Plastic Piping Systems
COMPANY PROFILE

INTRODUCTION:

SANGIR PLASTICS PVT. LTD. is part of Shreeram Group of Companies, having ventures in thermoplastics like PP, HDPE, PPR, PVDF, HIPS. It specializes in the manufacture of Pipes & Fittings, Rods, Tubes, Injection moulded engineering products from thermoplastics. The company's constant endeavor has been to extend the application of plastics and bring innovative solutions to the market.

Established in 1980, Shreeram Group of Companies has a wide spread in India and is active in all spheres of plastic products. Our sister concerns specialize in the manufacture of several related plastics products like sheets, rods, blocks & thermoformed items. SANGIR brand products are now well known in India and now also exported to Middle & Far East companies.

PRODUCT RANGE

SANGIR PLASTICS specializes in the manufactures of high quality Polypropylene (PP) & High Density Polyethylene (HDPE) pipes & fittings. Additionally it offers advanced plastics solutions through its additional range of piping including HIPS, PVDF Polypropylene products are manufactured from different forms of PP including homo polymer (PPH), block polymner (PPB) and random co-polymer (PPRC) and also lined or unlined Fibre-glass Reinforced Plastic (FRP) pipes & fittings. A team, dedicated towards services related to erection, commissioning and installation of piping systems, provides full support to the overall gamut of plastics product portfolio we offer to our customers.

EXPERIENCE

The top management team leading SANGIR bring a combined experience of over 50 years in the plastics industry and are well known for their knowledge, business and technical expertise in the field. The experience has brought much repute and confidence the customer base.

PRODUCT APPROVALS:

SANGIR products are approved by leading agencies & customers like:

- Bureau Veritas
- Dalal Consultants.
- Larsen and Toubro
- Gujarat Water Supply & Sewerage Board
- Toyo Engineering
- SGS Limited
- Hindustan Dorr Oliver
- Central Institute of Plastics Engineering Technology (CIPET).

The following pages present in insight into the manufacturing world of SANGIR PLASTICS. Technical data and useful information for installation, jointing and application of different plastics materials is also provided for engineering professionals.

MANUFACTURING DIVISION:

Activity : Manufacturing of PP, PPH,PPR, HDPE, HIPS, PVDF pipes.
: Fabrication of PP, HDPE, PVC, CPVC, PVDF fittings from pipes.
Fiber reinforcement of pipes and fittings

Location : Vapi, Gujarat State

Area : : 80,000 Sq.Ft. total area, 28000 built up.

Power : Direct 500 KVA & DG set of 500 KVA.

Machinery/Tools :

Sr. No.	Name of machine	Make	Range & capacity	Year of Installation
1)	Extruder model -90G complete with down line equipment - vaccum tank, haul off, automated hydraulics, cooling equipment, planetary cutter machine & automatic embossing machine	Windsor Machine, Ahmedabad	110 to 630 m OD 350 kgs/ Per hour Annually - 2200 MT	2005
2)	Extruder Model Lx-75 complete with down line equipment - vaccum tank, haul off, cooling equipment, cutter machine & automatic embossing machine	Windsor Machine, Mumbai	110 to 450 m OD 160-180 kgs/ Per hr Annually - 800 MT	1984 (auxillary equipment 2004)
3)	Extruder Model LX-65 - complete with down line equipment - vaccum tank, haul off, cooling equipment, cutter machine & embossing machine	Windsor Machine, Mumbai	110 to 160 m OD 100-120 kgs/ Per hr Annually - 560 MT	1984 (auxillary equipment 2005)
4)	Extruder 30mm	Gaurav engg, Vapi	2 to 15m OD 50 kgs/ Per hr Annually - 240 MT	1999
5)	Gen Set Model- KTA 19-G9	Cummins Diesel sells & services	Alternator – Stampord 500 kva	2006
6)	Material Handling Equipment	Hark Engg (P) Ltd, Vapi	Gantry girder & EOT crane –2T	2005
7)	Other Auxiliary equipment- - Blow moulding machine, - Press - 2 Lathe machines, 12 ft - Compressor, 12 Hp - 6 Socket & Butt Fusion machines - 4 Hot Air Welding sets	Various	40 Kg/Hr capacity 50 tonnes 12 ft 12HP	

QUALITY FOCUS

Sangir is an ISO 9001:2000 Company and adheres to all procedures and processes laid down thereunder. Management attention to ISO standards has been a priority and each year procedures are reinforced with better coordination facilities and technology abreast with evolving products, processes & customer requirements.

To maintain excellent quality standards, SANGIR PLASTICS has installed a wide range of high quality Testing Equipments. An independent Quality Control Department ensures that all products leaving the factory premises are tested for quality & conform to relevant specifications. Testing equipments are calibrated at frequent intervals to ensure accuracy & performance.

We use the same tests for quality conformance as used by Indian Institute of Technology Mumbai. High Quality tests are periodically carried out from every batch & up to date records & graphs are maintained continuing the tradition of **SANGIR PLASTICS** to provide only quality products.

Testing Equipment Available to Test :

- Tensile Strength
- Density
- Melt flow Index
- Migration
- Heat Reversion
- Spark Testing
- Creep & Rupture
- Carbon Content
- Carbon Dispersion
- Impact Resistance
- Hydro Testing

MANUFACTURING PROGRAMME:

Material	Method of Mfg.	Size Range(mm)	Pressure Rate of (Bar)	Range Prod. in-m/day	Specification
Thermoplastics					
1. PP	Extrusion	16-500	2.5-16	2500	DIN 8077
2. HDPE	Extrusion	12.5-560 16-560	2.5-16 2.5-10	2800 2600	DIN 8074 IS 4984
3. PP / HDPE fittings	Injection moulded Fab. from pipe	16-160 16-450	16 2.5-16	300 -diff. sizes 125	DIN 16962/3 -do- DIN 16962/3
4. PVDF	Extrusion	16-160	2.5-20	300	EN 10204
Thermosettings					
1. FRP-Unlined	Filament wound	40-1200	1-10	600	BS 7159
2. FRP-Lined	Linear-Extruder	25-250	6-16	750	DIN 16965
3. FRP-Unlined fittings	Hand moulded Fab.from pipe	25-600 200-1000	1.5-16 1.5-16	20 15	DIN 16966 or BS 7159

Note - 1. FFS - Fabricated from Sheets 2. FFP- Fabricated from Pipe 3. IM- Injection Moulded. SANGIR PLASTICS also offers Thermoplastic Pipes and Moulded Fittings in PVC, CPVC & PVDF material of reputed make. Fittings fabricated from pipes of these materials will be carried out at our works.

ERECTION PROGRAMME:

Material	Site joint method	Size Range(mm)	Erection Rate in mtr/day
1. PP, HDPE	Butt fusion	16-560	60
	Socket fusion	16-160	75
	Hot air welding	16-560	25
2. PVC, CPVC	Solvent cementing	16-160	60
	Hot air welding	16-315	25
	Union / Coupling joint	16-160	75
3. PVDF	Hot Air Welding	16-160	60

It has been our constant endeavor to understand the customers' requirements better & be able to serve them better. In designing of Piping systems, proper Routing, Laying, Supporting, Compensating for thermal expansion/contraction & other external loading etc. are factors which play a very important role besides internal pressure & corrosion resistance. With characteristics ranging from excellent chemical resistance to high thermal co-efficient and low modulus of elasticity makes plastic pipes behave in a manner different from steel pipes, when under stress & strains. SANGIR PLASTICS provides assistance in selection of MOC, designing of piping systems and technical back up for creating sound long lasting maintenance free piping systems.

We understand that, in order for the plastic piping to work maintenance free & for added plant life, it is essential that as manufacturers, we at **SANGIR PLASTICS** offer our customers a complete range of plastics comprising of:

Pipes & Ducts : Extruded, Hand laid, Filament wound, etc.
Fittings : Moulded, Fabricated, Socket Weld, Butt Weld, etc.
Pipe Supports : Shoe, U-bolt, Hangers, Flange/Valve holders, etc.
Valves : Gate, Globe, Diaphragm, Ball, etc.
Fume handling Products : Chimneys, Stacks, Blowers/Fans, Dampers, etc.
Flexible Sections : Bellows, Hoses, Slip joints, etc.
Fasteners : Plastic, SS, MS, GI, etc
Gaskets : Rubber, Asbestos, Teflon, etc.

In order to make these materials perform better, we offer you our services for information & experience in:

Designing : Selection of MOC, Support-size & Location, Flexible section-size & location, Pipes & fittings - thickness & dimensions, etc.
Drawing : Fabrication, Isometrics, as made.
Manufacturing : Pipes, Moulded fittings
Fabrication : Segmented fittings, Pipe supports.
Inspection by : Third party, Internal, Client/Consultant
Supply/Prefabrication : Pipes & Fittings as per isometric drawing.
Pipe Support : Fabrication (optional)
Erection : Prefabricated pipes & Fittings, Supports, Valves etc.
Testing : Spark Testing, Hydro Testing, Boil-out Testing, Vaccum Test.
Commissioning & Modification : Dismantling, Fabrication, Re-erection.

SANGIR PLASTICS offers piping systems in a variety of material of construction in thermoplastic & thermosetting resins. These have endless applications & suitability owning to their unique combination of good physical properties & excellent chemical corrosion resistance.

THERMOPLASTICS

1. **Polypropylene (PP)**
   Obtained through polymerization of propylene from polyolefinic resin. Pipes are made of homo, block or copolymers. Isotatic PP is mainly used for industrial applications. PP is resistant to strong acids, alkalies & weak solvents but sensitive to strong oxidizing acids & halogens. Heat resistance up to 90°C.

2. **High density polyethylene (HDPE)**
   A polyolefinic resin polymerized to form HDPE having high molecular form with medium to high density. Chemical resistance same as PP but heat resistance upto 60°C only.

3. **Unplasticized polyvinyl chloride (UPVC)**
   UPVC belongs to category of vinyl resins where in its molecular structure, each monomar unit contains one chlorine atom. Resistant to acids & alkalies but sensitive to aromatic solvents. Heat resistance upto 60°C.

4. **Chlorinated polyvinyl chloride (CPVC)**
   CPVC is made by chlorination reaction with homopolymer PVC, by increasing chlorine content in PVC to 70% max. Chemical resistance similar to PVC but heat resistance upto 90°C.

5. **Polyvinylidene fluoride (PVDF)**
   These are fluorinated polymers having chain or thread like molecules. Resistant to acids, oxidants, solvents & halogens while sensitive to amines & alkalies. Heat resistance upto 140°C.

THERMOSETTING

These resins are mixed with low alkali borosilicate E type glass when being polymerised to form a matrix structure called Fibre glass reinforced plastic (FRP / GRP). All resin systems are also available in fire retardant grade.

1. **Isopthalic**
   This is unsaturated polyester resin based on isopthalic acid. Resistant to weak organic inorganic acids, minerals, alkalis, salts but sensitive to oxidising acids, strong alkalis, halogens. Heat resistance upto 60°C.

2. **Bisphenol**
   This is modified bisphenol fumarate polyester resin having minimum easter linkages. Resistant to organic/inorganic acids, alkalies, salts & sensitive to solvent. Heat resistance upto 95°C

3. **Vinylester (GP & Superior)**
   This is unsaturated polyster resin based on polymer having epoxy backbone for GP grade & Epoxy phenolic backbone for superior grade. Resistant to oxidising & other acids, alkalies, salts & solvents. Sensitive to aromatic hydrocarbons & alchohols. Heat resistance upto 110°C.

4. **HET acid**
   This is Het acid based unsaturated polyester resin. Resistant to oxidising acids, chlorine, salts but sensitive to solvents & strong alkalis. Heat resistance upto 120°C & excellent fire retardant properties.

5. **NPG Isopthalic**
   These are neopentyl glycol isopthalic acid based unsaturated polyester resin. Chemical resistance same as isopthalic but heat resistance upto 100°C.

6. **Epoxy**
   Resistant to weak acids, solvents and salts bases but sensitive to alkalis, chlorine, strong acids. Heat resistance upto 100°C. This is hot cured process of lamination.

SANGIR PLASTICS makes FRP/GRP piping with any resin system listed above. For lined FRP pipes all thermoplastics mentioned above can be used as a linear. Since outside surface of Thermoplastic pipes is very smooth and glossy, Frp bonding or adhesion becomes a major problem. Also there is a variation in coefficient of thermal expansion between FRP & Thermoplastic. So excellent bonding becomes very essential when in service at high temp. where both are subject to high expansion rate.

This problem mainly occurs for PP pipes when used as a linear in FRP pipes. For other pipe material like PVC, CPVC & PVDF this problem can be overcome only by roughing the top surface & applying a coat of bonding resin prior to starting of FRP.

In order to overcome this problem **SANGIR PLASTICS** proudly announces to give Polypropylene (PP) pipes with synthetic glass cloth lining firmly embedded on outer surface of PP. Cloth is embedded such that PP protudes through the glass matrix and provides excellent interlocking. Fibre reinforcement is applied to these cloth bonded PP pipes initializing with a resin rich coat. This system imparts highest bonding or peel strength between PP & FRP.

Material Properties

Sr. No	Properties	Units	Thermosett (FRP)				Thermoplastic					
			Polyester (CM)	Polyester (FW)	Phenotic	Epoxy	PVC	CPVC	PP	PPGR	HDPE	PVDF
A	**PHYSICAL**											
1	Density	g/cm^3	1.5	1.7-2.2	1.85-	1.6-2	1.32-	1.42	0.89-	1.05-	0.942-	1.78
					1.95		1.44		0.91	1.24	0.96	
2	Hardness	Barcol	40	42	55	45						
		Shore					80	83	73	85	78	65
3	Heat Distortion Temp.	°C	90-110	90-110	250	125						
4	Softning Point	°C					160	195	170	195	130	180
5	Oxygen Index				55-70		45	60	17	39	17	43.7
6	Flash Ignition Temp.	°C	485	485	700	550	399	482	410	470	343	430
B	**MECHANICAL**											
1	Tensile Strength	Mpa	63-140	552-1724	340	69-138	40-50	50-65	30-38	41-100	20-40	40-60
2	Tensile Modulus	x 10^3 Mpa	6-12	28-62	23	20	2.4-4	2.3-5.2	1-1.6	3.1-6.2	0.4-1.2	2.4
3	Flexural Strength	Mpa	140-250	689-1862	600	69-144	69-100	75-115	36-55	48.2-75.8	-	74
4	Flexural Modulus	x 10^3 Mpa	5-8	34-48	33	17-31	2-3.5	2.5-7.5	1.2-1.7	2.6-5.9	0.7-1.8	2.25
5	Compression Strength	Mpa	130-170	310-483	328	17-276	55-90	50-100	30-38	38-48	18.25	
6	Izod impact strength	ft-lb/in-not.	-	40-60	15	2-30	0.4-20	0.3-25	0.5-2.2	1-5	0.5-20	0.9-18
7	Elongation at break	%	1.9-2.6		1.3		20-30	22-33	20-800	100-1000	20-80	20-450
8	Absolute roughness	mm	0.03-0.06	0.03-0.06	0.04-	0.035-	0.005-	0.0009-	0.001-	0.003	-0.002	-0.00028
					0.08	0.05	0.007	0.005	0.007	0.0085	0.009	0.00057
C	**THERMAL**											
1	Specific Heat	J/Kg°K	1298	963-1047	963	795	1000	1255	1925	-	1925-2300	960
2	Thermal Conductivity	W/m°K	0.2-0.23	0.28-0.33	0.26	0.16-0.41	0.12-0.17	0.11-0.18	0.14	-	0.33	0.19
3	Thermal expansion coeffcient	m/m°kx10^5	22-36	22-36	90-108	11-35	50-59	50-56	112	29-52	150-300	128
D	**ELECTRICAL**											
1	Dielectric strength	Volts/mil	NA	NA	120-400	300-400	375-750	370-740	450-560	375	440-600	300-600
2	Volume resistivity	Ohm-cm	20x10^{15}	20x10^{15}	>10^{13}	10^{14}	10^{15}	10^{15}	10^{16}	1.7x 10^{16}	10^{16}	10^{14}
3	Dielectric constant	60 Hz	3.7	3.7	5-7.1	3.5-5	3.2-3.6	3-3.6	2.5-2.75	0.0022	2.3-2.35	7.5
4	Dissipation Factor	60 Hz	0.005	0.005	0.04-0.05	0.01	7.2 x 10^{-3}	8x18 x 10^{-3}	5.4x7 x 10^{-3}	2.37	>0.0005	0.185
5	Arc resistance	Secs	NA	NA	4-190	120-180	60-80	65-83	136-185	74	melts	200

Note:
1] CM-Contact Moulded, FW-Filament wound
2] PPGR-Polypropylene (PP) with glass reinforcement
3] Polyester resins are isopthalic, bisphenol, vinyl ester etc

Following specifications are commonly used in plastic piping designing.

SPECIFICATION NO.	TITLE
PP (Poly Propylene)	
DIN 8077 / 78	PP Pipes, Dimensions, Testing & General Quality Requirement (GQR)
DIN 16962 part 1,2,3 4,6,7,8,9,11,12,13	Bends produced by segments, tees & branches, smooth bends, injection moulded elbows, tees, sockets & caps, reducers, branches & flanges, couplings respectively.
BS 4991	Pipes & fittings.
PVC (PolyVinyl Chloride)	
DIN 8061 part 1 / 2	Pipes, Dimensions, Testing & GQR
DIN 8063 part 1,2,3,4,5	Pipe Joints & Fittings
BS 3506	Pipes & Fittings for Industrial Usage
ASTM D 1784	PVC & CPVC Compounds
D 1785 / 6	Sch 40 & 80 Pipes
D 2241	SDR 13.5, 21 & 26 Plain end Pipes
D 2267	Sch 80 Socket type Fittings
D 2466	Sch 40 Fittings
D 2464	Sch 80 Threaded Fittings
D 2672	SDR service Belled end Pipes
D 2665	Drain, Waste, Vent pipe
D 2564	Solvent cement for PVC
D 2855	Making Solvent cemented Joint
D 2774	Underground Installation of Thermoplastic Pipes
IS 4985	Pipes
IS part 1,2,3,4,5,6,7,8	GR 45°elbow, 90°elbow, Tee, 45°tee, Socket, Union, Caps respectively.
IS 10124 part 1,2,3,4,5,6 7,8,9,10	GR, Socket, St. reducer, Caps, Tee, Tail piece, Adaptor, 90°bend, 60°bend, 45°bend, 30°bend.

HDPE (High Density Poly Ethylene)

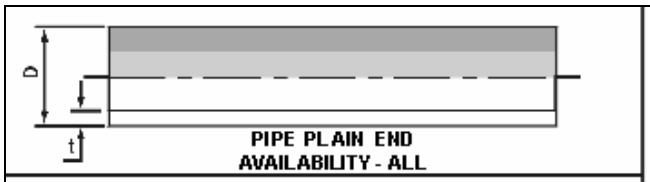
DIN 8074 / 75	Pipes, Dimensions, Testing, GQR
DIN 16963 part 1,2,3,4	Fittings, moulded, 90°elbow, 45°elbow, tee etc.
IS 4984:1995	Pipes
ISO 4427	Pipes
IS 8008	Fittings
IS 14151	Pipes for Sprinkler Irrigation

CPVC (Chlorinated Poly Vinyl Chloride)

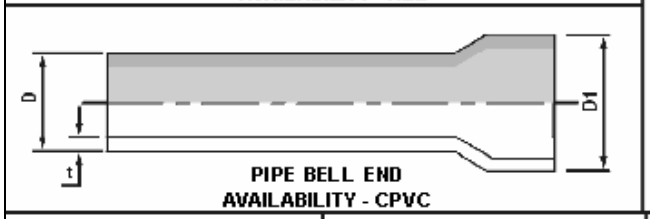
DIN 8079 / 80	Pipes, Dimensions, Testing, GQR
DIN 19538 part 1,2,3	Fittings
ASTM F-441	Pipes
F-434	Sch 80 Socket type fittings
F-437	Sch 40 Thread type fittings
F-480	Sch 40 Belled ends pipe
D-1784	PVC & CPVC Compounds
F-438	Sch 40 Socket type fittings
F-493	Solvent cement for CPVC
F-656	Making Solvent cemented joints

LINED / UNLINED FRP (Fibre Reinforced Plastics)

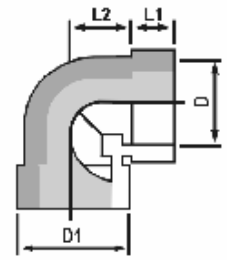
DIN 16965 part 1	Wound FRP Pipes, Type A
2	Wound FRP Pipes, Type B
3	Wound FRP Pipes, Type C
4	Wound FRP Pipes, Type D
5	Wound FRP Pipes, Type E
DIN 16966 part 2	Elbows
4	Tees, Branches
5	Reducers
6	Bush, Flanged joints
7	Flanges, Flanged joints
8	Laminated Site joints
BS 7159	Design & Construction of FRP Piping System
ASTM D 2996	Filament round Pipes
D 3754	Sewerage & Industrial Pressure Pipe
IS 6746	Thermosetting Resins, Tests



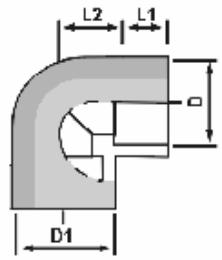
PIPE PLAIN END
AVAILABILITY - ALL



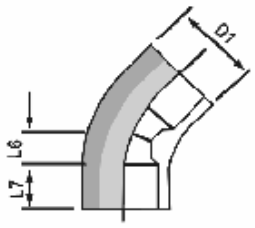
PIPE BELL END
AVAILABILITY - CPVC



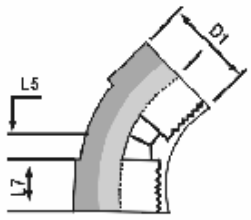
90°ELBOW - MOULDED WITH
PROTRUDING SOCKET
AVAILABILITY - ALL



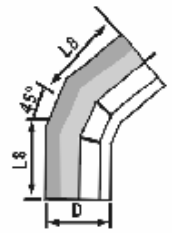
90° ELBOW - MOULDED WITH
INBUILT SOCKET
AVAILABILITY - ALL



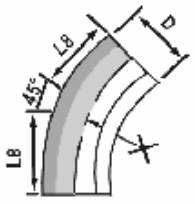
45° ELBOW - MOULDED WITH
INBUILT SOCKET
AVAILABILITY - ALL



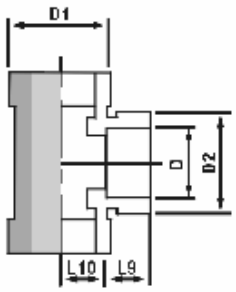
45° ELBOW - MOULDED WITH
THREADING
AVAILABILITY - PVC & CPVC



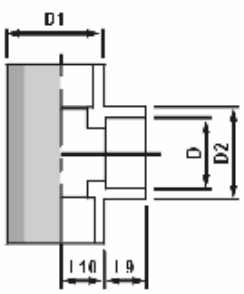
45° 2 CUT METER BEND
PRODUCED BY SEGMENTS
AVAILABILITY - ALL



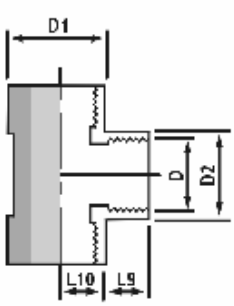
45° SMOOTH BEND
FORMED FROM PIPE
AVAILABILITY - PVC & CPVC



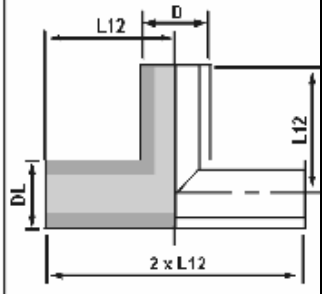
EQUAL/UNEQUAL TEE-MOULDED
WITH PROTRUDING SOCKET
FOR EQUAL TEE D1=D2
AVAILABILITY - ALL



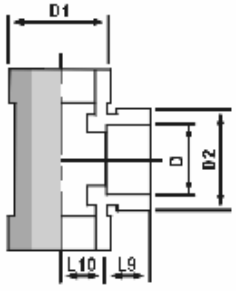
EQUAL/UNEQUAL TEE-MOULDED
WITH INBUILT SOCKET
FOR EQUAL TEE D1=D2
AVAILABILITY - PVC & CPVC



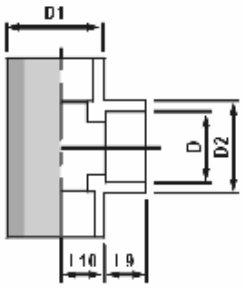
EQUAL/UNEQUAL TEE-MOULDED
WITH THREADING
FOR EQUAL TEE D1=D2
AVAILABILITY - ALL



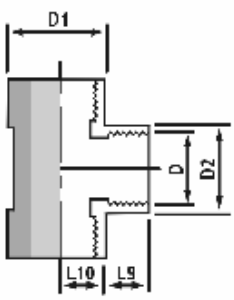
EQUAL/UNEQUAL TEE
FABRICATED FROM PIPE
FOR EQUAL TEE D1=D2
AVAILABILITY - PVC & CPVC



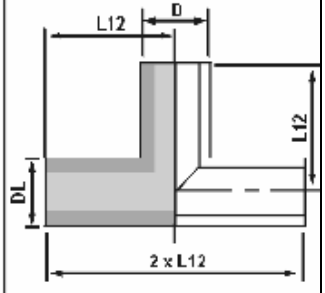
EQUAL/UNEQUAL TEE-MOULDED
WITH PROTRUDING SOCKET
FOR EQUAL TEE D1=D2
AVAILABILITY - ALL



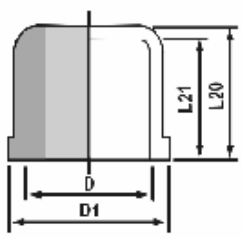
EQUAL/UNEQUAL TEE-MOULDED
WITH INBUILT SOCKET
FOR EQUAL TEE D1=D2
AVAILABILITY - PVC & CPVC



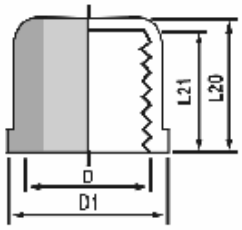
EQUAL/UNEQUAL TEE-MOULDED
WITH THREADING
FOR EQUAL TEE D1=D2
AVAILABILITY - ALL



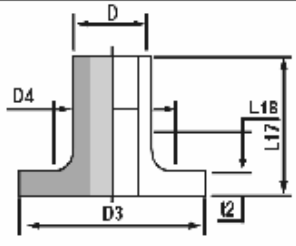
EQUAL/UNEQUAL TEE
FABRICATED FROM PIPE
FOR EQUAL TEE D1=D2
AVAILABILITY - PVC & CPVC



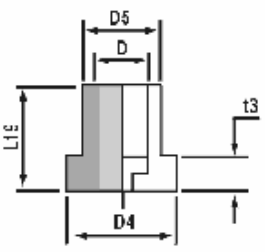
END CAP
AVAILABILITY - ALL



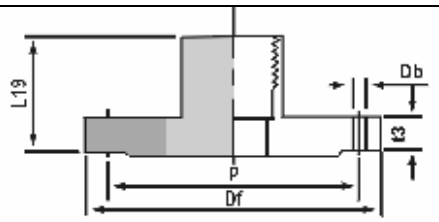
END CAP WITH THREADING
AVAILABILITY - CPVC



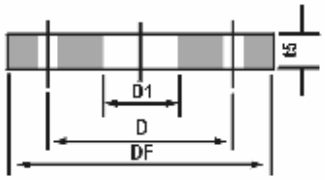
ADAPTOR WITH
SHORT OR LONG NECK
AVAILABILITY - ALL



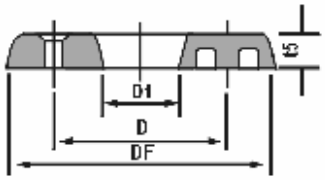
BUSHING SOCKET TYPE
AVAILABILITY - ALL



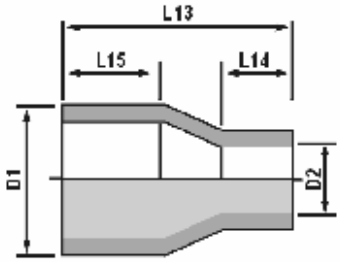
SOCKET TYPE FLANGE WITH THREADING
AVAILABILTY - CPVC



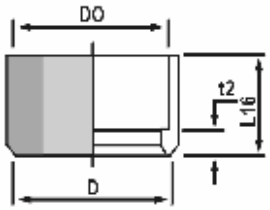
BACKING FLANGES
AVAILABILITY - ALL



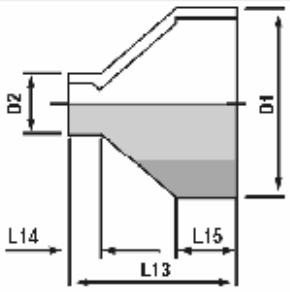
BACKING FLANGES
AVAILABILITY - ALL



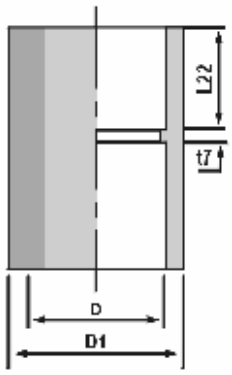
REDUCER - TURNED & FABRICATED
FROM BLOCK
(ECCENTRIC/CONCENTRIC)
AVAILABILITY - ALL



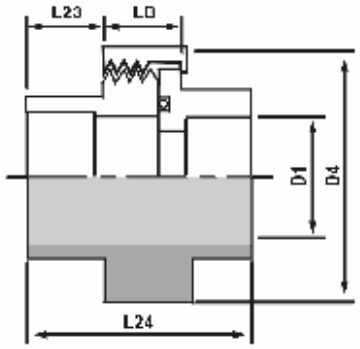
REDUCER - MOULDED
AVAILABILITY - ALL



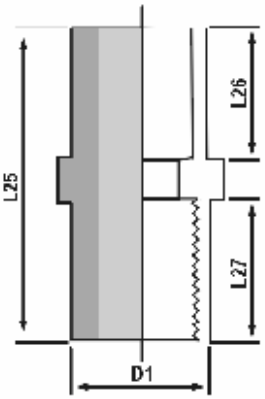
REDUCER - MOULDED & SOCKETED
(ECCENTRIC/CONCENTRIC)
AVAILABILITY - CPVC



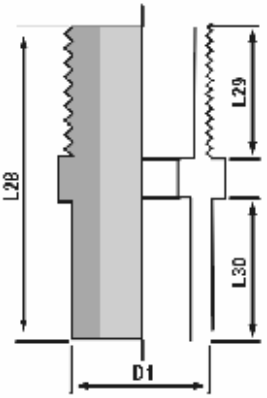
DOUBLE SOCKET/COUPLING
WITH OR WITHOUT THREAD-
ING AVAILABILITY - ALL



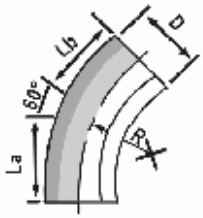
UNION WITH OR WITHOUT
O'RING SEATING
AVAILABILITY - CPVC



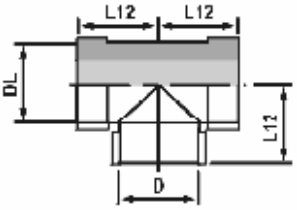
FEMALE ADAPTOR
AVAILABILITY - CPVC



MALE ADAPTOR
AVAILABILITY - CPVC

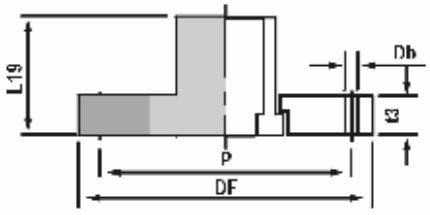


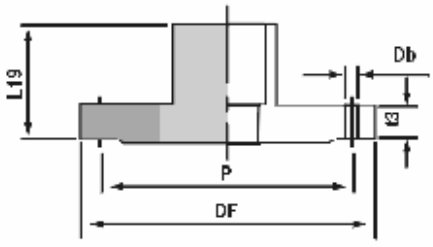
60° SMOOTH BEND FORMED
FROM PIPE
AVAILABILITY - PVC



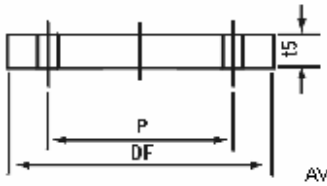
EQUAL/UNEQUAL TEE FABRICATED
FROM PIPE FOR EQUAL TEE DL = D
AVAILABILITY - PVC

VANSTONE STYLE FLANGE

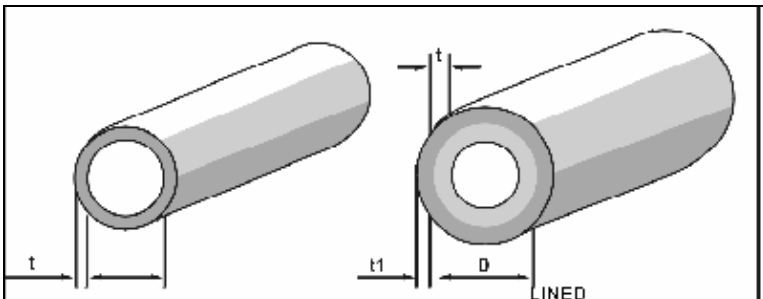




SOCKET TYPE FLANGE
AVAILABILITY - CPVC



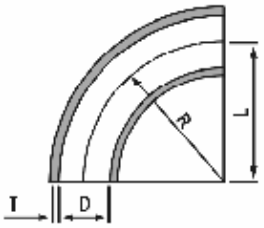
BLIND FLANGE
AVAILABILITY - ALL



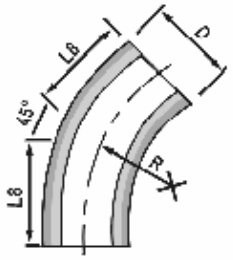
UNLINED

LINED
TYPE OF LINEAR - PP WITH GLASS CLOTH
- PVC
- CPVC
- PVDF

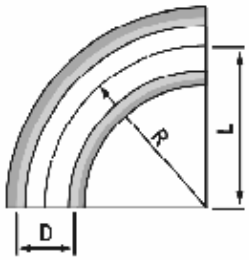
PIPE



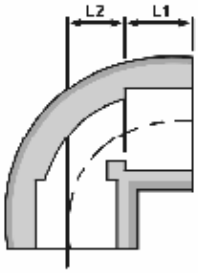
UNLINED 90° MOULDED BEND



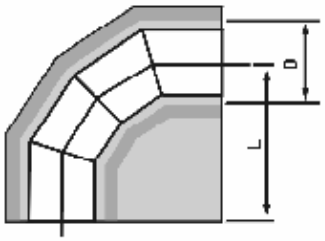
45° SMOOTH BEND WITH ONLY PVC LINEAR



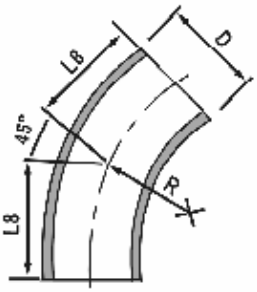
90° SMOOTH BEND WITH ONLY PVC LINEAR



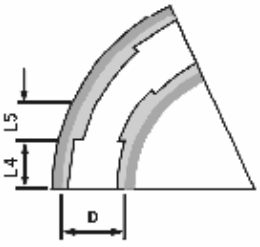
90° BEND WITH MOULDED LINEAR FOR L1,L2 REF. THERMOPLASTIC CHART



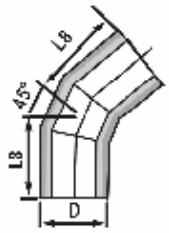
90° 3 CUT METER BEND WITH LINEAR



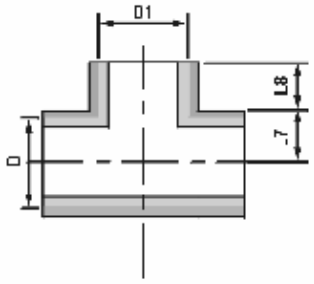
UNLINED 45° MOULDED BEND



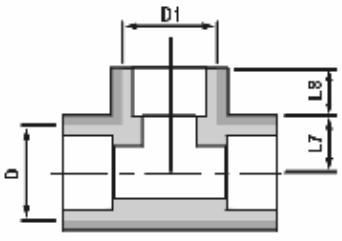
45° BEND WITH MOULDED LINEAR FOR L4,L5 REF. THERMOPLASTIC CHART



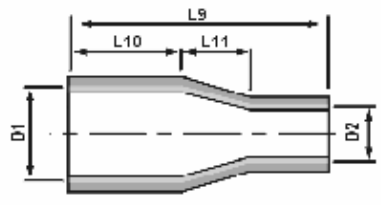
45° 2 CUT METER BEND WITH LINEAR

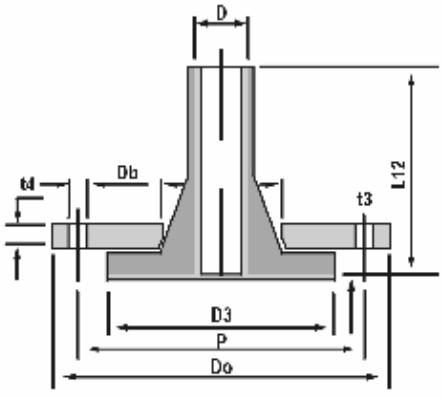


EQUAL/UNEQUAL TEE WITH OT WITHOUT LINEAR, FOR EQUAL TEE D = D1 FOR L7, L8 REF. THERMOPLASTIC CHART

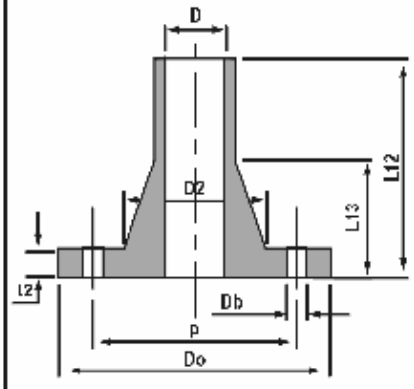


EQUAL/UNEQUAL TEE WITH MOULDED LINEAR, FOR EQUAL TEE D = D1 FOR L7, L8 REF. THERMOPLASTIC CHART





STUBEND WITH BACKING FLANGE WITH OR



FULL FACE FLANGE WITH OR WITHOUT

THERMOPLASTICS

PIPE THICKNESS AT PRESSURE RATINGS BASED ON SPECIFICATION (DIMENSION IN MM)

PIPE OD 'D'	PP, DIN 8077 & HDPE, DIN 8074						HDPE, IS 4984				PVC, IS 4985				CPVC, ASTM F441		PVDF, DIN	
	2.5	4	6	10	16	20	2.5	4	6	10	2.5	4	6	10	SCH.-40	SCH.-80	10	16
16				1.8	2.3	2.7				2								
20			1.8	1.9	2.8	3.4				2.3				1.1	2.8	3.7		
25			1.8	2.3	3.5	4.2				2.8				1.4	2.9	3.9		1.8
32			1.9	3	4.5	5.4			2.3	3.6				1.8	3.4	4.5		1.8
40		1.8	2.3	3.7	5.6	6.7		2	2.9	4.5			1.4	2.2	3.5	4.8		1.9
50	1.8	2	2.9	4.6	6.9	8.4		2.4	3.6	5.6			1.7	2.8	3.7	5	1.8	2.4
63	1.8	2.5	3.6	5.8	8.7	10.5	2	3	4.5	7.1		1.5	2.2	3.5	3.9	5.5	1.9	3
75	1.9	2.9	4.3	6.9	10.4	12.5	2.3	3.6	5.3	8.4		1.8	2.6	4.2	5.1	7	2.3	3.6
90	2.2	3.5	5.1	8.2	12.5	15	2.8	4.4	6.4	10.1	1.3	2.1	3.1	5	5.5	7.6	2.7	4.3
110	2.7	4.3	6.3	10.1	15.2	18.4	3.4	5.3	7.8	12.4	1.6	2.5	3.7	6	6	8.5	3.3	5.3
125	3.1	4.9	7.1	11.4	17.3	20.9	3.9	6	8.9	14.1	-	-	-	-	-	-	3.8	6
140	3.5	5.4	8	12.8	19.4	23.4	4.3	6.8	9.9	15.8	2	3.2	4.8	7.7	-	-	4.3	6.7
160	3.9	6.2	9.1	14.6	22.1	26.7	4.9	7.8	11.3	18	2.3	3.7	5.4	8.8	7.1	11	4.9	7.6
180	4.4	7	10.2	16.4	24.9	30	5.6	8.7	12.7	20.3	-	-	-	-	-	-	5.5	8.6
200	4.9	7.7	11.4	18.2	27.6	33.4	6.2	9.7	14.2	22.5	2.9	4.6	6.8	11	-	-	6.1	9.5
225	5.5	8.7	12.8	20.5	31.1	37.5	6.9	10.9	15.9	25.3	3.3	5.2	7.6		8.2	12.7	6.8	10.7
250	6.1	9.7	14.2	22.8	34.5		7.7	12.1	17.7	28.1	3.6	5.7	8.5		-	-		
280	6.9	10.8	15.9	25.5	38.7		8.6	13.5	19.8	31.5	4.1	6.4	9.5		9.3	15.1		
315	7.7	12.2	17.9	28.7			9.7	15.2	22.6	35.4	4.6	7.2	10.7		10.3	17.5		
355			20.1	32.3							-	-	-					
400	9.8	15.4	22.7	36.4							5.2	8.1	12.8					

FABRICATED FITTINGS

90° BEND	45° BEND	EQUAL TEE
L4	L8	L12
388	228	215
360	237	220
390	249	230
420	262	240
450	274	250
488	290	265
625	412	375
675	424	390
773	498	460
833	520	480
900	548	500

MOULDED FITTINGS OF VARIOUS MATERIALS BASED ON RELEVENT SPECIFICATION AND AVAILABILITY

1. PP, HDPE & PVDF FITTINGS BASED ON DIN SPECIFICATION (DIMENSION IN MM)

D	D1	90° ELBOW		45°ELBOW		EQUAL TEE		BRUSHING				ADAPTOR					END CAP	
		L1	L2	L6	L7	L9	L10	D4	D5	L19	t3	D3	D4	L17	L18	t2	L20	L21
16	22	13	9	-	-	14	9	-	-	-	-	-	-	-	-	-	-	-
20	27	14.5	11	5.5	16	16	11	34	27	16	7	45	27	50	13	7	23	16
25	33	16	15	6	19	19	14	41	33	19	7	58	33	50	13	9	27	19
32	41	18	17	7.5	22	22	18	50	40	22	7	68	40	50	13	10	31	22
40	50	20.5	22	10.5	26	26	22	61	50	26	8	78	50	50	15	11	36	26
50	61	31	27	11.5	31	31	27	73	61	31	8	88	61	50	15	12	43	31
63	76	38	34	14	38	38	34	90	73	38	9	102	75	50	20	14	51	38
75	91	44	40	17	44	44	40.5	103	90	44	10	122	89	50	20	16	59	44
90	107	51	48	21.5	51	51	48.5	125	108	51	10	138	105	80	20	17	69	51
110	130	61	60	26	61	61	61	150	131	61	12	158	125	80	25	18	83	61
160	193	174	86	38	86	86	89	212	188	86	16	212	175	80	28	25	-	-

2. PVC FITTINGS BASED ON IS7834 & 10124 SPECIFICATION (DIMENSION IN MM)														
PIPE OD D	90° ELBOW	45° ELBOW	EQUAL TEE-M	END CAP	SOCKET		90° BEND		60° BEND	45° BEND	EQUAL TEE-FAB	TAIL PIECE		
	L2	L6	L10	L21	L22	t7	R	L5	La	L8	L12	D30	D29	L51
16	9	4.5	9	14	14									
20	11	5	11	16	16									
25	13.5	6	13.5	19	19									
32	17	7.5	17	22	22									
40	21	9.5	21	26	26									
50	26	11.5	26	31	31									
63	32.5	14	32.5	37.5	37.5	20	189	63	63	63	98	101	64	68
75	38.5	16.5	38.5	43.5	43.5	20	225	75	75	75	115	121	79	80
90	46	19.5	46	51	51	35	270	90	90	90	137	136	91	95
110	56	23.5	56	61	61	35	330	110	110	110	166	156	112	115
125	63.5	27	63.5	68.5	68.5	35	375	125	125	125	188	186	127	130
140	71	30	71	76	76	45	420	140	140	140	209	186	142	145
160	81	34	81	86	86	45	480	160	160	160	238	212	162	165
180	91	38	91	96	96	45	540	180	180	180	267	212	183	185
200	101	43	101	106	106	45	600	200	200	200	296	267	203	205
225	114	48	114	118.5	118.5	55	675	225	225	225	333	267	228	230
250	126	53	126	131	131	55	750	250	250	250	369	322	253	255
280	141	60	141	146	146	55	840	280	280	280	412	322	284	285
315	158.5	67	158.5	163.5	163.5	55	945	315	315	315	463	372	319	320
355				183.5	183.5	65	1065	355	355	355	521	432	359	360
400				206	206	65	1200	400	400	400	586	483	405	405
450				231	231	65	1350	450	450	450	659	533	455	455
500				256	256	65	1500	500	500	500	731	588	506	505
560				286	286	75	1680	560	560	560	818	649	566	565
630				321	321	75	1890	630	630	630	920	719	637	335

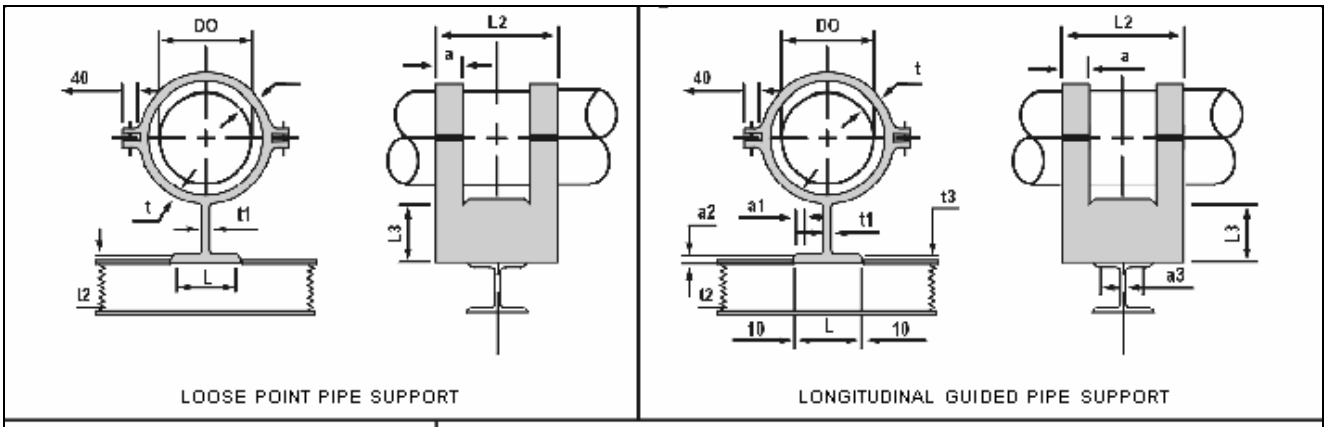
3. CPVC FITTINGS BASED ON ASTM SPECIFICATION (DIMENSION IN INCH). DIMENSIONS OF THREDED FITTINGS ON REQUEST

D	D1	900 ELBOW		450 ELBOW		EQUAL TEE		SOCKET/ VANSTONE FLANGE		COUPLING		FEMALE ADAPTOR			MALE ADAPTOR			END CAP		UNION		
		L1	L2	L6	L7	L9	L10	L19	t3	L21	L22	L25	L26	L27	L28	L29	L30	L20	L21	D4	L23	L24
1/2	1-7/32	57/64	33/64	1.4	15/16	57/64	33/64	1-1/16	1-5/32	1-7/8	7/8	1-3/4	29/32	13/16	11/16	57/64	1-59/64	1-1/4	7/8	2	29/32	2-3/8
3/4	1-27/64	1-1/32	37/64	11/32	1-1/16	1	19/32	1-3/16	1/2	2-1/8	1	1-57/64	1	13/16	3/4	1-1/64	2-1/16	1-3/8	1-1/32	2-3/8	1	2-19/32
1	1-3/4	1-5/32	23/32	5/16	1-3/16	1-9/64	45/64	15/16	9/16	2-3/8	1-1/8	2-13/64	1-7/32	1-1/32	59/64	1-1/8	20/32	1-21/32	1-5/32	2-11/16	1-5/32	2-7/8
1-1/4	2-7/64	1-9/32	55/64	5/16	1-5/16	1-17/64	57/64	1-1/2	5/8	2-5/8	1-1/4	2-23/64	1-17/64	7/8	31/32	1-17/64	2-9/16	1-27/32	1-9/32	3-3/32	19/32	3-3/8
1-1/2	2-25/64	1-25/64	1	29/64	17/16	1-25/64	1-1/64	1-1/2	23/32	2-29/32	1-3/8	2-31/64	1-25/64	63/64	31/32	1-25/64	2-23/32	1-29/32	1-13/32	3-13/16	1-13/32	3-7/8
2	2-7/8	1-1/2	1-1/4	19/32	1-17/32	1-9/16	1-1/4	1-11/16	3/4	3-1/8	1-1/2	2-21/32	1-33/64	29/32	1-1/64	1-1/2	2-7/8	2-1/8	1-17/32	4-13/16	1-1/2	4-3/16
2-1/2	3-5/8	1-25/32	1-17/32	47/64	1-3/4	1-25/32	1-9/16	-	-	3-3/4	1-3/4	3-3/8	1-3/4	1-3/8	1-7/16	1-3/4	3-1/2	2-5/8	1-3/4		-	-
3	4-1/4	1-7/8	1-7/8	15/16	1-7/8	1-7/8	2	2	29/32	4	1-7/8	3-11/16	1-7/8	1-9/16	1-25/32	1-7/8	4-1/16	3	1-29/32		1-29/32	5
4	5-21/64	2-17/64	2-11/32	1-3/8	2-1/4	2-1/4	2-3/8	2-1/2	1-3/32	4-47/64	2-1/4	4-3/32	2-7/32	1-9/16	1-5/8	2-1/4	4-5/16	3-1/2	2-9/32			
6	7-5/8	3	3-11/16	1-25/32	3	3-1/64	3-17/32	3-5/32	1-1/4	6-5/32	3											
8	9-3/4	4	4-5/8	3-1/4	4	4-1/64	4-33/64	4-9/16	1-1/2	9-5/16	4-17/32											
10								6-3/8	1-5/8	13-7/8	5-3/4											

THERMOSETTING (FRP) LINED/UNLINED

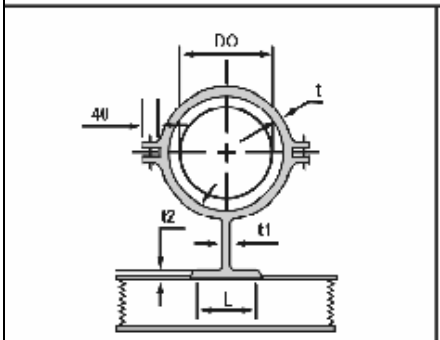
PIPE THICKNESS AT VARIOUS PRESSURE RATING & FITTING DIMENSIONS BASED ON DIN SPECIFICATION

PIPE NB D	UNLINED PIPE						LINED PIPE			90° BEND	40° BEND	EQUAL TEE	FULL FACE PLANGE				STUB WITH BACKING FLG.					PRESS RANGE FOR FLG.
	1.5	2.5	4	6	10	16	6	10	16	L2	L3	L6	L12S	L13	t2	D2	t3	t4	D3	D4	L12L	
25						5			3.8+2.9	110	70	110	150	30	14	50	12	14	68	50	200	16
32						5			3.8+2.9	130	80	130	150	32	15	58	14	15	78	58	200	16
40						5			3.8+2.9	150	90	150	150	35	16	68	14	16	88	68	200	16
50						5			3.8+2.9	180	105	180	150	40	18	82	14	18	102	82	200	16
65						5.1			3.8+2.9	140	85	140	150	44	20	95	15	20	122	95	200	10
80						6.1			4+2.9	165	100	165	150	48	22	111	16	22	138	111	200	10
100					5	7.3			4+2.9	205	115	205	150	55	24	133	18	24	158	133	200	10
125					5.9	8.8			4+2.9	245	135	245	200	64	27	160	20	27	188	160	265	10
150				5	6.8	10.5			4+3.2	285	150	285	200	71	30	188	22	30	212	188	265	10
200				5.8	8.7	13.6		4+2.9	4+3.7	365	190	365	200	80	33	245	25	32	268	237	355	6
250			5	6.7	10.8	16.8		4+3.1	4+4.4	450	225	450	250	90	37	300	28	34	320	293	355	6
300			5.5	7.9	13	19.9		4+3.7	4+5.3	525	260	525	250	100	42	350	30	36	370	343	450	6
350			6.3	9	14.5	23.1	4+2.9	4+4	4+5.8	600	290	600	300	95	40	410	32	38	430	387	450	4
400			7.1	10.2	16.5	26.2	4+3.1	4+4.4	4+6.4	680	325	680	300	105	44	460	35	42	482	441	450	4
450		5	7.8	11.5	19	30.5	4+3.3	4+4.8	4+7.2													
500		5.7	8.6	12.5	20.5	32.5	4+3.6	4+5.2	4+7.8	830	390	830	350	120	49	565	38	47	585	544	600	2.5
600	5	6.8	10.1	14.8			4+4.1	4+6.1	4+9.1	950	480	950	375	115	49	660	45		685	648	600	2.5
700	5.2	7.8	11.8	17			4+4.6	4+7	4+10.6	1100	490	1100		125	53	780	53			758		2.5
800	5.8	8.5	13.1	19.2			4+5.1	4+7.7	4+11.5	1250	545	1250		135	57	875	57			858		2.5
900	6.4	9.5	14.8	21.5			4+5.6	4+9	4+13.2	1400	605	1400		150	60	980	60			960		2.5
1000	7	10.5	16.3	23.8			4+6.1	4+9.4	4+14.5	1500	660	1500		155	65	1080	64			1060		2.5

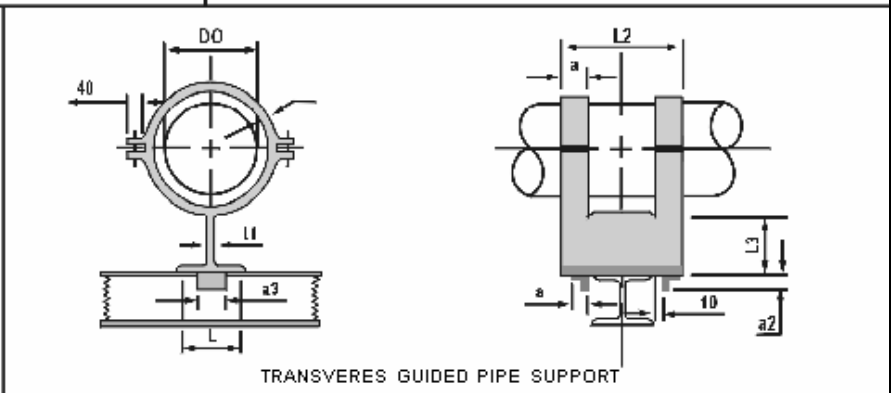


LOOSE POINT PIPE SUPPORT

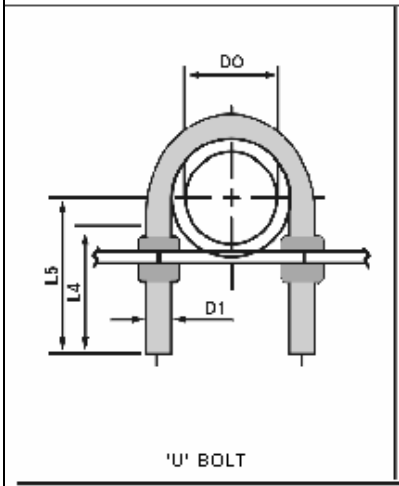
LONGITUDINAL GUIDED PIPE SUPPORT



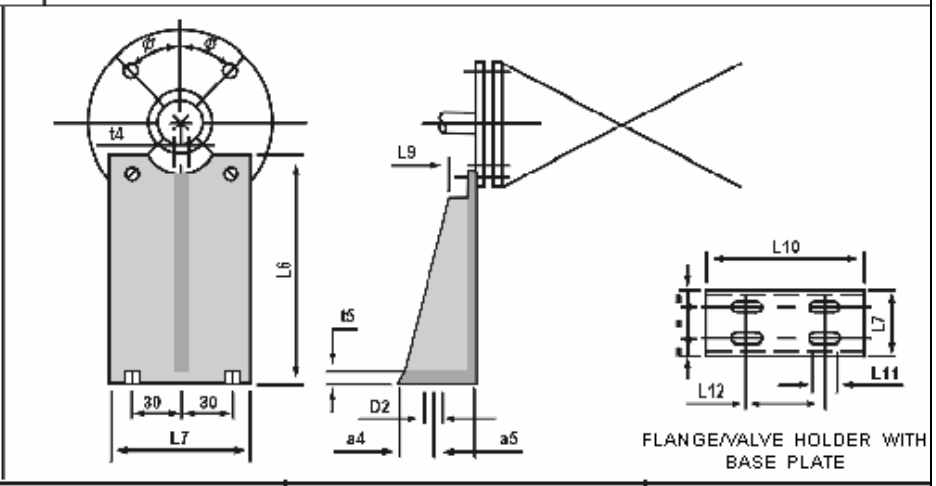
FIXED POINT SUPPORT



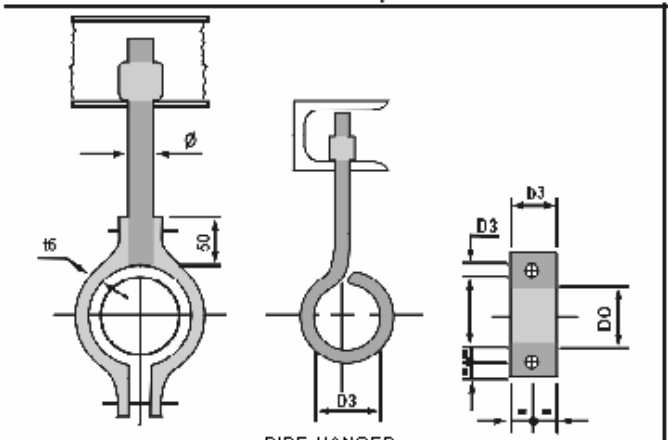
TRANSVERES GUIDED PIPE SUPPORT



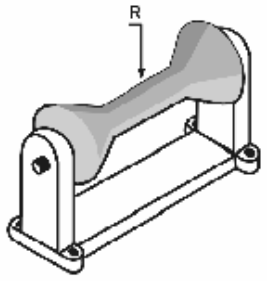
'U' BOLT



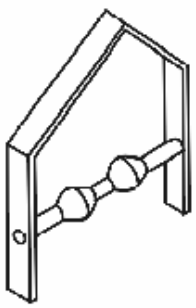
FLANGE/VALVE HOLDER WITH BASE PLATE



PIPE HANGER



ROLLER STAND



ROLLER HANGER

PIPE SUPPORT SPACING AT DIFFERENT TEMP. IN ° C																														
PIPE OD	PP; PN10 AT TEMP.°C						HDPE, PN10 AT TEMP. °C					PVC, PN10 AT TEMP.°C					PVDF, PN16 AT TEMP.°C.						CPVC, SCH.80 AT TEMP.°C.						PIPE NB	FRP
	20	40	60	80	90	110	20	30	40	50	60	20	30	40	50	60	20	40	60	80	100	120	30	40	60	70	80			
16												75	60	C	C	C	85	80	75	70	65	60	165	150	135	90	75		32	125
20	70	65	60	50	C	C	75	70	65	65	60	85	70	50	C	C	95	90	80	75	70	65	165	165	135	90	75		40	180
25	75	70	65	55	50	C	80	80	75	70	65	90	75	55	C	C	100	95	90	85	80	75	180	180	150	105	90		50	190
32	90	80	75	65	60	50	90	90	85	80	75	100	85	65	50	C	110	100	95	90	85	80	195	180	165	105	90		65	200
40	100	90	85	75	70	55	100	100	95	90	85	110	100	80	60	C	125	115	110	100	95	90	210	195	150	105	105		80	200
50	110	105	95	85	75	60	115	110	105	100	95	125	115	95	70	C	140	130	120	115	110	100	210	210	180	120	105		100	255
63	125	115	110	95	85	70	130	125	120	115	105	140	130	110	85	55	150	140	130	120	115	105	240	255	195	135	120		150	280
75	135	125	120	105	95	75	140	135	130	125	115	150	140	120	95	60	165	155	140	130	125	115							200	330
90	150	135	130	115	100	80	155	150	145	135	130	165	155	135	105	70	180	165	155	145	135	125	240	240	210	135	120		250	350
110	165	150	145	125	110	90	170	165	160	150	140	185	175	155	120	80	200	185	175	160	150	140	270	270	225	150	135		300	380
125	175	160	145	130	120	100	185	175	170	160	150						210	195	185	170	160	150							350	400
140	185	170	150	135	130	115	195	185	180	170	155	215	205	185	160	110	225	210	195	180	170	160							400	425
160	200	180	160	140	130	120	210	200	190	180	170	225	215	200	170	130	240	225	210	195	185	170	300	285	240	165	150		500	450
200	225	200	175	145	135	125	235	220	210	200	185	250	240	225	200	160	255	240	225	210	200	180	330	315	270	180	165		600	475
225	240	210	190	160	150	140	250	235	220	210	200						270	255	240	225	215	200						#		

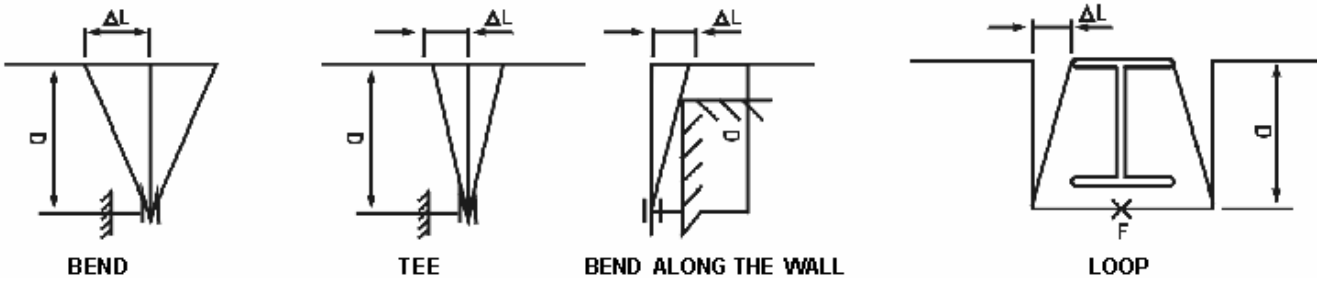
Very high coefficient of linear thermal expansion & low modulus of elasticity of plastic piping is one major area which requires careful attention while designing plastic piping system. The chart given below indicates the expansion (DL) that will take place at various temp changes (DT) of different materials on a pipe length (L)

L	DL in mm for change in temp. DT°C																			
mm	PP				HDPE				PVC				CPVC				FRP			
	20	30	40	50	20	30	40	50	20	30	40	50	20	30	40	50	20	30	40	50
2	6	9	12	15	8	12	16	20	3.2	4.8	6.4	8	1.4	2.1	2.7	3.4	1.2	1.8	2.4	3
4	12	18	24	30	16	24	32	40	6.4	9.6	13	16	2.7	4.1	5.5	7	2.4	3.6	4.8	5.5
6	18	27	56	45	24	36	48	60	9.6	14	19	24	4.1	6.1	8.2	10	3.6	5.4	7.2	9
8	24	36	48	60	32	48	64	80	13	19	26	32	5.5	8.2	11	14	4.8	7.2	9.8	12
10	30	45	60	75	40	60	80	99	16	24	32	40	6.8	10	14	17	6	9	11	15

Note :- *FRP values are with polyester resin system.*

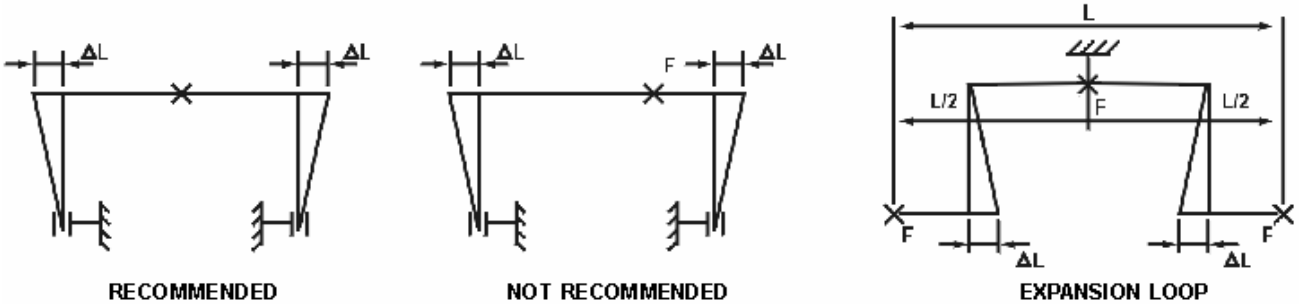
To prevent extra strain on pipeline due to thermal expansion, change in length is compensated by –

1. **Flexible sections**
   Pipe supports are so positioned that they allow advantage to be taken of the natural flexibility of the material. The length of such section is determined by the diameter of pipe & extent of expansion to be compensated. Flexible sections are naturally at any branching or change in direction of pipe line. The movement of flexible section should not be restrained by fixed supports, wall, girders etc. Below are typical flexible sections



Materials	PP	HDPE	PVC	CPVC	PVDF	FRP
Value of 'a'	30ÖdDL	26ÖdDL	33.5ÖdDL	3.5ÖdDL	21.7ÖdDL	4ÖdDL

Positioning of fixed supports is important for even distribution of change in length. Expansion loops can be installed to take up change in length.



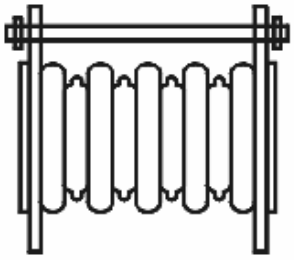
2. Compensators

The low modulus of electricity of thermoplastic means that the reaction force of thermoplastic pipe to thermal changes is low compared to metallic pipes. This makes normal compensators designed for metallic pipes, unsuitable because of their high resistance. Only freely moving compensators may be used in plastic piping.

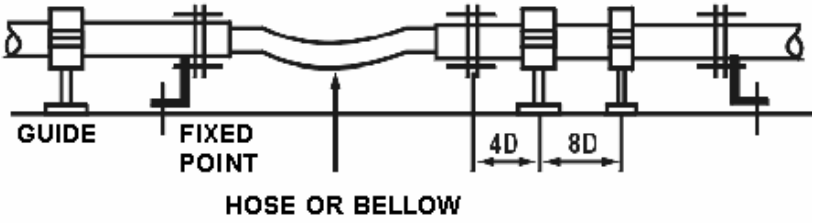
There are 2 types of compensators-Sliding joints, Flexible joints.

Sliding joints - These are characterized by a relative motion of two adjusting parts. Most widely used sliders are slip joints.

Flexible joints - Two types of flexible joints are available viz. Bellows, hoses.



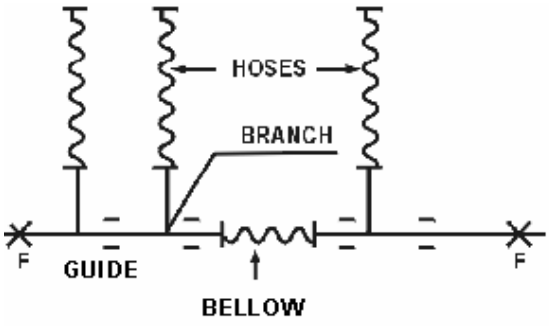
BELLOWS



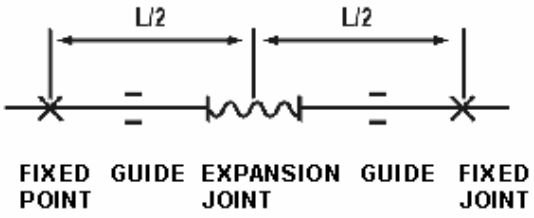
EXPANSION JOINT, ANCHOR & ALIGEMENT GUIDE LOCATION.

The thermal end thrust load exerted by pipes on compensators is

F = A E ąDT
F = Pipe themal end load, Kgf
A = II/4 (OD^2 - ID^2) = Resistant section area of pipes, mm^2
E = Modulus of elasticity, Kgf/mm^2
a = Unit liner coefficient of thermal expansion, m/m°C
DT = (Maximum - Minimum) temp, °C



COMBINATION OF HOSES & BELLOW



In case of a long header with several branches the hoses to be fixed in branches for lateral displacement & bellows in header to compensate thermal expansion. Typical arrangement of hoses and bellows is shown above

SANGIR PLASTICS is using various sophisticated methods to join plastic piping at fabrication shop & site. The thermoplastics can be joined either by welding, fusion or cementing while thermosetting/FRP can be joined by lamination.

1. THERMOPLASTICS

Methods	**Materials**				
	PP	**PVC**	**CPVC**	**PVDF**	**HDPE**
Hot air welding	+	+	+	+	+
Solvent cementing	0	+	+	0	0
Socket/Butt fusion	+	0	0	+	+

Note: + = methods used, 0 = methods not recommended.

Since the type & caliber of tools used for jointing in various methods are as important for high output, as maintaining excellent quality SANGIR PLASTICS has done indepth study over a period of time in developing new sophisticated & automated tools.

Hot air/gas welding

With hot gas welding the edge areas & the outer zones of the filler materials are transformed into plastic conditions as a rule by means of heated air & joined under pressure. The hot gas is being made free of water, dust & oil by fixing filters.

The filler or welding rods are available from 2 to 6 mm dia. Two types of welding nozzles can be employed viz fixed nozzle for rods of fixed length & running nozzle for continuous long bundle of rod. Temp required for different material is controlled by thermostat. Air required will be supplied through compressor.

Material	**Welding force (N) with welding rod of dia**		**Hot air temp, °C**	**Air quantity V/min**
	3mm	4mm		
PP	10 to 16	25 to 35	280-330	40-60
HDPE	10 to 16	25 to 35	300-350	40-60
PVC	15 to 20	30 to 45	220-300	50-75
CPVC	20 to 30	30 to 45	310-350	60-70

All the welders engaged in work are periodically tested for weld strength test. Also all welders are approved for the same test based on the test carried out at I.I.T. Mumbai.

Solvent cement jointing

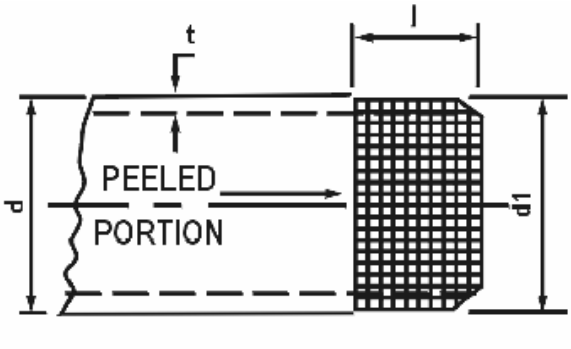
This method is employed only for jointing pipe with socket type fittings i.e. where pipe will be inserted into the fitting socket. Pipes & socket type fittings are cleaned, debured & chamfered to make it ready for cementing. Primer to be coated by using brush on the areas to be joined i.e. outside of pipe & inside of fitting till surface becomes tacky. Solvent cement is applied on this tacky surface for bonding. Then pipe will be inserted in fitting & both pieces will be held under pressure till it gets bonded firmly. At 25°C the handling time for cement is about 4 minutes & completed joint to be held at approx. 10 minutes at 25 - 30°C.

Socket fusing jointing

This method is used for jointing pipe with socket type fittings only. Moulded socket type fittings are available upto 160mm. diameter, so this method is used for jointing pipes and fittings upto 160mm. dia.

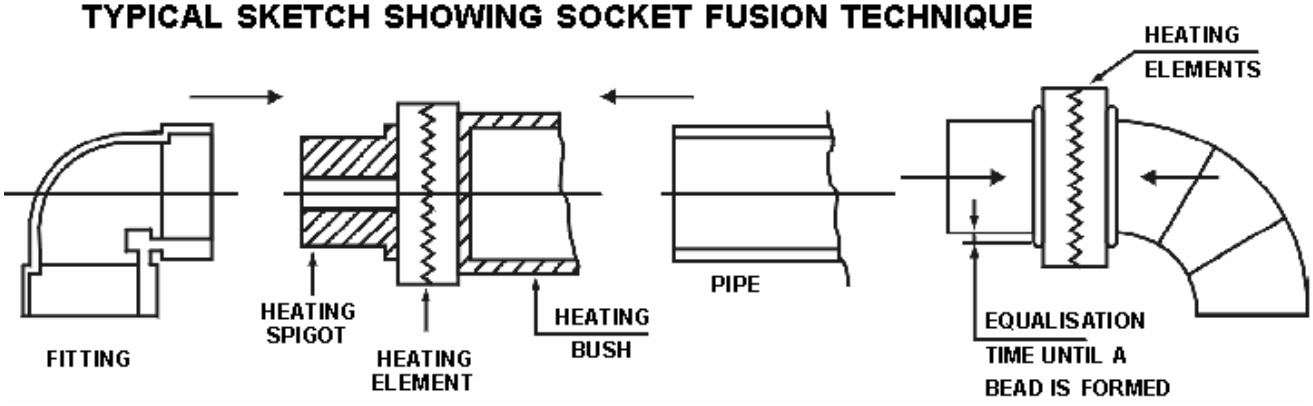
Length of pipe which has to be inserted in fitting socket for fusion to be peeled off in order to remove the glossiness on pipe surface & to make it rough. For hitting the parts, fittings to be inserted on heating spigot while pipe to be inserted in heating bush. Values of time for heating, change over time, jointing time, cooling time & pressure required etc. will be same as indicated for butt fusion.

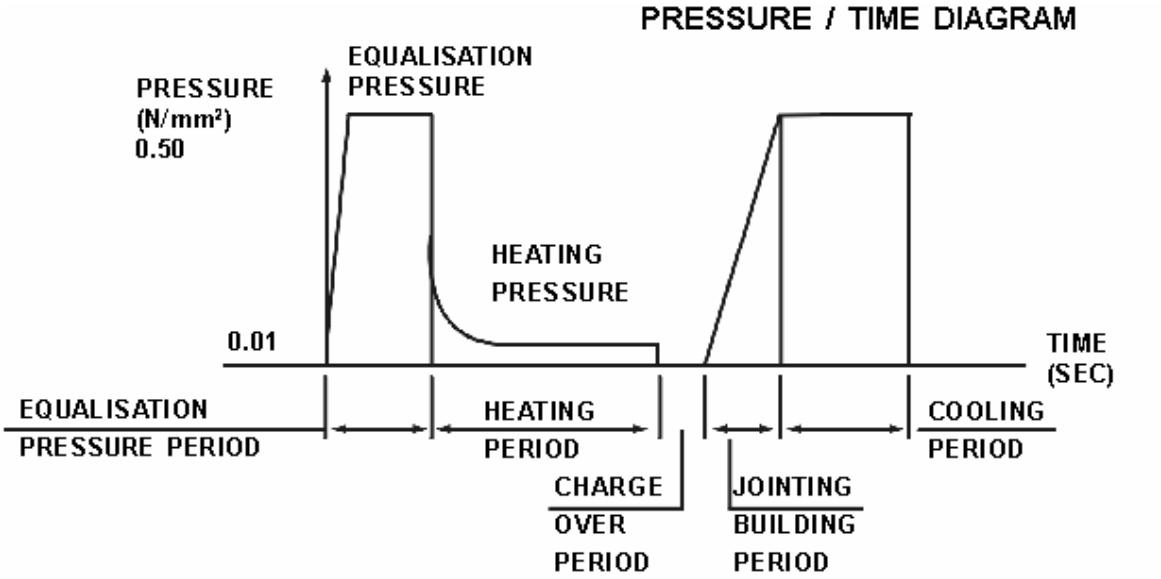
SANGIR PLASTICS is using fully automated machine to do the fusion, cutting, peeling, chamfering & deburring operations.



d	t	d1	L	Heating time (sec)
20	2.5	19.85 - 19.95	14	5
25	2.7	24.85 - 24.95	16	5
32	3.0	31.85 - 31.95	18	7
40	3.7	39.75 - 39.95	20	8
50	4.6	49.75 - 49.95	23	12
63	3.6	62.65 - 62.95	27	18
75	4.3	74.65 - 74.95	31	24
90	5.1	84.65 - 84.95	35	30
110	6.3	109.55 - 109.95	41	50

TYPICAL SKETCH SHOWING SOCKET FUSION TECHNIQUE





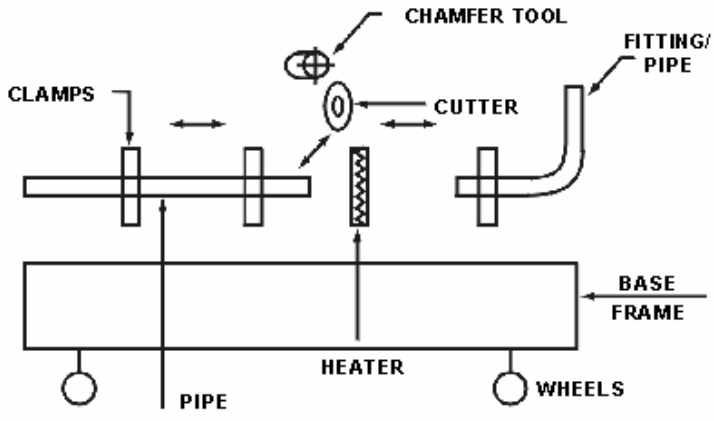
Values of butt fusion jointing process.

Pipe wall Thickness (mm.)	Heating Element Temp.°C	Equalisation at P=0.1N/mm^2 Height of Bead (mm.)	Heating time at P=0.01N/mm^2 for (sec) various materials			Change over time (sec.)	Time to reach full jointing pressure (sec.)	Cooling time under jointing pressure P=0.15N/mm^2 (sec.)
			PP	HDPE	PVDF			
2-3.7	215	0.5	-	30-40	40-70	4	3-6	4-5
4.3-6.9	210	0.5	65-115	40-70	70-40	5	5-8	6-10
7.1-11.4	205	1.0	115-180	70-120	90-120	6	8-10	10- 20
12.2-18.2	200	1.0	180-290	120-170	120-150	8	10-15	20-30
20.1-25.5	195	1.5	290-330	170-210	-	10	15-20	25-38

Butt fusion jointing - Angular (Bend fabrication)

The machine is used to cut the pipe in any required angle by cutter fixed on machine. Then these cut pieces or segments of pipe will be butt jointed in angular direction to form a bend. All values of butt fusion will be maintained as stated earlier.

Schematic diagram of socket / butt fusion machine. Champering, cutting to size, heating, pressurising etc. Operations done on the machine. Machine is mounted on moving trolley.

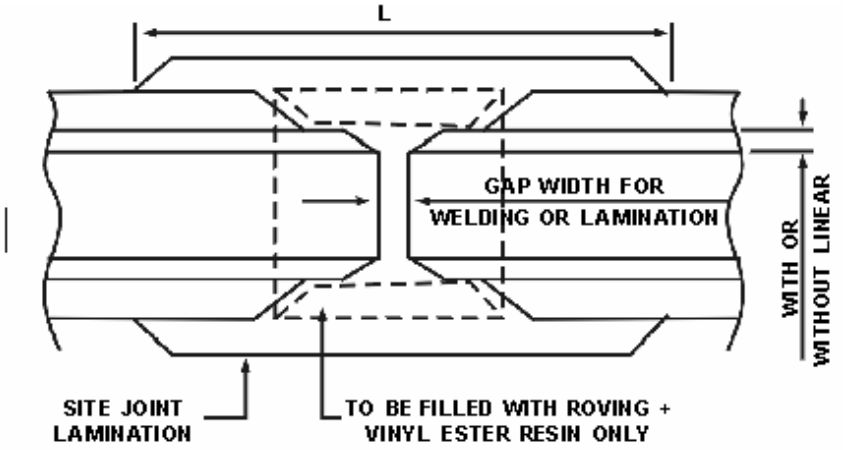


2. THERMOSETTING (FRP)

Lined FRP pipes requires removal of FRP at the edges for about 25mm, so as to expose inner linear. Linears can be welded/joined by any one of the method as explained in thermoplastic section. Rovings impregenated in resin will be filled in welding area & then glass mat of desired width will be wrapped one after another on joint area. Each layer of mat will be soaked in resin before wrapping new layer. No. of layers will be decided by joint thickness to be achieved.

For unlined FRP pipes only lamination to be carried out as stated above.

TYPICAL DETAILS OF SITE JOINT LAMINATION



Gap width, length of site joint lamination (L) & thickness of lamination (T) at various pressure ratings (Kg/cm²) of lined and unlined pipes.

PIPE NB	GAP WIDTH	LINED PIPES						UNLINED PIPES											
		6 Kg/cm²		10 Kg/cm²		16 Kg/cm²		1.6 Kg/cm²		2.5 Kg/cm²		4 Kg/cm²		6 Kg/cm²		10 Kg/cm²		16 Kg/cm²	
		T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L
25	0.5					4.0	110											4.0	110
32	0.5					4.0	110											4.0	110
40	0.5					4.0	110											4.0	110
50	0.6					4.0	110											4.0	110
65	0.7					4.0	110									4.0	110	4.5	110
80	0.8					4.0	120							4.0	110	4.0	110	5.0	120
100	0.9					4.5	140							4.0	110	4.0	110	6.5	140
125	1.0					5.5	175							4.0	110	5.0	110	8.0	175
150	1.1			4.0	130	6.5	210					4.0	110	4.0	110	6.0	130	9.5	210
200	1.3			5.5	165	8.5	280			4.0	110	4.0	110	4.5	110	8.0	165	13.0	280
250	1.6	4.0	125	6.5	205	10.5	345			4.0	110	4.0	110	6.0	125	10.0	205	16.0	345
300	1.8	5.0	150	8.0	250	12.5	415			4.0	110	4.5	110	7.0	150	11.5	250	19.0	415
350	2.0	5.5	170	9.0	290	15.0	460			4.0	110	5.5	115	8.0	170	13.5	290	22.0	460
400	2.0	6.5	200	10.5	330	17.0	550			4.0	110	6.0	130	9.0	200	15.5	330	25.0	550
500	2.0	8.0	240	13.0	410	21.0	685	4.0	110	5.0	110	7.5	160	11.5	240	19.5	410	31.5	685
600	2.7	9.5	290	15.5	480	25.0	745	4.0	110	6.0	120	9.0	190	14.0	290	23.0	480	38.0	745
700	2.7	11.0	335	18.0	560	24.5	880	4.5	110	6.5	140	10.5	220	16.0	335	27.0	560	44.0	880
800	3.6	12.5	390	20.5	640	33.5	990	5.0	130	7.5	160	12.5	225	18.5	390	31.0	640	50.0	990
900	3.6	14.0	430	23.0	720	37.5	1175	5.5	140	8.5	180	13.5	285	20.5	430	35.0	720	57.0	1175
1000	4.5	15.5	480	26.0	795	42.0	1235	6.5	160	9.5	200	15.0	315	23.5	480	39.0	795	63.0	1235

Client :-				Contractor :-					P=Performing agency;			
Consultant :-				Sub Vendor :-					W=Witnessing agency;			
Project :-				1=Client/Consultant					V=Verifying agency;			
Title :-				2=Contractor					IR=Inspection report			
QAP No :-				3=Sub Vendor								
Sr. No.	Component & Operations	Characteristic	Class	Type of check	Quantum of check	Reference document	Acceptance norm	Format of record	Inspection agency			Remarks
1	RAW MATERIAL (Thermoplastics)											
1.1	PP/HDPE	Melt flow index Softning point Heat distortion temp. Barcol hardness Specific gravity Elongation at yield		Review of TC	One per batch	ASTM	ASTM	Mfg. TC	-	-	1/2	TC to be furnished
1.	RAW MATERIAL (Thermosetting-FRP)											
1.1	Liquid Resin	Specific Gravity Volatile Contents Acid Value Peak Exothermic Temp. Moisture Contents	MA	Review of TC	One per batch	IS 6746	IS 6746	Mfg. TC	-	-	1/2	TC to be furnished
1.2	Fibre Glass	Moisture Contents Binder Contents Average mass/area % variation mass/area	MA	Review of TC	One per batch	BS 3496	BS 3496	Mfg. TC	-	-	1/2	TC to be furnished
2.	BROUGHT OUT ITEMS											
2.1	PVC/CPVC/PVDF	Tensile Strength % Elongation Flexural Strength Izod Impact strength	MA	Review of TC	One per batch			Mfg. TC	-	-	1/2	TC to be furnished
3.	STAGE INSPECTION (Optional)											
3.1	Raw Material	Drum/Bag/Box No. Supplier Identification Batch/Chalan No. Type/Code No.		Physical	100%	Tech. Spec.	Tech. Spec.	Inspection/IR	-	1/2	1/2	Physical checking prior to starting of manufacturing or review of IR
3.2	Mould/Pattern (For FRP only)	Dimensions		Measure	100%	Appd. Drg.	Appd. Drg.	Inspection/IR	-	1/2	1/2	Worker to make sample coupons from same raw material used for job & under identical condition
3.3	Workmanship approval	Welder Moulder	MA	Physical	Once	BS 4994	BS 4994	Inspection/IR	-	1/2	1/2	Worker to make sample coupons from same raw material used for job & under identical condition
4.	FINAL INSPECTION (Thermoplastics)											
4.1	Workmanship	Dimensions Surface Defects Welding	MA	Measure Physical	10% of lot 100% 10% of lot	Appd. Drg.	Appd. Drg.	Inspection/IR	3	2	1	Physical checking if waived then IR
4.2	Tests on PP/HDPE	Long term creep test Heat Reversion Spark test for fittings Pressure test Tensile Strength	MA	Physical	1 of each size 10% of lot 1 of each size	DIN 8078,8064	DIN 8078,8064	Inspection/IR	3	2	1	Random selection of samples
4.3	Tests on PVC/CPVC/PVDF pipes	Pressure test Spark test for fittings	MA	Physical	10% of lot				3	2	1	Random selection of samples
4.	FINAL INSPECTION (Thermosetting FRP)											
4.1	Workmanship	Dimensions Surface Defects Welding Extent of cure	MA	Physical Acetone rub	10% of lot	Appd.Drg. BS 4994	Appd.Drg. BS 4994	Inspection/IR	3	2	1	Physical checking if waived then IR
4.2	Tests	Pressure test Tensile Strength Bond strength of FRP & liner Glass content Spark test for fittings	MA	Physical	10% of lot Once 10% of lot	DIN 16966	DIN 16966	Inspection/IR	3	2	1	Random selection of samples

ENGINEERING DATA

Some typical formulas & information for designing of plastic piping are provided below:

1. Factor of safety

Based on 50 years of operating life at 20°C with water

Material	Safety factor
PVC	2.5
CPVC	2.75
PP	2.1
HDPE	1.6
PVDF	2

$C = K.20.e/p.(d-e)$

K = long term creep strength (N/mm)
d = outside diameter of pipe (mm)
e = wall thickness in (mm)
p = operating pressure (bar)
20 = constant
C = Factor of safety

2. Permissible working pressure

$P = 20.e.(K.e)/(d-e)$

P = permissible working pressure (bar)

3. Pipe wall thickness

$e = p.d/20.s+p$

e = wall thickness in mm
s = permissible comparative stress (N/mm^2)
P = permissible working pressure at 20°C (bar)

4. Pipe size

$di = 18.8\ddot{O}Q1/v$
$= 35.7\ddot{O}Q2/v$
$v = 353.44\ Q/di^2$

di = inside diameter of pipe (mm)
Q1 = flow rate (m^3/h)
Q2 = flow rate (L/s)
v = flow velocity (m/s)

5. Collapsing or buckling pressure

$Pc = (2\ E/1\text{-}m^2)\ (ç/D)^3$

$Pe\ £\ Pc/C$

E = modulus of elasticity (N/mm)
m = Poisions ratio (= 0.3)
Pc = collapsing pressure (N/mm^2)
D = Mean outside diameter (mm)
Pe = Max. allowable external pressure (gauge)
ç = Fluid Density (Kg/m^3)

6. Change in length due to expansion

$DL = \mu\ L\ DT$

μ = coefficient of linear thermal expansion (mm/m°C)
L = length of pipe (m)
DT = (Max-Min) temp (°C)

7. Deflection of pipe

Fm = A. W. Ls^4/E.I

W = static load (Kg/m) = pipe weight + weight of fluid
E = modulus of elasticity (Kg/m^2)
I = moment of inertia (mm^4)
A = Elastic deflection coefficient
Fm = max deflection (m)
Ls = distance between supports (m)

TYPE OF PIPE SUPPORT	A
Fixed ends	0.0026
Free ends	0.013
One end fixed, one free	0.0054
Cantilever	0.125

8. Pipe thermal end load

F = A E a DT

F = pipe thermal end load, Kgf
A = cross sectional area of pipe
= p/4 (OD^2-10^2) (mm^2)
E = modulus of elasticity (Kgf/mm^2)
DT = (Max - Min) temp (°C)
a = coefficient of thermal expansion (m/m °C)

9. Pressure loss

In pipe hp = 50.987 f.v^2/di

In fittings hf = k.v^2/2g

1/Öf = 2 log (e/3.7.di) + 2 log (2.51/Nre.Öf)

Nre =V.v.di/m

In valves, hv = $(Q/n)^2$.V/1000

Total Pressure loss (drop) h = hp+hf+hv

f = Fanning friction factor
v = mean velocity of fluid (m/s)
h = total pressure losses (m/m)
g = acceleration of gravity, (9.81 m/s)
k = Coefficient of resistance in fittings
e = Roughness of pipe wall (mm)
FRP = 0.03-0.06, PVC = 0.05,
PP/HDPE = 0.001-0.007
ç = Fluid density (Kg/m^3)
m = Absolute viscosity of fluid (centipoise)
n = valve flow characteristics (m^3/Hr)
Nre = Reynolds number

CORROSION RESISTANCE OF THERMOPLASTICS &THERMOSETS

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FRV Vinyl Ester
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FRE Epoxy
FRHA HET Acid
FRF Furane
FRPH Phenolic

Medium	%	Thermoplastics						Thermosets							
	Conc.														
		PVC	CPVC	ABS	PE	PP	PVDF	FRP	FRB	FRV	FRVS	FRE	FRHA	FRF	FRPH
A															
Actaldehyde	Pure	-	-	-	30	15	-	-	-	--	-	-	-	-	-
Axetic acid	10	50	80	50	60	100	120	65	95	100	100	110	-	110	-
	25	45	70	35	60	80	90	65	95	100	100	60	-	-	-
	50	40	60	-	60	60	70	50	70	80	80	20	-	110	-
Acetic acid-glacial	100	15	15	-	50	50	30	-	-	-	40	20	-	110	115
Acetic anhydride	Pure	-	-	-	30	30	-	-	-	-	40	-	-	25	-
Acetone	10	-	-	15	60	60	40	-	-	-	80	65	25	-	-
	100	-	-	-	60	60	-	-	-	-	-	-	-	-	-
Acrylic acid	25	-	-	-	-	-	-	-	40	40	40	38		-	-
Acrylonitrile	Pure	-	-	-	60	30	-	-	-	-	27	·	-	-	-
Adipic acid	Sat'd	40	80	-	60	80	20	-	-	70	93	100	-	-	-
Allyl alcohol	96	15	15	..	60	60	-	-	-	-	25	-	-	-	-
Alchohloic Spirits	40	20	20	-	20	20	20	-	-	-	-	-	-	-	-
Amyl alcohol	100	20	60	-	50	80	120	80	100	58	65	65	-	-	-
Alcohol butyl	100	65	85	-	50	80	120	20	20	58	58	65	-	-	-
Alcohol ethyl	Pure	60	85		-	80	120	65	65	38	38	65	-		
Alum	100	60	85	60	50	80	120	65	100	100	105	110	-		
Aluminium Chloride	Sat'd	60	80	60	60	60	120	65	100	100	120	110	-	110	115
Aluminium Fluoride	100	60	85		50	50	120	25	40	40	40	60	-		
Aluminium Hydroxide	100	60	85		50	50	120	-	70	80	90	65	-		
Aluminium Nitrate	Sat'd	60	85		.	80	120	65	70	80	80		65		
Aluminium Sulphate	100	60	85	60	50	80	120	60	100	100	120	110	99		
Aluminium Phosphate	100	60	85		50	80		20	20	65	65	65	-		
Ammonia (Gas)	Pure	60	80	-	60	60	50	25	80	80	80	110	-	80	50
Ammonia Aqua	10	60	85	-	-	65	120	·	.	-	-	20	-	85	40
Ammonium Acetate	65							·	45	45	45	-	-		
	100	50	60	-	60	100	100								
Ammonium Bifiuoride	100	60	85		50	50	120	-	-	65	65	·	-		
Ammonium Bisulphite	100	60	-		-	-	-	·	70	75	75	-	-		
Ammonium Carbonate	100	80	60	60	100	120	80	-	65	65	65	-	35		50
Ammonium Chloride	Sat'd	50	80	60	100	120	100	65	100	100	100	-	-	110	115
Amm. Hydrogen Fluoride	50	50	60	-	60	60	60								
Ammonium Fluoride	100							25	50	65	65				
Ammonium Hydroxide	15	60	60	50	60	60	-	25	60	65	65			-	-
	Sat'd	50	60	50	60	60	-		40	40	40				
Ammohium Nitrate	Sat'd	60	80	60	50	70	120	65	100	100	120	·	.		
Ammoilium Phosphate	All	60	80	50	60	100	120	-	80	100	100				
Ammonium Sulphate	Sat'd	80	60	60	100	120	80	65	100	a	120	-	-		60
Ammonium Sulphide	All	50	40	60	60	60	60	-	45	50	50	-	-		
Amyl Acetate	Pure	-	-	-	60	30	40	-	40	40	45	20			
Amyl Alcohol	Pure	50	60	-	60	80	110	35	100	50	100				
B															
Barium Carbonate	All	60	85	-	50	80	120	65	95	100	120	110	.		
Barium Chloride	All	60	-	-	50	50	120	65	100	100	100	110	-		
Barium HydrOxide	Sat'd	60	60	60	-	80	80	30	65	65	20	-			50
Barium Sulphate	All	60	85	-	50	50	-	65	100	100	120	-	-		
Barium Sulphide	All	60			20	20	120	-	60	80	80	-	-		
Beer		60	80	60	60	80	20	30	45	50	50	65			
Benzaldehydt	Sat'd				60	20	30	-	-	-	20	-	-		
Benzene	Pure				25	15	30	-	-	-	35			110	115
Benzene Sulphonic acid	Pure						100	-	95	65	95	20			
Benzoic acid	All	50	60	40	60	100	120	65	100	100	100	110			
Benzyl alcohol	Pure	15	15		50	50	50	-	35	-	35				

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Medium	%	Thermoplastics						Thermosets							
	Conc.														
		PVC	CPVC	ABS	PE	PP	PVDF	FRP	FRB	FRV	FRVS	FRE	FRHA	FRF	FRPH
Benzyl Chloride	All						70	-	-	-	25				
Black Liquor	All	60	85		50	50	120	-	100	100	100	110			
Bleach Solutions															
Calcium Hypochlorite	All	40	60	40	60	60	15		45	65	65	65		110	80
Chlorine Dioxide	Sat'd								-	70	90	90			
Chlorine Water	Sat'd	25	20	15	25	15	15		-	80	90	100			
Lithium Hypochlorite	All								-	-	65	65			
Peroxides (Dilute)									-	100	100	100			
Sodium Hypochlorite	15	50	60		15	15	15		-	65	80	65	20		
Borax	All	50	80	40	60	100	100	65	105	100	100	65			
Boric acid	All	50	80	60	60	100	120	65	100	100	100	65		110	95
BrasS plating solution								-	-	80	80				
Brine, Sea Water	All	50	60	60	60	100	120	65	100	100	100				
Bromine, dry gas	High	-	-	-	-	-	90	-	35	35	35				
Bromine, liquid	Pure	-	-	-	-	-	90	-	-	-	-	65			
Bromine, Wet gas	High	20	20	-	-	-	80	--	35	35	35	65			
Butadiene	Pure	20	20	-	20	60	100	-	--	-	-	65			
Butane	Pure	20	20	20	20	20	20					65			
Butanol	Pure	50	70		60	50	90								
B uytyl Acetate	Pure				20	15	25	-	-	-	25	65			
Butyl Alcohol	All	60	60		50	80	-	30	45	50	50	-			
Butyl Benzylpt~alate	All							-	90	85	100				
Butyl Cellosolve	100	20						25	35	35	35				
Butylene Glycol	Pure	50	60	60	60	80	60	60	80	70	80				
Butylene, liquid	Pure	20					20								
Butric acid	Pure	20	20		50	20	90	-	30	30	45	-			
	50							45	65	100	100	-			
C															
Calcium Bisulphite	Sat'd	20	20	40			120	60	80	80	80	65			
Calcium Chloride	All							-	90	90	90	-			
Calcium Cyanide		60	85					-	80	80	80				
Calcium Carbonate	All	60	85		50	65	120	65	100	100	100	100			
Calcium Chlorate	All	60			50	50	120	65	100	100	120	65			
Calcium Chloride	Sat'd	50	80	40	60	100	120	65	100	100	120	120		130	75
Calcium Hydroxide	Sat'd	60	60	60	60	80	15	40	70	80	80	50			
Calcium Hypochlorite - see Bleach Solution															
Calcium Nitrate	50	40	60	40	60	60	15	65	100	100	100	65			
Calcium Sulphate	All	60	85		50	80	120	65	100	100	120	120			
Calcium Sulphite	All							-	80	80	-				
Cane Sugar Liquor	All	60		50	50			65	80	80	80				
Capric acid	All							50	70	70	70				
Caprylic acid	All					65		65	70	80	100				
Carbon Dioxide	Dry gas	60	60	60	60	80	100	90	120	100	120	65			
Carbonic Acid	Sat'd	60	60	60	60	80	100	40	-	40	65				
Carbon Disulphide	Pure				15	15	20	-	-	-	20			70	85
Carbon Monoxide	Gas	60	85		50	65		90	180	100	180				
Carbon Tetrachloride	Pure						50	-	45	65	75	65		90	115
Caustic Potash Solution	50	50	80	60	60	100	-	-	45	80	80	20		90	
Caustic soda solution (Sodium Hydroxide)	10	65	50	60	60	60				65	80	70	65	30	80
	25	50	60	60	60	100	-	·	65	80	80	65			
	50	60	60	60	60	100	-		100	110	100	45		80	-
Chloric Acid	10	50	60	-	40	-	40								
Chlorine	Dry gas		20	-	-	-		50	100	100	120	65			

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		PVC	CPVC	ABS	PE	PP	PVDF	FRP	FRB	FRV	FRVS	FRE	FRHA	FRF	FRPH
~~Chlorine~~	Wet gas	15	20	15	25	-	90	50	100	100	120				
Chlorine water	Sat'd	20	20	15	20	15	15	-	80	90	100				
Chlorine Dioxide	Sat'd							-	80	90	100				
Chloroacetic acid	50	40	60		60	60	15	-	60	35	35	20			
	Pure	50	40		60	60	-								
Chlorobenzene	Pure	-		-	15	20	50				35	65			
Chloroform	Pure					15	80					65			
Chorosulphonic acid	Pure	15	15			-	15								
Chrome alum	Sat'd	60	60	40	60	60	40					110			
Chrome plating solution										50	55				
ChrOmic acid	25	35	60		20	20	90	-		50	50	35	40		70
	50	35	60		15	15	90			50	50				
Chromic acid+Sulphuric acid+water		50	60	-	-	-	70								
Citric acid	10	50	60	60	60	100	100	65	100	100	100	120	90		95
Cromium Sulphate	All							-	60	80	80				
Coconut Oil	Pure	50	60	-	50	60	120	60	80	80	95				
Copper Acetate	All	50	60	60	60	30	100	65	80	80	80	65			
Copper Chloride	All	60	85	-	50	60	120	65	100	100	120	120			
Copper Cyanide	All	60	85		50	65	120	60	100	100	100	65			
Copper Nitrate	All	60	85		50	65	120	60	100	100	100	65			
Copper Sulphate	All	60	80		40	60	110	65	100	100	120	65	90		105
Copper plating solution									80	80	80				
CimOil	Pure	15	30	15	50	50	80	·	80	80	100				
CresyliC acid	All	60	60				65	·		-					
Crude Oil. Sour/Sweet	100	60	85	-			120	65	100	100	110	110			
Cyclohexane	Pure	-			60	20	80	-	45	45	60				
Cyclohexanol	Pure	60	80		60	50	55								
D															
Detergents, Organic	All	50	80		60	80	100	-		80	90	65			
	100	40	65		45	70	90			65	80				
Detergents, Sulphonated	All	50	80		70	90	110	65	100	c	100	65			
Dextrine (Starch gum)	Comm	60	80	60	60	20	120								
Dextrose-see Glucose															
Diamrnonium Phosphate	65							-	-	100	100				
Dibulyl Carbitol	100							·	-	25	35				
DibulyiEther	100				15	15	-	25	45	80	95				
Dibulyl Pthalate	Pure				35	35	50	25	80	80	100	65			
Dibulyl Sebacate	Pure	-		-	20	20	20	-		50	65				
Dichloribenzene	Pure	-	-	-	15	15	70	-	45	-	45	65			
Dichloroethane	100	-	-		15	15	90	-		-	25				
Dichloroethylene	Pure				-	15	40	-	.	-	-	20			
DiChloropropane	100							-	-		35				
Diesel Oil		40	40	15	40	15	120	60	80	80	100	110			
Diethyl Amine	pure	15	15			20	30	-	-						
Diethyl Benzene	100							-	-	35	45				
Diglycolic aCid	30	50	60	20	60	60	20	-	-						
Diethyl Sulphate	100							-	-	35	45				
piethyl Glycol	100							6.5	100	80	100				
Diisobulyl Ketone	Pure	-		-	40	40	50	-	-	-	45				
Diisobutyl Pthalate	100							-	80	80	80				
Diisocyanate	100							50	50	50	50				
Diisopropanol Amine	100									50	65				
Dimethyi Formamide	Pure	-	-	-	50	60	-	-		-	-				

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Dimethyl Amine	Pure	15	15	-	40	20	15								
Dimethyl Pthalate	100							-	65	65	80				
Dimethyl Sulphoxide	100								45		45				
Dinonyl Pthalate	Pure	-	-		15	20	-								
Dioctyl Pthalate	Pure	-			15	20	-	-	60	65	100				
Dioxane	Pure				60	45	-	-	-	-	-	65			
Divinyl Senzene	100							-	-	35	45	65			
Dodecyl Alcohol (Lauryl)	100							-	65	65	80	-			
Dodecyl Benzene Sulphonic acid	All							-	100	50	50	-			
E															
Epichlorohydrin	100								45	-	25				
Ethyl Acetate	Pure	-		-	30	30	15	-	-	-	20				
Ethyl Alcohol		50	-	-	60	80	30	-	45	30	45			100	105
Ethylalcoholtacetic acid	Pure	50	60	-	60	20	70								
Ethyl Benzene	Pure	-		-		15	20	-	-	25	40				
Ethyl Chloride	Pure				15	15	90		-	-	25	-			
Ethyl Ether	Pure	-	-	-	15	20	40		-	-	-	65			
Ethylene Chlorohydrin	100	-	-	-	-	20	-	-	45	40	45	-			
Ethylene Diamine	Pure	15	15	-	60	20	25	-	45	45	45				
Ethylene Dichloride	100	-	-	-	-	50	-	-	-	-	25				
Ethylene Glycol	Pure	60	80	60	60	100	120	65	100	100	100	110		90	85
Ethylene Oxide	Pure	-	-	-		15	70	-	-	-	-	-			
F															
Fatty Acids	Pure	60	60	-	50	60	80	65	100	100	120	65		85	80
Fatty alcohol sulphonate	Aqueous	50	60		60	50	100								
Fertilizer sa~s	Aqueous	50	60		60	60	80								
Ferric Acetate	Sat'd	20						65	80	80	80				
Ferric Chloride	Sat'd	60	85	40	50	80	20	65	100	100	100	120		75	90
Ferric Nitrate	Sat'd	60	85	40	50	80	120	65	100	100	100	120			
Ferric Sulphate	Sat'd	60	85	30	20	80	110	65	100	100	100	110			
Ferrous Chloride	Sat'd	60	85	40	50	80	100	65	100	100	100	110		125	120
Ferrous Nitrate	Sat'd	20				80	100	60	100	100	100				
Ferrous Sulphate	Sat'd	60	85	40	20	80	90	65	100	100	100	65		80	90
Fluorine	Pure	-	-	-			-	-	20	20	-	20			
Fuel gas	DrylWet	60	85	-		20	120		100	80	100	110			
Fluosilicic acid	10							25	65	80	80	65			
	35	60	80	60	60	20	100	-	-	35	35	30			
Formaldehyde	40	40	60	60	60	40	80	25	45	65	65	65			
Formamide	Pure	-		-	60	60									
Formic acid	10							35	65	80	80	65		95	95
	50	50	80	15	60	50	100	45	45		50	-		95	90
	Pure	30	. 60	-	60	30	100	-	45	-	45	-		90	85
FERRON 11								-	25	25	40	20			
FERON 113-see 1,2,2-trifluoro; 1,2,2-Trichlroethane															
FERON12	Pure	20	20	20	-	-	15					20			
Fruit pulp		20	80	40	60	60									
Fuel Oil	100	30			15	15	100	60	100	90	120	110			
Furfural	20				50		20	-	35	-	-				
Furfuryl Alcohol	Pure	-		-	60	40	50	-		-	25				
G															

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Gasoline leaded laviation	100	60		-		120	-	60	80	80	80	110			
Gluconic Acid	50							40	45	80	80				
Gelatine	All	40	60	60	60	60	80								
GlucOse	All	50	60	60	60	100	120	65	100	100	120	120			
Gultaraldehyde	50							-	-	50	50				
Gultaric aCid	50							-	-	50	50				
Glycerine	Pure	60	80	40	60	100	120	65	100	100	100	120			
Glycol-see ethyiene glycol															
Glycoloc acid	35	20	40	40	60	20	100	45	60	60	60				
	70							-		35	35				
Goid plating solution								-	100	-	100				
Green liquor (pulp mill)	All	60			50	65		-	90	90	90	110			
H															
Heptane	Pure	20	30	20	20	20	100	65	65	100	100	65			
Hexane	Pure	20	40	20	20	20	100	60	70	70	70	65			
Hyriodic acid	40							-	-	65	65				
Hydrobromic aCid	25							65	80	80	80	82			
	50	60	70	40	60	60	100	-	70	65	70	65			
Hydrochloric acid	10	50	80	40	60	55	120	50	105	90	110	85		100	110
	30	50	80	15	60	35	100	30	65	85	110	65		85	100
	36	50	80		60	30	100		45	65	80			75	95
	Fumes							80	110	100	110	-			
HydroChloric acid-Free Chlorine	All							-	-	80	110	65			
HydroChloric acid-Organic	-							-	-	55					
Hydrocyanic acid	Pure	50	60		60	60	80	40	100	100	100	20			
Hydrofluoric acid	10							-	65	80	80			95	85
	20							-	40	35	40			80	70
	40	30	40	15	50	60	100	-	-	-	-			65	70
	50	20	40	-	50	60	100								
Hydrogen	pure	60	80	60	60	60	100	-	65	20	50	65			
Hydrogen Brorriide	Gas							25	-	80	80				
Hydrogen chloride	Gas,Pure	50	60		60	60	100	40	110	100	110				
Hydrogen Fluoride	Gas								80	80	80				
Hydrogen Peroxide	30	40	40	-	60	50	25	25	40	65	65	20		80	70
Hydrogen Sulphide	Pure	60	60	20	50	60	120	40	100	80	100	110			
HydrOchlorous aCid	10	60	50		50	65	120	40	-	80	80	110			
	20									60	60	110			
Hydrophosphorus acid	50							-	-	50	50				
Hydroxylamine Sulphate	All	40	40	-	60	60									
I															
Iodine	100	-	-		20	20	60	50	65	65	65	65			
	Vapours							50	70	65	80				
Iron plating solution								-	75	80	120				
Isobutyl Alcohol	100							-	50	50	50				
Isononyl Aicohol	100							40	50	65	65				
Isooctyl Alcohol	100							40	65	65	65				
Iso octane	Pure	20		-	20	20	100								
isopropyl Alcohol	pure	20	60	-	60	100	70	-	45	50	50	65			
Isopropyl Ether	Pure	-		-	15	15	60								
Isopropyl Arriine	100							-	-	50	50				
Isopropyl Myristate	100							50	100	100	110				

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Itaconic acid	Sat'd							-	50	50	50				
J															
Jet Fuel	100	60	85				65	60	80	80	80	110			
K															
Kerosene	100	60	85	-		20	120	60	80	80	80	120			
L															
	10	30	60	30	60	100	55								
Lactic acid	All							69	100	100	100	110			
LanOlin	Pure	30	'40	60	60	60	120								
Linseed Oil	Pure	50	40	20	60	100	120	60	99	99	110	110			
Lauryl Chloride	100	60	60	-	20	-	120	-	80	100	100			-	
Lead Acetate	All	60	60	60	60	60	100	60	80	100	110	110			
Lead Chloride	Sat'd	60	85					-	100	100	100	110			
Lead Nitrate	Sat'd	60						-	100	100	100				
Lead plating solution								-	100	100	100				
Levulinic acid	100							65	100	100	110				
Liquers		40			40	20	80								
Lithium Bromide	Sat'd	60	85					60	100	100	120				
Lithium Chloride	Sat'd							50	100	100	100	110			
Lithium Hydroxide	Sat'd							-	60	80	80	110			
Lithium Hypochlorite	All							-	-	65	65				
Lubricating oil free of		60	60	20	50	50	120								
aromatic compounds															
M															
Magnesium Bisulphite	All							50	80	80	80				
Magnesium Carbonate	All	60	85	40	50	65	120	50	65	80	80	120			
Magnesium Chloride	All	60	85	40	50	80	120	50	100	100	120	120		120	120
Magnesium Hydroxide	All	60	85	35	50	80	120	40	100	100	100	110			
Magnesium Nitrate	All	60	85	35	50	80	120	65	100	100	100	110			
Magnesium Sulphate	All	60	85	40	50	80	120	65	100	100	120	120		130	
Maleic acid	Sat'd	50	60	20	60	60	120	65	100	100	120	65			
Maganese Chloride	All							65	100	100	100				
Manganese Sulphate	All	20				65	120	65	100	100	100				
Mercurous Chloride	All							50	100	100	100				
Mercury	Pure	60	60	20	60	60	120	65	100	100	120	120			
Mercuric Chloride	Sat'd	50	60	20	60	60	120	50	100	100	100	20			
Methanol (methyl alcohol)	All	50	60		60	60	30	-	35	-	35			90	75
Methane	Pure	20	20	20	20	20	60								
Methyl Acetate	Pure				20	50	30								
Methyl Amine	32	15	15	-	20	20	15								
Methyl Bromide	Pure	-		-	15	-	60								
Methyl Chloride	Pure	-	-	-	15	-	60	20							
Methylene Ketone	Pure	-	-		25	30	-	-	-	.	20	65			
Methyl Isobutyl Ketone	100				50	20	20	-	-	-	-	65			
Methylene Chloride	100							-	-	-	-	20			
Milk & Milk products	All	60	80	60	60	100	120	50	100	100	100				
Mineral Oil	100	60	65		20	20	120	65	100	100	120	120			
Mixed acids: Sulphuric+nitric+ water	48+49+3	30	40	-	-		20								
	50+50+0	15	20	-	-	-	20								
	10+87+3	15	20	-	-		15								
	50+31+19	20	20	-	-		20								
	50+33+17	30	20	-	-		20								

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	10+20+70	40	20	-	15	-	80								
Mixed acids: Nitric+Hydrofluoric+Sulphuric	3+1 +2 parts	40	20	-	15	-	80								
Mixed acids: Sulphuric+Phospheric+Water	30+60+10	40	20	-	30	30	80								
Molasses		50	80	60	60	60	180	-	45	45	45				
Monochloroacetic acid, ethyl ester	Pure	15	40	-	60	60	15		-	-					
Monochloroacetic acid, methyl ester	Pure	15	40		60	60	30								
Monochlorobenzene	100							-	-	-	35				
Monothanolamine	100					65	20	-	-		25				
				-											
Mopholine	pure	-		-	60	60	50	-	-	-	25				
Myristic acid	All							55	100	100	120				
N															
Naptha	100	60	60		-	20	20	55	65	80	100	110			
Naptha Heavy aromatic	100							-	45	40	50				
Napthalene	pure	-		-	20	20	50	45	80	100	100	65			
Nickle chloride	All	60	85	60	50	80	120	65	100	100	100	120		125	115
Nickle Nitrate	All	60	85	60	50	80	120	65	100	100	100	120			
Nickle Sulphate	All	60	85	60	50	80	120	65	100	100	100	120		135	120
Nickle plating solution								-	100	80	100	65			
Nitric acid	5	60	80	30	60	20	100	45	80	65	80	65			
	15							30	65	50	65	60		70	80
	40	50	80	-	15	15	100		50		45			-	70
	65	30	40		15	-	70	-	40		20	-			-
Nitric acid fumes								-	80	80	80				
Nitrobenzene	pure	-			50	60	30	-	-	-	35				
Nitrotoluene	Pure	-	-		50	50	90								
Nitrous gases (Nitric Oxide)	Oil, moist	20	20	-	60	30	100								
Octanoic acid (Caprylic)	All							40	70	80	100				
Oil crude	100							65	100	100	120				
Oleic acid	pure	60	70	30	50	50	120	55	100	100	100	120			
Oleum	10%S03	-	15	-	-		-	-		-	-				
Oleum, Vapours	Traces	20	20	-	-	-									
Olive oil		60	80	60	50	80	80		55	100	100	120			
Oxalic acid	Sat'd	60	60	40	60	60	50	60	100	100	100	95		65	60
Oxygen	pure	60	80	60	50	30	95								
Ozone	2%in air	20	20	-	15	15	15								
P															
Palm oil		20	20	20	50	50	100	65	80	80	90				
Palmitic acid	pure	20	20	20	15	15	120	65	100	100	120				
Paraffin emulsions		40	60	60	50	50	100								
	10	50	60	40	60	60	100	-	-	65	65	110			
Perchloric acid	30							-	-	50	55	110			
	70	15	15		30	15	100	-		35	40	110			
Perchloroethylene	pure	-	-		15	15	70		40	25	45	65			
Petroleum	pure	20	20	-	50	30	120								
Petroleum ether	Pure	60	60		30	50	120								
Phenol	10	30	40	-	50	60	100	-		-	50			80	90

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	90	15	40	-	50	60	50	-	-	-	20			80	90
Phenylhydrazine	pure	-	-	-	15	15	40								
Phosgene	pure	-	-	-		15									
Potassium Sulphate	All	50	60	60	60	60	100	65	100	100	100	120		130	115
Propane	Pure	20	20	20	20	20	60	20							
Propanol nJiso	Pure	35	25	20	60	60	70								
Propionic acid	50	50	60	-	60	60	60	-	-	80	80				
	100	30	50	-	35	45	60	-	-	-	35				
Propylene Glycol	Pure	60	60	1Ei	60	60	60	65	100	100	100	65			
Propylene Oxide	Pure	15			20	20	30	-	-	-	-	-			
Prussic acid-see Hydrocyanic acid															
Pyridine	Pure	-	-		35	35	20	-	-	-					
R															
Ramasit fabric - water proofing agent		60					60								
Rayon spin bath								-	60	60	60				
S															
Saipetre -see potassium nitrate															
Silicofluoric acid -see Fiuosilicic acid															
Silicone Oil		30	40	20	60	100									
Salicylic acid	Sat'd	60				65		35	65	65	65				
Selenious acid	All	60							80	100	100				
Septic system								45	45	45	45				
Sewage								45	80	80	100				
Silver Nitrate (salt)	Sat'd	50	60	60	60	60	100	65	100	100	100	65			
Silver piating solution								-	100	90	100				
Slurry, Lime	Sat'd							45	70	80	80				
Soap solution	All	50	60	40	60	60	100					100			
Sodium Acetate	All	20	20	60	60	100	90	60	100	100	100	105			
Sodium Aluminate	All	60						30	65	65	65				
Sod tUm Benzoate	Sat'd	50	60	-	EiO	60	110	65	80	80	80	100			
Sodium Bicarbonate	Sat'd	60	60	60	60	80	100	-	80	80	80	105			
Sodium Bisulphate	All	50	60	60	60	60	120	65	100	100	100	120			
Sodium Bisulphite	All	30	60		60	60	120	65	100	100	100	110			
Sodium Borate	Sat'd	20				20		60	100	100	100				
Sodium Bromate	All	30	40		:\0	30	100	35	60	60	65				
Sodium Bromide	All	50	60	60	60	60	120	65	100	100	100	110			
Sodium Carbonate (Soda)	20							30	75	80	80	110	60	80	90
	All	60	60	60	60	100	100	-	70	80	80	90	50		
Sodium Chlorate	All	50	80	60	60	60	15	65	100	100	100	110			
Sodium Chloride (Cooking San)	All	50	80	60	60	80	120	65	100	100	100	120		75	85
	10							35	65	65	65				
Sodium Chlorite	50							-	35	35	50				
	Dilute	15	20	20	20	50	90								
Sodium Chromate	50							35	100	100	100				
	Dilute	50	60	60	20	40	100								
Sodium Cyanide	All	60	85		SO	80	120	-	65	100	100				
Sodium Dichromate	Sat'd	60	85		50	65		50	100	100	100	110			
Sodium Diphosphate	All							65	100	100	100				

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Medium	%	Thermoplastics						Thermosets							
	Conc.														
		PVC	CPVC	ABS	PE	PP	PVDF	FRP	FRB	FRV	FRVS	FRE	FRHA	FRF	FRPH
Sodium Dodecyl Benzene	All							-	100	100	100				
Sulphonate															
Sodium Disulphite	All	50	60		:20	20	100								
Sodium Hyposuiphite	10	50	60		60	60	50								
Sodium Ferricyanide	All	60	85		50	65		65	100	100	100	110			
Sodium ferrocyanide	All	60	85		50	65	120	65	100	100	100	120			
Sodium Fluoride	Sat'd	40	60	60	0.2	20	100	-	80	80	80	110			
Sodium Hydroxide see Caustic Soda															
Sodium Hypochlorite-see Bleach solution															
Sodium Lauryl Sulphate	All							-	70	70	70				
Sodium iodide	All	50	60	60	20	20	50								
Sodium Nitrate	Sat'd	50	60	40	60	60	120	65	100	100	100	110		120	110
Sodium Nitrite	Sat'd	20	30	40	20	20	120			99	99	110			
Sodium Oxalate	Sat'd	50	60	40	20	20	50								
SOdium persulphate	Sat'd	50	60	60	60	60	60	-	80	80	-				
Sodium Phosphate	Sat'd	50	60	20	60	100	70				120				
Sodium POlyacrylate	Sat'd							-	80	80	80				
Sodium Silicate	All	50	60	40	60	60	50	-	100	100	100	65			
Sodium Sulphate	Sat'd	50	60	60	60	80	120	65	100	100	100	120			
Sodium Sulphide	Sat'd	50	60	60	60	60	30	60	100	100	100	110			
Sodium Sulphite	Sat'd	50	60	40	60	60	100	30	100	100	100	105			
				-											
Sodium Tartarate	All							30	100	100	100				
Sodium Thiocyanate	Sat'd								-	80	80				
Sodium Thiosulphate	Sat'd	50	60	20	60	60	100	-	80	80	80	20			
Sodium Xylene Sulphonate	40								100	100	100				
Sorbitol Solution	All							50	65	70	80				
Soyabean oil	100							55	80	100	100				
	100	40			20	20	40								
Spinning bath acids containing															
Carbon Disulphide	200				20	20	40								
	700				20	20	40								
Spirits-Brandy	Cornm	60			60	60	100								
Stannic Chloride	All	60	85		50	65	120	35	65	100	100	110			
Stannous Chloride	Sat'd	35	50	40	60	60	100	35	100	100	100	65			
Starch solution	All	60		40	60	60	100								
Stearic acid	Pure	60	60	40	30	30	120	55	100	100	100	65			
Styrene	100										45				
Styrene Acrylic Emulsions										40	50				
Succinic acid	All	60	60	20	60	60	60								
Suger	All	50	60	30	60	100	120	65	100	100	100				
	10	60				80		50	100	100	100				
Sulphamic acid	Sat'd							40	65	65	65	65			
Sulphanilic Acid	All							-	80	100	100				
Sulphite/Sulphate Liquors(Pulp mins)		60							100	95	100	65			
Sulpher	Pure	15	15		60	80	120	65	120	100	150	65			
Sulpher Dichloride	Fumes									95	95				
Sulpher Dioxide	Dry/Wet	50	45		60	60	30	65	80	100	120	65			

CORROSION RESISTANCE OF THERMOPLASTICS &THERMOSETS

PVC - Poly Vinyl Chloride
CPVC - Chlorinated Poly Vinyl Chloride
ABS - Acrylonitrile Butadine Styrene
Note: "-" implies not recommended

PE Poly Ethylene
PP Poly Propylene
PVDF Poly Vinylidene Di Flouride

FRP Isopthalic
FRB Bisphenol
FRV Vinyl Ester
FRVS Vinyl Ester (superior)

FRE Epoxy
FRHA HET Acid
FRF Furane
FRPH Phenolic

Medium	%	Thermoplastics						Thermosets							
	Conc.														
		PVC	CPVC	ABS	PE	PP	PVDF	FRP	FRB	FRV	FRVS	FRE	FRHA	FRF	FRPH
Sulpher Trioxide	5	-			-			-	120	100	150				
	25	60	80	40	60	60	120	35	105	100	100	65	70	15	110
	50	60	80		60	60	120		105	85	100	65	70	10	100
Sulphuric acid	75	60	60	-	50	50	110	-	40	40	40	25	60	In	95
	90	40	60		15	15	95		-				-		
	96	50	60	-			40	-		-	-			:;0	95
	98	20	60		-							-	-		
Sulphuric acid	Vapours							-	100	100	120				
Sulphurous acid	Sat'd	50	60	40	60	60	100		45	45	45	65		'10	35
Sulphuryl chloride	Pure		-	-	-		15	-		-					
T															
Tanow	Pure	60	60	40	60	60	100								
Tannic aCid	All	20	60	40	60	60	20	65	100	100	100	110			
Tanning extracts from plant	Usual	20	40	40	20	20	20								
Tartaric acid	All	50	60	40	60	60	120	65	100	100	100	65	80		
Tetrachloroethane	Pure				15	15	50		-		50				
Tetrachioro$thylene - see perchloroethylell"															
Tetrachloropentane	100							-	-	25	35				
Tetrachloropytidine	100									25	35				
Tetraacetic aCid	All							35	50	65	65				
Thionyl Chloride	100														
Tetraethyl Lead	Pure	20	20		20	20	120					65			
Tetrahydrofurane	Pure		-		15		25								
Tin Dichloride see Stannous Chloride															
Tin Fluborate plating solution									100	100	100				
Tobias acid	All								100	100	100				
Toluene	Pure	-			15	15	50	-		25	45	65			
Toluene SUlph6nic ACid	All							-	100	100	100				
Tributyl Phosphate	Pure	-			60	60	20	-	50	50	60				
Trichloro Acetic Acid	50	30	40	-	60	60	50		100	100	100	65			
	Pure	15	-		30	60	15								
					--										
Trichlorobenzene	100														
Trichloro Ethane	Pure	-			15	15	50			40	45				
Trichioro Ethylene	Pure					15	80			-		65			
Trichloro Methane See Choloroforrn															
Trichlorophenol	100														
Tricresyl Phosphate	Pure	-			60	30		40	70	70	70				
Triethanolamine	Pure	15	20	20	60	20	20		65	50	50	65			
Triethanol Ammonium Laury! Sulphate	All							-	45	45	45				
Triethylamine	Pure		-			15		40	50	50	50	20			
Triethylene Glycol	100							65	80	80	80				
Tripropylene Glycol	100							65	80	80	80				
Tri Sodium Phosphate	All	60	85		50	65	120	40	80	100	120	65			
Trioctyl Phosphate	Pure				15	20									
Turpentine	Pure	30	30		25		20	25	65	65	100	65	40		
Tween Surfactant	All							45	65	65	80				
U															
	All							40	50	65	65	65			

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	Conc.														
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Urea	30	50													
			60	40	60	60	90								
Urine		50	60	40	60	60	100								
V															
Vinegar	All	60	60	40	60	80	100	65	100	100	100	65			
Vinyl Acetate	Pure	-				30	20				-	65			
Vinyl Chloride	pure								-	25	50				
Vinyl Toluene	100							-	-	25	50				
Viscose Spinning Solution		60			60	60	60								
W															
		60	80		60	80	30								
	All	60	80		60	80	120								
	All	60	80		60	70	120								
Waste gases contianing	Traces	60	80		60	60	120								
	Traces	60	80		60	50	100								
	Traces	60	80		60	80	120								
	Traces	60	80		,60	50	100								
	All	60	80		160	50	120								
	100							65	100	100	100	120			
	100	60	80	60	60	100	120	65	100	100	100	120			
	100							65	100	100	100	120	80		
	100	60	80	60	60	100	120	65	100	100	100	120		-	-
Water															
	100							65	100	100	100	120	80		-
	100	50	80	60	130	80	120	65	100	100	100	120			
				-											
	100	60	80	60	60	100	120	65	100	100	100	120			
		40	80	60	60	80	120								
Wine		20	60	40	60	60	100		45	45	45				
White Liquor (Pulp mill)									80	95	80				
Wax Alcohol	Pure	60	60		15	15	60								
X															
Xylene	Pure	-				-	50		45	30	45	65			
Y															
Yeast	All	40	40		80	60	80								
Z															
Zinc Chloride	All	50	60	40	60	60	120	65	100	100	105	120		130	115
Zinc Cyanide plating bath									100	85	100		50		