FLO-TEK®

Flow better with us

PVC *Pressure Pipes & Fittings*

UPVC | MPVC | High Impact |

OVERVIEW

Composition of PVC Pipe Materials

Polyvinyl Chloride or PVC is one of the most versatile types of pipe materials. It is produced by the polymerisation of vinyl chloride which is made from coal (or oil) and common salt. In fact, salt makes up over 50% of the polymer, thus making PVC one of the most environmentally friendly plastic materials, being least dependent on increasingly scarce hydrocarbon resources.

The unique properties of PVC can be enhanced by the addition of special additives, for example, to create strong and tough pipe materials such as modified PVC (PVC-M), foamed multilayer sewer and drainage pipes, and weather resistant, above ground drainage pipes. These additives, as well as heat stabilisers and lubricants, which are necessary to facilitate the extrusion of the pipes, are added to the PVC raw material in a special high speed mixer to produce a dry blend specially formulated for the pipe extrusion process.

During the manufacture of the pipe the dry blend is mixed in the extruder and through a combination of heat and shear, the material is "gelled" into a homogeneous molten mass ready for passage through the die and calibrator to form a pipe which has tight tolerances in terms of the outside diameter, wall thickness and mechanical properties.

It should be noted that in recent years heat stabilisers and lubricants have been changed from lead based compounds to alternative, environmentally friendly metals such as organic and calcium zinc compounds.

Flo-Tek's PVC Pipe Systems

SANS 966 Part 1 UPVC

Below-ground pressure applications for the conveyance of potable water in reticulation systems and for other applications in which continuous temperatures in excess of 25 °C are not encountered.

SANS 966 Part 2 (MPVC)

Below-ground pressure applications for the conveyance of potable water in reticulation systems and for other applications in which continuous temperatures in excess of 25 °C are not encountered.

SANS 1283 High Impact

Suitable for the conveyance of non-potable water at temperatures between 5 °C and 60 °C for underground use in mines.

SANS 1452-2

For water supply and for buried and above ground drainage and sewerage under pressure.

Features and Benefits

- Environmentally friendly & Lead-free material
- Excellent flow characteristics reduces friction losses
- Best long-term strength (serves in excess of 50 years)
- Long-term strength, toughness and stiffness
- Large bore and high flow capacity
- Durability and toughness
- Resistant to acids and alkalis
- Resistant to corrosion, scaling and modern cleaning methods
- Light mass for easy handling and installation
- Elastomeric double-lip sealing ring system
- Inflammable: Does not support combustion

Physical Properties

Major properties of PVC pressure and sewer and drain pipes are given in Table 8. Please note that not all of the thermoplastics properties are dependent on the operating temperature and the duration of the stress application.

For example, working pressures of pipes used at higher temperatures should be lowered (or a higher class to be used) in order to maintain the long-term design life of the pipe.

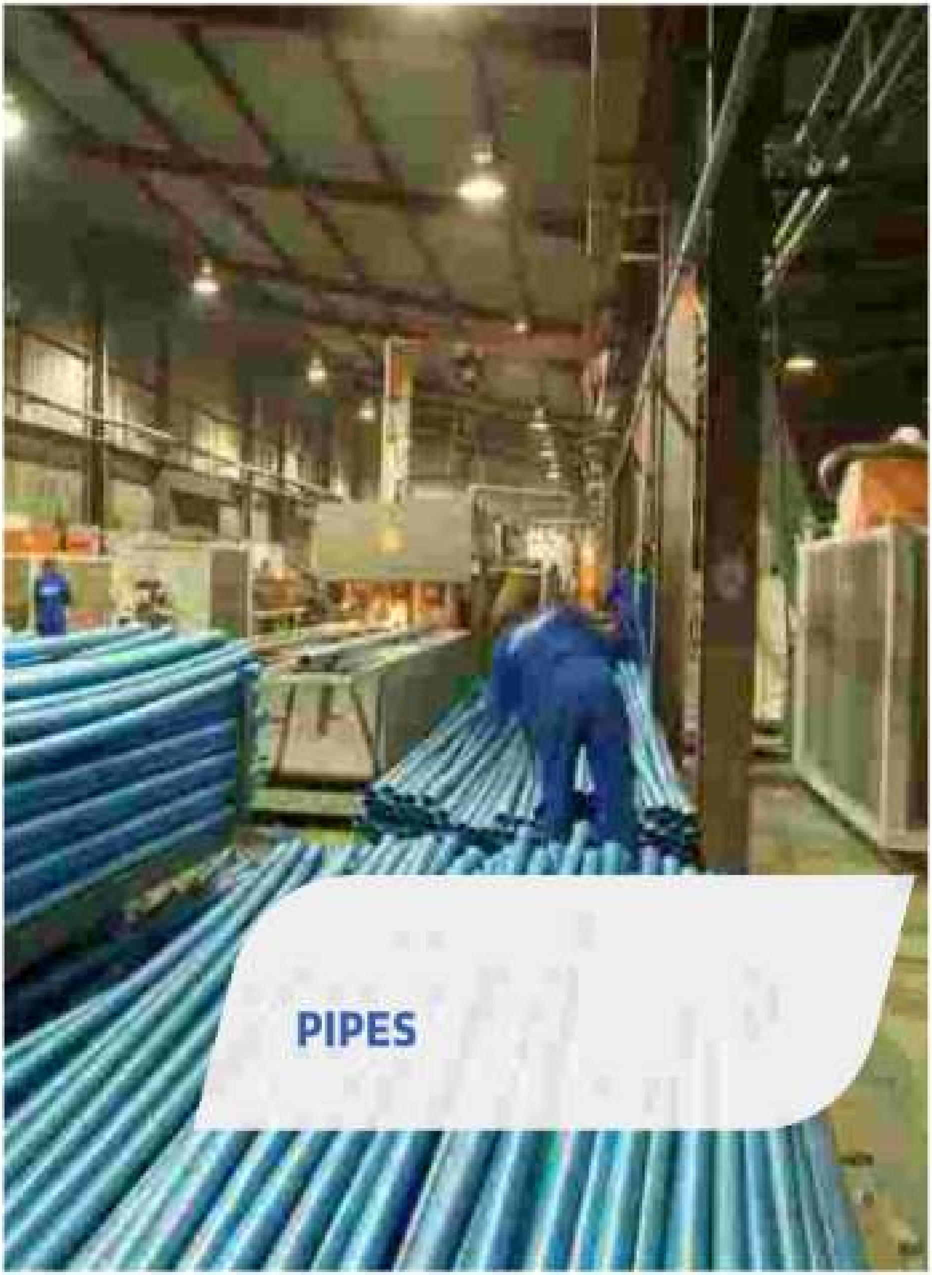
Product Range

PRODUCT	RANGE (Ø)	SPECIFICATION
PVC-U Pressure Pipes	20 - 600 mm	SANS 966-
PVC-U Pressure Pipes	50 - 500 mm	SANS 966-2
PVC-U Pressure and Pressure Sewer	25 - 500 mm	ISO 3452-2
PVC-M Mining Pressure Pipes High Impact	110 - 200 mm	SANS 1283
Borehole Casings and Screens	50 - 315 mm	DIN 4925 & ASTM F480-88

Product Properties

PHYSICAL	UNITS	PVC-U	PVC-M
Co-Efficient of Linear Expansion	°C⁻¹	8×10^{-5}	8×10^{-5}
Density	kg/m³	1.4×10^{3}	1.4×10^{3}
Flammability (oxygen index)	%	45	45
Shore Hardness (D)		70 - 80	70 - 80
Softening Point (Vicat - minimum)	°C	>80	>80
Specific Heat	J/kgK	1.0 x 10	1.0 x 10
Thermal Conductivity (0°C–50°C)	W/mK	0.14	0.14
MECHANICAL			
Elastic Modulus (long term 50 years)	MPa	1200	1400
Elastic Modulus (short term 100 seconds)	MPa	3000	3000
Elongation at break (Minimum)	%	45	45
Poisson's Ratio		0.4	0.4
Tensile Strength (50 years - extrapolated)	MPa	26	28
Tensile Strength (short term, Minimum)	MPa	45	45
FRICTION FACTORS			
Manning		0.008 – 0.009	0.008 – 0.009
Hazen Williams		150	150
Absolute Roughness (k)	mm	0.01	0.01

PIPES



PIPES

1. SANS 966 Part 1 PVC-U Pipes

From the stress-time line (also known as the creep rupture regression line) the minimum required strength (MRS) at 50 years is determined and the design stress (σ) is then obtained by applying a safety factor (C). The safety factor (or overall service design coefficient) takes into account the properties of the material and the service conditions and any unknown loading or environmental conditions.

$$\sigma_S = \frac{MRS}{C}$$

As can be determined from the stress time line, the MRS for PVC-U and for modified, high impact PVC-M pipe grades is 25 MPa. It is important to note that, since the design stress is the constant stress that the pipe wall can resist for at least 50 years, the safety factor applies at 50 years.

The safety factors used in the design of PVC-U and PVC-M Pipes have been accepted by the water and mining industries after many years of excellent performance.

Pipe Standards

Designation	Standard	MRS (MPa)	Design Stress	Safety Factor
PVC-U (20mm-90mm)	SANS 966-1	25	10.0	2.5
PVC-U (110mm-400mm)	SANS 966-1	25	12.5	2.0

Features and Benefits

- Manufactured from environment friendly virgin PVC & Lead free material does not affect water quality for human health.
- Excellent flow characteristics reduces friction losses.
- Best long – term strength/cost ratio of all pipe materials, service in excess of 50 years. So cost effective with user low lifetime ownership cost achieved.
- Unique combination of mechanical properties: long-term strength, toughness and stiffness, making it ideal for pressure, sewer and drainage pipes.
- Large bore and high flow capacity: lowers pumping costs and overall energy requirements.
- Durable: and toughness resistant to handling, transport and installation damage.
- Resistant to abrasion and scouring pre modern cleaning methods.
- Light mass: lower transport costs and easy handling and installation. Ideally suited for labour intensive projects.
- Elastomeric sealed-in sealing ring system: resistant to most chemicals. long-term sealing performance and easy, fast installation with unskilled labour.
- Inflammable: Does not support combustion.

Pipe Dimensions

All pipes are made to provide an effective length of 6.0 metres from 20 mm – 250 mm and 5.8 metres from 315 mm – 500 mm after installation; the outside diameters are the same for all pressure classes of the same nominal size and a class category of pipes. The minimum wall thickness and mass per metre are given in the table below.

SANS 966-1 PVC-U PRESSURE PIPE

MINIMUM WALL THICKNESS AND MASS PER METER OF RUBBER RING SOCKET PIPE FOR EACH SIZE & CLASS

NOMINAL SIZE	OUTSIDE DIAMETER		EFFECTIVE LENGTH	CLASS 4		CLASS 6		CLASS 9		CLASS 12		CLASS 16		CLASS 20	
mm	mm	Max.	m	mm	kg	mm	kg	mm	kg	mm	kg	mm	kg	mm	kg
20	20	20.2	6.0	–		–		–		–		1.5	0.13	1.9	0.16
25	25	25.2	6.0	–		–		–		–		1.9	0.21	2.3	0.25
32	32	32.2	6.0	–		–		–		1.9	0.28	2.4	0.34	2.9	0.40
40	40	40.2	6.0	–		–		1.8	0.33	2.3	0.41	3.0	0.53	3.7	0.64
50	50	50.2	6.0	–		1.8	0.42	2.2	0.51	2.9	0.66	3.7	0.84	4.6	1.02
63	63	63.2	6.0	–		1.9	0.57	2.8	0.80	3.6	1.04	4.7	1.34	5.8	1.62
75	75	75.2	6.0	1.8	0.64	2.2	0.79	3.2	1.13	4.3	1.48	5.6	1.91	6.9	2.30
90	90	90.2	6.0	1.8	0.78	2.7	1.16	3.8	1.65	5.1	2.15	6.7	2.75	8.2	3.30
NOTE: ABOVE WALL THICKNESS BASED ON MRS OF 20 MPa (SAFETY FACTOR 2.5)															
110	110	110.3	6.0	2.2	1.17	3.2	1.57	3.8	2.04	5.3	2.63	6.7	3.31	8.2	4.13
125	125	125.3	6.0	2.5	1.51	3.6	1.80	4.4	2.61	5.8	3.40	7.6	4.39	9.3	5.30
140	140	140.4	6.0	2.8	1.88	3.7	2.22	4.8	3.16	6.5	4.27	8.5	5.50	10.4	6.64
160	160	160.4	6.0	3.2	2.46	3.9	2.93	5.6	4.27	7.4	5.57	9.7	7.20	11.9	8.75
200	200	200.5	6.0	3.9	3.78	4.7	4.54	7.0	6.68	9.2	8.68	12.1	11.24	14.9	13.63
250	250	250.5	6.0	4.9	5.98	5.9	7.13	8.7	10.40	11.5	13.67	15.1	17.67	18.6	21.45
315	315	315.6	5.8	6.2	9.55	7.4	11.31	10.0	16.78	14.5	22.02	[illegible]	28.30	–	–
355	355	355.7	5.8	7.0	12.06	8.4	14.45	[illegible]	21.3	16.3	27.18	[illegible]	35.54	–	–
400	400	400.7	5.8	7.9	15.15	9.1	18.36	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	–	–
450	450	450.8	5.8	8.9	19.23	10.6	23.53	[illegible]	[illegible]	20.7	[illegible]	–	–	–	–
500	500	500.8	5.8	9.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22.9	[illegible]	–	–	–	–
NOTE: ABOVE WALL THICKNESS BASED ON MRS OF 12.5 MPa (SAFETY FACTOR 2)															

4. BOBS ISO 1452-2 PVC-U Pipes

Hartel pipes and fabricated fittings are intended for below ground water supply, drainage and sewerage under pressure applications in which continuous temperatures up to 25°C or 45°C are encountered.

Pipe Standards

Hartel's pressure pipe produced under this standard covers pressure sewer pipes, whereas there is no standard in SABS to cover pressure sewer pipe.

Description	Standard	MRS (Mpa)	Design Stress	Safety Factor
PVC-U (20mm-90mm)	ISO 1452-2	25	10.0	2.5
PVC-U (110mm-500mm)	ISO 1452-2	25	12.0	2.0

Features and Benefits

- Buried and sewerage under pressure application.
- Environment-friendly, lead-free material.
- Excellent flow characteristics reduces friction losses.
- Best long-term strength (serves in excess of 50 years).
- Long-term strength, toughness and stiffness.
- Large bore and high flow capacity.
- Durability and toughness.
- Resistant to acids and alkalis.
- Resistant to abrasion, allowing all modern cleaning methods.
- Light mass for easy handling and installation.
- Elastomeric sealed-in sealing ring system.
- Inflammable: Does not support combustion.

Pipe Dimensions

All pipes are made to provide an effective length of 6.0 meters from 20 mm – 250 mm and 5.8 meters from [illegible] mm – 500 mm after installation. The outside diameters are the same for all pressure classes of the same size and there are 7 classes of pipe. The minimum wall thickness (as per the applicable [illegible] ISO standard) and mass per meter are given in the tables below.

DIMENSIONS & WEIGHT OF PVC-U PRESSURE PIPES AS PER ISO 1452-2

MINIMUM WALL THICKNESS AND MASS PER METER FOR EACH SIZE AND PRESSURE CLASS

NOMINAL SIZE AND OUTSIDE DIAMETER	EFFECTIVE LENGTH (METERS)	NOMINAL (MINIMUM) WALL THICKNESS													
		S 20 (SDR 41) PN 6		S 16 (SDR 33) PN 8		S 12.5 (SDR 26) PN 10		S 10 (SDR 21) PN 12.5		S 8 (SDR 17) PN 16		S 6.3 (SDR 13.6) PN 20		S 5 (SDR 11) PN 25	
		mm	kg	mm	kg	mm	kg	mm	kg	mm	kg	mm	kg	mm	kg
		NOMINAL PRESSURE PN BASED ON DESIGN COEFFICIENT C = 2.5													
20	6	–	–	–	–	–	–	–	–	–	–	1.5	[illegible]	1.90	[illegible]
25	6	–	–	–	–	–	–	–	–	1.50	[illegible]	1.9	[illegible]	2.30	[illegible]
32	6	–	–			1.50	[illegible]	1.60	[illegible]	1.90	[illegible]	2.4	[illegible]	2.90	[illegible]
40	6	–	–	1.50	[illegible]	1.60	[illegible]	1.90	[illegible]	2.40	[illegible]	3	[illegible]	3.70	[illegible]
50	6	–	–	2.00	[illegible]	2.00	[illegible]	2.40	[illegible]	3.00	[illegible]	3.7	[illegible]	4.60	[illegible]
63	6	–	–	2.00	[illegible]	2.50	[illegible]	3.00	[illegible]	3.80	[illegible]	[illegible]	[illegible]	5.80	[illegible]
75	6	–	–	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
90	6	–	–	2.80	[illegible]	3.50	[illegible]	4.30	[illegible]	5.40	[illegible]	[illegible]	[illegible]	8.20	[illegible]
		S 20 (SDR 41) PN 8		S 16 (SDR 33) PN 10		S 12.5 (SDR 26) PN 12.5		S 10 (SDR 21) PN 16		S 8 (SDR 17) PN 20		S 6.3 (SDR 13.6) PN 25		S 5 (SDR 11) PN [illegible]	
		NOMINAL PRESSURE PN BASED ON DESIGN COEFFICIENT C = 2													
		mm	kg	mm	kg	mm	kg	mm	kg	mm	kg	mm	kg	mm	kg
110	6	2.70	[illegible]	3.40	[illegible]	4.20	[illegible]	5.30	[illegible]	6.60	[illegible]	8.1	[illegible]	10.00	[illegible]
125	6	3.10	[illegible]	3.90	[illegible]	4.80	[illegible]	6.00	[illegible]	7.40	[illegible]	9.2	[illegible]	11.40	[illegible]
140	6	3.50	[illegible]	4.30	[illegible]	5.40	[illegible]	6.70	[illegible]	8.30	[illegible]	10.3	[illegible]	12.70	[illegible]
160	6	4.00	[illegible]	4.90	[illegible]	6.20	[illegible]	7.70	[illegible]	9.50	[illegible]	11.8	[illegible]	14.60	[illegible]
200	6	4.90	[illegible]	6.20	[illegible]	7.70	[illegible]	9.60	[illegible]	11.90	[illegible]	14.7	[illegible]	18.20	[illegible]
250	6	6.20	[illegible]	7.70	[illegible]	9.60	[illegible]	11.90	[illegible]	14.80	[illegible]	18.4	[illegible]	–	–
315	5.8	7.70	[illegible]	9.70	[illegible]	12.10	[illegible]	15.00	[illegible]	18.70	[illegible]	23.2	[illegible]	–	–
355	5.8	8.70	[illegible]	10.90	[illegible]	13.60	[illegible]	16.90	[illegible]	21.10	[illegible]	26.1	[illegible]	–	–
400	5.8	9.80	[illegible]	12.30	[illegible]	15.30	[illegible]	19.10	[illegible]	23.70	[illegible]	29.4	[illegible]	–	–
450	5.8	11.00	[illegible]	13.80	[illegible]	17.20	[illegible]	21.50	[illegible]	26.70	[illegible]	33.1	[illegible]	–	–
500	5.8	12.30	[illegible]	15.30	[illegible]	19.10	[illegible]	23.90	[illegible]	29.70	[illegible]	36.8	[illegible]	–	–

DESIGN CONSIDERATIONS

Durability and the Long-Term Safety Factor

It should be noted that the stress – time line does not indicate a loss of strength with time rather that the material can support lower stresses for longer times. With each new loading, for example water hammer or pressure surges, the material acts according to the short-term strength properties. Short term strength is independent of how much time has passed since the first loading – the pipe acts as a new pipe.

Numerous studies conducted on PVC-U pipes excavated at various times up to 50 years have shown the excellent durability of these 'old' pipes with little or no difference in mechanical properties to recently manufactured pipes. Tensile strength, impact strength, burst pressure and elastic modulus show virtually no change with time in service. A study conducted on 60 year old PVC-U pipes states "although the plastics industry is a relatively young market development, PVC-U pipe is now about 70 years old, which is more than the predicted service lifetime of 50 years for PVC pipe applications."

Short -Term Safety Factor

The question is often asked "how do PVC-U and PVC-M pressure pipes withstand sudden surges in pressure caused, for example, by water hammer"? The short answer is, "extremely well"! The question usually results from a consideration of the safety factors of 2.0 and 1.4 applied in the design of the two materials, PVC-U and PVC-M, respectively. However, it should be noted that these are long-term (ie 50-year) safety factors, while the short-term safety factors are much greater.

The graph below graphically illustrates that the shorter the time the pressure is applied, the greater the strength exhibited by these materials, as the molecular structure needs time to yield to the stress.

The short-term safety factors of PVC-U and PVC-M are over 3 times the design operating pressure and can be as high as 4 or 5 times depending on the rate of the pressure surge.

Long -Term Hydrostatic Strength Properties and The Long-Term Safety Factor

The strength of plastics pipes can be defined in terms of the maximum stress to cause failure in a given time, usually 50 years, and is determined at various elevated times according to the procedure described in ISO 9080. The results are graphically illustrated by plotting the hoop stress against the time to fail on a log scale, as shown below.

Stress - Time line for PVC-U and PVC-M at 20°C [1]

- PVC-U and PVC-M regression line as per SANS 966 Parts 1 and 2
- PVC-M design stress: SANS 966-2 (18 MPa)
- PVC-U design stress: SANS 966-1 (12.5 MPa)

Pressure Variation and Surge Pressures

The stress-time lines are derived using constant stresses. In pipelines the stress on the material is rarely constant, varying as the pressure varies and as superimposed loads vary. The loads stabilise fairly quickly, usually within the first year or two of the installation, but pressure variations are there to stay. As with any other pipe material, due allowance for this must be made in designing a water reticulation network with PVC pipes.

Anti-surge devices such as air vessels, non-return valves, programmed use of pumps etc. should be incorporated where necessary. Lower surge pressures develop in PVC pipes as a result of lower surge wave velocities and this has enabled PVC pipes to be used in areas where water hammer has caused pipes manufactured from other materials to fracture. Above all, it enables one to operate with lower pressure classes for PVC.

Considerable research has been done on the fatigue properties of plastic pipelines. Recently, work has been published on fatigue properties of PVC-M related to actual site conditions in water distribution systems. It concludes that PVC-M pipes will not fail under conditions of dynamic and static stress within 50 years provided the total stress does not exceed 18 MPa and the stress amplitude over the million pressure cycles (equal to 55 cycles per day for 50 years) is below 3.0 MPa.

The Effect of Temperature Changes on Working Pressure

The pressure classes of PVC pipes bearing the SABS mark have been allocated on the basis of design at 20°C. PVC pressure pipes perform well at temperatures below 20°C and can withstand higher pressures at lower temperatures. Pipes used in applications where operating temperatures exceed 25°C should be de-rated to ensure that the 50 year design life is not adversely affected. The following pressure reduction factors should be applied.

WORKING TEMPERATURE (°C)	MULTIPLICATION FACTORS
25	1.0
30	0.9
35	0.8
40	0.7
45	0.6
50	0.5
55	0.4
60	0.3

Expansion and Contraction

All plastics have high co-efficients of expansion and contraction, several times those of metals. This must be allowed for in any installation by the use of expansion joints, expansion loops etc.

MATERIAL	CO-EFFICIENT OF EXPANSION (/°C)
PVC	6×10^{-5}
HDPE	20×10^{-5}
LDPE	20×10^{-5}
Steel	1.2×10^{-5}
Copper	2.0×10^{-5}

Examples based on the above are as follows:

- A PVC pipe will expand or contract by 0.06mm per metre per °C change in temperature.
- A HDPE pipe will expand or contract by 0.2mm per metre per °C change in temperature.
- A 30° rise in temperature will cause an increase in length of 10.8mm (0.06 x 30 x 6m) in a 6m length of PVC pipe and an increase of 36mm (0.2 x 30 x 6m) in a 6m length of HDPE pipe.

Calculating Water Hammer

The Wave Celerity for PVC-U and PVC-M which is used in the calculation of water hammer in pipelines is given in the table below.

Higher wave celerity values result in higher levels of water hammer. Each class of pipe has a constant value of wave celerity. By comparison the wave celerities for materials such as steel and fibre cement are much higher – by multiples of 3 or more.

CLASS	PVC-U	PVC-M
6	293	249
9	355	270
12	378	317
16	419	353
20	466	407
25	558	458

DESIGN CONSIDERATIONS ...

Resistance to Weathering (Ultraviolet Light)

Most plastics are affected by UV light. PVC pressure pipes have pigments and light stabilisers incorporated in their formulation and if pressure pipes have to be exposed for an indefinite period, they should be painted, preferably with one coat of white alkyd enamel or PVA or suitable covering should be provided. Paint containing solvent thinners should be avoided.

Long-term exposure (more than 4 - 6 months, but dependent on climatic conditions) to UV light can cause discolouration of the pigments in the pipe and, in extreme cases, lead to some embrittlement. Such embrittlement affects the ability to withstand impacts but does not reduce pressure handling capabilities.

It is recommended that pipes should be buried wherever possible.

Compressed Air

Normal forms of PVC pipe should NOT be used for the reticulation of compressed air.

Bending

An important feature of PVC pipes is that they may be deliberately bent, within limits, thus eliminating the need, in some cases, for separate bend fittings. As a rule of thumb the radius of such a bend must not be less than 300 times the pipe diameter.

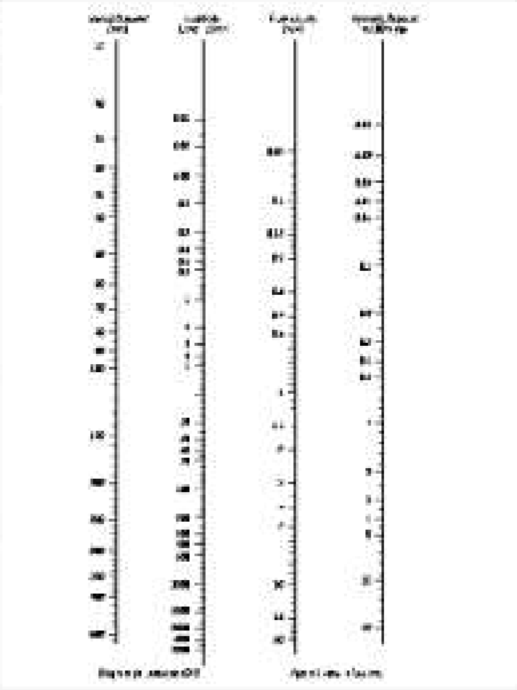
In addition each rubber ring joint can accommodate a further 2° of bend. This feature significantly reduces costs and speeds up installation times when compared to some traditional pipe materials.

Flow Rates, Velocities and Friction Losses

The flow velocities in pressure pipelines should fall in the range 0.8 to 2.5 m/s, the lower rate to maintain self-cleaning flow and assist in the removal of air and the upper limit to minimise the incidence of high surge. Approximate flow rates, flow velocities, friction losses in straight PVC pressure pipelines without fittings can be read off the following Nomogram.

How to use a Nomogram:

1. You need a straight edge and at least two of the four values.
2. Place the straight edge across all four columns so that it intersects the two known values.
3. Read off the other two values.



PIPE JOINTING

JOINTING METHODS

1. Cutting

PVC pipes can be easily cut using a number of different cutting tools, such as proprietary cutting tools which cut, deburr and chamfer in one operation. Circular saws or hand saws may be used. It is important to ensure that, after cutting, the pipe end is thoroughly deburred.

2. Rubber Ring Joints

A rubber ring socket is integrally moulded on one end of the pipe and incorporates a factory fitted rubber sealing ring which is retained in position. The opposite end of the pipe (spigot end) is suitably chamfered and has a depth of entry mark near its end. Each joint is capable of handling expansion and contraction as well as angular deflection of up to 1°C and a pressure of up to 75 kPa below the ambient atmospheric pressure. The seal ring is designed to provide a watertight joint at high and low pressures.

3. Depth of Entry

The depth of entry mark is a guide to ensure correct depth of insertion of the spigot into the socket of the next pipe. If pipes are cut to measure on site it is necessary to mark the depth of entry, according to the dimensions given in the following table as per the pipe being installed at the same time.

Re-marking can be done with a permanent felt tipped marker pen. The correct depth of entry allows for expansion and contraction of the pipes in the pipeline.

PIPE SIZE (mm)	DEPTH OF ENTRY (mm)
50	110
63	120
75	140
90	135
110	150
125	160
140	165
160	175
200	200
250	225
315	230
355	240
400	250
450	265
500	275

4. Chamfering

The spigot end of all rubber ring jointed pipes is chamfered at the time of manufacture. Chamfering facilitates the insertion of the spigot end into the socket of the next pipe without damaging or dislodging the rubber ring. If however, the chamfering has been cut off, it is important to re-chamfer the end correctly. Re-chamfering can easily be done using a file that leaves no sharp edges which may cut the rubber ring.

It should be at an angle of about 15° – 25° and the length of the chamfer should be such that at least half the wall of the thickness is removed. The chamfering should not be done to such an extent that a sharp edge is made at rim of the bore.

5. Lubricant

It is the most important to use correct lubricant when making a joint. The lubricant considerably reduces the effort required to insert the spigot into the socket and at the same time minimizes the possibility of dislodging the rubber ring. The lubricant should be water soluble, non-toxic and of a gel consistency. Alternative lubricants such as oil, grease, diesel, dish-washing liquid, etc must under no circumstances be used.

Joints Per Lubricant		
PIPE SIZE (mm)	JOINTS / 2kg	JOINTS / 5kg
50	290	725
63	250	625
75	220	550
90	180	450
110	140	350
125	130	325
140	120	300
160	110	275
200	75	188
250	60	150
315	50	125
355	35	88
400	30	75
450	28	70
500	25	60

JOINTING PROCEDURE

Rubber Ring Joints of Pipes

1. Check the spigot end of the pipe for correct chamfering (of an angle of approx. 15° and a half of the thickness). Ensure that the "depth of entry" mark is visible and that there are no burrs and damage present.
2. Wipe the spigot end clean.
3. Check the socket end of the pipe to ensure that the rubber ring is present and correctly fitted. Make sure that no dirt or mud is present.
4. Apply the thin film of Lubricant evenly around the circumference of the spigot up to about half the distance to the "depth of entry" mark.
5. Lubricate the rubber ring as well.
6. Place the spigot end of the pipe into the socket so that it rests against the rubber ring.
7. Ensure the two pipes are correctly aligned both horizontally and vertically. Failure to do this could lead to the rubber ring being dislodged when the next step is carried out.
8. Push the spigot into the socket until the "depth of entry" mark is just visible at the end of the socket. It should not be necessary to use undue force – if this becomes necessary, it is normally an indication that something is amiss and the joint making process should be started again.

Solvent Weld Joints of Pipes

It must be stressed that solvent cement jointing is a welding and not gluing process. It is important therefore that there is an interference fit between the spigot and socket to be joined. Do not attempt to make a joint when an interference fit between a dry spigot and socket is not achieved (i.e. a loose fit).

There are different types of solvent cement available for pressure pipes and for non-pressure applications. Make sure that the appropriate cement is being used. Do not dilute or add anything to the solvent cement.

Excellent solvent weld joints can be made to withstand high pressures, provided the correct welding procedure is followed.

Solvent Cement Joints of Pipes & Fittings

Assemble all the required fittings, pipes and equipment. For the best results, follow the jointing procedure below.

a. Make sure that the spigot has been cut square and that all burrs have been removed.
b. Mark the spigot with a pencil line (or similar) at a distance equal to the internal depth of the socket.
c. Check that, while dry, there is an interference fit between the spigot and the socket before the spigot reaches the full depth indicated by the pencil line.
d. Ensure that both the spigot and the socket are prepared (as illustrated).
e. Degrease and clean both with an appropriate cleaner (as illustrated). This also acts as a primer first.
f. With a suitable brush apply a thin film of solvent cement to the internal surface of the socket. Then apply the solvent cement in a similar manner up to the mark on the spigot. Do not use excess solvent cement. The brush width should be such that the solvent cement can be applied to both surfaces within about 30 seconds.
g. Make the joint immediately. While inserting the spigot rotate it by about 90° and ensure that it is fully inserted up to the pencil mark, so there is a bead of excess solvent cement indicating the correct amount has been applied. Hold steady for at least 30 seconds. Mechanical assistance may be necessary for large pipes.
h. Wipe off any excess solvent cement with a clean rag.
i. Do not disturb for at least 5 minutes.
j. Do not apply pressure for at least 24 hours.

RUBBER RING TYPE INTEGRAL PIPE END SOCKETS

Laying, backfilling and Hydrostatic test pressure Requirements

1. At the level of the top of the pipes, the trench should be not less than the external diameter of the pipe plus 300 mm.
2. The bottom of the trench should be carefully leveled and cleared of any sharp edges and stones. If this is not possible, apply suitable bedding material to a thickness of at least 100 mm over the bottom of the trench.
3. Only stable backfill materials should be used. In general, sands and fine gravels are the best materials.
4. If materials have been excavated from the trench which can be compacted sufficiently to fix the pipes properly in place, these may be used. This applies to sand, gravel, top soil and light soils.
5. Pipes should not be encased in concrete.
6. Correct assembly of the joint requires that the spigot end be chamfered and correctly lubricated prior to insertion into the socket.
7. The spigot shall be inserted into the socket up to the insertion depth of entry mark made by the manufacturer.
8. A confirmatory visual check of joints can be made on the base of the pipe by using a lamp.
9. If the elastomeric sealing ring is not in place at the time of delivery, clean the groove, remove any foreign bodies and then locate the ring correctly in the groove.
10. After the pipe has been firmly and uniformly bedded, start backfilling the trench, up to the top level of the pipe, in layers of thickness not exceeding 100 mm. The same material should then be compacted in successive layers over the pipe until a thorough compacted layer of 300 mm above the pipe is achieved. Do not roll or use heavy mechanical compaction until at least 600 mm of material has been placed over the pipe.
11. Pressure test requirements stipulate that pressure testing should take place with the pipes only partially backfilled, leaving the joints open for inspection during the pressure testing procedures.
12. For large scale networks, the tests are done on sections of maximum length 500m.
13. Air vents at high points should be open during the filling of the network.
14. Pipes should be slowly filled with water starting from the lowest point to avoid any pressure surges (or water hammer).
15. The air in the system should be allowed to escape during the filling with water.
16. It should be ensured that no air is trapped in any part of the system.
17. The test pressure should normally be not more than 1.5 times the maximum working pressure of the system.

Note: These are just guide lines. For detailed procedure please refer SANS 10112 (The installation of polyethylene and poly (vinyl chloride) (PVC-U and PVC-M) pipes). Please follow above points to achieve best result.

STORAGE AND TRANSPORTATION

Storage

Pipes should be stored on level, flat ground, free of stones. They may be stored on timber supports of at least 75 mm width placed 1.5 metres apart with side supports. The height of pipe stacks should not exceed 1.5 metres.

All pipe stacks and boxed fittings should be covered to avoid prolonged exposure to direct sunlight.

PIPE SELECTION CRITERIA

PRESSURE & NON-PRESSURE PIPES

A very good description of the criteria which may be used for the selection of the various plastics pipes available for each application is given in the SAPPMA Technical Manual (Second Edition, March 2009) [1].

The section in the Technical Manual covers the following:

HYDRAULIC REQUIREMENTS

- Basic Principles
- Operating Pressure, Hoop Stress and Wall Thickness
- Surge and Fatigue
- Factory Tests

EXTERNAL LOADS

- Design Basis
- Load Classification
- Pipe Stiffness
- Determining Required Pipe Stiffness
- Vertical Deflection

DURABILITY REQUIREMENTS

SYSTEM COMPONENTS

- Secondary Loads
- Manholes
- Jointing and Fittings
- Valves

PIPE INSTALLATION

An excellent section in the SAPPMA Manual covers the following on pipe installation procedures:

- Pre-construction Activities
- Excavation
- Embedment
- Pipe Laying and Jointing
- Backfilling
- Anchoring
- Support Spacing for Mine Pipes
- Support Spacing for Soil, Waste and Vent Pipes
- Site Tests

A COPY OF THE SAPPMA TECHNICAL MANUAL IS FREELY AVAILABLE FROM FLO-TEK PIPES AND IRRIGATION, EITHER IN HARD COPY OR ON CD. Please contact any of our Sales Offices or our Export Department.