Cosmoplast™

POLYETHYLENE

Pipeline Systems

ISO 4427/4437

WRAS Water Regulations Advisory Scheme

FM APPROVED

SASO
الهيئة السعودية للمواصفات والمقاييس والجودة
Saudi Standards, Metrology and Quality Org.

Cosmoplast

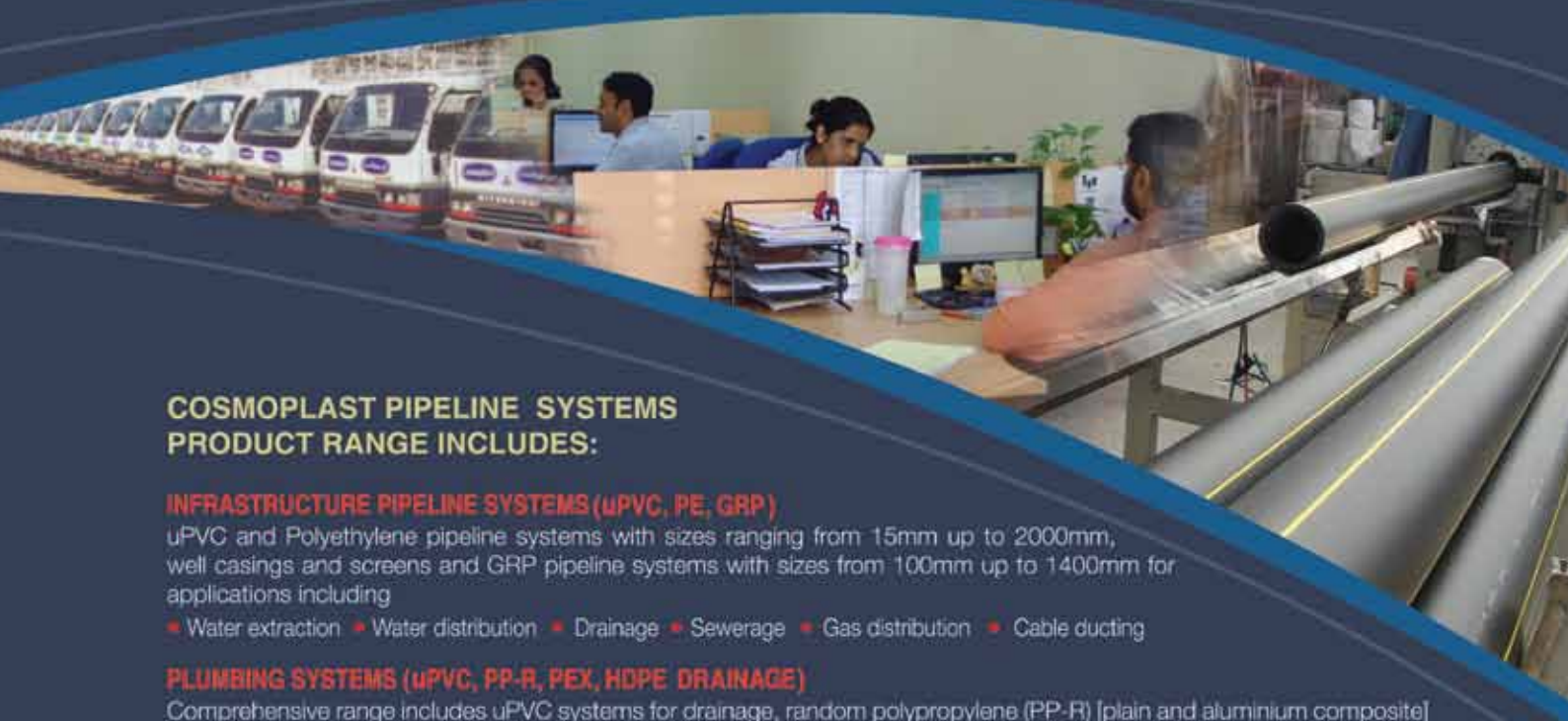
Cosmoplast, a primary member of Group Harwal, has been at the forefront of the plastic industry in the Gulf region since it's founding in 1976. Through constant growth and product diversification, the company continues to be the largest thermoplastic pipe manufacturer in the region.

Continuously enhancing its capabilities in plastic manufacturing technologies, Cosmoplast now utilizes a diverse range of materials such as uPVC, polyethylene (PE100, PE80, LLDPE), cross linked polyethylene (PEX), random copolymer polypropylene (PP-R), and glass-reinforced plastic (GRP).

Cosmoplast's ongoing research and development programs continue to add new products to its pipeline systems product range that now includes pre-insulated pipes, reinforced thermoplastic pipes, specialized plumbing systems and fabricated uPVC and GRP manhole systems. It's state of the art engineering, design and tool room facilities are fully capable of manufacturing moulds, dies, machinery equipments and other specialized tooling requirements to meet the company's continual expansion and product development requirements.

With this extended product range, Cosmoplast's pipeline systems cater to an extensive range of market sectors and applications covering infrastructure development, plumbing, oil & gas, district cooling, irrigation, landscaping and water extraction.

An ISO 9001 certified company, Cosmoplast has its production facilities based in Sharjah, Abu Dhabi and Dubai converting over 75,000 metric tons of plastic per annum. In addition to these, Cosmoplast also has upcoming facilities in Saudi Arabia, Moscow and Kaliningrad.



COSMOPLAST PIPELINE SYSTEMS PRODUCT RANGE INCLUDES:

INFRASTRUCTURE PIPELINE SYSTEMS (uPVC, PE, GRP)

uPVC and Polyethylene pipeline systems with sizes ranging from 15mm up to 2000mm, well casings and screens and GRP pipeline systems with sizes from 100mm up to 1400mm for applications including

- Water extraction
- Water distribution
- Drainage
- Sewerage
- Gas distribution
- Cable ducting

PLUMBING SYSTEMS (uPVC, PP-R, PEX, HDPE DRAINAGE)

Comprehensive range includes uPVC systems for drainage, random polypropylene (PP-R) [plain and aluminium composite] and cross linked polyethylene (PEX) systems for water and sanitary applications and uPVC high pressure pipes and fittings for water supply and A/C drain. Plumbing accessories such as pipe clamps, polyethylene compression fittings, solvent cements, lubricants and adhesives compliment this product range.

PRE-INSULATED PIPES (HDPE-HDPE, HDPE-GRP, HDPE-STEEL, GRP-HDPE, GRP-GRP, GRP-STEEL)

Jacket – core pipe combination with polyurethane insulation are used for applications such as District Cooling systems, Oil & Gas and other industrial applications. Cosmoplast provides HDPE and GRP pipes as jackets and HDPE, GRP and steel as core pipes.

IRRIGATION SYSTEMS (LLDPE)

Consists of high precision inline drip pipes and landscape and lawn edging. This range also includes saline resistant valves, drainage systems, sprinklers and central controllers.

REINFORCED THERMOPLASTIC PIPES (RTP)

Available in length of upto 500m, with a working pressure of 150 Bar at a temperature of 60 degrees celsius. RTP is used for gas distribution networks, oil flow lines and water injection lines.

ISO 4427/4437
BS EN 1329/1401

ISO 9001 FM 75767

HIGH DENSITY POLYETHYLENE PIPES AND FITTINGS FOR WATER SUPPLY SYSTEMS

Historical Overview:

Polyethylene material has been used in pipeline systems since the mid fifties, but only recently it started gaining its deserved recognition being the future and fundamental choice in pipeline selection.

COSMOPLAST has been at the leading edge in developing HDPE pipeline systems and has been one of the leaders in pushing both product and market development, thus helping the operational partners to fully utilize this dynamic and versatile material.

COSMOPLAST HDPE pipes and fittings are available in sizes from diameter 20mm to 1400 mm.Bigger sizes can also be fabricated on request.

POLYETHYLENE MATERIAL

Polyethylene is a thermoplastic Polyolefin (Alkene) material generated from the polymerization of Ethylene. As a highly crystalline non-polar thermoplastic with excellent chemical resistance to most household and industrial chemical it provides an excellent base for pipe production.

The polyethylene material used by Cosmoplast is a premium highly engineered material that provides maximum performance to service all of today's municipal and industrial water needs. It is formulated with a minimum of 2-2.5% carbon black for maximum protection against UV rays.

APPLICATION AREAS

Cosmoplast HDPE system is recognized in the industry for its zero leak rate, high performance, and long life expectancy.These unique features make Cosmoplast Polyethylene pipes and fittings the best option for various applications like:

- Municipal and industrial water transmission systems.
- Potable water service or distribution lines.
- Sewer piping systems.
- Pipeline Rehabilitation.
- Slip Lining.
- Horizontal and Directional Drilling.
- Geo-Thermalapplications.
- Mining applications.
- Rehabilitation of old pipelines.
- Electrical Ducting.
- Natural Gas Distribution.
- Irrigation and Landscaping.
- Liners and Jackets for District Cooling.

ADVANTAGES OF COSMOPLAST POLYETHYLENE MATERIAL

- Lifetime leak free joints thanks to the heat fusion joining technology.
- High Flexibility, thanks to the unique property of polyethylene material.
- High abrasion resistance.
- High Fatigue resistance.
- High Toughness.
- Light weight.
- High impact resistance.
- Low cost installation.
- Resistance to environmental stress cracking.
- Resistant to surges and durable performance under extreme temperature.
- High strength and stiffness to withstand internal pressure and external loads.
- High corrosion and Chemical resistant.
- Full joint traceability.
- Easy installation.
- Easy maintenance and repair.
- Excellent mechanical strength.
- Does not require protective coating.
- Smooth internal surface leading to Low friction loss and lack of scaling.
- Color coded for product application.
- Ideal for renovation work through pipe bursting techniques.
- Easy out of trench pipe jointing.
- Ease of use with relining techniques avoiding opening of trenches.
- Outstanding ability to withstand Rapid Crack Propagation (RCP).
- Homogenous, welded joint properties identical to that of the pipe.
- Does not require thrust blocking and anchoring.
- Lightweight and flexible allowing easier pipe handling and installation.
- Full technical back up from COSMOPLAST at every step.

COMPARISON BETWEEN POLYETHYLENE PIPELINE SYSTEMS AND THE CONVENTIONAL PIPELINES

Cosmoplast polyethylene pipes and fittings present many advantages in comparison with the conventional piping systems (such as Steel, ductile iron, clay pipes…etc). The below table summarizes the main points:

Comparison of **PE** piping System versus **CONVENTIONAL** Pipes such as **DUCTILE, CONCRETE, CLAY etc.**	Conventional	PE
Joint traceability ?	NO	YES
Low maintenance costs ?	NO	YES
Corrosion resistant ?	NO	YES
Flexible pipe, less liable to stress fractures ?	NO	YES
Operational system during branch additional ?	NO	YES
Reduced labour requirement in pipe lifting and installation due to weight dfferential	NO	YES
Reduced labour skill in Jointing operations	NO	YES
Extra protection required	YES	NO
Lower energy requirement to Overcome pipe friction ?	NO	YES
Reduced joint stress due to pipe flexibility ?	NO	YES
Liable to layer separation ?	YES	NO
Potential joint leakage ?	YES	NO

Long Laying Lengths

Cosmoplast HDPE pipes are manufactured in standard length of 12m. Smaller size pipe of 6" (160mm) and smaller can be extruded at continuous coil lengths of 50 – 500m. Longer lengths provide convenience in installation and allow for significant cost savings in labor and equipment.

Wide Range of Standards

Cosmoplast HDPE pipes are manufactured in accordance with many international standards like ISO4427, ISO4437, DIN8074, DIN8075, BSEN12201 as well as to specific customer requirements for individual applications.

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Quality Control

COSMOPLAST HDPE pipes and fittings are subject to strict quality control programs that monitors three critical aspects of the manufacturing process: the incoming raw material, pipe production, and finished goods.

Incoming material is tested to ensure that it meets all standard requirements before being released for production.

During production, pipes and fittings will be physically tested to ensure that its dimensional, mechanical and physical characteristics are in full compliance with the requirements of the standards they are produced to.

The finished product is subjected to further testing to ensure that it has met all the applicable specifications and requirements.

COSMOPLAST has an ISO 9001:2008 Quality Management System which ensures continuous improvement to its products, services and other operational processes. As a manufacturer, COSMOPLAST has always stayed focused on finding new ways to design, produce, sell and deliver quality products economically.

Many of the company's products are approved by third party certification agencies such as BSI Kitemark, DVGW, FM, SKZ, SASO and WRAS approvals.

Personnel are a fundamental component within a successful Quality Management System and to ensure that standards are maintained, COSMOPLAST is continually running training sessions for its employees while performing regular reviews and appraisals.

Corrosion Resistance

HDPE pipes and fittings have excellent resistance against electrolytic or galvanic corrosion or any known corrosive soil or water condition. HDPE is also characterized by highly abrasion resistance.

High Flow Capacity

COSMOPLAST HDPE pipes have a smooth internal surface which ensures less drag and a lower tendency for turbulence at highflow. Its superior flow characteristic eliminates scaling and pitting and guarantees consistent flow through out the pipe's entire service life.

Low Installation Cost

COSMOPLAST HDPE pipes are lightweight, flexible, and produced in long lengths, which results in easier and convenient installation. The flexible nature of the polyethylene pipes reduces the use of bends.

Alternate installation methods such as Directional Drilling, Pipe Bursting, Slip lining, Plough and Plant, Submerged or Floating Pipe, etc. can save considerable time and money in most potable water applications.

Easy Maintenance

COSMOPLAST polyethylene pipes are maintenance free with a design life of over 50 years under normal operating conditions. PE pipes offer long-term resistance to a variety of service conditions such as: abrasion, temperature and soil movements, bending, weathering, internal pressure, direct burial, point loading and squeeze-off.

Easy Handling

Polyethylene is about one-eighth the density of steel and thus does not require the use of heavy lifting equipment for installation.

High Impact Strength

Polyethylene pipe is able to structurally withstand a higher impact than equivalent rigid pipes, especially during cold weather installations when other materials are more prone to cracks and impact failure.

Slow crack growth is the primary cause of most pipe failures and this is primarily investigated by third party damage during the installation process. The advanced polyethylene material used by COSMOPLAST in its production process provides a highly resistant base to prevent fatigue and slow crack growth.

WIDE RANGE OF APPLICATIONS AND SIZES:

COSMOPLAST polyethylene product range includes Low Density (LDPE), Medium Density (MDPE) and High Density (HDPE) polyethylene pipes for various applications.

Low density polyethylene (LDPE) pipes for Irrigation applications are manufactured in diameters starting from 15mm. COSMOPLAST also manufactures inline drip pipe, which uses high precision pressure compensation drippers inserted at regular intervals set according to customer requirements.
Medium Density Polyethylene (MDPE) pipes for pressure applications including potable water and gas applications are manufactured in sizes from 20mm up to 250mm.

HIGH QUALITY RAW MATERIAL

COSMOPLAST obtains its high quality PE raw materials from the major multinational supply companies who has expertise in developing and pushing back the frontiers of polymer material technology.Borouge is the main supplier of polyethylene material for Cosmoplast pipeline systems.

The wide variety of materials such as PE 100, PE 80, low density and linear low-density material grades that Cosmoplast uses has various MRS (Minimum Required Strength) values. For example, PE100 material has MRS value of up to 10 MPa,such rating represents the material science capability within the PE sector and Cosmoplast ensures that it brings to the customer the very best materials available in the market today. Both excellent weathering ability and resistance to Ultra-Violet (UV) light (sunlight) can be obtained by utilizing the correct material configurations.

POLYETHYLENE PIPES FOR GAS APPLICATIONS:

Material

COSMOPLAST Polyethylene Gas pipes are made of high and medium density polyethylene materials, which are now the established norms for gas service and mains distribution worldwide. These pipes are made in yellow colour, the universal colour code for fuel gas lines.

Standards

Cosmoplast Polyethylene gas pipes are manufactured according to ISO4437 Standard.

Quality Control and Certification

COSMOPLAST gas pipes undergo a rigorous quality regime throughout the entire production process to ensure their reliability and effectiveness for gas transportation.All pipes are manufactured under a Quality Management System, accredited to ISO 9001.

COSMOPLAST PE Gas Pipes are certified by BSI and are awarded the Kitemark quality certificate for PE pipes to ISO 4437 standard.

Gas Pipe Sizes

COSMOPLAST manufactures gas pipes in a range of sizes from 20mm to 630mm in diameter, with operating pressures of up to 7 Bar. All Cosmoplast gas pipes are according to ISO 4437 Standard.
The polyethylene material used for Gas pipelines is either a specialized PE 80 or PE 100 grades.

INSTALLATION OF GAS PIPES

Polyethylene Gas pipes and fittings are installed by Electro-Fusion and Butt Fusion technologies which guarantee high quality permanent and leak free joints.
The high strength, flexibility and lightweight properties of Polyethylene material make it the most ideal and cost effective choice for the installation by contractors and their clients. Availability of coils makes it easier to install and reduces the number of joints.

Flow Characteristics:

One unique characteristic of polyethylene pipe is its structural ability to minimize pressure loss within the system due to its extremely smooth bore, thus allowing smaller pipe diameters to be used within the Gas distribution networks.

COSMOPLAST POLYETHYLENE FITTINGS

Cosmoplast produces wide range of polyethylene butt fusion fittings of SDR 11 and SDR 17 in its facilities.

Cosmoplast also has a well established partnership with the world's leading fitting manufacturers like Fusion PLC of the UK , Akatherm of Netherlands , SABfuse & Plastitalia of Italy respectively to stock and sell their product range of Electro-Fusion and butt fusion fittings.

COSMOPLAST also fabricates polyethylene fittings to suit specific applications, thus providing a complete one off solution to all customer requirements.

PHYSICAL & MECHANICAL PROPERTIES OF HDPE MATERIAL

The following table shows the main physical, mechanical and chemical properties of polyethylene material:

Property	Test Method	Units	PE 80	PE 100
Density (Compound)	ISO 1183	Kg/m^3	956	959
Melt Flow Rate (190˚C/5kg)	ISO 1133	g/10 min	0.3	0.25
Tensile Stress at Yield (50mm/min)	ISO 527-2	MPa	22	25
Elongation at Break	ISO 527-2	%	> 600	> 600
Charpy Impact Strength, notched	ISO179/1eA	kj/m^2	14	16
Carbon Black Content	ASTM D 1603	%	2-2.5	2 -2.5
Vicat Softening Point	ASTM D 1525	˚C	118	122
Brittleness Temperature	ASTM D 746	˚C	< -70	< -70
ESCR (10% Igepal), F50	ASTM D 1693A	Hrs.	> 10.000	> 10.000
Thermal Conductivity	DIN 52612	W/m˚K	0.4	0.4
Linear Thermal Expansion	ASTM D 696	mm/mm/k	1.5x10^{-4}	1.5x10^{-4}

PIPE SDR* AND RATED PRESSURE RELATIONSHIP

Material	Design stress N/mm^2	NOMINAL PRESSURE (PN)					
		4	6	8	10	12.5	16
PE 100**	8.0	SDR 41	SDR 26	SDR 21	SDR 17	SDR 13.6	SDR 11
PE 80**	6.3	SDR 33	SDR 21	SDR 17	SDR 13.6	SDR 11	SDR 9
PE 63	5.0	SDR 26	SDR 17.6	SDR 13.6	SDR 11	SDR 9	SDR 7.4

*SDR (standard dimensional ratio)= OD/e where OD= outside diameter (mm) e= wall thickness (mm)
Example 110mm OD pipe of 10mm wall thickness SDR=110/10=11
**As per ISO 4427 : 2007

The above is for use in designing water distribution systems with a safety factor 1.25 as per ISO 4427 or DIN 8074 standards. For use with gas distribution systems please review ISO 4437 specification tables on following pages

PRESSURE REDUCTION CO-EFFICIENTS FOR PE 100 & PE 80 AS PER ISO 4427 - 2:2007 (E)

PE 100					
Temp (˚C)	20	25	30	35	40
Pressure Reduction Co-efficient	1	0.93	0.87	0.8	0.74
SDR	Pressure (bar)				
7.4	25	23.3	21.8	20.0	18.5
9	20	18.6	17.4	16.0	14.8
11	16	14.9	13.9	12.8	11.8
13.6	12.5	11.6	10.9	10.0	9.3
17	10	9.3	8.7	8.0	7.4
21	8	7.4	7.0	6.4	5.9
26	6	5.6	5.2	4.8	4.4
33	5	4.7	4.4	4.0	3.7
41	4	3.7	3.5	3.2	3.0

PE 80					
Temp (˚C)	20	25	30	35	40
Pressure Reduction Co-efficient	1	0.93	0.87	0.8	0.74
SDR	Pressure (bar)				
6	25	23.3	21.8	20.0	18.5
7.4	20	18.6	17.4	16.0	14.8
9	16	14.9	13.9	12.8	11.8
11	12.5	11.6	10.9	10.0	9.3
13.6	10	9.3	8.7	8.0	7.4
17	8	7.4	7.0	6.4	5.9
21	6	5.6	5.2	4.8	4.4
26	5	4.7	4.4	4.0	3.7
33	4	3.7	3.5	3.2	3.0
41	3.2	3.0	2.8	2.6	2.4

Parameter Selection

- Starting from known pipe size and pressure rating. • Find SDR of required pressure rating (table1) make material choice PE 100 or PE 80. • Cross tabulate SDR against pipe size to give wall thickness (Table 3).
- Review temperature reduction factors in relation to expected environmental conditions and pressure rating (Table 2).

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Details of PE Pipes According to ISO 4427 - 2 : 2007(E)

SDR	6	7.4	9	11	13.6	17	21	26	33	41
Pipe Series (S)	2.5	3.2	4	5	6.3	8	10	12.5	16	20
Nominal Pressure (P N)[a] (bar)										
PE 80	PN 25	PN 20	PN 16	PN 12.5	PN 10	PN 8	PN 6[c]	PN 5	PN 4	PN 3.2
PE 100	-	PN 25	PN 20	PN 16	PN 12.5	PN 10	PN 8	PN 6[c]	PN 5	PN 4
Nominal size / OD (mm)	Wall Thickness [e]min (mm)									
20	3.4	3.0	2.3[b]	2.0	-	-	-	-	-	-
25	4.2	3.5	3.0	2.3[b]	2.0[b]	-	-	-	-	-
32	5.4	4.4	3.6	3.0	2.4	2.0	-	-	-	-
40	6.7	5.5	4.5	3.7	3.0	2.4	2.0	-	-	-
50	8.3	6.9	5.6	4.6	3.7	3.0	2.4	2.0	-	-
63	10.5	8.6	7.1	5.8	4.7	3.8	3.0	2.5	-	-
75	12.5	10.3	8.4	6.8	5.6	4.5	3.6	2.9	-	-
90	15.0	12.3	10.1	8.2	6.7	5.4	4.3	3.5	-	-
110	18.3	15.1	12.3	10.0	8.1	6.6	5.3	4.2	-	-
125	20.8	17.1	14.0	11.4	9.2	7.4	6.0	4.8	-	-
140	23.3	19.2	15.7	12.7	10.3	8.3	6.7	5.4	-	-
160	26.6	21.9	17.9	14.6	11.8	9.5	7.7	6.2	-	-
180	29.9	24.6	20.1	16.4	13.3	10.7	8.6	6.9	-	-
200	33.2	27.4	22.4	18.2	14.7	11.9	9.6	7.7	-	-
225	37.4	30.8	25.2	20.5	16.6	13.4	10.8	8.6	-	-
250	41.5	34.2	27.9	22.7	18.4	14.8	11.9	9.6	-	-
280	46.5	38.3	31.3	25.4	20.6	16.6	13.4	10.7	-	-
315	52.3	43.1	35.2	28.6	23.2	18.7	15.0	12.1	9.7	7.7
355	59.0	48.5	39.7	32.2	26.1	21.1	16.9	13.6	10.9	8.7
400	-	54.7	44.7	36.4	29.4	23.7	19.1	15.3	12.3	9.8
450	-	61.5	50.3	40.9	33.1	26.7	21.5	17.2	13.8	11.0
500	-	-	55.8	45.4	36.8	29.7	23.9	19.1	15.3	12.3
560	-	-	62.5	50.8	41.2	33.2	26.7	21.4	17.2	13.7
630	-	-	70.3	57.2	46.3	37.4	30.0	24.1	19.3	15.4
710	-	-	79.3	64.5	52.2	42.1	33.9	27.2	21.8	17.4
800	-	-	89.3	72.6	58.8	47.4	38.1	30.6	24.5	19.6
900	-	-	-	81.7	66.2	53.3	42.9	34.4	27.6	22.0
1000	-	-	-	90.2	72.5	59.3	47.7	38.2	30.6	24.5
1200	-	-	-	-	88.2	70.6	57.2	45.9	36.7	29.4
1400	-	-	-	-	102.9	82.4	66.7	53.5	42.9	34.3
1600	-	-	-	-	117.6	94.1	76.2	61.2	49.0	39.2
1800	-	-	-	-	-	105.9	85.17	69.1	54.5	43.8
2000	-	-	-	-	-	117.6	95.2	76.9	60.6	48.8

Note : Pipe sizes above 1200mm can be manufactured as per customer requirements

[a] = PN values are based on C = 1.25

[b] = The calculated value of [e]min according to ISO 4065 is rounded up to the nearest value of either 2.0, 2.3 or 3.0. This is to satisfy certain national requirements. For practical reasons, a wall thickness of 3.0mm is recommended for electrofusion joining and lining applications

[c] = Actual calculated values are 6.4 bar for PE 100 and 6.3 bar for PE 80

1 bar = 0.1 MPa; 1MPa = 10^5a; 1MPa = 1 N/mm^2

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Details of PE Pipes According to DIN 8074/75

Nominal OD (mm)	Pipe Series													
	25	20	16	12.5	10.5	10	8.3	8	6.3	5	4	3.2	2.5	2
	Standard Dimension Ratio (SDR)													
	51	41	33	26	22	21	17.6	17	13.6	11	9	7.4	6	5
	Wall Thickness (mm)													
10	-	-	-	-	-	-	-	-	-	-	-	-	1.8	2.0
12	-	-	-	-	-	-	-	-	-	-	-	1.8	2.0	2.4
16	-	-	-	-	-	-	-	-	-	-	1.8	2.2	2.7	3.3
20	-	-	-	-	-	-	-	-	1.8	1.9	2.3	2.8	3.4	4.1
25	-	-	-	-	-	-	-	1.8	1.9	2.3	2.8	3.5	4.2	5.1
32	-	-	-	-	-	-	1.8	1.9	2.4	2.9	3.6	4.4	5.4	6.5
40	-	-	-	1.8	1.9	1.9	2.3	2.4	3.0	3.7	4.5	5.5	6.7	8.1
50	-	-	1.8	2.0	2.3	2.4	2.9	3.0	3.7	4.6	5.6	6.9	8.3	10.1
63	-	1.8	2.0	2.5	2.9	3.0	3.6	3.8	4.7	5.8	7.1	8.6	10.5	12.7
75	1.8	1.9	2.3	2.9	3.5	3.6	4.3	4.5	5.6	6.8	8.4	10.3	12.5	15.1
90	1.8	2.2	2.8	3.5	4.1	4.3	5.1	5.4	6.7	8.2	10.1	12.3	15.0	18.1
110	2.2	2.7	3.4	4.2	5.0	5.3	6.3	6.6	8.1	10.0	12.3	15.1	18.3	22.1
125	2.5	3.1	3.9	4.8	5.7	6.0	7.1	7.4	9.2	11.4	14.0	17.1	20.8	25.1
140	2.8	3.5	4.3	5.4	6.4	6.7	8.0	8.3	10.3	12.7	15.7	19.2	23.3	28.1
160	3.2	4.0	4.9	6.2	7.3	7.7	9.1	9.5	11.8	14.6	17.9	21.9	26.6	32.1
180	3.6	4.4	5.5	6.9	8.2	8.6	10.2	10.7	13.3	16.4	20.1	24.6	29.9	36.1
200	3.9	4.9	6.2	7.7	9.1	9.6	11.4	11.9	14.7	18.2	22.4	27.4	33.2	40.1
225	4.4	5.5	6.9	8.6	10.3	10.8	12.8	13.4	16.6	20.5	25.2	30.8	37.4	45.1
250	4.9	6.2	7.7	9.6	11.4	11.9	14.2	14.8	18.4	22.7	27.9	34.2	41.6	50.1
280	5.5	6.9	8.6	10.7	12.8	13.4	15.9	16.6	20.6	25.4	31.3	38.3	46.5	56.2
315	6.2	7.7	9.7	12.1	14.4	15.0	17.9	18.7	23.2	28.6	35.2	43.1	52.3	63.2
355	7.0	8.7	10.9	13.6	16.2	16.9	20.1	21.1	26.1	32.2	39.7	48.5	59.0	-
400	7.9	9.8	12.3	15.3	18.2	19.1	22.7	23.7	29.4	36.3	44.7	54.7	66.5	-
450	8.8	11.0	13.8	17.2	20.5	21.5	25.5	26.7	33.1	40.9	50.3	61.5	-	-
500	9.8	12.3	15.3	19.1	22.8	23.9	28.4	29.7	36.8	45.4	55.8	68.3	-	-
560	11.0	13.7	17.2	21.4	25.5	26.7	31.7	33.2	41.2	50.8	62.5	-	-	-
630	12.3	15.4	19.3	24.1	28.7	30.0	35.7	37.4	46.3	57.2	-	-	-	-
710	13.9	17.4	21.8	27.2	32.3	33.9	40.2	42.1	52.2	64.5	-	-	-	-
800	15.5	19.6	24.5	30.6	36.4	38.1	45.3	47.4	58.8	-	-	-	-	-
900	17.6	22.0	27.6	34.4	41.1	42.9	51.0	53.3	66.1	-	-	-	-	-
1000	19.6	24.5	30.6	38.2	45.5	47.7	56.7	59.3	-	-	-	-	-	-
1200	23.5	29.4	36.7	45.9	54.6	57.2	68.0	-	-	-	-	-	-	-
1400	27.4	34.4	42.9	53.5	63.7	66.7	-	-	-	-	-	-	-	-
1600	31.3	39.2	49.0	61.2	-	-	-	-	-	-	-	-	-	-

Details of PE Pipes According to DIN 8074/75

Allowable Working Pressure for Pipes Made from PE 80, Conveying Water with a Safety Factor of 1.25

Temperature in°c	Years of Service	Pipe Series													
		25	20	16	12.5	10.5	10	8.3	8	6.3	5	4	3.2	2.5	2
		Standard Dimension Ratio (SDR)													
		51	41	33	26	22	21	17.6	17	13.6	11	9	7.4	6	5
		Allowable Working Pressure													
10	5	3.1	4.0	5.0	6.3	7.5	7.9	9.4	10.1	12.6	15.8	20.2	25.3	31.6	40.5
	10	3.1	3.9	4.9	6.2	7.4	7.8	9.3	9.9	12.5	15.5	19.8	24.8	31.0	39.7
	25	3.0	3.8	4.8	6.0	7.2	7.6	9.0	9.7	12.1	15.1	19.4	24.2	30.3	38.8
	50	2.9	3.8	4.7	5.9	7.1	7.5	8.9	9.5	11.9	14.8	19.0	23.8	29.7	38.0
	100	2.9	3.7	4.6	5.8	7.0	7.3	8.7	9.3	11.6	14.6	18.7	23.3	29.2	37.4
20	5	2.6	3.4	4.2	5.3	6.3	6.6	7.9	8.5	10.6	13.2	17.0	21.2	26.5	34.0
	10	2.6	3.3	4.1	5.2	6.2	6.5	7.8	8.3	10.4	13.0	16.7	20.8	26.0	33.4
	25	2.5	3.2	4.0	5.0	6.1	6.4	7.6	8.1	10.1	12.7	16.2	20.3	25.4	32.5
	50	2.5	3.2	4.0	5.0	6.0	6.3	7.5	8.0	10.0	12.5	16.0	20.0	25.0	32.0
	100	2.4	3.1	3.9	4.9	5.8	6.1	7.3	7.8	9.8	12.2	15.7	19.6	24.5	31.4
30	5	2.2	2.8	3.6	4.5	5.4	5.6	6.7	7.2	9.0	11.2	14.4	18.8	22.5	28.9
	10	2.2	2.8	3.5	4.4	5.3	5.5	6.6	7.0	8.8	11.0	14.1	17.7	22.1	28.3
	25	2.1	2.7	3.4	4.3	5.1	5.4	6.4	6.9	8.6	10.8	13.8	17.3	21.6	27.6
	50	2.1	2.7	3.3	4.2	5.0	5.3	6.3	6.7	8.4	10.6	13.5	16.9	21.2	27.1
40	5	1.9	2.4	3.1	3.8	4.6	4.8	5.8	6.2	7.7	9.6	12.4	15.5	19.3	24.8
	10	1.9	2.4	3.0	3.8	4.5	4.7	5.7	6.0	7.6	9.5	12.1	15.2	19.0	24.3
	25	1.8	2.3	2.9	3.7	4.4	4.6	5.5	5.9	7.4	9.2	11.8	14.8	18.5	23.7
	50	1.8	2.3	2.9	3.6	4.3	4.5	5.4	5.8	7.2	9.1	11.6	14.5	18.2	23.3
50	5	1.6	2.1	2.6	3.3	4.0	4.2	5.0	5.3	6.7	8.4	10.7	13.4	16.8	21.5
	10	1.6	2.0	2.5	3.2	3.8	4.0	4.8	5.1	6.4	8.1	10.3	12.9	16.2	20.7
	15	1.4	1.8	2.2	2.8	3.4	3.6	4.3	4.5	5.7	7.1	9.1	11.4	14.3	18.3
60	5	1.1	1.4	1.8	2.2	2.7	2.8	3.3	3.6	4.5	5.6	7.2	9.0	11.3	14.4
70	2	0.8	1.1	1.3	1.7	2.0	2.2	2.6	2.7	3.4	4.3	5.5	6.9	8.7	11.1

Details of PE Pipes According to DIN 8074/75

Allowable Working Pressure for Pipes Made from PE 100, Conveying Water with a Safety Factor of 1.25

Temperature in°c	Years of Service	Pipe Series													
		25	20	16	12.5	10.5	10	8.3	8	6.3	5	4	3.2	2.5	2
		Standard Dimension Ratio (SDR)													
		51	41	33	26	22	21	17.6	17	13.6	11	9	7.4	6	5
		Allowable Working Pressure													
10	5	4.0	5.0	6.3	7.9	9.4	10.1	12.1	12.6	15.7	20.2	25.2	31.5	40.4	50.5
	10	3.9	4.9	6.2	7.8	9.3	9.9	11.9	12.4	15.5	19.8	24.8	31.0	39.7	49.6
	25	3.8	4.8	6.0	7.6	9.0	9.6	11.6	12.1	15.1	19.3	24.2	30.2	38.7	48.4
	50	3.8	4.7	5.9	7.5	8.9	9.5	11.4	11.9	14.8	19.0	23.8	29.7	38.0	47.6
	100	3.7	4.6	5.8	7.3	8.7	9.3	11.2	11.6	14.6	18.7	23.3	29.2	37.4	46.7
20	5	3.3	4.2	5.3	6.6	7.9	8.4	10.2	10.6	13.2	16.9	21.2	26.5	33.9	42.4
	10	3.3	4.1	5.2	6.5	7.8	8.3	10.0	10.4	13.0	16.6	20.8	26.0	33.3	41.6
	25	3.2	4.0	5.0	6.4	7.6	8.1	9.8	10.1	12.7	16.2	20.3	25.4	32.5	40.7
	50	3.2	4.0	5.0	6.3	7.5	8.0	9.6	10.0	12.5	16.0	20.0	25.0	32.0	40.0
	100	3.1	3.9	4.9	6.1	7.3	7.8	9.4	9.8	12.2	15.7	19.6	24.5	31.4	39.2
30	5	2.8	3.6	4.5	5.6	6.7	7.2	8.6	9.0	11.2	14.4	18.0	22.5	28.8	36.0
	10	2.8	3.5	4.4	5.5	6.6	7.0	8.5	8.8	11.0	14.1	17.7	22.1	28.3	35.4
	25	2.7	3.4	4.3	5.4	6.4	6.9	8.3	8.6	10.8	13.8	17.2	21.6	27.6	34.5
	50	2.7	3.3	4.2	5.3	6.3	6.7	8.1	8.4	10.6	13.5	16.9	21.2	27.1	33.9
40	5	2.4	3.0	3.8	4.8	5.8	6.1	7.4	7.7	9.6	12.3	15.4	19.3	24.7	30.9
	10	2.4	3.0	3.8	4.7	5.7	6.0	7.3	7.6	9.5	12.1	15.2	19.0	24.3	30.4
	25	2.3	2.9	3.7	4.6	5.5	5.9	7.1	7.4	9.2	11.8	14.8	18.5	23.7	29.7
	50	2.3	2.9	3.6	4.5	5.4	5.8	7.0	7.2	9.1	11.6	14.5	18.2	23.3	29.1
50	5	2.1	2.6	3.3	4.2	5.0	5.3	6.4	6.7	8.3	10.7	13.4	16.7	21.4	26.8
	10	2.0	2.6	3.2	4.0	4.8	5.2	6.2	6.5	8.1	10.4	13.0	16.2	20.3	26.0
	15	1.9	2.3	2.9	3.7	4.4	4.7	5.7	5.9	7.4	9.5	11.8	14.8	19.0	23.7
60	5	1.5	1.9	2.4	3.0	3.6	3.8	4.6	4.8	6.0	7.7	9.7	12.1	15.5	19.4
70	2	1.2	1.5	1.9	2.4	2.9	3.1	3.7	3.9	4.9	6.2	7.8	9.8	12.5	15.7

Details of PE Pipes According to BS EN 12201:2:2003

	Pipe Series											
	SDR 6 S 2.5		SDR 7.4 S 3.2		SDR 9 S 4		SDR 11 S 5		SDR 13.6 S 6.3		SDR 17 S 8	
	Nominal Pressure, PN[a] in bar											
PE 40	-		PN 10		PN 8		-		PN 5		PN 4	
PE 63	-		-				PN 10		PN 8		-	
PE 80	PN 25		PN 20		PN 16		PN 12.5		PN 10		PN 8	
PE 100	-		PN 25		PN 20		PN 16		PN 12.5		PN 10	
Nominal	Wall thickness[b]											
Size	emin	emax	emin	emax	emin	emax	emin	emax	emin	emax	emin	emax
16	3.0[c]	3.4	2.3[c]	2.7	2.0[c]	2.3	-	-	-	-	-	-
20	3.4	3.9	3.0[c]	3.4	2.3	2.7	2.0[c]	2.3	-	-	-	-
25	4.2	4.8	2.5	4.0	3.0[c]	3.4	2.3	2.7	2.0[c]	2.3	-	-
32	5.4	6.1	4.4	5.0	3.6	4.1	3.0[c]	3.4	2.4	2.8	2.0[c]	2.3
40	6.7	7.5	5.5	6.2	4.5	5.1	3.7	4.2	3.0	3.5	2.4	2.8
50	8.3	9.3	6.9	7.7	5.6	6.3	4.6	5.2	3.7	4.2	3.0	3.4
63	10.5	11.7	8.6	9.6	7.1	8.0	5.8	6.5	4.7	5.3	3.8	4.3
75	12.5	13.9	10.3	11.5	8.4	9.4	6.8	7.6	5.6	6.3	4.5	5.1
90	15.0	16.7	12.3	13.7	10.1	11.3	8.2	9.2	6.7	7.5	5.4	6.1
110	18.3	20.3	15.1	16.8	12.3	13.7	10.0	11.1	8.1	9.1	6.6	7.4
125	20.8	23.0	17.1	19.0	14.0	15.6	11.4	12.7	9.2	10.3	7.4	8.3
140	23.3	25.8	19.2	21.3	15.7	17.4	12.7	14.1	10.3	11.5	8.3	9.3
160	26.6	29.4	21.9	242	17.9	19.8	14.6	16.2	11.8	13.1	9.5	10.6
180	29.9	33.0	24.6	27.2	20.1	22.3	16.4	18.2	13.3	14.8	10.7	11.9
200	33.2	36.7	27.4	30.3	22.4	24.8	18.2	20.2	14.7	16.3	11.9	13.2
225	37.4	41.3	30.8	34.0	25.2	27.9	20.5	22.7	16.6	18.4	13.4	14.9
250	41.5	45.8	34.2	37.8	27.9	30.8	22.7	25.1	18.4	20.4	14.8	16.4
280	46.5	51.3	38.3	42.3	31.3	34.6	25.4	28.1	20.6	22.8	16.6	18.4
315	52.3	57.7	43.1	47.6	35.2	38.9	28.6	31.6	23.2	25.7	18.7	20.7
355	59.0	65.0	48.5	53.5	39.7	43.8	32.2	35.6	26.1	28.9	21.1	23.4
400	-	-	54.7	60.3	44.7	49.3	36.3	40.1	29.4	32.5	23.7	26.2
450	-	-	61.5	67.8	50.3	55.5	40.9	45.1	33.1	36.6	26.7	29.7
500	-	-	-	-	55.8	61.5	45.4	50.1	36.8	40.6	29.7	32.8
560	-	-	-	-	-	-	50.8	56.0	41.2	45.5	33.2	36.7
630	-	-	-	-	-	-	57.2	63.1	46.3	51.1	37.4	41.3
710	-	-	-	-	-	-	-	-	52.2	57.6	42.1	46.5
800	-	-	-	-	-	-	-	-	58.8	64.8	47.4	52.3
900	-	-	-	-	-	-	-	-	-	-	53.3	58.8
1000	-	-	-	-	-	-	-	-	-	-	59.3	65.4
1200	-	-	-	-	-	-	-	-	-	-	-	-
1400	-	-	-	-	-	-	-	-	-	-	-	-
1600	-	-	-	-	-	-	-	-	-	-	-	-

a. PN Values are based on C=1.25

b. Tolerances in accordance with grade V of ISO 11922-1 : 1997 (1)

c. The calculated value of e min (ISO 4065 (2)) is rounded upto the nearest value of either 2.0, 2.3 or 3.0. This is to satisfy certain national requirements.

Details of PE Pipes According to BS EN 12201 : 2 : 2003

	Pipe Series									
	SDR 17.6 S 8.3		SDR21 S 10		SDR 26 S 12.5		SDR 33 S 16		SDR 41 S 20	
	Nominal Pressure, PN[a] in bar									
PE 40	-		PN 3.2		PN 2.5		-		-	
PE 63	PN 6		PN 5		PN 4		PN 3.2		PN 2.5	
PE 80	-		PN 6[c]		PN 5		PN 4		PN 3.5	
PE 100	-		PN 8		PN 6[c]		PN 5		PN 4	
Nominal	Wall thickness[b]									
Size	emin	emax	emax	emax	emax	emax	emax	emax	emax	emax
16	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-
32	2.0[d]	2.3	-	-	-	-	-	-	-	-
40	2.3	2.7	2.0[d]	2.3	-	-	-	-	-	-
50	2.9	3.3	2.4	2.6	2.0	2.1	-	-	-	-
63	3.6	4.1	3.0	3.4	2.5	2.9	-	-	-	-
75	4.3	4.9	3.6	4.1	2.9	3.3	-	-	-	-
90	5.1	5.8	4.3	4.9	3.5	4.0	-	-	-	-
110	6.3	7.1	5.3	6.0	4.2	4.8	-	-	-	-
125	7.1	8.0	6.0	6.7	4.8	5.4	-	-	-	-
140	8.0	9.0	6.7	7.5	5.4	6.1	-	-	-	-
160	9.1	10.2	7.7	8.5	6.2	7.0	-	-	-	-
180	10.2	11.4	8.6	9.6	6.9	7.7	-	-	-	-
200	11.4	12.7	9.6	10.7	7.7	8.6	-	-	-	-
225	12.8	14.2	10.8	12.0	8.6	9.6	-	-	-	-
250	14.2	15.8	11.9	13.2	9.6	10.7	-	-	-	-
280	15.9	17.6	13.4	13.4	10.7	11.9	-	-	-	-
315	17.9	19.8	15.0	16.6	12.1	13.5	9.7	10.8	7.7	8.6
355	20.1	22.3	16.9	18.7	13.6	16.1	10.9	12.1	8.7	9.7
400	22.7	25.1	19.1	21.2	15.3	17.0	12.3	13.7	9.8	10.9
450	25.5	28.2	21.5	23.8	17.2	19.1	13.8	15.3	11.0	12.2
500	28.3	31.3	23.9	26.4	19.1	21.2	15.3	17.0	12.3	13.7
560	31.7	35.0	26.7	29.5	21.4	23.7	17.2	19.1	13.7	15.2
630	35.7	39.4	30.0	33.1	24.1	26.7	19.3	21.4	15.4	17.1
710	40.2	44.4	33.9	37.4	27.2	30.1	21.8	24.1	17.4	19.3
800	45.3	50.0	38.1	42.1	30.6	33.8	24.5	27.1	19.6	21.7
900	51.0	56.2	42.9	47.3	34.4	38.3	27.6	30.5	22.0	24.3
1000	56.6	62.4	47.7	52.6	38.2	42.2	30.6	33.5	24.5	27.1
1200	-	-	57.2	63.1	45.9	50.6	36.7	40.5	29.4	32.5
1400	-	-	-	-	53.5	59.0	42.9	47.3	34.3	37.9
1600	-	-	-	-	61.2	67.5	49.0	54.0	39.2	43.3

a. PN Values are based on C=1.25
b. Tolerances in accordance with grade V of ISO 11922-1 : 1997 (1)
c. Actual calculated values are 6.4 bar for FE 100 and 6.3 bar for FE 80
d. The calculated value of e min ((1S0 4065 (2)) is rounded upto the nearest value of either 2.0, 2.3 or 3.0. This is to satisfy certain national requirements.

Details of PE Gas Pipes According to ISO 4437 : 2007 (E)

Nominal outside diameter (mm)	Minimum wall thickness (mm)						
	SDR 9	SDR 11[a]	SDR 13.6	SDR 17[a]	SDR 17.6	SDR 21	SDR 26
16	3.0	2.3[c]	-	-	-	-	-
20	3.0	2.3[c]	-	-	-	-	-
25	3.0	2.3[c]	2.0[b]	-	-	-	-
32	3.6	3.0	2.4[c]	2.0[b]	2.0[b]	-	-
40	4.5	3.7	3.0	2.4[c]	2.3[c]	2.0[b]	-
50	5.6	4.6	3.7	3.0	2.9[c]	2.4[c]	2.0[b]
63	7.1	5.8	4.7	3.8	3.6	3.0	2.5[c]
75	8.4	6.8	5.6	4.5	4.3	3.6	2.9[c]
90	10.1	8.2	6.7	5.4	5.2	4.3	3.5
110	12.3	10.0	8.1	6.6	6.3	5.3	4.2
125	14.0	11.4	9.2	7.4	7.1	6.0	4.8
140	15.7	12.7	10.3	8.3	8.0	6.7	5.4
160	17.9	14.6	11.8	9.5	9.1	7.7	6.2
180	20.1	16.4	13.3	10.7	10.3	8.6	6.9
200	22.4	18.2	14.7	11.9	11.4	9.6	7.7
225	25.2	20.5	16.6	13.4	12.8	10.8	8.6
250	27.9	22.7	18.4	14.8	14.2	11.9	9.6
280	31.3	25.4	20.6	16.6	15.9	13.4	10.7
315	35.2	28.6	23.2	18.7	17.9	15.0	12.1
355	39.7	32.2	26.1	21.1	20.2	16.9	13.6
400	44.7	36.4	29.4	23.7	22.8	19.1	15.3
450	50.3	40.9	33.1	26.7	25.6	21.5	17.2
500	55.8	45.5	36.8	29.7	28.4	23.9	19.1
560	-	50.9	41.2	33.2	31.9	26.7	21.4
630	-	57.3	46.3	37.4	35.8	30.0	24.1

Note: Pipe sizes above 630 mm can be manufactured as per customer requirements.

[a] = Preferred series.
[b] = For practical reasons electrofusion and butt fusion of pipes 2.0 mm is not recommended.
[c] = Minimum wall thickness values greater than limits of 2.3mm, 2.4mm and 2.9mm may be imposed for practical reasons in accordance with national requirements. See manufacturer's technical files or national specifications for advice.

GAS PIPE COIL SPECIFICATIONS

Pipe OD (mm)	Pipe Length (mtr)	Coil OD (mtr)	Coil ID (mtr)	Coil Width (mtr)
160	100	4.16	3.21	0.65
125	100	3.58	2.73	0.63
110	100	3.00	2.20	0.52
90	100	2.46	1.80	0.41
63	100	1.85	1.3	0.39
32	150	1.04	0.72	0.39
25	200	1.04	0.72	0.39

ISO 4427/4437 WRAS Water Regulations Advisory Scheme FM APPROVED

ISO 9001 FM 75767

DESIGN CRITERIA

PE material is identified by their minimum required strength (MRS) which is evaluated by conducting regression analysis test. The MRS value @ 20°C for PE 100 and PE 80 material is 10 and 8 Mpa respectively.

Pipe design stress, σ_S, which is used to determine the continuous pressure rating of a pipe is calculated by dividing the MRS value by overall service (design) coefficient C.

ie...$\sigma_S = MRS/C$

In case of gas, value of C depends on appropriate design codes, national regulations, type of gas etc. However the minimum values of C for water and gas applications as per different standards are as follows

For water applications (minimum) ISO 4427 C = 1.25

For gas applications (minimum) ISO 4437 C = 2.0

Design stress @ 20°C as per value C

For PE 100 water piping system σ_S = 10/1.25 = 8 Mpa

For PE 80 water piping system σ_S = 8/1.25 = 6.3Mpa

For PE 100 Gas piping system σ_S = 10/2 = 5 Mpa

For PE 80 Gas piping system σ_S = 8/2 = 4 Mpa

Continuous pipe internal pressure rating in bars @ 20°C

Application	Safety Factor	Material	SDR 9	SDR 11	SDR 17
Water	1.25	PE 100	20	16	10
		PE 80	16	12.5	8
Gas	2	PE 100	12.5	10	6
		PE 80	10	8	5

DESIGN LIFE OF POLYETHYLENE PIPES:

The burst pressure of PE Pipes is time dependent and therefore it is necessary to define the strength of the material at a reference lifetime.

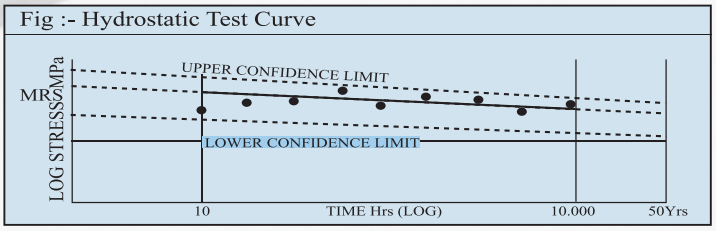
The time normally chosen for this reference value is 50 years, as the various safety factor that are incorporated into the design mean that the actual lifetime will be many times greater. In order to generate the burst strength of the material at 50 years, a number of pipe samples are pressure tested to failure at lifetimes between 10 and 10,000 hours.

The results of these tests are graphically and numerically analyzed to obtain the minimum required strength (MRS) at 50 years. A graphical representation of this process is shown in the figure below. Within the ISO standards it is recommended that the MRS value is based on the 97.5% lower confidence limit obtained by regression analysis.
Thus the minimum required strength (MRS) for the different polymers are listed below:

Type	MRS (Mpa)	Design Stress	
PE 63	6.3	MRS* 1.25	5.0
PE 80	8.0		6.3
PE 100	10.0		8.0

*1.25 ~ Service co-efficient for water

Fig :- Hydrostatic Test Curve



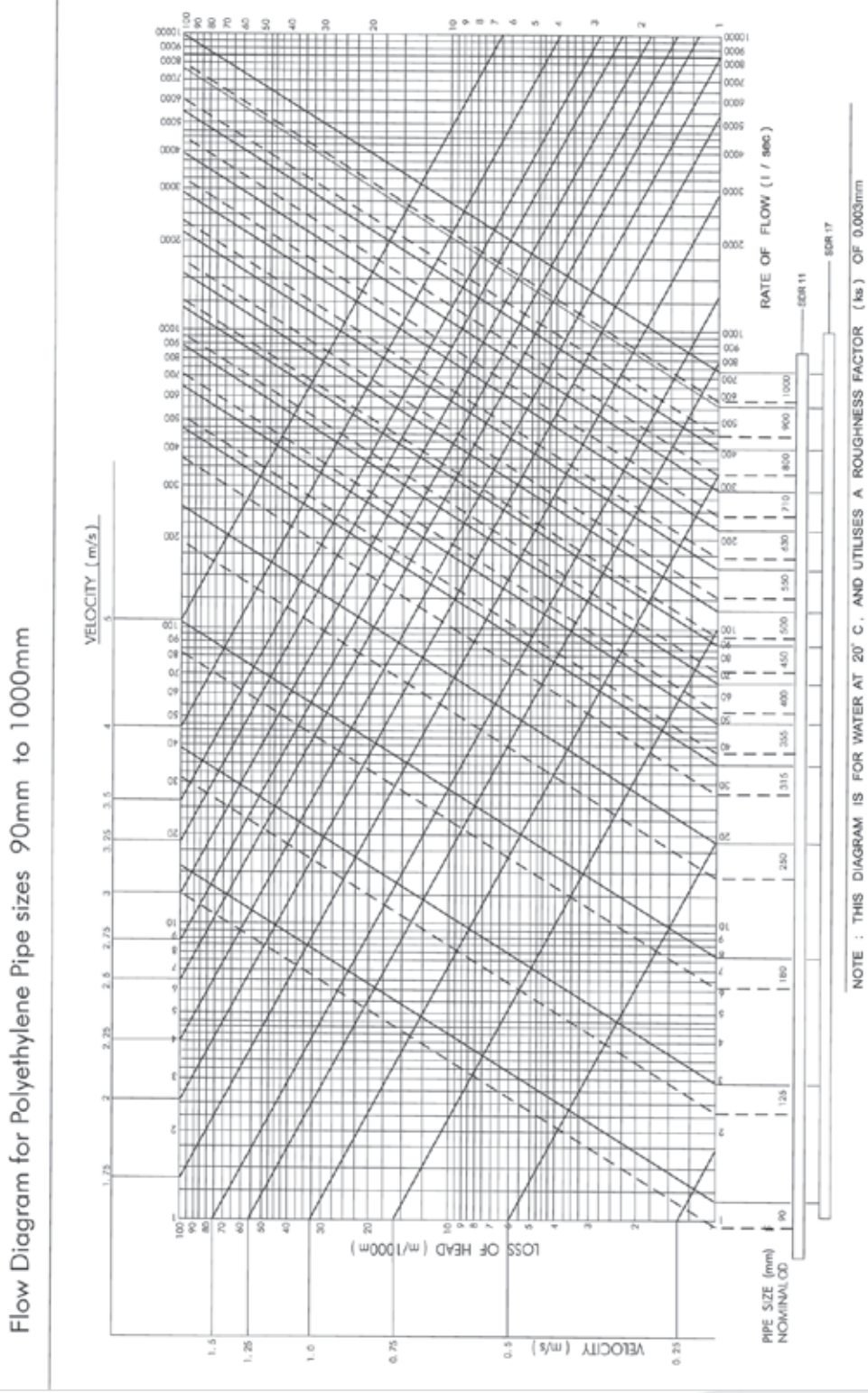
WATER QUALITY

The quality of water depends firstly on its source, and secondly on the treatment it undergoes before it enters the distribution systems. However, the pipeline through which it passes can seriously impair the quality of the water delivered to the consumer. An encrusted, corroded or damage pipe will disrupt water flow as well as produce unacceptable sediment and encrustation, which harbour and propagate bacterial growth. Cement Mortar and Epoxy Resin Lining's in a sound pipe can give solutions in the short term, but these solutions are very dependent on quality of installation workmanship.

Moreover, the heavy metals contained in some pipe materials will in time leak into the network becoming a potential health hazard. Similarly, when tuberculation occurs; odors, unpleasant taste and discoloration will affect water quality. These problems, which are familiar to water engineers, can be overcome by specifying a PE pipeline system, whether for new lay or rehabilitation. PE does not corrode or become encrusted.

Additionally, its smooth bore will encourage highly effective flow and discourage sediment build up. Where pipelines are renewed and rehabilitated using PE the cause of odor, taste and turbidity are removed. A PE pipe will not improve water quality, but it will ensure that the water received by the customer is in the same condition as when it entered the PE pipe network. Cosmoplast PE pipes are certified by WRAS (Water Regulations Advisory Scheme) according to BS 6920 standard.

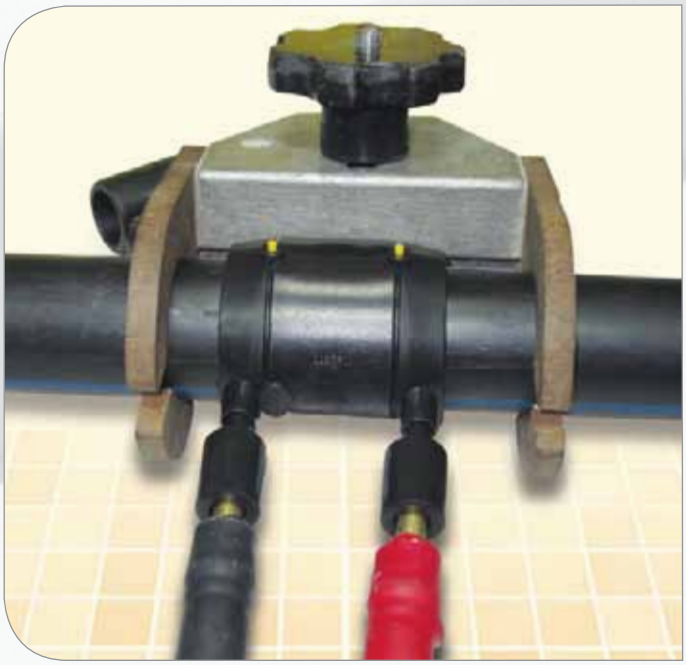
Flow diagram for PE pipe sizes 90mm – 1000mm



JOINTING TECHNIQUES

Cosmoplast polyethylene pipes and fittings can be installed using the state of art effortless techniques utilizing the Electro-Fusion and Butt Fusion technologies. Polyethylene pipes can also be joined by various other methods such as socket fusion, saddle fusion and mechanical connections.

Butt Fusion techniques creates a permanent heat-fused bond, thus creating a leak-free system without the need of secondary fittings or bonding material. The fusion bond area created is not only homogenous with the material around it but also as strong as the original adjoining pipe structure.
Electro fusion provides a similar option to a fusion bond and is generally used for small diameter pipes, 160mm and below.



Electro Fusion Technique

Butt Fusion Technique

ADVANTAGES OF BUTT FUSION AND ELECTRO-FUSION TECHNIQUES

Butt Fusion and Electro-Fusion techniques eliminate the potential for leakage points which could be incurred by spigot and socket type pipe connections.

The Life Cycle Cost of polyethylene pipe differs from other pipe materials due to the zero leakage rate of a properly fused joint.

Polyethylene pipe fused joints are self-restraining therefore eliminating costly thrust restraints or thrust blocks.

Polyethylene pipes' fused joints eliminate infiltration and exfiltration problems, which can be experienced with alternate pipe joint systems.

JOINTING PROCEDURES

BUTT FUSION PROCESS

The Following Equipments and tools are required for the butt fusion process:

- Automatic Butt Fusion Machine suitable for the pipe size.
- Power source compatible with the machine power.
- Bead gauge and Bead Remover.
- Pipe Cutter.
- Pipe Rollers.

Preparations before starting the Butt Fusion process

- The Butt fusion machine should be placed on a flat, clean, and dry board in a suitable shelter for protection from contamination, chilled wind and direct sunlight.
- Make sure that all machine parts [Control Box, Heater, Chassis, Trimmer] are clean and free from dust, humidity or any other contaminations.
- Make sure that the machine has been serviced & calibrated regularly.
- Check the Input power source and make sure that it is compatible with the power requirements of the machine.

Jointing Procedure

Note: The installer should follow the manufacturer's instructions listed in the catalogue of the used welding machine.

1 Connect the machine units together as per the manufacturer manual and connect to the suitable power supply and switch it ON.

2 Clean the pipe and fitting ends properly with a dry cloth to remove any grease or dust that may affect the quality of the joint.

3 Prepare the machine for jointing by entering to the setup mode (if fully automatic welding machine is used, then enter the required data like; Operator name, Project name, Location, joint ..etc as required).

4 Insert the trimming tool in the chassis and then fix the pipe ends (using the clamps) close to the trimmer with the correct alignment (2 or 3 pipe rollers must be used for free movement and to reduce the dynamic drag).

5 Start the trimming process; it will start cutting both pipe ends (or the pipe and fitting) equally, stop the trimming process when the waste become a continuous roll or strip.

6 Remove the Trimmer from the chassis. The cutting waste must be removed carefully from the chassis. Avoid touching the trimmed face on the pipe or fitting to avoid contaminating the trimmed area.

7 Start the check cycle; it will bring the pipe ends together and apply the jointing pressure with drag pressure. Ensure that there is no visible gap and the pipe alignment is correct. In case of mismatch between the two pipe ends, the pipes shall be realigned and re trimmed.

8 Insert heater unit in the chassis and wait until it is heated to the required temperature, then insert the heater plate between the pipe ends..

9 Start the joint cycle; it will bring the pipe ends together and apply the bead up pressure which will form the initial bead.

10 When the initial bead is formed, the pressure will be reduced for appropriate soak time.

11 Once the soak time period is completed, the pipe / fitting ends will be moved away from the heater which will automatically be ejected up and the melted pipe ends will be pressed against each other within a minimum time [Dwell time].

12 After pressing the pipe ends against each other, the pressure shall be increased to the bead rollover process.

13 After completing the bead rollover process, the pressure will be minimized to the cooling pressure until the cooling time is completed.

14 After completing the cooling process, the pressure will be released completely and the pipes can be released from the clamps.

15 The joint should be inspected to ensure that it is free from any visible defect.

ELECTRO-FUSION PROCESS

The Following Equipments and tools are required for the Electro fusion process:

- Automatic Electro-Fusion Machine.
- Power source compatible with the machine power.
- Suitable pipe clamps.
- Pipe Cutter.
- Electro fusion fittings with size similar to the pipe size.
- Scrubbing Tools.
- Marker pen.

Preparations before starting the Electro-Fusion process:

- The Electro-Fusion machine should be placed on a flat, clean, and dry board in a suitable shelter for protection from contamination, chilled wind and direct sunlight.
- Make sure that all machine parts are clean and free from dust, humidity or any other contaminations.
- Check the Input power source and make sure that it is compatible with the power requirements of the machine.

Jointing Procedure:

1 Connect the machine to the suitable power supply and switch it ON.

2 Check that both pipe and fitting to be joined are compatible.

3 Make sure that the pipe ends are clean and square cut.

4 Scrub the pipe ends uniformly with a proper scrubbing tool to remove the oxidized layer.

5 Take out the fittings from its sealed bag and immediately insert the scrubbed pipe ends inside it until they touch the centre stopper.

6 Secure the pipe ends and the fitting in the restraining clamp.

7 Connect the machine output leads to the fittings terminals.

8 Enter the voltage and fusion time indicated on the fitting into the machine control box or use universal barcode scanner to scan the fitting barcode.

9 Press the start button on the control box, the heating cycle will start and progress as indicated on the computer display until the heating is completed. In this stage the socket pins (indicators) on the fittings will appear.

10 Allow proper cooling then remove the clamps and inspect the joint.

COSMOPLAST FUSION SERVICES

As part of its services for the HDPE installers, COSMOPLAST has a specialized department that stocks and operates wide range of Butt Fusion and Electro-Fusion machines, equipment and spare parts needed for any installation work. COSMOPLAST also offers complete equipment servicing, maintenance and repair. This complete range of jointing systems includes:

- Automatic/manual Electro-Fusion control boxes with complete clamping systems.
- Electrofusion fittings, couplers and joints.
- Both Automatic and Manual butt fusion systems.
- Internal and External de-beaders.
- Cutters and squeeze tools.
- Data transfer system [jointing feedback].

Cosmoplast Fusion Department provides the below services:

- Selling and Hiring of wide range of fusion machines and equipments.
- Training for senior technicians at its facilities.
- Practical training for installation technicians at customers' premises and sites.
- Supervision of installations at the sites.
- Fabrication of specialized fittings and connections.
- Servicing, repairing and calibration of fusion machines.
- Cosmoplast highly skilled fusion technicians provide technical assistance for on-site assessment and guidance during installation operations.

In co-operation with leading European manufacturers, we at COSMOPLAST with our experience in PE pipes manufacturing and jointing capabilities provide a product and service second to none in this area.

TRENCHING & BACK FILLING

Polyethylene pipe systems are designed to make installation quicker, easier and more cost-effective. Installation is as much part of the costing equation as ease of maintenance and the price of the pipe system itself.

Advantage of polyethylene in installation is its lightness and flexibility, coupled with its durability and totally secure jointing methods. For all modern pipe laying techniques, whether in rehabilitation work or the construction of new pipelines Polyethylene pipes usually provide the simplest and most economical solution.

When polyethylene pipe is laid it may suffer surface damage. Precautions should be taken to reduce this, although test work carried out has proved that scoring up to 10% of the pipe wall thickness will not affect the performance of the pipe.

Generally, at least 3 pipe lengths of ground should be excavated ahead of mains laying to expose any obstructions which may necessitate deviation from the planned route.

General Points on Trench Excavation

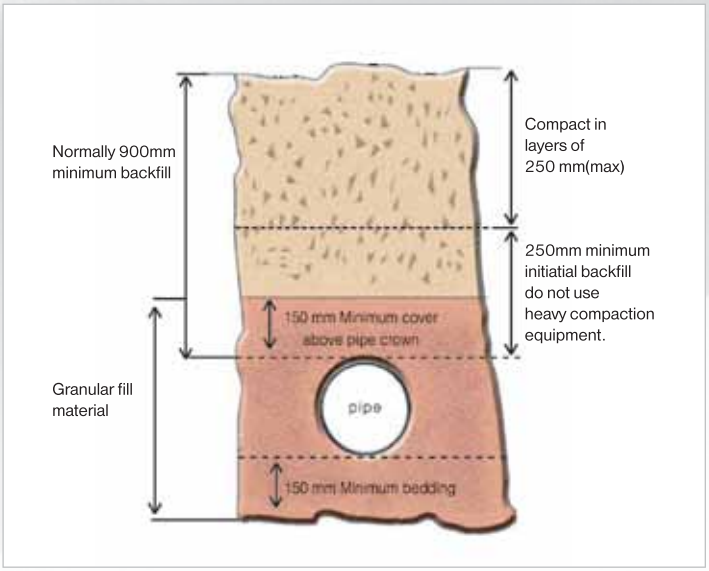
Installation of Polyethylene pipeline systems requires minimal trench width; therefore considerable saving can be made in terms both of reduced labour costs and less waste spoil to be removed from site. Additionally, reinstatement costs are cut and smaller quantities of imported backfill are needed.

The dimensions of a trench line opening are normally governed by the pipe diameter, method of jointing and site conditions. Normal minimum depth of cover for mains should be 900mm from ground level to the crown of the pipe. Trench width should be as narrow as possible, but never less than the outside diameter of the pipe plus 250mm to allow for correct compaction of side fill.

In some instances it may be acceptable to lay HDPE pipe directly on the bottom of the trench - but only where the soil is uniform, relatively soft and fine-grained without large flints, stones and other hard objects. The trench bottom should be brought to an even finish, providing consistent support for pipes along their whole length.

In other cases, the trench should be cut to a depth, which will allow for the necessary thickness of selected bedding material below the bottom of the pipe. If soil from the excavation is unsuitable, granular material should be imported. Gravel or broken stone graded between five and ten millimetres in size provides suitable bedding, since it needs little compaction. Coarse sand, a sand and gravel mix, or gravel smaller than 20mm are also all acceptable straight from the quarry.
Excavators with narrow buckets are best suited to conventional trenching methods. Pipes are located by being lifted into the correct position. After installation, the ground can be backfilled and consolidated.

RECOMMENDED TRENCH COMPOSITION



BACK FILLING

Unless special procedures apply, such as local agreements for carriageway reinstatement, appropriate excavated material may be returned to the trench and compacted in layers of a thickness specified by the appropriate utility. Ensure the trenches should be compacted properly after the initial backfilling, to prevent lateral movement of pipes. Heavy compaction equipment should not be used until the fill over the crown of the pipe is at least 300mm

TRANSPORTATION

- Vehicles transporting pipes should have a flat bed, which include supports that are free of sharp edges or projections.
- Pipes should be evenly supported over their full length and not overhang the vehicle.
- Where different sizes of pipe are to be transported together larger diameter pipe should be loaded first with the vehicle having side supports at no larger than 1.5 meter intervals.

HANDLING OF POLYETHYLENE PIPES

- Care and attention should always be applied when handling pipes. This should be done not only for the protection of the pipes but also for the safety of the handling personnel.
- Pipes should never be dropped onto hard or uneven surfaces.
- Pipes should never be thrown from vehicles.
- Pipes should never be dragged or rolled along the ground.
- Where possible, pipes should always be unloaded individually. In cases where pipes are already bundled into frames, proper lifting equipment (lift truck etc.) should be used.
- Where pipe weights exceed practical personnel handling weight capability, rope or web slings should be used with mechanical lifting equipment.
- Metal chains, hooks or ropes should never be used.

SITE STORAGE

Bundled Pipes

- Pipes supplied in factory bundles should be stored on flat even ground able to withstand weight of both pipes and lifting apparatus.
- Pipes should be kept away from sharp projections or other jagged cut crops.
- Bundle strapping should remain in position until such time that the pipe is to be used.
  Stack height should not exceed 1.5m and not more than three stacks should be bundled together.

Loose Pipes

- Pipes should be stored on flat even ground able to withstand weight of pipes and lifting apparatus.
- Different sizes of pipes should be stored separately. Where this is not possible, larger and/ or thicker walled pipes should be placed at the bottom of the stack.
- Pipes should not be stacked over a height of 1.5m so that the pipes do not disfigure.
- Pipes should be kept away from sharp projections; stones or other jagged cut crops.
- Never place pipes in contact with lubricating or hydraulic oils, gasoline or solvents.
- Keep pipes away from intense heat.
- Exercise special care when handling pipes in humid or wet conditions, as the pipes may become slippery.

Protection from Ultra-Violet

- A first-in, first-out stock rotation system of pipe and fittings usage should always be adopted.
- For hotter climates, as experienced in the Gulf, it is recommended that pipes should be kept away from direct sunlight and be covered.
- Good ventilation at all times during storage is essential.

Technical Support & Training:

Cosmoplast Industrial Co. provides its customers with full technical support as detailed below

- A full range of PE installation and jointing equipment available for either sale or hire.
- Specialized centre for PE equipment servicing, maintenance and repair
- Complete spare parts availability for Fusion equipment.
- In house training for management and senior technicians.
- Practical training for engineers and technicians at customer's premises and sites.
- On-site assessment and supervision to provide technical assistance and guidance during installation operations.
- On-site surveys to asses best methods of practice and systems installation in conjunction with system designers, consultants and site engineers.





Cosmoplast

PRODUCT RANGE

POLYETHYLENE MOULDED FITTINGS

HDPE 90° Elbow	SIZE (mm)	
	SDR11	SDR17
	75	75
	90	90
	110	110
	125	125
	140	140
	160	160
	180	180
	200	200
	225	225
	250	250
	-	280
	315	315
	355	355
	400	400
	450	450
	500	500
	630	630

HDPE 45° Elbow	SIZE (mm)	
	SDR11	SDR17
	75	75
	90	90
	110	110
	125	125
	160	140
	180	160
	200	180
	225	200
	250	225
	280	250
	315	280
	355	315
	400	400
	450	450
	500	500
	630	630

HDPE TEE

SIZE (mm)	
SDR11	SDR17
75	90
90	110
110	125
125	140
160	160
180	180
200	200
225	225
250	250
280	280
315	315
355	355
400	400
450	450
500	500
630	630

HDPE REDUCING TEE

SIZE (mm)	
SDR11	SDR17
90x75x90	90x75x90
110x63x110	110x63x110
110x75x110	110x90x110
110x90x110	125x63x125
125x63x125	125x90x125
125x90x125	160x63x160
160x63x160	160x90x160
160x90x160	160x110x160
160x110x160	180x160x180
180x160x180	200x90x200
200x63x200	200x110x200
200x90x200	200x160x200
200x110x200	225x160x225
200x160x200	225x200x225
225x160x225	250x110x250
225x200x225	250x160x250
250x110x250	250x200x250
250x160x250	280x90x280
250x200x250	280x110x280
280x250x280	280x160x280
315x200x315	280x225x280
315x250x315	280x250x280
355x250x355	315x160x315
355x315x355	315x250x315
400x355x400	355x250x355
450x315x450	355x315x355
500x315x500	400x200x400
500x400x500	400x250x400
500x450x500	400x315x400
630x450x630	400x355x400
630x500x630	450x250x450
-	450x315x450
-	500x315x500
-	500x400x500
-	500x450x500
-	630x450x630
-	630x500x630

HDPE REDUCER

SIZE (mm)	
SDR11	SDR17
75x63	75x63
90x75	90x75
110x75	110x90
110x90	125x75
125x90	140x110
125x110	140x125
160x63	160x90
160x90	160x110
160x110	160x140
160x125	180x125
180x125	180x160
180x160	200x90
200x63	200x110
200x90	200x160
200x110	225x160
200x160	250x110
225x160	250x160
225x200	250x180
250x110	250x200
250x125	280x250
250x160	315x160
250x180	315x200
250x200	315x250
250x225	355x250
280x250	355x315
315X250	400x250
315x280	400x315
355x315	450x400
400x315	500x400
500x400	500x450
500x450	560x400
560x450	560x450
630x450	560x500
630x500	630x400
630x560	630x450
-	630x500
-	630x560
-	710x630
-	800x630
-	800x710
-	900x800
-	1000x800
-	1000x900

HDPE CAP

SIZE (mm)	
SDR11	SDR17
50	-
63	63
75	75
90	90
110	110
125	125
140	160
160	180
180	200
200	225
225	250
250	280
280	315
315	355
355	400
400	450
450	500
500	560
630	630

HDPE ELECTRO-FUSION COUPLER	SIZE (mm)	
	SDR11	SDR17
	63	450
	75	500
	90	560
	110	630
	125	710
	160	-
	200	-
	225	-
	250	-
	315	-
	355	-
	400	-

HDPE STUB END (Flange Adaptor)	SIZE (mm)	
	SDR11	SDR17
	75	90
	90	110
	110	125
	125	140
	140	160
	160	180
	180	200
	200	225
	225	250
	250	280
	280	315
	315	355
	355	400
	400	450
	450	500
	500	560
	560	630
	630	710
	-	800
	-	900
	-	1000
	-	1200

STEEL FLANGE, PN16	SIZE (mm)
	63
	90
	110
	125
	160
	200
	225
	250
	315
	355
	400
	450
	500
	560
	630

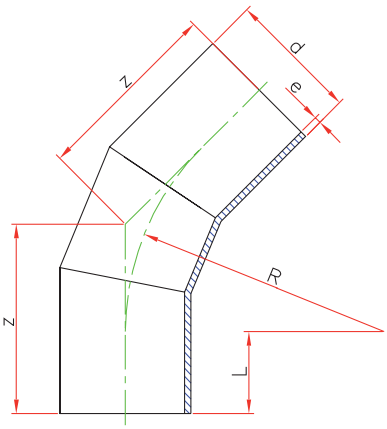
STEEL FLANGE WITH PP PAINT COATING, PN16	SIZE (mm)
	63
	90
	110
	160
	200
	250
	315
	355
	400
	450
	500
	630

STEEL FLANGE WITH PP INJECTION COATING, PN16	SIZE (mm)
	63
	75
	90
	110
	125
	160
	200
	225
	250
	315

STEEL BLIND FLANGE	SIZE (mm)
	63
	75
	90
	110
	125
	160
	200
	225
	250
	315
	355
	400
	450
	500

HDPE FABRICATED FITTINGS

ELBOW 45°	d (ø mm)	Z (mm)	L (mm)	R (mm)	e(mm)	
					SDR11	SDR17
	90	200	150	120	8.2	5.4
	110	200	150	120	10	6.6
	125	300	150	362	11.4	7.4
	140	300	150	362	12.7	8.3
	160	400	200	482	14.6	9.5
	180	400	200	482	14.6	10.7
	200	500	200	723	18.2	11.9
	225	650	250	965	20.5	13.4
	250	650	250	965	22.7	14.8
	280	700	300	965	25.4	16.6
	315	700	300	965	28.6	18.7
	400	820	350	1136	36.4	23.7
	450	930	350	1400	40.9	26.7
	500	1180	350	2003	45.5	29.7
	560	1300	400	2172	50.9	33.2
	630	1400	400	2414	57.3	37.4
	710	1500	500	2414	64.5	42.1
	800	1500	500	2414	72.6	47.4
	900	1600	500	2655	-	53.5
	1000	1600	600	2414	-	59.3
	1100	1700	600	2655	-	-
	1200	1700	700	2414	-	-



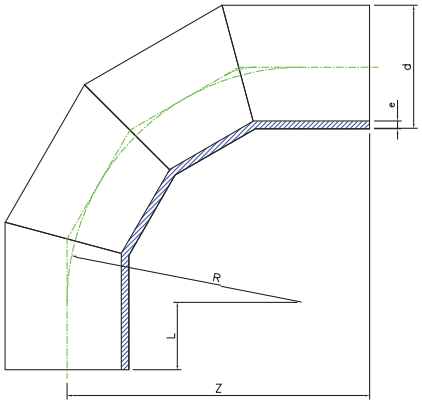
ISO 4427/4437

WRAS Water Regulations Advisory Scheme

FM APPROVED

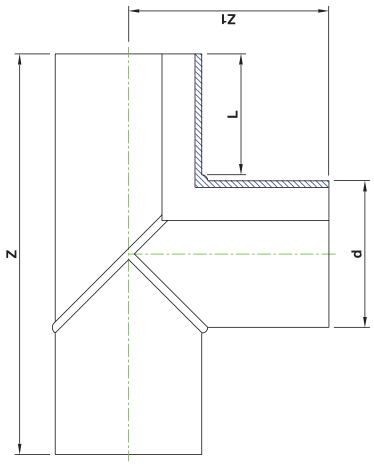
ISO 9001 FM 75767

ELBOW 90°



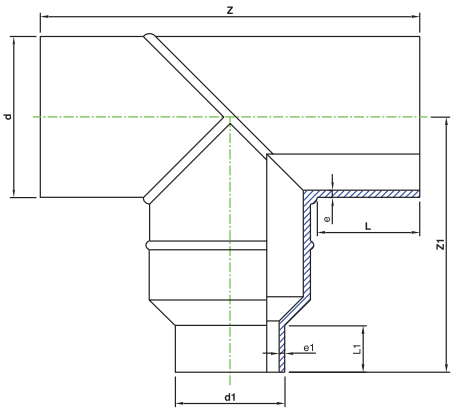
d (ø mm)	Z (mm)	L (mm)	R (mm)	e(mm)	
				SDR11	SDR17
315	790	300	490	28.6	18.7
355	850	300	550	32.3	21.1
400	955	350	605	36.4	23.7
450	1030	350	680	40.9	26.7
500	1150	350	800	45.5	29.7
630	1350	350	1000	57.3	37.4
710	1415	350	1065	64.5	42.1
800	1550	350	1200	72.6	47.4
900	1700	350	1350	-	53.3
1000	1900	400	1500	-	59.3
1200	2250	450	1805	-	-

FABRICATED TEE



d (ø mm)	Z (mm)	L (mm)	R (mm)	e(mm)	
				SDR11	SDR17
315	950	475	300	28.6	18.7
355	980	490	300	32.3	21.1
400	1000	500	300	36.4	23.7
450	1100	550	350	40.9	26.7
500	1250	625	350	45.5	29.7
630	1340	670	350	57.3	37.4
710	1410	705	350	64.5	42.1
800	1500	750	350	72.6	47.4
900	1700	850	400	-	53.3
1000	2040	1020	520	-	59.3
1200	2400	1200	600	-	-

REDUCER TEE



d (ø mm)	d1 (ø mm)	Z (mm)	Z1 (mm)	L (mm)	L1 (mm)	e (mm)	e1 (mm)
125	63	366	215	92	61	7.4	3.8
125	75	366	235	92	72	7.4	4.5
125	90	366	235	92	80	7.4	5.4
140	75	396	240	92	70	8.3	4.5
140	90	396	240	92	78	8.3	5.4
140	110	396	235	92	82	8.3	6.6
140	125	396	240	92	87	8.3	7.4
160	125	428	265	104	90	9.5	5.4
160	140	428	280	104	96	9.5	8.3
180	110	460	285	105	92	10.7	6.6
180	125	460	285	105	90	10.7	7.4
180	140	460	305	105	110	10.7	8.3
200	125	500	310	115	92	11.9	7.4
200	140	500	315	115	110	11.9	8.3
200	180	500	315	115	110	11.9	10.7
225	125	540	320	122	92	13.4	7.4
225	140	540	345	122	110	13.4	8.3
225	200	540	335	122	115	13.4	11.9
250	180	576	340	130	105	14.8	10.7
250	200	576	350	130	112	14.8	11.9
250	225	576	370	130	120	14.8	13.4
280	200	616	400	139	112	16.6	11.9
280	225	616	400	139	120	16.6	13.4
280	250	616	400	139	130	16.6	14.8
315	200	690	480	150	134	18.7	11.9
315	280	690	480	150	139	18.7	16.6
355	250	818	480	165	130	21.1	14.8
355	280	818	480	165	139	21.1	16.6
355	315	818	490	165	150	21.1	18.7
400	280	910	540	180	139	23.7	16.6
400	315	910	580	180	150	23.7	18.7
400	355	910	675	180	165	23.7	21.1

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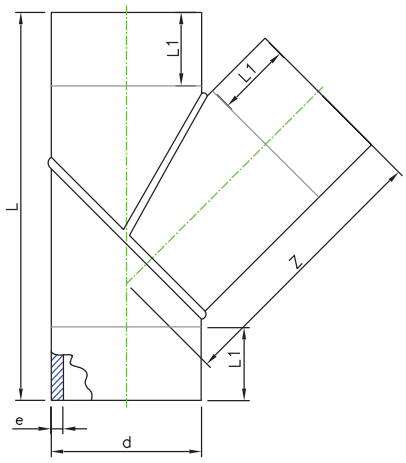

d (ø mm)	L (mm)	L1 (mm)	Z (mm)	e(mm)	
				SDR11	SDR17
90	600	150	350	8.2	5.4
110	600	150	400	10	6.6
125	700	150	400	11.4	7.4
140	700	150	480	12.7	8.3
160	750	200	480	14.6	9.5
180	750	200	500	16.4	10.7
200	800	300	530	18.2	11.9
225	850	300	600	20.5	13.4
250	960	350	650	22.7	14.8
710	1900	450	1250	57.3	42.1
800	2100	450	1320	72.6	47.4

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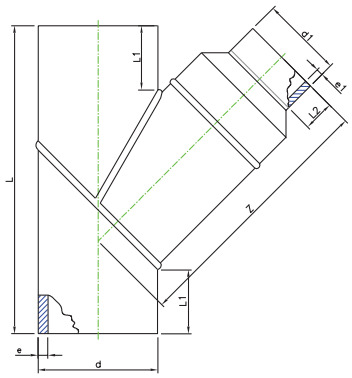


d (ø mm)	d1 (ø mm)	L (mm)	L1 (mm)	L2 (mm)	Z (mm)	e(mm)		e1(mm)	
						SDR11	SDR17	SDR11	SDR17
90	63	1327	600	150	400	8.2	5.4	5.8	3.8
110	90	1356	600	150	450	10	6.6	8.2	5.4
125	90	1577	700	150	500	11.4	7.4	8.2	5.4
140	110	1598	700	150	500	12.7	8.3	10	6.6
160	110	1726	750	200	520	14.6	9.5	10	6.6
180	110	1755	750	200	520	16.4	10.7	10	6.6
200	160	1883	800	200	600	18.2	11.9	14.6	9.5
225	180	1958	820	250	650	20.5	13.4	16.4	10.7
250	180	2274	960	250	700	22.7	14.8	16.4	10.7

Polyethylene Chemical Resistance Table

This table establishes a classification of the chemical resistance of pipe materials to specified fluids over a range of temperatures upto 20°C and 60°C.

Source : ISO / TR 10358 : 1993
The pipe materials covered by this classification are:
Low-density polyethylene PE-LD
High-density polyethylene PE-HD

The preliminary chemical-resistance classification given in the table as per ISO / TR 10358: 1993 is as below:

S- Satisfactory
L- Limited
NS- Not Satisfactory

The concentration and / or purity of the fluid is indicated, using the following symbols:
Dil. Sol. = Dilute aqueous solution at a concentration equal to or less than 10 %.
Sol. = Aqueous solution at a concentration higher than 10 %, but not saturated.
Sat. Sol. = Saturated aqueous solution , prepared at 20°C.
tg = At least technical-grade only
tg-s = Technical grade, solid
tg-l = Technical grade, liquid
tg-g = Technical grade, gas
Work. Sol. = Working solution of the concentration usually used in the industry concerned.
Susp. = Suspension used in the industry.

Chemical	Concentration	PE-LD		PE-HD	
		20°C	60°C	20°C	60°C
Acetaldehyde	40%	L	NS	S	L
Acetamde	-	-	-	S	S
Acetic Acid	10%	S	S	S	S
Acetic Acid	60%	S	L	S	S
Acetic Acid, Glacial	Greater than 96%	L	NS	S	L
Acetic anhydride	tg-l	L	NS	S	L
Acetone	tg-l	L	NS	L	L
Acrylonitrile	tg-l	S	S	S	S
Acetylsilicacid	-	S	S	S	S
Adipic Acid	Sat. Sol	S	S	S	S
Allyl Alcohol	tg-l	L	NS	S	S
Allyl Alcohol	96%	-	-	S	S
Allyl Chloride	-	L	NS	L	NS
Aluminium Chloride	Sat.sol	S	S	S	S
Aluminium Fluoride	Susp	S	S	S	S
Aluminium hydroxide	Sat.sol	S	S	S	S
Aluminium nitrate	Susp	S	S	S	S
Aluminium oxychloride	Susp	S	S	S	S
Al/potassium sulphate	Sat.sol	S	S	S	S
Aluminium sulphate	Sat.sol	S	S	S	S
Ammonia, dry gas	tg-g	S	S	S	S
Ammonia, liquid	100%	L	L	S	S
Ammonia, aqueous	Sat.sol	S	S	S	S
Ammonium Carbonate	Sat.Sol	S	S	S	S
Ammonium chloride	Sat.sol	S	S	S	S
Ammonium fluoride	Sol	S	-	S	S

Chemical	Concentration	PE-LD		PE-HD	
		20°C	60°C	20°C	60°C
Ammonium hydrogen carbonate	Sat.sol	S	S	S	S
Ammonium hydroxide	10%	S	S	S	S
Ammonium metaphosphate	Sat.sol	S	S	S	S
Ammonium nitrate	Sat.sol	S	S	S	S
Ammonium persulphate	Sat.sol	S	S	S	S
Ammonium sulphate	Sat.sol	S	S	S	S
Ammonium suphide	Sat.sol	S	S	S	S
Ammonium thiocyanate	Sat.sol	S	S	S	S
Amyl acetate	tg-l	NS	NS	L	L
Amyl alcohol	tg-l	L	L	S	L
Amyl chloride	100%	NS	NS	-	-
Aniline	tg-l	NS	NS	S	L
Antimony (III) chloride	Sat.sol	S	S	S	S
Apple juice	Work-Sol	-	-	S	L
Aqua regia	HCl/HNO3=3/1	NS	NS	NS	NS
Asorbic acid	10%	S	S	S	S
Barium bromide	Sat.sol	S	S	S	S
Barium carbonate	Susp	S	S	S	S
Barium chloride	Sat.sol	S	S	S	S
Barium hydroxide	Sat.sol	S	S	S	S
Barium sulphate	Susp	S	S	S	S
Barium sulphide	Sat.sol	S	S	S	S
Beer	Work-Sol	S	S	S	S
Benzaldehyde	tg-l	L	NS	S	L
Benzene	tg-l	NS	NS	L	L
Benzoic acid	Sat.sol	S	S	S	S

Chemical	Concentration	PE-LD		PE-HD	
		20°C	60°C	20°C	60°C
Benzyl alcohol	tg-l	S	L	S	S
Bismuth carbonate	Susp	S	S	S	S
Borax	Sat.sol	S	S	S	S
Boric acid	Sat.sol	S	S	S	S
Boron Trifluoride	Sat.sol	S	-	S	-
Bromine, drygas	tg-g	NS	NS	NS	NS
Bromine, liquid	tg-l	NS	NS	NS	NS
Butane, gas	tg-g	-	-	S	S
N Butanol	tg-l	S	L	S	S
Butyric acid	tg-l	L	L	S	L
Calcium carbonate	Susp	S	S	S	S
Calcium chlorate	Sat.sol	S	S	S	S
Calcium chloride	Sat.sol	S	S	S	S
Calcium hydroxide	Sat.sol	S	S	S	S
Calcium hypochlorite	Sol	S	S	S	S
Calcium nitrate	Sat.sol	S	S	S	S
Calcium sulphate	Susp.	S	S	S	S
Calcium sulphide	Dil.sol	-	-	L	L
Calcium hydrogen sulphide	Sol	-	-	S	S
Carbon dioxide, dry gas	tg-g	S	S	S	S
Carbon dioxide, wet	tg-g	S	S	S	S
Carbon disulphide	tg-l	NS	NS	L	NS
Carbon monoxide	tg-g	S	S	S	S
Carbon tetrachloride	tg-l	NS	NS	L	NS
Chlorine, water	Sat.sol	L	L	S	S
Chlorine, aqueous	Sat.sol	NS	NS	L	NS
Chlorine, dry gas	tg-g	NS	NS	L	NS
Chloroacetic acid	Sol	-	-	S	S
Chlorobenzene	tg-l	NS	NS	-	-
Chloroform	100%	NS	NS	NS	NS
Chloromethane, gas	tg-g	L	-	L	-
Chlorosulphonic acid	tg-s	NS	NS	NS	NS
Chrome alum	Sol	S	S	S	S
Chromic acid	Sat.sol	S	S	-	-
Chromic acid	20%	-	-	S	L
Chromic acid	50%	-	-	S	L
Citric acid	Sat.sol	S	S	S	S
Copper (II) chloride	Sat.sol	S	S	S	S
Copper cyanide	Sat.sol	S	S	S	S
Copper (II) fluoride	Sat.sol	S	S	-	-
Copper (II) fluoride	2%	S	S	S	S
Copper (II) nitrate	Sat.sol	S	S	S	S
Copper (II) sulphate	Sat.sol	S	S	S	S
Cresylic acid	Sat.sol	-	-	L	-
Crotonaldehyde	Sat.sol	L	-	-	-
Cyclohexanol	tg-s	L	NS	-	-
Cyclohexanol	100%	-	-	S	S
Cyclohexanone	tg-l	NS	NS	S	L
Decalin	tg-l	-	-	S	L
Developers (photographic)	Work.conc	-	-	S	S
Dextrose	Sol	S	S	S	S
Dimethyl amine gas	tg-g	NS	NS	-	-
Dioctyl phthalate	tg-l	L	NS	S	L
Dioxane	tg-l	-	-	S	S

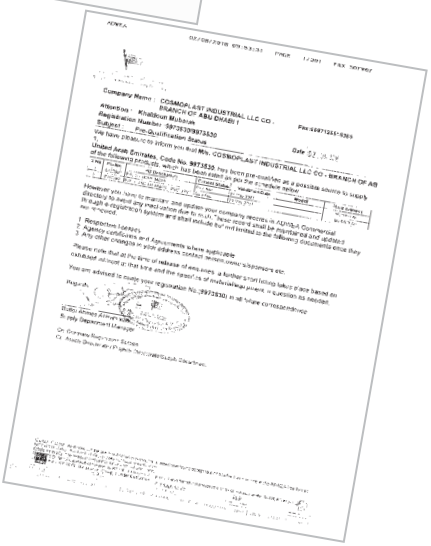
Chemical	Concentration	PE-LD		PE-HD	
		20°C	60°C	20°C	60°C
Disodium phosphate	-	S	S	S	S
Ethanol	40%	S	L	S	L
Ethanol	95%	L	L	-	-
Ethyl acetate	100%	L	NS	S	NS
Ethyl chloride, gas	tg-g	NS	NS	-	-
Ethyl ether	tg-l	NS	NS	NS	NS
Ethylene glycol	tg-l	S	S	S	S
Ferric chloride	Sat.sol	S	S	S	S
Ferric Nitrate	Sat.sol	S	S	S	S
Ferric Sulphate	Sat.sol	S	S	S	S
Ferrous chloride	Sat.sol	S	S	S	S
Ferrous sulphate	Sat.sol	S	S	S	S
Fluorine gas, dry	tg-g	NS	NS	NS	NS
Fluorine gas, wet	tg-g	NS	NS	NS	NS
Fluorosilic acid	40%	S	S	S	S
Formic acid	40%	S	S	S	S
Formic acid	98 to 100%	S	S	S	S
Furfuryl alcohol	tg-l	L	NS	S	L
Gas , manufactured	tg-g	-	S	-	-
Gasoline,(fuel)	Work. Sol.	L	NS	S	L
Gelatine	Sol	S	S	S	S
Glucose	Sol	S	S	S	S
Glycerine	tg-l	S	S	S	S
Glycolic acid	30%	S	L	-	-
Glycolic acid	Sol	-	-	S	S
Gas, natural, dry	tg-g	-	-	S	-
Heptane	tg-l	NS	NS	S	NS
Hexachlorophene	-	NS	NS	L	L
Honey		S	S	S	S
Hydrobromic acid	50%	S	S	S	S
Hydrobromic acid	Upto 100%	S	S	S	S
Hydrochloric acid	Upto 36%	S	S	S	S
Hydrochloric acid	Conc	S	S	S	S
Hydrochlorous acid	Conc	S	S	S	S
Hydrocyanic acid	10%	S	S	S	S
Hydrofluoric acid	60%	S	L	S	L
Hydrogen	tg-g	S	S	S	S
Hydrofluoric acid	10%	S	S	S	S
Hydrogen peroxide	10%	S	S	S	S
Hydrogen peroxide	30%	S	L	S	S
Hydrogen peroxide	90%	S	NS	S	NS
Hydrogen sulphide gas,dry	tg-g	S	S	S	S
Hydroquinone	Sat.sol	S	S	S	S
Iodine (in potassium sol)	Sat sol	NS	NS	NS	NS
Iodine (in alcohol)	Work. Sol.	NS	NS	NS	NS
Lactic acid	10%	S	S	S	S
Lactic acid	28%	S	S	S	S
Lactic acid	Upto 100%	S	S	S	S
Lead acetate	Dil.sol	S	S	S	S
Lead acetate	Sat.sol	S	S	S	S
Magnesium carbonate	Susp.	S	S	S	S
Magnesium chloride	Sat.sol	S	S	S	S
Magnesium hydroxide	Sat.sol	S	S	S	S
Magnesium nitrate	Sat.sol	S	S	S	S

Chemical	Concentration	PE-LD		PE-HD	
		20°C	60°C	20°C	60°C
Magnesium sulphate	Sat.sol	S	S	S	S
Maleic acid	Sat.sol	S	S	S	S
Mayonnaik	Work. Sol.	S	S	S	S
Mustard, aqueous	Work. Sol.			S	
Mercury (I) nitrate	Sol	-	-	S	-
Mercury (II) chloride	Sat.sol	S	S	S	S
Mercury (II) cyanide	Sat.sol	S	S	S	S
Mercury	100%	S	S	S	S
Milk	Work. Sol.	S	S	S	S
Mineral oils	Work. Sol.	L	NS	S	L
Molasses	Sol	S	S	S	S
Nickel chloride	Sat.sol	S	S	S	S
Nickel nitrate	Sat.sol	S	S	S	S
Nickel sulphate	Sat.sol	S	S	S	-
Nicotinic acid	Dil.sol	L	L	S	-
Nitric acid	25%	S	S	S	S
Nitric acid	50%	L	NS	L	NS
Nitric acid	70%	S	L	S	L
Nitric acid	50%	NS	NS	NS	NS
Oil and fats	tg-l	L	NS	S	L
Oleic acid	tg-l	L	NS	S	S
Oleum (H2SO4+10%SO3)		NS	NS	NS	NS
Oleum (H2SO4+50%SO3)		NS	NS	NS	NS
Oxalic acid	Sat.sol	S	S	S	S
Oxygen,gas	tg-g	S	-	S	L
Ozone, gas	Sat.sol	NS	NS	L	NS
Phenol	Sol	L	NS	S	S
Phosphine	tg-g	S	S	S	S
Phosphoric Acid	Upto 50%	S	S	S	S
Phosphoric (III) chloride	100%	S	S	S	L
Picnic acid	Sat.sol	S	L	S	-
Potassium bicarbonate	Sat.sol	S	S	S	S
Potassium borate	Sat.sol	S	S	S	S
Potassium bromate	Sat.sol	S	S	S	S
Potassium bromide	Sat.sol	S	S	S	S
Potassium carbonate	Sat.sol	S	S	S	S
Potassium chlorate	Sat.sol	S	S	S	S
Potassium chloride	Sat.sol	S	S	S	S
Potassium chromate	Sat.sol	S	S	S	S
Potassium cyanide	Sol	S	S	S	S
Potassium dichromate	Sat.sol	S	S	S	S
Potassium fluoride	Sat.sol	S	S	S	S
Potsssium hexacyanoferrate (III)	Sat.sol	S	S	S	S
Potassium hexacyanoferrate (II)	Sat.sol	S	S	S	S
Potassium hydrogen carbonate	Sat.sol	S	S	S	S
Potassium hydrogen sulphate	Sat.sol	S	S	S	S
Potassium hydrogen sulphite	Sol	S	S	S	S
Potassium hydroxide	10%	S	S	S	S
Potassium hydroxide	Sol	S	S	S	S
Potassium hypochlorite	Sol.	S	L	S	L
Potassium nitrate	Sat.sol	S	S	S	S
Potassium orthophosphate	Sat.sol	S	S	S	S
Potassium oxalate	Sat.sol	S	S	S	S
Potassium perchlorate	Sat.sol	S	S	S	S

Chemical	Concentration	PE-LD		PE-HD	
		20°C	60°C	20°C	60°C
Potassium persulphate	Sat.sol	S	S	S	S
Potassium sulphate	Sat.sol	S	S	S	S
Potassium sulphide	Sol	S	S	S	S
Potassium sulphite	Sat.sol	S	S	-	-
Potassium thiosulphate	Sat.sol	S	S	S	S
Propargul alcohol	-	S	S	S	S
Propionic acid	tg-l	-	-	S	L
Pyridine	100%	-	-	S	L
Silver acetate	Sat.sol	S	S	S	S
Silver cyanide	Sat.sol	S	S	S	S
Silver nitrate	Sat.sol	S	S	S	S
Sodium acetate	Sat.sol	S	S	S	S
Sodium antimonite	Sat.sol	S	S	S	S
Sodium arsenite	Sat.sol	S	S	S	S
Sodium benzoate	Sat.sol	S	S	S	S
Sodium bicarbonate	Sat.sol	S	S	S	S
Sodium bisulphate	Sat.sol	S	S	S	S
Sodium bisulphate	Sat.sol	S	S	S	S
Sodium bromide	Sat.sol	S	S	S	S
Sodium carbonate	Sat.sol	S	S	S	S
Sodium chlorate	Sat.sol	S	S	S	S
Sodium chloride	Sat.sol	S	S	S	S
Sodium chlorite	2%	S	-	S	-
Sodium Cdlorid	20%	S	-	-	-
Sodium Cyanide	Sat.sol	S	S	S	S
Sodium dichromate	Sat.sol	S	S	S	S
Sodium fluoride	Sat.sol	S	S	S	S
sodium ferrycyanide	Sat.sol	S	S	S	S
Sodikum hexacyanoferrate (III)	Sat.sol	S	S	S	S
Sodium hexacyanoferrate (II)	Sat.sol	-	-	S	S
Sodium hydrogen carbonate	Sat.sol	S	S	S	S
Sodium hydrogen sulphate	Sat.sol	S	S	S	S
Sodium hydrogen sulphite	Sol	S	S	S	S
Sodium hydroxide	40%	S	S	S	S
Sodium hydroxide	Sol	-	-	S	S
Sodium hypochlorite	15%	-	-	S	S
Sodium nitrate	Sat.sol	S	S	S	S
Sodium nitrate	Sat.sol	S	S	S	S
Sodium ortophosphate	Sat.sol	S	S	S	S
Sodium oxalate	Sat.sol	S	S	S	S
Sodium phosphate	Sat.sol	S	S	S	S
Sodium silicate	Sol	S	S	S	S
Sodium sulphate	Sat.sol	S	S	S	S
Sodium sulphide	Sat.sol	S	S	S	S
Sodium sulphite	Sat.sol	S	S	S	S
Sulphur dioxide, dry	tg-g	S	S	S	S
Sulphur trioxide	tg-l	NS	NS	NS	NS
Sulphur acid	10 to 50%	S	S	S	S
Sulphuric acid	10%	S	S	S	S
Sulphuric acid	50%	S	S	S	S
Sulphuric acid	50%to75%	S	S	S	S
Sulphuric acid	98%	L	NS	S	NS
Sulphuric Acid	Fuming	NS	NS	NS	NS
Sulphurous acid	Upto 30%	S	S	S	S

Chemical	Concentration	PE-LD		PE-HD	
		20°C	60°C	20°C	60°C
Tallow	-	S	L	S	L
Tannic acid	Sol	S	S	S	S
Tartaric acid	Sat.sol	S	S	S	S
Tartaric acid	Sol	S	S	S	S
Tetrahydrofuran	tg-l	NS	NS	-	-
Tetrahydronaphthalene	100%	L	NS	S	L
Thionyl chloride	100%	NS	NS	NS	NS
Tin (II) chloride	Sat.sol	S	S	S	S
Tin (IV) chloride	Sol	S	S	S	S
Tin (IV) chloride	Sat.sol	-	-	S	S
Titanium tetrachloride	Sat.sol	NS	NS	NS	NS
Toluene	tg-l	NS	NS	L	NS
Tribromomethane	-	NS	NS	NS	NS
Trichloroethylene	100%	NS	NS	NS	NS
Triethanolamine	tg-l	S	-	S	-
Triethanolamine	Sol	-	-	S	L
Urea	Sol	S	S	S	S
Urine	-	S	S	S	S
Vegetables oils	tg-l	S	L	S	S
Vinegar		S	S	S	S

Chemical	Concentration	PE-LD		PE-HD	
		20°C	60°C	20°C	60°C
Water		S	S	S	S
Water, brackish	Sat.sol	S	S	S	S
Water,distilled	Sat.sol	S	S	S	S
Water, fresh	Sat.sol	S	S	S	S
Water, mineral	Work. Sol.	S	S	S	S
Water, potable	Work. Sol.	S	S	S	S
Water,sea	Work. Sol.	S	S	S	S
Whiskay	Work. Sol.	S	S	S	S
Wines & sprits	Work. Sol.	S	S	S	S
Wetting agents	-	S	S	S	S
Wines and spirits	Sat.sol	S	S	S	S
Xylene	tg-l	NS	NS	L	NS
Yeast	Sol	S	S	S	S
Zinc bromide	Sat.sol	S	S	S	S
Zinc carbonate	Sat.sol	S	S	S	S
Zinc chloride	Sat.sol	S	S	S	S
Zinc oxide	Sysp	S	S	S	S
Zinc Nitrste	Sat.sol	S	S	S	S
Zinc stearate	-	S	S	S	S
Zinc sulphate	Sat.sol	S	S	S	S



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It is not intended as a substitute for competent professional advice which should
always be sought in the design of any pipeline system
In line with our continuing product development programme,
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ISO 4427/4437

WRAS
Water Regulations Advisory Scheme

FM
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ISO 9001 FM 75767

Pipeline Systems

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