Technical

PVC Pressure Pipe & Fittings

WATER WORKS

Smarter pipeline solutions

PVC Pressure Pipe & Fittings
SECTION D
D1

PVC Pressure Pipe & Fittings Technical Information

Pressure Ratings

- PVC pressure fittings up to PN18 (260PSI approximately) depending on the size and configuration. Please check with Waterworks technical department.
- PVC pressure pipe is as listed.

N.B. Pressure rating must be adjusted if fittings are to be used at elevated temperatures above 20°C.

Temperature Range

- Operating temperature 4°C to 40°C
- Maximum temperature 60°C

N.B. Minimum and maximum temperatures are not recommended for continuous operation or for applications of continuous fluctuations to these temperatures.

Materials

Polyvinyl chloride (PVC)
Unplasticised Polyvinyl Chloride (uPVC).

N.B. uPVC is often thought to mean UV resistant. This in fact is strictly speaking incorrect. PVC installed outdoors should either be insulated or painted with a water-based paint to protect the pipework from UV attack.

Nominal Size	Outside Diameter		Wall Thickness											
	Mean Outside Diameter		PN 4.5		PN 6		PN 9		PN 12		PN 15		PN 18	
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
15	21.2	21.5	-	-	-	-	-	-	-	-	1.4	1.7	1.6	2.0
20	26.6	26.9	-	-	-	-	-	-	1.4	1.7	1.7	2.1	2.0	2.4
25	33.4	33.7	-	-	-	-	1.4	1.7	1.7	2.1	2.1	2.5	2.5	3.0
32	42.1	42.4	-	-	-	-	1.7	2.1	2.2	2.6	2.7	3.2	3.2	3.7
40	48.1	48.4	-	-	1.4	1.7	1.9	2.3	2.5	3.0	3.1	3.6	3.6	4.2
50	60.2	60.5	-	-	1.6	2.0	2.4	2.8	3.1	3.6	3.8	4.4	4.6	5.3
65	75.2	75.5	1.5	1.9	2.0	2.4	3.0	3.5	3.9	4.5	4.8	5.5	5.7	6.5
80	88.7	89.1	1.8	2.2	2.4	2.8	3.5	4.1	4.6	5.3	5.7	6.5	6.7	7.6
100	114.1	114.5	2.3	2.7	3.0	3.5	4.5	5.2	5.9	6.7	7.3	8.2	8.6	9.7
125	140.0	140.4	2.8	3.3	3.7	4.3	5.5	6.3	7.2	8.1	8.9	10.0	10.6	11.9
150	160.0	160.5	3.2	3.7	4.2	4.8	6.3	7.1	8.3	9.3	10.2	11.4	12.1	13.5
175	200.0	200.5	3.6	4.2	4.8	5.4	7.1	8.0	9.3	10.4	11.5	12.8	13.6	15.2
200	225.0	225.6	4.0	4.6	5.4	6.1	7.9	8.9	10.5	11.7	12.9	14.4	15.3	17.1
225	250.0	250.7	4.5	5.1	6.0	6.7	8.8	9.9	11.6	13.0	14.4	16.0	17.0	19.0
250	280.0	280.8	5.0	5.7	6.7	7.5	9.9	11.1	13.0	14.5	16.1	17.9	19.1	21.2
300	315.0	315.9	5.7	6.4	7.5	8.5	11.1	12.4	14.7	16.3	18.1	20.1	21.5	23.8
350	355.0	356.0	6.4	7.2	8.1	9.5	12.5	14.0	16.5	18.4	20.4	22.6	24.2	26.8
375	400.0	401.0	7.2	8.1	9.5	10.7	14.1	15.7	18.6	20.7	23.0	25.5	27.3	30.2

N.B. Refer to 'Sch. 80 PVC' and 'Sch. 80 CPVC' for dimensions and pressure ratings.

PVC Pressure Pipe & Fittings Technical Information

Temperature De-rating

The pressure ratings given are for water, non-shock, @ 23°C. The specified derating factors for PVC or for CPVC are suitable for pipe conveying water at elevated temperatures. To determine the pressure rating at an elevated temperature, multiply the given pressure rating at 23°C by the appropriate de-rating factor shown in the tables below.

E.g. 50mm PVC Schedule 80 has a maximum working pressure of 400 PSI (refer to tables on 'Pipe Dimensions & Pressure Ratings' page for maximum working pressure). To calculate the maximum working pressure at 49°C we must multiply 400 by the de-rating factor 0.40. 400 x 0.40 = 160 PSI is the maximum working pressure at 49°C.

When working near maximum specified temperature, solvent cement joints are recommended in place of threaded connections. Where disassembly is required at elevated temperatures use Spears special reinforced (SR) adaptors, flanges, unions or grooved coupling connections.

Only Schedule 80 or heavier wall thickness pipe (PVC or CPVC) should be threaded. Do NOT thread Schedule 40 pipe. Threading requires a 50% reduction in the pipe's specified pressure rating at 23°C.

See Chemical Resistance Data for Pressure Piping information for both chemical compatibility and potential temperature limitations when using certain chemicals.

PVC Pipe

Operating Temp (°C)	De-rating Factor
23	1
27	0.88
32	0.75
38	0.62
43	0.51
49	0.4
54	0.31
60	0.22

Flow Velocity & Friction Loss

PN9

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	25mm		32mm		40mm		50mm	
0.08	0.11	0.07						
0.10	0.14	0.10						
0.20	0.27	0.36	0.17	0.12	0.13	0.06		
0.30	0.41	0.76	0.26	0.25	0.20	0.13		
0.40	0.55	1.30	0.34	0.42	0.26	0.22	0.17	0.07
0.50	0.68	1.97	0.43	0.63	0.33	0.33	0.21	0.11
0.60	0.82	2.76	0.52	0.89	0.39	0.46	0.25	0.15
0.70	0.96	3.67	0.60	1.18	0.46	0.61	0.29	0.20
0.80	1.09	4.70	0.69	1.51	0.52	0.78	0.33	0.26
0.90	1.23	5.85	0.77	1.88	0.59	0.97	0.38	0.32
1.00	1.37	7.11	0.86	2.29	0.65	1.18	0.42	0.39
1.20	1.64	9.97	1.03	3.20	0.79	1.65	0.50	0.55
1.40	1.92	13.26	1.20	4.26	0.92	2.20	0.59	0.73
1.60	2.19	16.98	1.37	5.46	1.05	2.82	0.67	0.93
1.80	2.46	21.12	1.55	6.79	1.18	3.50	0.75	1.16
2.00	2.74	25.67	1.72	8.25	1.31	4.26	0.84	1.41
2.50			2.15	12.48	1.64	6.44	1.04	2.13
3.00			2.58	17.49	1.96	9.03	1.25	2.99
3.50			3.01	23.27	2.29	12.01	1.46	3.97

WATER WORKS

PVC Pressure Pipe & Fittings Technical Information

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	25mm		32mm		40mm		50mm	
4.00					2.62	15.38	1.67	5.09
4.50					2.95	19.13	1.88	6.33
5.00							2.09	7.69
5.50							2.30	9.17
6.00							2.51	10.78
6.50							2.72	12.50
7.00							2.93	14.34

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	65mm		80mm		100mm		150mm	
0.60	0.16	0.05						
0.70	0.19	0.07						
0.80	0.21	0.08						
0.90	0.24	0.11	0.17	0.05				
1.00	0.27	0.13	0.19	0.06				
1.20	0.32	0.18	0.23	0.08				
1.40	0.38	0.24	0.27	0.11				
1.60	0.43	0.30	0.31	0.14				
1.80	0.48	0.38	0.35	0.17	0.21	0.05		
2.00	0.54	0.46	0.39	0.21	0.23	0.06		
2.50	0.67	0.70	0.48	0.31	0.29	0.09		
3.00	0.80	0.97	0.58	0.44	0.35	0.13		
3.50	0.94	1.30	0.67	0.58	0.41	0.17		
4.00	1.07	1.66	0.77	0.74	0.47	0.22		
4.50	1.21	2.06	0.87	0.92	0.52	0.27	0.27	0.05
5.00	1.34	2.51	0.96	1.12	0.58	0.33	0.30	0.06
5.50	1.48	2.99	1.06	1.34	0.64	0.39	0.32	0.07
6.00	1.61	3.51	1.16	1.57	0.70	0.46	0.35	0.09
6.50	1.74	4.07	1.25	1.83	0.76	0.54	0.38	0.10
7.00	1.88	4.67	1.35	2.09	0.81	0.61	0.41	0.11
7.50	2.01	5.31	1.44	2.38	0.87	0.70	0.44	0.13
8.00	2.15	5.98	1.54	2.68	0.93	0.79	0.47	0.15
8.50	2.28	6.69	1.64	3.00	0.99	0.88	0.50	0.16
9.00	2.41	7.44	1.73	3.34	1.05	0.98	0.53	0.18
9.50	2.55	8.22	1.83	3.69	1.11	1.08	0.56	0.20
10.00	2.68	9.04	1.93	4.06	1.16	1.19	0.59	0.22
11.00	2.95	10.78	2.12	4.84	1.28	1.42	0.65	0.26
12.00	3.22	12.66	2.31	5.68	1.40	1.67	0.71	0.31
13.00	3.49	14.68	2.50	6.59	1.51	1.93	0.77	0.36
14.00	3.76	16.84	2.70	7.56	1.63	2.22	0.83	0.41
15.00	4.02	19.13	2.89	8.59	1.75	2.52	0.89	0.47
16.00	4.29	21.56	3.08	9.68	1.86	2.84	0.94	0.53
18.00			3.47	12.05	2.09	3.53	1.06	0.66
20.00			3.85	14.64	2.33	4.29	1.18	0.80
22.00					2.56	5.12	1.30	0.96
24.00					2.79	6.01	1.42	1.12
26.00					3.03	6.97	1.53	1.30
28.00					3.26	8.00	1.65	1.49
30.00					3.49	9.09	1.77	1.70
35.00					4.07	12.09	2.07	2.26
40.00							2.36	2.89
45.00							2.66	3.59

PVC Pressure Pipe & Fittings Technical Information

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	65mm		80mm		100mm		150mm	
50.00							2.95	4.37
55.00							3.25	5.21
60.00							3.54	6.12
65.00							3.84	7.10
70.00							4.13	8.15

PN12

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	20mm		25mm		32mm		40mm	
0.04	0.09	0.07						
0.06	0.14	0.14						
0.08	0.18	0.23	0.11	0.08				
0.10	0.23	0.36	0.14	0.11				
0.20	0.45	1.28	0.29	0.41	0.18	0.13	0.14	0.07
0.30	0.68	2.72	0.43	0.88	0.27	0.28	0.21	0.15
0.40	0.91	4.63	0.57	1.50	0.36	0.48	0.28	0.25
0.50	1.13	6.99	0.72	2.26	0.45	0.72	0.35	0.38
0.60	1.36	9.80	0.86	3.17	0.54	1.01	0.42	0.53
0.70	1.59	13.04	1.00	4.22	0.63	1.34	0.49	0.71
0.80	1.81	16.70	1.15	5.40	0.72	1.72	0.56	0.90
0.90	2.04	20.77	1.29	6.72	0.81	2.14	0.63	1.12
1.00	2.27	25.25	1.43	8.17	0.91	2.60	0.70	1.37
1.20	2.72	35.39	1.72	11.45	1.09	3.64	0.83	1.91
1.40			2.01	15.23	1.27	4.85	0.97	2.55
1.60			2.29	19.51	1.45	6.21	1.11	3.26
1.80			2.58	24.26	1.63	7.72	1.25	4.05
2.00					1.81	9.38	1.39	4.93
2.50					2.26	14.18	1.74	7.45
3.00					2.72	19.88	2.09	10.44
3.50							2.43	13.89
4.00							2.78	17.79

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	50mm		65mm		80mm		100mm		150mm	
0.30	0.13	0.05								
0.40	0.18	0.08								
0.50	0.22	0.13								
0.60	0.26	0.18	0.17	0.06						
0.70	0.31	0.23	0.20	0.08						
0.80	0.35	0.30	0.23	0.10						
0.90	0.40	0.37	0.26	0.12	0.18	0.05				
1.00	0.44	0.45	0.28	0.15	0.20	0.07				
1.20	0.53	0.63	0.34	0.20	0.24	0.09				
1.40	0.62	0.84	0.40	0.27	0.29	0.12				
1.60	0.71	1.08	0.45	0.35	0.33	0.16	0.20	0.05		
1.80	0.79	1.34	0.51	0.43	0.37	0.19	0.22	0.06		
2.00	0.88	1.63	0.57	0.53	0.41	0.24	0.25	0.07		
2.50	1.10	2.47	0.71	0.80	0.51	0.36	0.31	0.10		
3.00	1.32	3.46	0.85	1.12	0.61	0.50	0.37	0.15		

PVC Pressure Pipe & Fittings Technical Information

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	50mm		65mm		80mm		100mm		150mm	
3.50	1.55	4.60	0.99	1.48	0.71	0.67	0.43	0.20		
4.00	1.77	5.89	1.13	1.90	0.82	0.85	0.49	0.25	0.25	0.05
4.50	1.99	7.33	1.28	2.36	0.92	1.06	0.55	0.31	0.28	0.06
5.00	2.21	8.91	1.42	2.87	1.02	1.29	0.62	0.38	0.31	0.07
5.50	2.43	10.63	1.56	3.43	1.12	1.54	0.68	0.45	0.34	0.08
6.00	2.65	12.48	1.70	4.02	1.22	1.81	0.74	0.53	0.38	0.10
6.50	2.87	14.48	1.84	4.67	1.33	2.10	0.80	0.61	0.41	0.12
7.00	3.09	16.61	1.99	5.35	1.43	2.41	0.86	0.70	0.44	0.13
7.50	3.31	18.87	2.13	6.08	1.53	2.74	0.92	0.80	0.47	0.15
8.00	3.53	21.27	2.27	6.85	1.63	3.09	0.98	0.90	0.50	0.17
8.50	3.75	23.80	2.41	7.67	1.73	3.45	1.05	1.01	0.53	0.19
9.00	3.97	26.45	2.55	8.52	1.84	3.84	1.11	1.12	0.56	0.21
9.50	4.19	29.24	2.70	9.42	1.94	4.24	1.17	1.24	0.59	0.23
10.00	4.42	32.15	2.84	10.35	2.04	4.66	1.23	1.36	0.63	0.26
11.00			3.12	12.35	2.24	5.56	1.35	1.63	0.69	0.30
12.00			3.40	14.51	2.45	6.54	1.48	1.91	0.75	0.36
13.00			3.69	16.82	2.65	7.58	1.60	2.22	0.81	0.42
14.00			3.97	19.29	2.86	8.70	1.72	2.54	0.88	0.48
15.00			4.26	21.92	3.06	9.88	1.85	2.89	0.94	0.54
16.00			4.54	24.70	3.26	11.14	1.97	3.25	1.00	0.61
18.00					3.67	13.85	2.22	4.05	1.13	0.76
20.00					4.08	16.84	2.46	4.92	1.25	0.92
22.00							2.71	5.87	1.38	1.10
24.00							2.95	6.90	1.50	1.29
26.00							3.20	8.00	1.63	1.50
28.00							3.45	9.17	1.75	1.72
30.00							3.69	10.43	1.88	1.95
35.00							4.31	13.87	2.19	2.60
40.00									2.50	3.33
45.00									2.81	4.14
50.00									3.13	5.03
55.00									3.44	6.00
60.00									3.75	7.05
65.00									4.06	8.18
70.00									4.38	9.38

PN15

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	15mm		20mm		25mm	
0.02	0.08	0.07				
0.04	0.15	0.24	0.10	0.08		
0.06	0.23	0.50	0.14	0.16	0.09	0.05
0.08	0.30	0.85	0.19	0.28	0.12	0.09
0.10	0.38	1.28	0.24	0.42	0.15	0.13
0.20	0.76	4.64	0.48	1.50	0.30	0.48
0.30	1.14	9.82	0.72	3.18	0.45	1.02
0.40	1.52	16.74	0.96	5.42	0.61	1.73
0.50	1.90	25.30	1.20	8.20	0.76	2.62
0.60	2.28	35.46	1.44	11.50	0.91	3.67
0.70	2.66	47.18	1.68	15.29	1.06	4.88
0.80			1.93	19.58	1.21	6.25

WATER WORKS

PVC Pressure Pipe & Fittings Technical Information

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	15mm		20mm		25mm	
0.90			2.17	24.36	1.36	7.77
1.00			2.41	29.61	1.51	9.45
1.20			2.89	41.50	1.82	13.24
1.40					2.12	17.62
1.60					2.42	22.56
1.80					2.73	28.06
3.50						
4.00						

Schedule 80 PVC & CPVC

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	8mm		10mm		15mm		20mm	
0.02	0.39	3.58	0.19	0.62				
0.03	0.79	12.87	0.38	2.26				
0.05	1.18	27.29	0.57	4.80				
0.06	1.58	46.49	0.77	8.19	0.45	2.24	0.24	0.48
0.13	3.15	167.86	1.53	29.55	0.90	8.07	0.48	1.73
0.32	7.89	916.04	3.82	161.24	2.25	44.11	1.19	9.46
0.44			5.35	300.69	3.15	82.27	1.67	17.63
0.63					4.50	159.28	2.38	34.12
0.95							3.58	72.28
1.26							4.77	123.15

Flow Rate L/s	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
	25mm		32mm		40mm		50mm	
0.06	0.14	0.14	0.08	0.02	0.06	0.02	0.03	0.00
0.13	0.28	0.48	0.16	0.12	0.12	0.05	0.07	0.02
0.32	0.71	2.68	0.40	0.65	0.29	0.30	0.17	0.09
0.44	0.99	4.98	0.55	1.20	0.41	0.55	0.24	0.16
0.63	1.42	9.64	0.79	2.31	0.59	1.06	0.34	0.30
0.95	2.13	20.44	1.19	4.91	0.87	2.24	0.51	0.62
1.26	2.84	34.81	1.58	8.35	1.17	3.81	0.68	1.08
1.58	3.55	52.65	1.98	12.64	1.46	5.74	0.85	1.61
1.89	4.26	73.78	2.37	17.72	1.75	8.05	1.02	2.28
2.21	4.97	98.16	2.76	23.55	2.05	10.70	1.19	3.02
2.52	5.68	125.71	3.16	30.18	2.33	13.70	1.36	3.88
2.84			3.55	37.53	2.63	17.05	1.53	4.82
3.15			3.95	45.61	2.92	20.72	1.70	5.86
3.79			4.74	63.95	3.51	29.05	2.04	8.21
4.42			5.53	85.06	4.09	38.64	2.38	10.94
4.73			5.92	96.66	4.38	43.90	2.55	12.43
5.05			6.32	108.94	4.67	49.49	2.72	14.00
5.68					5.25	61.55	3.06	17.42
6.31					5.84	74.79	3.40	21.18
7.89					7.30	113.09	4.25	32.02
9.46					8.76	158.51	5.10	44.87
11.04							5.95	59.71
12.62							6.80	76.45
15.77							8.50	115.58

PVC Pressure Pipe & Fittings Technical Information

Flow Rate L/s	65mm		80mm		100mm		125mm	
	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
0.06	0.02	0.00	0.02	0.00				
0.13	0.05	0.00	0.03	0.00				
0.32	0.12	0.02	0.08	0.02				
0.44	0.17	0.07	0.11	0.02				
0.63	0.24	0.12	0.15	0.05				
0.95	0.36	0.25	0.23	0.09				
1.26	0.48	0.44	0.30	0.16	0.17	0.05		
1.58	0.59	0.67	0.38	0.23	0.22	0.07		
1.89	0.71	0.95	0.45	0.32	0.26	0.09	0.16	0.02
2.21	0.83	1.27	0.53	0.42	0.30	0.12	0.19	0.05
2.52	0.95	1.61	0.61	0.55	0.35	0.14	0.22	0.05
2.84	1.07	2.01	0.68	0.67	0.39	0.18	0.25	0.05
3.15	1.19	2.45	0.76	0.83	0.43	0.21	0.27	0.07
3.79	1.42	3.44	0.91	1.15	0.52	0.30	0.33	0.09
4.42	1.66	4.57	1.06	1.55	0.61	0.39	0.38	0.14
4.73	1.78	5.19	1.14	1.75	0.65	0.44	0.41	0.14
5.05	1.90	5.84	1.21	1.96	0.69	0.51	0.44	0.16
5.68	2.14	7.27	1.37	2.45	0.78	0.62	0.49	0.21
6.31	2.37	8.84	1.52	2.98	0.87	0.76	0.55	0.25
7.89	2.97	13.33	1.90	4.50	1.09	1.15	0.68	0.37
9.46	3.56	18.71	2.28	6.30	1.30	1.61	0.82	0.53
11.04	4.15	24.89	2.65	8.37	1.52	2.15	0.96	0.69
12.62	4.75	31.86	3.04	10.73	1.74	2.77	1.09	0.90
15.77	5.93	48.17	3.79	16.22	2.17	4.18	1.37	1.36
18.93	7.12	67.53	4.55	22.75	2.61	5.86	1.64	1.91
22.08					3.04	7.77	1.92	2.54
25.24					3.47	9.97	2.19	3.25
28.39					3.91	12.39	2.46	4.04
31.55							2.74	4.91

Flow Rate L/s	150mm		200mm		250mm		300mm	
	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m	Velocity m/s	Head Loss m/100m
3.15	0.19	0.02						
3.79	0.23	0.05						
4.42	0.27	0.05						
4.73	0.29	0.07						
5.05	0.30	0.07						
5.68	0.34	0.09						
6.31	0.38	0.09						
7.89	0.48	0.16	0.27	0.05				
9.46	0.57	0.23	0.33	0.05				
11.04	0.67	0.30	0.38	0.07				
12.62	0.77	0.37	0.44	0.09	0.28	0.02		
15.77	0.95	0.58	0.54	0.14	0.34	0.05		
18.93	1.15	0.78	0.65	0.21	0.41	0.07		
22.08	1.34	1.06	0.76	0.28	0.48	0.09	0.34	0.05
25.24	1.53	1.36	0.87	0.35	0.55	0.12	0.39	0.05
28.39	1.72	1.68	0.98	0.44	0.62	0.14	0.44	0.07
31.55	1.91	2.05	1.09	0.53	0.69	0.16	0.49	0.07
47.32			1.63	1.11	1.04	0.37	0.73	0.16
63.09			2.17	1.87	1.38	0.62	0.98	0.28
78.86					1.73	0.95	1.22	0.39
94.64					2.07	1.31	1.46	0.55
126.18							1.95	0.97

PVC Pressure Pipe & Fittings Technical Information

Hydraulic Shock
Hydraulic shock is the rapid increase in pressure due to a shock wave produced by a sudden change in system fluid velocity, if uncontrolled or insufficient pressure rated piping is used, these pressure surges can easily burst pipe and break valves or fittings. The term "water hammer" commonly used is derived from the sounds produced, but it is the hydraulic shock vibrations that can be damaging to piping systems. This is typically the result of sudden starting or stopping of a flowing column of liquid, such as water. Energy from the momentum of water in motion is converted to pressure when the flow is abruptly halted. A shock wave is produced that travels through the piping until it is stopped and bounces back to the original obstruction. This instantaneous shock to the system can lead to excessively high pressures. Hydraulic shock is frequently produced by rapid valve opening and closing, pumps starting and stopping, or even from a high speed wall of water hitting a chance of direction fitting, such as an elbow. The effect is greater as piping systems is longer, the velocity change is greater and closing time is shorter.

Evaluating Hydraulic Shock Pressure Surges
An indication of the maximum surge pressure relative to velocity changes is essential in estimating the pressure rating requirements in designing a piping system. The following chart gives the maximum surge pressure at velocities of 1, 5, and 10 metres per second for different sizes of pipe, based on instantaneous valve closure in a PVC system. While listed, 10 metres per second is not recommended and is shown for comparative purposes. Velocity is best held to a maximum of 5 metres per second in plastic piping systems.

Schedule 40 Pipe Pressure Surge (PSI) at Different Velocities

Size	15mm	20mm	25mm	32mm	40mm	50mm	65mm	80mm	100mm	150mm	200mm	250mm	300mm
1 m/s	89.57	80.71	78.08	70.87	67.26	61.68	64.63	60.37	55.45	49.54	46.59	44.29	42.65
5 m/s	447.18	404.2	390.75	354.66	336.61	309.06	323.16	301.18	277.23	247.38	232.28	221.13	213.91
10 m/s	894.69	808.07	781.5	709.65	672.9	617.78	646	602.03	554.46	495.08	464.57	442.26	428.15

Schedule 80 Pipe Pressure Surge (PSI) at Different Velocities

Size	15mm	20mm	25mm	32mm	40mm	50mm	65mm	80mm	100mm	150mm	200mm	250mm	300mm
1 m/s	105.64	95.8	91.86	83.66	79.72	74.15	76.12	71.52	66.6	62.01	58.4	56.76	56.1
5 m/s	528.22	478.35	458.99	418.96	399.28	371.06	379.92	357.94	333.33	309.71	291.34	284.12	280.51
10 m/s	1056.43	957.02	918.31	837.93	798.56	742.13	760.17	715.55	666.34	619.75	582.68	567.91	561.02

Controlling Hydraulic Shock in System Design & Operation
Since hydraulic shock is a function of speed, mass and time, there are several ways to prevent, minimize or eliminate system damage by limiting or controlling the magnitude of pressure surges.

- Limit Fluid Velocity – one of the safest surge control techniques in plastic piping systems is to limit fluid velocities to a maximum of 5 metres per second. Attempt to balance system operation flow demands and the magnitude of velocity variations.
- Control Valve Closing Time – avoid rapid opening and closing. Pneumatic or electric actuation may be considered for greater control. Use of multi-turn or gear operated valves may also be beneficial in slowing valve opening and closing. When all valves and controls are properly sized and adjusted, surges generated by changes in pump flows and demands can be reduced to non-harmful levels.
- Control Pump Operation – operate the system to maintain uniform pump flow rates. Use slow starting pumps where long runs and larger diameters are downstream. Where possible, partially close discharge valves to minimise volume when starting pumps, until lines are completely filled. Air chambers or surge relief tanks in conjunction with pressure regulating and surge relief valves can be used at pumping stations.
- Check Valves – installing a check valve in pump discharge lines will aid in keeping the line full. Be careful in selecting check valves. Check valves operate on flow reversal and can be rapid closing. Spring or lever assisted swing check valves can reduce hydraulic shock by avoiding "slamming" the valve closed.

PVC Pressure Pipe & Fittings Technical Information

Thermal Expansion & Contraction

Piping systems expand and contract with changes in temperature. Thermoplastic piping expands and contracts more than metallic piping when subjected to temperature changes, as much as ten times that of steel. The effects of thermal expansion and contraction must be considered during the design phase, particularly for systems involving long runs, hot water lines, hot drain lines, and piping systems exposed to environmental temperature extremes. Installation versus working temperature or summer to winter extremes must be considered and addressed with appropriate system design to prevent damage to the piping system.

The degree of movement (change in length) generated as the result of temperature changes, must be calculated based on the type of piping material and anticipated temperature changes of the system. The rate of expansion does not vary with pipe size. This movement must then be compensated for by the construction of appropriate sized expansion loops, offsets, bends or the installation of expansion joints. This absorbs the stresses generated, minimizing damage to the piping.
The following table is a thermal expansion guide showing the change of length of the pipe in millimetres per metre. This is only intended as a guide.

Temperature Change (°C)	PVC	CPVC
5	1.19	1.32
10	1.45	1.60
15	1.70	1.88
20	1.98	2.18
25	2.24	2.46
30	2.49	2.74
35	2.74	3.05
40	3.02	3.33
45	3.28	3.61
50	3.53	3.91
55	3.78	4.19
60	4.06	4.47
65		4.78
70		5.05
75		5.33
80		5.64
90		6.20
95		6.50

Weatherability

When standard rigid PVC or CPVC pipe is exposed to UV radiation from sunlight the following conditions have been noted:

- A colour change, slight increase in tensile strength, slight increase in modulus or tensile elasticity, and a slight decrease in impact strength may occur.
- The effects of UV exposure do not continue when exposure to UV is terminated.
- The effects of UV exposure do not penetrate even thin shields such as paint coatings or wrapping.

It is recommended that PVC and CPVC piping products exposed to the direct affects of sunlight be painted with a light-coloured acrylic or latex paint that is chemically compatible with the PVC/CPVC products. Check with paint manufacturer for compatibility. Oil-based paints should not be used.

Additional consideration should be given to the affects of expansion/contraction caused by heat absorption from sunlight in outdoor applications.

WATER WORKS

PVC Pressure Pipe & Fittings Technical Information

Installation

The following is a general description of basic techniques used to make solvent cement joints. Adjustments will need to be made to method and tools used according to size of piping, but the same principles apply. Waterworks offers installation training to assist installers make satisfactory joints under varying conditions using best practise and safety procedures.
To consistently make good joints in PVC, the following should be carefully understood:

1. The joining surfaces of pipe and fitting must be softened and made semi-fluid.
2. Sufficient cement must be applied to fill the gap between pipe and fitting.
3. Assembly of pipe and fittings must be made while the surfaces are still wet and fluid.
4. Joint strength develops as the cement dries (cures). In the tight part of the joint (interference area) the surfaces will fuse together, in the loose part the cement will bond to both surfaces.

Step One: Cutting the Pipe

PVC Pipe can be cut with a ratchet cutter, wheel plastic pipe cutter, a power saw, or any other fine-tooth saw. It is important the pipe is cut as square as possible to provide the maximum bonding surface area.

Step Two: Deburring & Bevelling

Burrs and filings can prevent contact between the tube and fitting during assembly and must be removed from the outside and inside of the pipe. A slight bevel (chamfer) must be placed at the outside end of the pipe to ease the entry of the tube into the socket and minimise the chance of cement being wiped off the fitting. A bevel of between 10-15° is suggested.

Step Three: Fitting & Joining Preparation

1. Using a clean, dry rag, wipe any loose dirt and moisture from the fittings socket and pipe end. Moisture can slow the cure time, and at this stage of assembly, excessive moisture can reduce joint strength.
2. Check the dry fit of the pipe and fitting. The pipe should enter the fitting's socket easily ¼ to ¾ of the way, or at least have interference between pipe and fitting bottom.
3. Measure socket depth and mark on pipe for reference during cement application.
4. It is advisable to additionally mark pipe and fitting for alignment orientation position, especially with larger fittings.

Step Four: Solvent Cementing Assembly

(Primer Use – Softening of pipe and fitting jointing surfaces can be achieved by the cement itself or by using a suitable primer. A primer will usually penetrate and soften the surfaces more quickly than the cement alone).

1. Apply Primer – Using an applicator that is at least half the size of the pipe diameter, vigorously scrub the joining surface of the fitting, then the pipe, then the fitting. Work quickly to apply 2-3 coats in this manner.
2. Apply Solvent Cement – Apply the cement while the primer is still wet. Using an applicator at least half the size of the pipe diameter, work the cement into the joining surfaces using a continuous, circular motion. Use sufficient cement but avoid puddling the cement on or within the fitting and pipe. Puddled cement causes excess softening and damage to the PVC material. If interference fit was at the bottom of the socket, use extra cement and make a second application to pipe.

Step Five: Assemble Joint

Immediately insert pipe into the fitting socket while rotating the pipe quarter turn. Align the fitting in the proper orientation at this time. Make sure the pipe bottoms out at the fitting's stop. Hold the assembly for at least 30 seconds to ensure initial bonding. Tapered pipe sockets can result in pipe backing out of the joint if not held under constant pressure. A bead of cement must be present around the pipe and fitting juncture. If this bead is not continuous around the socket's shoulder, insufficient cement was applied, and the joint must be disassembled or cut out and replaced.

Set and Cure Times

Set Time

The initial set time is the recommended waiting period before handling newly assembled joints. After initial set, the joints will withstand the stresses of normal installation. However, a badly misaligned installation will cause excessive stresses in the joint, pipe and fittings.

Average Set Times

Temperature Range	Pipe Sizes 15mm to 32mm	Pipe Sizes 40mm to 50mm	Pipe Sizes 65mm to 200mm	Pipe Sizes 250mm to 375mm
15°C – 37°C	2 minutes	5 minutes	30 minutes	2 hours
4°C – 15°C	5 minutes	10 minutes	2 hours	8 hours
-17°C – 4°C	10 minutes	15 minutes	12 hours	24 hours

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PVC Pressure Pipe & Fittings Technical Information

Cure Time

The cure time is the recommended waiting period before pressurising newly assembled joints.

Average Cure Times

Relative Humidity 60% or Less	Pipe sizes 15mm to 32mm		Pipe Sizes 40mm to 50mm		Pipe Sizes 65mm to 200mm		Pipe Sizes 250mm to 375mm
Temperature Range During Assembly and Cure Periods	Up to 160 PSI	160 PSI to 260 PSI	Up to 160 PSI	160 PSI to 260 PSI	Up to 160 PSI	160 PSI to 260 PSI	Up to 260 PSI
15°C - 37°C	15 minutes	6 hours	30 minutes	12 hours	1.5 hours	24 hours	48 hours
4°C - 15°C	20 minutes	12 hours	45 minutes	24 hours	4 hours	48 hours	96 hours
-17°C to 4 °C	30 minutes	48 hours	1 hour	96 hours	72 hours	8 days	8 days

N.B. In damp or humid weather, allow 50% more cure time. The cure schedules shown are suggested as guides only. They are based on laboratory test data and should not be taken to be the recommendations of all cement manufacturers. Individual solvent cement manufacturer's recommendations for the cement being used should be followed.

Estimated Quantities of Solvent Cement

A variety of conditions can affect the amount of solvent cement required for making reliable joints. These include pipe size, tolerances, socket depths as well as installation conditions and type of cement used. Fitting sockets are tapered for proper assembly, which produces a slight gap at the socket entrance when installed with pipe. As pipe sizes increase, heavier bodied cements should be used for increase gap fitting capabilities. It is best to use liberal amounts of solvent cement since insufficient cement use is one of the most common reasons for joint failure. The following information on cement usage is a recommendation only and other factors or unanticipated conditions may be encountered. Quantities are based on use with average socket lengths.

Estimated Number of Joints Per One Litre of Solvent Cement

Fitting Size (mm)	15	20	25	32	40	50	65	80	100	150	200	250	300	350	400
Joints per 1L	300	200	125	140	90	60	50	40	30	10	5	2-3	1-2	0.75	1.25

Threaded Connections

Threaded connections require the application of a thread sealant that is compatible with PVC material. Other joint compounds or pastes may contain substances that could cause stress cracks in PVC material.

Apply sealant to the male threads only. Make sure all threads are covered. If using PTFE tape, apply in the direction of the threads by starting with the first full thread and continuing over the entire thread length. Make sure all threads are covered. Generally, 2-3 wraps are sufficient to produce a watertight connection.

DO NOT over-torque any threaded connections. Generally, one to two turns beyond finger-tight are required for a threaded connection. Use a smooth-jawed wrench or strap wrench when installing threaded connections.

Underground Installation

Underground piping must be installed in accordance with any applicable codes. Attention should be given to local pipe laying techniques applicable to area subsoil. This may provide insights to particular pipe bedding issues. The following information is applicable to solvent cement joining of PVC and CPVC piping as a general guide. Key installation tips:

- Pipe and fittings should be inspected for cuts, scratches, gouges or split ends. Damaged sections found must be cut-out and discarded.
- Thermoplastic pipe should ALWAYS be installed below the frost level according to local conditions. Pipe for conveying liquids susceptible to freezing should be buried no less than 300mm below the maximum frost level.
- Permanent lines subjected to heavy traffic should have a minimum cover of 600mm. For light traffic 300-450mm is normally sufficient for pipe sizes up to 80mm. Larger sizes, bearing stresses should be calculated to determine cover required.

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- When it is installed beneath surfaces that are subject to heavy weight or constant traffic such as roadways and railroad tracks, thermoplastic piping should be run with a metal or concrete casing.
- The trench bottom should be continuous, relatively smooth and free of rocks. Where ledge road, hardpan or boulders are encountered, it is necessary to pad the trench bottom using a minimum of 100mm of tampered earth or sand beneath the pipe as a cushion.
- Snaking of pipe may be used for small diameter piping systems, typically 80mm or less, but may also apply to larger diameter piping under specific applications and site conditions. Snaking of pipe is used to compensate for thermal expansion and contraction due to temperature changes. Snaking is particularly necessary during the late afternoon or a hot summer's day where drying time will extend through the cool of the night where thermal contraction could result in joint pull out.
- Expansion and contraction can be excessive in systems operating at near or at the maximum allowable temperatures with intermittent flow and buried lines. In these cases, the lines should not be snaked. The use of properly installed expansion joints with a suitable enclosure can be used.
- Underground pipe should be inspected and tested for leaks prior to backfilling. In hot weather, it is best to backfill early in the morning when the line is fully contracted.
- The pipe should be supported over its entire length. Blocking should not be used to change pipe or to intermittently support pipe across excavated sections.
- Surround the pipe with 150-200mm of backfill materials free of rocks and having a particle size of 15mm of less. It should be placed in layers. Each soil layer should be sufficiently compacted to uniformly develop lateral passive soil forces during the back-fill operation. It may be advisable to pressurise the pipe to 15-25PSI during the backfilling.
- Vibratory methods are preferred when compacting sand or gravels. Best results are obtained when the soils are in a nearly saturated condition. Where water flooding is used, the initial backfill should be sufficient to ensure complete coverage of the pipe.
- The remainder of the backfill should be placed and spread in uniform layers to fill the trench completely so that there will be no unfilled spaces under or around rocks or lumps of earth in the backfill. Remove large or sharp rocks, frozen clods and other debris greater than 80mm in diameter. Rolling equipment should only be used to consolidate the final backfill.
- Avoid threaded connections in underground applications. Where transition to alternate materials is required the use of a flange component with suitable gasket is recommended.
- Valves and other concentrated weight loads should be independently support. Avoid excessive bending of pipe.

Above Ground Installation

Thermal Expansion & Contraction
Attention must be given to above ground installations where ambient temperature swings can cause thermoplastic systems to expand and contract both indoors and out. For example, a system installed in an unheated building during the winter months will expand considerably when the temperatures rise. Conversely, systems installed at higher ambient temperatures will contract as temperatures fall. Refer to Waterworks technical department for further assistance.

Outdoor Applications & Protection
PVC and CPVC piping systems must be protected from freezing. Many standard cold weather piping design and installation practises can be used to protect the system from freezing such as use of pipe insulation, anti-freeze solutions, and heat trace tapes. The suitability and compatibility of these products for use with PVC and CPVC should be verified with product manufacturers prior to use.

Caution should be exercised in installing PVC and CPVC piping products in metal boxes or enclosures exposed to direct sunlight. Such enclosures can act as 'ovens' that significantly increase the environmental temperature over ambient air conditions, resulting in product damage and failure.

PVC and CPVC piping exposed to the direct sunlight (UV radiation) should be painted with a reflective, light coloured acrylic or latex paint. Avoid dark colours, especially black. Heat absorption can exceed the heat handling capacity of the pipe and fittings material. Compatibility information regarding use with PVC/CPVC products should be confirmed with the paint manufacturer. Oil-based paints should not be used.

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Hangers and Supports

Hanger Support Spacing
Support location and spacing depends on the pipe diameter, system operating temperature, and the location of any concentrated stress loads (i.e. valves, flanges, test equipment and any other heavy system components). Hangers must have an adequate load-bearing surface free of any rough or sharp edges that could damage the pipe during use. Hangers also must not restrict linear movement of the system in order to allow thermal expansion and contraction from temperature changes.

Hanger Selection
Hangers designed for metallic pipe can be used if they provide an adequate load-bearing surface, which is smooth and free of rough or sharp edges that could damage the pipe. Improper supports can generate excessive sag resulting in failure. Movement caused by thermal expansion/contraction and pressure fluctuations must be considered. Hangers and supports used must permit axial movement of the system, but not compress the pipe. Supplemental, guides may be required in addition to hangers in order to maintain alignment and direct movement into in-line expansion joints.

Placement
Hangers should be installed within 600mm of each side of a pipe joint, while changes in direction should be supported as close as possible to the fitting to reduce stress. Heavy system components such as valves, flanged assemblies, tees and other concentrated stress loads must be independently supported. Valves should additionally be adequately braced to prevent movement/stress loads from operational torque. Support of potential solids accumulation loads within the line should also be considered.

Anchor Guides
Anchors direct movement of the piping by providing restraint at key points such as long straight runs, at changes in direction of the system, and where expansion joints and other methods of thermal compensation are utilised. They may be used to control forces caused by expansion and contraction pressure surges, vibration, and other transient conditions. Guides are necessary to help direct this movement between anchors by allowing longitudinal movement while restricting lateral movement. Depending on the application and type, guides may or may not act as supports. Support guides should have the same load bearing surface and other requirements of hangers designed for the system. Guides must be rigidly attached to the structure to prevent lateral movement but should not restrict longitudinal movement of the pipe through the guide. Anchors and guides must be engineered and installed without point loading the system.

Recommended Pipe Support Spacing
The following hanger support spacing recommendations are according to size, schedule, and operating temperatures. The below table is only intended as a guide for white PVC pressure pipe.

Nominal Pipe Size (mm)	Temperature					
	-7°C	16°C	27°C	38°C	49°C	60°C
	Spacing (m)					
15	1.50	1.35	1.35	1.20	0.75	0.75
20	1.65	1.50	1.35	1.20	0.75	0.75
25	1.80	1.65	1.50	1.35	0.90	0.75
32	1.80	1.65	1.65	1.50	0.90	0.90
40	1.95	1.80	1.65	1.50	1.00	0.90
50	1.95	1.80	1.65	1.50	1.00	0.90
65	2.25	2.15	1.95	1.80	1.20	1.00
80	2.45	2.15	2.15	1.80	1.20	1.00
100	2.60	2.25	2.15	1.95	1.35	1.20
150	2.90	2.60	2.45	2.25	1.50	1.35
200	3.00	2.75	2.60	2.45	1.50	1.35
250	3.35	3.00	2.75	2.60	1.65	1.50
300	3.65	3.50	3.20	2.90	1.95	1.65
350	3.95	3.65	3.35	3.00	2.15	1.50
400	4.25	3.95	3.65	3.35	2.45	1.80