Puhui Industry Co., Ltd.

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Puhui Industry is a high-tech enterprise specializing in R&D, production and sales of PE & PVC pipes and fittings. The annual outputs reach 100,000 tons.

Our company has first-class equipment and technical elites, focused on the development and applications of new technologies in the PVC/ PE industries. We have independently developed PE/ PVC pipes for underground coal mine, polyethylene (PE) and PVC pipes for fresh water, connecting hoses for methane drainage in coal mines, PE steel wire mesh pipes for underground coal mines, PE steel wire mesh pipes for fresh water, spiral reinforcement pipe for coal mine degasification, pipes for electricity, gas distribution, and others. We have obtained a number of national patents and independent intellectual property rights.

Puhui strictly implements national standards, industrial standards, and Total Quality Management System. We have certificated by ISO9001-2008 quality management system, ISO14001: 2004 environmental management system, GB/T28001-2011 occupational health, safety management system, and labeled as Chinese environment-friendly products and Xinhua water-saving products.

Puhui insist on providing high quality products and excellent services. The company's PVC and polyethylene (HDPE) pipes have been widely used for methane extraction in coal mine, ventilation and drainage, urban fresh water supply and drainage pipes networks, agricultural irrigation system, sewage drainage system, landscaping water supply network and other fields. As a well-known brand in China, we enjoy widely praise from users for our excellent quality and services.

ADVANTAGES:

1. Famous trademark: focused on this industry for 30 years, we have many patented designs and rich experiences of large-scale engineering.

2.Strict quality control: strict quality control with 100% pass rate.

Our production lines are all equipped with a full set of testing equipment, professional quality inspection personnel. Every step can be traced to people ensuring 100% pass rate. Puhui Industry has certificated by the ISO9001: 2000 quality management system, ISO14001 environmental management system, and labeled as Chinese environment-friendly products.

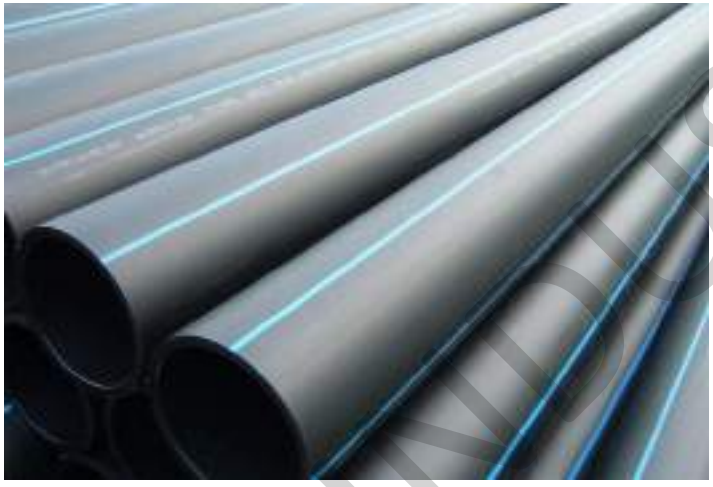
3.Million tons of production capacity

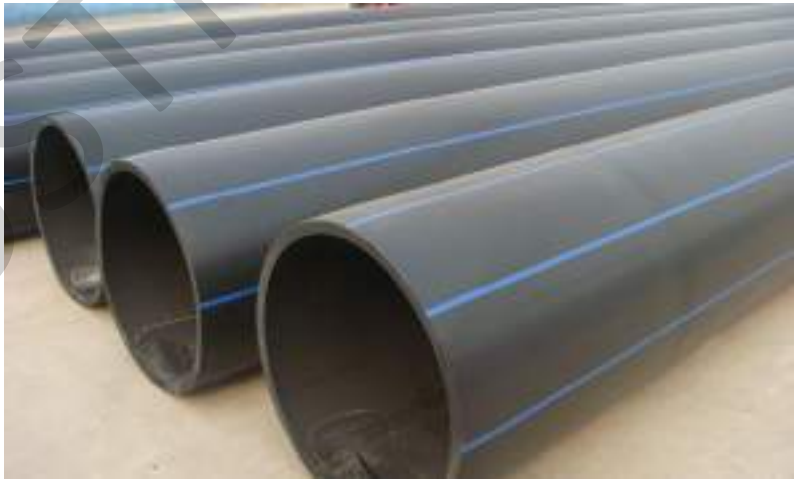
Covered over 65,000 square meters, Puhui ensures timely delivery with a huge storage capacity, annual outputs of 90,000 tons, more than 200 production and research team members.

4. One-Step services

We create comprehensive and high-quality design according to customer's real situation, provide guidance on transportation, construction, installation, pre-sales services, and after-sales maintenance.

Polyethylene (PE) pipes for water supply is made of PE100 as and extruded through a plastic extruder under high temperature and high pressure. With the features of high strength, corrosion resistance, no rust, non-toxicity, no bacteria, etc., it is widely used in the urban water supply network, irrigation water diversion projects and agricultural irrigation fields. It is an ideal replacement to ordinary iron pipes and PVC pipes for water supply.





Contents

Schedule of Manufacturers (Vendor List) for Key Materials/ Equipment
主要材料/设备生产厂家（供应商名单）细目表

No. 序号	**Material/Equipment** 材料/设备	**Name and Address of Manufacturer (where applicable)** 厂家名称和地址	**Country of origin** 原产国	**Name & Address of Supplier (including country)** 供应商名称和地址（包括国家）	**Make/Model (Where Applicable** 品牌和型号（适用）	**Applications** 产品用途	**Processes** 工艺技术	**Certifications** 企业认证	
								Quality Management System **质量管理体系**	**HSE Management System** **HSE 管理体系**
1)	HDPE Pipes and Fittings for Distribution System and Raw Water Rising Main-Synthetic Resin/High-density Polyethylene (HDPE) Pipe Grade 用于配水系统和原水上升主干管的高密度聚乙烯 HDPE 管道和配件-高密度聚乙烯树脂-管材料	Sinopec Shanghai Petrochemical 上海石化 Shanghai 上海	China	Sinopec Chemical	YGH041T (PE100), 5310M, 6100M, 6360M, 6380M, 7600M, 7800M, D G D B2480, D G D B2480H, G H 051T、Q H B16A, Q H B16B, TR418, TR480, YEM-4803T(PE80), YEM -4902T(PE100), YGH 041, YG M 091	pressurized water pipes, fuel gas pipelines and other industrial pipes, non-pressure pipes such as double-wall corrugated pipes, hollow-wall winding pipes, silicon-core pipes, agricultural irrigation pipes and aluminum-plastics compound pipes crosslinked polyethylene pipes (PEX) for supplying cold and hot water	Borealis A/S “Borstar Bimodel” PE Process 北欧化工公司的“北星双峰”PE 工艺	ISO 9001	GB/T 19001-2000 GB/T 24001-2004 GB/T 28001-2001
2)	Sinopec PP pipe grade-PP pipe grade–propylene impact copolymer (PP-B) and propylene random copolymer (PP-R) used for water supply systems 中国石化聚丙烯管材料,抗冲共聚聚丙烯（PP-B）和无规共聚聚丙烯（PP-R）用于供水系统	Sinopec Shanghai Petrochemical 上海石化 Shanghai 上海	China	Sinopec Chemical	4420 4240 B8101 C180C	water supply systems, heating systems and chemical piping systems	Borealis A/S “Borstar Bimodel” PE Process 北欧化工公司的“北星双峰”PE 工艺	ISO 9001	GB/T 1040

主要生产企业及工艺列表- Manufacturers and Process

生产企业 Manufacturers	所在地 Locations	产能（万吨/年） Design Capacity (10,000 Tons/a)	工艺技术 Processes	企业认证 Certifications	
				质量管理体系 Quality Management system	HSE 管理体系 HSE Management System
燕山分公司 Yanshan Petrochemical	北京 Beijing	14	日本三井油化淤浆法工艺 Slurry Process of Japan Mitsui Petrochemical Industries	ISO 9001	GB/T 19001-2000
中沙石化 SINOPEC SABIC TianJin Petrochemical Company	天津 Tianjin	30	INEOS 公司 INNOVENES 工艺 INNOVENES Process of INEOS	ISO 9001	GB/T 19001-2000
齐鲁分公司 Qilu Petrochemical	淄博 Zibo	14	美国联碳公司(现 Univation)低压气相流化床工艺 Low-pressure Gas-phase Fluidized bed Process of US Univation	ISO 9001	GB/T 19001-2000
上海石化 Shanghai Petrochemical	上海 Shanghai	25	北欧化工公司的“北星双峰”PE 工艺 Borealis A/S “ Borstar Bimodel ” PE Process	ISO 9001	GB/T 19001-2000 GB/T 24001-2004 GB/T 28001-2001
扬子石化 Yangzi Petrochemical	南京 Nanjing	17	日本三井油化淤浆法工艺 Slurry Process of Japan Mitsui Petrochemical Industries	ISO 9001	GB/T 19001-2000
福建联合石化 Fujian Refining & Petrochemical Company Limited	泉州 Quanzhou	40	美国 Univation 公司低压气相流化床工艺 Low-pressure Gas-phase Fluidized bed Process of US Univation	ISO 9001	GB/T 19001-2000
茂名分公司 Maoming Petrochemical	茂名 Maoming	35	美国 CPC 公司的环管淤浆法工艺 Loop Slurry Process of US CPC	ISO 9001	GB/T 19001-2000
中韩石化	武汉 Wuhan	30	英国 INEOS 公司环管淤浆法工艺 Loop Slurry Process of UK INEOS	ISO 9001	GB/T 19001-2000

HDPE Pipe Grade

Overview

Sinopec HDPE pipe grade has broad or bimodal distribution of molecular weight. It has strong creep resistance and good balance of rigidity and toughness. It is very durable and has low sag when being processed. Pipes produced using this resin have good strength, rigidity and impact resistance and excellent property of SCG and RCP.

ApplicationsHDPE pipe grade can be used in the production of pressure pipes, such as pressurized water pipes, fuel gas pipelines and other industrial pipes. It can also be used for making non-pressure pipes such as double-wall corrugated pipes, hollow-wall winding pipes, silicon-core pipes, agricultural irrigation pipes and aluminum-plastics compound pipes. In addition, through reactive extrusion (silane cross-linking), it can be used for producing crosslinked polyethylene pipes (PEX) for supplying cold and hot water.





HDPE Pipes and Fittings Raw Material

Package, Storage and Transportation

The resin is packaged in internally film-coated polypropylene woven bags, brown paper bags or laminated polyethylene film bags. The net weight is 25Kg/bag. The resin should be stored in a drafty, dry warehouse and away from fire and direct sunlight. It should not be piled up in the open air. During transportation, the material should not be exposed to strong sunlight or rain and should not be transported together with sand, soil, scrap metal, coal or glass. Transportation together with toxic, corrosive and flammable substance is strictly prohibited.

HDPE PIPE 主要产品牌号性能指标典型值（非保证值）
HDPE PIPE Grades and Typical Values (Not Warranted Values)

产品牌号 Grades		YGH041	YGH041T (PE100)	YGH051T (PE80)	YGM091T (PE80)	PN049-030-122	PN043-090-122
熔体流动速率 MFR	g/10min	0.25	0.3	0.6	0.8	0.3(MI5)	0.9(MI5)
密度 Density	g/cm 3	0.95	0.959	0.956	0.951	0.949	0.94
拉伸屈服强度 Tensile Strength at yield	MPa≥	19	20	19	17	24	22
拉伸屈服应变 Tensile Strain at yield	%≥		7	8	8		
拉伸弹性模量 Tensile Modulus	MPa≥	860	860	860	500		1100
断裂伸长率 Elongation at break	%≥ (23℃50mm/分)	580				1100	600
产品认证 Certifications			SCG/RCP	SCG/RCP	SCG/RCP	300	
生产企业 Manufacturers		上海 Shanghai	上海 Shanghai	上海 Shanghai	上海 Shanghai	中沙 SSTPC	中沙 SSTPC

产品牌号 Grades		6100M	6380M	7600M	2300XM	K44-08-122	DGDB2480
熔体流动速率 MFR	g/10min	0.13	0.1	0.04	5.5	8.75(HLMI)	12
密度 Density	g/cm 3	0.954	0.949	0.948	0.949	0.944	0.946
拉伸屈服强度 Tensile Strength at yield	MPa≥	26	22	22.1	22.8	22	19
拉伸屈服应变 Tensile Strain at yield	%≥	750	800	726		800	
弯曲弹性模量 Flexural Modulusk	MPa≥	900	850	1000		810(拉伸)	900
产品认证 Certifications		食品卫生/FDA	食品卫生 SCG/RCP	SCG/RCP	食品卫生/FDA		
生产企业 Manufacturers		燕山 Yanshan	燕山 Yanshan	燕山 Yanshan	上海 Shanghai	中沙 SSTPC	福建联合 FREP

产品牌号 Grades		QHM22F	2480	2480 H	YEM-4803T	YEM-4902T	TR-480M	PN049-030-122
熔体流动速率 MFR	g/10min	11.4	12.5	10	0.3	0.23	0.5	0.3
密度 Density	g/cm 3	0.937	0.945	0.943	0.951	0.951	0.944	0.949
拉伸屈服强度 Tensile Strength at yield	MPa≥	20.2	20	19	24	24	20	23.5
拉伸屈服应变 Tensile Strain at yield	%≥	713	500	500		300	350	664
弯曲弹性模量 Flexural Modulusk	MPa≥				720	730	800	
产品认证 Certifications				SCG/RCP	SCG/RCP	SCG/RCP	食品卫生	
生产企业 Manufacturers		齐鲁 Qilu	齐鲁 Qilu	齐鲁 Qilu	扬子 Yangzi	扬子 Yangzi	茂名 Maoming	中韩石化

PPR Pipe Grade

Overview

Sinopec PP pipe grade is a copolymer produced by copolymerization of a small amount of ethylene in propylene chain segments. There are two main types of PP pipe grade–propylene impact copolymer (PP-B) and propylene random copolymer (PP-R). The resin has good creep resistance, excellent long-term aging resistance, impact resistance, and good extraction resistance at high temperatures.

Package, Storage and Transportation

The resin is packaged in internally film-coated polypropylene woven bags or FFS film bags. The net weight is 25Kg/bag. The resin should be stored in a drafty, dry warehouse and away from fire and direct sunlight. It should not be piled up in the open air. During transportation, the material should not be exposed to strong sunlight or rain and should not be transported together with sand, soil, scrap metal, coal or glass. Transportation together with toxic, corrosive and flammable substance is strictly prohibited.

PPR PIPE 主要产品牌号性能指标典型值（非保证值）及用途
PPR PIPE Grades, Typical Values (Not Warranted Values) and Applications

产品牌号 Grades		B8101	4220	PPR4400	BR4400	B1101	C180
熔体流动速率 MFR	g/10min	0.4	0.3	0.23	0.23	0.3	0.3
拉伸强度 Tensile strength at yield	MPa	23.5	24	24.3	24.3	28.8	22
断裂伸长率 Elongation at break	%	200	750		590	636	
主要用途 Applications		冷水管材 Cold Water Pipes	冷、热水管材 Cold and Hot Water Pipes	冷、热水管材，工业管道系统 Cold and Hot Water Pipes, Industrial Piping System 冷、热水管材，工业管道系统 Cold and Hot Water Pipes,	冷、热水管材，工业管道系统 Cold and Hot Water Pipes, Industrial Piping System	化工管道系统、片材和板材 Chemical Piping System, Sheets and Plates	冷水管材 Cold Water Pipes
产品认证 Certifications				SCG/RCP	SCG/RCP	SCG/RCP	食品卫生
生产企业 Manufacturers		燕山、茂名 Yanshan, Maoming	燕山 Yanshan	燕山 Yanshan	燕山 Yanshan	燕山 Yanshan	扬子 Yangzi

产品牌号 Grades		YPR-503	PPB-E00-V (YPM-2203T)	PPR-M00 (YPR-503)	YEM-4903T	H5416	QPR01	T4401
熔体流动速率 MFR	g/10min	0.3	0.35	0.35	0.3	0.2	0.21	0.3
拉伸强度 Tensile strength at yield	MPa	22	22	22	23	28	25	25
断裂伸长率 Elongation at break	%							
主要用途 Applications		冷、热水管材 Cold and Hot Water Pipes	冷水管材 Cold Water Pipes	热水管材 Hot Water Pipes	PE100	冷、热水管材，PPR80 Cold and Hot Water Pipes，PPR80	冷水管材 Cold Water Pipes	冷水管材 Cold Water Pipes
产品认证 Certifications				SCG/RCP	SCG/RCP	SCG/RCP	食品卫生	
生产企业 Manufacturers		扬子 Yangzi	扬子 Yangzi	扬子 Yangzi	扬子 Yangzi	中沙 SSTPC	齐鲁 Qilu	茂名 Maoming

牌号 Grades	MFR		Density，g/cm³		Tensile strength at yield，MPa		Elongation at break，%		environmental stress cracking，h		主要用途 Applications
	typical value	Test Standard	typical value	Test Standard	typical value	Test Standard	typical value	Test Standard	typical value	Test Standard	
5310M	0.73	GB/T 3682	0.954	GB/T 1033	19	GB/T 1040	400	GB/T 1040			农用水管、热水管 子、电缆支架等
6100M	0.16	GB/T 3682	0.951	GB/T 1033	18	GB/T 1040	600	GB/T 1040	600	GB/T 1842	埋地排水管
6360M	0.22	GB/T 3682	0.954	GB/T 1033	20	GB/T 1040	600	GB/T 1040	1000	GB/T 1842	压力管材
6380M	0.11	GB/T 3682	0.949	GB/T 1033					1500	GB/T 1842	
7600M	0.035	GB/T 3682	0.95	GB/T 1033	20	GB/T 1040	500	GB/T 1040	10000	GB/T 1842	大口径双壁波纹管
7800M	0.04	GB/T 3682	0.957	GB/T 1033	24	GB/T 1040	600	GB/T 1040	500	GB/T 1842	
DGDB2480	12.5	GB/T 3682	0.945	GB/T 1033	21	GB/T 1040	650	GB/T 1040			
DGDB2480H	10	GB/T 3682	0.943	GB/T 1033	20	GB/T 1040	700	GB/T 1040			非承压管材
GH051T	0.5	GB/T 3682	0.96	GB/T 1033							
QHB16A	3.5	GB/T 3682	0.952	GB/T 1033	25.5	ISO 527	700	ISO 527			
QHB16B	5.5	GB/T 3682	0.952	GB/T 1033	25.5	ISO 527	700	ISO 527			
TR418	0.2	ASTM D1238	0.939	ASTM D1505	19	ASTM D638	500	ASTM D638	500	ASTM D638	
TR480	0.11	ASTM D1238	0.944	ASTM D1505	22	ASTM D638	500	ASTM D638	500	ASTM D638	
YEM-4803T(PE80)	0.32	GB/T 3682	0.95	GB/T 1033	23	GB/T 1040			1000	GB/T 1842	管材
YEM-4902T(PE100)	0.22	GB/T 3682	0.949	GB/T 1033	24	GB/T 1040			1000	GB/T 1842	管材
YGH041	0.26	GB/T 3682	0.95	GB/T 1033	24	ISO 527	600	ISO 527			承压管材
YGH041T	0.38	GB/T 3682	0.958	GB/T 1033	23	ISO 527	520	ISO 527			承压管材
YGM091	0.74	GB/T 3682	0.944	GB/T 1033	19	ISO 527	600	ISO 527			承压管材

中国石化合成树脂产品认证情况一览表
Certifications of Sinopec Synthetic Resins

	产品名称 Products	牌号 Grades	生产企业 Manufacturers	已取得的相关认证 Certifications
高密度聚乙烯 HDPE	管材料 Pipe Grade	6100M	燕山 Yanshan	食品卫生/FDA
		6360M	燕山 Yanshan	FDA
		2300XM	燕山 Yanshan	食品卫生/FDA
		YGH041T	上海 Shanghai	SCG/RCP
		YGH051T	上海 Shanghai	SCG/RCP
		YGM091T	上海 Shanghai	SCG/RCP
		6380M	燕山 Yanshan	食品卫生/SCG/RCP
		7600M	燕山 Yanshan	食品卫生/SCG/RCP
		YEM-4803T	扬子 Yangzi	食品卫生/SCG/RCP
		YEM-4902T	扬子 Yangzi	食品卫生/SCG/RCP
		2480H	齐鲁 Qilu	SCG/RCP
		TR480M	茂名 Maoming	食品卫生/FDA

1. High Density Polyethylene (HDPE) Pipes

HDPE Pipes & Fittings

DIN 8074 Polyethylene (PE) - Pipes
D I N EN 12201 Plastics piping systems for water supply, and for drainage and sewerage under pressure - Polyethylene
BS ISO 4427-1:2007: Plastics piping systems. Polyethylene (PE) pipes and fittings for water supply. General
ISO 12176 (butt welding and electrofusion), ISO 21307 and DVS 2207-1 (butt welding), ISO 14236 (mechanical joints),
Main Lines: HD-PE 100, SDR 17, PN 10
Consumer Connections: HD-PE 80, SDR 11, PN 10 Fittings shall in general be Steel or Ductile Iron whilst electro-fusion jointed bends and tees shall be allowed providing these are not formed by bending straight pipe below the minimum radius specified.

HDPE Pressure Pipes and Fittings shall be manufactured using a pre-compounded blue pigmented PE100 resin, having a Minimum Required Strength (MRS) value of ≥ 10.0 MPa, at a service temperature of 20°C for a minimum design service life of 50 years.

The pipes and fittings shall be manufactured in accordance with EN 12201:2011, ISO 4427 / ISO 4437 or other acceptable International Standard. The Pipes and Fittings shall comply with the following:

HDPE/YGH051T/上海石化(Shanghai Petrochemical)

高密度聚乙烯 HDPE YGH051T 管道专用料 HDPE YGH051T PIPE RAW MATERIAL

用途描述 Applications：		水管、燃气管、排污管、换衬管、海水泄出管和工业用管。 Water Pipe, Gas Pipe, Drainage Pipe, Bushing Pipe, Sea Water Discharge Pipe And Industrial Pipe.			
备注说明： Remark:		特性：具有很好的碳黑分散性和卓绝的抗快速开裂传播及抗慢速开裂增长性能。 Properties: Excellent Dispersion Of Carbon Black And Excellent Resistance To Fast Cracking Propagation And Slow Cracking Growth.			
性能项目 Performance Testing		试验条件[状态] Test Condition [Status]	测试标准 Test Standard	测试数据 Test Data	数据单位 Data Unit
基本性能 Basic Performance	密度(基本树脂) Density (Basic Resin)	---	ISO 1183/ISO 1872-2B	958	kg/m^3
	密度(共混物) Density (Blend)	---	ISO 1183/ISO 1872-2B	959	kg/m^3
	熔体流动速率 The Melt Flow Rate	190℃,2.16kg	ISO 1133	0.1	g/10min
	熔体流动速率 The Melt Flow Rate	190℃,5kg	ISO 1133	0.4	g/10min
机械性能 Mechanical Property	肖氏硬度 Hardness	---	ISO 868	56	---
	简支梁冲击强度 Charpy Notched Impact Strength	23℃	ISO 79-LeU	无破坏 non-destructive	KJ/m^2
	拉伸屈服应力 Tensile Yield Stress	---	ISO/DIS6259	23	MPa
	断裂伸长率 Breaking Elongation	---	ISO/DIS6259	>600	%
	耐环境应力开裂 Environmental Stress Cracking Resistance (ESCR)	---	ASTM D-1693-A	>10000	h
热 性 能 Thermal Properties	脆化温度 Brittle Temperature	---	ASTM D-746	<-70	℃
	热稳定性 Thermal Stability	---	EN 728	15	min
其它性能 Other Property	碳黑含量 Carbon Black Content	---	ASTM D-603	2.3	%

***Tested by our factory**

Physical Properties

High Density Polyethylene (HDPE) is a thermoplastic material which is supplied by the manufacturer in a 'ready to use' pelletised form. The grades suitable for pipe manufacture are PE 63, PE 80 and PE 100. The pipe manufacturer converts this material into pressure pipe.

Table of Physical Properties

The properties given below are for HDPE grades used to manufacture pipe. It should be noted that many of these properties are relative to temperature and the duration of stress application.

Property		Value	Unit	Test Method	Test Specimen
Density at 23℃		0.958	g/cm³	ISO 1183	10mm x 10mm x 4mm
Viscosity Number		380	ml/g	ISO 1628-3	0.1% solution of granules in decahydronaphthalene
Melt Flow Rate	MFR 190/5	0.23	g/10min	ISO 1133	granules sample weight 3g to 6g
	MFR 190/21.6	6.5	g/10min		
Tensile Properties	Yield Stress	26	%	ISO 527, Test Rate 50mm/min	ISO 3167, 4mm thick (test specimen no. 3,4mm thick according to DIN 53 455)
	Enlonggation at Yield Stress	10	N/m ㎡	ISO 527, Test Rate 50mm/min	
	Tensile modulus of Elasticity(secant between 0.05 & 0.25% strain)	900	N/m ㎡	ISO 527	
	Tensile Creep Modulus(1 hour value)	650	N/m ㎡	ISO899, Test Load 2 N/m ㎡	
	Tensile Creep Modulus(1000 hour value)	350	N/m ㎡		
Flexural Properties	Flexural Creep Modulus(1 min value)	1100	N/m ㎡	DIN 54832-Z4 σ b=2 N/m ㎡	110mm x 10mm x 4mm loaded flat
	Flexural Stress (3.5% deflection)	20	N/m ㎡	ISO 178, Test Rate 2 mm/min	80mm x 10mm x 4mm
Stiffness in Torsion		180	N/m ㎡	DIN 53447	60mm x 6.35mm x 3mm
Hardness	Ball Indentation Hardness	41	N/m ㎡	ISO 2039 part 1 Test Load 132N	4mm sheet
	Shore Hardness D (3 sec value)	61	-	ISO 868	6mm sheet
	Shore Hardness D (15 sec value)	59	-		
Notched Impact Strength acN(test specimen from compression moulded sheet)	at 23℃	20	KJ/㎡	ISO 179/1eA	80mm x 10mm x 4mm
	at -30℃	10	KJ/㎡		
Vicat softening Point VST/B/50		67	℃	ISO 306	4mm sheet
Oxidation Induction Time	200℃ in O_2	≥60	min	ISO TR 10837	granules

***Tested by clients**

Water use polyethylene (PE) pipe Factory Inspection Report

Sichuan Xinming Plastic Industry Co., LTD.

***Finished products tested by factor**

Model	PE100 SDR13.6 dn 250×18.4		Production Date	Oct. 28th 2017 ~ Oct. 30th 2017	
Batch No.	PES-011001				
Batch	90 pcs × 9 m		Sampling Date	Oct. 28th 2017	
Sample No.	8 pcs		Testing Date	Oct. 28th 2017 ~ Nov. 7th 2017	
Sampling sampling	Wang Xiaohua, Li Guichun		Inspection Standard	GB/T 13663-2000	
Appearance & Specification	Inspection Item	Decision Rule	Technical Index	Inspection Result	Result
	Color	n=8, Ac=1, Re=2	Black, Blue Line	Conformation	Qualified
	Appearance	n=8, Ac=1, Re=2	The inner and outer surfaces should be clean and smooth and not allowed air bubbles, obvious scratches, dents, impurities and uneven color defects. Pipe ends should be cut flat and perpendicular to the axis.	The inner and outer surfaces should be clean and smooth and no air bubbles, obvious scratches, dents, impurities and uneven color defects. Pipe ends should be cut flat and perpendicular to the axis.	Qualified
	AVG of Outer diameter（mm）	n=8, Ac=1, Re=2	$^{+2.3}_{250\ \ 0}$	251.32	Qualified
	Wall Thickness（mm）	n=8, Ac=1, Re=2	$^{+3.6}_{18.4\ \ 0}$	18.57	Qualified
	Length（mm）	n=8, Ac=1, Re=2	$^{+36}_{9000\ \ -18}$	9015	Qualified
	Out-of-roundness (mm)	n=8, Ac=1, Re=2	≤5.0	2.0	Qualified
Physical & Mechanical Test	Hydrostatic strength, 80℃ Ring Stress 5.5 MPa	According to GB/T 13663-2000	Brittle failure time > 165 h	No leakage or rupture	Qualified
	Oxidation induction time, 200℃	According to GB/T 13663-2000	≥20 min	65.6	Qualified
Conclusion	After inspection, this batch of products meet the requirements of GB/T 13663-2000 standard.				
	This inspection report is for this batch of pipes only				

Pipes:	Material: Colour:	Polyethylene PE100 (MRS100), density ≥0.95 kg/dm³ **Blue** **Black with Blue stripes** **Black with Blue outer coextruded layer**
	Pressure Rating:	SDR 7.4 – PN 25 SDR 9 – PN 20 SDR 11 – PN 16 SDR 13.6 – PN 12.5 SDR 17 – PN 10 SDR 21 – PN 8 SDR26 – PN 6 SDR 33 – PN 5
	Supply Lengths:	All pipe sizes up to and including OD 75 mm shall be supplied in coils of 50 or 100 meters. All pipes, OD 90mm and above shall be supplied in straight lengths not exceeding 12 metres.
Fittings:	Material:	Polyethylene PE100 (MRS100), density ≥0.95 kg/dm³
	Colour:	Black or Blue
	Type of Joint:	Electrofusion / Spigot type for Butt Fusion / Compression (for sizes 110mm and below)/ Hot melt socket
	Pressure Rating:	SDR 17 – PN10 SDR 11 – PN16
Diameters:	*as per EN 12201-2*	

ISO Size and Dimension Data

PE100

ISO HDPE SERIES

Pressure Ratings are calculated using a 1,25 design coefficient (C) for MRS at 20°C as listed in PPI TR-4 for PE 100 materials. Pressure ratings are based on water applications. Temperature, Chemical, and Environmental use considerations may require use of additional design coefficients.

ISO 4427 Pipes Series		S 3.2			S 4			S 5			S 6.3		
ASTM F714 DR		DR 7.4			DR 9			DR 11			DR 13.60		
Nominal Pressure PE 100		PN = 25 bar			PN = 20 bar			PN = 16 bar			PN = 12.5 bar		
Nominal Size DN (mm)	Equiv Size (in)	Minium Wall (mm)	Average ID (mm)	Weight (kgs)	Minium Wall (mm)	Average ID (mm)	Weight (kgs)	Miniu m Wall (mm)	Average ID (mm)	Weight (kgs)	Minium Wall (mm)	Average ID (mm)	Weight (kgs)
20	0.79	3	13.6	0.17	2.3	15.12	0.14	2.0	15.76	0.12	1.5	16.88	0.09
25	0.98	3.5	17.6	0.25	3	18.64	0.22	2.3	20.12	0.17	2.0	20.76	0.15
32	1.26	4.4	22.7	0.4	3.6	24.37	0.34	3.0	25.64	0.29	2.4	26.91	0.24
40	1.57	5.5	28.3	0.63	4.5	30.46	0.53	3.7	32.16	0.45	3.0	33.64	0.37
50	1.97	6.9	35.4	0.99	5.6	38.13	0.83	4.6	40.25	0.69	3.7	42.16	0.57
63	2.48	8.6	44.8	1.56	7.1	47.95	1.32	5.8	50.70	1.10	4.7	53.04	0.91
75	2.95	10.3	53.2	2.22	8.4	57.19	1.86	6.8	60.58	1.54	5.6	63.13	1.29
90	3.54	12.3	63.9	3.18	10.1	68.59	2.68	8.2	72.62	2.23	6.7	75.80	1.86
110	4.33	15.1	78	4.76	12.3	83.92	4.00	10.0	88.80	3.33	8.1	92.83	2.74
125	4.92	17.1	88.7	6.14	14	95.32	5.17	11.4	100.83	4.31	9.2	105.50	3.54
140	5.51	19.2	99.3	7.71	15.7	106.72	6.49	12.7	113.08	5.38	10.3	118.16	4.44
160	6.3	21.9	113.6	10.06	17.9	122.05	8.46	14.6	129.05	7.06	11.8	134.98	5.81
180	7.09	24.6	127.8	12.7	20.1	137.39	10.69	16.4	145.23	8.92	13.3	151.80	7.37
200	7.87	27.4	141.9	15.72	22.4	152.51	13.23	18.2	161.42	11.00	14.7	168.84	9.06
255	8.86	30.8	159.7	19.89	25.2	171.58	16.74	20.5	181.54	13.94	16.6	189.81	11.50
250	9.84	34.2	177.5	24.54	27.9	190.85	20.60	22.7	201.88	17.16	18.4	210.99	14.17
280	11.02	38.3	198.8	30.78	31.3	213.64	25.88	25.4	226.15	21.50	20.6	236.33	17.77
315	12.4	43.1	223.6	38.97	25.2	240.38	32.75	28.6	254.37	27.24	23.2	265.82	22.51
355	13.98	48.5	252.2	49.43	39.7	270.84	41.62	32.2	286.74	34.56	26.1	299.67	28.54
400	15.75	54.7	284	62.8	44.7	305.24	52.81	36.3	323.04	43.90	29.4	337.67	36.23
450	17.72	61.5	319.6	79.44	50.3	343.36	66.85	40.9	363.29	55.64	33.1	379.83	45.88
500	19.69	67.6	356.7	97.19	55.8	381.7	82.42	45.4	403.75	68.63	36.8	421.98	56.68
560	22.05	75.7	399.5	121.9	62.5	427.5	103.39	50.8	452.30	86.01	41.2	472.66	71.07
630	24.8	85.1	449.6	154.19	70.3	480.96	130.83	57.2	508.74	108.94	46.3	531.84	89.86
710	27.95	95.9	506.7	195.82	79.3	541.88	166.30	64.5	573.26	138.44	52.2	599.34	114.17
800	31.5				89.3	610.68	211.03	72.6	646.09	175.59	58.8	675.34	144.91
900	35.43							81.7	726.80	222.30	66.2	759.66	183.53
1000	3.37							90.2	808.78	272.87	72.5	846.30	223.59
1200	47.24										88.2	1013.02	326.06
1400	55.12										102.9	1181.85	443.80

ISO 4427 Pipe Series		S 3.2			S10			S12.5			S16		
ASTM F714 DR		DR 17			DR 21			DR 26			DR 33		
Nominal Pressure PE100		PN= 10 bar			PN= 8 bar			PN= 6 bar			PN= 5 bar		
Nominal Size DN (mm)	Equiv Size (in)	Minium Wall (mm)	Average ID (mm)	Weight (kgs)	Minium Wall (mm)	Average ID (mm)	Weight (kgs)	Minium Wall (mm)	Average ID (mm)	Weight (kgs)	Minium Wall (mm)	Average ID (mm)	Weight (kgs)
20	0.79	1.2	17.51	0.07	1	17.98	0.06	0.6	18.72	0.04	0.61	18.72	0.04
25	0.98	1.5	21.88	0.12	1.2	22.48	0.09	0.8	23.39	0.06	0.76	23.39	0.06
32	1.26	2.0	27.76	0.2	1.5	28.77	0.15	1	29.94	0.1	0.97	29.94	0.1
40	1.57	2.4	34.91	0.3	2	35.76	0.25	1.2	37.43	0.16	1.21	37.43	0.16
50	1.97	3.0	43.64	0.47	2.4	44.91	0.38	2	45.76	0.32	1.52	46.76	0.24
63	2.48	3.8	54.94	0.75	3	56.64	0.6	2.5	57.7	0.5	1.91	58.95	0.39
75	2.95	4.5	65.46	1.05	3.6	67.37	0.85	2.9	68.85	0.7	2.27	40.18	0.55
90	3.54	5.4	78.55	1.52	4.3	80.88	1.23	3.5	82.58	1.01	2.73	84.22	0.79
110	4.33	6.6	96.01	2.27	5.3	98.76	1.85	4.2	101.1	1.48	3.33	102.93	1.18
125	4.92	7.4	109.31	2.89	6	112.28	2.37	4.8	114.82	1.92	3.79	116.97	1.53
140	5.51	8.3	122.4	3.63	6.7	125.8	2.97	5.4	128.55	2.42	4.24	131.01	1.92
160	6.30	9.5	139.86	4.75	7.7	143.68	3.9	6.2	146.86	3.17	4.85	149.72	2.5
180	7.09	10.7	157.32	6.02	8.6	161.77	4.9	6.9	165.37	9.97	5.45	168.44	3.17
200	7.87	11.9	174.77	7.44	9.6	179.65	6.08	7.7	183.68	4.92	6.06	187.15	3.91
225	8.86	13.4	196.59	9.43	10.8	202.1	7.69	8.6	206.77	6.19	6.82	210.55	4.95
250	9.84	14.8	218.62	11.57	11.9	224.77	9.42	9.6	229.65	7.67	7.58	233.94	6.11
280	11.02	16.6	244.81	14.54	13.4	251.59	11.88	10.7	257.32	9.58	8.48	262.01	7.66
315	12.40	18.7	275.36	18.42	15	283.2	14.96	12.1	289.35	12.19	9.7	294.44	9.85
355	13.98	21.1	310.27	23.43	16.9	319.17	19	13.6	326.17	15.44	10.9	331.89	12.47
400	15.75	23.7	349.76	29.65	19.1	359.51	24.19	15.3	367.56	19.57	12.3	373.92	15.86
450	17.72	26.7	393.4	37.58	21.5	404.42	30.63	17.2	413.54	24.75	13.8	420.74	20.02
500	19.69	29.7	437.04	46.44	23.9	449.33	37.84	19.1	459.51	30.54	15.3	467.56	24.66
560	22.05	33.2	489.62	58.15	26.7	503.4	47.35	21.4	514.63	38.32	17.2	523.54	31.04
630	24.80	37.4	550.71	73.69	30	566.4	59.85	24.1	578.91	48.55	19.3	589.08	39.19
710	27.95	42.1	620.75	93.5	33.9	638.13	76.21.	27.2	652.34	61.75	21.8	663.78	49.88
800	31.50	47.4	699.51	118.62	38.1	719.23	96.52	30.6	735.13	78.28	24.5	748.06	63.18
900	35.43	53.3	787	150.06	42.9	809.05	122.26	34.4	827.07	99.01	27.6	841.49	80.06
1000	39.37	59.3	874.28	185.48	47.7	898.88	151.04	38.2	919.02	122.16	30.6	935.13	98.63
1200	47.24	67.9	1056.05	255.6	57.2	1078.74	217.35	45.9	1102.69	176.14	36.7	1122.2	141.96
1400	55.12	82.4	1225.31	361.00	66.7	1258.6	295.7	53.5	1286.58	239.53	42.9	1309.05	193.58

Physical Properties

High Density Polyethylene (HDPE) is a thermoplastic material which is supplied by the manufacturer in a 'ready to use' pelletised form. The grades suitable for pipe manufacture are PE 63, PE 80 and PE 100. The pipe manufacturer converts this material into pressure pipe.

Table of Physical Properties

The properties given below are for HDPE grades used to manufacture pipe. It should be noted that many of these properties are relative to temperature and the duration of stress application.

Property		Value	Unit	Test Method	Test Specimen
Density at 23 °C		0.958	g/cm³	ISO 1183	10mm x 10mm x 4mm
Viscosity Number		380	ml/g	ISO 1628-3	0.1% solution of granules in decahydronaphthalene
Melt Flow Rate	MFR 190/5	0.23	g/10min	ISO 1133	granules sample weight 3g to 6g
	MFR 190/21.6	6.5	g/10min		
Tensile Properties	Yield Stress	26	N/mm²	ISO 527, Test Rate 50 mm/min	ISO 3167, 4mm thick (test specimen no. 3, 4mm thick according to DIN 53 455
	Enlonggation at Yield Stress	10	%	ISO 527, Test Rate 50 mm/min	
	Tensile modulus of Elasticity (secant between 0.05 & 0.25% strain)	900	N/mm²	ISO 527	
	Tensile Creep Modulus (1 hour value)	650	N/mm²	ISO 899, Test Load 2 N/mm²	
	Tensile Creep Modulus (1000 hour value)	350	N/mm²		
Flexural Properties	Flexural Creep Modulus (1 min value)	1100	N/mm²	DIN 54852-Z4 σb=2 N/mm²	110mm x 10mm x 4mm loaded flat
	Flexural Stress (3.5% deflection)	20	N/mm²	ISO 178, Test Rate 2 mm/min	80mm x 10mm x 4mm
Stiffness in Torsion		180	N/mm²	DIN 53447	60mm x 6.35mm x 3mm
Hardness	Ball Indentation Hardness	41	N/mm²	ISO 2039 part 1 Test Load 132N	4mm sheet
	Shore Hardness D (3 sec value)	61	~	ISO 868	6mm sheet
	Shore Hardness D (15 sec value)	59	~		
Notched Impact Strength acN (test specimen from compression moulded sheet)	at 23 °C	20	kJ/m²	ISO 179/1eA	80mm x 10mm x 4mm
	at -30 °C	10	kJ/m²		
Vicat softening Point VST/B/50		67	°C	ISO 306	4mm sheet
Oxidation Induction Time	200 °C in O	>=60	min	ISO TR 10837	granules

Comparison with Other Plastic Materials

Property	HDPE	PP	PVC	PVC-C*	PB*
Surface feel	Waxy	Waxy	Smooth	Smooth	Waxy
Appearance (water pipes)	Black	Pale grey-beige	Blue	Grey-beige	Black
Sound produced when dropped	Medium clatter	High clatter	High clatter	High clatter	Dull thud
Combustibility and appearance of flame	Bright flame: Drops continue to burn after falling	Bright flame: Drops continue to burn after falling	Carbonises in flame: Extinguishes away from flame	Carbonises in flame: Extinguishes away from flame	Bright flame; Drops continue to burn after falling
Odour of smoke after flame is extinguished	Like candles	Like resin	Pungent like hydrochloric acid	Pungent like hydrochloric acid	Like candles but more acrid than HDPE
Nail test (impression made by fingernail)	Impression possible	Very light impression possible	Impression not possible	Impression not possible	Impression easily poduced
Special features					Smears when sawn
Floats in water	Yes	Yes	No	No	Yes
Notch sensitivity	No	Slight	Yes	Yes	Yes
Weather resistance	Stabilised, good	Stabilised, good	Stabilised, good	Stabilised, good	Stabilised, good
Method of permanent jointing	Fusion	Fusion	Solvent cement	Solvent cement	Fusion
Suitable for mechanical jointing	Yes	Yes	Yes	Yes	Yes
Stress crack sensitivity with regard to jointing with safe media, e.g water	Some	Slight	None	None	None
Linear expansion mm/m/°C	0.2	0.15	0.08	0.07	0.12
Thermal conductivity kcal/mh°C	0.4	0.19	0.14	0.14	0.2
Specific heat kcal/mh°C	0.42	0.4	0.23	0.23	0.47
Specific weight kg/cm²	0.955	0.905	1.42	1.5	0.92
Tensile strength at 20 °C kp/cm²	240	320	550	550	200
Modulus of elasticity at 20 °C kp/cm²	8000	15000	30000	30000	5000

This product flyer is intended for reference purposes. It should not be used in place of the advice from a licensed Professional Engineer. Nominal pressure (PN) is based on C = 1,25 and an
operating temperature of 20°C. Weight is calculated using DN and Minimum wall plus 6% for use in estimating fluid flow. Actual ID will vary. When designing components to fit the pipe ID, refer to pipe dimensions and tolerances in the applicable pipe manufacturing specification. To obtain pressure in psi, multiply bar by 14.5 (1 bar ≈ 14.5 psi).

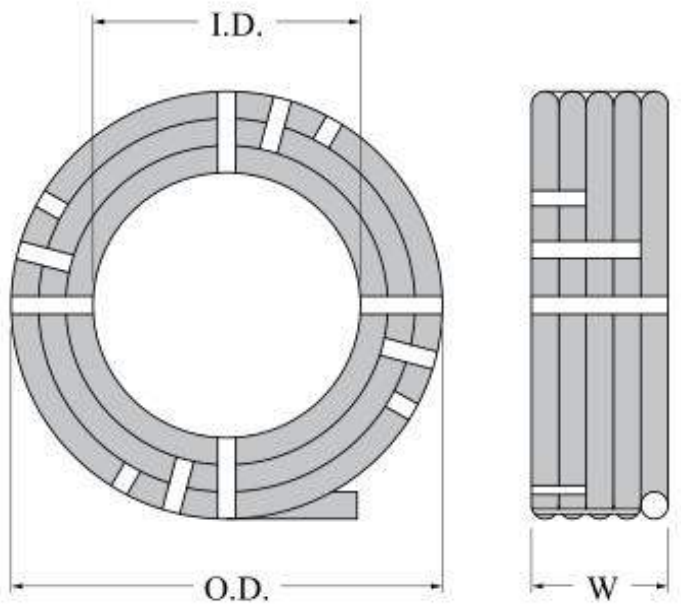
Pipe Specification

Specifications of pipes by roll

The HDPE pipes manufactured by Phindustry Pipe Systems are manufactured to, and carry the SABS mark for, SANS ISO 4427. These pipes are manufactured from three different designated materials viz: PE 63, PE 80 and PE 100. In these tables it can be seen that SANS ISO 4427 have grouped together the different pressure classes, produced from different material designations, under a common heading known as the Standard Diameter (Dimension) Ratio or SDR. The minimum wall thicknesses specified are not exactly that which would be derived from a calculation using Barlow's formula or the SDR but are the rounded up values of the highest
minimum wall thickness calculated for any size and class in the SDR group.

Coil Dimensions

		Coil Dimensions				
		I.D.	O.D.		Width(W)	
		mm	mm	mm	mm	mm
O.D.	SDR's	Coil Length - metres				
mm		50/100m	50m	100m	50m	100m
16	7.4/9/11	600	n/a	860	n/a	180
20	7.4/9/11/13.6	600	n/a	860	n/a	180
25	7.4/9/11/13.6/17	600	n/a	890	n/a	200
32	7.4/9/11/13.6/17	700	n/a	1090	n/a	220
40	7.4/9/11/13.6/17/26	700	n/a	1090	n/a	220
50	7.4/9/11/13.6/17/26	1300	1410	1560	150	220
63	7.4/9/11/13.6/17/26	1300	1780	1960	190	280
75	7.4/9/11/13.6/17	1300	1780	1960	190	280
90	7.4/9/11	2500	3100	3300	270	360
90	13.6/17/21	1800	2360	2540	360	450
110	7.4/9/11	2500	3160	n/a	330	n/a
110	13.6/17/21	2200	2860	n/a	400	n/a



Hydrostatic Design Stress (HDS)

Designation of material	MRS at 50 years and 20℃- Mpa	Maximum allowable hydrostatic design stress σ - Mpa
PE63	6.3	5
PE80	8	6.3
PE100	10	8

Notes on Pipe Dimension tables:

- HDS (Hydrostatic Design Stress), in (MPA), is obtained by applying a design factor of not less than 1.26 to the minimum required strength value of the pipe.
- Out of roundness (Ovality) Grade N.
- PE 63 material is NLA. Therefore PE 80 material is used to manufacture PE 63 specification, increasing the design safety factor from 1,26 to 1,6.
- SDR = Standard Dimension Ratio = Outside diameter / wall thickness

Performance Characteristics

The pipes shall have the following basic minimum performance characteristics:

Paramete	Unit	Value
Average Density as per ISO 1183	Gm/cm^3	≥ 0.95
Melt Flow Index MFI 190°C / 50N as per ISO 1133	Gm/10 min.	0.4-0.55
Minimum Tensile Strength	N/mm^2	25
Elongation at Break	%	≥ 600%
C-Modulus (Modulus of Elasticity)	N/mm^2	1200
Minimum Radius of Curvature at 20°C		25 x OD
Linear Coefficient of Thermal Expansion (VDE 0304)	$°K^{-1}$	1.3×10^{-4}

Marking and Identification

Pipes shall be clearly and indelibly marked to show the following:

- Name of Manufacturer / Brand
- Nominal Diameter x Minimum Wall Thickness
- Material Classification (i.e. PE100)
- Standard Dimension Ratio and Pressure Rating (SDR17 PN10 or SDR11 PN16)
- Reference Standard of Manufacture (e.g. EN 12201)
- Date of Manufacture

Quality Assurance Plan

HDPE pressure pipeline testing

It is always advisable to out the PE pipeline testing before the covering. Generally the testing are carried out sectioning parts of proper length, which must be closed with suitable systems.
For example, with blank flanges provided with connections for pressure gauge, pump, breathers, etc.
The pipeline must be anchored avoiding the movement of under pressure pipelines, and proceeding with partial trench covering leaving the joints uncovered for further inspection. The pipeline is filled with water from the most low-laying point where the manometer must be installed. Particular car is applied for the out coming of air from breathers, cocks, etc.
The pipeline is placed under pressure at a value up to 1.5 times the nominal pressure at 20°C for 1 hour.
If there is a pressure loss, it is important to measure the necessary quantity of water to restore the testing pressure.

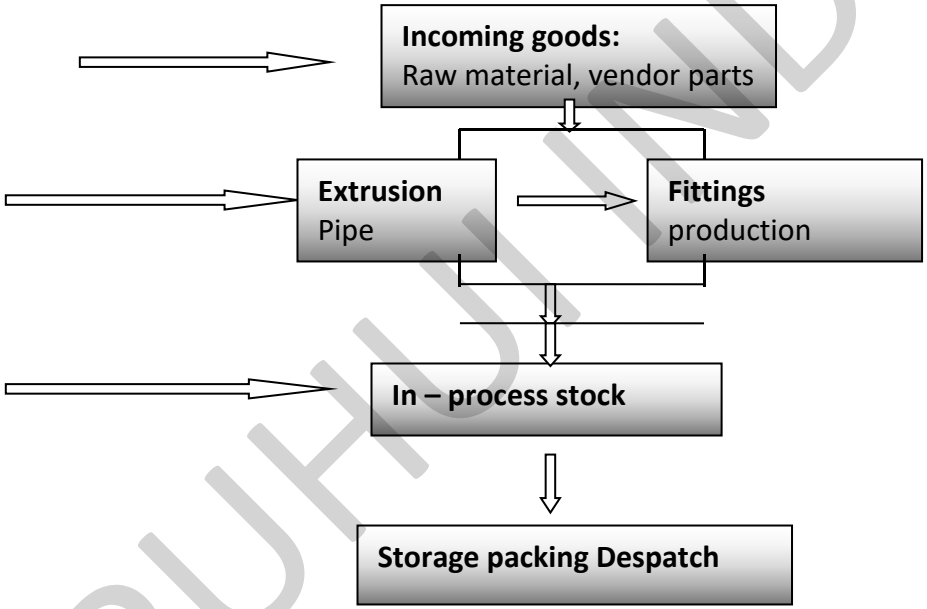
System control:

Test and acceptance parts

In-process inspec

Final inspection:

- imensional control
- urface finish
- elt flow index
- mpact bending test
-



This quantity must not exceed the water quantity, derived from the formula:

QH20 = 0.125 x L / 1000 x P / 3 x D / 25 x N

Where:
L = Length in meters
P = Testing pressure in bar
D = Inside diameters in millimeters
N = Number of hours

If the testing at 1 hour is positive, that of 12 hours will follow for the same pressure value, with check carried out with above calculation.

The Stress Regression Line

The traditional method of portraying the primary mechanical property of HDPE, tensile strength, is by means of a graph of log stress vs. log time to failure. This is known as the stress regression line. It is a plot of the circumferential hoop stress in the wall of the pipe (from internal pressure) against time to failure.

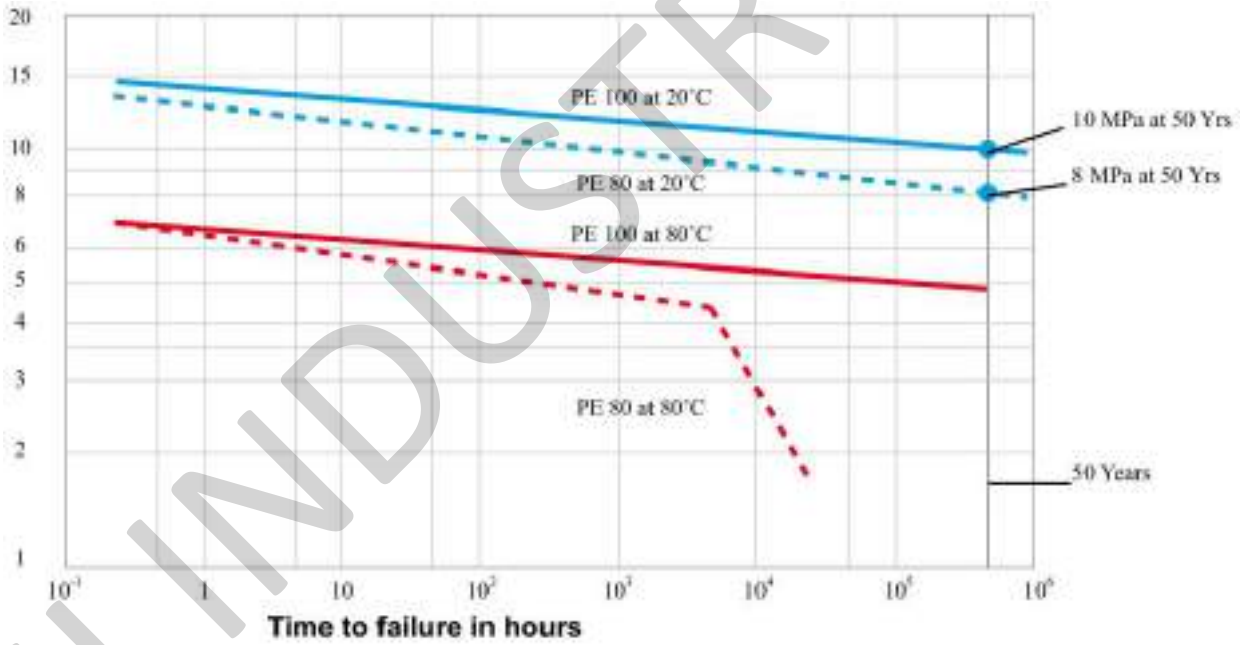
Numerous actual test results, measured at 20 °C and 60 °C, over a range of times up to 10,000 hours, are plotted on a log scale and a regression line is calculated to fit this data. The resultant regression line is then extrapolated to 50 years (438,000 hours). The method of calculation is an internationally accepted procedure described in ISO/TR 9080. The required values of stress and time are specified in SANS ISO 4427.

The internationally accepted method for calculating circumferential hoop stress is derived from Barlow's formula and is as follows:

$\sigma = p(d - t)/2t$

where:
p = internal pressure (MPa)
t = minimum wall thickness (mm)
d = mean external diameter (mm)
σ = circumferential hoop stress in wall of pipe (MPa)
The Stress Regression Line for HDPE is given right.

σ Burst Stress MPa



Principal stress/time curves for PE 80 and PE 100 pipes at 20˚C and 80˚C. The standard cu for HDPE Type 2 at 80˚C (acc. to DIN 8075) is shown in comparison. The minimum require strength (MRS) at 20˚C and 50 years is 10 MPa for PE 100 and 8 MPa for PE 80 giving the design stress 8 MPa and 6 MPa respectively.

Designation of material	MRS at 50 years and 20° C Mpa	Maximum allowable hydrostatic design stress, σ – Mpa
PE 100	10	8
PE 80	8	6.3
PE 63	6.3	5

Design Stress and Safety Factor (service factor)

Safety factors take into account handling conditions, service conditions and other circumstances not directly considered in the design. In terms of SANS ISO 4427 the minimum safety factor is 1.25. This factor, when applied to the Minimum Required Strength (MRS), for the particular material classification (e.g. PE 80, PE 100), gives the maximum allowable hydrostatic design stress for the designated material.

The table below illustrates the relationship between MRS and σ for various design coefficients at 20 °C.

Hydrostatic design stress of pipe σ - MPa	MRS of material - MPa		
	10	8	6.3
	Design coefficient, C		
8	1.25		
6.3	1.59	1.27	
5	2	1.6	1.26

The design engineer may wish to apply a greater safety factor depending on operating conditions and environmental considerations. Applying Barlow's formula (below) it is possible to calculate the minimum wall thickness for any given size and pressure class of pipe.

$$t = p \times d/(2\sigma + p)$$

where:
- t = minimum wall thickness (mm)
- p = internal pressure (MPa)
- d = mean external diameter (mm)
- σ = design stress (MPa)

For example the minimum wall thickness for a 250 mm Class 10 HDPE pipe made from PE 80 material is:

$$t = 1.0 \times 250/\{(2 \times 6.3) + 1.0\}$$
$$= 18.38 \text{ mm}$$

Round up to 18.4 mm for manufacture and/or the appropriate SDR for the Class and Material designation.

Melt Flow Index

The melt flow index of polyethylene materials is a measure of the mass of melted material, at 190 °C, that will pass through a specific orifice in 10 minutes when subjected to a specific pressure. The melt flow index (MFI) is largely dependant on the molecular mass. Higher molecular masses result in lower MFI because long, well packed molecules do not flow as easily as short, less packed molecules.

Since both density and MFI are decisive for the strength properties, they are regulated in most standards for polyethylene pipes. In terms of the SABS specification the Melt Flow Index must conform to the raw material manufacturers pipe grade specification.
This information can be obtained from the raw material manufacturers data sheets.
(See Table of Physical Properties on page 18)

Tensile Strength

The tensile strength of polyethylene materials increases with an increase in molecular mass since long, well packed molecules are more difficult to separate. This property is also effectively regulated by standards.

(See Table of Physical Properties on page 18)

Effect of Temperature Change
Working Pressure

The standard design temperature for HDPE pipes is 20°C and working pressures are usually quoted for this temperature. HDPE pressure pipes function perfectly well below 20 °C right down to freezing point and can in fact, withstand higher pressures than those quoted at 20 °C.
As can be seen from the stress regression lines, the creep rupture strength diminishes with increasing temperature and working pressures must be down-rated if the same factors of safety are to be maintained. The applicable reduction factors are given under “Temperature Considerations” on page 59.

Sub Zero Temperatures

Water has been known to freeze in HDPE pipes without causing fractures, but permanent strain can result, leading to severe reduction in the working life of the pipe. Hence HDPE pipes - like other pipes - should be protected against sub zero temperatures.

Expansion and Contraction

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

Impact Resistance

It should be noted that it is possible to change the impact strength of certain plastic materials, however this usually comes at the expense of properties such as tensile strength, hardness or stiffness. This property is therefore effectively regulated (as with density and MFI) by most standards.

Ultra Violet Resistance

HDPE pipes, when manufactured to SANS ISO 4427, contain 2.5% (by mass) of carbon black. This provides exceptional protection against the effects of ultra violet light.

Flammability

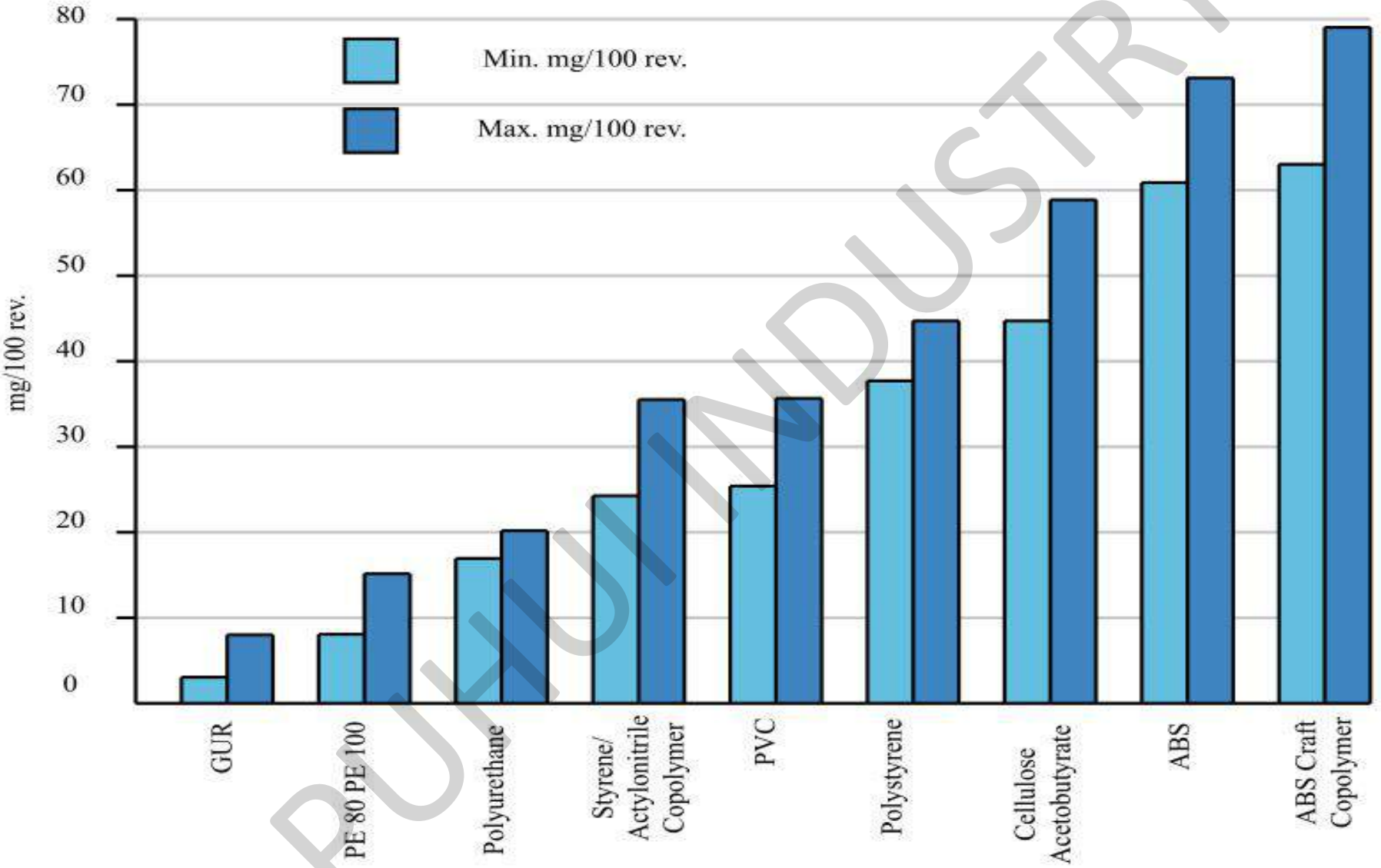
As with impact resistance, it is possible to improve the fire resistance of HDPE by the addition of various compounds. Again this comes at the expense of other properties. Fire resistance is measured by a limiting oxygen index (LOI).

Abrasion Resistance

A number of international investigations to assess the abrasion resistance of various plastic materials have been carried out. Generally the results of such investigations are expressed as a loss of volume in relation to the original wall thickness. The results to date have varied in regard to the abrasion resistance of various pipe materials. However, what they all show is that plastics possess superior abrasion resistance relative to other pipe materials. For example, in one investigation, HDPE pipes suffered wear to the extent of 4 mm after 1600 hours while the corresponding wear occurred in steel pipes after 1000 hours. The graph below provides a further indication of relative wear rates.

Material	Co-efficient of expansion (K-l)
MPVC	8×10^{-5}
HDPE	20×10^{-5}
LDPE	20×10^{-5}
Steel	$1,2 \times 10^{-5}$
Copper	$2,0 \times 10^{-5}$

Graph of Relative Wear rates



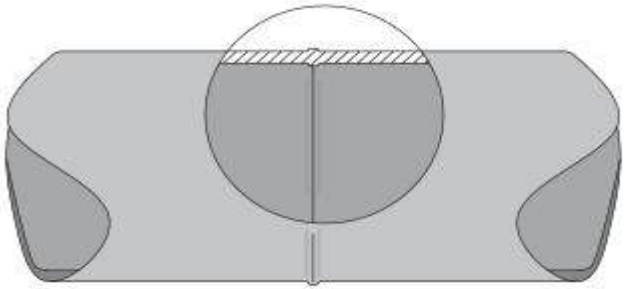
Dry sliding abrasion of a number of PE 80, PE 100 and some other grades of thermoplastic materials.
Taber Abrasion Method in accordance with DIN 53754 E

Jointing

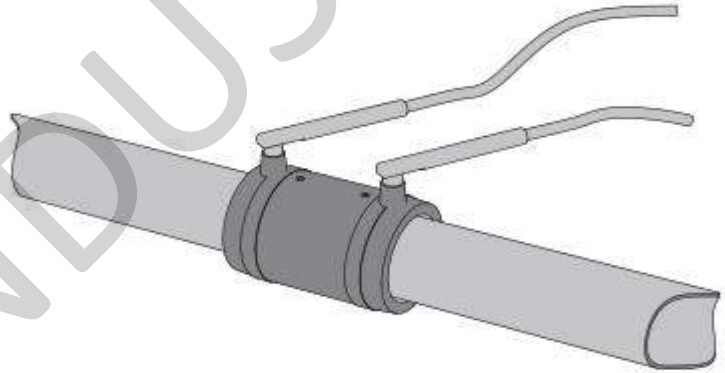
One of the greatest features of HDPE pipes is the fact that a wide variety of jointing systems is available to suit a whole range of applications. The jointing systems can be divided into permanent jointing and detachable jointing. The schematic below illustrates the available systems.

Permanent Jointing

Buttwelding



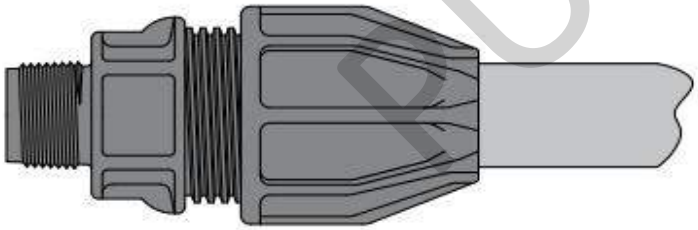
Electro-fusion



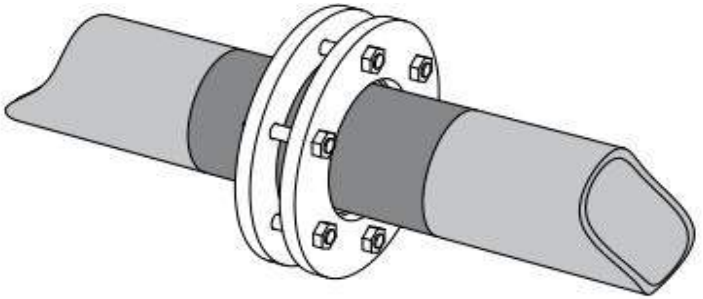
Both buttwelding and electro-fusion systems allow transition to detachable joints.

Non-Permanent (detachable) Jointing

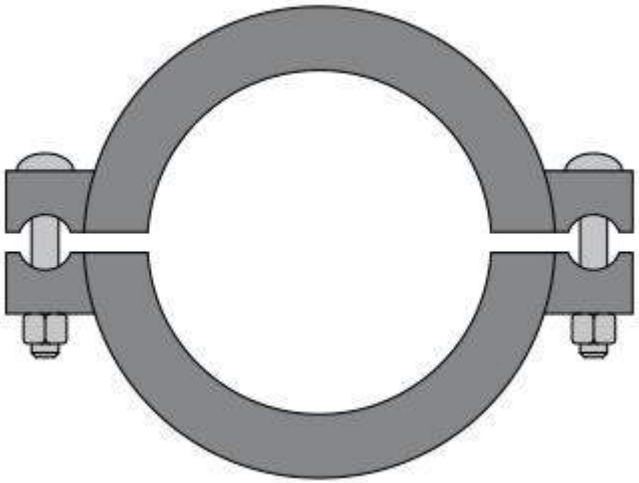
Compression Fittings*



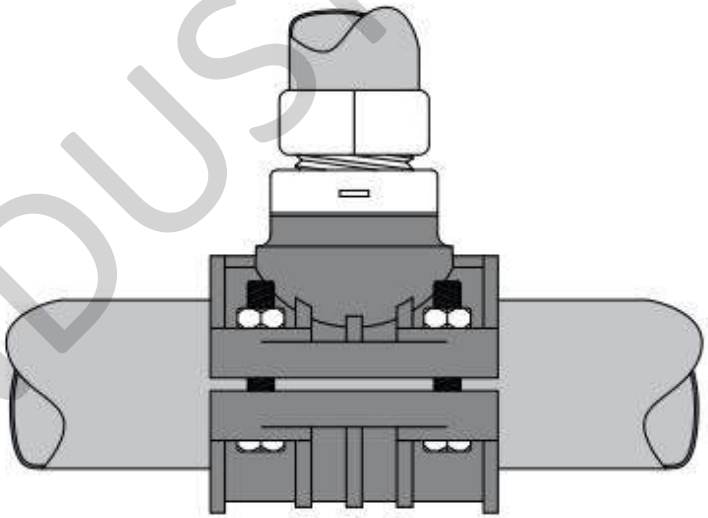
Flanging



Tak System



Saddles and Holderbats



*Refer to our Phindustry Astore Compression Fittings document for full details on these products.
** Refer to our saddles and Holderbats document for full details on these products.

Buttwelding Principles

General

Butt-fusion jointing is a thermofusion process which involves the simultaneous heating of the ends of two components which are to be joined until a melt state is attained on each contact surface. The two surfaces are then brought together under controlled pressure for a specific cooling time and homogeneous fusion is formed upon cooling. The resultant joint is resistant to end thrust and has comparable performance under pressure to the pipe.
This method of jointing requires an electrically heated plate to raise the temperature of the pipe ends to the required fusion temperature and is used for PE 63, PE 80 and PE 100 grades of material for pipe of size 32 mm and above of the same Standard Dimension Ratio (SDR). When joining pipes using butt-fusion techniques, the heater plate temperatures are the same for PE 63, PE 80 and PE 100, 195 °C to 200 °C.

The Site Fusion Jointing Specification WIS 4-32-08 Issue 2, 1994 emphasises the importance for the butt-fusion machine to be able to control the reduced secondary ram pressures that are now required for dual pressure butt-fusion jointing. For SDR 11 pipes of sizes 250 mm, 280 mm and 315 mm and for all pipe (SDRs 11, 17.6, 26) of size 355 mm and above the butt fusion pressures should be reduced after 10 seconds and therefore the use of an automatic butt fusion machine is required.
(These conditions are tabulated on page34)

Depending on the design and make, butt-fusion machines may or may not be capable of accepting fittings as moulded for direct welding to pipes. Phindustry therefore offers two ranges of fittings for butt-fusion systems to provide the greatest flexibility in this regard:

- **long spigot fittings**
- **'pupped' fittings**

Pupped fittings are fabricated by butt-fusing, (in the factory), 0.5 m lengths of pipe to each leg of a spigot fitting, thereby allowing the straight length of pipe to be gripped by clamps of the butt-fusion machine.

The Phindustry butt-fusion system comprises, therefore:

- Straight polyethylene pipe
- Long spigot fittings
- Pupped fittings
- Accessories

Equipment

- Generator to supply the heater plate, trimmer and hydraulic pump
- Butt-fusion machine fitted with the correct size clamp shells, trimmer, heater plate, hydraulic pump and timer
- Pipe support rollers
- Welding tent
- Cleaning material, lint free cotton cloth or paper towel
- External/Internal debeading tool
- Bead gauge
- Digital thermometer with surface probe to check heater plate.
- Pipe end covers
- Baseboard
- Pipe cutters
- Air temperature thermometer
- Indelible marker pen
- Timer

Jointing Method

Pre-Welding Checks

Before commencing a welding operation check that:

- There is sufficient fuel for the generator to complete the joint and that it is functioning correctly before it is connected to the machine.
- The trimming tool and hydraulic pump are in working order.
- The heater plate is clean and residue from previous welds have been removed.
- A tent is available to provide shelter during welding.
- The machine is complete and undamaged.
- You know the correct welding parameters for the machine and pipe being welded.
- The heater plate is at the correct temperature. (Connect the heater plate to the power supply and retain for at least 20 minutes inside the thermally insulated guard). To remove dirt deposits the heater plate may be washed, when cold, with copious quantities of clean water at the start of the jointing session. Only clean, lint free materials must be used to clean the plate. To remove grease and oily films the plate may be wiped with lint free material dampened by a suitable solvent, eg. Isopropanol.
- Check that the pipes and/or fittings to be jointed are of the same size, SDR and materials.

Dummy Welds

Even though washing may remove large deposits of dirt, very fine particles of dust may still remain on the heater plate. To remove such dust it is necessary to make a dummy joint at the start of each jointing session, whenever the plate has been allowed to cool below 180 °C, or at a change of pipe size. Two dummy joints will be made if the pipe size is greater than 180mm.

A dummy joint can be made using pipe off cuts of the same size, SDR and material as the pipe being installed. It is not necessary to complete the joint. The procedure can be discontinued after the full heat cycle.

Manual Welding

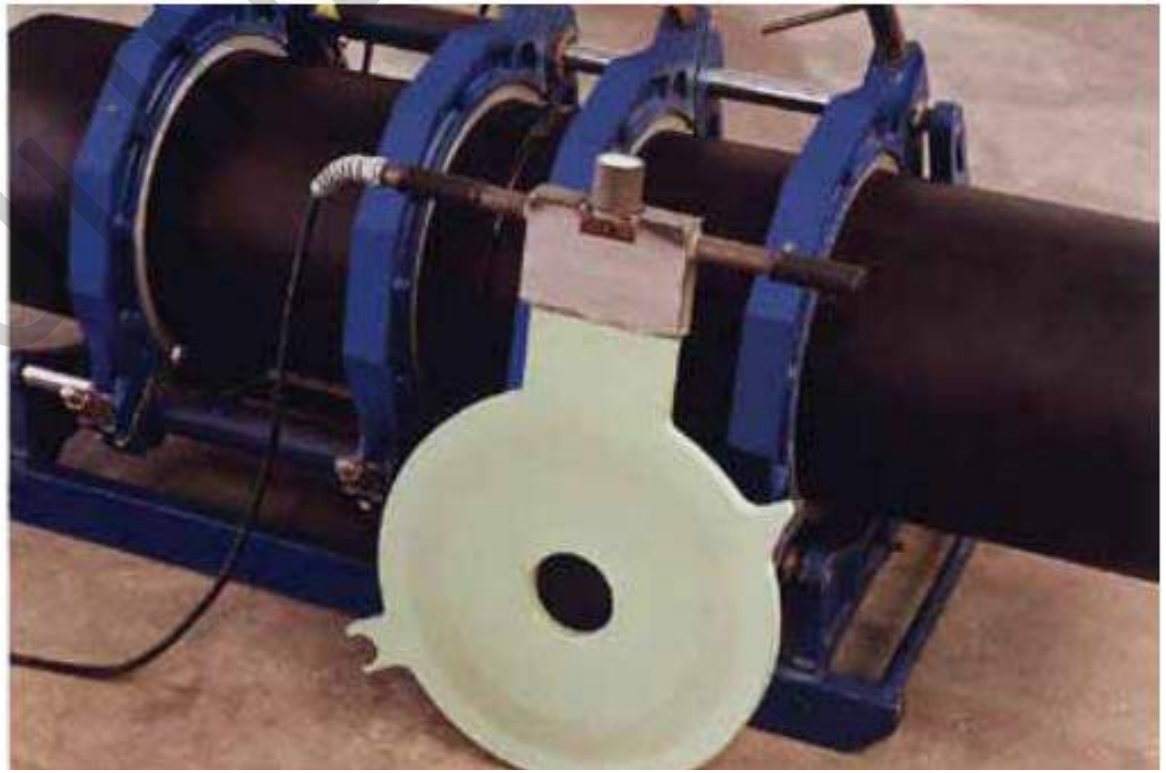
Procedure

- Place the pipes in the clamps with the ends against the trimming tool and with the pipe markings aligned.
- Align and level the components using the support rollers.
- Tighten the pipe clamps to grip and re-round the pipes.
- Cover the free ends of the pipes to prevent cooling of the plate by internal draughts.
- Switch on the trimming tool and close the clamps slowly so that the pipe ends are moved against the trimming tool until continuous shavings are cut from each surface.
- Keep the trimming tool turning whilst opening the clamps to avoid steps on the trimmed surfaces.
- Remove the trimming tool taking care not to touch the trimmed ends.
- Remove loose shavings from the machine and component ends.

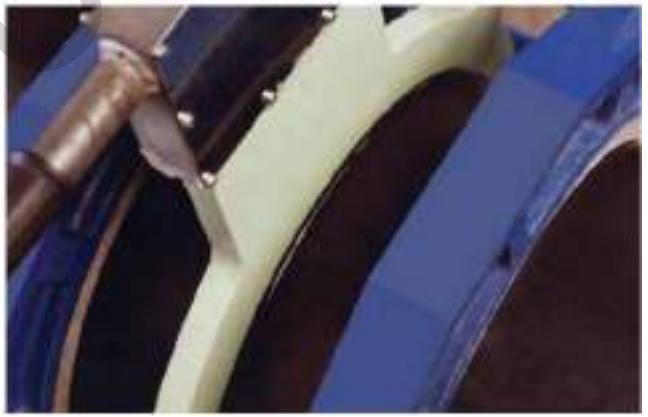
Do not touch the prepared surfaces.

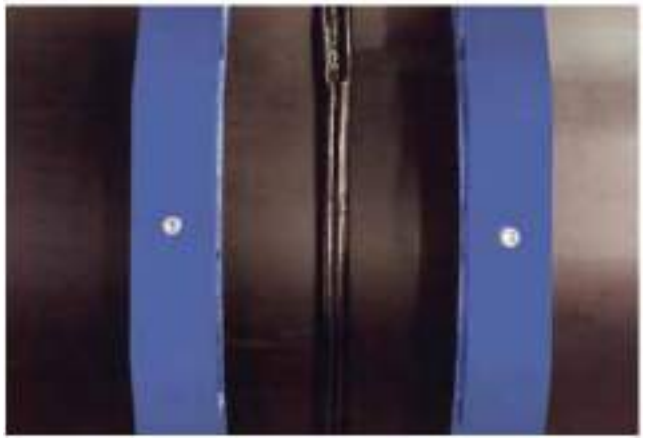
- Check that both surfaces are completely planed. If they are not then repeat the trimming process.
- Close the clamps and check that there is no visible gap between the trimmed faces.
- The maximum permitted outsider diameter mismatch is:
- **1.0 mm for pipe sizes 90 mm to 315 mm**
- **2.0 mm for pipe sizes 316 mm to 800 mm**
- If the mismatch is greater than these values then the pipe must be realigned and re-trimmed.
- Open and then close the clamps and note the drag pressure needed to move the pipes together using the hydraulic system.

Drag pressure is the minimum gauge pressure required to overcome the sliding frictional drag on the rams due to the operation of the machine and the weight of the pipes/ fittings being jointed, The drag pressure (in bar) must be assessed accurately prior to making each fusion joint and must be added to the basic ram pressure values shown on the machine. (When fully automatic machines are used this operation will normally be carried out automatically.)



- Remove the heater plate from its protective cover. Check that it is clean and up to temperature.
- Place the heater plate in the machine and close the clamps so that the surfaces to be joined are touching the plate. Using the hydraulic system apply the pressure previously determined.
- Maintain the applied pressure until the pipe begins to melt and a uniform bead of 2-3 mm is formed on each end.
- After the initial bead up, the pressure in the hydraulic system shall be released so that the pressure gauge registers between zero and the drag pressure so as to control the bead growth during the heat soak time. Check that the pipe does not slip in the clamps. The pipe ends must maintain contact with the heater plates.
- When the heat soak time is completed, open the clamps and remove the heater plate ensuring that the plate does not touch the melted surfaces.
- Immediately close the clamps (within 8 to 10 seconds of removing the plate) and bring the melted surfaces together at the previously determined pressure.
- Maintain the required pressure for the minimum cooling time as indicated in the table.
- After this time the assembly can be removed from the machine but should not be handled for a further period equal to the cooling times given on page 34..
- Examine the joint for cleanliness and uniformity and check that the bead width is within the specified limits.
- Remove the external bead and if required the internal beads using suitable debeading tools.
- The beads and joint shall be numbered/coded using an indelible marker pen.
- Twist the beads at several positions. If the bead is seen to split at any point then the joint must be cut out from the pipeline and remade. If a similar defect re-occurs, cease all further jointing until the equipment has been thoroughly cleaned, examined and new trial joints were made and shown to be satisfactory.





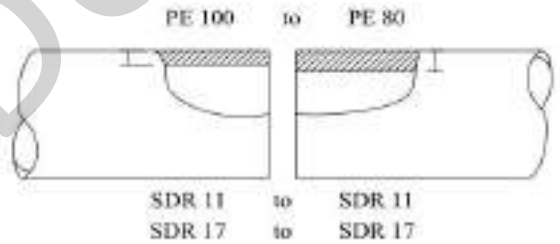
Rules for Butt-Fusion

NEVER

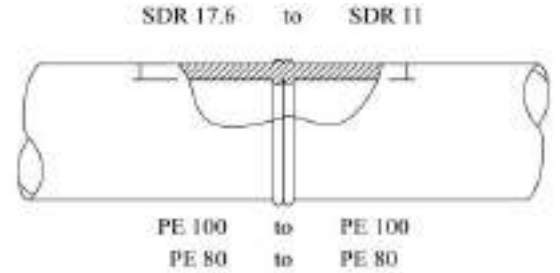
- Attempt to weld together pipes of different SDR (wall thickness).
- Touch trimmed pipe ends.
- Leave trimming swarf inside pipe or on welding machine.
- Allow equipment to get wet or dusty.
- Use non-approved machinery.
- Remove a weld from the machine before cooling time has elapsed.
- Allow untrained personnel to use welding equipment.
- Cut corners in any part of the welding procedure.
- Weld pipes of different material on site (In factory controlled conditions it may be possible to do this).
- Use a generator of inadequate capacity.

Summary

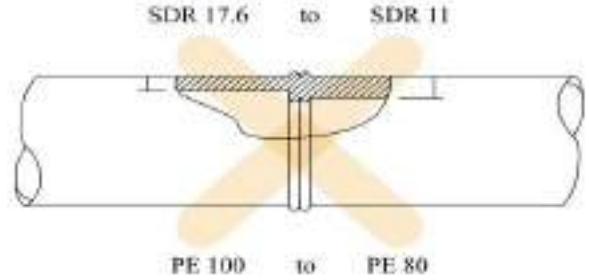
(a) Dissimilar materials and dissimilar wall thicknesses can be jointed by electrofusion. (Please note that the maximum working pressure should not exceed the lower of the two pipes.)



(b) Similar materials and/or wall thicknesses may be jointed by butt fusion or electrofusion. (Please note that SDR 17 can be butt fused to SDR 17.6.)



c) Dissimilar wall thicknesses must not be jointed by butt fusion. (PE 80 can be butt fused to PE 100 under closely controlled factory conditions.)



Buttweld Time and Pressure Tables

Outside Diameter	SDR	Wallthickness (min)	Bead up interface stress	Initial bead size(approx)	Soak Time	Min soak interface stress	Max Plate removal time	Fusion and cooling interface stress	Cooling time in clamps	Cooling time out of clamps	Cooling time for coiled pipe in clamps	Typical final overall bead width(MM)	
mm		mm	Mpa	mm	sec	Mpa	sec	Mpa	min	min	min	min	max
90	26	3.5	0.15	2	95	0	10	0.15	10	5	15	8	15
90	17.6	5.1	0.15	2	110	0	10	0.15	10	5	15	8	15
90	11	8.2	0.15	2	140	0	10	0.15	10	5	15	9	16
110	26	4.2	0.15	2	100	0	10	0.15	10	5	15	8	15
110	17.6	6.3	0.15	2	125	0	10	0.15	10	5	15	9	16
110	11	10	0.15	2	160	0	10	0.15	10	5	15	10	17
125	26	4.8	0.15	2	110	0	10	0.15	10	5	15	8	15
125	17.6	7.1	0.15	2	130	0	10	0.15	10	5	15	9	16
125	11	11.4	0.15	2	175	0	10	0.15	10	5	15	10	17
160	26	6.2	0.15	2	120	0	10	0.15	10	5	15	9	16
160	17.6	9.1	0.15	2	150	0	10	0.15	10	5	15	9	16
160	11	14.6	0.15	2	205	0	10	0.15	10	5	15	11	18
180	26	6.9	0.15	2	130	0	10	0.15	10	5	15	9	16
180	17.6	10.2	0.15	2	160	0	10	0.15	10	5	15	10	17
180	11	16.4	0.15	2	225	0	10	0.15	10	5	15	11	18
225	26	8.6	0.15	2	145	0	10	0.15	10			9	16
225	17.6	12.8	0.15	2	190	0	10	0.15	10			10	17
225	11	20.5	0.15	2	265	0	10	0.15	10			11	18
250	26	9.6	0.15	2	155	0	10	0.15	10			9	16
250	17.6	14.2	0.15	2	200	0	10	0.15	10			10	17
280	26	10.7	0.15	2	170	0	10	0.15	10			13	22
280	17.6	15.9	0.15	2	220	0	10	0.15	10			14	23
315	26	12.1	0.15	2	180	0	10	0.15	10			13	22
315	17.6	17.9	0.15	2	240	0	10	0.15	10			14	23
	Tolerance		±0.02		±3			±0.02					

Outside diameter	SDR	Wall Thickness (min)	Bead up interface stress	Initial bead size (approx)	Soak time	Min soak interface stress	Max plate removal time	Fusion interface stress (after 10 sec)	Cooling interface stress (after 10 sec)	Cooling time in clampls	Cooking time out of clamps	Typical final overall bead width(MM)	
mm		mm	Mpa	mm	sec	Mpa	sec	Mpa	min	min	min	min	max
250	11	22.7	0.15	2	285	0	10	0.15	0.025	15	7.5	15	24
280	11	25.4	0.15	3	315	0	10	0.15	0.025	15	7.5	16	25
315	11	28.6	0.15	3	345	0	10	0.15	0.025	15	7.5	17	26
355	26	13.6	0.15	3	195	0	10	0.15	0.025	10	5	13	22
355	17.6	20.1	0.15	3	260	0	10	0.15	0.025	15	7.5	15	24
355	11	32.3	0.15	3	385	0	10	0.15	0.025	15	7.5	18	27
400	26	15.3	0.15	3	215	0	10	0.15	0.025	10	5	14	23
400	17.6	22.7	0.15	3	285	0	10	0.15	0.025	15	7.5	15	24
400	11	36.4	0.15	3	425	0	10	0.15	0.025	20	10	18	27
450	26	17.2	0.15	3	235	0	10	0.15	0.025	10	5	14	23
450	17.6	25.6	0.15	3	315	0	10	0.15	0.025	15	7.5	16	25
450	11	41	0.15	3	470	0	10	0.15	0.025	20	10	19	28
500	26	17.2	0.15	3	250	0	10	0.15	0.025	10	5	15	24
500	17.6	25.6	0.15	3	345	0	10	0.15	0.025	15	7.5	16	25
500	11	41	0.15	3	515	0	10	0.15	0.025	20	10	20	29
560	26	21.4	0.15	3	275	0	10	0.15	0.025	15	7.5	15	24
560	17.6	31.7	0.15	3	380	0	10	0.15	0.025	15	7.5	17	26
560	11	50.8	0.15	3	570	0	10	0.15	0.025	20	10	22	31
630	26	24.1	0.15	3	300	0	10	0.15	0.025	15	7.5	16	25
630	17.6	35.7	0.15	3	420	0	10	0.15	0.025	15	7.5	18	27
630	11	57.2	0.15	3	635	0	10	0.15	0.025	20	12.5	23	32
710	26	27.2	0.15	3	335	0	10	0.15	0.025	20	7.5	16	25
710	17.6	40.2	0.15	3	465	0	10	0.15	0.025	20	10	19	28
800	26	30.6	0.15	3	370	0	10	0.15	0.025	20	7.5	17	26
800	17.6	45.3	0.15	3	515	0	10	0.15	0.025	20	10	20	29
900	26	34.6	0.15	3	405	0	10	0.15	0.025	20	10	18	27
900	17.6	50.9	0.15	3	570	0	10	0.15	0.025	20	10	22	31
1000	26	38.4	0.15	3	445	0	10	0.15	0.025	20	10	19	28
1000	17.6	56.6	0.15	3	630	0	10	0.15	0.025	25	12.5	23	32
	Tolerance		±0.02		±3			±0.02	±0.01				

Table 2 – Dual pressure butt-fusion jointing conditions for PE63, PE80 and PE100 **Heater Plate Surface Temperature: 195℃ to 200℃**

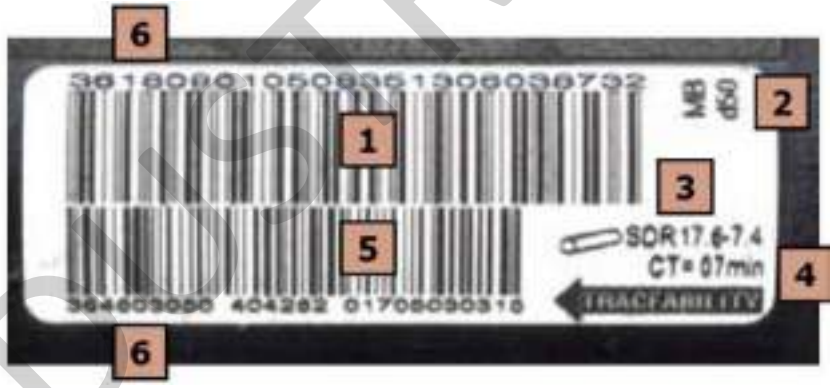
Electrofusion Principles

Introduction

The PH industry system comprises a complete range of polyethylene pipes, electrofusion fittings (couplers, elbows, tees, tapping tees and branching saddles), together with long spigot fittings. A range of accessories and ancillary equipment complements the system.

Technology and Product Design

All electrofusion fittings employ the same basic principle. The socket of the fitting incorporates an electrical heating coil. An electrofusion control unit (ECU) supplies the electrical energy necessary to heat the coil. When the coil is energised the material adjacent to it melts and forms an expanding pool which comes into contact with the surface of the pipe. The continued introduction of heat energy causes the pipe surface to melt and a mixing of pipe melt and fitting melt takes place; this is vital to produce a good weld. Following the termination of the heat cycle, the fitting and pipe are left to cool and the melted material solidifies to form a sound joint.



Note:

1. Fitting information barcode; scanned into fusion unit before welding and supplier's fitting type, welding time and resistance.
2. Fitting type and size.
3. Pipe SDR range where the fitting is safe to use.
4. The cooling times given in the bar code, and identified by the additional letters "C.T.", are the times in minutes during which the fused joint should not be moved. Cooling times required before pressurization can be found on page 20.
5. Fitting traceability barcode; when using the FRIAMAT® Prime or Memo fusion
units, components can be automatically traced back to source via a special barcode containing specific fittings data such as manufacturer dimension, raw material and batch. The tracing data can be electronically archived together with the fusion processing data.
6. Emergency barcode information for manual input.

Electrofusion Control Unit

Phindustry Pipe Systems supply electrofusion control units to meet all conceivable needs. In addition, a comprehensive range of accessories is also offered. Electrofusion control units are designed to operate from an electrical mains or field generator supply having an output of 220 volt and a rating of generally 3 to 3.5 kVA for 39.5 volt fittings and 6 to 7 kVA for 80 volt fittings. Electrofusion control units can also be obtained combined with an integral generator. All units have been designed for arduous site conditions. They are equipped with combined carrying and protective frames.

Bar Coded Electrofusion Fittings

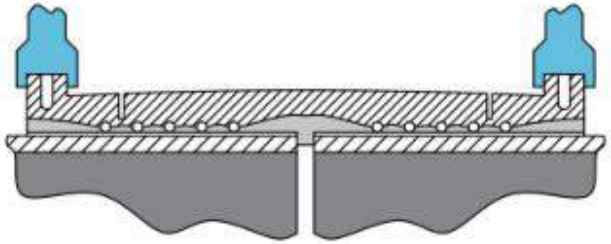
Technology is now available which eliminates the need to enter the fusion time manually. Special control units can be supplied with the ability to read a bar code where fixed to an electrofusion fitting. These machines have a 'light pen' attached which the operator uses to input the data contained within the bar code. Bar code control units also have data logging facilities to ensure traceability of welding parameters. An output socket allows the downloading of this information onto a computer database or printer to obtain a complete record of the joints which have been made. This information can be downloaded daily, or on completion of the project. The units will store up to 200 operations. The ECU will display a description of the fitting which includes three digits to denote size and this should be read and checked by the operator before proceeding.

High integrity, consistently reproducible electrofusion joints will only be achieved if the following criteria are met:

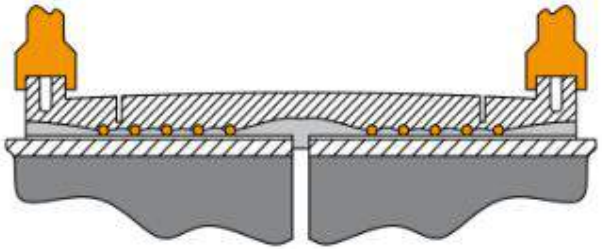
- Heating coils are as close to the joint surfaces as possible.
- Wire position is accurately controlled during manufacture and during the subsequent fusion process.
- Heat distribution is uniform over the length of the hot zone.
- Melt pressure and temperature are both accurately controlled.
- Coils are protected from damage prior to, during and after fusion.
- Spigot ends are scraped.

Electrofusion Sequence

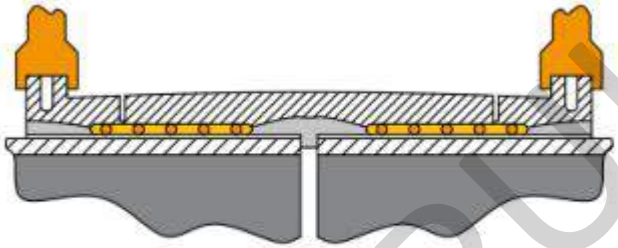
The sectional drawings show the jointing sequence from energising the coil until completion of fusion. The whole cycle is electronically monitored by the electrofusion control unit (ECU).



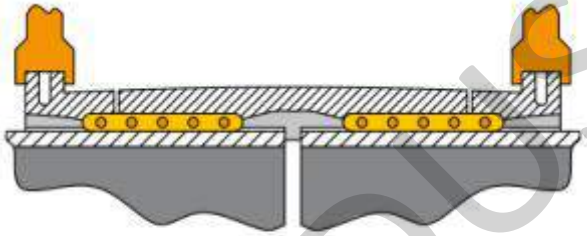
1. Pipe positioned in coupler prior to energising coil.



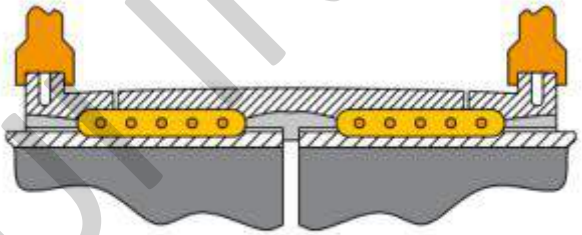
2. Coil energised.



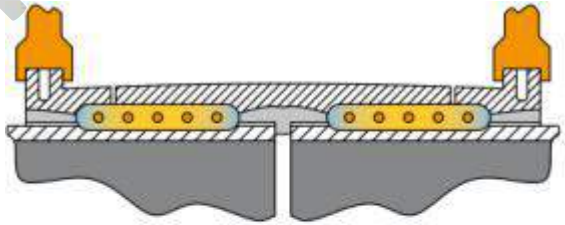
3. Material surrounding coil starts to melt.



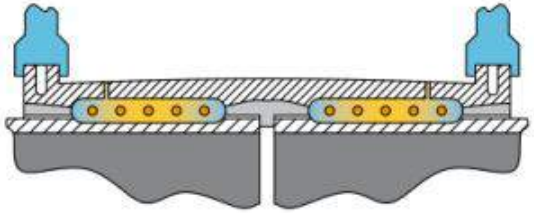
4. Area of melt extends leading to expansion towards pipe surface.



5. Heat transfers to pipe wall and material starts to melt



6. Melt solidifies at the start of the cold zones, thereby sealing the melt zone. Further input of energy causes increase in melt pressure.



7. Melt pressure reaches optimum value at end of energising cycle. Emergence of the melt at the indicator holes shows that fusion is complete.

Temperature/ Fusion Time

****The use of mechanical end preparation tools is preferred as hand scraping requires great care and can be time consuming especially on larger diameter pipes. It is essential that material is removed by scraping or peeling; scratching or abrading is not sufficient.**

Material Compatibility

Puhui Industry electrofusion fittings and long spigot fittings are compatible with pipes made from any of the following materials:

Remove the fitting from its packaging and check that the bore of the fitting is clean and dry.

- Clean the scraped area of the pipe with isopropanol wipes.
- Insert the pipe ends into the fitting so that they are in contact with the centre stop.
- For all socket electrofusion fittings (couplers, reducers, elbows and tees) it is recommended that clamps be used. The clamps must be adjusted to suit the particular size and type of fitting being welded so the pipes cannot move during the fusion cycle. If possible, rotate the fitting to check that the pipe ends are correctly aligned.
- Remove the terminal protection caps from the terminal shrouds.
- Connect the ECU output leads to the fitting terminals.

Manufacturer	Product Name	Material Type
BP	Riddex	PC2040; 002-50; 001-55; PC3100; PC4100
Ato Fina	Finathene	3902; XS10
Basell	Hostalen	CPR100
Solvay	Eltex	TUB171; TUB174 TUB121; TUB124
Repsol	Alcudia	3802
DOW	MS010	PE 80; PE 100
Polymers from other major producers may be expected to perform to equivalent standards but have not been tested by PH industry Pipe Systems.		

Compatibility of Eletrofusion Jointing and Pipe SDR

As a general rule, electrofusion fittings can be used to join pipes of diffirent SDRs; for example to join SDR 11 to SDR 17.6 pipe. However, with some of the more unusual SDR sizes extra care needs to be taken.

- **It does not matter which lead is connected to each terminal. The connections are not live and neutral.**

Check that there is sufficient fuel in the generator to complete the joint. Start the generator and check for correct operation.

- Operate the ECU according to the instructions, which should have been thoroughly read and understood prior to any welding operations. The ECU will either have some form of automatic operating system or require manual operation. Whichever system the ECU uses, all fittings are marked with both fusion and cool times in seconds plus the necessary input voltage
- If the fitting has melt indicators check that they have risen. The molten material should have risen to a point just above, or just below, the surface of the fitting.
- It is recommended that the joint be left in the clamps for the cooling time specified on the fitting, although the terminal leads may be removed carefully without disturbing the joint.
- If the fusion cycle terminates before completion of the countdown, check for faults as indicated by the ECU display.
- Once the fault has been rectified the welding process can be recommenced, but the timer has to be reset to zero.
- If using a transformed supply, make sure that the supply lead to the ECU is not of excessive length. NEVER extend the length of the leads from the ECU to the fitting.
- Do not pressurise the system until the joints have cooled to ambient temperatures.

***Electrofusion Jointing of Coiled Pipe Up to 63 mm diameter: Clamps must be used which align and restrain the pipes. Greater than 63 mm diameter: To electrofuse coiled pipe with a diameter greater than 63 mm, the pipe must be rerounded.**

Fabricated Fittings

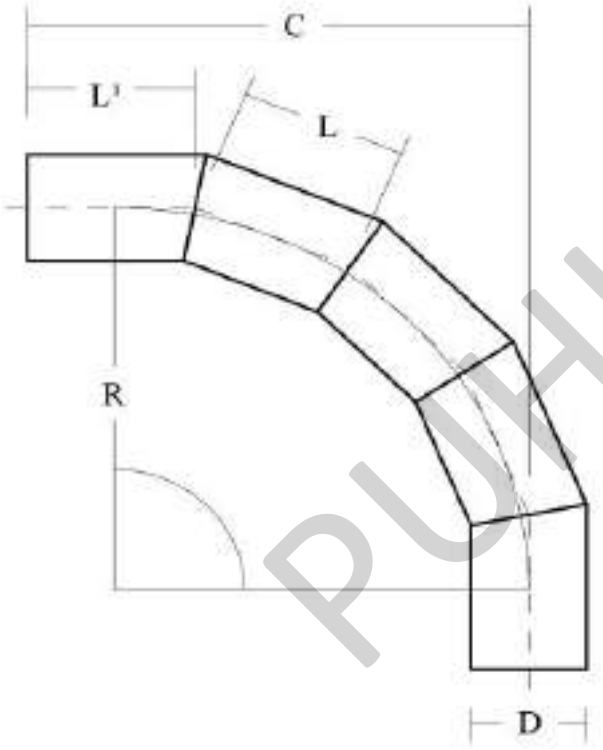
Dimensions

Pipe fittings can be manufactured from pipe in a wide variety of sizes and pressure classes but mostly from 75mm OD upwards and Class 6 or higher. The fittings can be plain ended (for buttwelding, electrofusion fittings or compression fittings) or have stubs fitted for flanges or Tak Clamps. Permissible working pressure is 60% of class of pipe used to fabricate fitting. e.g. 10 bar pipe produces a 6 bar fabricated fitting.

▲ **Calculated using PE 100 material.**

Segmented Bends

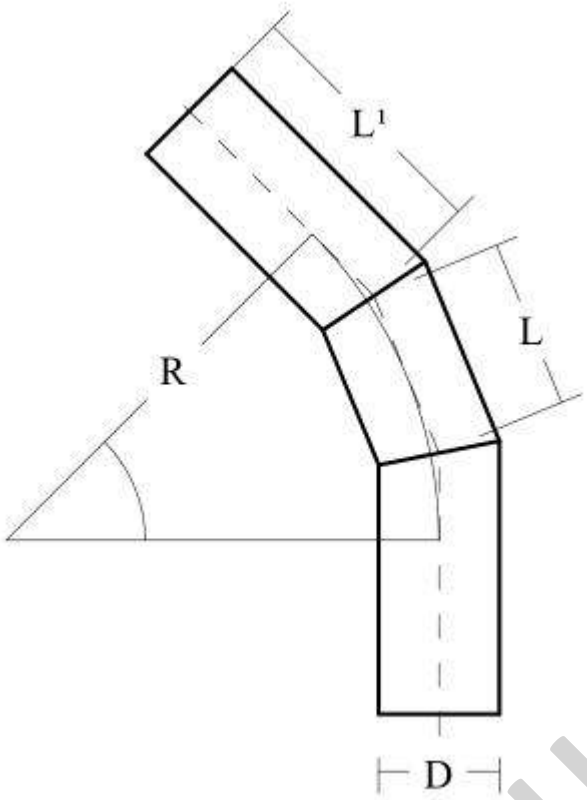
90° Bend



OD D (mm)	L (mm)	C (mm)	L¹ (mm)	R (mm)
110	155	478	160	395
125	155	478	160	395
140	155	478	160	395
160	155	478	160	395
180	155	478	160	395
200	250	792	280	637
225	250	792	280	637
250	250	792	280	637
280	250	792	280	637
315	250	792	280	637
355	380	1178	400	968
400	380	1178	400	968
450	380	1178	400	968
500	380	1178	400	968
560	470	1450	560	1350
630	590	1800	600	1520

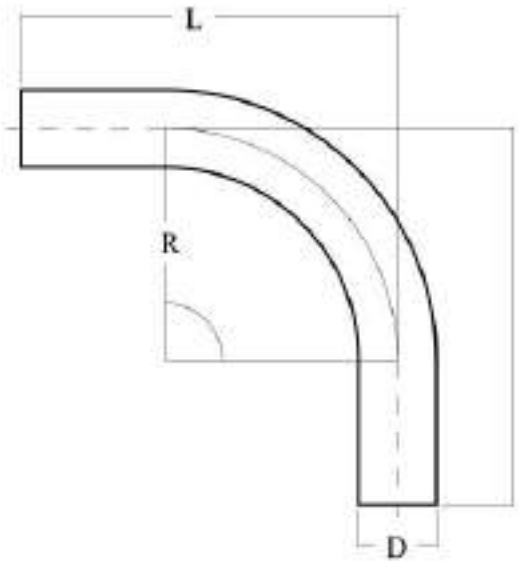
Angles other than 90° and 45° can be manufactured on request.

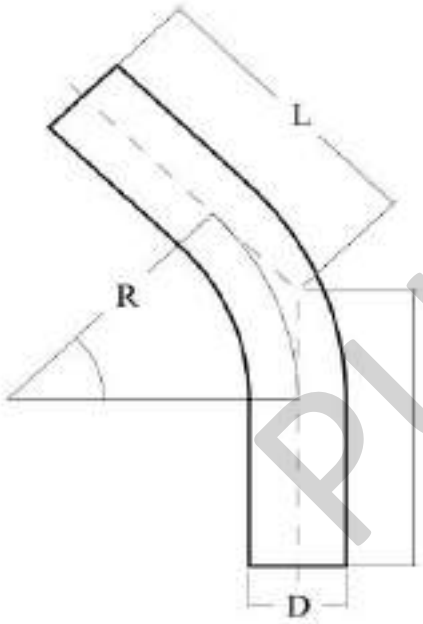
45° Bend



OD D (mm)	L (mm)	L¹ (mm)	R (mm)
75	155	238	395
90	155	238	395
110	155	238	395
125	155	238	395
140	155	238	395
160	155	238	395
180	155	238	395
200	250	405	637
225	250	405	637
250	250	405	637
280	250	405	637
315	250	405	637
355	380	590	968
400	380	590	968
150	380	590	968
500	380	590	968
560	470	900	1200
630	590	900	1500

Seamless Bends - 45° and 90°

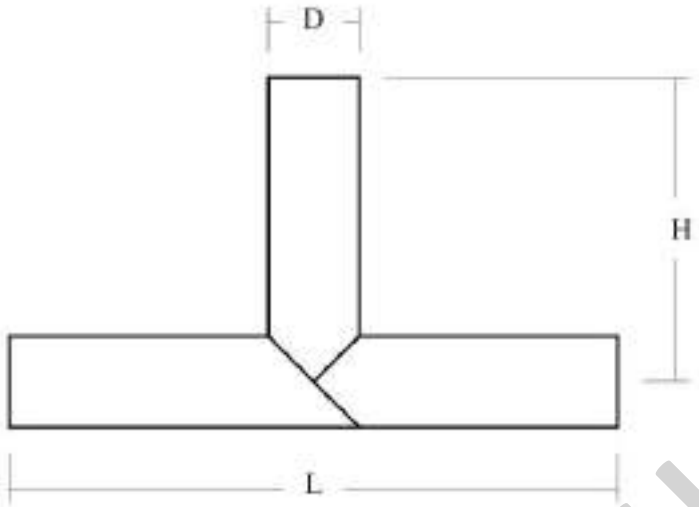




OD D (mm)	R (mm)	L (mm)	90° L (mm)
110	330	35	535
120	375	360	580
140	420	380	625
160	480	405	685
180	540	430	745
200	600	455	805
225	675	485	880
250	750	515	955
280	840	555	1045
315	945	585	1150
355	1065	645	1270
400	1200	705	1405
450	1350	765	1555
500	1500	830	1705

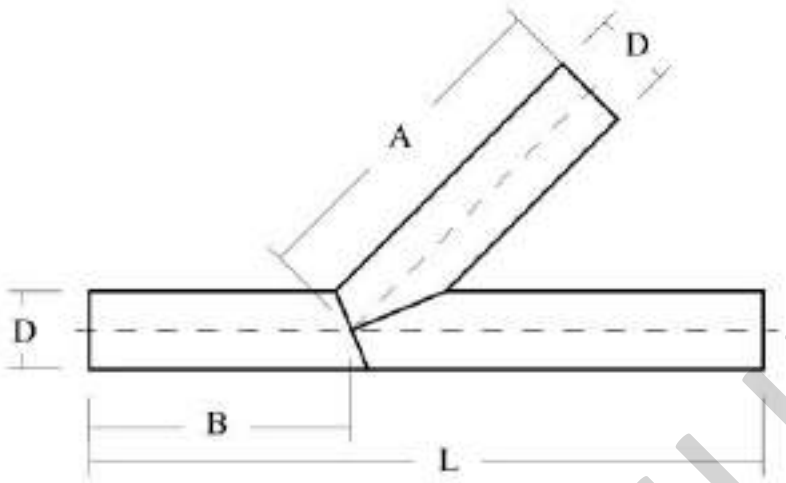
Minimum of SDR 17 for sizes 160 mm and greater.
Minimum of SDR 11 for smaller sizes.

Tees



OD D (mm)	H (mm)	L (mm)
90	200	400
110	455	910
125	465	930
140	470	940
160	480	960
180	490	980
200	500	1000
225	515	1030
250	525	1050
280	740	1480
315	760	1520
355	780	1560
400	800	1600
450	925	1850
500	950	1900
560	1180	2360
630	1215	2430

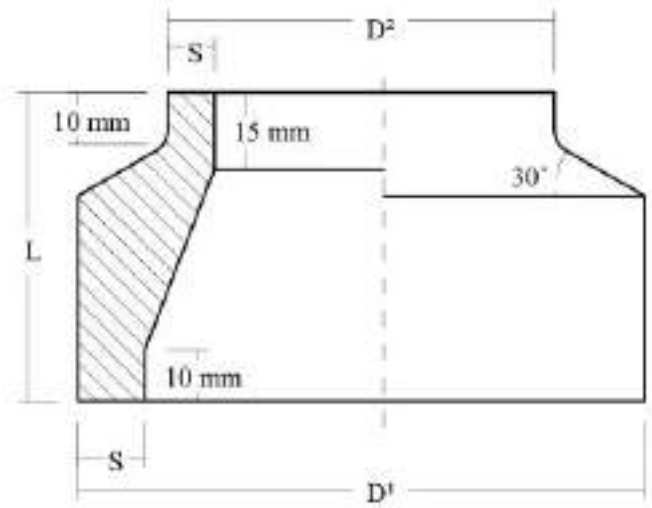
Lateral plain ended



The internal angle of laterals is between 45° (min) and 90° (max)

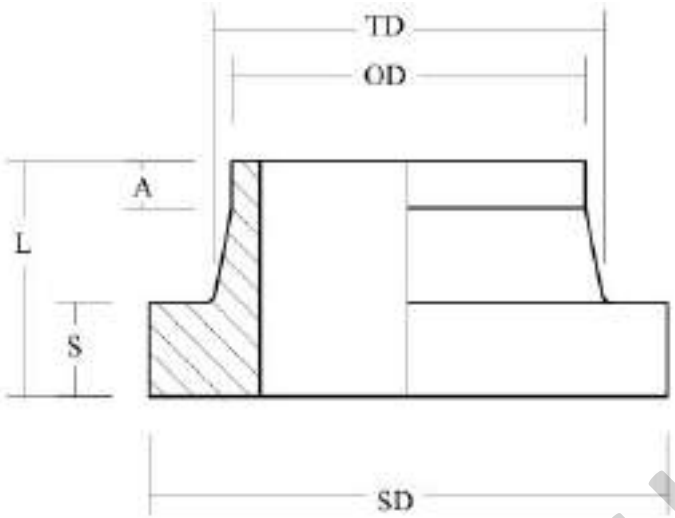
OD D (mm)	A (mm)	B (mm)	L (mm)
50	200	150	400
63	200	150	400
75	475	370	950
90	475	370	950
110	475	370	950
125	475	370	950
140	475	370	950
160	475	370	950
180	875	530	1350
200	875	530	1350
225	875	530	1350
250	875	530	1350
280	900	700	1800
315	900	700	1800
355	900	700	1800
400	900	700	1800
450	1100	870	2200
500	1100	870	2200
560	1200	950	2400
630	1200	950	2400

Machined Reducing Bushes



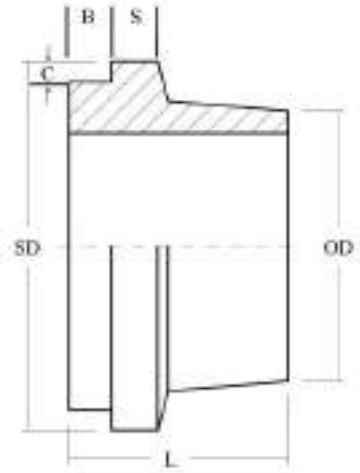
OD D¹ (mm)	OD D² (mm)	L (mm)
25	20	60
32	20/25	60
40	20/25/32	60
50	25/32/40	60
63	25/32/40/50	60
75	32/40/50/63	60
90	40/50/63/75	60
110	63/75/90	60
125	75/90/110	60
140	90/110/125	80
160	90/110/125/140	80
180	110/125/140/160	80
200	140/160/180	80
225	160/180/200	80
250	180/200/225	80
280	200/225/250	80
315	250/280	80
355	280/315	90
400	315/355	90
450	355/400	90
500	400/450	90

Stub Flange Detail



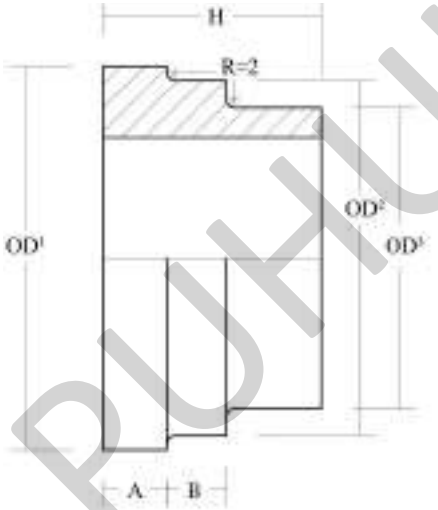
Pipe OD (mm)	D	TD	A	S	L
20	45	27	30	7	50
25	56	3	28	9	50
32	65	40	27	10	50
40	73	50	24	11	50
50	82	61	23	12	50
63	98	75	16	14	50
75	110	89	14	16	50
90	129	105	43	17	80
110	158	125	37	18	80
125	158	132	35	25	80
140	188	155	27	25	80
160	212	175	27	25	80
180	212	180	20	30	80
200	268	232	28	32	100
225	268	235	38	32	100
250	320	285	25	35	100
280	320	291	35	35	100
315	370	335	25	35	100
355	430	373	40	40	120
400	428	427	29	46	120
450	540	514	10	60	130
500	585	530	10	60	120
560	645	615	10	60	130
630	685	642	20	60	120

Tak-Stub detail



Pipe OD (mm)	SD	S	B	C	L
110	1420	23	12	10	53
125	167	20	12	10	55
140	175	28	12	10	60
160	196	32.5	12	10	65
180	224	33	12	10	65
200	246	34.5	13	12	68
225	272	33	13	12	74
250	297	35	15	12	75
280	326	38	15	12	78

Stub Detail

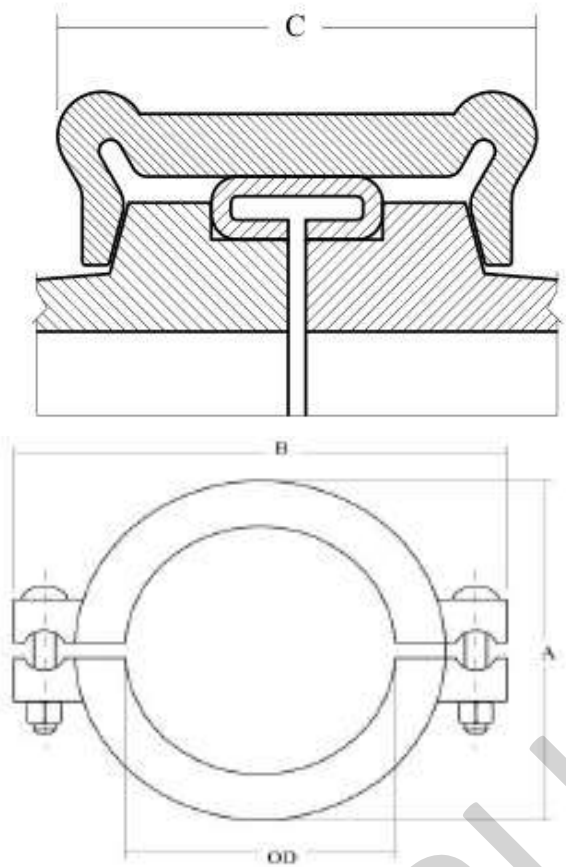


Pipe OD(mm)	SD	TD	A	S	L	Clamp Size
50	68.5	60	10	16	50	2''
63	97	90	15	16	50	3''
75	97	90	15	16	50	3''
90	124.5	115	15	16.5	55	4''
110	124.5	115	15	16.5	55	4''
125	178.5	167	15	17	55	6''
140	178.5	167	15	17	55	6''
160	178.5	167	15	17	55	6''
180	231.5	218	21	21	75	8''
200	231.5	218	21	21	75	8''
225	286	273	21	21	75	10''
250	286	273	21	21	75	10''

Victualtic Tak Fittings

Tak fittings are used with Tak stubs to establish detachable joints in HDPE pressure pipe systems. Stubs may be buttwelded to pipe or spigot ends on buttweld fittings.

Tak clamps enable detachable joints to be made with pipes that have Tak stubs butt welded to them.



Tak Clamp Detail			
Pipe OD (mm)	A (mm)	B (mm)	C (mm)
110	165	212	86
125	186	237	80
140	198	245	95
160	215	272	104
180	246	300	105
200	278	322	111
225	29	348	108
250	322	373	118
280	354	402	122

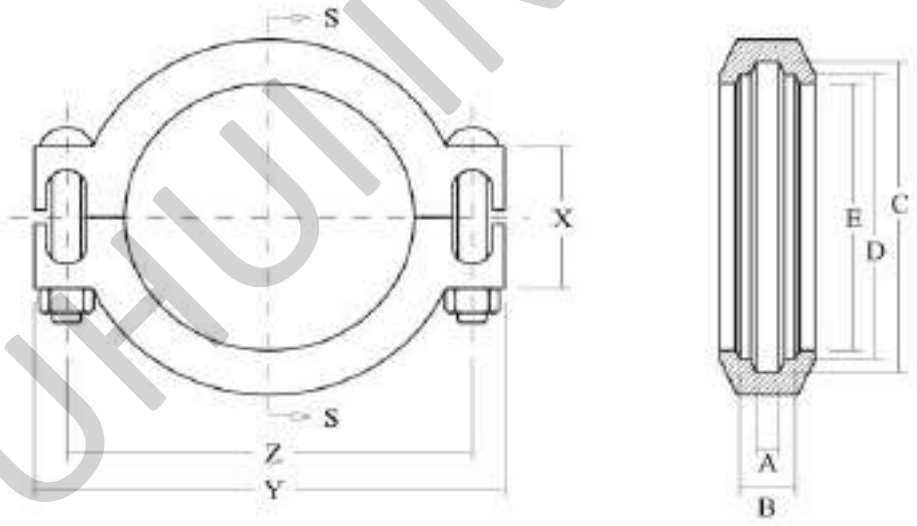
Victaulic Fittings

Victualic fittings are used with Victualic stubs to establish detachable joints in HDPE pressure pipe systems. Stubs may be buttwelded to pipe or spigot ends on buttweld fittings.

Victaulic clamps enable detachable joints to be made with pipes that have Victaulic stubs butt welded to them.

Victualic Clamp Detail

Norminal Size (mm)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	X (mm)	Y (mm)	Z (mm)	Bolt Size
50	25	35	82.5	68	61	44.5	146	113	M12
80	25	35	110	96	90.5	63.5	186	146	M16
100	27	38	141.5	123	116	63.5	232	184	M16
150	27	38	194	176	167	89	279	232	M16
200	30	44	255.5	233	221	111	356	308	M20
250	30	44	314.5	287	275	11	410	365	M20



Buttweld Fittings

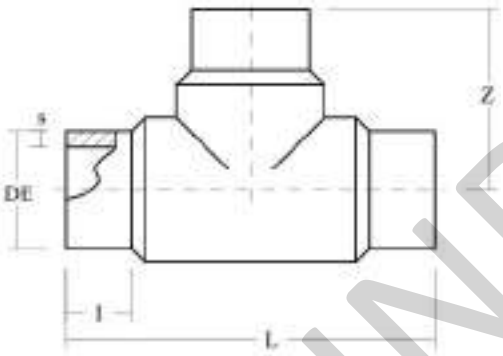
Buttwelding is a very economical and reliable jointing technique for making permanent welded joints, requiring only buttwelding equipment. Buttwelding is particularly suitable for prefabricating pipe sections and special fittings. Both
Puhui fittings with short spigot ends and fittings with long spigot ends are suitable for buttwelding. Only pipes and fittings from the same wall thickness series can be buttwelded together.

Tees 90°

SDR 17 &11

SDR 33

DE	L	Z	I
110	249	121	50
125	262	132	47
140	293	145	48
160	318	160	55
180	356	175	59
200	385	194	55
225	442	212	59
250	465	232	70
280	536	268	80
315	530	263	75
355	658	330	95
400	690	345	104
450	890	450	130
500	895	450	130

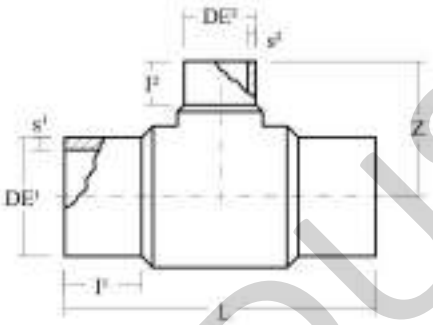


DE	L	Z	I
20	50	25	8
25	60	30	10
32	72	36	120
40	88	44	16
50	116	58	21
63	146	73	24
75	170	85	28
90	200	100	23
110	240	120	43
125	250	125	26
140	280	140	32
160	320	160	40
180	390	195	73
200	430	215	70
225	480	240	72
250	550	275	86
280	620	310	105
315	700	350	111
355	658	330	95
400	682	345	104
450	890	450	130
500	890	450	130

Reducing Tees

SDR 17 & 11

DE¹	DE²	L	Z	l¹	l²
63	50	215	103	63	56
75	32	255	107	70	46
75	50	253	108	70	55
75	63	255	117	70	63
90	32	203	85	52	23
90	50	203	94	52	27
90	63	269	135	79	63
90	75	272	138	73	70
110	32	230	91	65	22
110	50	230	101	65	27
110	63	309	156	83	64
110	75	309	151	82	70
110	90	310	152	82	79
125	63	264	110	70	31
125	90	335	170	110	91
125	110	335	170	87	82
140	63	291	120	82	32
140	75	291	130	81	35
140	90	291	130	81	38
140	110	291	137	50	43
160	63	340	174	98	64
160	75	340	179	98	74
160	90	340	179	98	79
160	110	390	201	98	83
160	125	315	150	58	47

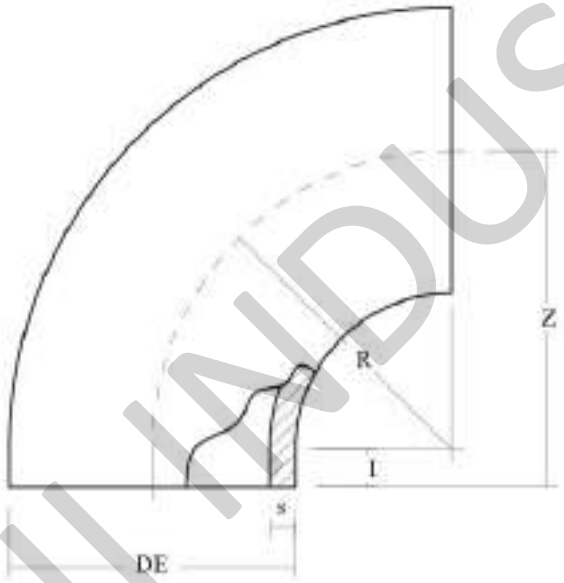


DE¹	DE²	L	Z	l¹	l²
180	63	348	132	125	30
180	75	348	140	112	30
180	90	395	200	136	97
180	110	395	210	140	98
180	125	348	160	92	50
180	160	412	206	101	91
200	63	382	145	143	41
200	90	388	162	125	38
200	110	388	160	120	40
200	125	388	165	114	43
200	160	388	178	98	53
225	75	445	227	118	75
225	90	445	227	118	79
225	110	455	227	117	83
225	125	435	173	135	40
225	160	488	244	119	98
225	180	553	283	131	131
250	110	435	190	134	37
250	160	440	213	110	58
315	110	555	290	170	100
315	160	585	310	170	120
315	225	650	335	170	145
315	250	680	340	170	150

Bends 90°

SDR 33

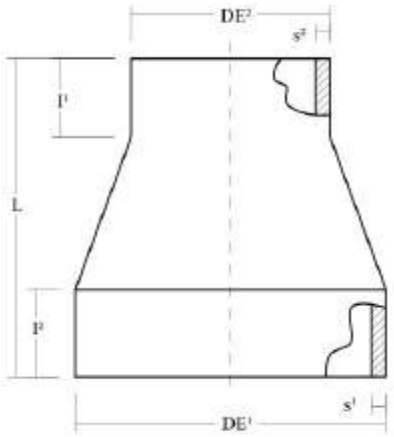
DE	Z	I	R
110	120	10	110
125	140	15	125
140	150	10	140
160	180	25	155
180	200	25	175
200	220	23	197
225	250	20	230
250	290	25	365
280	290	10	280
315	340	40	300
355	340	40	300
400	345	45	300
450	450	50	400
500	450	50	400



SDR 17 & 11

DE	Z	I	R
20	25	5	20
25	30	5	25
32	36	4	32
40	43	3	40
50	51	1	50
63	64	1	63
75	85	10	75
90	100	10	90
110	120	10	110
125	140	15	125
140	155	15	140
160	175	15	160
180	195	15	180
200	215	15	200
225	245	20	225
250	275	25	250
280	310	30	280
315	350	35	315
355	340	40	300
400	345	45	300
450	450	50	400
500	450	50	400

Reducers – Concentric



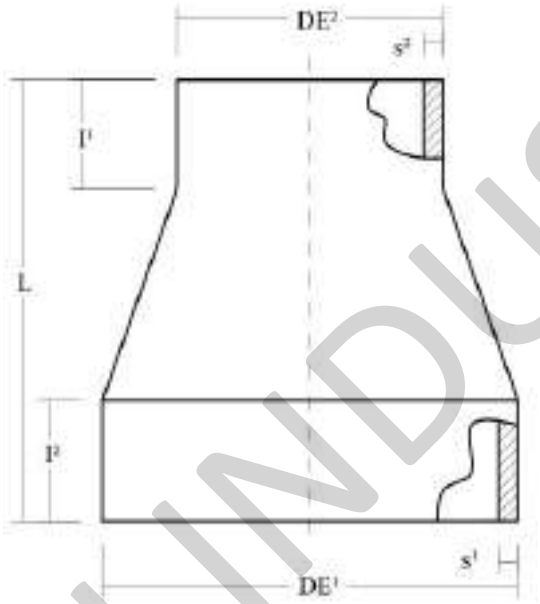
SDR33

DE¹	DE²	L	l¹	l²
40	20	50	12	12
40	25	50	12	12
40	32	50	12	12
50	25	55	12	12
50	32	55	12	12
50	40	55	12	12
63	32	65	16	12
63	40	65	16	12
63	50	65	16	12
75	32	80	19	12
75	40	71	19	12
75	50	71	19	12
75	63	71	19	16
90	50	80	30	12
90	63	80	22	16
90	75	80	22	19
110	50	104	28	12
110	63	97	28	16
110	75	97	28	19
110	90	97	28	22
125	63	112	30	16
125	75	108	32	19
125	90	108	32	22
125	110	108	32	28

DE¹	DE²	L	l¹	l²
140	75	123	35	19
140	90	115	35	22
140	110	115	35	28
140	125	115	35	32
160	90	135	40	22
160	110	124	40	28
160	125	124	40	32
160	140	124	40	35
180	90	157	45	22
180	110	157	45	28
180	125	136	45	32
180	140	136	45	35
180	160	136	45	40
200	140	154	50	35
200	160	151	50	40
200	180	151	50	45
225	140	160	60	50
225	160	171	55	40
225	180	171	55	45
225	200	171	55	50
250	160	194	60	40
250	180	182	60	45
250	200	182	60	50
250	225	182	60	55
280	200	200	80	65
280	225	200	80	75
280	250	200	80	85
315	200	230	90	80
315	225	230	90	85
315	250	230	90	90
315	280	230	90	105

SDR 11

DE¹	DE²	L	l¹	l²
25	20	37	12	12
32	20	43	12	12
32	25	43	12	12
40	20	50	12	12
40	25	50	12	12
40	32	50	12	12
50	25	55	12	12
50	32	55	12	12
50	40	55	12	12
63	32	65	16	12
63	40	65	16	12
63	50	65	16	12
75	32	80	19	12
75	40	71	19	12
75	50	71	19	12
75	63	71	19	16
90	50	80	30	12
90	63	80	22	16
90	75	80	22	19
110	50	97	28	12
110	63	105	28	16
110	75	97	28	19
110	90	97	28	22
125	63	112	30	16
125	75	108	32	19
125	90	108	32	22
125	110	108	32	28
140	75	123	35	19

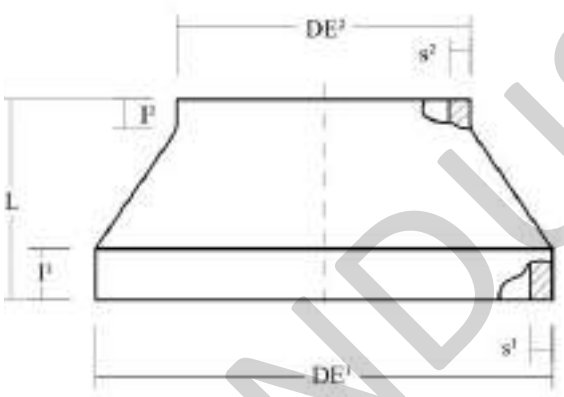


DE¹	DE²	L	l¹	l²
140	90	115	35	22
140	110	115	35	28
140	125	115	35	32
160	90	135	40	22
160	110	124	40	28
160	125	124	40	32
160	140	124	40	35
180	90	157	45	22
180	110	157	45	28
180	125	136	45	32
180	140	136	45	35
180	160	136	45	40
200	140	154	50	35
200	160	151	50	40
200	180	151	50	45
225	140	160	60	50
225	160	171	55	40
225	180	171	55	45
225	200	171	55	50
250	160	194	60	40
250	180	182	60	45
250	200	182	60	50
250	225	182	60	55
280	200	200	80	65
280	225	200	80	75
280	250	200	80	85
315	200	230	90	80
315	225	230	90	85
315	250	230	90	90
315	280	230	90	105

Reducers – Eccentric

SDR 33

DE¹	DE²	L	l¹	l²
355	200	183	30	20
355	225	170	34	28
355	250	125	30	22
355	280	100	32	23
355	315	72	30	21
400	225	196	25	20
400	250	175	25	20
400	280	148	25	20
400	315	118	25	20
400	355	84	25	20
450	280	192	25	20
450	315	161	25	20
450	355	127	25	20
450	400	88	25	20
500	280	235	25	20
500	315	205	25	20
500	355	170	25	20
500	400	131	25	20
500	450	88	25	20
560	355	222	25	20
560	400	183	25	20
560	450	140	25	20
560	500	97	25	20
630	355	283	25	20
630	400	244	25	20
630	450	200	25	20
630	500	157	25	20
630	560	105	25	20



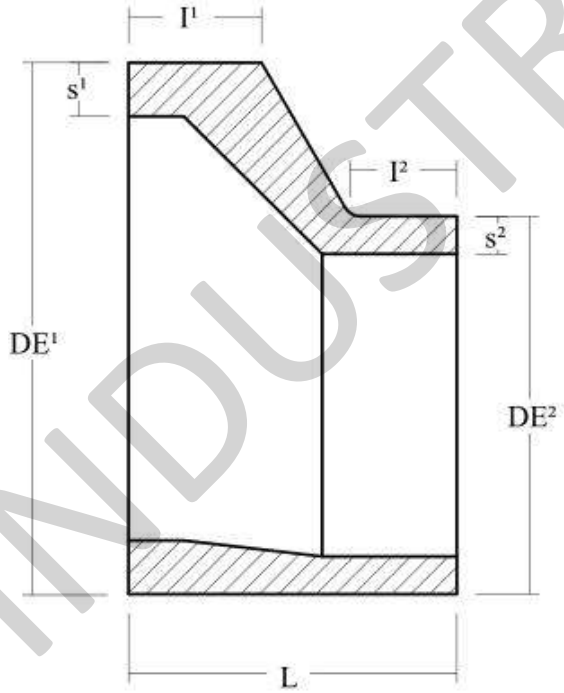
SDR 17 & 11

DE¹	DE²	L	l¹	l²
355	200	183	30	20
355	225	170	34	28
355	250	125	30	22
355	280	100	32	23
355	315	72	30	21
400	225	196	25	20
400	250	175	25	20
400	280	148	25	20
400	315	118	25	20
400	355	84	25	20
450	280	192	25	20
450	315	161	25	20
450	355	127	25	20
450	400	88	25	20
500	280	235	25	20
500	315	205	25	20
500	355	170	25	20
500	400	131	25	20
500	450	88	25	20
560	355	222	25	20
560	400	183	25	20
560	450	140	25	20
560	500	97	25	20
630	355	283	25	20
630	400	244	25	20
630	450	200	25	20
630	500	157	25	20
630	560	105	25	20

Reducers - Eccentric

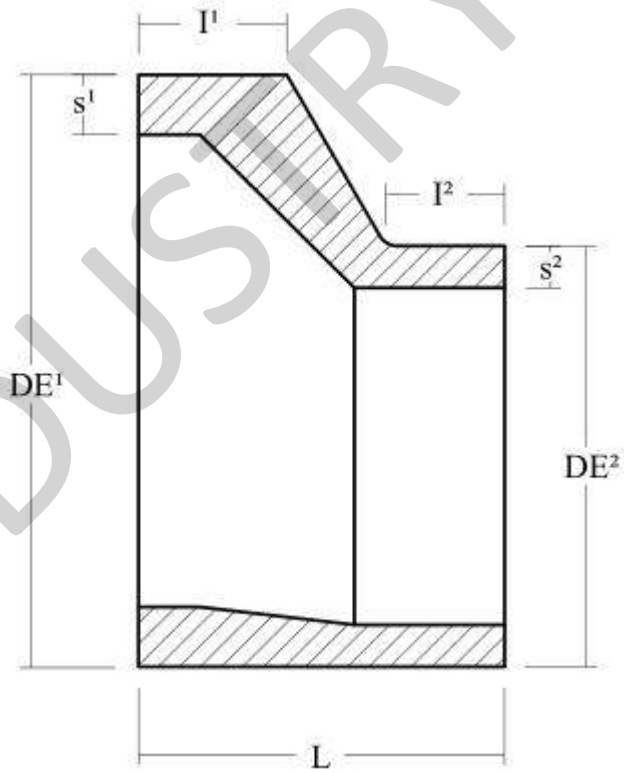
SDR 33

DE¹	DE²	L	l¹	l²
160	90	140	54	40
160	110	120	45	40
160	125	110	44	40
160	140	90	33	40
180	110	140	54	40
180	125	130	52	40
180	140	110	41	40
180	160	100	43	40
200	125	150	61	40
200	140	130	50	40
200	160	110	41	40
200	180	100	43	40
225	140	160	65	40
225	160	140	57	40
225	180	120	48	40
225	200	100	40	40
250	160	160	62	40
250	180	140	54	40
250	200	130	55	40
250	225	100	40	40
280	180	170	66	40
280	200	150	58	40
280	225	130	52	40
280	250	110	47	40
315	200	190	78	40
315	225	160	62	40
315	250	140	57	40
315	280	120	54	40



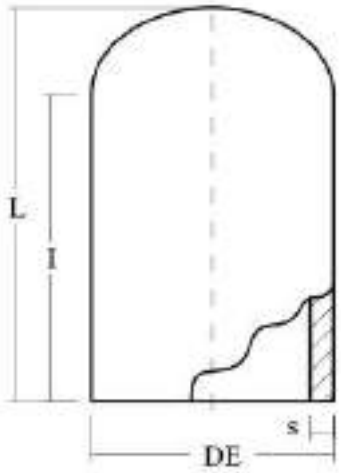
SDR 17 & 11

DE¹	DE²	SDR 17		SDR 11		I²
		L	I¹	L	I¹	
160	90	140	54	140	54	40
160	110	120	45	120	45	40
160	125	110	44	110	44	40
160	140	90	33	100	43	40
180	110	140	54	140	54	40
180	125	130	52	130	52	40
180	140	110	41	120	51	40
180	160	90	33	100	43	40
200	125	150	61	150	61	40
200	140	130	50	130	50	40
200	160	110	41	120	51	40
200	180	100	43	100	43	40
225	140	160	65	160	65	40
225	160	140	57	140	57	40
225	180	120	48	120	48	40
225	200	100	40	110	50	40
250	160	160	62	170	72	40
250	180	140	54	150	64	40
250	200	130	55	130	55	40
250	225	100	40	110	50	40
280	180	170	66	180	76	40
280	200	150	58	160	68	40
280	225	130	52	140	62	40
280	250	110	47	120	57	40
315	200	190	78	190	78	40
315	225	160	62	170	72	40
315	250	140	57	150	67	40
315	280	120	54	130	64	40



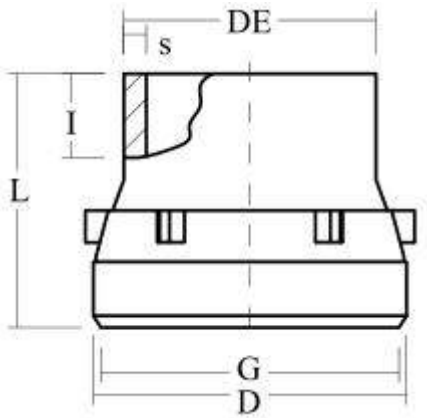
End Caps

DE	L	I
20	45	35
25	52	40
32	58	45
40	67	50
50	75	55
63	85	62
75	82	66
90	110	78
110	125	88
125	55	25
140	65	30
160	80	40
180	90	47
200	100	50
225	110	60



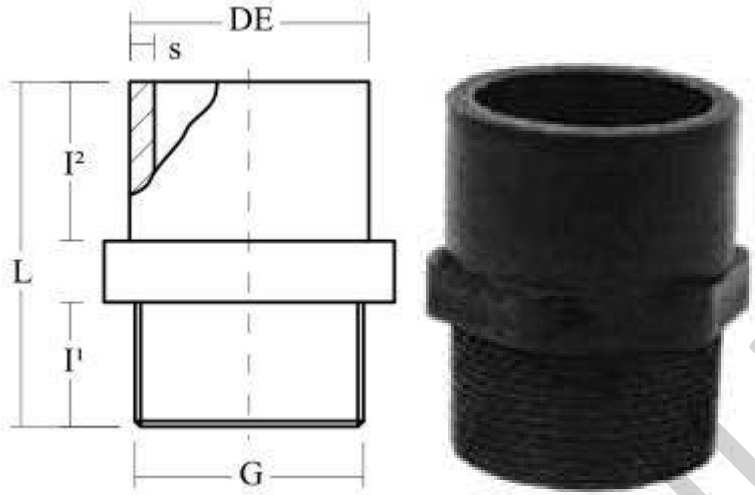
Adaptors - Female Thread

DE	G	L	I	D
25	½″	40	17	36
25	¾″	39	10	41
32	½″	36	14	36
32	¾″	36	12	41
32	1″	39	11	48
40	¾″	45	16	50
40	1″	45	13	52
40	1¼″	45	20	64
50	½″	47	20	53
50	1″	47	20	54
50	1¼″	49	21	63
50	1½″	49	17	69
63	2″	54	17	85
75	2½″	58	16	90



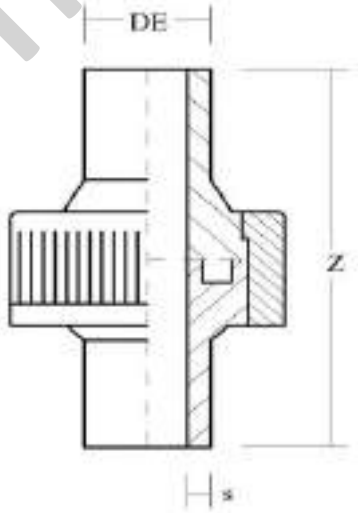
Adaptors - Male Thread

DE	G	L	l^1	l^2
20	½″	46	19	18
25	¾″	51	22	20
32	1″	61	28	24
40	1¼″	66	29	26
50	1½″	74	32	28
63	2″	80	35	31



Unions
SDR 17 & 11

DE	Long-Z	short-Z
20	190	110
25	190	110
32	190	110
40	190	110
50	190	110
63	190	110
75	260	110
90	300	180
110	340	180



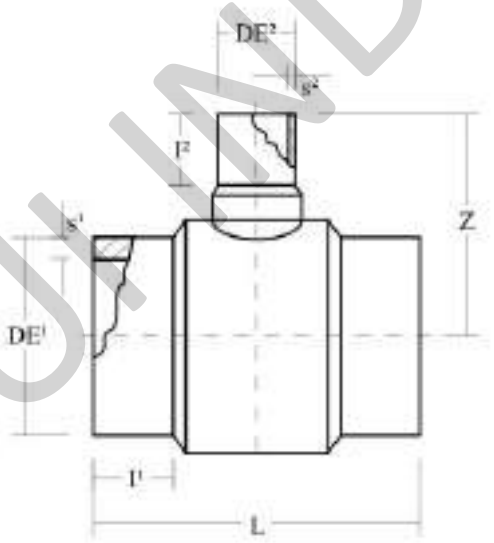
Electrofusion Fittings

Electrofusion is a simple and rapid jointing technique for making permanent welding joints. The efficient assembly on site of pipes, fittings or prefabricated pipework can be achieved using electrofusion couplers and electrofusion equipment. Only fittings with long spigot ends are suitable for electrofusion.

Reducing Tees - Long

SDR 17 & 11

DE¹	DE²	L	Z	l¹	l²
63	32	228	91	70	46
63	50	213	100	63	56
75	32	256	103	70	46
75	50	253	113	70	55
75	63	252	117	70	63
90	50	275	117	79	55
90	63	264	134	79	63
90	75	272	138	74	70
110	63	316	135	88	62
110	75	305	154	82	70
110	90	310	155	91	78
125	90	330	168	110	91
125	110	340	170	87	82
140	63	386	160	105	77
140	75	386	173	105	78
140	90	388	182	105	87
140	110	388	188	105	95
160	63	424	174	110	72
160	75	424	180	111	73
160	90	424	190	111	84
160	110	424	197	111	93
180	75	460	190	116	93
180	90	460	200	116	85
180	110	420	200	116	95
180	125	430	215	116	100
180	140	460	220	116	104
180	160	460	225	116	110

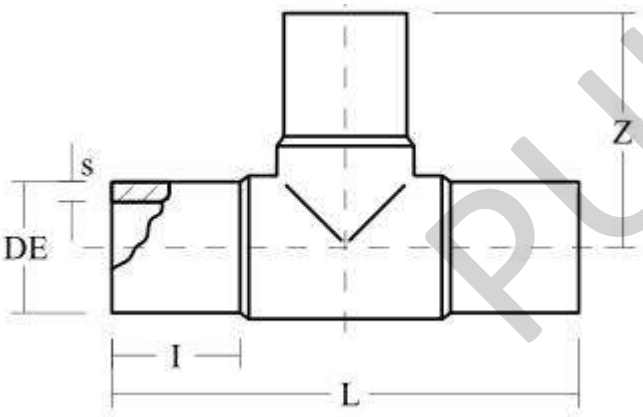


DE¹	DE²	L	Z	l¹	l²
200	63	550	225	134	80
200	90	550	227	134	95
200	110	550	240	134	103
200	125	550	240	134	110
200	160	550	265	134	114
225	63	540	241	130	69
225	75	540	248	130	76
225	90	440	224	120	80
225	110	522	271	120	92
225	125	522	266	120	93
225	140	540	276	130	104
225	160	522	252	120	109
225	180	552	280	131	131
250	110	575	242	130	82
250	160	575	261	130	98
315	110	546	290	170	100
315	160	575	310	170	120
315	225	638	335	170	145
315	250	670	333	170	150

Tees 90° - Long

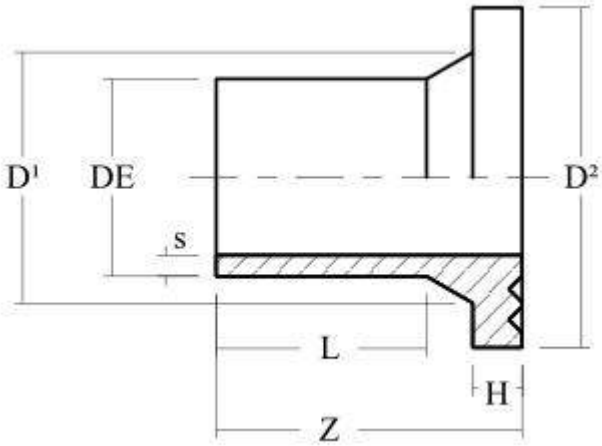
SDR 17 & 11

DE	L	Z	I
20	107	54	35
25	124	62	41
32	150	75	51
40	164	82	55
50	166	83	51
63	228	114	70
75	240	120	73
90	306	153	86
110	366	168	95
125	354	177	100
140	386	193	105
160	450	225	124
180	466	233	119
200	502	251	127
225	554	272	138
250	628	314	148
280	692	346	160
315	760	380	170



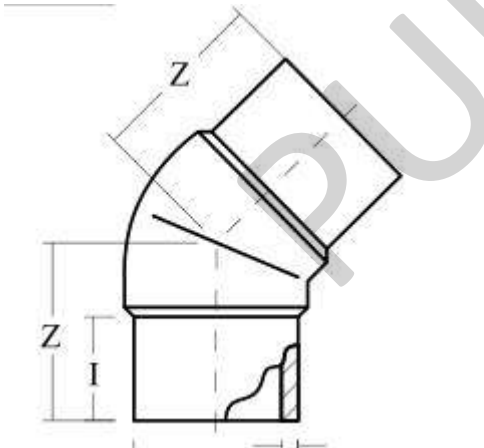
Stub Flanges - Long

DE	SDR 17		SDR 11		D'	D²	Z
	H	L	H	L			
20			7	64	27	45	88
25			9	51	33	58	90
32			11	57	40	68	95
40			12	55	50	78	100
50			12	63	61	88	110
63	14	66	15	66	75	102	120
75	18	78	17	78	89	122	130
90	18	84	18	84	105	138	145
110	18	100	18	115	125	158	155
125	18	108	25	125	132	158	170
140	18	109	25	109	155	188	175
160	18	110	25	140	175	212	195
180	20	115	31	115	182	212	195
200	24	127	32	127	232	268	205
225	24	137	33	137	235	268	215
250	25	146	35	130	285	320	205
280	25	156	35	156	291	320	245
315	25	160	35	155	335	370	225

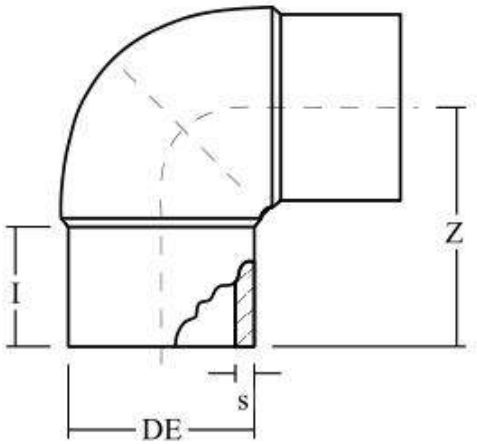


Elbows 45° - Long
Elbows 90° - Long
SDR 17 & 11

DE	Z	I
20	44	39
25	41	35
32	48	47
40	58	44
50	74	54
63	82	56
75	96	75
90	120	84
110	129	91
125	147	101
140	153	104
160	169	113
180	186	120
200	201	127
225	218	134
250	217	155
280	232	162
315	251	173

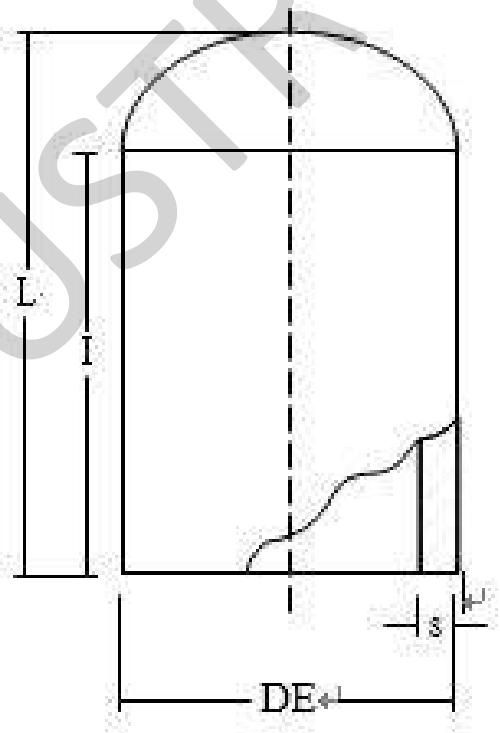


DE	Z	I
20	70	60
25	63	42
32	72	47
40	69	44
50	77	50
63	95	56
75	116	72
90	139	78
110	158	86
125	180	104
140	198	119
160	210	117
180	222	116
200	250	128
225	269	136
250	307	180
280	340	200
315	370	210



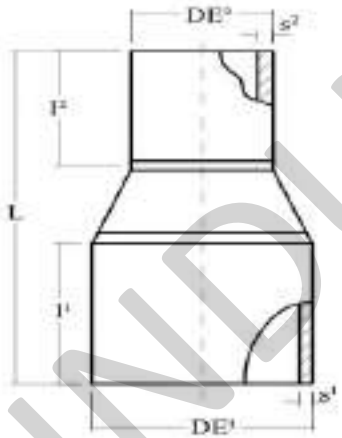
End Caps

DE	L	I
20	45	35
25	52	40
32	58	44
40	67	50
50	75	55
63	85	62
75	95	63
90	110	79
110	127	88
125	124	95
140	140	110
160	152	121
180	169	134
200	184	140
225	200	160
250	230	152
280	257	162
315	262	167



SDR 17 & 11
Reducers Concentric - Long

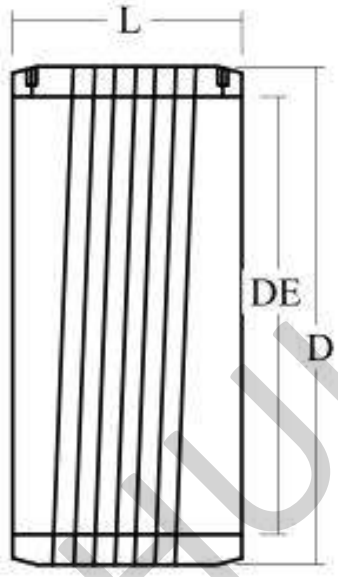
DE¹	DE²	SDR 17			SDR 11		
		L	l¹	l²	L	l¹	l²
25	20				87	40	41
32	20				92	43	39
32	25				89	44	37
40	20				94	45	36
40	25				96	47	35
40	32				93	50	39
50	25	130	55	40	136	62	48
50	32	132	55	44	134	61	50
50	40	134	55	49	134	61	56
63	32	146	63	44	150	69	50
63	40	150	63	49	152	69	55
63	50	150	63	55	151	69	60
75	50	-	-	-	148	64	58
75	63	147	66	63	149	65	59
90	50	142	64	49	142	64	49
90	63	144	69	55	144	69	55
90	75	163	74	65	163	76	61
110	63	174	85	63	174	85	63
110	75	180	85	57	180	85	57
110	90	179	79	74	179	99	93
125	63	187	87	61	187	87	61
125	75	205	105	76	205	105	76
125	90	216	99	86	216	99	86
125	110	201	89	84	200	90	82
140	75	230	112	70	230	112	70
140	90	230	112	79	230	112	79
140	110	230	112	82	230	112	82
140	125	214	99	92	211	96	90
160	90	216	101	72	217	102	74
160	110	223	104	84	223	104	84
160	125	227	95	91	231	98	92
160	140	217	110	95	217	110	95



DE¹	DE²	SDR 17			SDR 11		
		L	l¹	l²	L	l¹	l²
180	90	237	105	79	237	105	79
180	110	270	120	92	270	120	92
180	125	278	116	103	278	116	103
180	140	270	120	110	270	120	110
180	160	277	115	114	277	115	114
200	125	283	123	103	283	123	103
200	140	275	120	110	275	120	110
200	160	253	105	100	252	105	100
200	180	272	120	115	272	120	115
225	110	312	130	94	312	130	94
225	140	295	130	110	295	130	110
225	160	312	130	109	312	130	109
225	180	310	130	111	310	130	111
225	200	272	124	115	272	124	115
250	160	339	138	111	339	138	111
250	180	338	137	123	338	137	123
250	200	337	137	127	337	137	127
250	225	337	146	137	337	137	137
280	180	350	146	119	350	146	119
280	200	350	146	124	350	146	124
280	225	350	146	129	350	146	129
280	250	350	146	134	350	146	134
315	200	380	180	134	380	180	134
315	225	380	157	133	380	157	133
315	250	380	157	138	380	157	138

Sockets SDR 33

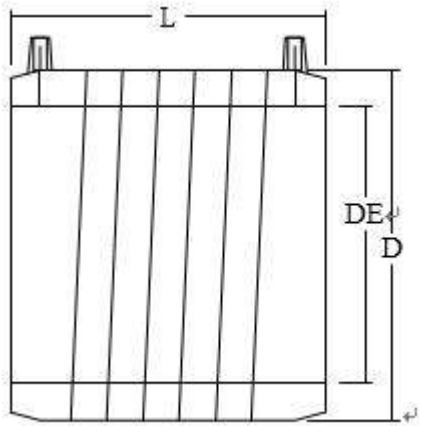
DE	L	D
110	160	128
125	160	140
140	170	160
160	180	184
180	180	206
200	180	250
225	200	250
250	200	280
280	200	315
315	220	355
315	220	400
400	220	450
450	220	500
500	250	560



SDR 11

DE	L	D
20	60	33
25	66	38
32	77	45
40	86	54
50	98	68
63	112	82
75	122	98
90	138	118
110	158	142
125	172	160
140	184	181
160	202	206
180	210	220
200	220	247
225	236	277
250	246	315
280	268	355
315	285	400
355	300	450
400	320	500
450	340	560
500	360	630
560*	380	630
630*	420	710

* Maximum pressure rating – 10

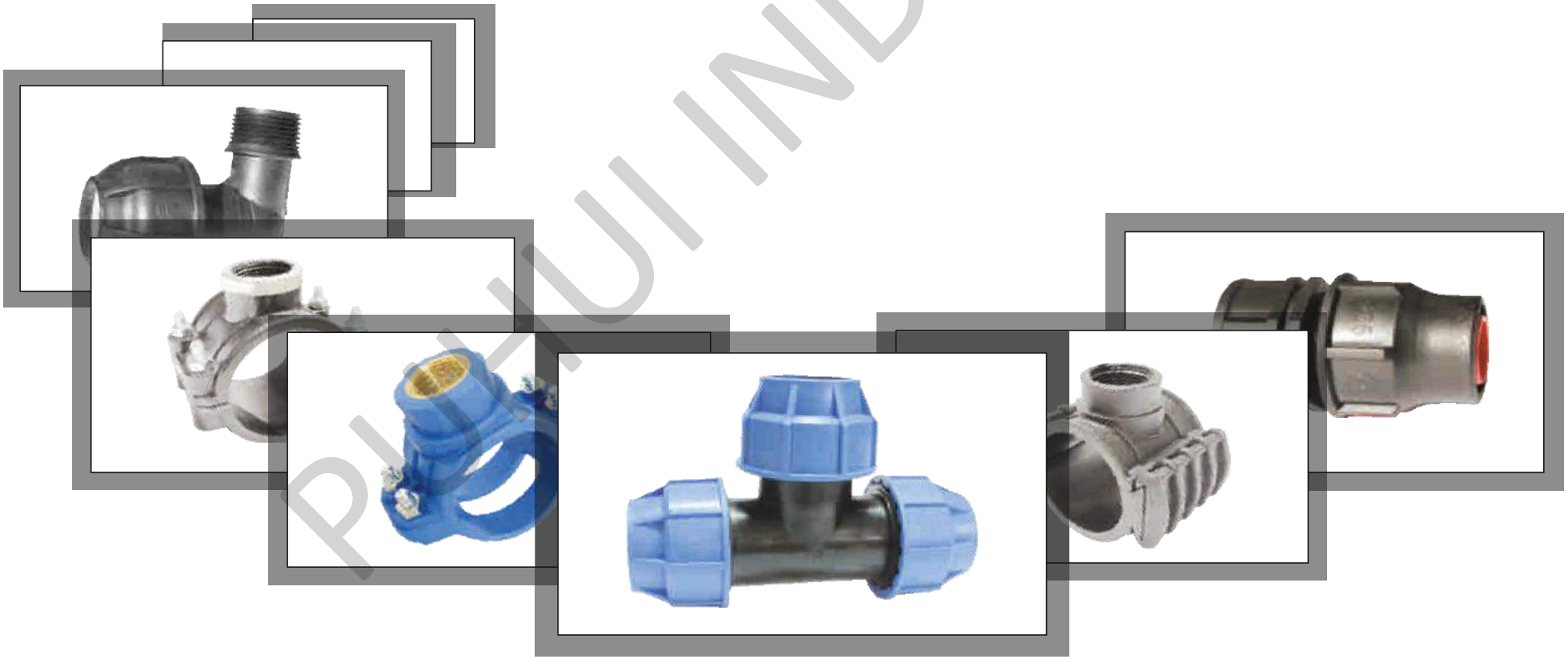


Polypropylene Saddles

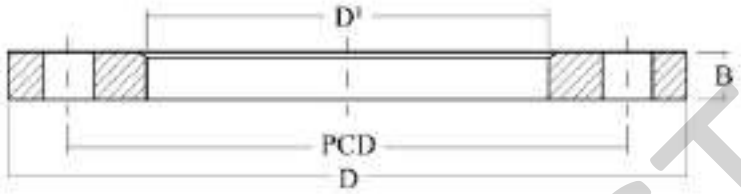
See the Saddles and Holderbats document for our complete range of fittings.

for polyethylene pipes dedicated to water reticulation systems in civils, agricultural and industrial industries.

The Phindustry Saddles are engineered for use above or below ground for the transfer of fluids; including water, chemicals or slurries.
Holderbats have been engineered as a fitting to provide good support for suspended pipes.



Flanges



Pipe Size	BS 10 Table D						BS 10 Table E					ASA 150				
	Dimensions (mm)				Bolts		Dimensions (mm)			Bolts		Dimensions (mm)			Bolts	
	D	D1	B	PCD	No	Size	D	B	PCD	No	Size	D	B	PCD	No	Size
20	95	30	5	66.7	4	M12	95	7	66.7	4	M12	88	10	60	4	M12
25	101	38	5	73	4	M12	101	7	73	4	M12	98	10	69	4	M12
32	114	45	5	82.6	4	M12	114	7	82.6	4	M12	107	10	79	4	M12
40	120	52	6	87.3	4	M12	120	8	87.3	4	M12	117	12	88	4	M12
50	133	63	6	98.4	4	M12	133	9	98.4	4	M12	127	12	98	4	M12
63	152	74	8	114.3	4	M16	152	10	114.3	4	M16	152	12	120	4	M16
75	165	86	8	127	4	M16	165	10	127	4	M16	177	12	139	4	M16
90	184	103	10	146	4	M16	184	12	146	4	M16	190	12	152	4	M16
110	215	135	10	177.8	4	M16	215	14	177.8	8	M16	228	15	190	8	M16
125	215	135	10	177.8	4	M16	215	14	177.8	8	M16	228	15	190	8	M16
140	254	158	13	209.6	8	M16	254	15	209.6	8	M16	254	15	215	8	M20
160	279	188	13	235	8	M16	279	18	235	8	M20	279	20	241	8	M20
180	279	188	13	235	8	M16	279	18	235	8	M20	279	20	241	8	M20
200	336	236	13	292	8	M16	336	19	292	8	M20	342	20	298	8	M20
225	336	236	13	292	8	M16	336	19	292	8	M20	342	20	298	8	M20
250	406	279	16	355.6	8	M20	406	22	355.6	12	M20	406	25	361	12	M24
280	406	292	16	355.6	8	M20	406	22	355.6	12	M20	406	25	361	12	M24
315	457	330	19	406.4	12	M20	457	25	406.4	12	M24	482	30	431	12	M24
355	527	367	22	469.9	12	M24	527	29	469.9	12	M24	533	30	476	12	M26
400	577	430	22	520.7	12	M24	577	32	520.7	12	M24	596	30	539	16	M26
450	641	476	25	584.2	12	M24	641	35	584.2	16	M24	635	30	577	16	M30
500	704	533	28	641.4	16	M24	704	38	641.4	16	M24	698	30	635	20	M30
560	825	592	31	755.7	16	M27	825	47	755.7	16	M30	812	35	749	20	M32
630	825	662	31	755.7	16	M27	825	47	755.7	16	M30	-	-	-	-	-

Pipe Size	SANS 1123:2007 1600/3						SANS 1123:2007 1000/3					SANS 1123:2007 600/3				
	Dimensions (mm)				Bolts		Dimensions (mm)			Bolts		Dimensions (mm)			Bolts	
	D	D1	B	PCD	No	Size	D	B	PCD	No	Size	D	B	PCD	No	Size
20	95	30	10	65	4	M12	95	10	65	4	M12	80	10	55	4	M10
25	105	38	10	75	4	M12	105	10	75	4	M12	90	10	65	4	M10
32	115	45	10	85	4	M12	115	10	85	4	M12	100	10	75	4	M10
40	140	52	10	100	4	M16	140	10	100	4	M16	120	10	90	4	M12
50	150	63	10	110	4	M16	150	10	110	4	M16	130	10	100	4	M12
63	165	74	12	125	4	M16	165	12	125	4	M16	140	10	110	4	M12
75	185	86	12	145	4	M16	185	12	145	4	M16	160	10	130	4	M12
90	200	103	14	160	8	M16	200	12	160	8	M16	190	10	150	4	M16
110	220	136	14	180	8	M16	220	12	180	8	M16	210	10	170	4	M16
125	220	136	14	180	8	M16	220	12	180	8	M16	210	10	170	4	M16
140	250	158	16	210	8	M16	250	14	210	8	M16	240	12	200	8	M16
160	285	190	18	240	8	M20	285	16	240	8	M20	265	12	225	8	M16
180	285	190	18	240	8	M20	285	16	240	8	M20	265	12	225	8	M16
200	340	236	22	295	12	M20	340	18	295	8	M20	320	14	280	8	M16
225	340	236	22	295	12	M20	340	18	295	8	M20	320	14	280	8	M16
250	405	279	25	355	12	M24	395	20	350	12	M20	375	16	335	12	M16
280	405	292	25	355	12	M24	395	20	350	12	M20	375	16	335	12	M16
315	460	330	28	410	12	M24	445	22	400	12	M20	440	20	395	12	M20
355	520	376	30	470	16	M24	506	25	460	16	M20	490	22	445	12	M20
400	580	430	35	525	16	M24	565	25	515	16	M24	540	22	495	16	M20
450	640	476	40	585	20	M24	615	30	565	20	M24	595	25	550	16	M20
500	715	533	40	650	20	M30	670	32	620	20	M24	645	25	600	20	M20
560	775	592	40	710	20	M30	730	35	675	20	M24	705	28	655	20	M24
630	840	662	50	770	20	M30	780	40	725	20	M26	755	30	705	20	M24

Bolt Dimentions for Flanged Connections

OD	Bolts		Length of Bolts			
			Plastic to plastic		Plastic to steel	
	No	Size	PN 4 - 10	PN 12 - 20	PN 4 - 10	PN 12 - 20
20	4	M12	65	65	50	50
25	4	M12	65	65	50	50
32	4	M12	65	65	50	50
40	4	M16	80	90	60	70
50	4	M16	80	90	60	70
63	4	M16	90	90	65	80
75	4	M16	90	90	65	80
90	8	M16	90	100	65	80
110	8	M16	100	120	70	90
125	8	M16	120	120	80	90
140	8	M16	120	120	90	90
160	8	M20	130	170	90	120
180	8	M20	140	170	100	120
200	8/12*	M20	140	170	100	120
225	8/12*	M20	150	170	120	120
250	12	M20	160	220	120	150
280	12	M20	160	220	120	150
315	12	M20	190	230	120	160
355	12/16*	M20/24*	190	230	130	160
400	16	M24	210	240	140	170
450	20	M24	240	250	150	180
500	20	M24/30*	240	-	150	-
560	20	M24/30*	240	-	170	-
630	20	M24/30*	260	-	180	-

Flange drilled to SANS 1123:2007 Table 1000 and 1600

The bolt diameters and lengths refer to flanges drilled to the above standard only. The lengths of bolts allow for gaskets and washers.

*Items marked depict different bolt quantities and sizes for Table 1000 and Table 1600 flanges respectively.

Design Considerations

Flow

The flow charts given here, on pages 49 - 56, have each been calculated for a particular SDR and can therefore by applied to various pressure classes depending on the material designation and design stress. Only sizes covered by SANS ISO 4427 have been included in these charts. The table on the right gives the PN classes (pressure in bar) covered by each SDR.

The nomogram on page 57 provides a guide to friction losses that can be expected when using clean HDPE pressure pipes with clean water at 20 °C. No account has been taken of any possible fittings in a line.

SDR	PE100	PE80	PE63
33	----	4	3.2
26	6.3	----	4
21	8	6.3	----
17	10	8	6.3
13.6	12.5	10	8
11	16	12.5	10
9	20	16	12.5
7.4	----	20	16

Flow Charts

To interpret the information given in the following flow charts, follow the instructions below:

1. Choose the particular chart for the material designation (PE 100, PE 80, PE 63) and pressure class (PN 16, PN 10 etc.) of pipe being used.
2. In one of the first 3 columns find the nearest value of the quantity of water to be pumped. The three columns give the quantity of water in different units – GPH = Gallons per hour, m^3/hr = cubic metres per hour, l/s = litres per second.
3. Run your eye along the horizontal line found in instruction 2 above until you get to numbers which are shaded light green. The number in the shaded block is the friction loss (expressed in metres per 100 metres) for the size of pipe given at the top of the particular column.
4. The reverse sequence can be used to determine the amount of water that can be put through a given pipe size (and how much friction loss is created).

Colour code	Velocity-m/s	Comments
Unshaded numbers above the yellow	< 0.5 but not < 0.3	too big
Yellow	- 0.5 to 0.99	a smaller pipe may be more suitable
Light Green	- 1.0 to 1.49	about right
Dark Green	- 1.5 to 1.99	about right
Tan	- 2.0 to 2.49	a bigger pipe may be more suitable
Unshaded numbers below the tan	> 2.5 but < 3.0	too small

1. The colour coding represents the approximate velocity of the waterin the size of pipe chosen.

2. If two or more size columns have the same colouring then there is a choice of suitable sizes each with its own friction loss value.

3. The range of velocities (meters per second) represented be the colours is asabove

SDR 33

Size (mm-O.D.)			315	355	400	450	500	560	630
Min W.T.			9.7	10.9	12.3	13.8	15.3	17.2	19.3
I.D.			295.6	333.2	375.4	422.4	469.4	525.6	591.4
G.P.H.	m3/hr.	l/s.							
15840	72	20							
17424	79.2	22	0.04						
19008	86.4	24	0.04						
20592	93.6	26	0.05	0.03					
22176	100.8	28	0.06	0.03					
23760	108	30	0.06	0.04					
25344	115.2	32	0.07	0.04					
26928	122.4	34	0.08	0.04	0.02				
28512	129.6	36	0.09	0.05	0.03				
30096	136.8	38	0.09	0.05	0.03				
31680	144	40	0.10	0.06	0.03				
35640	162	45	0.13	0.07	0.04	0.02			
39600	180	50	0.15	0.09	0.05	0.03			
43560	198	55	0.18	0.10	0.06	0.03	0.02		
47520	216	60	0.21	0.12	0.07	0.04	0.02		
51480	234	65	0.24	0.14	0.08	0.04	0.03	0.02	
55440	252	70	0.28	0.16	0.09	0.05	0.03	0.02	
59400	270	75	0.32	0.18	0.10	0.06	0.03	0.02	
63360	288	80	0.35	0.20	0.11	0.06	0.04	0.02	
71280	324	90	0.44	0.25	0.14	0.08	0.05	0.03	0.02
79200	360	100	0.52	0.30	0.17	0.1	0.06	0.03	0.02
87120	396	110	0.62	0.35	0.20	0.11	0.07	0.04	0.02
95040	432	120	0.72	0.41	0.23	0.13	0.08	0.05	0.03
102960	468	130	0.83	0.47	0.27	0.15	0.09	0.05	0.03
110880	504	140	0.95	0.54	0.30	0.17	0.10	0.06	0.03
118800	540	150	1.08	0.61	0.34	0.2	0.12	0.07	0.04
126720	576	160	1.21	0.68	0.39	0.22	0.13	0.08	0.04
134640	612	170	1.34	0.76	0.43	0.24	0.15	0.09	0.05
142560	648	180	1.48	0.84	0.47	0.27	0.16	0.10	0.05
150480	684	190	1.63	0.92	0.52	0.3	0.18	0.10	0.06
158400	720	200	1.79	1.01	0.57	0.33	0.20	0.11	0.07
166320	756	210	1.95	1.10	0.62	0.36	0.21	0.13	0.07
174240	792	220		1.20	0.68	0.39	0.23	0.14	0.08
182160	828	230		1.29	0.73	0.42	0.25	0.15	0.08
190080	864	240		1.40	0.79	0.45	0.27	0.16	0.09
198000	900	250		1.50	0.85	0.48	0.29	0.17	0.10
205920	936	260		1.61	0.91	0.52	0.31	0.18	0.10
213840	972	270			0.97	0.55	0.34	0.20	0.11
221760	1008	280			1.04	0.59	0.36	0.21	0.12
229680	1044	290			1.10	0.63	0.38	0.22	0.13

237600	1080	300			1.17	0.67	0.40	0.24	0.13
245520	1116	310			1.24	0.71	0.43	0.25	0.14
253440	1152	320			1.31	0.75	0.45	0.26	0.15
261360	1188	330			1.39	0.79	0.48	0.28	0.16
269280	1224	340				0.83	0.50	0.29	0.17
277200	1260	350				0.88	0.53	0.31	0.18
285120	1296	360				0.92	0.56	0.33	0.19
293040	1332	370				0.97	0.59	0.34	0.19
300960	1368	380				1.02	0.61	0.36	0.20
308880	1404	390				1.06	0.64	0.37	0.21
316800	1440	400				1.11	0.67	0.39	0.22
332640	1512	420				1.21	0.73	0.43	0.24
348480	1584	440					0.80	0.46	0.26
364320	1656	460					0.86	0.50	0.29
380160	1728	480					0.93	0.54	0.31
396000	1800	500					1.00	0.58	0.33
435600	1980	550						0.69	0.39
475200	2160	600						0.80	0.46
514800	2340	650						0.93	0.53
554400	2520	700							0.60
594000	2700	750							0.68
633600	2880	800							0.76

SDR 26

Size (mm-O.D.)			50	63	75	90	110	125	140	160	200	250	315	355	400	450	500	560	630
Min W.T.			2.0	2.5	2.9	3.5	4.2	4.8	5.4	6.2	7.7	9.6	12.1	13.6	15.3	17.2	19.1	21.4	24.1
I.D.			46.0	58.0	69.2	83	101.6	115.4	129.2	147.6	184.6	230.8	290.8	327.8	369.4	415.6	461.8	517.2	581.8
G.P.H.	m3/hr.	l/s.																	
396	1.8	0.5	0.32																
792	3.6	1	1.08	0.36															
1584	7.2	2	3.69	1.22	0.53	0.22													
2376	10.8	3	7.56	2.50	1.08	0.45	0.17												
3168	14.4	4	12.57	4.16	1.79	0.75	0.29	0.16	0.09										
3960	18	5	18.66	6.18	2.66	1.12	0.43	0.23	0.14										
4752	21.6	6		8.53	3.67	1.54	0.59	0.32	0.19	0.10									
5544	25.2	7		11.20	4.83	2.03	0.77	0.42	0.25	0.13									
6336	28.8	8			6.11	2.57	0.98	0.53	0.31	0.16	0.06								
7128	32.4	9			7.53	3.16	1.21	0.66	0.38	0.20	0.07								
7920	36	10			9.07	3.81	1.45	0.79	0.46	0.24	0.08								
9504	43.2	12				5.26	2.01	1.09	0.64	0.34	0.12								
11088	50.4	14				6.91	2.64	1.44	0.84	0.44	0.15	0.05							
12672	57.6	16				8.76	3.34	1.82	1.06	0.56	0.19	0.07							
14256	64.8	18					4.11	2.24	1.31	0.69	0.24	0.08							
15840	72	20					4.96	2.70	1.57	0.83	0.29	0.10	0.03						
17424	79.2	22					5.87	3.20	1.86	0.99	0.34	0.12	0.04						
19008	86.4	24					6.84	3.73	2.17	1.15	0.40	0.14	0.05						
20592	93.6	26						4.29	2.51	1.33	0.46	0.16	0.05	0.03					
22176	100.8	28						4.90	2.86	1.51	0.52	0.18	0.06	0.03					
23760	108	30						5.53	3.23	1.71	0.59	0.20	0.07	0.04					
25344	115.2	32							3.62	1.92	0.66	0.23	0.08	0.04	0.02				
26928	122.4	34							4.03	2.13	0.73	0.25	0.08	0.05	0.03				
28512	129.6	36							4.46	2.36	0.81	0.28	0.09	0.05	0.03				
30096	136.8	38							4.90	2.60	0.89	0.31	0.10	0.06	0.03				
31680	144	40							5.37	2.85	0.98	0.34	0.11	0.06	0.04	0.02			
35640	162	45								3.51	1.21	0.42	0.14	0.08	0.04	0.03			
39600	180	50								4.22	1.45	0.50	0.17	0.09	0.05	0.03	0.02		
43560	198	55									1.72	0.59	0.20	0.11	0.06	0.04	0.02		
47520	216	60									2.01	0.69	0.23	0.13	0.07	0.04	0.03		
51480	234	65									2.31	0.80	0.26	0.15	0.08	0.05	0.03	0.02	
55440	252	70									2.64	0.91	0.30	0.17	0.10	0.05	0.03	0.02	
59400	270	75									2.98	1.03	0.34	0.19	0.11	0.06	0.04	0.02	
63360	288	80									3.34	1.15	0.38	0.22	0.12	0.07	0.04	0.02	0.01
71280	324	90										1.42	0.47	0.27	0.15	0.09	0.05	0.03	0.02
79200	360	100										1.71	0.57	0.32	0.18	0.10	0.06	0.04	0.02
87120	396	110										2.02	0.67	0.38	0.21	0.12	0.07	0.04	0.02
95040	432	120										2.36	0.78	0.44	0.25	0.14	0.09	0.05	0.03
102960	468	130											0.90	0.51	0.29	0.16	0.10	0.06	0.03
110880	504	140											1.03	0.58	0.33	0.19	0.11	0.07	0.04
118800	540	150											1.16	0.66	0.37	0.21	0.13	0.07	0.04
126720	576	160											1.30	0.74	0.42	0.24	0.14	0.08	0.05
134640	612	170											1.45	0.82	0.46	0.26	0.16	0.09	0.05
142560	648	180											1.61	0.91	0.51	0.29	0.18	0.10	0.06
150480	684	190											1.77	1.00	0.56	0.32	0.19	0.11	0.06
158400	720	200												1.09	0.62	0.35	0.21	0.12	0.07
166320	756	210												1.19	0.67	0.38	0.23	0.14	0.08
174240	792	220												1.29	0.73	0.42	0.25	0.15	0.08
182160	828	230												1.40	0.79	0.45	0.27	0.16	0.09
190080	864	240												1.51	0.85	0.49	0.29	0.17	0.10
198000	900	250												1.62	0.92	0.52	0.32	0.18	0.11
205920	936	260													0.98	0.56	0.34	0.20	0.11

213840	972	270													1.05	0.60	0.36	0.21	0.12
221760	1008	280													1.12	0.64	0.39	0.23	0.13
229680	1044	290													1.19	0.68	0.41	0.24	0.14
237600	1080	300													1.27	0.72	0.44	0.25	0.15
245520	1116	310													1.34	0.77	0.46	0.27	0.15
253440	1152	320													1.42	0.81	0.49	0.29	0.16
261360	1188	330														0.85	0.52	0.30	0.17
269280	1224	340														0.90	0.55	0.32	0.18
277200	1260	350														0.95	0.57	0.33	0.19
285120	1296	360														1.00	0.60	0.35	0.20
293040	1332	370														1.05	0.63	0.37	0.21
300960	1368	380														1.10	0.66	0.39	0.22
308880	1404	390														1.15	0.69	0.40	0.23
316800	1440	400														1.20	0.73	0.42	0.24
332640	1512	420															0.79	0.46	0.26
348480	1584	440															0.86	0.50	0.29
364320	1656	460															0.93	0.54	0.31
380160	1728	480															1.00	0.58	0.33
396000	1800	500															1.08	0.63	0.36
435600	1980	550																0.74	0.42
475200	2160	600																0.87	0.49
514800	2340	650																	0.57
554400	2520	700																	0.65
594000	2700	750																	0.73
633600	2880	800																	

SDR 21

Size (mm-O.D.)			40	50	63	75	90	110	125	140	160	200	250	315	355	400	450	500	560	630
Min W.T.			2.0	2.4	3.0	3.8	4.3	5.3	6.0	6.7	7.7	9.6	11.9	15.0	16.9	19.1	21.5	23.9	26.7	30.0
I.D.			36.0	45.2	57.0	67.4	81.4	99.4	113.0	126.6	144.6	180.8	226.2	285.0	321.2	361.8	407.0	452.2	506.6	570.0
G.P.H.	m3/hr.	l/s.																		
317	1.4	0.4	0.69																	
396	1.8	0.5	1.02	0.34																
475	2.2	0.6	1.41	0.48																
554	2.5	0.7	1.85	0.63																
634	2.9	0.8	2.34	0.79	0.26															
713	3.2	0.9	2.89	0.98	0.32															
792	3.6	1	3.48	1.18	0.39	0.17														
1584	7.2	2	11.87	4.01	1.33	0.60	0.24													
2376	10.8	3	24.33	8.22	2.72	1.22	0.50	0.19	0.10											
3168	14.4	4		13.67	4.52	2.03	0.83	0.32	0.17	0.10										
3960	18	5		20.29	6.71	3.02	1.23	0.47	0.26	0.15	0.08									
4752	21.6	6			9.27	4.17	1.69	0.65	0.35	0.21	0.11									
5544	25.2	7			12.17	5.47	2.22	0.86	0.47	0.27	0.14									
6336	28.8	8				6.93	2.82	1.09	0.59	0.34	0.18	0.06								
7128	32.4	9				8.54	3.47	1.34	0.73	0.42	0.22	0.08								
7920	36	10				10.29	4.18	1.61	0.87	0.51	0.27	0.09								
9504	43.2	12					5.78	2.23	1.21	0.70	0.37	0.13	0.04							
11088	50.4	14					7.59	2.93	1.59	0.92	0.49	0.17	0.06							
12672	57.6	16						3.71	2.01	1.17	0.62	0.21	0.07							
14256	64.8	18						4.56	2.48	1.44	0.76	0.26	0.09							
15840	72	20						5.50	2.98	1.74	0.92	0.32	0.11	0.04						
17424	79.2	22						6.51	3.53	2.05	1.09	0.38	0.13	0.04						
19008	86.4	24							4.12	2.40	1.27	0.44	0.15	0.05	0.03					
20592	93.6	26							4.75	2.76	1.46	0.50	0.17	0.06	0.03					
22176	100.8	28							5.41	3.15	1.67	0.58	0.20	0.07	0.04					
23760	108	30							6.12	3.56	1.89	0.65	0.22	0.07	0.04					
25344	115.2	32								3.99	2.11	0.73	0.25	0.08	0.05	0.03				
26928	122.4	34								4.44	2.35	0.81	0.28	0.09	0.05	0.03				
28512	129.6	36								4.91	2.60	0.90	0.31	0.10	0.06	0.03				
30096	136.8	38									2.87	0.99	0.34	0.11	0.06	0.04				
31680	144	40									3.14	1.08	0.37	0.12	0.07	0.04	0.02			
35640	162	45									3.87	1.33	0.46	0.15	0.09	0.05	0.03			
39600	180	50										1.61	0.55	0.18	0.10	0.06	0.03	0.02		
43560	198	55										1.90	0.65	0.22	0.12	0.07	0.04	0.02		
47520	216	60										2.22	0.76	0.25	0.14	0.08	0.05	0.03	0.02	
51480	234	65										2.55	0.88	0.29	0.16	0.09	0.05	0.03	0.02	
55440	252	70										2.91	1.00	0.33	0.19	0.11	0.06	0.04	0.02	
59400	270	75										3.29	1.13	0.38	0.21	0.12	0.07	0.04	0.02	
63360	288	80											1.27	0.42	0.24	0.13	0.08	0.05	0.03	0.02
71280	324	90											1.56	0.52	0.29	0.17	0.09	0.06	0.03	0.02
79200	360	100											1.88	0.62	0.35	0.20	0.11	0.07	0.04	0.02

87120	396	110											2.23	0.74	0.42	0.24	0.14	0.08	0.05	0.03
95040	432	120											2.60	0.86	0.49	0.28	0.16	0.10	0.06	0.03
102960	468	130												0.99	0.56	0.32	0.18	0.11	0.06	0.04
110880	504	140												1.13	0.64	0.36	0.21	0.13	0.07	0.04
118800	540	150												1.28	0.72	0.41	0.23	0.14	0.08	0.05
126720	576	160												1.43	0.81	0.46	0.26	0.16	0.09	0.05
134640	612	170												1.60	0.90	0.51	0.29	0.18	0.10	0.06
142560	648	180												1.77	1.00	0.57	0.32	0.20	0.11	0.06
150480	684	190												1.95	1.10	0.62	0.36	0.22	0.13	0.07
158400	720	200													1.20	0.68	0.39	0.24	0.14	0.08
166320	756	210													1.31	0.74	0.42	0.26	0.15	0.09
174240	792	220													1.43	0.81	0.46	0.28	0.16	0.09
182160	828	230													1.54	0.87	0.50	0.30	0.18	0.10
190080	864	240													1.66	0.94	0.54	0.33	0.19	0.11
198000	900	250														1.01	0.58	0.35	0.20	0.12
205920	936	260														1.09	0.62	0.37	0.22	0.12
213840	972	270														1.16	0.66	0.40	0.23	0.13
221760	1008	280														1.24	0.71	0.43	0.25	0.14
229680	1044	290														1.32	0.75	0.45	0.26	0.15
237600	1080	300														1.40	0.80	0.48	0.28	0.16
245520	1116	310															0.85	0.51	0.30	0.17
253440	1152	320															0.89	0.54	0.31	0.18
261360	1188	330															0.94	0.57	0.33	0.19
269280	1224	340															1.00	0.60	0.35	0.20
277200	1260	350															1.05	0.63	0.37	0.21
285120	1296	360															1.10	0.67	0.39	0.22
293040	1332	370															1.16	0.70	0.41	0.23
300960	1368	380															1.21	0.73	0.43	0.24
308880	1404	390															1.27	0.77	0.45	0.25
316800	1440	400																0.80	0.47	0.27
332640	1512	420																0.88	0.51	0.29
348480	1584	440																0.95	0.55	0.32
364320	1656	460																1.03	0.60	0.34
380160	1728	480																1.11	0.65	0.37
396000	1800	500																	0.69	0.40
435600	1980	550																	0.82	0.47
475200	2160	600																	0.96	0.55
514800	2340	650																		0.63
554400	2520	700																		0.72
594000	2700	750																		0.81
633600	2880	800																		

SDR17

Size (mm-O.D.)			32	40	50	63	75	90	110	125	140	160	200	250	315	355	400	450	500	560	630
W.T.			2.0	2.4	3.0	3.8	4.5	5.4	6.6	7.4	8.3	9.5	11.9	14.8	18.7	21.1	23.7	26.7	29.7	33.2	37.4
I.D.			28.0	35.2	44.0	55.4	66.0	79.2	96.8	110.2	123.4	141.0	176.2	220.4	277.6	312.8	352.6	396.6	440.6	493.6	555.2
G.P.H.	m3/hr.	l/s.																			
79	0.4	0.1																			
158	0.7	0.2	0.67																		
238	1.1	0.3	1.37	0.46																	
317	1.4	0.4	2.28	0.77																	
396	1.8	0.5	3.38	1.14	0.39																
475	2.2	0.6	4.67	1.57	0.54																
554	2.5	0.7	6.14	2.06	0.71																
634	2.9	0.8	7.77	2.61	0.90	0.30															
713	3.2	0.9	9.58	3.21	1.11	0.37															
792	3.6	1	11.54	3.87	1.34	0.45	0.19														
1584	7.2	2		13.21	4.56	1.52	0.66	0.28													
2376	10.8	3			9.34	3.11	1.35	0.57	0.22	0.12											
3168	14.4	4			15.54	5.18	2.25	0.94	0.36	0.19	0.11										
3960	18	5				7.69	3.33	1.40	0.54	0.29	0.17	0.09									
4752	21.6	6				10.62	4.61	1.93	0.74	0.40	0.23	0.12									
5544	25.2	7				13.95	6.05	2.54	0.97	0.52	0.31	0.16									
6336	28.8	8					7.66	3.21	1.23	0.66	0.39	0.21	0.07								
7128	32.4	9					9.44	3.96	1.52	0.82	0.48	0.25	0.09								
7920	36	10					11.37	4.77	1.83	0.99	0.57	0.30	0.11								
9504	43.2	12						6.58	2.53	1.36	0.79	0.42	0.15	0.05							
11088	50.4	14						8.65	3.32	1.79	1.04	0.55	0.19	0.07							
12672	57.6	16							4.21	2.27	1.32	0.70	0.24	0.08							
14256	64.8	18							5.18	2.79	1.63	0.86	0.30	0.10	0.03						
15840	72	20							6.24	3.36	1.96	1.04	0.36	0.12	0.04						
17424	79.2	22							7.39	3.98	2.32	1.23	0.42	0.15	0.05						
19008	86.4	24								4.64	2.71	1.43	0.50	0.17	0.06	0.03					
20592	93.6	26								5.35	3.12	1.65	0.57	0.20	0.07	0.04					
22176	100.8	28								6.10	3.56	1.88	0.65	0.22	0.07	0.04					
23760	108	30									4.02	2.13	0.73	0.25	0.08	0.05	0.03				
25344	115.2	32									4.50	2.38	0.82	0.28	0.09	0.05	0.03				
26928	122.4	34									5.02	2.66	0.92	0.32	0.10	0.06	0.03				
28512	129.6	36										2.94	1.01	0.35	0.12	0.07	0.04				
30096	136.8	38										3.23	1.12	0.38	0.13	0.07	0.04	0.02			
31680	144	40										3.54	1.22	0.42	0.14	0.08	0.04	0.03			
35640	162	45										4.36	1.51	0.52	0.17	0.10	0.06	0.03			
39600	180	50											1.81	0.62	0.21	0.12	0.07	0.04	0.02		
43560	198	55											2.15	0.74	0.25	0.14	0.08	0.04	0.03		
47520	216	60											2.51	0.86	0.29	0.16	0.09	0.05	0.03	0.02	
51480	234	65											2.89	0.99	0.33	0.19	0.11	0.06	0.04	0.02	
55440	252	70											3.29	1.13	0.38	0.21	0.12	0.07	0.04	0.02	

59400	270	75												1.28	0.43	0.24	0.14	0.08	0.05	0.03	0.02
63360	288	80												1.43	0.48	0.27	0.15	0.09	0.05	0.03	0.02
71280	324	90												1.77	0.59	0.33	0.19	0.11	0.06	0.04	0.02
79200	360	100												2.13	0.71	0.40	0.23	0.13	0.08	0.05	0.03
87120	396	110												2.52	0.84	0.47	0.27	0.15	0.09	0.05	0.03
95040	432	120													0.98	0.55	0.31	0.18	0.11	0.06	0.04
102960	468	130													1.13	0.64	0.36	0.21	0.12	0.07	0.04
110880	504	140													1.28	0.73	0.41	0.23	0.14	0.08	0.05
118800	540	150													1.45	0.82	0.46	0.26	0.16	0.09	0.05
126720	576	160													1.63	0.92	0.52	0.30	0.18	0.10	0.06
134640	612	170													1.81	1.02	0.58	0.33	0.20	0.12	0.07
142560	648	180													2.00	1.13	0.64	0.37	0.22	0.13	0.07
150480	684	190														1.25	0.70	0.40	0.24	0.14	0.08
158400	720	200														1.37	0.77	0.44	0.27	0.16	0.09
166320	756	210														1.49	0.84	0.48	0.29	0.17	0.10
174240	792	220														1.62	0.91	0.52	0.32	0.18	0.10
182160	828	230														1.75	0.99	0.56	0.34	0.20	0.11
190080	864	240															1.07	0.61	0.37	0.21	0.12
198000	900	250															1.15	0.65	0.40	0.23	0.13
205920	936	260															1.23	0.70	0.42	0.25	0.14
213840	972	270															1.31	0.75	0.45	0.26	0.15
221760	1008	280															1.40	0.80	0.48	0.28	0.16
229680	1044	290															1.49	0.85	0.51	0.30	0.17
237600	1080	300																0.90	0.55	0.32	0.18
245520	1116	310																0.96	0.58	0.34	0.19
253440	1152	320																1.01	0.61	0.36	0.20
261360	1188	330																1.07	0.65	0.38	0.21
269280	1224	340																1.13	0.68	0.40	0.23
277200	1260	350																1.19	0.72	0.42	0.24
285120	1296	360																1.25	0.75	0.44	0.25
293040	1332	370																1.31	0.79	0.46	0.26
300960	1368	380																	0.83	0.48	0.28
308880	1404	390																	0.87	0.51	0.29
316800	1440	400																	0.91	0.53	0.30
332640	1512	420																	0.99	0.58	0.33
348480	1584	440																	1.08	0.63	0.36
364320	1656	460																		0.68	0.39
380160	1728	480																		0.73	0.42
396000	1800	500																		0.79	0.45
435600	1980	550																		0.93	0.53
475200	2160	600																			0.62
514800	2340	650																			0.71
554400	2520	700																			0.81
594000	2700	750																			

SDR 13.6

Size (mm-O.D.)			25	32	40	50	63	75	90	110	125	140	160	200	250	315	355	400	450	500	560	630
W.T.			2.0	2.4	3.0	3.7	4.7	5.6	6.7	8.1	9.2	10.3	11.8	14.7	18.4	23.2	26.1	29.4	33.1	36.8	41.2	46.3
I.D.			21.0	27.2	34.0	42.6	53.6	63.8	76.6	93.8	106.6	119.4	136.4	170.6	213.2	268.6	302.8	341.2	383.8	426.4	477.6	537.4
G.P.H.	m3/hr.	l/s.																				
79	0.4	0.1																				
158	0.7	0.2	2.64	0.77																		
238	1.1	0.3	5.40	1.57	0.54																	
317	1.4	0.4	8.99	2.62	0.90	0.31																
396	1.8	0.5	13.35	3.89	1.34	0.46																
475	2.2	0.6	18.43	5.37	1.85	0.63																
554	2.5	0.7	24.21	7.05	2.43	0.83	0.28															
634	2.9	0.8	30.66	8.93	3.08	1.05	0.35															
713	3.2	0.9	37.77	11.00	3.79	1.29	0.43															
792	3.6	1	45.51	13.25	4.57	1.56	0.52	0.23														
1584	7.2	2			15.59	5.32	1.78	0.77	0.32													
2376	10.8	3				10.9	3.64	1.59	0.66	0.25	0.14											
3168	14.4	4				18.13	6.06	2.64	0.10	0.42	0.23	0.13										
3960	18	5					9.00	3.92	1.64	0.62	0.34	0.20	0.10									
4752	21.6	6					12.43	5.41	2.26	0.86	0.47	0.27	0.14									
5544	25.2	7						7.11	2.97	1.13	0.61	0.36	0.19	0.07								
6336	28.8	8						9.01	3.77	1.43	0.78	0.45	0.24	0.08								
7128	32.4	9						11.10	4.64	1.76	0.96	0.56	0.30	0.10								
7920	36	10							5.59	2.13	1.16	0.67	0.36	0.12								
9504	43.2	12							7.2	2.94	1.60	0.93	0.49	0.17	0.06							
11088	50.4	14								3.86	2.10	1.22	0.65	0.22	0.08							
12672	57.6	16								4.89	2.65	1.55	0.82	0.28	0.10							
14256	64.8	18								6.02	3.27	1.90	1.01	0.35	0.12	0.04						
15840	72	20								7.25	3.94	2.29	1.22	0.42	0.14	0.05						
17424	79.2	22									4.66	2.72	1.44	0.50	0.17	0.06	0.03					
19008	86.4	24									5.44	3.17	1.68	0.58	0.20	0.07	0.04					
20592	93.6	26									6.27	3.65	1.93	0.67	0.23	0.08	0.04					
22176	100.8	28										4.16	2.21	0.76	0.26	0.09	0.05	0.03				
23760	108	30										4.70	2.49	0.86	0.30	0.10	0.06	0.03				
25344	115.2	32											2.79	0.96	0.33	0.11	0.06	0.04				
26928	122.4	34											3.11	1.07	0.37	0.12	0.07	0.04				
28512	129.6	36											3.44	1.18	0.41	0.14	0.08	0.04	0.02			
30096	136.8	38											3.79	1.30	0.45	0.15	0.08	0.05	0.03			
31680	144	40											4.15	1.43	0.49	0.16	0.09	0.05	0.03			
35640	162	45												1.76	0.61	0.20	0.11	0.06	0.04	0.02		
39600	180	50												2.12	0.73	0.24	0.14	0.08	0.04	0.03		
43560	198	55												2.51	0.87	0.29	0.16	0.09	0.05	0.03	0.02	
47520	216	60												2.92	1.01	0.34	0.19	0.11	0.06	0.04	0.02	
51480	234	65												3.37	1.16	0.39	0.22	0.12	0.07	0.04	0.02	
55440	252	70													1.33	0.44	0.25	0.14	0.08	0.05	0.03	0.02

59400	270	75													1.50	0.50	0.28	0.16	0.09	0.05	0.03	0.02
63360	288	80													1.68	0.56	0.32	0.18	0.10	0.06	0.04	0.02
71280	324	90													2.07	0.69	0.39	0.22	0.13	0.08	0.04	0.03
79200	360	100													2.49	0.83	0.47	0.26	0.15	0.09	0.05	0.03
87120	396	110														0.98	0.55	0.31	0.18	0.11	0.06	0.04
95040	432	120														1.14	0.65	0.37	0.21	0.13	0.07	0.04
102960	468	130														1.32	0.74	0.42	0.24	0.15	0.08	0.05
110880	504	140														1.50	0.85	0.48	0.27	0.17	0.10	0.05
118800	540	150														1.70	0.96	0.54	0.31	0.19	0.11	0.06
126720	576	160														1.90	1.07	0.61	0.35	0.21	0.12	0.07
134640	612	170															1.20	0.68	0.39	0.23	0.14	0.08
142560	648	180															1.32	0.75	0.43	0.26	0.15	0.09
150480	684	190															1.46	0.82	0.47	0.28	0.17	0.09
158400	720	200															1.60	0.90	0.51	0.31	0.18	0.10
166320	756	210															1.74	0.98	0.56	0.34	0.20	0.11
174240	792	220																1.07	0.61	0.37	0.21	0.12
182160	828	230																1.16	0.66	0.40	0.23	0.13
190080	864	240																1.25	0.71	0.43	0.25	0.14
198000	900	250																1.34	0.76	0.46	0.27	0.15
205920	936	260																1.44	0.82	0.50	0.29	0.16
213840	972	270																1.54	0.88	0.53	0.31	0.18
221760	1008	280																	0.93	0.57	0.33	0.19
229680	1044	290																	0.99	0.60	0.35	0.20
237600	1080	300																	1.06	0.64	0.37	0.21
245520	1116	310																	1.12	0.68	0.39	0.22
253440	1152	320																	1.18	0.72	0.42	0.24
261360	1188	330																	1.25	0.76	0.44	0.25
269280	1224	340																	1.32	0.80	0.46	0.26
277200	1260	350																		0.84	0.49	0.28
285120	1296	360																		0.88	0.51	0.29
293040	1332	370																		0.93	0.54	0.31
300960	1368	380																		0.97	0.57	0.32
308880	1404	390																		1.02	0.59	0.34
316800	1440	400																		1.06	0.62	0.35
332640	1512	420																		1.16	0.67	0.38
348480	1584	440																			0.73	0.42
364320	1656	460																			0.79	0.45
380160	1728	480																			0.85	0.49
396000	1800	500																			0.92	0.52
435600	1980	550																				0.62
475200	2160	600																				0.72
514800	2340	650																				0.83
554400	2520	700																				

SDR 11

Size (mm-O.D.)			20	25	32	40	50	63	75	90	110	125	140	160	200	250	315	355	400	450	500	560	630
W.T.			2.0	2.3	3.0	3.7	4.6	5.8	6.8	8.2	10.0	11.4	12.7	14.6	18.2	22.7	28.6	32.2	36.3	40.9	45.4	50.8	57.2
I.D.			16.0	20.4	26.0	32.6	40.8	51.4	61.4	73.6	90.0	102.2	114.6	130.8	163.6	204.6	257.8	290.6	327.4	368.2	409.2	458.4	515.6
G.P.H.	m3/hr.	l/s.																					
79	0.4	0.1	2.83	0.89																			
158	0.7	0.2	9.65	3.03	0.95																		
238	1.1	0.3	19.77	6.20	1.95	0.66																	
317	1.4	0.4	32.90	10.32	3.25	1.10	0.38																
396	1.8	0.5	48.83	15.32	4.82	1.64	0.56																
475	2.2	0.6	67.42	21.16	6.65	2.26	0.78																
554	2.5	0.7		27.80	8.74	2.97	1.02	0.34															
634	2.9	0.8		35.21	11.07	3.76	1.29	0.43															
713	3.2	0.9		43.37	13.64	4.64	1.59	0.53	0.23														
792	3.6	1			16.43	5.59	1.92	0.64	0.27														
1584	7.2	2				19.05	6.53	2.17	0.93	0.39	0.15												
2376	10.8	3					13.39	4.45	1.91	0.80	0.31	0.17											
3168	14.4	4						7.40	3.17	1.34	0.51	0.28	0.16	0.09									
3960	18	5						10.99	4.71	1.98	0.76	0.41	0.24	0.13									
4752	21.6	6						15.18	6.50	2.74	1.05	0.57	0.33	0.18									
5544	25.2	7							8.54	3.60	1.38	0.75	0.44	0.23	0.08								
6336	28.8	8							10.82	4.56	1.75	0.95	0.55	0.29	0.10								
7128	32.4	9								5.61	2.15	1.17	0.68	0.36	0.12								
7920	36	10								6.76	2.59	1.41	0.82	0.44	0.15	0.05							
9504	43.2	12								9.34	3.58	1.95	1.13	0.60	0.21	0.07							
11088	50.4	14									4.70	2.56	1.48	0.79	0.27	0.09							
12672	57.6	16									5.95	3.25	1.88	1.00	0.34	0.12	0.04						
14256	64.8	18									7.33	4.00	2.32	1.23	0.42	0.15	0.05						
15840	72	20										4.82	2.79	1.49	0.51	0.18	0.06	0.03					
17424	79.2	22										5.70	3.30	1.76	0.60	0.21	0.07	0.04					
19008	86.4	24										6.65	3.85	2.05	0.71	0.24	0.08	0.05					
20592	93.6	26											4.44	2.36	0.81	0.28	0.09	0.05					
22176	100.8	28											5.06	2.69	0.93	0.32	0.11	0.06	0.03				
23760	108	30											5.72	3.04	1.05	0.36	0.12	0.07	0.04				
25344	115.2	32												3.41	1.17	0.40	0.13	0.08	0.04	0.02			
26928	122.4	34												3.80	1.31	0.45	0.15	0.08	0.05	0.03			
28512	129.6	36												4.20	1.45	0.50	0.17	0.09	0.05	0.03			
30096	136.8	38												4.63	1.59	0.55	0.18	0.10	0.06	0.03			
31680	144	40												5.06	1.74	0.60	0.20	0.11	0.06	0.04	0.02		
35640	162	45													2.15	0.74	0.25	0.14	0.08	0.04	0.03		
39600	180	50													2.59	0.89	0.30	0.17	0.09	0.05	0.03	0.02	
43560	198	55													3.06	1.05	0.35	0.20	0.11	0.06	0.04	0.02	

47520	216	60													3.57	1.23	0.41	0.23	0.13	0.07	0.05	0.03	
51480	234	65														1.42	0.47	0.27	0.15	0.09	0.05	0.03	0.02
55440	252	70														1.61	0.54	0.30	0.17	0.10	0.06	0.03	0.02
59400	270	75														1.82	0.61	0.34	0.19	0.11	0.07	0.04	0.02
63360	288	80														2.04	0.68	0.38	0.22	0.12	0.07	0.04	0.02
71280	324	90														2.52	0.84	0.47	0.27	0.15	0.09	0.05	0.03
79200	360	100															1.01	0.57	0.32	0.18	0.11	0.06	0.04
87120	396	110															1.19	0.67	0.38	0.22	0.13	0.08	0.04
95040	432	120															1.39	0.79	0.45	0.25	0.15	0.09	0.05
102960	468	130															1.60	0.91	0.51	0.29	0.18	0.10	0.06
110880	504	140															1.83	1.03	0.58	0.33	0.20	0.12	0.07
118800	540	150															2.07	1.17	0.66	0.38	0.23	0.13	0.08
126720	576	160																1.31	0.74	0.42	0.26	0.15	0.08
134640	612	170																1.46	0.82	0.47	0.28	0.17	0.09
142560	648	180																1.61	0.91	0.52	0.31	0.18	0.10
150480	684	190																1.77	1.00	0.57	0.35	0.20	0.12
158400	720	200																	1.10	0.63	0.38	0.22	0.13
166320	756	210																	1.20	0.68	0.41	0.24	0.14
174240	792	220																	1.30	0.74	0.45	0.26	0.15
182160	828	230																	1.41	0.80	0.49	0.28	0.16
190080	864	240																	1.52	0.87	0.52	0.30	0.17
198000	900	250																	1.63	0.93	0.56	0.33	0.19
205920	936	260																		1.00	0.60	0.35	0.20
213840	972	270																		1.07	0.65	0.38	0.21
221760	1008	280																		1.14	0.69	0.40	0.23
229680	1044	290																		1.21	0.73	0.43	0.24
237600	1080	300																		1.29	0.78	0.45	0.26
245520	1116	310																		1.36	0.82	0.48	0.27
253440	1152	320																			0.87	0.51	0.29
261360	1188	330																			0.92	0.54	0.31
269280	1224	340																			0.97	0.56	0.32
277200	1260	350																			1.02	0.59	0.34
285120	1296	360																			1.07	0.62	0.36
293040	1332	370																			1.13	0.66	0.37
300960	1368	380																			1.18	0.69	0.39
308880	1404	390																			1.24	0.72	0.41
316800	1440	400																				0.75	0.43
332640	1512	420																				0.82	0.47
348480	1584	440																				0.89	0.51
364320	1656	460																				0.96	0.55
380160	1728	480																				1.04	0.59
396000	1800	500																					0.64
435600	1980	550																					0.75
475200	2160	600																					0.88

SDR 9

Size (mm-O.D.)			16	20	25	32	40	50	63	75	90	110	125	140	160	200	250	315	355	400	450	500	560	630
W.T.			2.0	2.3	3.0	3.6	4.5	5.6	7.1	8.4	10.1	12.3	14.0	15.7	17.9	22.4	27.9	35.2	39.7	44.7	50.3	55.8	62.5	70.3
I.D.			12.0	15.4	19.0	24.8	31.0	38.8	48.8	58.2	69.8	85.4	97.0	108.6	124.2	155.2	194.2	244.6	275.6	310.6	349.4	388.4	435.0	489.4
G.P.H.	m3/hr.	l/s.																						
79	0.4	0.1	11.15	3.39	1.25	0.35																		
158	0.7	0.2	38.04	11.57	4.25	1.19	0.41																	
238	1.1	0.3	77.97	23.72	8.71	2.44	0.84																	
317	1.4	0.4		39.47	14.49	4.07	1.40	0.48																
396	1.8	0.5		58.59	21.51	6.04	2.08	0.71																
475	2.2	0.6			29.70	8.34	2.88	0.99	0.33															
554	2.5	0.7			39.02	10.95	3.78	1.29	0.43															
634	2.9	0.8			44.75	13.87	4.78	1.64	0.55	0.24														
713	3.2	0.9				17.08	5.89	2.02	0.68	0.29														
792	3.6	1				20.59	7.10	2.43	0.82	0.35														
1584	7.2	2					24.22	8.30	2.78	1.20	0.5	0.19												
2376	10.8	3						17.02	5.70	2.46	1.03	0.39	0.22	0.13										
3168	14.4	4							9.48	4.09	1.72	0.66	0.36	0.21	0.11									
3960	18	5							14.08	6.08	2.55	0.98	0.53	0.31	0.16									
4752	21.6	6								8.39	3.53	1.35	0.73	0.43	0.23	0.08								
5544	25.2	7								11.02	4.63	1.77	0.96	0.56	0.30	0.10								
6336	28.8	8									5.87	2.24	1.22	0.71	0.38	0.13								
7128	32.4	9									7.23	2.76	1.50	0.88	0.46	0.16	0.05							
7920	36	10									8.71	3.33	1.81	1.06	0.56	0.19	0.07							
9504	43.2	12										4.59	2.50	1.46	0.77	0.27	0.09							
11088	50.4	14										6.04	3.29	1.92	1.01	0.35	0.12	0.04						
12672	57.6	16										7.64	4.16	2.43	1.28	0.44	0.15	0.05						
14256	64.8	18											5.13	2.99	1.58	0.55	0.19	0.06	0.04					
15840	72	20											6.18	3.61	1.90	0.66	0.23	0.07	0.04					
17424	79.2	22											7.32	4.27	2.25	0.78	0.27	0.09	0.05					
19008	86.4	24												4.98	2.63	0.91	0.31	0.10	0.06	0.03				
20592	93.6	26												5.74	3.02	1.04	0.36	0.12	0.07	0.04				
22176	100.8	28													3.45	1.19	0.41	0.14	0.08	0.04				
23760	108	30													3.90	1.35	0.46	0.15	0.09	0.05	0.03			
25344	115.2	32													4.37	1.51	0.52	0.17	0.10	0.06	0.03			
26928	122.4	34													4.86	1.68	0.58	0.19	0.11	0.06	0.04			
28512	129.6	36													5.38	1.86	0.64	0.21	0.12	0.07	0.04	0.02		
30096	136.8	38														2.05	0.70	0.23	0.13	0.07	0.04	0.03		
31680	144	40														2.24	0.77	0.26	0.14	0.08	0.05	0.03	0.02	
35640	162	45														2.76	0.95	0.32	0.18	0.10	0.06	0.03	0.02	
39600	180	50														3.32	1.14	0.38	0.21	0.12	0.07	0.04	0.02	
43560	198	55														3.94	1.35	0.45	0.25	0.14	0.08	0.05	0.03	0.02
47520	216	60															1.58	0.52	0.30	0.17	0.10	0.06	0.03	0.02

51480	234	65															1.82	0.60	0.34	0.19	0.11	0.07	0.04	0.02
55440	252	70															2.07	0.69	0.39	0.22	0.13	0.08	0.04	0.03
59400	270	75															2.34	0.78	0.44	0.25	0.14	0.09	0.05	0.03
63360	288	80															2.62	0.87	0.49	0.28	0.16	0.10	0.06	0.03
71280	324	90																1.07	0.61	0.34	0.20	0.12	0.07	0.04
79200	360	100																1.29	0.73	0.41	0.24	0.14	0.08	0.05
87120	396	110																1.53	0.87	0.49	0.28	0.17	0.10	0.06
95040	432	120																1.79	1.01	0.57	0.33	0.20	0.11	0.07
102960	468	130																2.06	1.17	0.66	0.38	0.23	0.13	0.08
110880	504	140																2.35	1.33	0.75	0.43	0.26	0.15	0.09
118800	540	150																	1.50	0.85	0.48	0.29	0.17	0.10
126720	576	160																	1.68	0.95	0.54	0.33	0.19	0.11
134640	612	170																	1.87	1.06	0.60	0.36	0.21	0.12
142560	648	180																		1.17	0.67	0.40	0.24	0.13
150480	684	190																		1.29	0.74	0.44	0.26	0.15
158400	720	200																		1.41	0.81	0.49	0.28	0.16
166320	756	210																		1.54	0.88	0.53	0.31	0.18
174240	792	220																		1.67	0.95	0.58	0.34	0.19
182160	828	230																			1.03	0.62	0.36	0.21
190080	864	240																			1.11	0.67	0.39	0.22
198000	900	250																			1.20	0.72	0.42	0.24
205920	936	260																			1.28	0.77	0.45	0.26
213840	972	270																			1.37	0.83	0.48	0.27
221760	1008	280																			1.46	0.88	0.51	0.29
229680	1044	290																				0.94	0.55	0.31
237600	1080	300																				1.00	0.58	0.33
245520	1116	310																				1.06	0.62	0.35
253440	1152	320																				1.12	0.65	0.37
261360	1188	330																				1.18	0.69	0.39
269280	1224	340																				1.24	0.72	0.41
277200	1260	350																				1.31	0.76	0.43
285120	1296	360																					0.80	0.46
293040	1332	370																					0.84	0.48
300960	1368	380																					0.88	0.50
308880	1404	390																					0.92	0.53
316800	1440	400																					0.97	0.55
332640	1512	420																					1.05	0.60
348480	1584	440																					1.14	0.65
364320	1656	460																						0.71
380160	1728	480																						0.76
396000	1800	500																						0.82

SDR 7.4

Size (mm-O.D.)			16	20	25	32	40	50	63	75	90	110	125	140	160	200	250	315	355	400	450
W.T.			2.3	3.0	3.5	4.4	5.5	6.9	8.6	10.3	12.3	15.1	17.1	19.2	21.9	27.4	34.2	43.1	48.5	54.7	61.5
I.D.			11.4	14.0	18.0	23.2	29.0	36.2	45.8	54.4	65.4	79.8	90.8	101.6	116.2	145.2	181.6	228.8	258.0	290.6	327.0
G.P.H.	m3/hr.	l/s.																			
79	0.4	0.1	14.25	5.35	1.61																
158	0.7	0.2	48.59	18.24	5.50	1.64	0.57														
238	1.1	0.3	99.59	37.38	11.27	3.36	1.16														
317	1.4	0.4		62.19	18.76	5.59	1.93	0.67													
396	1.8	0.5			27.84	8.30	2.86	0.99	0.32												
475	2.2	0.6			38.44	11.46	3.95	1.37	0.45												
554	2.5	0.7			50.50	15.05	5.19	1.80	0.59	0.26											
634	2.9	0.8				19.06	6.58	2.28	0.74	0.33											
713	3.2	0.9				23.48	8.10	2.81	0.92	0.40											
792	3.6	1				28.30	9.76	3.39	1.10	0.49	0.20										
1584	7.2	2						11.56	3.76	1.66	0.69	0.27	0.14								
2376	10.8	3						23.69	7.71	3.39	1.41	0.55	0.29	0.17							
3168	14.4	4							12.84	5.65	2.35	0.91	0.49	0.29	0.15						
3960	18	5								8.39	3.48	1.35	0.73	0.43	0.22	0.08					
4752	21.6	6								11.58	4.81	1.86	1.01	0.59	0.31	0.11					
5544	25.2	7									6.32	2.45	1.32	0.77	0.41	0.14					
6336	28.8	8									8.00	3.10	1.67	0.98	0.52	0.18	0.06				
7128	32.4	9									9.86	3.82	2.06	1.21	0.64	0.22	0.08				
7920	36	10									11.88	4.60	2.48	1.45	0.77	0.26	0.09				
9504	43.2	12										6.35	3.43	2.01	1.06	0.37	0.13				
11088	50.4	14										8.34	4.51	2.64	1.39	0.48	0.17	0.05			
12672	57.6	16											5.71	3.34	1.76	0.61	0.21	0.07	0.04		
14256	64.8	18											7.03	4.11	2.17	0.75	0.26	0.09	0.05		
15840	72	20												4.96	2.61	0.90	0.31	0.10	0.06	0.03	
17424	79.2	22												5.87	3.09	1.07	0.37	0.12	0.07	0.04	
19008	86.4	24												6.84	3.61	1.25	0.43	0.14	0.08	0.05	
20592	93.6	26													4.16	1.44	0.49	0.16	0.09	0.05	0.03
22176	100.8	28													4.74	1.64	0.56	0.19	0.11	0.06	0.03
23760	108	30													5.35	1.85	0.64	0.21	0.12	0.07	0.04

25344	115.2	32													6.00	2.07	0.71	0.24	0.13	0.08	0.04
26928	122.4	34														2.31	0.79	0.26	0.15	0.08	0.05
28512	129.6	36														2.55	0.88	0.29	0.16	0.09	0.05
30096	136.8	38														2.81	0.97	0.32	0.18	0.10	0.06
31680	144	40														3.08	1.06	0.35	0.20	0.11	0.06
35640	162	45														3.79	1.30	0.43	0.24	0.14	0.08
39600	180	50														4.45	1.57	0.52	0.29	0.17	0.10
43560	198	55															1.86	0.62	0.35	0.20	0.11
47520	216	60															2.17	0.72	0.41	0.23	0.13
51480	234	65															2.50	0.83	0.47	0.27	0.15
55440	252	70															2.85	0.95	0.53	0.30	0.17
59400	270	75															3.22	1.07	0.60	0.34	0.19
63360	288	80																1.20	0.68	0.38	0.22
71280	324	90																1.48	0.83	0.47	0.27
79200	360	100																1.78	1.00	0.57	0.32
87120	396	110																2.11	1.19	0.67	0.38
95040	432	120																2.46	1.39	0.79	0.45
102960	468	130																	1.60	0.91	0.52
110880	504	140																	1.82	1.03	0.59
118800	540	150																	2.06	1.17	0.66
126720	576	160																		1.31	0.74
134640	612	170																		1.46	0.83
142560	648	180																		1.61	0.92
150480	684	190																		1.77	1.01
158400	720	200																			1.11
166320	756	210																			1.21
174240	792	220																			1.31
182160	828	230																			1.42
190080	864	240																			1.53
198000	900	250																			1.64
205920	936	260																			

Nomogram

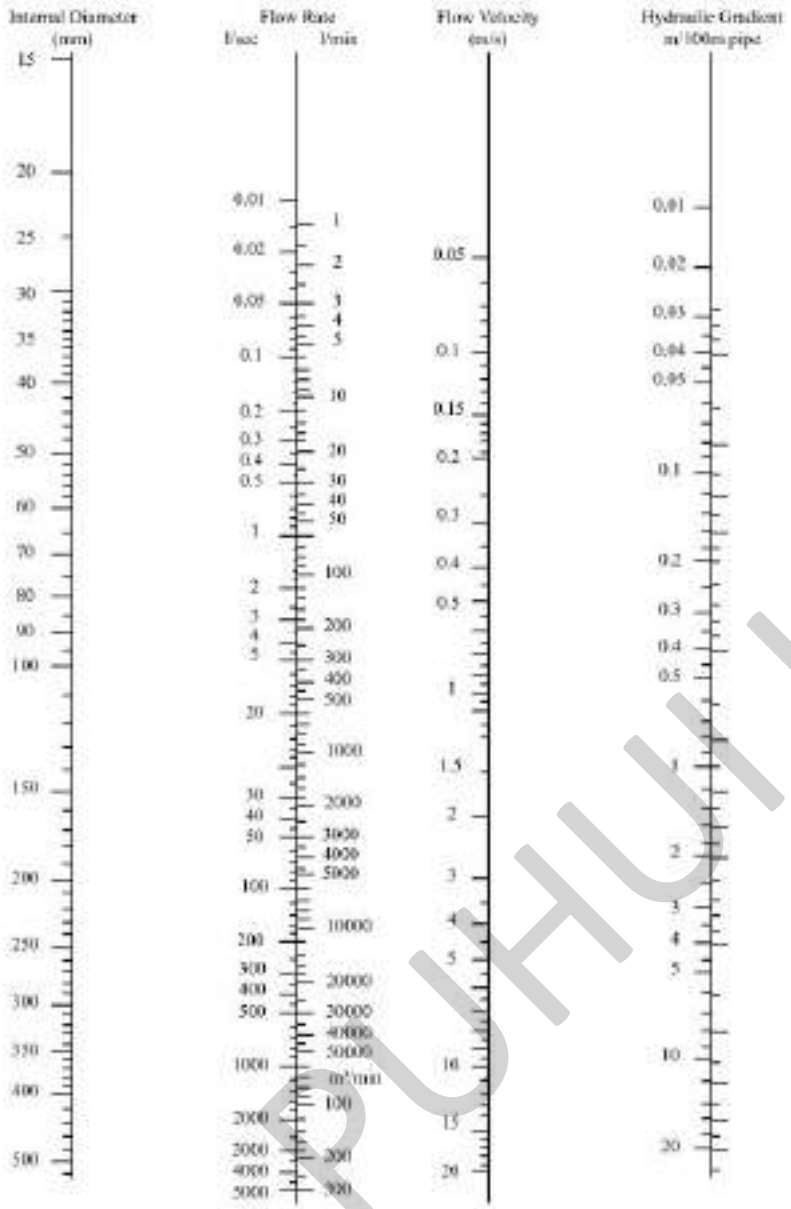


Diagram for water at 20 ˚C

Approximate values only

Note: For sizes not covered by Nomogram, please contact Technical Support Department.
The nomogram is based on the Prandti - Coalbrook formula using a k factor of k= 0.007 mm.
Factors applicable to other flow formulae are:
Hazen Williams c = 150
Manning n = 0.010
Darcy roughness factor = 0.007

Pressure Considerations

Static

The hydrostatic pressure capacity of HDPE pipe is related to a number of variables:

- The ratio between the outside diameter and the wall thickness (standard dimension ratio - SDR).
- The hydrostatic design stress of the HDPE material being used (PE 63, PE 80, PE 100).
- The operating temperature.
- The duration and variability of the stress applied by the internal hydrostatic pressure.
- The chemical resistance of the pipe to the chemical being carried (the standard pressure rating is based on a pipe carrying water).

Although HDPE pipe can withstand short-term hydrostatic water pressures at levels substantially higher than the pressure rating, or class, (see “The Stress Regression Line” and “Design Stress and Safety Factor” on page 9) the duty of HDPE pipe should always be based on the pipe’s long-term strength at 20 °C to ensure a design life of at least 50 years.

As stated earlier, the relationship between the internal pressure, the diameter and wall thickness and the circumferential hoop stress in the pipe wall, is given by the Barlow Formula, which can also be expressed as follows.

$p = 2 \times t \times \sigma / d$ or alternatively $t = p \times d/(2.\sigma + p)$

Where: p = internal pressure (MPa)

t = minimum wall thickness (mm) d = mean outside diameter (mm)

σ = circumferential hoop stress (MPa)

These formulae have been standardized for use in design, testing and research and are applicable at all levels of pressure and stress. For design purposes, p is taken as the maximum allowable working pressure and σ, the maximum allowable hoop stress at 20 °C.

The design hoop stresses used in SANS ISO 4427 are as follows:

Material	Design Stress
PE 63	5 MPa
PE 80	6.3 MPa
PE100	8 MPa

Dynamic

The pressure classes of SANS ISO 4427 HDPE pipes are based on constant internal water pressures.

HDPE pipes are however capable of handling dynamic pressure events which exceed the values given by the classes but such occurrences can have a negative effect on the standard 50 year life expectancy and in extreme cases can result in product failure.

Water Hammer

Pipelines may be subjected to short-term increase in pressure above the normal working pressure due to water hammer. Water hammer will occur in a pipeline when its equilibrium is disturbed by rapid changes

in flow conditions. Examples of such conditions are; starting and stopping of pumps, rapid opening and closing of valves, pipe failures, etc.

A rapid change in the velocity Δv of water in the pipeline gives rise to a pressure increase Δp according to the formula:

$\Delta p = c\Delta v/g$

Where: c = the wave celerity (metres per second) g = the acceleration due to gravity.

The approximate wave celerities for HDPE pipes are as follows:

SDR	Wave Celerity - m/s
33	204
26	229
21	258
17	290
13.6	327
11	368
9	416
7.4	471

By way of comparison the wave celerity for steel pipes is about 3-5 times higher than for HDPE – 1000 to 1400 m/s.

Since part of the formula for calculating wave celerity incorporates the ratio between diameter and wall thickness (SDR), which is roughly constant for all sizes within a pressure class, the wave celerities are also constant for all sizes within a pressure class.

It is important to note that the pressure increase due to water hammer in a particular class of pipe is a function of the change in velocity and it is therefore important (for this and other reasons) to keep pumping velocities in a pipeline within the conventional norm of 1 to 2 m/s.

In general steps should be taken during design and operation to minimize the frequency and intensity of water hammer. However the total pressure may be permitted to reach a value 50% higher than the nominal pressure if the frequency can be described as “occasional”.

Temperature Considerations

Effect on Pressure

Pressure de-rating factors should be applied to HDPE pipes when operating temperatures rise above 20°C. The de-rating factors below are applicable to HDPE.

Temperature	Multiply Working Pressure by:
0 - 20 °C	1
20 - 25 °C	0.8
25 - 30 °C	0.63
30 - 35 °C	0.5
35 - 40 °C	0.4
40 - 45 °C	0.32
45 - 50 °C	0.25

The maximum recommended working temperature is 50°C

At lower temperatures, between 20 °C and 0 °C, the pressure handling capability does increase but it is recommended that this be ignored. In the unlikely event of water freezing inside an HDPE pipe damage is unlikely to occur. Nonetheless it is recommended that the pipeline system be protected against freezing to obviate flow restrictions.

Effect on Dimensions

Due to the relatively high co-efficient of expansion and contraction (given in “Expansion and Contraction” on page 10) it is necessary to make allowance for this in any design and installation which is exposed to wide variations of temperature.

HDPE pipes will expand or contract by 0.2 mm per meter per °C rise or fall in temperature. A 30 °C temperature rise will therefore cause a 36 mm expansion of a 6 meter pipe.

Trench Load Considerations

It has been well established by researchers over many years that, for flexible pipes, it is the interaction between the soil and the pipe which has to be considered more extensively than is the case for rigid pipes where the material strength of the pipe is the critical issue. The points discussed here are given as a guide only to good design by the engineer.

Soil and Traffic Loads

The vertical load on a HDPE pipe due to soil is a function of the trench width and depth, the unit weight and type of the soil and the pipe diameter and wall thickness. This loading must generally be corrected for the fact that the soil is cohesive and the side fill reacts with the fill above the pipe. Furthermore flexible pipes deflect and shed load to the side fill. This vertical deflection is limited by lateral soil resistance. The resultant load is therefore less than that which column theory suggests.

The Soil Loading graphs below show that, after initial rapid increases with increased depth, this rate of increase falls away to almost zero at depths of about 6 metres or more. Typical maximum values of soil loads (without live loads) are between 500 and 27000 N/m (for sizes up to 630 mm), depending largely on soil type, modulus and pipe stiffness. As soil compaction is increased so the maximum soil load on the pipe reduces, assuming that good backfilling procedures have been followed.

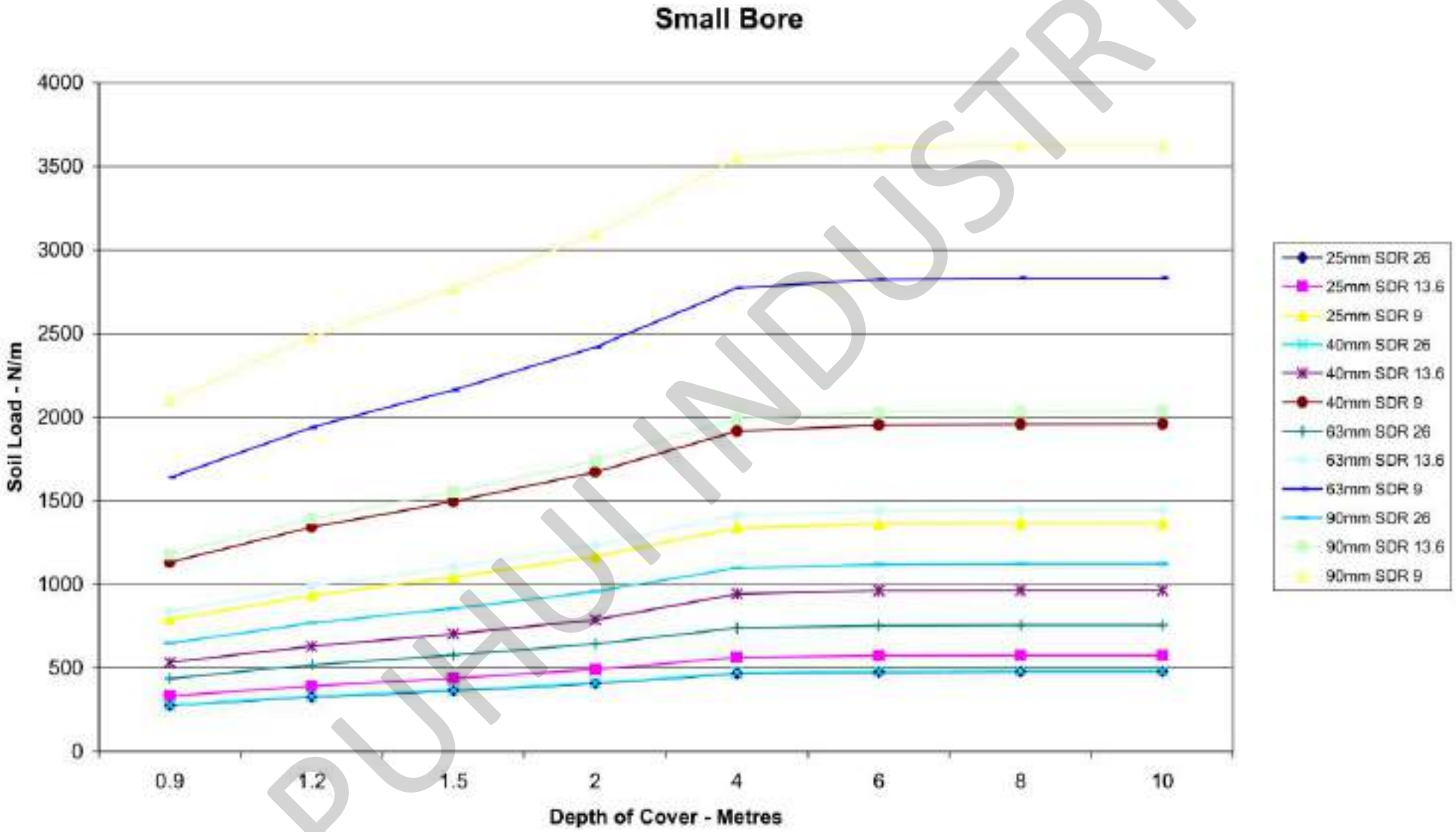
If a 60 KN live load is added then the soil load increases dramatically (if compaction is poor but less dramatically if it is good) at shallow depths, but from about 3 metres deep this difference becomes negligible.

As can be seen from the Deflection vs. Soil Load graph there is a straight line relationship between deflection and soil load for each size and class of pipe. Therefore when the soil load reaches a maximum then the deflection is also at a maximum.

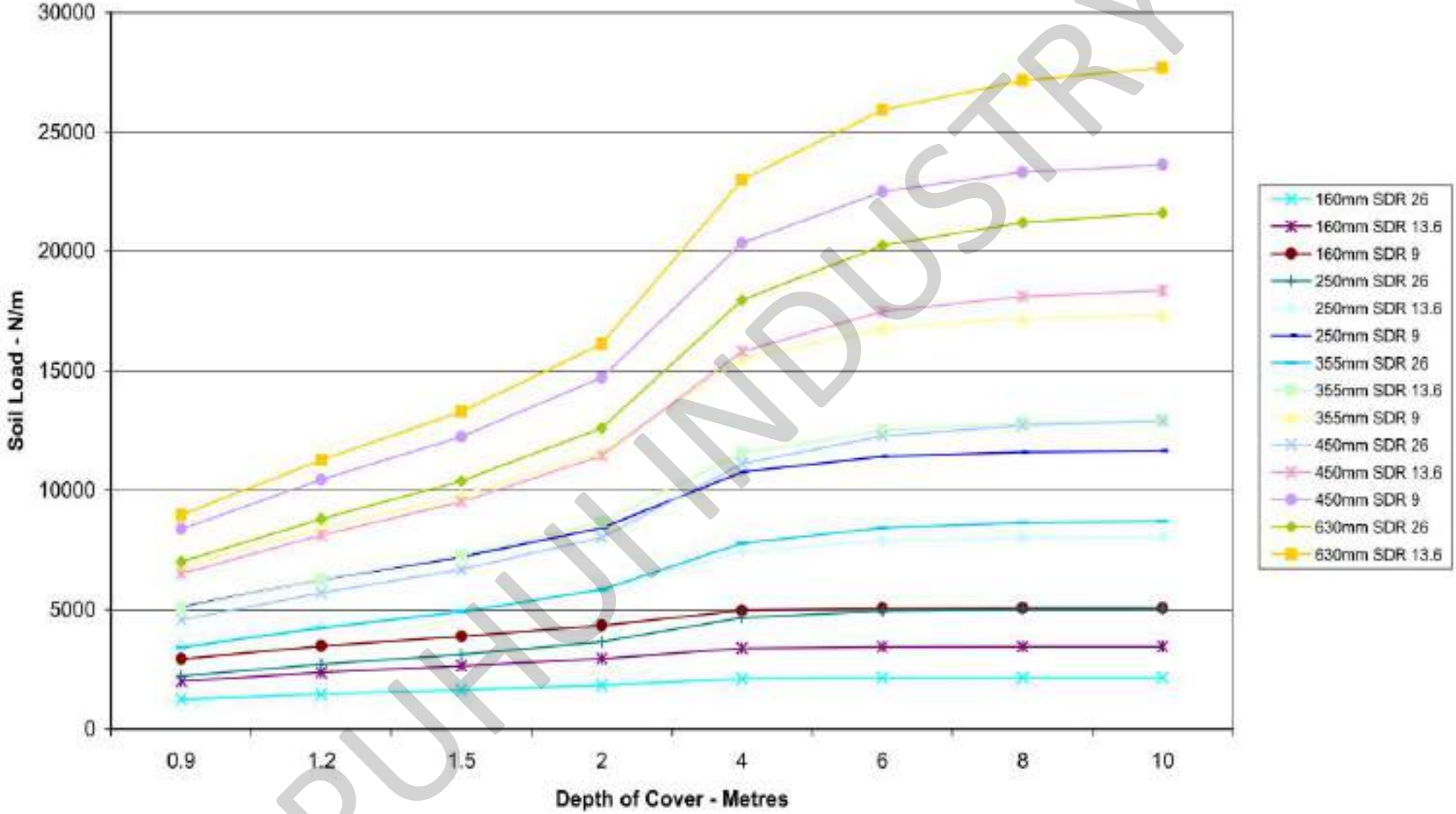
These graphs include the maximum soil loads from the soil load graphs and as can be seen the maximum deflection (for the conditions represented) is less than 2% - for a 630 mm SDR 26 pipe - even with a 60 KN live load. This Deflection vs. Soil Load graph also shows that the small diameter, lower pressure-class pipes (thinner walls) are at the left hand side of the graph and are almost vertical while the bigger diameter, higher pressure class pipes are progressively further right and are not as vertical. Large diameter pipes carry more load because of their greater surface area – thicker pipes carry more soil load because it is more difficult to deflect them since less load shedding occurs.

The graphs have been based on calculations using values typical for reasonable backfill material which has been
poorly compacted (soil modulus of 3 MPa) and on two scenarios – excluding and including a 60 KN live load. Trench widths of 0.4 m, 0.6 m, 0.7 m, 0.8 m and 0.9 m were used for the following groups of pipe sizes: 50 mm
- 160 mm, 200 mm - 315 mm, 355 mm - 400 mm, 450 mm - 500 mm and 560 mm - 630 mm. Different soil cover over the pipes were used, varying from 0.9 m to 10 m.
The method of calculation was provided by Professor David Stephenson formerly of Witwatersrand University.
The effect of these loads on HDPE pipes is very similar to that on PVC pipes.

Soil Loading on HDPE, No Live Load, Soil Modulus: 3 MPa

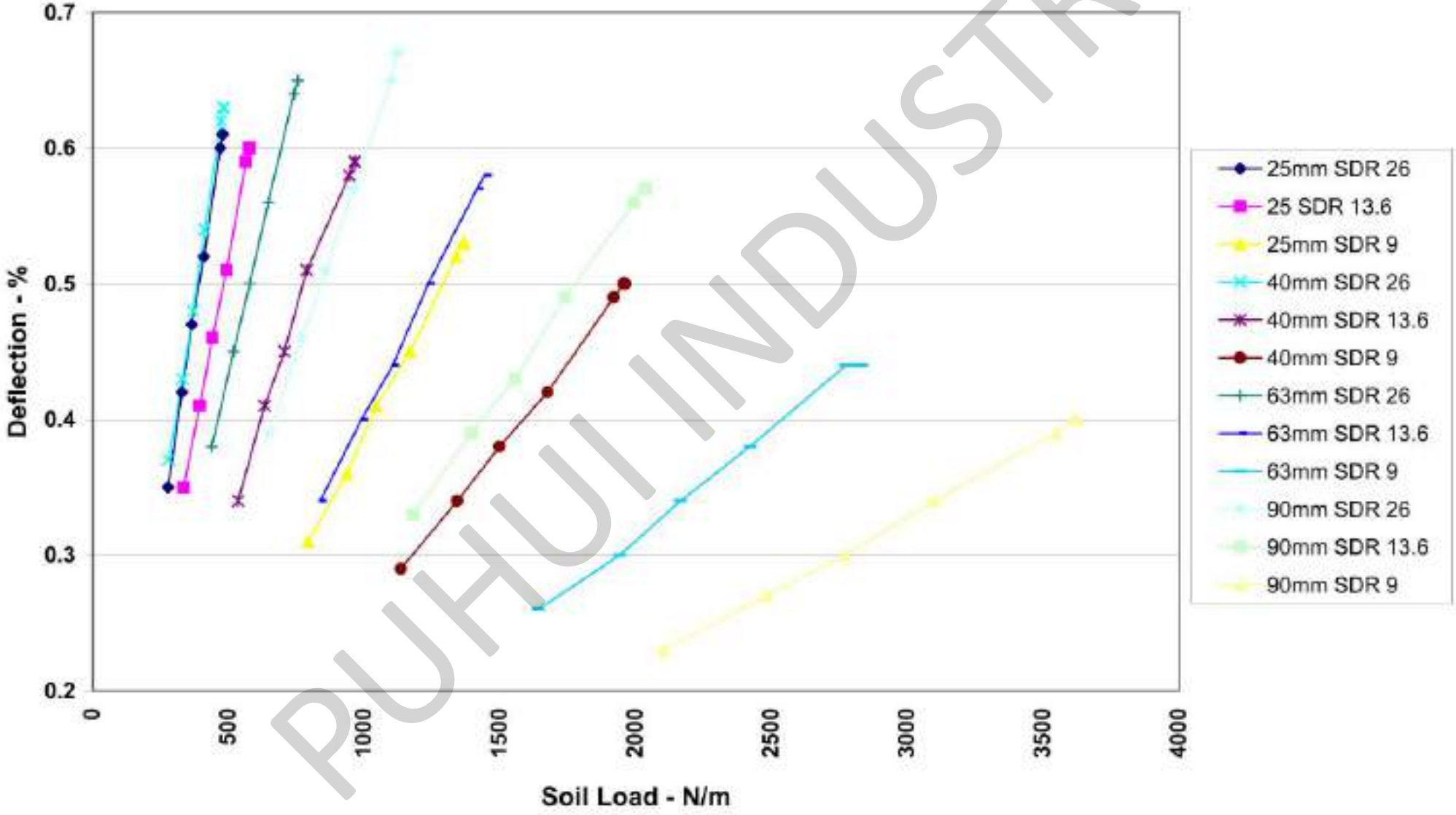


Large Bore

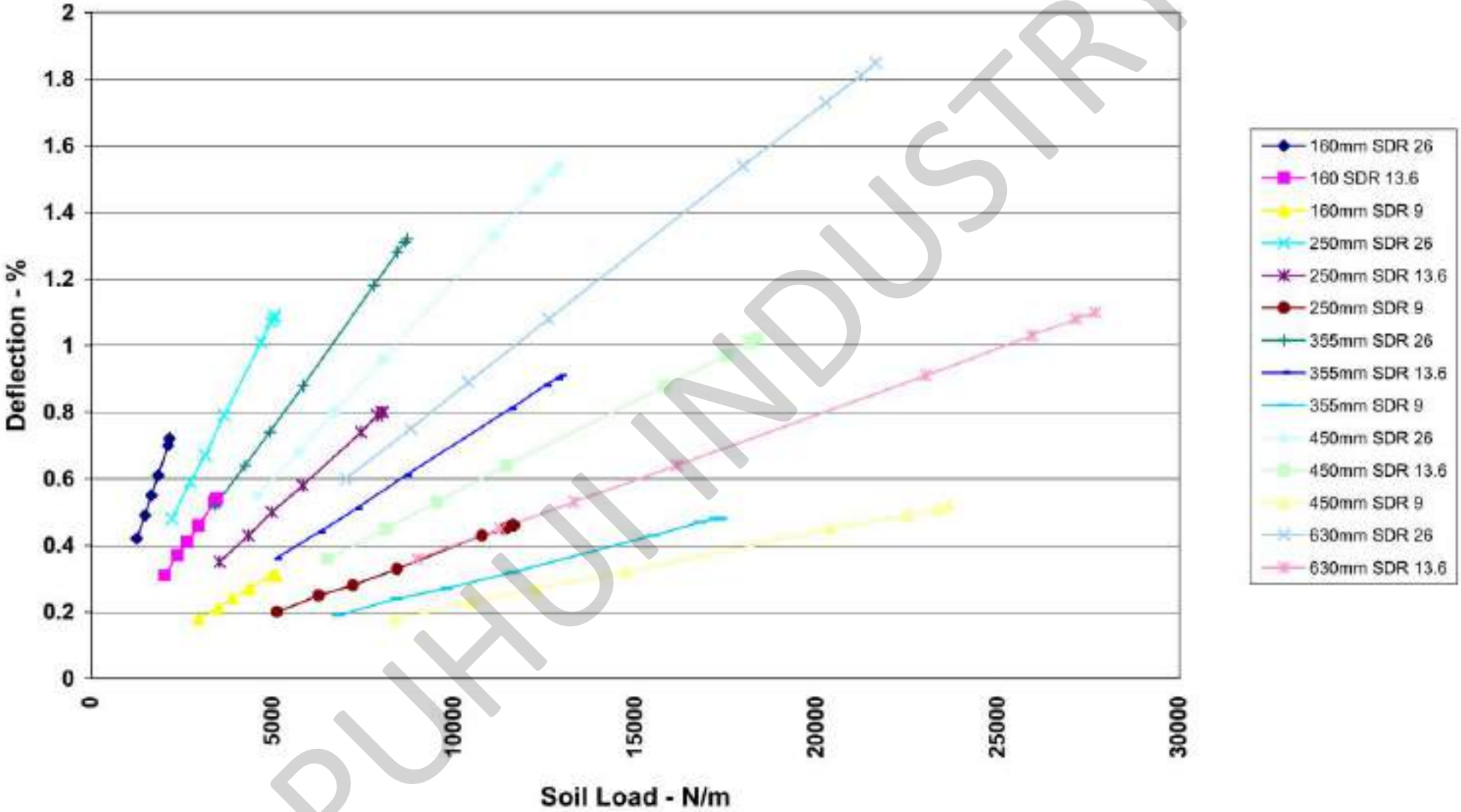


Deflection vs Soil Load HDPE, No Live Load, Soil Modulus: 3 MPa

Small Bore

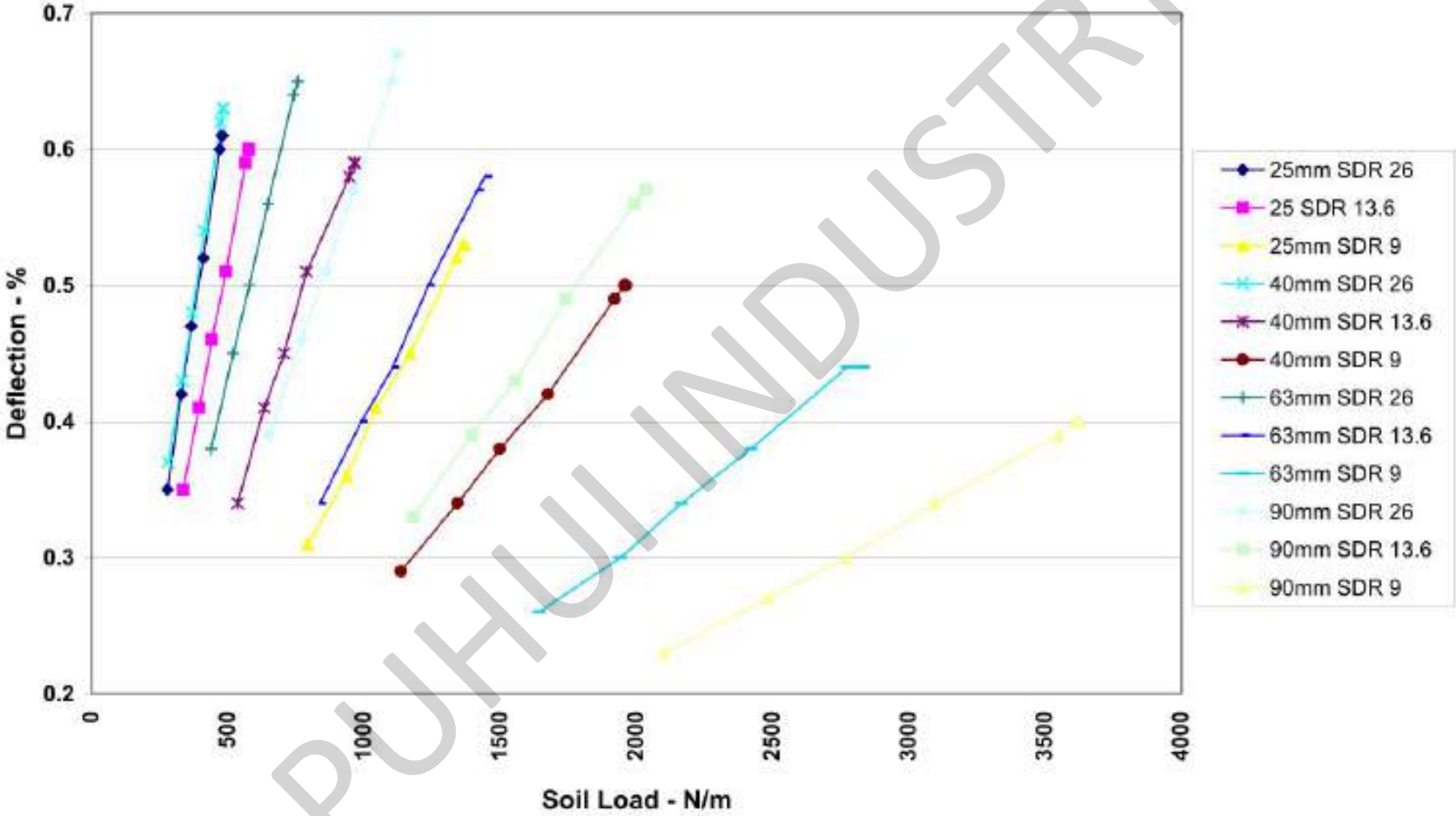


Large Bore

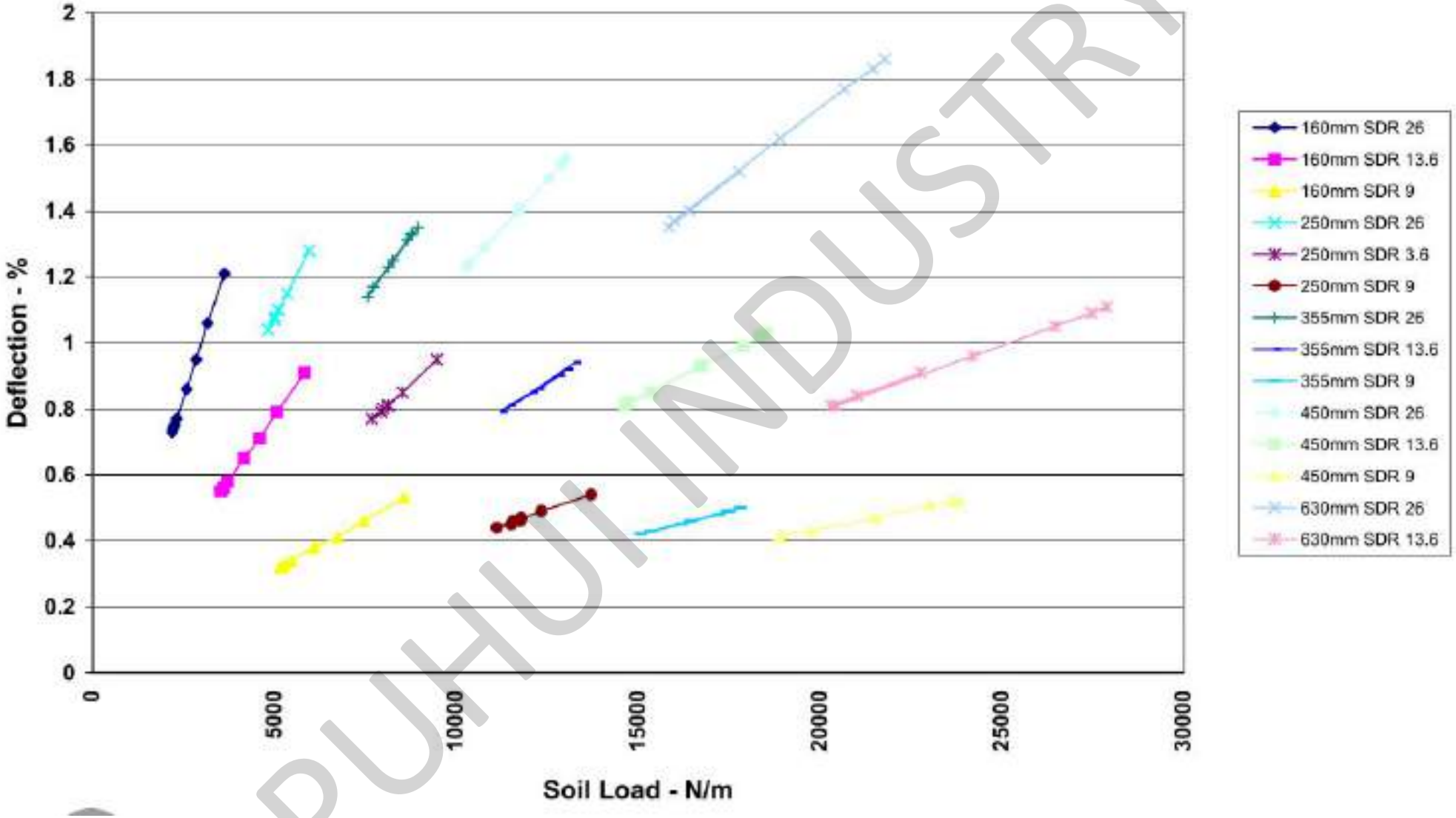


Deflection vs Soil Load HDPE, No Live Load, Soil Modulus: 3 MPa

Small Bore



Large Bore



Calculations with a higher soil modulus (not shown), implying better compaction, show much lower deflection percentages and reduce the gap between the static soil load and the live load.

Above Ground Installation

For exposed above-ground pipework proper anchorage and support is essential. It must cater for thermal stresses or movement over the ambient temperature range to which the pipe system will be exposed.

Above-ground HDPE systems should preferably be installed at or near maximum operating temperature. This will ensure that the pipe is thermally expanded when clamps or supports are bolted into position and the pipe will be prevented from contracting. Tensile stresses will develop as the pipework cools, and the pipeline will therefore remain straight between supports. When reheated to installation temperature, any sagging will be minimized.

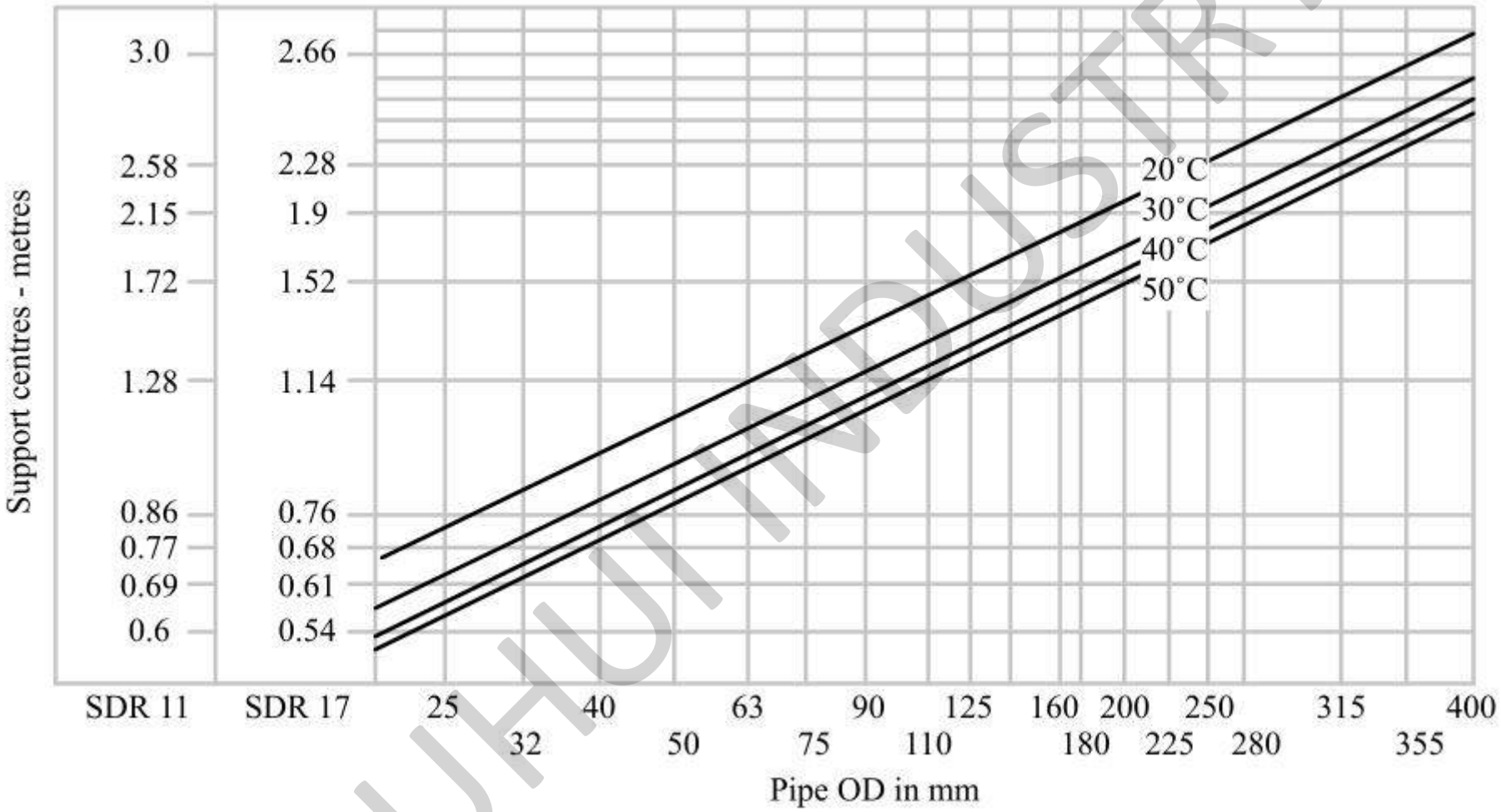
When suspending HDPE pipes the recommended centre distance between supports at various temperatures is given by the following graph. The graph is based on PE 63 material and SDR 11 and SDR 17.

As a rule of thumb the following adjustments can be made for variations in temperature and class:

- Reduce the centre distance by 3% for every 10 °C increase in temperature.
- Increase the centre distance by 2.5% for every 10% increase in wall thickness above above/below SDR 17.

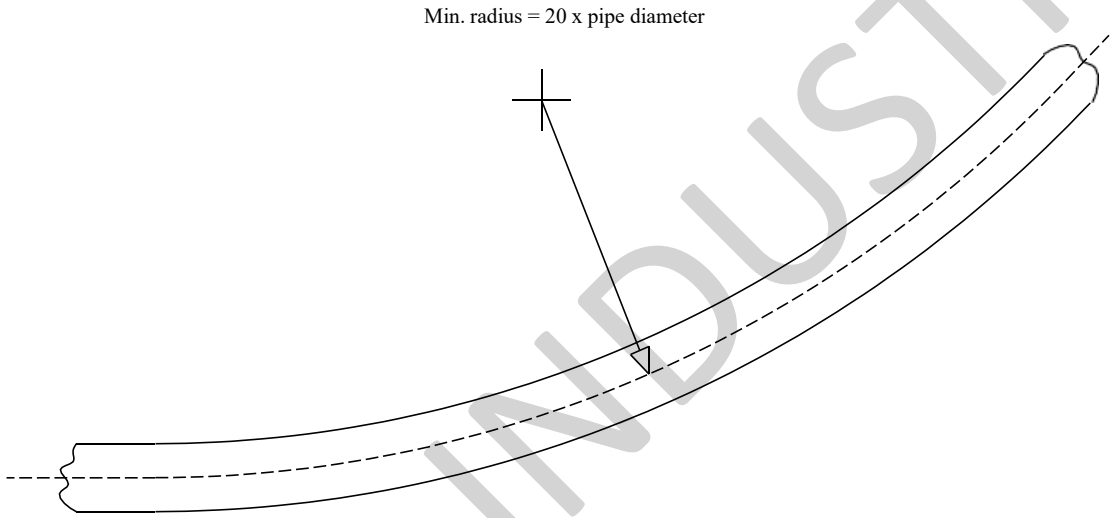
Pipe clamps used for anchorage and support should have flat, non-abrasive contact faces, or be lined with rubber sheeting and should not be over-tightened. The width of support brackets and hangers should normally be either 100 mm or half the nominal pipe diameter, whichever is the greater. Support brackets should allow free axial movement.

Supporting Distances of HDPE at various operating temperatures



Bending

One of the important features of using HDPE pipes is its flexibility. However it is important that the bending radius at any point should not be less than 20 times the pipe outside diameter when at an ambient temperature of 20 °C. When lower temperatures are encountered it is necessary to progressively increase the minimum bending radius by a factor of up to 2.5 times at 0 °C.



Disclaimer

Whilst every care has been taken in the preparation of this instruction manual, neither PH industry Pipe Systems nor any of their agencies can be held liable for any errors in this publication. It should also be noted that this manual is intended for reference only. Due consultation is required when designing for particular applications, and no liability will be entertained in this regard.

Certifications

Certificate of Compliance

Certificate's Holder: Sichuan Xinming Plastic Industrial Co., Ltd.
Group 10, Changtan Village, Xiaohekou Town, Dongxing District, Neijiang City, Sichuan, China

Certification ECM Mark:

Product: Polyethylene (PE) Pipes
Model(s): DN16-2000mm/0.3-2.5MPa

Verification to: Standard:
BS EN 12201-1:2011,
BS EN 12201-2:2011+A1:2013

related to CE Directive(s):
(EU) 305/2011 (Regulation for the Marketing of Construction Products)

Certificate – Certificado – 證明書 – Certificat – 증명서 – 证书

SCC
HUAJIAN CERTIFICATION

CERTIFICATE OF CONFORMITY OF QUALITY MANAGEMENT SYSTEM CERTIFICATION

NO.: 28420180502600M

This is to certify that the quality system of

SICHUAN XINMING PLASTIC INDUSTRY CO.,LTD.

GROUP 10,CHANGTAN VILLAGE,XIAOHEKOU TOWN,DONGXING DISTRICT, NEIJIANG CITY,SICHUAN PROVINCE

Organization Code: 91510018210964154L

is in conformity with

GB/T19001-2016/ISO 9001:2015 Standard

The scope of the certification

PRODUCTION AND SALE OF POLYVINYL CHLORIDE (PVC) PIPE AND POLYETHYLENE (PE) PIPE ARE USED IN COAL MINE;POLYETHYLENE (PE) PIPE FOR WATER SUPPLY,RIGID POLYVINYL CHLORIDE (PVC) TUBE FOR CPVC BURIAL AND POLYETHYLENE (PE) TUBE FOR GAS BURIAL

(If the above scope involves pre-approval of administration permission and compulsory certification, this certificate only covers products/ services in the approved / certified scope.)

Approval of the first surveillance audit | Approval of the second surveillance audit | Approval of the third surveillance audit

Issuer | Issuing authority

SCC
HUAJIAN CERTIFICATION

CERTIFICATE OF CONFORMITY OF ENVIRONMENTAL MANAGEMENT SYSTEM CERTIFICATE

NO.: 28420188E5011R0M

This is to certify that the Environmental Management system of

SICHUAN XINMING PLASTIC INDUSTRY CO.,LTD.

GROUP 10,CHANGTAN VILLAGE,XIAOHEKOU TOWN,DONGXING DISTRICT, NEIJIANG CITY,SICHUAN PROVINCE

Organization Code: 91511011621064154L

is in conformity with

GB/T24001-2016/ISO 14001:2015Standard

The scope of the certification

THE RELATIVE MANAGEMENT ACTIVITIES OF PRODUCTION AND SALE OF POLYVINYL CHLORIDE (PVC) PIPE AND POLYETHYLENE (PE) PIPE ARE USED IN COAL MINE;POLYETHYLENE (PE) PIPE FOR WATER SUPPLY,RIGID POLYVINYL CHLORIDE (PVC) TUBE FOR CPVC BURIAL AND POLYETHYLENE (PE) TUBE FOR GAS BURIAL

(If the above scope involves pre-approval of administration permission and compulsory certification, this certificate only covers products/ services in the approved / certified scope.)

The initial date of issue:2018-04-10 Term of validity of this certificate:from 2018-04-10 to 2021-04-27 inclusive

This certificate remains valid only if the certified organization accepts and passes regular surveillance audits

Approval of the first surveillance audit

Approval of the second surveillance audit

Approval of the third surveillance audit

Issuer

Issuing authority

SCC
HUAJIAN CERTIFICATION

CERTIFICATE OF CONFORMITY OF OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM

NO.: 28420188S1010780M

This is to certify that the Occupational Health and Safety Management system of

SICHUAN XINMING PLASTIC INDUSTRY CO.,LTD.

GROUP 10,CHANGTAN VILLAGE,XIAOHEKOU TOWN,DONGXING DISTRICT, NEIJIANG CITY,SICHUAN PROVINCE

Organization Code: 91511011621064154L

is in conformity with

GB/T 28001–2011/OHSAS 18001:2007 Standard

The scope of the certification

THE RELATIVE MANAGEMENT ACTIVITIES OF PRODUCTION AND SALE OF POLYVINYL CHLORIDE (PVC) PIPE AND POLYETHYLENE (PE) PIPE ARE USED IN COAL MINE;POLYETHYLENE (PE) PIPE FOR WATER SUPPLY,RIGID POLYVINYL CHLORIDE (PVC) TUBE FOR CPVC BURIAL AND POLYETHYLENE (PE) TUBE FOR GAS BURIAL

(If the above scope involves pre-approval of administration permission and compulsory certification, this certificate only covers products/ services in the approved / certified scope.)

The initial date of issue:2018-04-10 Term of validity of this certificate:from 2018-04-10 to 2019-04-27 inclusive

This certificate remains valid only if the certified organization accepts and passes regular surveillance audits

Approval of the first surveillance audit

Approval of the second surveillance audit

Approval of the third surveillance audit

Issuer

Issuing authority

Puhui Industry Co., Ltd.

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