Pakistan PVC Limited

CONTENTS

Pakistan PVC Limited is a Chlor-Alkali/PVC Complex, producing PVC Resins and processing these and other thermo-plastic compounds into finished and semi-finished products. The Plant is situated at Shaffiabad , Gharo district Thatta , 66 KM from Karachi. Another production facility for pipes and fittings has been put up at Islamabad Industrial Area.

It was constructed in the middle sixties in collaboration with M/s Shin-Etsu Chemical Industry Company Limited of Japan, the largest producer of PVC Resin in the world and M/s Sekisui Chemical Company Limited of Japan. The plant started producing PVC Pipes as early as in 1966 and we were the pioneers to introduce this product in this country.

The Plants have been upgraded from time to time. Turning the PVC Pipe Plant into the largest and the most modern extrusion facility in the country. The machinery , coming from the best extrusion machinery manufacturers in the world , M/s Toshiba of Japan , M/s Wavin Overseas of Holland , M/s Shekisui of Japan and M/s Cincinatti of Austria. Besides the PVC Pipe Plant , the Company has various units for the production of PVC Resin based Compounds and finished products for consumer and industrial use. SHAVYL pipes and fittings are made according to the internationally established standard. Our trained engineers are sent to foreign countries not only to acquire most modern technology but also to render technical assistance to our various customers.

The data given in this brochure refers to 'SHAVYL' Pipe meeting BS 3505: 1968. It is common to pipes meeting other standards too.

The information in this publication and otherwise supplied to users is based upon our experience and is given in good faith. But because of the many particular factors, which are outside our knowledge and control and effect the use of products, no warranty is given or is to be implied with respect to such information.

The company's policy is one of continuous development and therefore the right is reserved to change specifications without prior notice

INTRODUCTION

This is the technical handbook for the engineers who design and install water pipelines in urban and far-flung areas. It contains information, based on the specialized experience of our company as well as that of our technical collaborators in meeting the specific demands of various areas with almost all types of geo-physical terrain's. And our Technical Services Department can take care of all the normal and abnormal problems. We have always been entirely devoted to producing uPVC extrusions and moldings. And since 1966 have pioneered the early developments of the use of uPVC for water distribution and electrical fittings in this country. In this field of manufacture we are specialists.

QUALITY CONTROL

Pakistan PVC Limited maintains a continuous and strict control over quality of the pipes through every stage of its process. The Plant is laid out to permit careful supervision of the blending process as well as close production control. Foreign trained engineers and a well-equipped testing laboratory help in regular quality checks. In this way a product of high purity and mechanical strength is ensured. The importance of this rigid control cannot be over-emphasized, since the user is rarely in a position to carry out more than the most perfunctory tests or make simple visual comparisons.

SHAVYL RIGID PVC PRESSURE PIPES

SHAVYL unplasticized Poly Vinyl Chloride pipes are produced according to specifications under the technical know-how of Shekisui Chemical Company, Japan and Wavin Overseas Ltd., Holland.

Four types of pressure pipes are produced at present; B-Class for working pressures upto 6 kg/cm2, C-Class for working pressure upto 9 kg/cm2, D-Class for working pressure upto 12 kg/cm2 and E-Class for working pressure upto 15 kg/cm2. All ranges of SHAVYL fittings and accessories for these pipes are also available. For any other special requirements we can also produce Special-Class Pipes.

USES AND LIMITATIONS

SHAVYL pipes are made in diameter upto 14-in. (350-mm) nominal size and with wall thickness suitable for working pressures equivalent to 6, 9, 12 & 15 bars (200, 300, 400 & 500 ft. head). The advantages of uPVC pipes over other material such as Cast Iron and Asbestos Cement are well known.

SHAVYL pipes should not be used for hot water systems, because the material softens at higher temperatures. Their use for pressure duties is therefore precluded if operating temperatures exceed 60 C (140 F). Experience and tests have shown that SHAVYL pipes very rarely suffer bursts due to frosts, owing to the elasticity and good insulating properties of the material. However, SHAVYL pipes cannot be guaranteed against weakening if water is allowed to freeze and thaw in them repeatedly. For this reason it is recommended that SHAVYL pipes be laid below the frost line. If sub-zero temperatures are encountered in aboveground installations, precautions should be taken to protect the pipe against frost as well as mechanical damage, as uPVC becomes more brittle at these temperatures. Reasonable care should be exercised when handling pipe during cold weather. Thermal expansion is higher than in the case of metal and cement pipes. With a temperature rise of 10 C (18 F), a 3 meter (10 ft.) length of SHAVYL pipe will expand approximately 1.6 mm (1/16 in.). For buried pipes however, elongation will not occur as the fractional forces between uPVC pipe and surrounding soil are greater than the internal forces caused by temperature changes.

FLOW

As previously mentioned the smooth bores of SHAVYL pipes have better flow characteristics than those of metal and cement pipes. For those who prefer to work with from other formulae, the frictions co-efficient of SHAVYL pipes are: -

Friction Co-Efficient

	Up to and Including Size12 (323 mm)	*Over-Size 12 (323 mm)*
Hazen Williams Colebrook	135 - 150 0.00001	150 0.00001

APPLICATIONS OF SHAVYL PIPES

The possibilities for SHAVYL pipes are unlimited; irrigation, electric, drainage and sewerage are only a few of the many ways in which SHAVYL pipes can be used.

WATER SUPPLIES

Non-toxic SHAVYL pipes will not effect the taste, odor, or smell of drinking water. It will never corrode and is therefore extremely sanitary. Deposits and scales will not build up inside as in conventional steel pipes. Its strength is greater than that of asbestos pipes.

IRRIGATION

SHAVYL pipes are ideal for agricultural irrigation and sprinkler systems. Non drinking water which contains fertilizers and insects. Inhibitors do not attack SHAVYL pipes.

INDUSTRY

Resistant to most chemicals, SHAVYL pipes have an important role to play in the world of chemicals. Light, non-corrosive and easy to assemble, it accommodates more complex piping work than possible with steel or cast-iron pipes.

TUBEWELLS

Free flowing, anti-corrosive, easily installed; lightweight SHAVYL PVC pipes are an ideal choice for strainers and casings of tube-wells. Sinking of these pipes is much easier than that of other useable materials.

DRAINAGE, WASTE, SEWERAGE AND VENTILATIONS

Drainage and sewerage systems for private homes, buildings and elevated highways, waste lines for corrosive gases and ventilation systems for office buildings and factories are few of the many possibilities for SHAVYL pipes where it can be used with considerable advantages.

CONDUITS

Since SHAVYL pipes are themselves an integral insulator, there is an ever increasing demand for it as an electrical conduit. To facilitate wiring work a full line of fittings are available, constructed from the same material as the pipes.

WALL THICKNESS

OF SHAVYL PIPES

BRITISH STANDARD SPECIFICATIONS

3505 : 1968 uPVC PIPE

WALL THICKNESS

Nominal Size	Outside Diameter		B-CLASS 6.0 bar (60m head of water)		C- CLASS 9.0 bar (90m head of water)		D-CLASS 12.0 bar (120m head of water)		E-CLASS 15.0 bar (150m head of water)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Inch	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
3/8	17.0	17.3							1.5	1.9
1/2	21.2	21.5							1.7	2.1
3/4	26.6	26.9							1.9	2.5
1	33.4	33.7							2.2	2.7
1 1/4	42.1	42.4					2.2	2.4	2.7	3.2
1 1/2	48.1	48.4					2.5	2.8	3.1	3.4
2	60.2	60.5			2.5	2.8	3.1	3.4	3.9	4.3
2 1/2	75.2	75.5			3.0	3.3	3.9	4.5	4.8	5.3
3	88.7	89.1	2.9	3.3	3.5	4.1	4.6	5.3	5.7	6.6
4	114.1	114.5	3.4	4.0	4.5	5.2	6.0	6.9	7.3	8.4
5	140.0	140.4	3.8	4.4	5.5	6.4	7.3	8.4	0.0	0.0
6	168.0	168.5	4.5	5.2	6.6	7.6	8.8	10.2	0.0	0.0
8	218.8	219.4	5.3	6.1	7.8	9.0	10.3	11.9	12.6	14.3
10	272.6	273.4	6.6	7.6	9.7	11.2	12.8	14.8	15.7	18.1
12	323.4	324.3	7.8	9.0	11.5	13.3	15.2	17.5	18.7	21.6
14	355.0	356.0	8.5	9.8	12.6	14.5	0.0	0.0	0.0	0.0

1 bar approx.= 1 kg/cm2

WEIGHT OF PVC PIPE PER METER (Minimum)

Normal Size (Inch)	CLASS-B Kgs/M	CLASS-C Kgs/M	CLASS-D Kgs/M	CLASS-E Kgs/M
3/8 "	-	-	-	0.11
1/2 "	-	-	-	0.15
3/4 "	-	-	-	0.22
1 "	-	-	-	0.32
1 1/4 "	-	-	0.41	0.5
1 1/2 "	-	-	0.54	0.65
2 "	-	0.68	0.82	1.03
2 1/2 "	-	1.01	1.20	1.58
3 "	1.17	1.41	1.82	2.22
4 "	1.78	2.32	3.03	3.65
5 "	2.44	3.49	4.55	5.51
6 "	3.46	5.01	6.57	7.95
8 "	5.30	7.72	10.05	12.17
10 "	8.26	11.97	15.59	18.89
12 "	11.55	16.85	21.91	26.28
14 "	13.87	20.27	26.49	36.16

S H A V Y L

PIPE DIMENSIONS BS 3505 = 1968

NOMINAL SIZE IN INCHES	OUTSIDE DIAMETER IN ML/MTR		CLASS B				CLASS C				CLASS D				CLASS E			
			WALL THICKNESS IN ML / MTR		WEIGHT KG / MTR		WALL THICKNESS IN ML / MTR		WEIGHT KG / MTR		WALL THICKNESS IN ML / MTR		WEIGHT KG / MTR		WALL THICKNESS IN ML / MTR		WEIGHT KG / MTR	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
3/8"	17.0	17.3													1.50	1.70	0.104	0.119
1/2"	21.2	21.5									1.45	1.73	0.128	0.153	1.70	1.90	0.149	0.167
3/4"	26.6	26.9									1.55	1.83	0.174	0.206	1.90	2.10	0.210	0.234
1"	33.4	33.7									1.93	2.24	0.273	0.316	2.20	2.40	0.308	0.337
1-1/4"	42.1	42.4									2.20	2.40	0.394	0.431	2.70	3.00	0.478	0.531
1-1/2"	48.1	48.4									2.50	2.80	0.512	0.574	3.10	3.40	0.627	0.687
2"	60.2	60.5					2.5	2.8	0.648	0.726	3.10	3.40	0.795	0.872	3.90	4.30	0.987	1.086
2-1/2"	75.2	75.5					3.0	3.3	0.973	1.071	3.90	4.30	1.250	1.376	4.80	5.30	1.519	1.672
3"	88.7	89.1	2.9	3.3	1.118	1.272	3.5	3.9	1.340	1.493	4.60	5.10	1.739	1.926	5.70	6.30	2.127	2.345
4"	114.1	114.5	3.4	3.8	1.692	1.891	4.5	5.0	2.217	2.461	6.00	6.60	2.910	3.200	7.30	8.00	3.500	3.890
5"	140.0	140.4	3.8	4.2	2.326	2.571	5.5	6.1	3.325	3.883	7.30	8.00	4.355	4.762	9.00	9.90	5.300	5.808
6"	168.0	168.5	4.5	5.0	3.300	3.675	6.6	7.3	4.719	5.290	8.80	9.70	6.298	6.925	10.80	11.90	7.633	8.378
7"	193.5	194.0	5.2	5.7	4.402	4.825	7.7	8.5	6.432	7.089	10.10	11.10	8.328	9.127	12.40	13.60	10.096	11.080
8"	218.8	219.4	5.3	5.8	5.087	5.570	7.8	8.6	7.399	8.150	10.30	11.30	9.655	10.572	12.60	13.90	11.681	12.642
9"	244.1	244.8	5.9	6.5	6.318	6.964	8.7	9.6	9.507	10.151	11.50	12.70	12.026	13.252	14.10	15.50	14.580	15.973
10"	272.6	273.4	6.6	7.3	7.893	8.733	9.7	10.7	11.466	12.637	12.80	14.10	14.951	16.437	15.70	17.30	18.133	19.910
12"	323.4	324.3	7.8	8.6	11.067	12.206	11.5	12.7	16.126	17.792	15.20	16.70	21.062	23.095	18.70	20.60	25.617	28.121
14"	355.0	356.0	8.5	9.4	13.241	14.648	12.6	13.9	19.396	21.379	16.70	18.40	25.400	27.928	20.50	22.60	30.830	33.876
16"	405.9	406.9	9.7	10.7	17.278	19.060	14.5	16.0	25.516	28.119	19.00	20.90	33.050	36.271	23.40	25.30	40.241	44.206
18"	456.7	457.7	11.0	12.1	22.042	24.241	16.3	17.9	32.276	35.394	21.40	23.60	41.882	46.060				
20"	507.5	508.5	12.2	13.4	27.167	29.827	18.1	19.9	39.826	43.715								
22"	558.3	559.3	13.4	14.8	32.828	36.231	19.9	21.9	48.172	52.913								
24"	609.1	610.1	14.6	16.1	39.023	42.997	21.7	23.9	57.800	62.989								

PROPERTIES

General Properties

TEST	UNIT	VALUE AT 20 C	REMARKS	DESIGN DATA
Specific Gravity Shore Rock well	deg.	1.38 - 1.45 70 - 90 110 - 120	Mode 1.43 Equivalent to the hardness of aluminum	1.43
Inflammability		Self-extinguishing	Ignites when flame approaches but the fire extinguishes by itself when brought away from flame.	
Weather Resistance		Color fading but no decrease in strength	Tensile strength increases slightly and elongation decreases.	
Primary Softening Point	C	75 - 80	Softening initiates at this point	
Welding temperature	C	180 - 185	Becomes slightly viscous	
Molding temperature	C	190 - 200	Becomes paste like to collapse pipe shape	
Decomposition point	c	205 - 210	Scorching by carbon-ization and dehydro-chloriation.	
Specific Volume Resistively	Mcm	3-5 x 10(15)	High Electric Insulator Non Magnetizing.	
Di-electric	kV/mm	23 - 28		

STRENGTH OF BURIED PVC PIPES

Buried pipelines have to withstand the vertical loads due to the weight of the soil and the surcharge loads due to traffic.

BEARING CAPACITIES OF SOIL

The bearing capacities of soils depend on the soil texture and are generally:

Table

Soil Texture	Bearing Capacity Vertical		Bearing Capacity	
	Ton/m2	(lb/in2)	Ton/m2	(lb/in2)
Soft silt & Slurry	1.4-4	(2-5.3)	0.4-1	(0.6-1.4)
Wet Slit	10-20	(14.2-28.4)	2.5	(3.6)
Soft Clay	10-15	(14.2-21.3)	2.5	(3.6)
Hard Clay	20-25	(28.4-35.6)	5-6	(7.1-8.5)
Wet Sand	20	(28.4)	5	(7.1)
Coarse Sand	30	(42.7)	6	(8.5)
Gravel contain Stone	40-50	(56.9-71.1)	7.5	(10.7)
Gravel contain Sand	50-60	(71.1-85.3)	10	(14.2)
Soft Rock	70-100	(99.6-142.2)	10-25	(14.2-35.6)
Hard Rock	200-400	(284.5-586.9)	50 & over	(71.1 & over)

EARTH LOAD

The load of backfill acting upon a buried pipe is calculated from the empirical formula of master and Anderson:

$$PE = Cd, V B \text{------------------------- (3)}$$

$$CD = \frac{1 - e^{-2k \tan O . \frac{H}{B}}}{2k \tan O}$$

$$K = \frac{1 - \sin O}{1 + \sin O}$$

Where, PE = static earth load, in Kg/cm2

V = specific weight of backfill, in Kg/cm3
(Normal soil = 0.0018 Kg/cm3)

H = depth of cover, in cm

O = angle of repose of soil, in deg.
(Normal soil = 40 deg.)

B = width of trench, in cm.

WHEEL LOAD

Kogler formula is used to calculate the wheel load when loads such as those of trucks act upon a buried pipe:

$$Pt = \frac{2w\,t \quad (1+1)}{(a+2H)(c+b+2H)} \text{--------------------(4)}$$

Where:

- Pt = wheel load, in Kg/cm2
- i = impact coefficient (normally 0.3)
- Wt = load per wheel, in Kg
- a = length of wheel in contact with ground, in cm
- b = width of wheel in contact with ground, in cm
- c = distance between wheels of two parallel trucks, in cm
- H = depth of cover, in cm

COMBINED EXTERNAL LOAD

Combined external loads acting upon a buried pipe are expressed by:

	P	=	PE + Pt
Where	P	=	combined external load, kg/cm2
	PE	=	static earth load, Kg/cm2
	Pt	=	Wheel load, Kg/cm2

Relationship between burial depth and combined external loads is given below:

DEPTHS		**EARTH LOAD**	**WHEEL LOAD**	**Combined Load**
Cm	ft	Kg/cm2	Kg/cm2	Kg/cm2
30	(1)	0.0493	1.226	1.2753
60	(2)	0.0905	0.546	0.6365
90	(3)	0.1248	0.313	0.4378
120	(4)	0.1533	0.204	0.3573
150	(5)	0.1771	0.144	0.3211
180	(6)	0.1969	0.107	0.3039
210	(7)	0.2135	0.083	0.2965
240	(8)	0.2272	0.066	0.2932

ELONGATION & CONTRACTION OF PVC PIPES

OPEN PIPING

In case of open piping the elongation and contraction should be studied by the following relation:

	dL	=	a L. dt--------------------------(7)
Where:	dL	=	Length of elongation or contraction, m
	a	=	Coefficient of linear expansion per C (PVC)Pipe = 7 x 10(-5)/ C
	L	=	Length of piping in m
	dt	=	Temperature difference, in C

Measure the maximum and minimum atmospheric temperature and the maximum and minimum water temperature. Then take the highest and the lowest temperatures of the four. The difference between these two should be used.

BURIED PIPING

Each temperature varies throughout the day or the year due to atmospheric temperature and sunlight. The earth temperature at 0.6 to 1.2-m. depth is nearly equivalent to mean monthly temperature and that to around 10 m. depth to mean annual atmospheric temperature. Therefore, PVC pipes installed under ground are subjected to extremely small temperature fluctuations. The elongation and contraction owing to temperature fluctuations is inhibited by the friction force developed between the pipe and soil and is built up in the pipe as thermal stress. This obviates the need for providing a remedy for elongation and contraction.

The thermal stress is computed by:

$$h = a.E. \quad dt \text{-------------------------(9)}$$

Where: h = thermal stress in Kg/cm2
a = coefficient of linear expansion per degree C.(PVC Pipe = 7x10(-5)/ oC
e = Young's Modulus in Kg/cm2
Dt = temperature difference in oC

WATER HAMMER

Water hammer occurs when a value installed in a pipeline filled with the following water is abruptly opened or closed. The velocity of wave propagation at such time is given by:

$$C = \frac{\sqrt{K.\frac{g}{r}}}{\sqrt{1+\frac{K}{E}\frac{d}{t}}} \text{----------------------(10)}$$

Where: C = velocity of pressure propagation, in m/sec
K = bulk modulus of elasticity of liquid, in Kg/m2 (2.07 x 10(8) Kg/m2)
E = Young's Modulus in Kg/m2, (3.4 x 10(8) Kg/m2 for PVC Pipe)
r = specific weight of liquid, in Kg/m3
g = acceleration due to gravity (9.8 m/sec2)
d = inside diameter of pipe, in m.
t = wall thickness of pipe, in m.

Pressure increase by water hammer is given by:

$$P = \frac{C.V.}{g}$$

Where: P = head of increased pressure, in m.
C = velocity of pressure propagation, in m/Sec
V = velocity of flow in pipe before valve operation in m/Sec
g = acceleration due to gravity, (9.8 m/Sec2)

DESIGN DATA FOR MAINS

FLOW AND FRICTION LOSS IN PIPES

Quantity of flow can be calculated from the following formula if the velocity of flow in the pipe is known:

Q = AV------------------------------ (11)

Where: Q = flow rate in m3/Sec
A = cross-sectional area of pipe in m2
V = velocity of flow in pipe in m/Sec.

William – Hazen Formula, can calculate velocity of flow:

V = 0.35464C. D (0.63) 1(0.54)

Which gives:
Q = 0.27853C. D(2.63) 1(0.54)
I = 10.666C(-1.85) D(-4.87) Q(1.85)
D = 1.6258C(-0.38) Q(0.38) Q(-0.205)

Where: C = coefficient of velocity (140 is used for design)
D = inside diameter of pipe in m.
I = hydraulic gradient = $\frac{h}{L}$
L = length of piping in m.
h = friction head loss in m.

Thus these equations can be used to calculate either loss of head or pipe diameter.

For 2 inch and smaller pipes the following formula suffices:

Q = C. D(2.72) 1(0.57) --------------------- (12)

Where: Q = flow rate in cm3/Sec
C = coefficient of velocity (215 is used for design)
D = inside diameter of pipe in cm
I = hydraulic gradient $\frac{H}{L}=\frac{h}{L}$
H = head in m.
L = length of piping in m.
h = friction head loss in m.

For flow charts showing hydraulic gradients-velocity-flow relations see pages__-__.

PIPE INSTALLATION

Extremely reliable and satisfactory installations can be achieved without difficulty using SHAVYL PVC Pipes,
provided the special properties of this material are fully understood and taken into account. These are the most important factors to consider:

(a) Due allowance must be made for the co-efficient of thermal expansion.
(b) Pipe work must be given adequate support, particularly in respect of heavy fittings.
(c) In the design of special components, abrupt changes in cross-section must be avoided, since the material is notch-sensitive.

SHAVYL Pipes are generally laid with the crown about one meter below the surface. Allowance to be made for the relatively high co-efficient of expansion of PVC, particularly when laying on a hot day. Such pipes should be allowed to cool off in the trench before making the final connections and completing the backfill. Air release valves should be incorporated at all high points. These valves may be screwed into saddles, which can be used for ferrules for service connection. Valves and other heavy fittings should be properly anchored.

EXCAVATION

The trench should not be opened too far in advance laying and should be back-filled as soon as possible. The width of the trench at the crown of the pipe should be as narrow as practicable, but not less than the outside diameter of the pipe plus 300 mm (12 in.) to allow proper compaction of the side-fill. Above the crown of the pipe the trench may be of any convenient width.

The trench should be excavated to the depth below the invert of the pipe will allow any necessary bedding. Before placing this bedding, this trench bottom should be prepared. All soft spots should be hardened in by gravel or broken stone. Rock projections should be removed. In fine grained soil such clays, sits or fine sand, disturbance and corrosion of the bottom of the trench should be prevented by placing a layer of bedding material 75mm (3in.) thick on the virgin surface before permitting traffic on the bottom.

MATERIAL FOR BEDDING AND SIDEFILL

Clay should never be used immediately around the pipe, for bedding, side-fill or backfill. It is not possible to compact it sufficiently, and it is liable to swell, shrink and erode.

Some other soils, however, as excavated from the trench (such as free draining coarse sand, gravel, loam and soils of friable nature) may be suitable , but must be capable of being compacted sufficiently to provide support for the pipe. Fills such as hard chalk, which break up when wet, should not be used.

Should the material excavated from the trench be unsuitable, then granular material must be acquired. The most suitable is gravel or broken stone from 10mm to 5 mm (3/8 to 3/16 in.) in size, since it requires little tamping; but coarse sand, or sand and gravel from 20mm. (3/4 in.) down as it comes from the guarry, is acceptable. An excess of fine particles makes the mixture more difficult to compact when damp.

BEDDING AND SIDEFILLING

With flexible pipe it is of great importance that the side-fill should be very firmly compacted between the sides of the pipe and the soil sides of the trench. Any trench sheeting should be partially withdrawn to allow this to be done. Before back filling, any leveling pegs or temporary packing should be removed. Then thickness of the bedding under the barrel of the pipe should not be less than on third of the diameter, and a minimum of 100mm. (4in) thick. In very soft or wet conditions or where the bottom of the trench is very irregular, this thickness should be increased as necessary to give a suitable bed.

The bedding should be thoroughly compacted in layers not more than 150 mm, (6 in) thick to give a uniform bed, true to gradient, on which the pipe may be laid. Pipes should be laid directly on this bedding. Bricks or other hard material must not be placed under the pipes for temporary support. After the pipes have been laid and tested, further bedding material should be placed around the pipe and thoroughly compacted in 75 mm. (3 in.) layers by careful tampering upto the crown of the pipe, eliminating all cavities under the two lower quadrants of the pipe.

The same material should then be placed over the crown of the pipe for not less than two thirds of the diameter, with a minimum height of 100 mm (4 in.) and a maximum of 300 mm (12 in.) and be thoroughly compacted. The process of filling and tamping should proceed equally on either side of the pipe, so as to maintain an equal pressure on both sides.

BACKFILLING

Normal filling of the trench should proceed in layers not exceeding 300 mm. (12 in.) in thickness, each layer being well rammed. Heavy mechanical rammers should not be used until the fill has reached a depth of 300 mm. (12 in.) above the top of the pipe.

Special consideration and selection of back-filling material will be necessary if the risk of surface subsidence is an important consideration: for example, under roads.

USE OF CONCRETE SPECIAL CASES

Generally, the use of concrete with PVC pipes is wasteful, since it converts a flexible pipeline into a beam of negligible flexural strength, which will fracture under minor ground movement. More than 2 Ft. of cover concrete is normally unnecessary.

Less than 450mm (18 in.) of cover, elsewhere than under roads, narrow concrete slabs on a cushion of filling material above the pipe should be used as a protection against picks, etc. At shallow depths under roads, etc. special consideration should be given to all the engineering factors involved, such as the class of roads, its construction, and the proximity of other services.

At or above ground level concrete surround should be used to protect the pipe.

JOINING AND COUPLING

CUTTING

SHAVYL pipe can be cut by using, ordinary Hack Saw for smaller dia pipe and wide saw for larger diameter. Pipe must be cut at right angle either by hand or using Mitre Box against pipe axis.

CLEANING

Before applying jointing solution care should be taken that pipe ends sockets of fitting should thoroughly be cleaned of sand , oil and dust.

JOINTING SOLUTION

Pakistan PVC Limited also manufacture SHAVYL Jointing Solution for most effective jointing of SHAVYL pipe and fittings.

It is advisable to apply the jointing solution thinly and uniformly Excessive solution will not offer desirable effectiveness. Cans containing jointing solution should be always closed when not in use and should be kept in dark cool place.

CAUTION

In jointing PVC pipe through jointing solution in cool climates (less than 5 C) it takes more time for jointing solution to dry during installation. Therefore, in then installation works in cold climates, care should be taken to apply a very thin and uniform coat of jointing solution.

SHAVYL pipe is joined by any of the following methods:

	JOINTING METHODS	REMARKS
1.	T.S. Method	Pipes upto
2.	One Step Sleeve Method	Pipes upto 8”
3.	Two Step Zero Gauge, Method	Medium and large dia pipe.
4.	Two Step plus Gauge Method	Medium and large pipe
5.	Metal fitting Method	All Pipes
6.	Branching Process	All pipes
7.	‘Z’ Joint System	From 2” to 14”

Jointing of SHAVYL pipes is relatively simple, but for a reliable joint it is important that the jointing procedure given below must be followed exactly. As with all pipe jointing, cleanliness is of prime importance and pipes especially jointing ends should be supported clear of the ground to prevent dirt being smeared on to the surface. After applying jointing solution, joints be assembled as quickly as possible and certainly within 1-2 minutes depending on the temperature.

T.S. (TAPER SLEEVED METHOD)

This method is to join pipe using T.S. fitting performed in our factory. The inner sides of socket of all T.S. fitting have a slight taper. Pushing this socket over plain end of pipe after applying SHAVYL solution can do jointing simply and correctly.

PROCEDURE

1. Clean the inside of fitting socket and outside of pipe's plain end with acetone or petrol.
2. Apply SHAVYL solution thinly and uniformly on the inside of the socket and outside of the pipe end to the marked length.
3. Push the pipe into the socket of the fitting strongly upto marked end.
4. After insertion wait for 20-30 second without disturbance. This will develop bond to prevent back out of pipe.
5. Wipe away excess solution.

NOTE: IN THIS T.S. METHOD, PIPE SHOULD NOT BE GIVEN A HEAVY PULL LOAD IN THE AXEL DIRECTION FOR 3 HOURS ATLEAST.

ONE STEP SLEEVE METHOD

Cases where SHAVYL pipe supplied without taper sleeve, joints can be made by sleeve jointing methods. As in this method, pipe is heated to soften with a blowlamp or heater; it is also called the heat application jointing method. Its procedure is as follows:

1. Bevel the outside of the male end and inside of the female end with file at 3 degree.
2. Clean the jointing part with a cloth.
3. Apply SHAVTL jointing Solution thinly and uniformly to the outside of the male end to the engaged (1.2D).
4. Heat the outside of the female end uniformly with a blowlamp. (Heating length should be 1.5D)
5. After the female end has been properly heated and it is softened apply the SHAVYL Jointing Solution to its side and immediately push the male end into it. Care should be taken not to burn the pipe.
6. Correct the alignment and keep holding for few seconds without any disturbance.
7. Wipe away excess solution.
8. Cool it evenly by soaked cloth or water spray.

TWO STEP ZERO GAUGE METHOD

This is the method to join medium and large diameter pipes. Pipe for the jointing is prefabricated with a Zero gauge socket at one end. Each pair of pipes to be joined is put with tally marks and serial number because the outsides of the male end of the pipe and inside of its socket end are the same size. The following is the procedure for this method:

(a) Bevel the outside of the male end inside of the female end at 3 degrees.
(b) Coat male end with grease.
(c) Heat the female pipe to make it soft and rubber like. (The heating length should be 1.5 times outside diameter of the pipe).
(d) Insert male pipe into female end
(e) Keep two pipes straight and cool the sleeve portion with water.
(f) When cooled completely put a matching mark and number on both pipes (for re-jointing).
(g) Pull out male pipe, thus forming a Zero Socket.

NOTE; THESE ARE THE 1ST STEPS OF THE PROCESS INVOLVED IN THIS METHOD AND ARE USUALLY CARRIED OUT IN A WORKSHOP APART FROM THE SITE BUT IT IS ALSO PERMISSIBLE TO DO THIS JOB ON THE SITE.

(h) Remove grease completely from the male and female end by petrol or acetone.
(i) Apply SHAVYL Jointing Solution thinly and uniformly on the inside of the socket and outside of the male pipe.
(j) Push male end into socket up-to the tally marks and hold them straight for 10-20 seconds.
(k) Wipe away excess solution with dry cloth.

Now joining with two step zero gauge method is completed.

NOTE; TO INCREASE JOINT STRENGTH MORE QUICKLY, UNIFORMLY HEAT THE JOINT WITH A BLOW LAMP TO THE DEGREE THAT IT LEAVES A TRACE OF NAIL TIP WHEN PUSHED BY A FINGER TIP AND IT IS REMOVED. AFTER HEATING COOL PIPE. DO NOT BRING THE BLOW LAMP TOO CLOSE TO PIPE, OTHERWISE IT MAY POSSIBLY CAUSE SOLUTION TO BURN AND PIPE TO BE SCROCHED.

TWO STEP PLUS GAUGE METHOD

In this method, the inside diameter of the socket is slightly larger than the outside diameter of the pipe and the socket part pushed over the plain end pipe is heated on the site for a closer fit.

PROCEDURE

(a) Clean the inside of the socket and the outside of the plain end of pipe and apply SHAVYL jointing solution thinly and uniformly on them.
(b) Push the pipe into the socket and hold.
(c) Heat with a blow lamp or gas burner. The socket tends to restore to its original diameter using this ability; the socket is adhered closely on the outside diameter of the pipe.
(d) Wipe away the excess solution.
(e) Cool the joined portion with water.

METAL FITTING METHOD

Tapered Core

To join a SHAVYL Pipe to a pipe of different taper joint is used. For this purpose a performed tapered core and a tapered flange is used.

PROCEDURE

a. Furnish the SHAVYL Pipe with a tapered flange.
b. Heat the pipe end with a blow lamp. The portion to be heated must be a little longer than the length of the taper core.
c. When the pipe softens apply SHAVYL Solution to outside of the tapered core and inside the pipe.
d. Insert the tapered core into the pipe and check the angle.
e. Cool the jointed portion with water.
f. Fasten the flanges together with bolts.

BRANCHING PROCESS

For the branching of a pipe, molded tees are commonly used, which are provided with molded socket, a pipe is inserted into it. Joints of various types larger than 75 mm (dia) branching are made by welding.

In this process the SHAVYL Pipe is heated by a jet of hot air from a special welding torch onto the contact area of the surfaces being united. Though this is a common method of welding thermoplastic materials, it requires considerable experience. The welding temperature is about 200 D.C. the filler rod should be of similar composition to the material welded (use SHAVYL Welding Rods).

SADDLES

SHAVYL Pipes do not have sufficient wall thickness for fer-rules to be screwed directly into them. Metal Saddles made especially for these pipes are available for the purpose, and is easy to fit saddle for making service or branch connections from any point in on existing SHAVYL Pipe Water main quickly and easily.

PROCEDURE

a. Isolate and depressurize section of main to be tapped.
b. A hole is drilled in the existing main and rubber ring is placed around the hole.
c. The two halves of the Saddle are then placed in position and fastened with the bolts.
d. Tight the valve-socket using Teflon packing in the branch portion of the clamp saddle.
e. Join pipe with valve-socket.

REPAIRING DAMAGED SHAVYL PIPE.

Some time installed pipes may have the following defects;

a. A portion of pipe is crushed or cracked.
b. Leakage at a Sleeve portion.
c. Leakage at a Welded Section.

In case of 2 and 3, pipe repair is easy, as these can be welded on the spot by welding machine.

In case of (1) it is recommended to use a socket as explained below:

REPAIR SOCKET

One sleeve of this socket is longer than the other by two or two and a half times.

a. The appropriate length of damaged pipe is removed.
b. Apply Jointing Solution over the ends of pipes.
c. The longer sleeve of the repair socket is pushed over one pipe until the tapered portion or neck prevents further sleeving.
d. Then the shorter sleeve is pushed over the other pipe to the full length of the sleeve or till the longer sleeve is pulled back and removed half way.

   This process is called the "PUSH AND PULL METHOD"
   After this , finish the joining process by finish-heating.

COUPLING WITH 'Z' TYPE RUBBER RINGS (Z-JOINT)

SHAVYL Z-JOINT

Z-Joint is a patented invention of Wavin, Golland. Z-Joint is available from 2" to 14" diameter Z-Joint is formed on the end of the pipe and therefore integral with it. It consists of a socket which is designed to give clearance fit on outside diameter of the corresponding pipe spigot end. In the socket is formed a rectangular groove into which is seated a rubber ring. The Z-joint ring is designed as a compression ring incorporating a hydraulic seal. The result of this is that within the limits of its pressure range, the higher pressure tighter the seal. The forming of the groove, and to a lesser extent, the socket, result in a thinning of the pipe wall in those regions and they would not therefore comply with the design requirements at the pipe. To compensate for this an external sleeve of the same material is shrunk onto the pipe before forming of the socket and the groove.

JOINTING METHOD FOR SHAVYL Z-JOINTS

DIRECTIONS:

1. Clean the inside of sockets particularly the groove of the socket and Z-joint ring. Insert the ring and check that it is properly seated.
2. Lubricate evenly round the spigot (not the joint ring) with Z-joint lubricant.
3. Make sure that the pipes align correctly in both planes. Push the spigot into the socket upto the depth of entry mark.

CAUTIONS: If the pipe does not enter the socket without undue force being used, withdraw the pipe, remove the joint ring and recheck the Ring Seating and pipe Alignment.

Anchor changes of pipe line directions with thrust block. Test first few joints and then after every 1000 meters. Before testing the line must be back filled, leaving the joints exposed. Z-joint pipe can be assembled in conditions of cold, wet or extreme heat.

NOTE: When Z-joint are used on buried services, changes in the length of the main are caused due to soil settlement, and to expansion or con traction caused by temperature changes. The Z-joint is designed to permit an ample degree of axial movement to accommodate these changes.

PRESSURE TESTING OF PIPE LINE

It is advisable to pressure test the pipe line at each stage of laying to ensure it has been laid and jointed correctly. Thus any fault is immediately evident and can be corrected before the line is commissioned.

a. Back-fill the line, leaving joints and fittings exposed.
b. Fill water, ensure that no air is left in the pipe. (See 'e' below)
c. Joints should be left for hours before being tested.
d. Ends should be blanked off using detachable couplings, such as flange adapters and these should be supported to contain the trust against the pressure.
e. To ensure against burst, all air should be purged from the pipe before testing. This can be achieved by filling the line with water from its lowest point and inserting bleeding valves at the highest points. As a secondary precaution, where water pressure is available, a foam pig should be forced through the line. The pig is a cylinder of polyurethane rubber foam 12" –18" long and should have a diameter about 25% greater than the bore of the pipe.
f. For normal water work practice, test pressure need not exceed twice the safe working pressure of the pipe. The elasticity of SHAVYL pipe itself will cause slight expansion under pressure.

A slight initial fall in the pressure reading will not necessarily indicate a fault. Likewise, thermal expansion caused by temperature change may affect the initial pressure reading slightly.

Note: Service Engineers are available to demonstrate the technique of Jointing/Testing etc. Please contact to our Technical Department for any assistance.