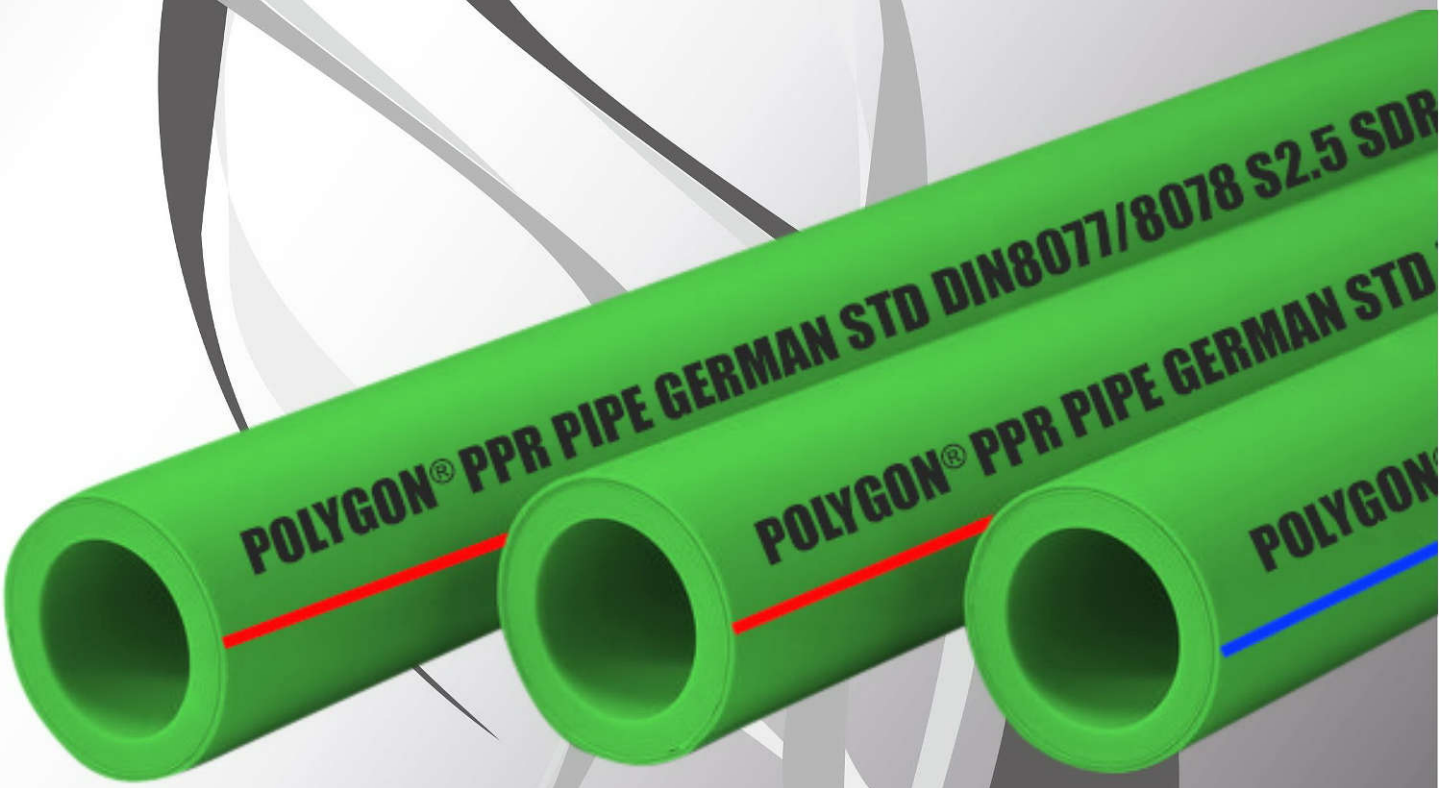
POLYGON®
PP-R Pipe



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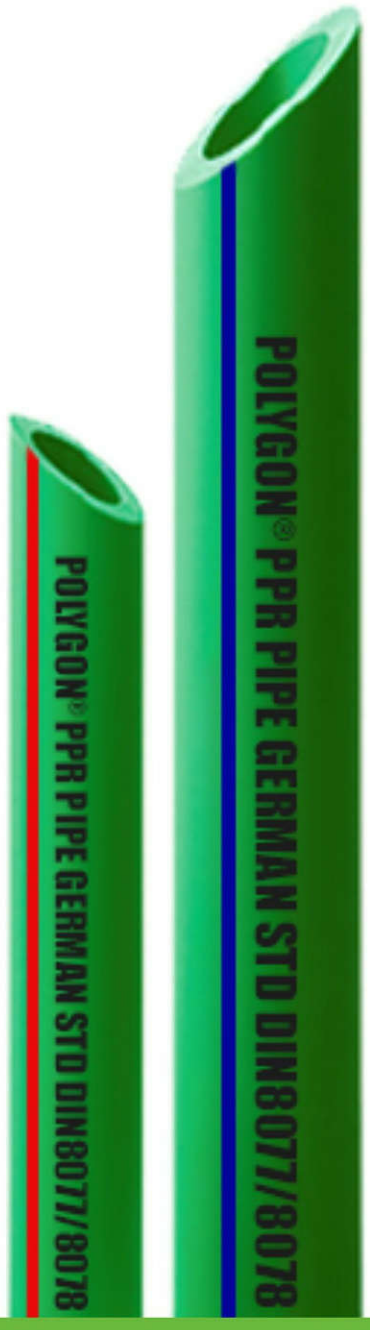


1. Material Properties

Polygon ® PP- R pipe system is made of Vestolen P9421 that is one of the best PP- R material over the world, the material is supplied in granules pre colored. Special heat resistance is only one of the features of this material, its physical and chemical properties are well suited to the transfer of potable water and in the heating field. Depending on pressure it is possible to use Polygon® PP- R pipe for constant temperatures up to 70°C with service life of more than 50 years. Peak tempe ratures of 100°C arising from short disruption are unproblematic. Before processing, the granule under goes specific tests in our laboratories to verify its suitability for use.

Property	Unit	Value	Test Method
Melt flow rate MFR190/5 MFR230/2.16 MFR230/5	 g/10 min g/10 min g/10 min	 0.5 0.3 1.5	ISO 1133
Density	Kg/m^3	898	ISO 1183
Flexural Modulus 1)	Mpa	900	ASTM D790
Tensile properties 2) Tensile stress at yield Tensile strength at break Elongation at break	 Mpa MPa %	 27 32 >50	ISO 37
Impact strength (Charpy) 23°C 0°C -10°C	 KJ/m^2 KJ/m^2 KJ/m^2	 No Failure No Failure No Failure	ISO 179/1eU
Notched Impact strength (Charpy) 3) 23°C 0°C -10°C	 KJ/m^2 KJ/m^2 KJ/m^2	 30 4 2.5	ISO 179/1eA
Ball indentation hardness	Mpa	43	ISO 2039 T1 (132 N)
Coefficient of linear thermal expansion	K^{-1}	1.5×10^{-4}	VDE 0304 Part 1 § 4
Thermal conductivity	W/m K	0.24	DIN 52612
Specific heat	KJ/Kg K	2.0	Adiabatic calorimeter
Vicat softening temperature At 10N At 50N	 °C °C	 130 61	 ISO 306/A ISO 306/B

Note :

1) Three Point Bending
2) Test Speed 50 mm/min, test specimen 2.0 mm thick
3) With V shape notch 0.25 mm

Good Properties

-Extremely long life of at least 50 years
-Taste and odor neutral
-Unique and unrivaled connection technique with security for a life-time
-Good chemical resistance
-Good impact strength
-Physiologically harmless
-Bacteriologically neutral
-Heat-preservation and energy-saving
-Resistance to high temperature (100° C)
-Convenient and reliable installation
-No pipe furring
-Sound insulation
-Recyclable-for the benefit of environment

2. Fields of Application

-Potable water pipe networks for cold and warm water installations
.i.e. in residential buildings, hospitals, hotels, office and school buildings, shipbuilding, etc.
-Pipe networks for rainwater utilization systems
-Pipe networks for compress swimming pool facilities
-Pipe networks for solar plants
-Pipe networks in agriculture and horticulture
-Heating pipes for residential house
-Pipe networks for industry, i.e. transport of aggressive fluids (acids, leys, etc)
-Transport of liquid foods

3. Contrast of Property for Some Pipe Systems

Pipe Style / Property	Iron Pipe	Copper Pipe	Upvc Pipe	Cpvc Pipe	Pex-Al-Pex Pipe	PB Pipe	**Polygon® PP-R Pipe**
Service life	5-10 years	50 years	30 years	50 years	50 years	50 years	50 years
Resistance to High Temperature	Good	Good	Bad	Good	Good	Good	Good
Hygienic property	Bad	Common	Bad	Common	Good	Good	Good
Recyclable and No Pollution	No	No	No	No	Yes	Yes	Yes
Pipe Furring	Yes	Yes	No	No	No	No	No
Corrosion-Resistant	Bad	Bad	Good	Good	Good	Good	Good
Installation	Hard	Hard	Easy	Easy	Easy	Easy	Easy
Price	Low	High	Low	High	High	High	Common
Reliability	Common	Common	Common	Common	Common	Common	Good

4. Hydrostatic Pressure Performance

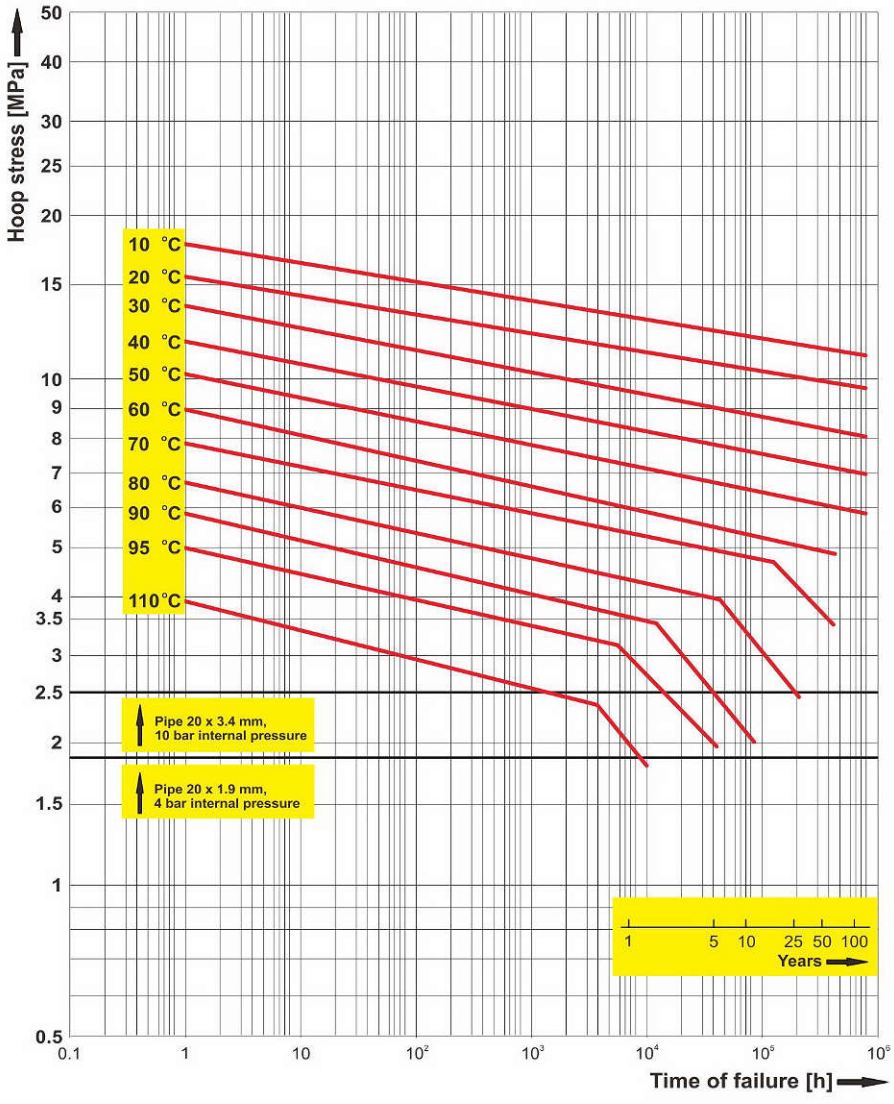
To plot the hydrostatic pressure performance graph (table 1) independently of dimensions, the hoop stress (δ) is calculated according to the formula :

$$\delta = \frac{P\,(de - e)}{2e}$$

P = Internal pressure
de = the external diameter of pipe (mm)
e = the wall thickness of the pipe (mm)

With all water carrying pipes, resistance to internal pressure is an important factor, which affects long life characteristics. To therefore assure the optimum in long life performance, straight and curved Polygon® PP- R pipe have been subjected to extensive hydrostatic pressure testing at variety of different temperatures, the results, and the success of these tests can be seen in the table 1.

Table 1 : Resistance to internal pressure



5. Permissible Working Pressure

The table lists the permissible working pressure for pipes with different pressure class under specific temperature and work life. The data is calculated from formula and table 1. Under normal work pressure and condition, the life of Polygon® PP- R pipe system can reach 50 years at least !

Temperature	Service life (year)	Pipe S 5		Pipe S 3.2		Pipe S 2.5	
		Pipe SDR 11		Pipe SDR 7.4		Pipe SDR 6	
		Pipe PN 10		Pipe PN 16		Pipe PN 20	
		Permissible working pressure, in bar					
		SF = 1.25	SF = 1.5	SF = 1.25	SF = 1.5	SF = 1.25	SF = 1.2
10°	1	21.1	17.6	33.4	27.8	42.0	35.0
	5	20.0	16.6	31.6	26.4	39.8	33.2
	10	19.3	16.1	30.6	25.5	38.5	32.1
	25	18.7	15.6	29.6	24.7	37.3	31.1
	50	18.2	15.2	28.8	24.0	36.3	30.3
	100	17.7	14.8	28.1	23.4	35.4	29.5
20°	1	18.0	15.0	28.6	23.8	36.0	30.0
	5	16.9	14.1	26.8	22.3	33.8	28.1
	10	16.4	13.7	26.1	21.7	32.8	27.3
	25	16.0	13.3	25.3	21.1	31.8	26.5
	50	15.5	12.9	24.5	20.4	30.9	25.7
	100	15.0	12.5	23.8	19.8	29.9	24.9
30°	1	15.3	12.8	24.3	20.2	30.6	25.5
	5	14.4	12.0	22.8	19.0	28.7	23.9
	10	13.9	11.6	22.0	18.3	27.7	23.1
	25	13.4	11.2	21.3	17.1	26.8	22.3
	50	13.1	10.9	20.7	17.3	26.1	21.8
	100	12.8	10.6	20.2	16.9	25.5	21.2
40°	1	12.9	10.8	20.5	17.1	25.8	21.5
	5	12.1	10.1	19.2	16.0	24.2	20.2
	10	11.8	9.8	18.7	15.6	23.6	19.6
	25	11.3	9.4	18.0	15.0	22.6	18.8
	50	11.0	9.2	17.5	14.5	22.0	18.3
	100	10.7	8.9	16.9	14.1	21.3	17.8
50°	1	11.0	9.2	17.5	14.5	22.0	18.3
	5	10.2	8.5	16.2	13.5	20.4	17.0
	10	9.9	8.2	15.7	13.1	19.7	16.5
	25	9.6	8.0	15.2	12.6	19.1	15.9
	50	9.3	7.7	14.7	12.2	18.5	15.4
	100	8.9	7.4	14.2	11.8	17.8	14.9
60°	1	9.3	7.7	14.7	12.2	18.5	15.4
	5	8.6	7.2	13.7	11.4	17.2	14.3
	10	8.3	6.9	13.2	11.0	16.6	13.8
	25	8.0	6.7	12.6	10.5	15.9	13.3
	50	7.7	6.4	12.1	10.1	15.3	12.7
70°	1	7.8	6.5	12.4	10.3	15.6	13.0
	5	7.2	6.0	11.4	9.5	14.3	11.9
	10	7.0	5.9	11.1	9.3	14.0	11.7
	25	6.1	5.1	9.6	8.0	12.1	10.1
	50	5.1	4.3	8.1	6.7	10.2	8.5
80°	1	6.5	5.5	10.4	8.6	13.1	10.9
	5	5.7	4.8	9.1	7.6	11.5	9.6
	10	4.8	4.0	7.6	6.3	9.6	8.0
	25	3.8	3.2	6.1	5.1	7.6	6.4
95°	1	4.6	3.9	7.3	6.1	9.2	7.7
	5	3.0	2.5	4.8	4.0	6.1	5.0
	10	2.6	2.1	4.0	3.4	5.1	4.2

SDR = Standard Dimension Ratio
(diameter/wall thickness ratio)
SDR = 2xS+1≈d/s
(S=Pipe series index from ISO4065)
SF = Safety-factor

6. Fire Protection

Polygon® PP- R pipes and fittings comply with requirements of the fire classification B2 (normal inflammable). Compared to natural products like wood, cork or wool, Polygon® PP- R pipes do not show an increased brand gas toxicity. Therefore, in case of fire, there is no risk of the develop ment of dioxin.

Measures against fire and smoke transmission with pipes are fire retardant seals. They are fixed at the passage through a building, which demands fire resistance. The fire resistance period is the minimum period in minutes needed during the fire test to take precautionary measures for the prevention of fire and smoke transmission. The extent of the preventive measures depends on the kind of the installation. The determining of fire areas and fire classification has to be made in acc. with the law of the country. Information is given by the Planning Department and Building Control Office or the Fire Protection Representative. Basically fire walls and ceilings with pipe passages have to be furnished to the same fire resistance classification. All fire protection systems with a corresponding classification are suitable for Polygon® PP- R pipes.

7. Fire Load

The values required for determining the fire load within a fire section are calculated from the total of all flammable materials located within this area such as electric cables, pipe systems, insulating and heat relief materials.

The calculation for establishing the combustion heat V (KWh/m) for a fire section in the event of an outbreak is dependent on dimensions and materials.

The basis used for the calculation of Polygon® PP- R pipes made of PP- R is the lower calorific value Hu = 12.2kwh/kg (as per DIN V 18230 T1) in conjunction with the mass of material pipe (kg/m). Depending on the calculation procedure, the fire load is worked out with reference to the burn-up factor. This value is designated as m_{factor} and is taken as 0.8 for PP- R.

Combustion values v (kwh/m) for Polygon® PP-R pipes	External ϕ	SDR 11	SDR 6
	mm	PN10	PN20
	20	1.31	2.10
	25	2.00	2.76
	32	3.25	5.30
	40	5.03	8.19
	50	7.78	12.81
	63	12.32	20.13
	75	17.32	28.55
	90	24.77	41.00
	110	36.72	61.49

8. UV - Resistance

PP- R pipe and fitting should not be installed (without protection) where subject to UV - radiation If Polygon® PP- R pipe system must be installed outside of building and exposed under sun light, one UV - resistant foam pipe can be applied to protect Polygon® PP - R pipe system.

9. Hygienic Harmlessness

DIN 1998 T12

- Stipulates, that all parts of an installation coming directly in contact with potable water are commodity goods acc. to the spirit of the Law for Food and Commodity Goods. Plastic pipes have to comply with the follows :
- KTW - recommendations of the Federal Public Health Department
- DVGW - working sheet W270
  Increase of Microorganism on Materials used for potable Water Applications-Test and Evaluation
- BS 6920 Suitability of non - metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water.

Material :

The hygienic harmlessness of the material used for the Polygon® PP- R pipe system is indepen dently verified through test certificates from the Hygiene Institute Gelsenkirchen. The suitability for potable water pipes in the field of cold and warm water is confirmed by current tests.

Processing :

The joining method requires no additives such as fluxes or solder. The connection is exclusively made by coupling welding.

Potable water-our most precious commodity good :

The increasing use of PP- R in the field of food - packing confirms the hygienic qualities of the material.

This makes Polygon® PP- R pipe system the optimal packing for one of our most precious commo dity goods - our potable water.

10. Sound Insulation & Chemical Resistance

The sound insulation qualities of PP- R and the Polygon® PP- R pipe system, when related to water flow and hydraulic shock within a building, provide a sound proofing effect on noise transmission Therefore the sound transmission is much lower compared to metallic pipes.

Chemical resistance is one of the remarkable properties of the Polygon® PP- R pipe system. However the chemical resistance o f the nickel - plated brass inserts may not comparable with the chemical resistance of a pure PP- R pipe system. As these metal compound fittings may not be suitable for all industry application of the Polygon® PP- R pipe system, it is advisable to use Polygon® PP- R pipe flange socket.

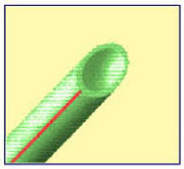
11. Compliance With the System Standard

The quality of Polygon® PP- R pipe system made of Vestolen P9421 compliant with the require ments of various national and international independent authorities and institutions.

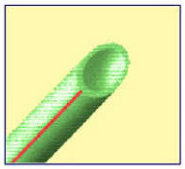
Argentina	IRAM	Kuwait	
Australia	Certified Product Australian Standard	Malaysia	SIRIM
Austria	GW GEPROFT, Registrierung	Netherlands	kiwa
Belgium	aig	Poland	TIN
Canada		Qatar	
France	CSTB	Spain	AENOR Producto Certificado
Germany	DVGW, SKZ, DVGW TZW, Hy	Switzerland	SVGW SSIGE
Greece	ΕΛΟΤ	Turkey	TSE
Italy		USA	NSF

12. PP-R Pipes and Fittings

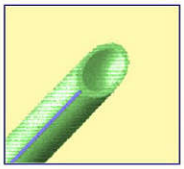
Color : Dark Green — Form Supplied : 4 M Straight Lengths



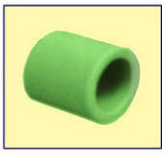
PIPE SERIES SDR 6/S2.5/PN 20	
Dimension	Wall Thickness
20	3.4
25	4.2
32	5.4
40	6.7
50	8.3
63	10.5
75	12.5
90	15
110	18.3



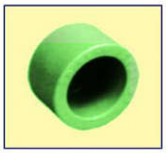
PIPE SERIES SDR 9/S4/PN 16	
Dimension	Wall Thickness
20	2.3
25	2.8
32	3.6
40	4.5
50	5.6
63	7.1
75	8.4
90	10.1
110	13.7



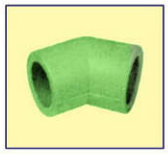
PIPE SERIES SDR 11/S5/PN 10	
Dimension	Wall Thickness
20	1.9
25	2.3
32	2.9
40	3.7
50	4.6
63	5.8
75	6.8
90	8.2
110	10.0
160	14.6



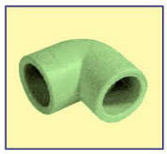
COUPLING (Sock)
20 mm
25 mm
32 mm
40 mm
50 mm
63 mm
75 mm
90 mm
110 mm
160 mm



CAP
20 mm
25 mm
32 mm
40 mm
50 mm
63 mm
75 mm
90 mm
110 mm
160 mm

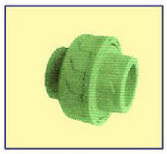


ELBOW 45°
20 mm
25 mm
32 mm
40 mm
50 mm
63 mm
75 mm
90 mm
110 mm
160 mm



ELBOW 90°
20 mm
25 mm
32 mm
40 mm
50 mm
63 mm
75 mm
90 mm
110 mm
160 mm

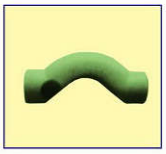
TEE
20 mm
25 mm
32 mm
40 mm
50 mm
63 mm
75 mm
90 mm
110 mm
160 mm



PLASTIC UNION
20 mm
25 mm
32 mm

UNION THREADED
MALE
1/2" x 20
3/4" x 25
1" x 32
1 1/4" x 40
1 1/2" x 50
2" x 63

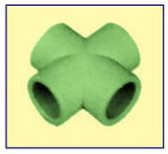
UNION THREADED
FEMALE
1/2" x 20
3/4" x 25
1" x 32
1 1/4" x 40
1 1/2" x 50
2" x 63



BY PASS BEND (Over Bridge Bow)
20 mm
25 mm
32 mm

FLANGE CORE
32
40
50
90
110
160

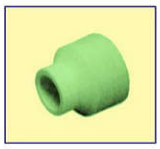
STOP VALVE
20
25
32
40
50
63



CROSS
20 mm
25 mm
32 mm

PIPE PLUG
20 mm
25 mm

13. Fittings and Tools



REDUCER SOCK
25/20
32/20
32/25
40/20
40/25
40/32
50/20
50/25
50/32
50/40
63/20
63/25
63/32
63/40
63/50
75/32
75/40
75/50
75/63
90/40
90/50
90/63
90/75
110/50
110/63
110/75
110/90
160/110

REDUCER TEE
25/20
32/20
32/25
40/20
40/25
40/32
50/20
50/25
50/32
50/40
63/20
63/25
63/32
63/40
63/50
75/32
75/40
75/50
75/63
90/40
90/50
90/63
90/75
110/50
110/63
110/75
110/90
160/110

ELBOW 90° REDUCER
25/20
32/20
32/25

WELD IN SADDLE
50/20
50/25
50/32
63/20
63/32
75/20
75/25
75/32

SOCK THREADED	
MALE	FEMALE
20 x 1/2"	20 x 1/2"
20 x 3/4"	20 x 3/4"
25 x 1/2"	25 x 1/2"
25 x 3/4"	25 x 3/4"
32 x 3/4"	32 x 3/4"
32 x 1"	32 x 1"
40 x 1 1/4"	40 x 1 1/4"
50 x 1 1/2"	50 x 1 1/2"
63 x 2"	63 x 2"

ELBOW THREADED	
MALE	FEMALE
20 x 1/2"	20 x 1/2"
20 x 3/4"	20 x 3/4"
25 x 1/2"	25 x 1/2"
25 x 3/4"	25 x 3/4"
32 x 3/4"	32 x 3/4"
-	32 x 1"

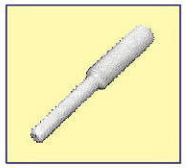
THREADED TEE	
MALE	FEMALE
20 x 1/2"	20 x 1/2"
25 x 1/2"	25 x 1/2"
25 x 3/4"	25 x 3/4"
32 x 3/4"	32 x 1/2"
32 x 1"	32 x 3/4"
-	32 x 1"

WELDING MACHINE
20-32 mm
20-63 mm
75-110 mm

CUTTER
16-50
50-125

CUTTER
20-40

HOLE REPAIR DIE
7-11 mm



HOLE REPAIR BAR
7-11 mm

POLYGON®

PP-R Pipe

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