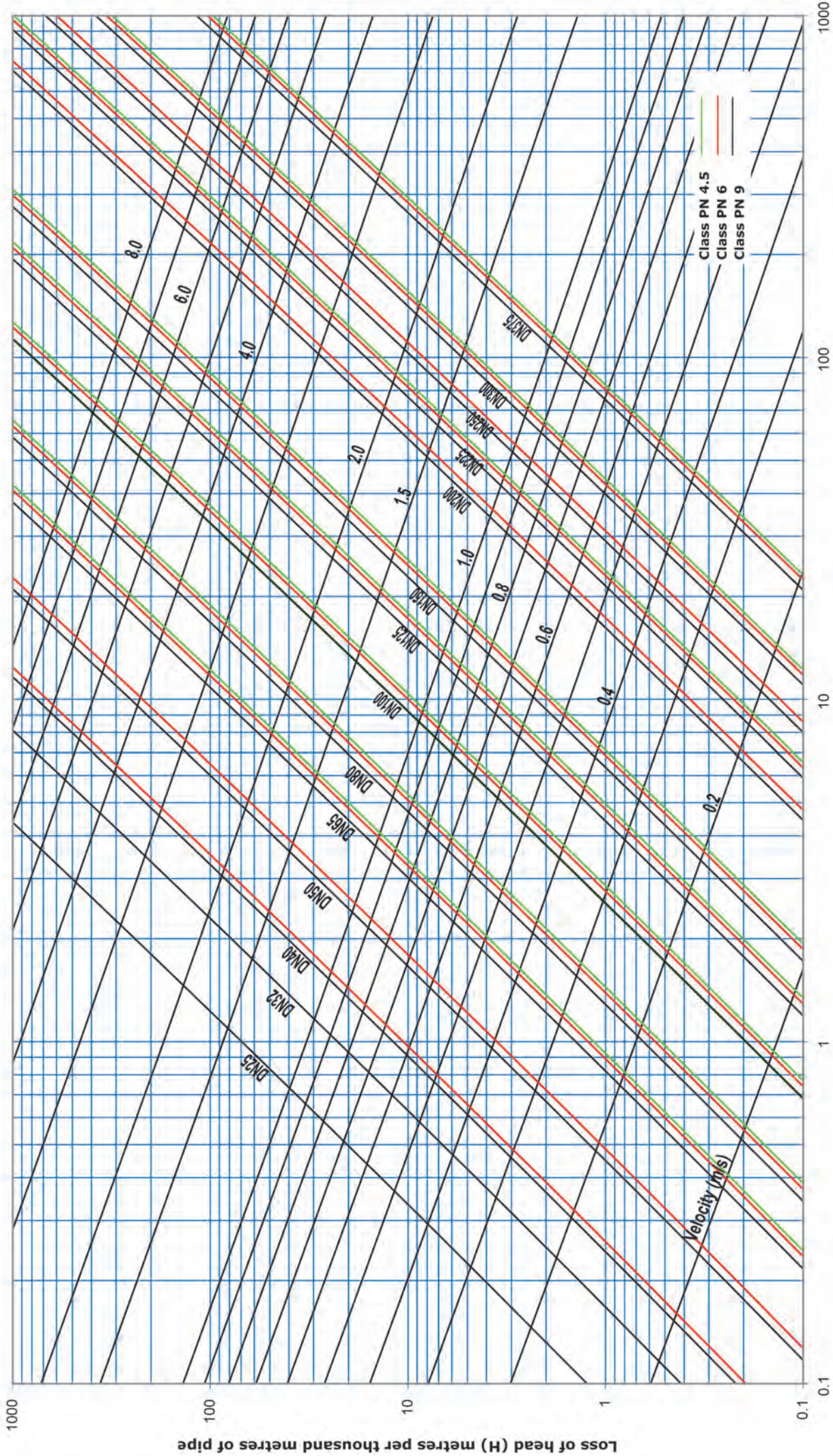


Figure 5.1 - Typical hydraulic grades and surge envelopes required for design

5.3 Water hammer surges and cyclical effects

Water hammer effects in thermoplastic materials are considerably reduced compared with ductile iron, steel and concrete due to the much lower modulus of elasticity.

Figure 5.2 - Flow resistance chart – PVC-U Pressure Pipe (Series 1) PN4.5, PN6 and PN9

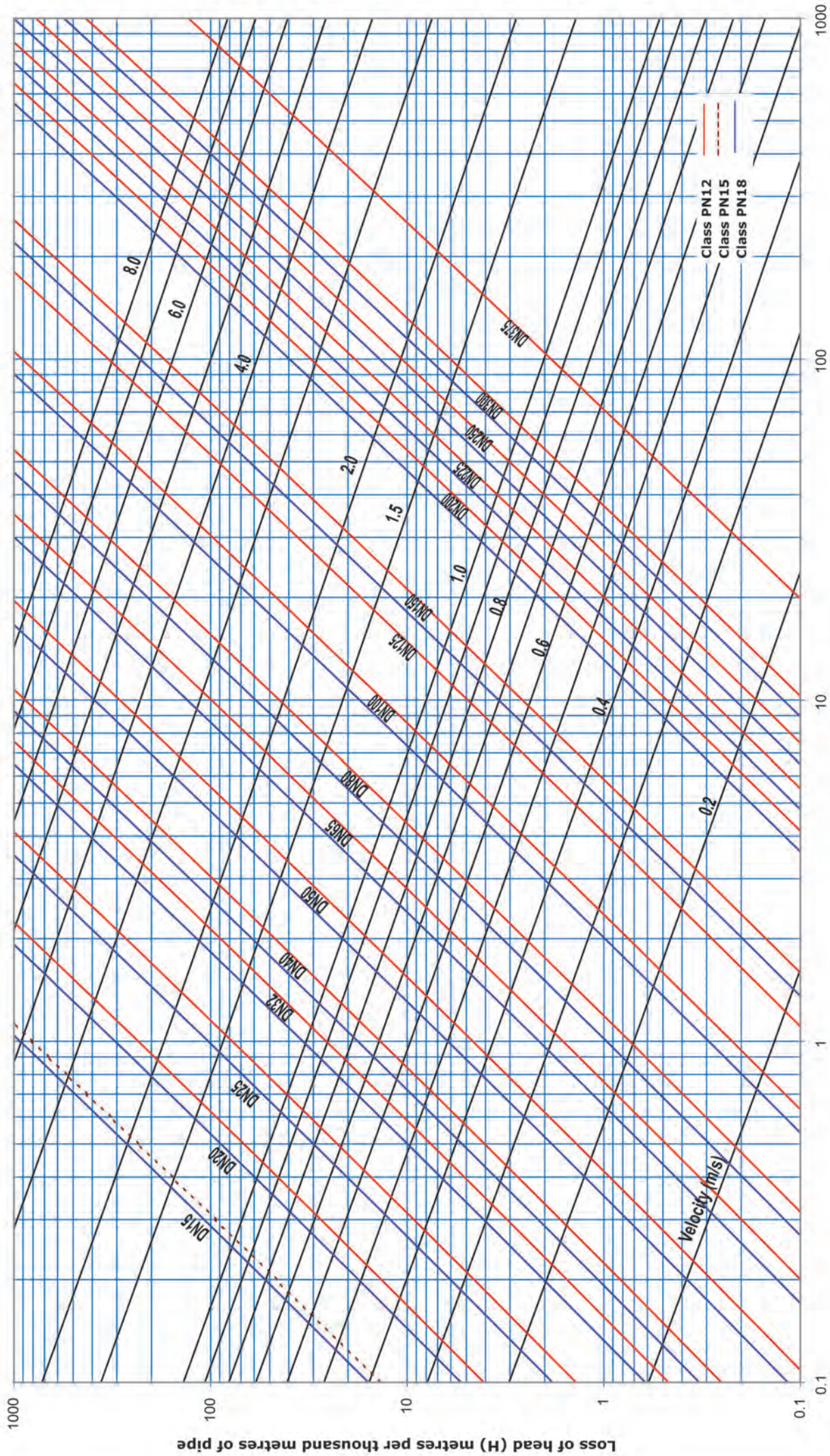


Notes:

1. This chart has been prepared using the Colebrook - White Formula with a roughness co-efficient $k=0.003\text{mm}$
2. This chart has been calculated for the viscosity of water at 20 C

Discharge (Q) litres per second

Figure 5.3 - Flow resistance chart – PVC-U Pressure Pipe (Series 1) PN12, PN15 and PN18



Notes:

1. This chart has been prepared using the Colebrook - White Formula with a roughness co-efficient $k=0.003\text{mm}$

2. This chart has been calculated for the viscosity of water at 20 C

Discharge (Q) litres per second

Typical values for celerity for PVC-U pipes of various pressure classes are provided in Table 5.1.

Where repeated pressure variations occur in PVC-U pipeline, (a pump switching on and off in a rising main) it may be necessary to consider the effect of fatigue over the life of the pipeline.

The designer should take into account the frequency of the cyclic pressure fluctuations during the life of the pipeline. The amplitude of the pressure change between the maximum and minimum operating pressures, including all transients when divided by the load factor given in Table 5.2 should not exceed the nominal pressure class rating of the pipeline.

Table 5.1 - Water hammer celerity

Material	Approximate celerity (m/s)
4.5	253
6	293
9	362
12	421
15	446
16	495
18	528
20	561

In practice the pressure changes in water reticulation systems are seldom of sufficient amplitude and frequency for fatigue to affect pipe class selection, but they can be an important consideration for sewer rising mains.

Table 5.2 - PVC-U fatigue load factors

Total Cycles	Approximate number of cycles /day for 100 year life	Fatigue cycle factor f
26,400	1	1
100,000	3	1
200,000	5.5	0.81
500,000	14	0.62
1,000,000	27	0.50
2,500,000	82	0.38
5,000,000	137	0.38
10,000,000	274	0.38

Reference: PIPA Industry Guidelines "PVC Pressure Pipes, Design for Dynamic Stresses" Issue 1.2 POP101

The frequency is defined as the number of combined pump start and stop cycles. If an allowance is considered necessary to allow for attenuation of water hammer oscillations, the frequency can then be taken as being twice the number of start/ stop cycles. (It can be shown mathematically that this is appropriate for the exponential decay typical of pressure surge oscillations).

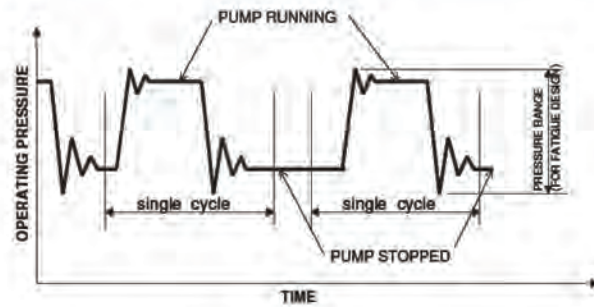


Figure 5.4 - Inputs for fatigue design – pressure amplitude and frequency

The dynamic fatigue consideration requires a pipe to be selected with a pressure rating which, when multiplied by the fatigue factor, will give a value (Maximum Cyclic Pressure Range) greater than the pressure range or amplitude.

Examples:

1) Question A water main will for most of its lifetime experience diurnal operating pressures of 55 metres and 85 metres, that is a pressure change amplitude of 30 metres with a total number of cycles over 50 years of 18250 fluctuations.

Solution: Since the maximum operating pressure is 85 metres and from Table 5.2, the fatigue load factor is 1, a PN 9 pipe would be suitable. No de-rating is needed for cycling.

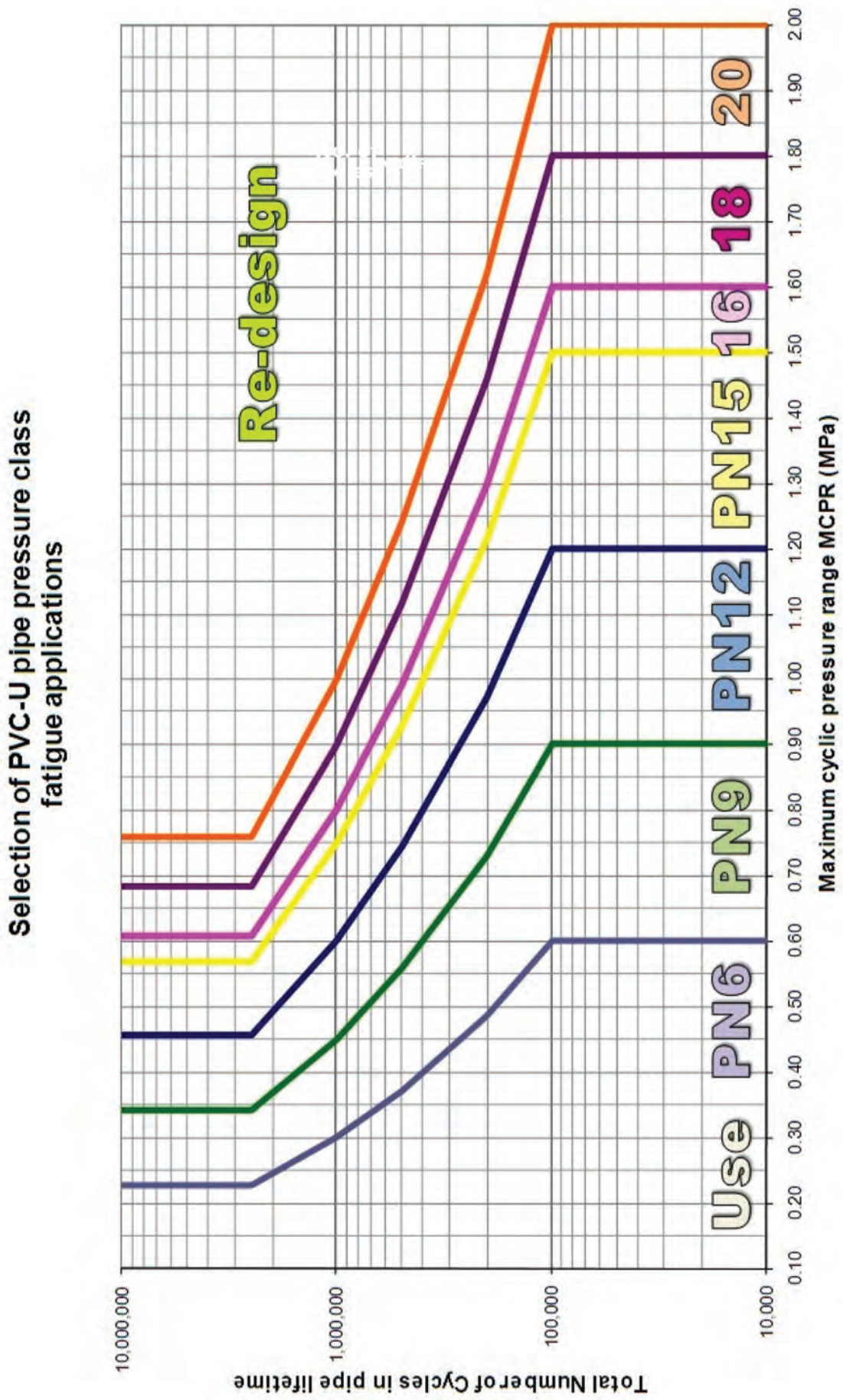
2) Question A sewer pump station has a wet well capacity which will require a pump start (and stop) 3 times per hour on average over a 40 year design life (for the rising main). The static head on the main without pump operation is 12 metres and with a maximum pump station operating of 29 metres. A surge analysis shows the normal shut down phase generates a (maximum) hammer effect of 32 metre maximum head and (minimum) minus 8 metre head at shut down.

Solution: Steady state operating conditions would suggest that a Class 6 pipe might be selected. However the amplitude of the maximum pressure transient during the pumping cycle is 32-(-8)= 40 metres and this must be checked for fatigue effect.

The number of cycles used for this check is usually the number of pump stop/start operations. But in this case the number of cycles is to be multiplied by 2, i.e. 1,051,200 x 2 = 2,102,400 to allow for surge wave attenuation.

The dynamic fatigue consideration requires a pipe to be selected, which will give a maximum cyclic pressure range greater than the pressure fluctuation amplitude of 40 metres. Therefore the class rating can be obtained by dividing the pressure amplitude by the fatigue factor obtained from Table 5.2 for a frequency of 2.1 million pressure fluctuations. (It should be noted that pressure amplitude of 0.38 times the rated pressure is the threshold value below which fatigue will not occur irrespective of frequency.) Here $40 / 0.38 = 105.3\text{m}$. Therefore the appropriate pipe class selection would be PN12 rated to 120 metres. (Alternatively Figure 5.3 could be used to directly determine the appropriate class).

Figure 5.5 – Fatigue loading chart



6.1 Flexible pipe design

In engineering terminology the Iplex range of PVC-U pressure pipes are considered to be “flexible” pipes, which means they are designed to deform or deflect diametrically within specified limits without structural damage.

The external soil and live loadings above flexible pipes may cause a decrease in the vertical diameter and an increase in the horizontal diameter of the pipe. The horizontal movement of the pipe walls in the soil material at the sides develops a passive resistance within the soil to support the external load. That is, the pipeline performance is influenced by the soil type, density and height of water table. The higher the effective soil modulus at pipe depth, the less the pipe will deflect.

Initial deflections of up to 3% are permissible and will not affect the pressure rating of the pipe. A complete design procedure is available for Iplex PVC-U pipes. Consult Iplex for further details or refer to AS/NZS 2566.1 “Buried flexible pipelines Part 1 Structural design”. Iplex has developed computer software, which is available for download, free of charge. It is based on this standard and covers all its pipeline materials in addition to Series 1 PVC-U.

Table 6.1 – Typical stiffness for PVC-U pressure pipe

Nominal pressure PN	Estimated stiffness (N/m.m)
4.5	2,230
6	5,400
9	19,800
12	49,760
15	71,600
16	136,500
18	205,900
20	301,400

6.2 Minimum cover heights – AS/NZS 2566

For areas with no traffic loading a minimum cover height of 450mm to the top of the pipe should be adopted. Under sealed roadways the minimum cover height is 600mm and in unsealed roadways, 750mm.

Pipe embedment material should have a minimum compaction Density Index of 65% or standard dry density compaction of 90%. After pipes are laid and centred in the trench, the embedment material should be compacted in 80-100mm layers to the specified density. The embedment should continue 80mm to 150mm above the pipe to provide protection from the backfill.

6.3 Thrust block design for fittings

For rubber ring jointed pipeline systems provision must be made for potentially unrestrained forces at changes of size or direction. For e.g, bends, tees, reducers, valves and closed ends.

In buried installations, fittings are usually restrained by blocks of concrete cast in-situ. These thrust blocks are formed and sized to distribute the applied force from the fitting to a safe soil pressure / concrete interface. The resistance provided will depend on the soil type and depth.

Where bends are in the vertical plane, convex and close to the surface, the mass of a concrete anchor block alone may have to be the restraining force.

AS/NZS 2566.2 and AS2032 specify the use of thrust blocks for all in-line gate valves. Although no longer allowed, Water Agencies have in the past omitted valve restraints for small diameter (\leq DN 200) reticulation pipelines.

Where there is risk of axial thrust, it is strongly recommended that only those DI fittings with full circle bearing surfaces at the base of the socket should be used. It is also beneficial if the PVC-U spigots are trimmed back and the chamfer reduced to DI chamfer lengths. This serves to increase the effective end bearing area for the PVC spigot inside the DI socket.

Installers should be alerted to the potential for catastrophic failure where there is insufficient buried pipe downstream of an unanchored valve to provide enough soil friction to resist the hydrostatic thrust when the valve is closed.

Figure 6.1 - Typical thrust block arrangements (Reference AS/NZS 2566)

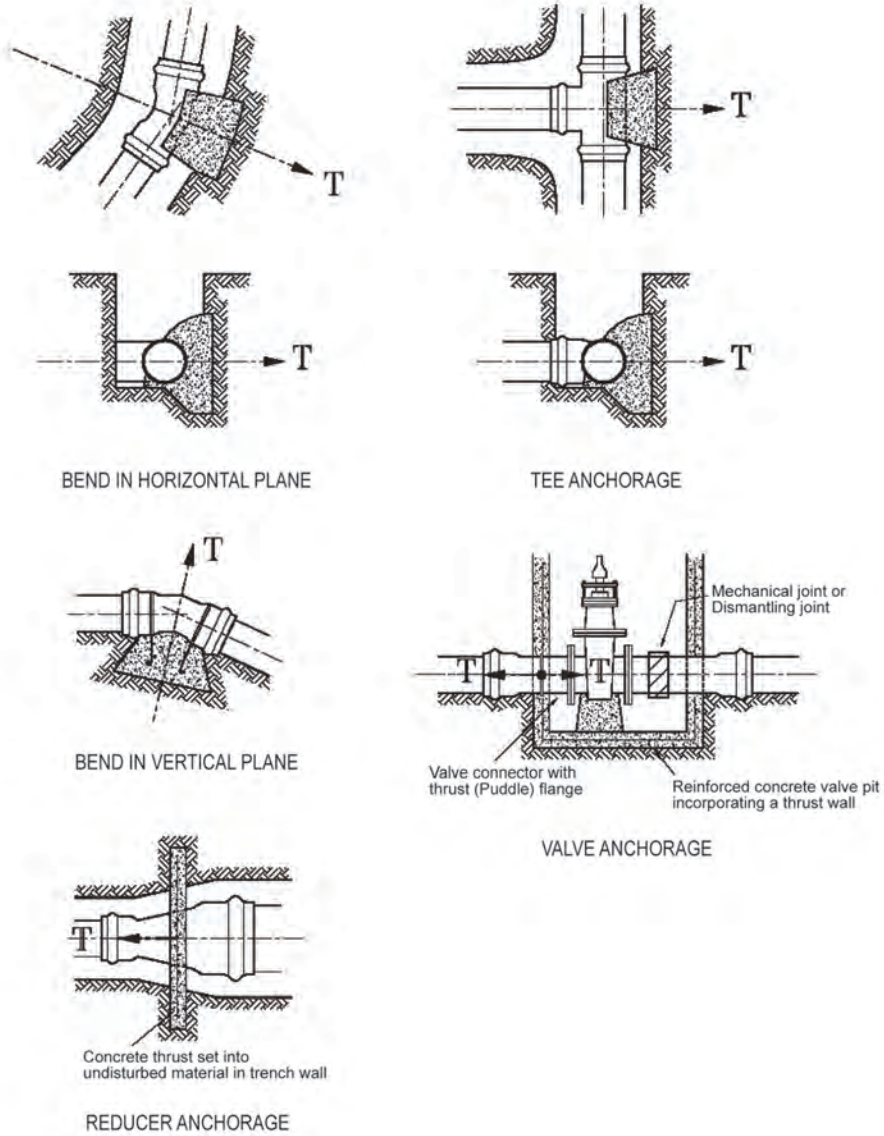


Table 6.2 - Hydrostatic forces (kN) on rubber ring jointed fittings per 10metres of hydrostatic head

Pipe DN	Pipe OD	Bend 90°	Bend 45°	Bend 22½°	Bend 11¼°	Tee/ Closed end/ valve
100	122	1.62	0.88	0.45	0.22	1.15
150	177	3.41	1.85	0.94	0.47	2.41
200	232	5.86	3.18	1.61	0.81	4.14
225	259	7.31	3.96	2.01	1.01	5.17
250	286	8.91	4.83	2.45	1.23	6.30
300	345	12.96	7.02	3.57	1.79	9.16

Note: For concentric reducers the resultant thrust will be the difference between the “closed end” forces for the two pipe sizes.

Table 6.3 – Soil bearing capacities (kPa)

Soil group description as per AS 1786	Minimum soil cover above centre line of thrust block in metres			
	0.75	1.0	1.25	1.5
GW,SW	57	76	95	114
GP,SP	48	64	80	97
GM,SM	48	64	80	96
GC,SC	79	92	105	119
CL	74	85	95	106
ML	69	81	93	106
OH	0	0	0	0

Thrust blocks must be configured to distribute the hydrostatic force to a ‘wall’ of undisturbed soil, which is approximately perpendicular to the imposed load.

The equation for this calculation is:

$$A = (T / b) \times f$$

Where,

A = area perpendicular to force (m²)

T = hydrostatic thrust (kN)

b = soil bearing capacity (kPa)

f = factor of safety (in the order of 1.1 to 1.5)

Example:

Question A DN300 PVC-U pipeline has a maximum operating head (include field test heads) of 150 metres. What is the minimum area for a thrust block for a 90° ductile iron bend buried with 1 metre cover to the centre-line in a type SC soil?

Solution: From Table 6.2, the hydrostatic thrust ‘T’ is 12.96kN x 15 = 194.4 kN.

From Table 6.3, ‘b’ = 92 kPa.

Therefore:

$$A = (194.4 / 92) \times 1.1 = 2.32 \text{ m}^2$$



Figure 6.2 - Concrete thrust block, correctly oriented to transfer the hydraulic thrust to the specially trimmed undisturbed soil of the vertical trench walls perpendicular to the load.

7.1 Handling and storage

While PVC-U pipes are light and easy to handle, careless handling can cause unnecessary damage. Pipes and fittings should not be dropped or thrown onto hard surfaces or allowed to come into contact with sharp objects, which could inflict deep scratches. PVC-U pipes should not be allowed to slide across sharp edges. During construction storage areas should be selected which are free from surface irregularities such as stones, branches or other sharp projections.

PVC-U pipes may distort under high loads. Therefore stack heights should be kept to a minimum for long-term storage. At elevated temperatures pipes may bow due to uneven heating of individual pipe lengths. Where this may be a problem during installation they should be protected from direct sunlight immediately prior to use.

If PVC-U pipes are stored for extended periods (> 12 months) they should be protected from direct sunlight by using hessian covers or similar which will allow adequate air circulation. Black plastic covers must not be used owing to the high temperatures developed when stored in the sun.

Socketed pipes should be stacked in layers with sockets placed at alternative ends of the rack, and protruding, to avoid uneven stacks and distortion. The sockets should not be allowed to carry loads.

If mechanical handling equipment such as forklifts or cranes are to be used on bundles, adequate spreader and lifting bars should be provided. Wire slings must be kept clear of the pipes. When unloading alongside excavated trenches, it is recommended that pipes be placed on the opposite side of the trench from excavated material.

Rubber rings, jointing fluid, solvent cement and priming fluid should be stored under cover until pipe laying commences.



Figure 7.1 – Potable water pipeline is easily manoeuvred in the trench during installation.

7.2 Trenching

Trenches should be excavated in accordance with the plans and specifications and should allow adequate space for compaction of the embedment material in the side support zone.

Trenches should be straight and as narrow as practicable at the top of the pipe. The minimum trench widths are specified in Table 7.1.

Table 7.1 - Minimum embedment zone dimensions – AS/NZS 2566

DN	h	B*	k
80	75	300	100
100	75	350	100
150	75	400	100
200	100	550	150
225	100	550	150
250	100	600	150
300	100	650	150
375	100	800	150

* Note: The tabulated values may provide insufficient clearances for installation purposes in certain circumstances.

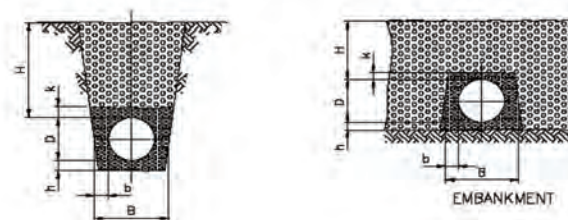


Figure 7.2 - Embedment, clearance and cover dimensions

7.3 Embedment & backfilling

The quality of the embedment material and its compaction, combined with the type and density of the native soil are all relevant to the ultimate performance of PVC-U pipes once installed.

The trench bottom should be as smooth as possible and to grade. Embedment material, used in the bedding, side support and overlay are generally non-cohesive granular materials. PVC-U pipes should not be buried in contact with soil particle sizes larger than 5% of pipe diameter, with 20 mm as maximum.

Soil clods must be excluded from the pipe embedment zone and under no circumstances should temporary supports such as bricks or timber be left under or in contact with pipes. If the excavated material is not granular or friable, or does not comply with the project specification, then suitable embedment must be imported.

Jointing or “clearance holes” should be excavated in the bedding for pipe sockets to ensure the pipes are evenly supported along their full length. In the absence of any specification and if the pipe classes are PN 6 or PN9, it is important that only non-cohesive or granular embedment be used. Careful attention to the placement of embedment material and the specified relative compaction with an absence of voids is important.

Mechanical joints, especially flanged joints, should be left exposed if possible until the line is tested. Pipes should not be left uncovered. The possibility of pipe flotation in the event of rain and water in the trench will occur unless it is backfilled to a height of at least one and a half diameters above the pipe. The method of placing the remainder of the trench backfill will depend on whether the pipeline is located in an area with no traffic loading or under a roadway. In a roadway it is normal practice to continue backfilling and compacting with good quality embedment material up to pavement level. Heavy compaction of backfill should not commence without at least 300mm of material covering the pipeline.



Figure 7.3 – Imported embedment material is well compacted around the pipe for support.

7.4 Joining instructions – Solvent weld joint (DN15 – DN150)

To achieve a strong, leak free joint in a pressure pipe the correct type of solvent cement must be used. For pressure applications Type P is used.

Note: The pressure pipe joint is designed for an interference fit and only after the application of the solvent cement will it be possible to close the joint fully.

7.5 How solvent cement works

Iplex solvent cement is a solution of resin in a mixture of solvents, which soften the surfaces when applied to PVC pipes and PVC fittings. It is not glue, as adhesion is due to the solidification of dissolved PVC polymer.

A thin uniform coat is applied to both the spigot and socket and the joint is assembled while the surfaces are still wet and fluid. The cement layers intermingle and become one. The strength of the joint develops as the solvent permeates the PVC and the volatile constituents evaporate.

7.6 Importance of priming fluids

Before applying the solvent cement, it is essential to use Iplex Priming Fluid for successful jointing as the fluid not only cleans and degreases, but also removes the glazed surface from the PVC, which allows the solvent cement to permeate into the wall of the pipe or fitting.

Table 7.2 - Estimated usage rate (Number of joints) for priming fluid and solvent cement (based on 500ml container)

Nominal diameter DN	Priming Fluid (500ml)	Solvent cement (500ml)
15	1050	300
20	625	175
25	450	130
32	325	95
40	250	70
50	150	42
65	125	35
80	100	30
100	70	25
150	45	15

There are two types of solvent cement joints; pressure joints which require an interference fit and non - pressure joints which may have a small clearance when assembled.

Iplex solvent cements are formulated specifically for each of these applications. Each product is clearly colour coded in accordance with AS3879 (Int.) for easy identification; green for pressure, blue for non-pressure and red for priming.

Note: The use of imported solvent welded PVC-U fittings with parallel sockets will require gap filling solvent complying with ASTM D-2564. Failure to use the appropriate solvent and cleaner will result in joint failure.

7.7 Iplex solvent cement - Type P

Type P is used for pressurized potable water installations and is formulated to develop high shear strengths with interference fit.

7.8 Iplex solvent cement - Type N

Type N is used for non-pressure applications and is formulated with the gap filling properties needed with a clearance fit. ***It must not be used for pressure applications.***

7.9 Iplex priming fluid

Priming fluid is used to remove grease and dirt and then to etch the glossy surface of PVC pipes and fittings. It must be applied with a clean, lint free cotton cloth. ***Brushing the priming fluid on or simply pouring the fluid over the pipes and fittings will not remove grease and dirt.***

7.10 Solvent weld jointing instructions

Follow steps 1 - 9 carefully. Short cuts will result in poor joints that are likely to cause system failure. Do not work with hot pipes or on hot windy days without protecting the pipes. Keep the lid on to minimise evaporation. Use solvent cements within twelve months of the date stamped on the bottom of the bottle/can. If the solvent cement has become so thick that it does not flow easily, it must be discarded.

7.10.1 Cut spigot square and deburr

Cut the spigot as square as possible using a mitre box and hacksaw or power saw. Remove all swarf and burrs from both the inside and outside edges of the pipe with a knife, file, reamer or sandpaper. Swarf and burrs if left will wipe off the solvent cement and prevent proper jointing. Also swarf inside pipes can become dislodged and jam taps and valves.



7.10.2 Check alignment

Check the pipe and spigot or fittings for proper alignment. The time for any adjustments is now, not later.



7.10.3 Mark clearly

Mark the spigot with a pencil or marker at a distance equal to the internal depth of the socket. Only use pencil or a marker. ***Do not score or damage the surface of the pipe or fitting.***



7.10.4 Dry fit the joint

For pressure pipes the interference fit must be reached before the spigot is inserted fully to the pencil mark.

7.10.5 Clean and soften the surface

Thoroughly clean the inside of the socket and the area between the pencil mark and the spigot end with a clean, lint free cotton cloth dipped in priming fluid (do not use synthetic material). This removes dirt and grease and softens the PVC surface. Do not brush or pour the priming fluid on.



7.10.6 Coat the socket first, then the spigot

Apply a thin, uniform coat of Iplex solvent cement to the socket. Take care to ensure the solvent build up does not occur in the root of the socket - pooling of cement there will severely weaken the pipe or fitting. Then apply a uniform coat of solvent cement to the external surface of the spigot up to the pencil mark.



7.10.7 Assemble - hold for 30 seconds

Assemble the joint quickly before the cement dries by pushing the spigot firmly into the socket as far as the pencil mark, ending with a quarter turn to spread the cement evenly. Hold the joint in this position for at least thirty seconds without movement.



7.10.8 A vital 5 minutes

Wipe off the excess solvent cement from the outside of the joint and where possible from the inside of the joint. Do not disturb the joint for at least a further five minutes. Movement may break the initial bond.



7.10.9 Curing and testing

Cure time is the time taken for the solvent weld joint to reach the pressure rating of the pipe.

Do not pressure test the joint for at least 24 hours.



7.11 Safety precautions for solvent weld procedures:

- Solvent cement and priming fluids are highly flammable
- In the event of fire, smother with sand or earth or use suitable fire extinguisher
- Store solvent cements and priming fluid in a cool place away from heat, flames and sparks
- Ensure can lids are tightly closed when not in use
- Do not add any other ingredients or solvents to these products
- Do not use solvent cements or priming fluid in confined spaces without adequate ventilation, or near open flames or sparks
- Do not smoke while using these products
- If spilt on skin, wash off with soap and water
- If poisoning occurs, consult a doctor or Poisons Information Centre
- Keep container sealed when not in use
- Safe use – Ensure that directions on the containers of solvent cement and primers are followed at all times

7.12 Joining instructions – Rubber ring joint (DN80 – DN375)

Iplex PVC-U pipes are supplied with the Rieber jointing system. The Rieber seal is fitted at the time of manufacture and subsequently **MUST NOT BE REMOVED**.

If the ring is tampered with or damaged in any way after leaving the factory then the socket and affected ring must be cut off and scrapped. It is essential to use Iplex Standard or Iplex Plus bactericidal jointing fluid with the Rieber joint.

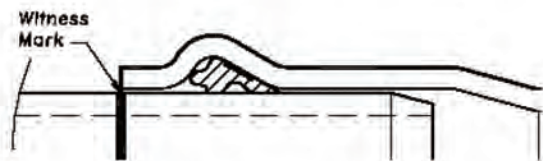


Figure 7.4 - Rieber rubber ring joint is supplied pre-installed in pipe socket.

7.12.1 Cutting pipes

PVC-U pipes can be cut to length on site using either a hand saw or powered cutting disc. Ensure that the cut end is then chamfered with an appropriate field-lathing tool to the correct length. The chamfer and new witness mark should replicate the manufactured dimensions.

7.12.2 Cleaning

Remove all dust and dirt from the pipe spigot and socket paying particular attention to the cleanliness of the fixed ring.

7.12.3 Lubricate

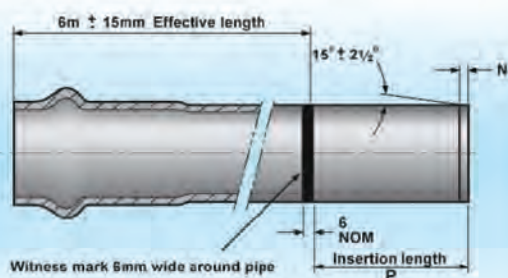
Apply lubricant to the spigot, fully covering the circumference up to the witness mark. Ensure the lubricant is also applied to the pipe chamfer.

7.12.4 Assembly

Insert the leading edge of the spigot into the socket mouth. It is essential that the pipes be aligned in a straight line before attempting to make the joint. A small, longitudinal force applied to the socket end of the pipe is sufficient to insert the spigot into the adjacent pipe socket. For larger diameter pipes requiring a crowbar for jointing, protect the pipe socket with a wooden block.

Care must be taken to ensure that the pipe is not under-inserted as this may result in a leaking joint as the pipe contracts as a result of Poisson's and/or thermal effects. Under-insertion is signified by the witness mark not being pushed up to the end of the socket. *Note: When pressurised, Poisson contraction will cause a shortening of the pipes and this might re-expose the witness mark. This is acceptable.*

If simple insertion past the witness mark has occurred there is no significant risk to the performance of the joint. Only if the spigot has been forced so hard that it has stressed the transition region at the back of the socket to the barrel of the pipe is there a cause for concern. This is generally only a risk with uncontrolled insertion using mechanical equipment like the bucket of a back hoe.



Pipe ends to be within $\pm 2^\circ$ of being normal to main axis of pipe free from chips and rough edges and with sharp edges removed

Figure 7.5 – Typical pipe spigot details for rubber ring joint pipes.

Table 7.3 – Typical pipe spigot details for rubber ring jointed pipes

DN	Mean insertion depth "P"	Mean chamfer length "N"
80	121	13
100	129	14
150	145	18
200	173	17
225	180	25
250	194	27
300	201	30
375	236	35

If insufficient Iplex Plus is available to complete jointing pipes for non-potable water applications a solution of soap and water can be used until extra lubricant is delivered. This cannot be done for water supply pipelines, as they will usually require the use of approved bactericidal lubricants.

Keep container closed when not in use to avoid spillage or contamination by dust or dirt.

Safety Use - Follow the directions given on the container.

7.13 Ductile iron socket joints

PVC-U pipes can be used with ductile iron socketed fittings complying with AS/NZS 2280.

7.14 Jointing fluids (lubricants)

Note: It is essential to use Iplex Standard or Iplex Plus bactericidal jointing fluid with all Iplex PVC-U elastomeric jointed systems. Other lubricants especially MINERAL BASED GREASES, MUST NOT BE USED.

Iplex Plus bactericidal jointing fluid is recommended for potable water supplies as it contains a bactericide designed to limit the growth of bacteria by disinfection at its source. During installation bacteria can enter the system and form a colony in the joint area, which is highly resistant, (even to high levels of chlorine) and can cause continuing infection of the line. Being water-soluble, the fluid is quickly removed from potable water systems when flushing commences.

Iplex Plus is safe and has no detrimental effect on the rubbers used in gasket materials and because of its properties, can also lower jointing forces.

Keep the container closed when not in use to avoid spillage or contamination by dust or dirt.

As a safety precaution avoid contact with eyes. If contact does occur, flush with copious amounts of water. If ingested drink copious amounts of water.

7.15 Expansion and contraction

Distortion can occur when laying pipes in direct sunlight. When one side of the pipe is hotter than the other it may develop a slightly bent shape, which may make jointing difficult. Common practice is to rotate pipes or place pipes in the shade to offset any uneven temperatures within the pipe. Plastic pipe will contract as it cools, after laying in hot weather. A 6-metre length of PVC-U pipe will expand or contract approximately 5mm for each 10°C rise or fall in temperature.

The following precautions should be taken to ensure that the joints do not pull apart:

- Laying is best done in the cooler parts of the day.
- Rubber ring systems will allow for thermal movement of the pipeline after having been laid. In both cases, backfill each length, at least partially, as laying proceeds.

7.16 Installing on a curved alignment

PVC-U pipes are flexible enough to be easily curved evenly along their length.

Pipes should always be joined directly in line before the alignment of the pipes is altered.



Figure 7.6 – PVC-U curved pipeline following road curvature.

Table 7.4 – Minimum pipeline radii

Pipe class	Radius of curved pipe*
All	300 x Nominal pipe diameter

**Note: Some authorities may not allow PVC-U pipes to be curved or may not allow curved PVC-U pipes to be drilled or tapped. As an alternative, tapped DI connectors can be used.*

7.17 Concrete encasement

Where concrete encasement is required, PVC-U pipes shall be set to line and level on either bags of natural fibre filled with sand and cement mix or on concrete blocks or saddles cast to the outside diameter of the barrel and located near the socket. Precautions shall be taken to prevent movement, flotation or deformation of the pipe while pouring concrete.

Where damage to pressure pipe surfaces could occur as a result of differential movement of the encased pipe, the pipe and fittings shall be protected by wrapping the pipe in a compressible membrane made of polyethylene, PVC, Petrolatum tape or felt.

For further information refer to AS/NZS 2032 'Installation of PVC pipe systems'.

7.18 Tapped service connections

PVC-U pipes can be tapped using approved tapping bands and hole cutters. Fine toothed 'shell cutters' or hole saws are recommended.

Several proprietary bands including Crevet Taptite DI and Milnes Gunmetal bands are recommended for use with PVC-U pressure pipe. Tapping saddles must comply with AS/NZS 4793 "Mechanical Tapping Bands for Waterworks Purposes".



Figure 7.7 – Series 1 PVC-U pressure pipe with twin tapping saddles. Note minimum spacing between tapping saddles.



7.19 Above ground suspended pipelines

Un-plasticised PVC pressure pipes can be used above ground provided they are protected from long-term exposure to ultra violet radiation. In direct sunlight acrylic paint may be a suitable barrier. As a general rule pipes should be rubber ring jointed and a minimum class PN9 should be specified.

Full circle supports should surround the pipes and “padded” with compressible material such as 3mm thick insertion rubber, protecting the exterior surface of the pipe from abrasion. Special provision for thrust support of fittings is also required.

Table 7.5 - Recommended span between supports for PVC-U pipes (for deflections less than L/500)

Pipe designation	Span (metre)
DN100 PN 9 or higher	2
DN150 PN 9 or higher	2
DN150 PN 12 or higher	3
DN200 to DN450 PN 9 or higher	3

8.1 Field testing

The test procedures of clause 6.3.3 of AS/NZS 2566.2 “Buried flexible pipelines, Part 2: Installation” are recommended for PVC-U. The recommended test pressure should not be less than the maximum design pressure and at the same time not exceed 1.25 times the pressure rating at any point along the pipeline.

Before carrying out the test, ensure the pipe installation, including, backfilling and curing of concrete thrust and anchor blocks is completed. Pipes should also be substantially backfilled to ensure they cannot move. Where joints are exposed some movement of the witness mark away from the socket will be apparent due to “Poissons effect” that is the shortening of the pipes under circumferential working stress.

It is recommended that mechanical joints and flanged connections remain exposed so that they can be visually checked for leaks. When testing against closed valves, arrangements should also be made for checking these for leaks. Appendix M4 of AS/NZS 2566.2 describes the test procedure and Figure 8.2 illustrates the usual test equipment arrangement.

Figure 8.1 gives an example of how variations in the elevation of the pipeline and the maximum design pressure envelope, can be accommodated

when setting the location of the test section and magnitude of the hydrostatic test pressure. If thrust restraints are part of the installation they should be designed for the full test pressure to be applied.

If no make-up water is required to maintain pressure after one hour at test pressure, or after the time needed to inspect the whole pipeline, it can be considered that the test has passed. The need for make up water may not indicate a leak if it is within certain limits. Clause 6.3.4.1 of AS/NZS 2566.2 gives the following equation for calculating the allowable make – up necessary to maintain the test pressure.

$$Q < 0.14.L.D.H$$

Where,

- Q = allowable make-up water, (litres per hour)
- D = nominal diameter, in (metres)
- L = test length, in (kilometers)
- H = average test head over length of pipeline under test, in (metres)

This allowance is intended to compensate in particular for the apparent loss due to entrapped air being forced into solution.

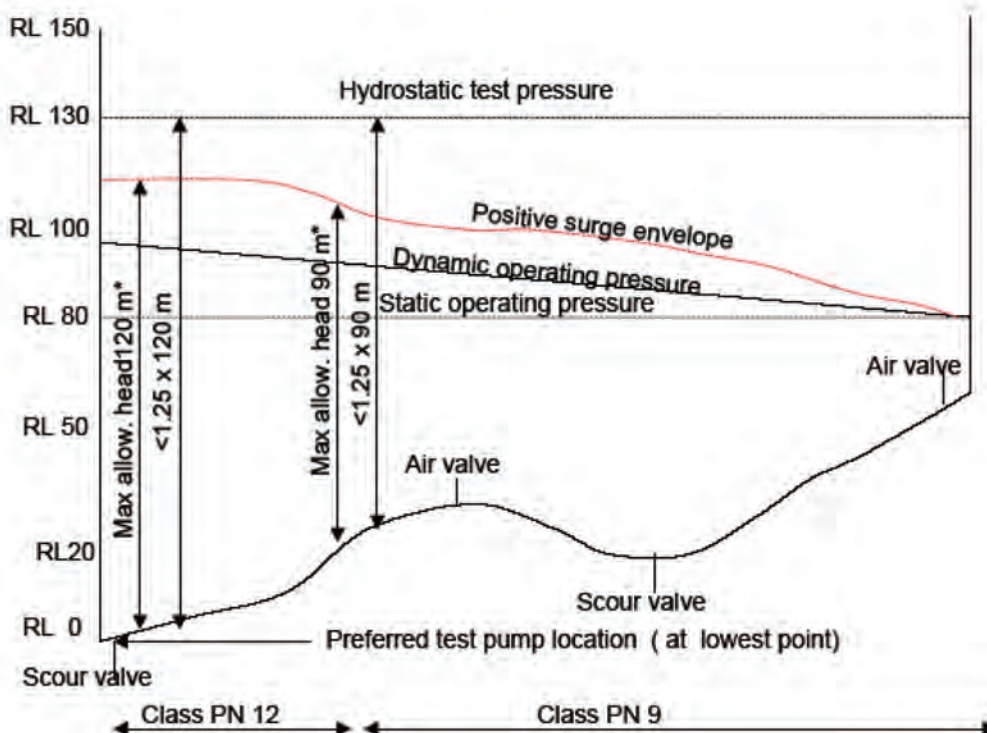


Figure 8.1 - Using longitudinal section of pipeline for determining appropriate hydrostatic test pressures

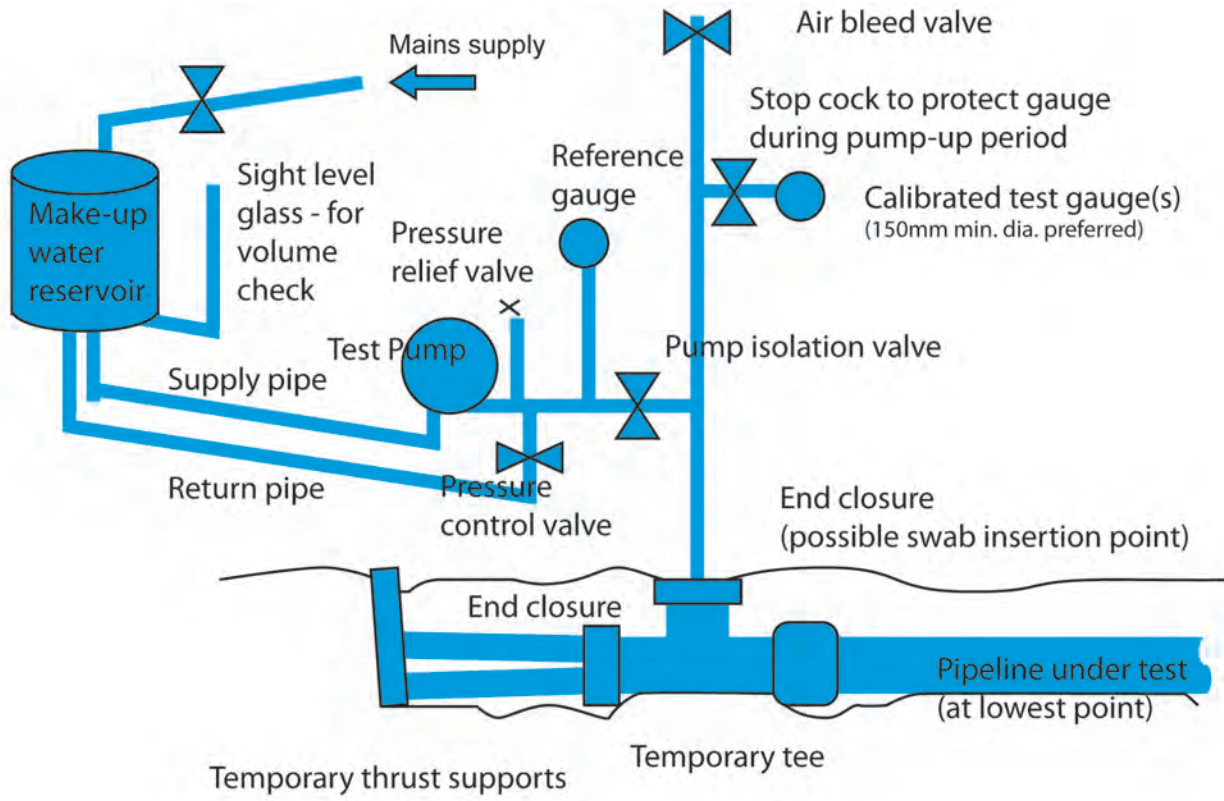


Figure 8.2 - Typical arrangement of testing equipment

WARNING:

High pressure (i.e. >30kPa) air testing is not recommended for safety reasons as the energy stored by compressed air or other gas in a pipeline can be extremely destructive and life threatening if released accidentally.



Q) Do I have to use primer when joining PVC-U pipes with solvent weld joints?

A) Yes, the primer removes dirt and grease from the pipe as well as etches the pipe for the application of the solvent cement.

Q) Can a mixture of solvent weld joint fittings and ductile iron fittings be used in the same pipeline system?

A) Yes, both types of fittings can be used; thrust blocks must be used when using ductile iron rubber ring jointed fittings.

Q) Can PVC-U pipes be used above ground?

A) Yes, these pipes must be supported at regular intervals and can be painted with acrylic based paint to reduce exposure to UV radiation.

Q) Is PVC-U suitable for use in compressed air lines?

A) No, PVC pipes are not suitable for use as compressed air lines. Polyethylene pipes can be used for these applications.

Q) Can tapping saddles be used on PVC-U pipes?

A) Tapping saddles manufactured to AS/NZS 4793 can be used on PVC-U pipes. It is important not to use a tapping saddle within 600 mm of a joint and if using multiple saddles, there must be at least 600 mm spacing between the saddles.




Q) Are ductile iron fittings available for Series 1 PVC-U pipe?

A) There is a range of ductile iron fittings for Series 1 pipe, please contact Iplex for further information regarding the range of products.

IPLEX
Pipelines

ABN 56 079 613 308

FOR ALL ENQUIRIES AND ORDERS CONTACT IPLEX ONLINE:

 Phone: 13 18 40
 Fax: 13 18 60
 www.iplex.com.au

COPYRIGHT © 2010 IPLEX PIPELINES AUSTRALIA PTY. LTD.