



POLYESTER PIPES



Due to the many years of development and production of polyester items, GRP pipes, in particular, company Poliester Cevi d.o.o. Priboj has specialised in the production of specific product groups and in particular GRP pipes. Following the latest developments in pipe and tank production, the company has fully won over the production of cylindrical products made of polyester, gaining a vast experience and knowledge in the process.

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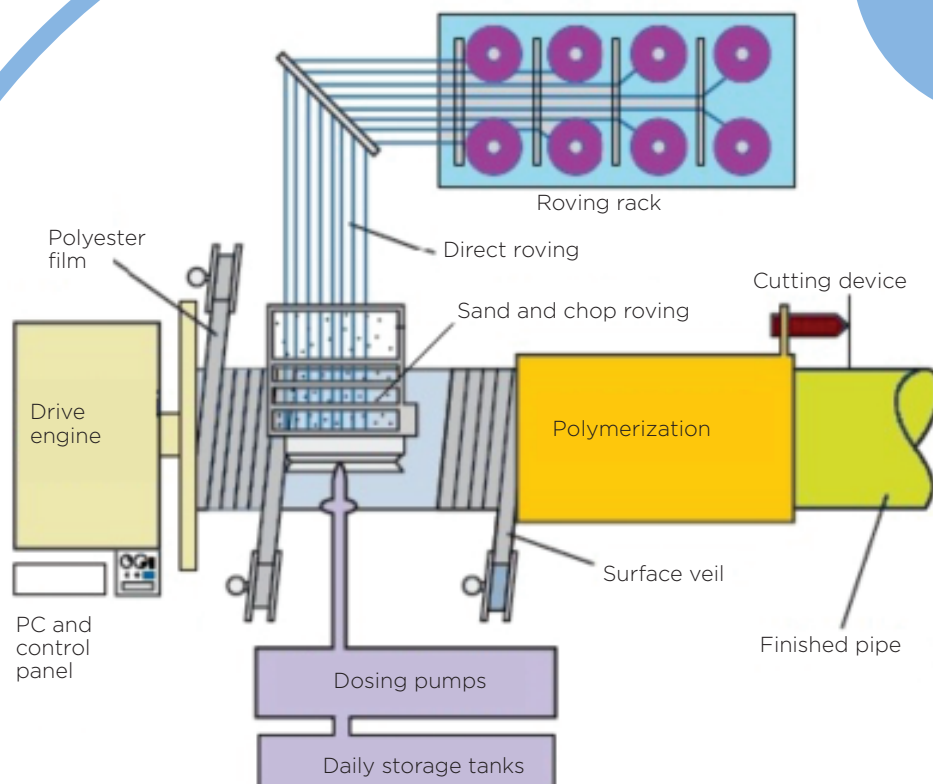


Polyester pipe is a product of the continuous filament winding machine and is commonly abbreviated as GRP, FRP, or fibreglass pipe. Such a pipe can exhibit a wide range of mechanical and chemical properties by combining glass fibres, thermosetting resin, and special fillers in the appropriate ratio during the production stage.

The composite structure may contain granular or platelet fillers, agents, pigments, or dye. By selecting an appropriate ratio of resin, glass fibres, fillers, as well as design, the manufacturer may create a product which meets the most stringent product specifications.

Fibreglass composite technology allows the GRP pipe to be favourably compared with pipes made of traditional materials in terms of price-performance ratio. Since fibreglass composites provide such outstanding properties, the number and type of products manufactured efficiently, effectively and with quality increases each year. Poliester Cevi d.o.o. Priboj has obtained numerous certificates and technical reports on the products' quality, as well as the Integrated Management System certificates in accordance with ISO 9001, ISO 14001 and ISO 45001.

Figure 1 -
Pipe
production
process



PIPE WALL STRUCTURE

LAYER	CONSTRUCTION	FUNCTION
Internal liner	Surface veil	Protection
Barrier	Chop roving	Protection
Internal structural layer	Direct and chop roving	High coefficient of structural reinforcements
Core	Silica sand, chop and direct roving	Durable hard core
External structural layer	Direct and chop roving	High coefficient of structural reinforcements
Surface layer	Surface veil	Protection

Note: Resin is implied in each layer!

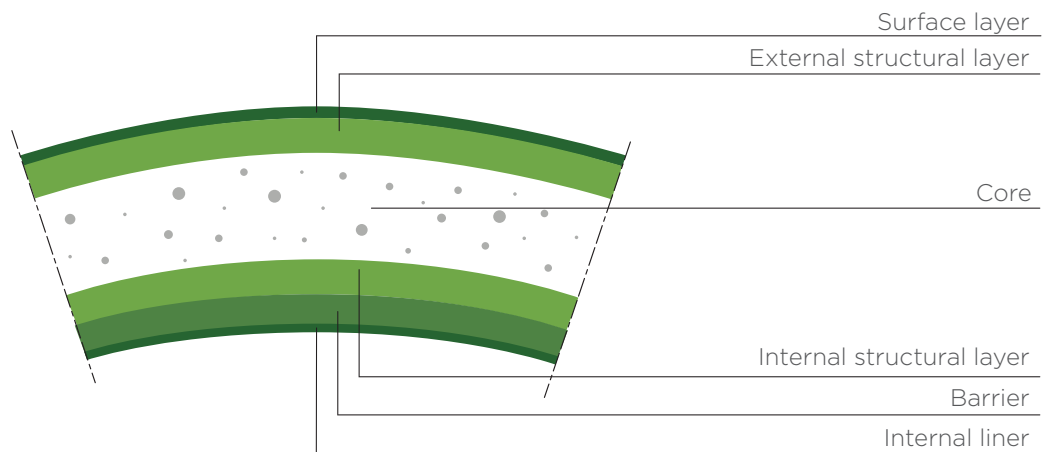


Figure 2 - Pipe wall structure

The good physical and chemical properties of polyester pipes have resulted in a wide range of applications, including:

- Sewage systems;
- Bridge drainage;
- Potable water transportation;
- Raw water transportation;
- Industry waste water transportation;
- Sea water transportation;
- Irrigation systems;
- Cooling water transportation;
- Ventilation systems;
- Drainage systems;
- Pipelines for hydropower plants;
- Pipelines for mine shafts and suspended/overhead pipelines.

Polyester pipes are produced using non-corrosive material which results in:

- Long lasting and efficient lifetime;
- Unnecessary cathodic protection;
- Unnecessary lining, coating and painting;
- Low maintenance costs;
- Stable hydraulic properties over an extended period of time

<p>Low pipe weights(1/4 of the cast iron pipe weight or 1/10 of the concrete pipe weight).</p>	<p>Easy to install. Expensive equipment for pipe assembly is unnecessary. Low transportation costs.</p>
<p>Exceptional smoothness of pipe walls.</p>	<p>The minimum weight of settled sludge contributes to low maintenance costs.</p>
<p>Pipes are produced in long sections.</p>	<p>Fewer connections reduce the assembly time.</p>
<p>Couplings are made of polyester with double sleeves and rubber gaskets.</p>	<p>Ease of assembly – short assembly time. Leak-tight and efficient couplings are designed to eliminate infiltration and leakage. Joint connectors are redundant. They enable flexible changes in the pipeline axes.</p>
<p>Specifications meet the standards worldwide.</p>	<p>Provides a high-quality specification of the product.</p>
<p>The optimal price-performance ratio in pipes, based on the full knowledge of the properties and characteristics of the material and the process.</p>	<p>The pipe system of fibreglass composites displays extraordinary strength properties in relation to its weight. In that sense, they are superior to steel pipes.</p>
<p>Production based on high technology.</p>	<p>Constant quality is guaranteed for all applications.</p>

MATERIAL SYSTEM

The material system consists of glass fibres, thermosetting resins and additives, designed and processed to satisfy the criteria of specific functional performances. Knowing the relationships between system components allows for defining the price, properties and performances of polyester pipes.

The material system used in polyester pipes production is comprised from:

- Roving (glass reinforcement);
- Resin;
- Catalyst system;
- Silica sand;
- Additives.

ROVING

Roving glass (roving) is an alkali-free glass fibre expressed in tex unit (g/1000m length). It is used in the form of direct and/or chop roving.

Hoop/Direct roving of various tex values provides pressure resistance and exceptional mechanical properties.

Chop roving provides strength in various directions.

RESIN

One of the basic components of polyester pipes is resin. At delivery, polyester resin already includes monomers. By further adding the monomer component, such as styrene, resin viscosity may be changed. The standard application temperature is 25°C.

CATALYST SYSTEM

The catalyst system consists of the accelerator and catalyst. The accelerator is added before the production process starts, while the catalyst is added during the pipe production process.

SAND

Sand (silica sand) is added to the pipe core and internal layer of the BETO coupling. The role of sand is to provide the pipe stiffness and enable easier grooving inside the BETO coupling.

ADDITIVES

Additives are mixed with resin and are used as accelerators. If the pipes are used for bridge drainage, i.e. are not installed underground, UV-stabilizer is also added into the resin.

MECHANICAL, PHYSICAL, AND CHEMICAL PROPERTIES

Polyester pipes are resistant to a wide range of chemicals and temperatures and may also be fabricated as specifically resistant to abrasion and weathering. The choice of resin depends on how aggressive the environment is or the media being transported. The system of materials shall provide excellent mechanical-physical and chemical properties which are required in the finished product.

Density	(1800-2100) kg/m ³
Elastic modulus	(6 -24) GPa
Elastic modulus circumferential - tensile and bending	17 000 MPa - low pressure pipes 24 000 MPa - high pressure pipes
Elastic modulus longitudinal - tensile and bending	(6000-12 500) MPa
Tensile strength circumferential	(130-700) MPa
Tensile strength axial	(30-60) MPa
Bending strength circumferential	140-500 MPa
Elongation at break	1,5-2,0 %
Linear expansion coefficient	24-30·10 ⁻⁶ 1/°C
Max. temperature of transported media	50 °C
Thermal conductivity coefficient	0,14-0,25 W/mK

HYDRAULIC PROPERTIES

In almost any conditions of application, polyester pipes display considerable advantages in terms of fluid flow (due to their smooth internal surface), corrosion resistance and resistance to deposit accumulation, when compared to other materials, whether metallic or non-metallic.

The most significant advantages are:

- The smooth internal surface of polyester pipes results in lower fluid resistance which contributes to a significant reduction of the maintenance costs during the life period of a pipe system.
- In most applications, the internal surface of the pipe remains smooth over time. Likewise, the fluid resistance does not increase.
- The internal diameter of polyester pipe (ID) is usually smaller than the ID of the corresponding steel pipe for the same conditions, which significantly reduces costs.

Absolute roughness	k = 0,012 mm
Hazen-Williams constant	C = 150
Manning constant	n = 0,0095-0,012

PIPE DIAMETERS

Polyester pipes may be supplied with a wide span of diameters, such as:

Nominal diameter DN (mm)				
100	400	900	1500	2100
150	450	1000	1600	2200
200	500	1100	1700	2300
250	600	1200	1800	2400
300	700	1300	1900	2500
350	800	1400	2000	3000

PRESSURE CLASS

Polyester pipes are supplied with pressure classes as follows.

SN (Pa)		SN 2500								SN 5000								SN 10000							
DN(mm)	PN(bar)	1	2,5	6	10	16	20	25	32	1	2,5	6	10	16	20	25	32	1	2,5	6	10	16	20	25	32
100																									
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STIFFNESS CLASS

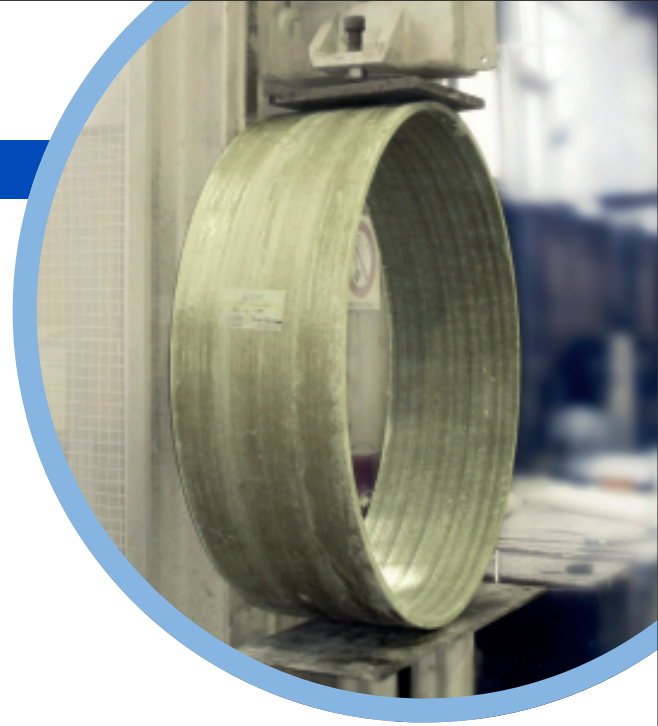
Pipe stiffness is the ability of the pipe to withstand traffic and soil (i.e. trench) loads, as well as the internal pressure. The pipe stiffness is the ratio of the product of ring flexural modulus of elasticity (pipe wall material) and the moment of inertia of the unit length of pipe to the third power of the pipe diameter ($STIS = EI/D^3$).

According to the AWWA C950 and ASTM standards, the material stiffness is expressed in psi units, while the EN ISO standards express the stiffness in N/m^2 (Pa). Polyester pipes may be supplied with four standard stiffness classes, although they may be supplied with a higher stiffness class as per the customer's request.

Standard stiffness classes	
Designation	Stiffness
SN	N/m^2 (Pa)
1250	1250
2500	2500
5000	5000
10000	10000

LENGTH

The standard length of polyester pipes is 6 and/or 12 meters. However, they may be supplied in other lengths depending on the customer's request.



HYDROSTATIC PRESSURE

Hydrostatic testing is the main indicator of pipe quality and is a prerequisite for all pressure pipes unless agreed otherwise. Test pressure is $1.5 \times \text{PN}$ (PN=nominal pressure).



PRODUCTS LINE

Different production processes enable the fabrication of the most diverse GRP products for various applications.

The main GRP products are:

- pipes
- couplings
- fittings
- storage tanks, filters, pumping stations
- the light liquid separating units
- inspection chambers (manholes).

Along with other products for various applications available at the customer's request, the line of products for the drainage of wastewater from bridges and motorways takes a special place. This line covers the entire system of pipes and fittings with diameters ranging from DN50 (fittings) to DN800, with stiffness classes SN5.000 and SN10.000.

GRP products for bridge drainage are fabricated with UV protection, as well as with the flammability class B2 in accordance with the DIN 4102 standard as per the customer's request. Moreover, to meet the aesthetic criteria of melting with the environment, these may be fabricated in any colour as per the customer's request.



For more information on the drainage line, as well as manholes, inspection chambers and the line of products for the small hydropower plants, our separate catalogue editions are available upon your request.

Polyester fittings are supplied with same pressure classes as the pipes and are fabricated by different procedures depending on their final application and customer's request, following the prescribed product standards.

Fitting production procedures include:

- laminating pipe segments together
- winding on a mould
- hand lay-up on a mould.

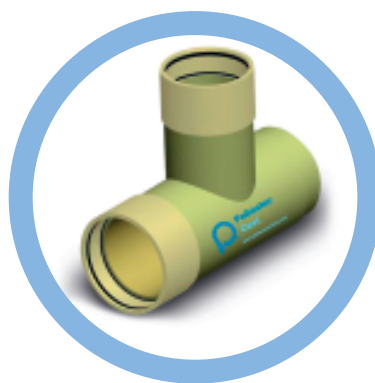
The assortment of fittings includes:

- Tees
- Branches
- Bends/Elbows (for any angle)
- Reducers (concentric and eccentric)
- Saddles
- Flanges / Stub ends (F and FF-pieces)

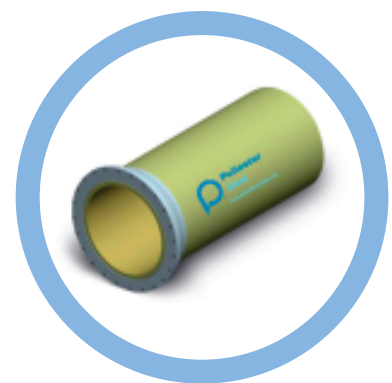
Along with these and depending on the products line, other fittings that make the drainage and transportation of waste water easier and more efficient are also available.



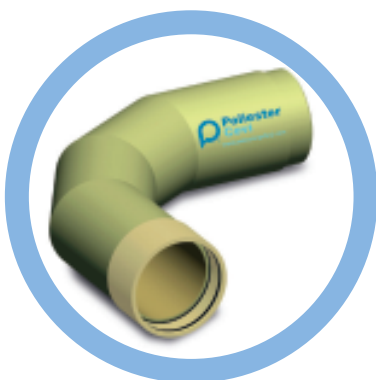
Branch



Tee



Flange / Stub end



Bend








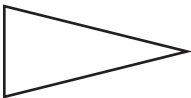
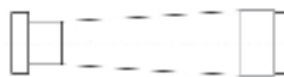
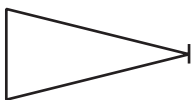
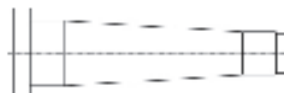

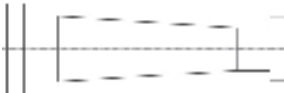






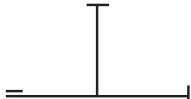



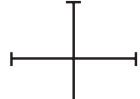




Reducer


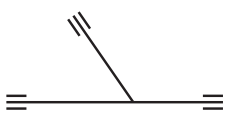

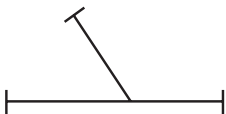


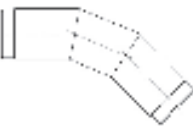
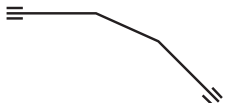

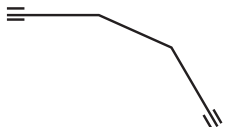

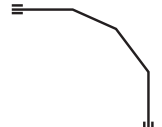
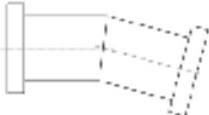




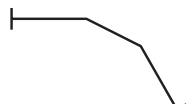




Saddle

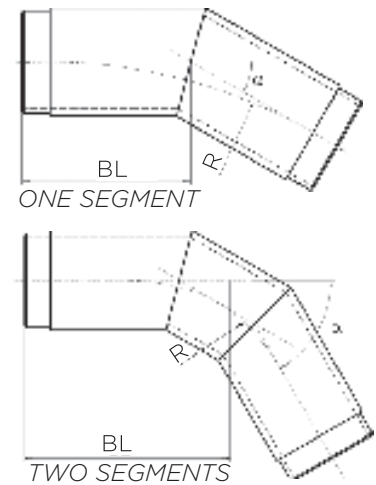
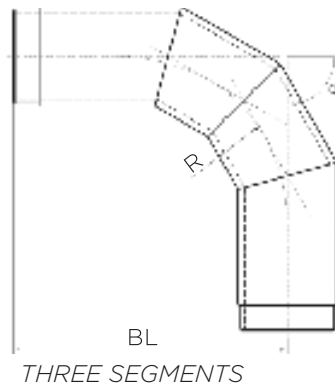
SPECIFICATION OF GRP FITTINGS

FITTING	ABBREVIATION	SKETCH	SYMBOL
Pipe with bevelled ends	SS		
Pipe with a flange and bevelled end	SSP		
Pipe flanged on both ends	SPP		
Reducer with bevelled ends	SR		
Reducer flanged on the smaller DN and bevelled at larger DN	SRPm		
Reducer flanged on the larger DN and with a bevelled end	SRPv		
Flanged reducer	RP		
Tee with bevelled ends	SO		
Tee with bevelled ends and a flange	SOP		
Tee with two flanges and a bevelled end	SOPP		
Flanged Tee	OP		
Flanged X-piece	KP		
X-piece with bevelled ends	KS		

SPECIFICATION OF GRP FITTINGS

FITTING	ABBREVIATION	SKETCH	SYMBOL
Branch 15° - 60° with bevelled ends	KRS		
Flanged branch 15° - 60°	KRP		
Bend 30° with bevelled ends	LS 1		
Bend 30° - 45° with bevelled ends	LS 2		
Bend 45° - 60° with bevelled ends	LS 3		
Bend 60° - 90° with bevelled ends	LS 4		
Flanged bend 30°	LP 1		
Flanged bend 30° - 45°	LP 2		
Flanged bend 45° - 60°	LP 3		
Flanged bend 60° - 90°	LP 4		
<p>Note: Manufacturing technology of GRP fittings enables the production of other fittings which are not included in this list.</p>			

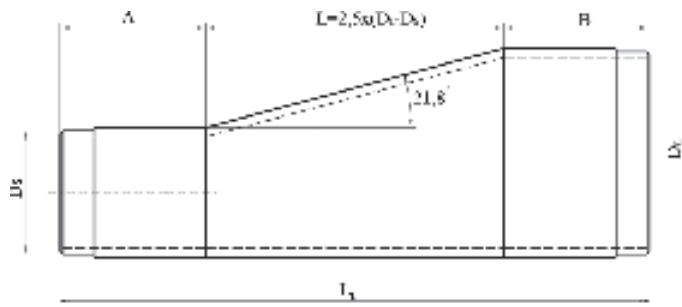
FITTINGS - BENDS / ELBOWS



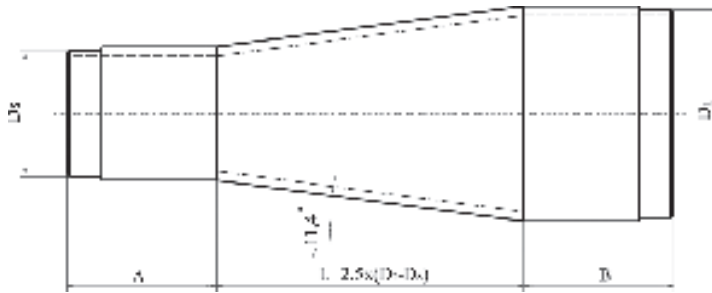
Effective axial length of bend (mm) - BL

α-angle		11,25°	15°	22,5°	30°	45°	60°	90°
DN mm	OD mm	# 1	# 1	# 1	# 1	# 2	# 2	# 3
		BL (mm)	BL (mm)	BL (mm)	BL (mm)	BL (mm)	BL (mm)	BL (mm)
100	110	250	250	250	250	250	300	350
150	160	250	250	250	250	300	300	400
200	210	250	250	250	300	350	400	500
250	271	300	300	300	300	400	450	600
300	327	350	350	400	400	500	550	750
350	376	400	400	450	450	550	600	800
400	413	450	450	450	450	600	650	900
450	478	450	450	500	500	650	700	1000
500	515	450	450	500	500	650	750	1050
600	617	400	400	400	450	600	700	1100
700	719	400	400	450	450	650	800	1200
800	821	450	450	450	500	700	850	1350
900	923	450	450	500	550	800	950	1500
1000	1025	450	500	500	550	850	1000	1650
1100	1127	500	550	550	600	900	1100	1800
1200	1229	500	550	600	600	950	1200	1950
1300	1331	600	600	650	700	1050	1300	2100
1400	1433	600	600	650	700	1100	1350	2250
1500	1535	650	650	700	750	1200	1450	2400
1600	1637	650	700	750	800	1250	1550	2550
1700	1739	650	700	800	850	1300	1600	2700
1800	1841	700	750	800	850	1350	1700	2850
1900	1943	700	750	800	850	1400	1750	2950
2000	2045	700	750	800	900	1450	1800	3100
2100	2147	700	750	800	900	1500	1850	3200
2200	2249	700	750	800	900	1550	1950	3350
2300	2351	700	750	800	950	1550	2000	3450
2400	2453	700	750	800	1000	1550	2100	3600

- Segments



ECCENTRIC

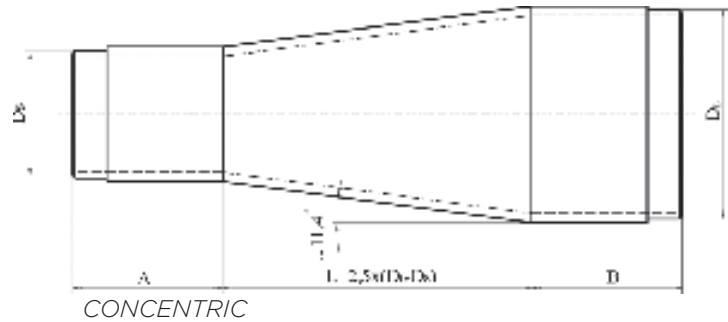
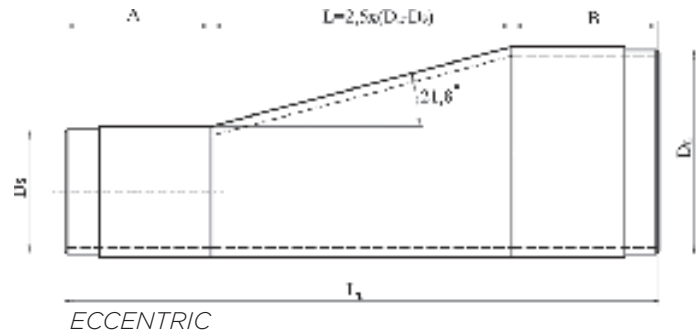


CONCENTRIC



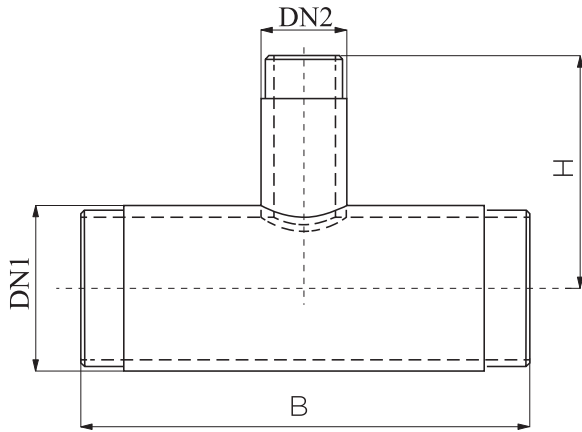
Larger diameter D_L (mm)	Smaller diameter D_S (mm)	Taper length L (mm)	Pipe length $A=B$ (mm)	Axial length L_L (mm)
300	200	250	400	1050
300	250	125	400	925
350	250	250	400	1050
350	300	125	400	925
400	300	250	400	1050
400	350	125	400	925
450	350	250	400	1050
450	400	125	400	925
500	400	250	400	1050
500	450	125	400	925
600	450	375	400	1175
600	500	250	400	1050
700	500	500	400	1300
700	600	250	400	1050
800	600	500	400	1300
800	700	250	400	1050
900	700	500	400	1300
900	800	250	400	1050
1000	800	500	400	1300
1000	900	250	400	1050
1100	900	500	500	1500
1100	1000	250	500	1250
1200	1000	500	500	1500
1200	1100	250	500	1250
1300	1100	500	500	1500
1300	1200	250	500	1250
1400	1200	500	500	1500
1400	1300	250	500	1250

FITTINGS - REDUCERS

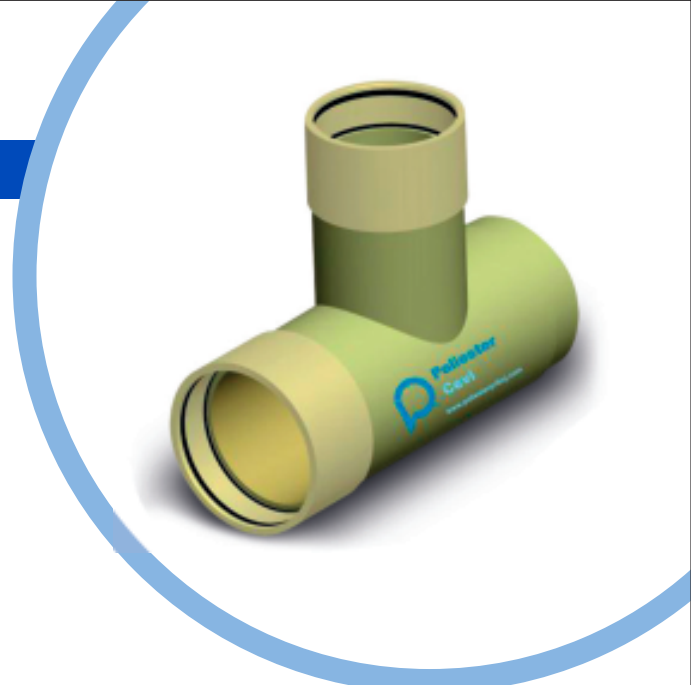


Larger diameter D_L (mm)	Smaller diameter D_s (mm)	Taper length L (mm)	Pipe length $A=B$ (mm)	Axial length L_L (mm)
1500	1300	500	600	1700
1500	1400	250	600	1450
1600	1400	500	600	1700
1600	1500	250	600	1450
1700	1500	500	600	1700
1700	1600	250	600	1450
1800	1600	500	600	1700
1800	1700	250	600	1450
1900	1700	500	600	1700
1900	1800	250	600	1450
2000	1800	500	600	1700
2000	1900	250	600	1450
2100	1900	500	600	1700
2100	2000	250	600	1450
2200	2000	500	600	1700
2200	2100	250	600	1450
2300	2100	500	600	1700
2300	2200	250	600	1450
2400	2200	500	600	1700
2400	2300	250	600	1450

FITTINGS - TEES



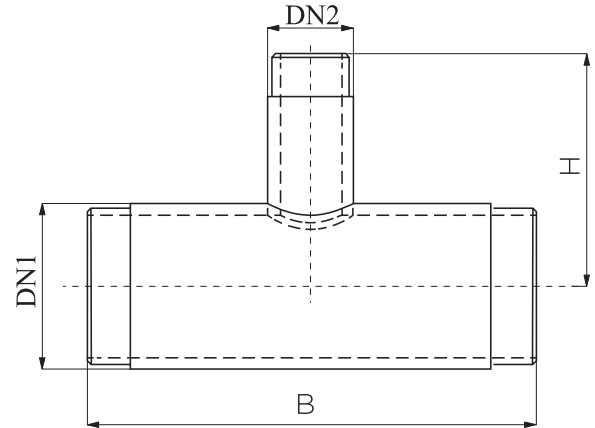
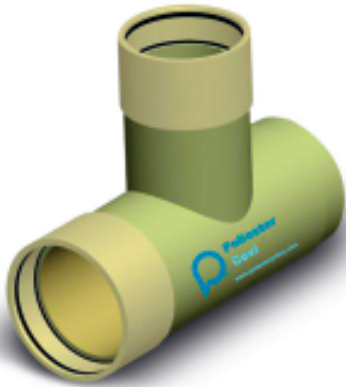
H - branch
B - header



Pressure class PN1 bar
DN2 100-1000mm

DN2 \ DN1	100		150		200		250		300		350		400		450		500		600		700		800		900		1000	
	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H
300	700	400	700	400	800	400	800	400	900	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	700	450	700	450	800	450	800	450	900	500	950	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	700	450	700	450	800	450	800	450	900	500	1000	500	1000	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
450	700	500	700	500	800	500	800	500	900	550	1000	550	1000	550	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500	700	500	700	500	800	500	800	500	900	550	1000	550	1000	550	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600	800	550	800	550	900	550	900	600	900	600	1000	600	1100	600	1150	600	1200	600	1300	650	-	-	-	-	-	-	-	-
700	800	600	850	600	900	600	900	650	900	650	1000	650	1100	650	1150	700	1200	700	1300	700	1400	700	-	-	-	-	-	-
800	800	650	900	650	900	650	900	700	900	700	1000	700	1100	700	1150	750	1200	750	1400	750	1500	800	1600	800	-	-	-	-
900	800	700	900	700	900	700	900	750	900	750	1000	750	1100	750	1150	800	1200	800	1400	850	1500	850	1600	850	1700	850	-	-
1000	850	750	900	750	900	750	900	750	900	800	1000	800	1100	800	1150	850	1200	850	1400	900	1500	900	1600	900	1800	950	1900	950
1100	850	800	900	800	950	800	950	850	950	850	1050	900	1100	900	1150	900	1200	900	1400	950	1550	950	1650	1000	1800	100	1900	1050
1200	850	850	900	850	950	900	950	900	1000	900	1050	950	1100	950	1150	950	1200	950	1400	1000	1600	1000	1700	1050	1800	1050	1900	1100
1300	850	900	950	900	1000	950	1000	950	1000	950	1050	1000	1100	1000	1200	1000	1250	1000	1400	1050	1550	1050	1700	1100	1850	1100	1950	1150
1400	900	950	950	950	1000	1000	1000	1000	1000	1000	1050	1050	1100	1050	1200	1050	1300	1050	1400	1100	1500	1100	1700	1150	1900	1150	2000	1200
1500	900	1000	950	1000	1000	1050	1000	1100	1000	1100	1100	1100	1150	1100	1250	1150	1300	1150	1400	1150	1550	1200	1700	1200	1850	1250	2000	1250
1600	950	1050	1000	1050	1000	1100	1000	1150	1000	1150	1100	1150	1200	1150	1200	1200	1300	1200	1400	1200	1600	1250	1700	1250	1800	1300	2000	1300
1700	950	1000	1000	1100	1000	1150	1000	1150	1000	1200	1100	1200	1200	1200	1250	1250	1300	1250	1400	1250	1600	1300	1700	1300	1800	1350	2050	1400
1800	950	1200	1000	1200	1000	1250	1000	1250	1000	1250	1100	1250	1200	1250	1300	1300	1300	1400	1300	1600	1350	1700	1350	1800	1350	2100	1450	
1900	1000	1250	1000	1250	1000	1250	1000	1300	1000	1300	1100	1350	1200	1350	1300	1300	1350	1450	1400	1600	1400	1700	1400	1850	1450	2050	1500	
2000	1000	1250	1000	1250	1000	1300	1000	1350	1000	1350	1100	1400	1200	1400	1250	1400	1300	1400	1500	1450	1600	1450	1700	1450	1900	1500	2000	1500
2100	1000	1300	1050	1300	1050	1350	1050	1400	1050	1400	1150	1450	1200	1450	1300	1450	1350	1450	1500	1500	1650	1500	1750	1550	1900	1550	2050	1600
2200	1000	1350	1050	1350	1050	1400	1050	1450	1050	1450	1150	1500	1200	1500	1300	1500	1350	1500	1500	1550	1650	1550	1750	1600	1900	1600	2050	1650
2300	1000	1350	1050	1400	1050	1500	1050	1550	1050	1550	1150	1550	1200	1550	1300	1550	1400	1550	1500	1600	1700	1600	1800	1650	1900	1650	2100	1700
2400	1000	1400	1050	1500	1050	1550	1000	1600	1000	1600	1100	1600	1200	1600	1300	1600	1400	1600	1500	1650	1700	1650	1800	1700	1900	1700	2100	1750

FITTINGS - TEES

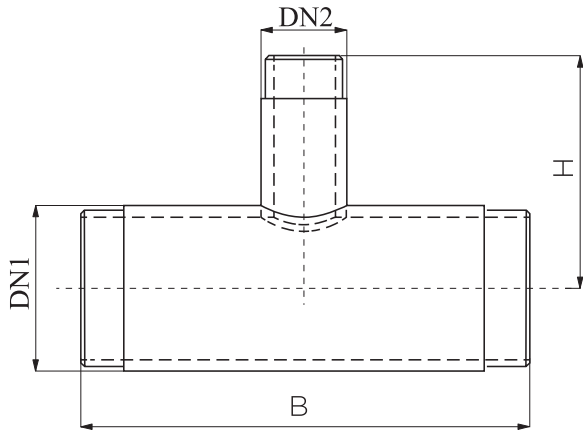


H - branch
B - header

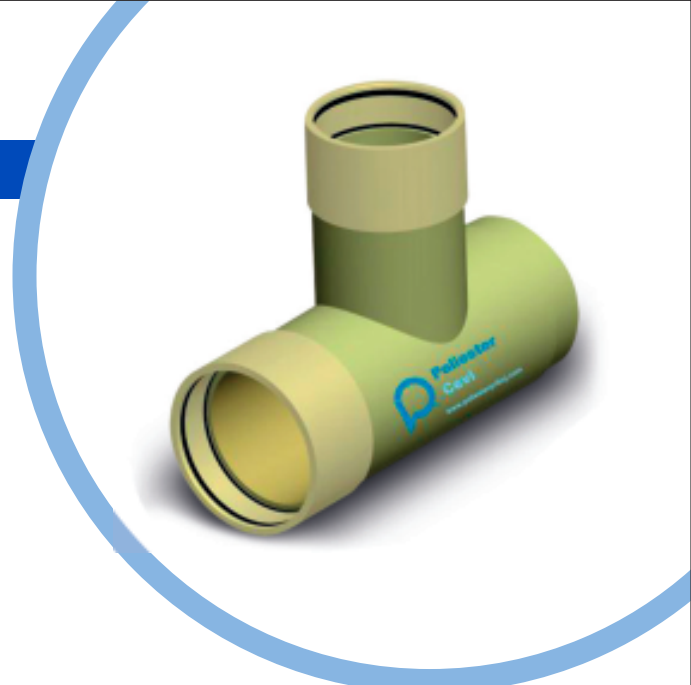
Pressure class PN1 bar
DN2 1100-2400mm

DN2 \ DNI	1100		1200		1300		1400		1500		1600		1700		1800		1900		2000		2100		2200		2300		2400	
	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H
300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1100	2050	1050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1200	2050	1100	2200	1100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1300	2100	1150	2200	1150	2350	1200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1400	2100	1200	2200	1200	2350	1250	2500	1250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1500	2150	1300	2250	1300	2400	1300	2500	1300	2650	1350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1600	2150	1350	2300	1350	2400	1350	2500	1350	2650	1400	2800	1400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1700	2200	1400	2300	1400	2450	1450	2550	1450	2700	1450	2800	1450	2950	1500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1800	2200	1450	2300	1450	2450	1500	2600	1500	2700	1500	2800	1500	2950	1550	3100	1550	-	-	-	-	-	-	-	-	-	-	-	-
1900	2200	1500	2350	1500	2500	1550	2600	1550	2750	1600	2850	1600	3000	1600	3100	1600	3250	1650	-	-	-	-	-	-	-	-	-	-
2000	2200	1550	2400	1550	2500	1600	2600	1600	2750	1650	2900	1650	3000	1650	3100	1650	3250	1700	3400	1700	-	-	-	-	-	-	-	-
2100	2200	1600	2400	1600	2500	1650	2650	1700	2800	1700	2900	1700	3050	1750	3150	1750	3250	1750	3400	1750	3500	1750	-	-	-	-	-	-
2200	2200	1650	2350	1650	2500	1700	2650	1750	2800	1750	2900	1750	3050	1800	3150	1800	3250	1800	3350	1800	3500	1850	3650	1850	-	-	-	-
2300	2200	1600	2350	1700	2500	1750	2700	1800	2800	1800	2900	1800	3050	1850	3200	1850	3250	1850	3350	1850	3500	1900	3650	1900	3800	1900	-	-
2400	2200	1750	2300	1750	2500	1800	2700	1850	2800	1850	2900	1850	3050	1900	3200	1900	3250	1900	3300	1900	3500	1900	3600	1950	3750	1900	3900	1950

FITTINGS - TEES



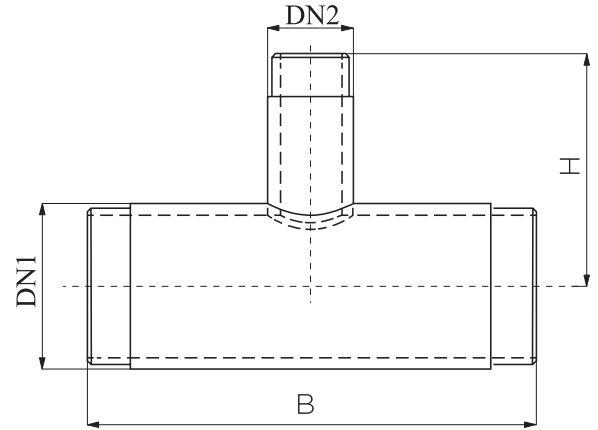
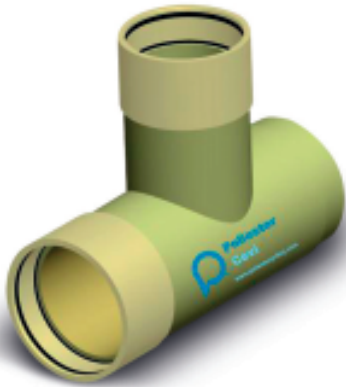
H - branch
B - header



Pressure class PN6-10 bar
DN2 100-1000mm

DN1 \ DN2	100		150		200		250		300		350		400		450		500		600		700		800		900		1000	
	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H
300	1000	550	1200	650	1300	650	1300	650	1400	700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	1050	600	1200	700	1400	750	1400	750	1500	800	1600	800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	1100	650	1200	700	1500	800	1500	800	1600	850	1700	850	1700	850	-	-	-	-	-	-	-	-	-	-	-	-	-	-
450	1200	750	1300	750	1450	850	1650	900	1700	950	1800	950	1800	950	1900	950	-	-	-	-	-	-	-	-	-	-	-	-
500	1300	800	1400	800	1400	850	1800	950	1800	1000	1900	1000	1900	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600	800	600	850	650	900	650	950	700	1100	700	1250	750	1400	750	1450	750	1500	750	1700	850	-	-	-	-	-	-	-	-
700	900	650	950	650	1000	700	1050	700	1200	750	1350	800	1500	850	1550	850	1600	850	1700	900	1900	900	-	-	-	-	-	-
800	1100	700	1150	750	1200	800	1250	800	1300	850	1350	850	1400	850	1550	900	1700	950	1800	1000	1900	1000	2100	1050	-	-	-	-
900	1200	750	1250	800	1300	850	1350	900	1400	950	1450	950	1500	950	1600	1000	1700	1000	1900	1050	2000	1050	2100	1100	2300	1150	-	-
1000	1200	800	1250	850	1300	900	1350	950	1400	1000	1450	1000	1500	1000	1550	1000	1600	1000	1900	1150	2000	1150	2200	1200	2300	1200	2500	1250
1100	1250	900	1300	950	1350	1000	1400	1050	1450	1100	1500	1100	1550	1100	1600	1100	1650	1100	1850	1200	2100	1250	2250	1300	2350	1300	2500	1300
1200	1300	1000	1350	1050	1400	1100	1450	1150	1500	1200	1550	1200	1600	1200	1650	1200	1700	1200	1800	1200	2200	1350	2300	1350	2400	1350	2500	1350
1300	1350	1100	1400	1150	1450	1200	1500	1250	1550	1300	1600	1300	1650	1300	1700	1300	1750	1300	1900	1300	2150	1400	2350	1450	2450	1450	2550	1450
1400	1400	1150	1450	1200	1500	1250	1550	1300	1600	1350	1650	1350	1700	1350	1750	1350	1800	1350	2000	1400	2100	1400	2400	1500	2500	1500	2600	1500
1500	1400	1250	1450	1300	1500	1350	1550	1400	1650	1450	1750	1450	1850	1450	1900	1450	1900	1450	2050	1500	2150	1500	2450	1550	2600	1600	2700	1600
1600	1500	1300	1550	1350	1600	1400	1650	1450	1700	1500	1750	155	1800	1550	1900	1550	2000	1500	2100	1550	2200	1550	2300	1550	2700	1700	2800	1700
1700	1700	1500	1750	1550	1800	1600	1800	1650	1850	1650	1850	1650	1900	1650	2000	1650	2100	1650	2200	1700	2300	1700	2400	1750	2800	1750	2900	1900

FITTINGS - TEES

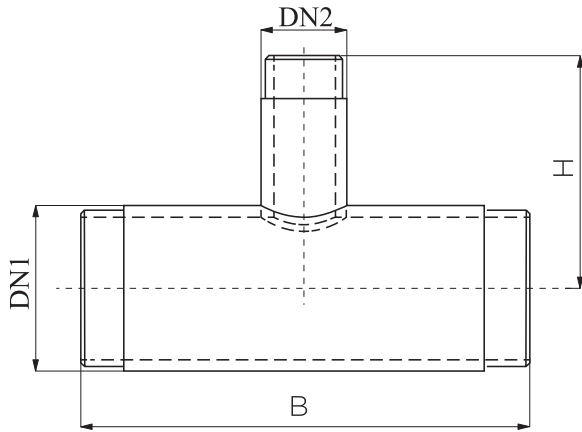


H - branch
B - header

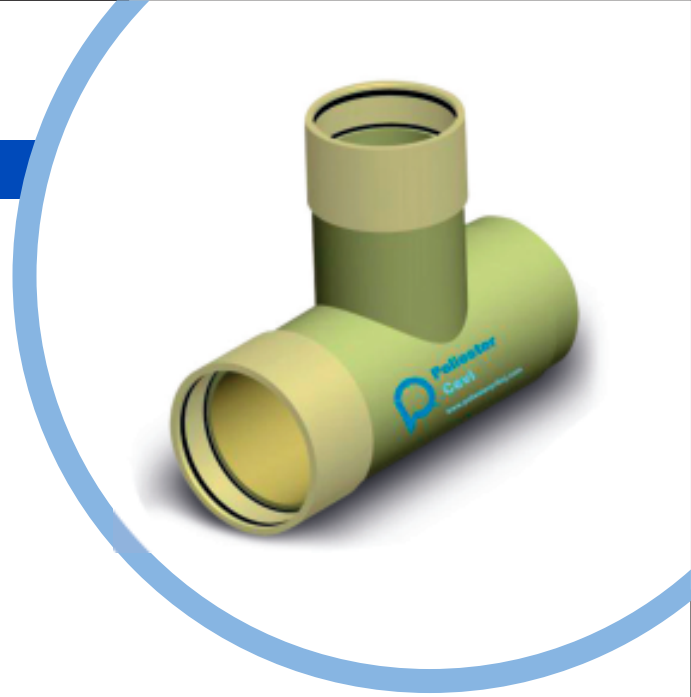
Pressure class PN6-10 bar
DN2 1100-2400mm

DN2 \ DN1	1100		1200		1300		1400		1500		1600		1700		1800		1900		2000		2100		2200		2300		2400	
	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H
300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1100	2650	1350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1200	2650	1400	2800	1400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1300	2700	1500	2850	1500	3000	1500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1400	2750	1550	2900	1550	3050	1600	3200	1600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1500	2850	1650	3000	1650	3150	1700	3300	1700	3400	1700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1600	2950	1750	3100	1750	3250	1800	3400	1800	3500	1800	3600	1800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1700	3050	1950	3200	1950	3400	2000	3600	2000	3700	2000	3800	2000	3900	2200	-	-	-	-	-	-	-	-	-	-	-	-	-	-

FITTINGS - TEES



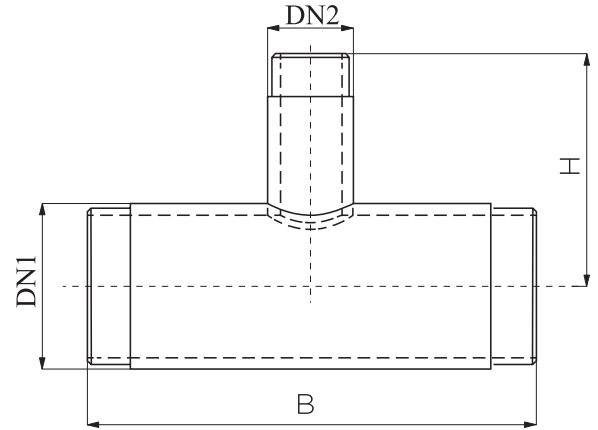
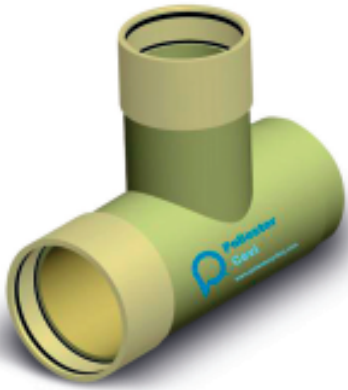
H - branch
B - header



Pressure class PN16 bar
DN2 100-1000mm

DN2 \ DNI	100		150		200		250		300		350		400		450		500		600		700		800		900		1000			
	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H		
300	1300	700	1600	850	1700	850	1700	850	1800	900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
350	1400	800	1600	850	1850	950	1900	1000	1950	1000	2000	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
400	1500	850	1600	850	2000	1050	2100	1100	2100	1100	2200	1100	2300	1150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
450	1600	950	1700	950	1950	1050	2250	1200	2300	1250	2400	1250	2500	1250	2600	1300	-	-	-	-	-	-	-	-	-	-	-	-	-	
500	1700	1000	1800	1050	1900	1050	2400	1300	2500	1350	2600	1350	2700	1350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
600	800	600	950	650	1100	700	1250	750	1400	800	1550	850	1700	900	1750	900	1800	900	1900	1900	950	-	-	-	-	-	-	-	-	
700	900	700	1050	750	1200	800	1350	850	1500	900	1650	950	1800	1000	1850	1000	1900	1000	2000	1050	2100	1050	2100	1050	-	-	-	-	-	
800	1300	800	1450	850	1500	900	1550	950	1600	1000	1650	1000	1700	1000	1850	1150	2000	1150	2100	1150	2200	1150	2300	1150	-	-	-	-	-	
900	1350	900	1450	950	1500	1000	1550	1050	1600	1100	1700	1100	1800	1100	1950	1200	2100	1250	2200	1300	2400	1300	2500	1300	2600	1300	2600	1300	-	-
1000	1450	1000	1500	1050	1600	1100	1650	1150	1700	1200	1750	1200	1800	1200	1900	1200	2000	1200	2400	1400	2500	1400	2600	1400	2800	1400	2800	1400	2900	1400
1100	1500	1100	1550	1150	1600	1200	1650	1250	1750	1300	1850	1300	1900	1300	2000	1300	2050	1300	2300	1400	2600	1500	2700	1500	2850	1500	2850	1500	2950	1500
1200	1500	1150	1550	1200	1600	1250	1700	1300	1800	1350	1900	1350	2000	1350	2050	1350	2100	1350	2200	1400	2700	1600	2800	1600	2900	1600	3000	1600	3000	1600

FITTINGS - TEES

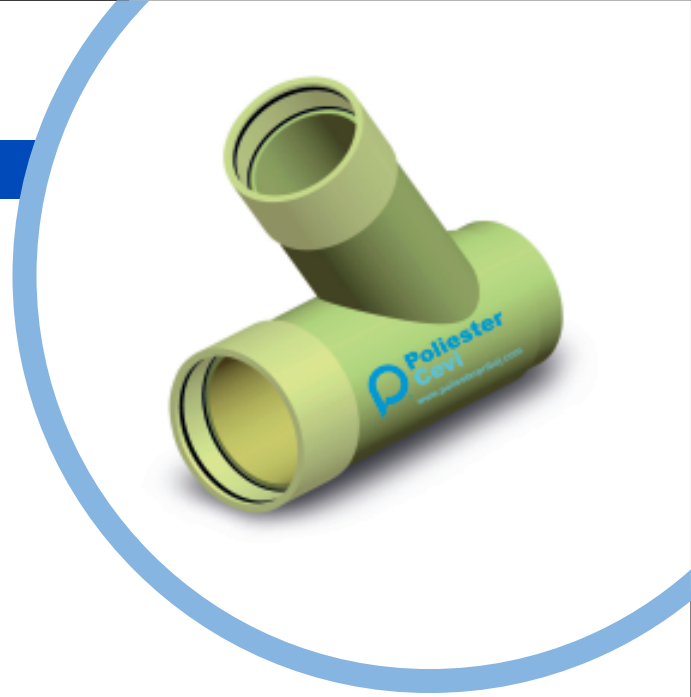
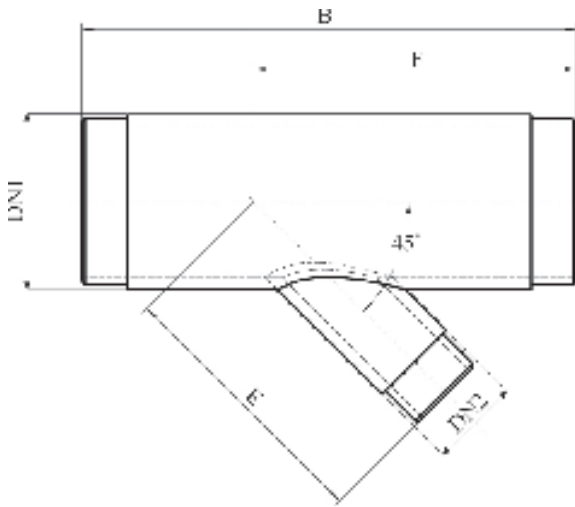


H - branch
B - header

Pressure class PN16 bar
DN2 1100-2400mm

DN2 \ DN1	1100		1200		1300		1400		1500		1600		1700		1800		1900		2000		2100		2200		2300		2400	
	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H
300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1100	3050	1500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1200	3100	1600	3200	1600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

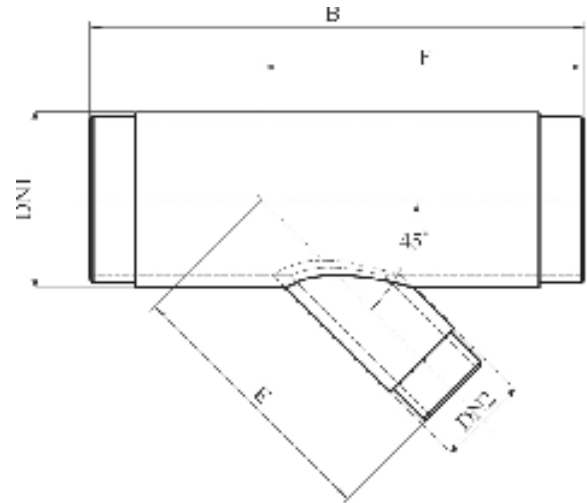
FITTINGS - BRANCHES



Pressure class PN1 bar
DN2 100-600mm

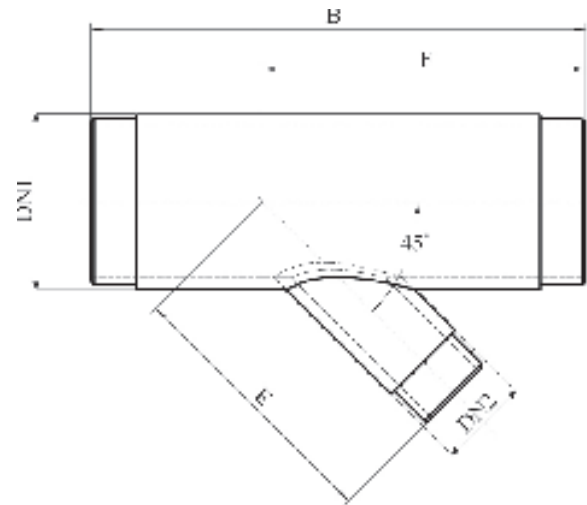
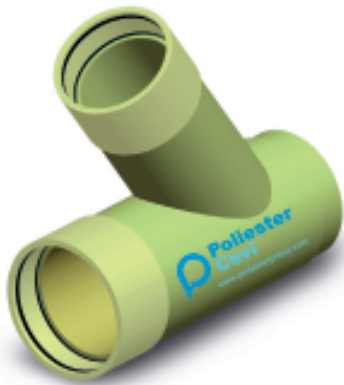
DN1 \ DN2	100			150			200			250			300			350			400			500			600			
	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	
300	700	500	500	800	570	550	900	570	600	1000	640	650	1100	710	700	-	-	-	-	-	-	-	-	-	-	-	-	-
350	700	550	550	800	600	600	900	600	650	1000	700	700	1100	750	750	1200	850	800	1300	850	850	-	-	-	-	-	-	-
400	700	570	600	800	640	600	900	640	650	1000	710	700	1100	780	750	1200	850	800	1300	850	850	-	-	-	-	-	-	-
450	700	650	700	800	650	600	900	700	700	1000	750	750	1100	850	800	1200	920	850	1300	920	900	-	-	-	-	-	-	-
500	700	710	750	800	710	650	900	780	700	1000	780	750	1100	850	800	1200	920	850	1300	920	900	1500	990	1000	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-	-	-	1100	920	850	1200	950	900	1300	990	950	1500	1060	1050	1600	1130	1100	-
700	-	-	-	-	-	-	-	-	-	-	-	-	1100	990	900	1200	1025	950	1300	1060	1000	1500	1130	1100	1700	1200	1200	-
800	-	-	-	-	-	-	-	-	-	-	-	-	1100	1060	950	1200	1095	1000	1300	1130	1050	1500	1200	1150	1700	1270	1250	-
900	-	-	-	-	-	-	-	-	-	-	-	-	1100	1130	1000	1200	1165	1050	1300	1200	1100	1500	1270	1200	1170	1410	1300	-
1000	-	-	-	-	-	-	-	-	-	-	-	-	1100	1200	1050	1200	1235	1100	1300	1270	1150	1500	1340	1250	1800	1490	1400	-
1100	-	-	-	-	-	-	-	-	-	-	-	-	1150	1270	1075	1250	1305	1150	1350	1340	1225	1500	1415	1300	1750	1525	1425	-
1200	-	-	-	-	-	-	-	-	-	-	-	-	1200	1340	1200	1300	1375	1250	1400	1410	1300	1500	1490	1350	1700	1560	1450	-
1300	-	-	-	-	-	-	-	-	-	-	-	-	1200	1450	1250	1300	1485	1300	1400	1520	1350	1550	1595	1425	1750	1665	1525	-
1400	-	-	-	-	-	-	-	-	-	-	-	-	1200	1560	1300	1300	1595	1350	1400	1630	1400	1600	1700	1500	1800	1770	1600	-
1500	-	-	-	-	-	-	-	-	-	-	-	-	1200	1630	1350	1300	1665	1400	1400	1700	1450	1600	1770	1550	1800	1840	1650	-
1600	-	-	-	-	-	-	-	-	-	-	-	-	1200	1700	1400	1300	1735	1450	1400	1770	1500	1600	1840	1600	1800	1910	1700	-
1700	-	-	-	-	-	-	-	-	-	-	-	-	1250	1780	1475	1350	1815	1550	1450	1850	1575	1650	1900	1675	1800	1980	1750	-
1800	-	-	-	-	-	-	-	-	-	-	-	-	1300	800	1550	1400	850	1600	1500	875	1650	1700	940	1750	1800	1025	1800	-
1900	-	-	-	-	-	-	-	-	-	-	-	-	1300	1910	1600	1400	1945	1650	1500	1980	1700	1700	2030	1800	1850	2160	1900	-
2000	-	-	-	-	-	-	-	-	-	-	-	-	1300	850	1650	1400	890	1700	1500	925	1750	1700	1000	1850	1900	1100	1950	-
2100	-	-	-	-	-	-	-	-	-	-	-	-	1300	2050	1700	1400	2085	1750	1500	2120	1800	1700	2210	1900	1900	2330	2000	-
2200	-	-	-	-	-	-	-	-	-	-	-	-	1300	2120	1750	1400	2155	1800	1500	2190	1850	1700	2300	1950	1900	2400	2050	-
2300	-	-	-	-	-	-	-	-	-	-	-	-	1300	2190	1800	1400	2225	1850	1500	2260	1900	1700	2390	2000	1900	2470	2100	-
2400	-	-	-	-	-	-	-	-	-	-	-	-	1300	950	1850	1400	990	1900	1500	1025	1950	1700	1125	2050	1900	1200	2150	-

FITTINGS - BRANCHES



Pressure class PN1 bar
DN2 700-1500mm

DN1 \ DN2	700			800			900			1000			1100			1200			1300			1400			1500			
	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	
300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
700	1900	1270	1300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
800	1900	1340	1350	2100	1410	1450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
900	1900	1490	1400	2100	1560	1500	2300	1630	1600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1000	1900	1560	1450	2100	1630	1550	2300	1700	1650	2500	1770	1750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1100	1950	1630	1525	2150	1700	1625	2350	1770	1725	2590	1840	1825	2650	1910	1925	-	-	-	-	-	-	-	-	-	-	-	-	-
1200	2000	1700	1600	2200	1770	1700	2400	1840	1800	2500	1910	1850	2700	1980	1950	2900	2050	2050	-	-	-	-	-	-	-	-	-	-
1300	2000	1770	1650	2200	1875	1750	2400	1910	1850	2550	1980	1925	2725	2050	2010	2900	2120	2100	3100	2190	2200	-	-	-	-	-	-	-
1400	2000	1840	1700	2200	1980	1800	2400	1980	1900	2600	2050	2000	2750	2120	2075	2900	2190	2150	3100	2260	2250	3300	2330	2350	-	-	-	-
1500	2000	1910	1750	2200	1980	1850	2400	2085	1950	2600	2155	2050	2775	2225	2140	2950	2295	2225	3150	2370	2325	3350	2440	2425	3550	2510	2525	-
1600	2000	1980	1800	2200	2050	1900	2400	2190	2000	2600	2260	2100	2800	2330	2200	3000	2400	2300	3200	2475	2400	3400	2550	2500	3550	2650	2575	-
1700	2000	2050	1850	2200	2120	1950	2400	2220	2100	2650	2300	2175	2850	2390	2275	3050	2480	2375	3225	2550	2465	3400	2610	2550	3575	2690	2600	-
1800	2000	1100	1900	2200	1175	2000	2400	1250	2200	2700	1350	2250	2900	2480	2350	3100	1500	2450	3250	2600	2525	3400	1650	2600	3600	2750	2700	-
1900	2050	2230	1975	2250	2310	2075	2400	2370	2200	2700	2480	2300	2900	2550	2400	3100	2610	2500	3275	2680	2590	3450	2750	2675	3625	2830	2765	-
2000	2100	1175	2050	2300	1250	2150	2400	1325	2200	2700	1400	2350	2900	2610	2450	3100	1550	2550	3300	2750	2650	3500	1700	2750	3650	2900	2825	-
2100	2100	2410	2100	2300	2480	2200	2425	2550	2260	2700	2620	2400	2900	2690	2500	3085	2750	2590	3300	2840	2700	3525	2920	2810	3675	2990	2890	-
2200	2100	2480	2150	2300	2550	2250	2450	2620	2320	2700	2690	2450	2875	2760	2540	3050	2830	2625	3300	2920	2750	3550	3010	2870	3700	3080	2950	-
2300	2100	2550	2200	2300	2620	2300	2475	2690	2400	2700	2760	2500	2870	2840	2575	3025	2910	2650	3300	3000	2800	3575	3100	2950	3725	3170	3025	-
2400	2100	1275	2250	2300	1350	2350	2500	1425	2450	2700	1500	2550	2850	1575	2625	3000	1650	2700	3300	1735	2850	3600	1825	3000	3750	1900	3075	-



Pressure class PN1 bar
DN2 1600-2400mm

DN1 \ DN2	1600			1700			1800			1900			2000			2100			2200			2300			2400			
	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	B	E	F	
300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1600	3700	2690	2650	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1700	3750	2760	2650	3900	2840	2725	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1800	3800	1800	2800	3950	2900	2875	4100	1950	2950	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1900	3800	2900	2850	3975	2970	2950	4150	3040	3050	4300	3140	3120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000	3800	1850	2900	4000	3040	3000	4200	1950	3100	4350	3170	3175	4500	2150	3250	-	-	-	-	-	-	-	-	-	-	-	-	-
2100	3825	3060	2960	4025	3130	3060	4225	3200	3160	4365	3260	3230	4500	3320	3300	4675	3400	3450	-	-	-	-	-	-	-	-	-	-
2200	3850	3150	3020	4050	3220	3120	4250	3290	3220	4375	3350	3285	4500	3390	3350	4600	3490	3425	4680	3590	3500	-	-	-	-	-	-	-
2300	3875	3240	3100	4075	3310	3200	4275	3380	3300	4390	3420	3350	4500	3460	3400	4690	3560	3500	4900	3660	3600	5050	3760	3700	-	-	-	-
2400	3900	1975	3150	4100	2050	3250	4300	2125	3350	4400	2190	3400	4500	2250	3450	4675	2325	3540	4850	2400	3625	5025	2475	3715	5200	2550	3800	-

PIPE ASSEMBLY METHOD

Various methods are available for joining fibreglass pipes, both for gravity flow and for pressure pipelines. Joints shall provide sealing against fluids and withstand longitudinal forces.

GRP pipes may be joined by one of the following methods:

- GRP BETO couplings (Fig. 3);
- Straub or Teekay steel coupling (Figures 5 and 6)
- Butt-strap joint (Fig. 7)
- Flanges / Stub ends



Figure 3 - Beto coupling

POLYESTER BETO COUPLING

Beto coupling is a symmetric, double-sided sliding coupling made of reinforced polyester. It is supplied with rubber sealing rings and a rubber profile - stopper (fig. 4). The sealing rings which provide leak-tightness and the stopper which secures the proper position of both pipe and coupling are placed in precisely processed grooves inside the coupling.

The width of GRP BETO coupling:

- For DN300 up to DN500 - B=270 mm
- For DN >500 - B=330 mm

Three factors contribute to the efficient sealing of a Beto coupling, such as:

- Sealing lips
- Gasket compression
- Wedge-shaped grooves.

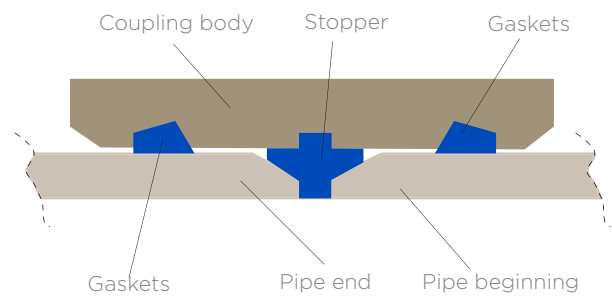


Figure 4 - Joint with a Beto coupling

STEEL COUPLING

When connecting GRP pipes to pipes made of different materials, this is one of the recommended methods. This type of assembly has proved to be very useful in the reparation of damaged pipes. Couplings of this type may be supplied as flexible or repair. They include a steel casing/body with internal sliding rubber gaskets. The body can be stainless steel or coated with specially designed material. The usage of metal coupling is both time and cost-efficient. The most notable manufacturers are TEEKAY and STRAUB (fig. 5 and fig. 6.).

Figure 5 - TEEKAY Repair coupling

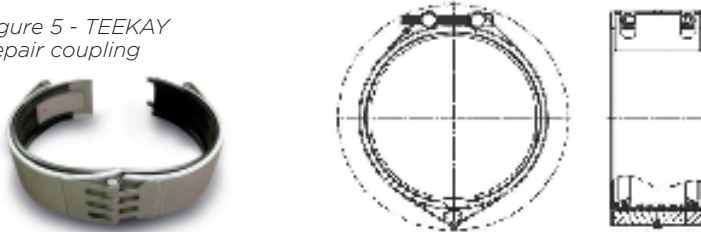


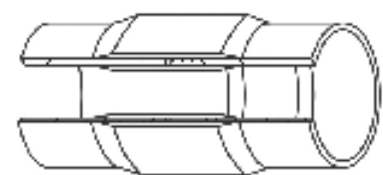
Figure 6 - Straub fixed coupling



BUTT AND STRAP JOINT

The butt and strap joint (fig. 7) is normally used for joints which are to withstand larger axial forces and where inseparable pipe connection is necessary (subaqueous pipelines etc.). The length and thickness of the joint depend on usage conditions, pipe diameter, operating pressure, etc.

Figure 7 - Butt and strap joint



FLANGED JOINT

Flanges are bonded to pipe ends and are mechanically connected. Sealing is achieved by elastomeric sealing rings. This type of connection is separable but highly reliable and it enables the installation to be disassembled in some further stage, if necessary. It is convenient when connecting to pipes made of other materials, as well as valves and various other fixtures.

It is supplied as

- Pre-cast fixed flange on a short piece of GRP pipe (fig. 8);
- Pre-cast loose GRP flange and a stub end on a GRP pipe (fig. 9).



Figure 8 - Joint with fixed flanges



Figure 9 - Joint with loose flanges

Sand covered



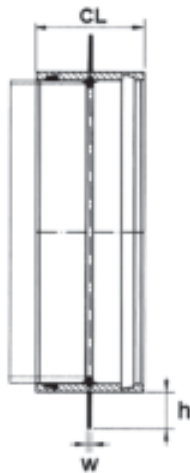
Type A

Sand covered



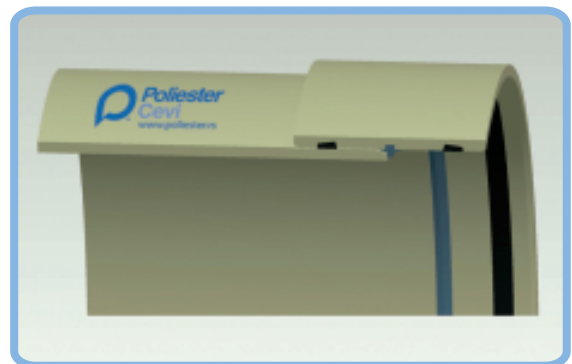
Type B

Sand covered

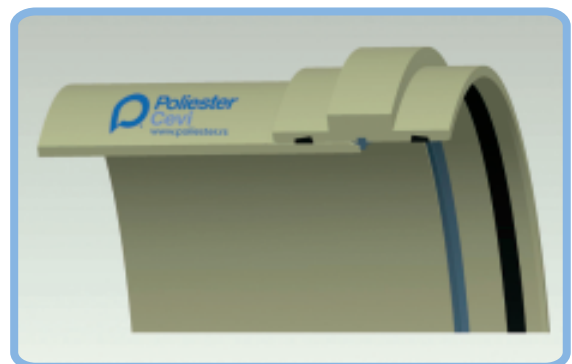


Type C

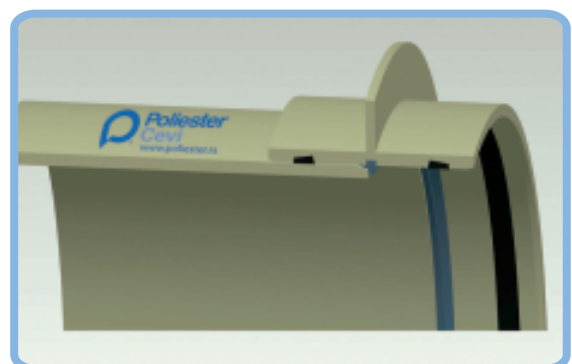
DN (mm)	Tip / Type A, B, C	Tip / Type B		Tip / Type C	
	CL (mm)	W (mm)	H (mm)	W (mm)	H (mm)
150	172	50	8	8	80
200	200	50	9	8	80
250	200	50	10	8	80
300	270	50	11	8	80
350	270	50	12	8	80
400	270	50	13	8	80
450	270	50	14	8	80
500	270	50	15	8	80
600	330	50	17	8	80
700	330	50	19	8	80
800	330	80	22	10	80
900	330	80	25	10	80
1000	330	80	27	12	100
1100	330	80	29	12	100
1200	330	80	30	12	100
1300	330	80	34	12	100
1400	330	100	35	15	100
1500	330	100	38	15	100
1600	330	120	39	15	100
1700	330	120	42	20	100
1800	330	120	45	20	120
1900	330	120	46	20	120
2000	330	120	49	20	120
2100	330	120	49	20	120
2200	330	120	50	20	120
2300	330	120	53	20	120
2400	330	120	55	20	120



GPR Masonry Coupling „A”
(The outer surface of the Coupling is sandblasted)



GPR Masonry Coupling „B”
(The outer surface of the Coupling is sandblasted)



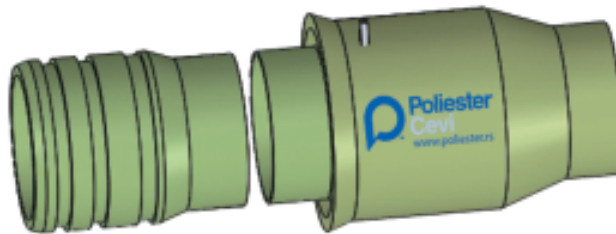
GPR Masonry Coupling „C”
(The outer surface of the Coupling is sandblasted)

GRP/GRE PIPES WITH LOCK JOINT

GRP/GRE pipes and fittings DN100 - DN400

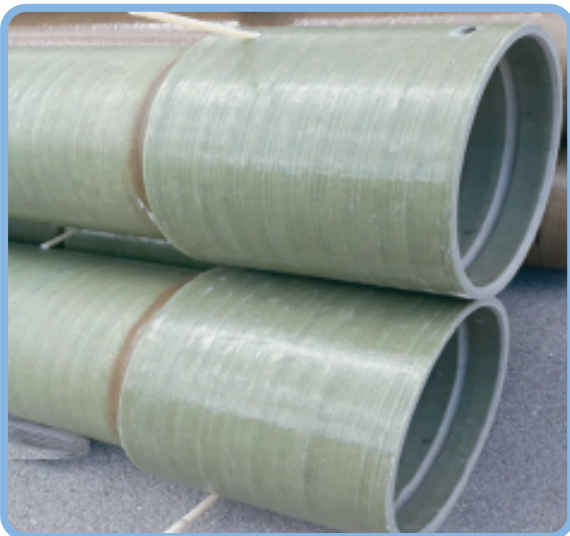


The appearance of pipes and the joining system



Pipe joint model

GRP/GRE pipes and fittings DN500 - DN1200



The appearance of pipes and the joining system



Pipe joint model

SELECTION AND INSTALLATION

The selection of GRP pipes is based on compliance with the requirements for stiffness and pressure class.

The stiffness shall be chosen according to:

- Native soil compactness (blow count acc. to Proctor);
- Depth of cover layer above the pipe crown;
- Type of backfill material;
- Negative pressure, if any;
- Traffic loads

The tables below show approximate limits relative to backfill material, negative pressure in the pipe and traffic loads.

INSTALLATION	MAX. COVER LAYER DEPTH (m)			
	SN 1250	SN 2500	SN 5000	SN 10000
1	7	8	12	16
2	6	7	10	14
3	4	5	8	12
4	NR	3	6	10
5	NR	NR	NR	3

Native soil, dumped
 Bedding (pipe zone material) depth DN/4 or max. 150mm
 Gravel with max. relative density greater than 70% (ASTM D4253)
 Clean sands with less than 12% fines; 90% standard Proctor density (ASTM D698)
 Sand at 90% standard Proctor density or gravel greater than 70%, max. relative density up to 4
 Sand, dumped

DN - Nominal pipe diameter (mm)
 NR - Not recommended
 1* - max. 300 mm

NOTE: Other backfill materials may be allowed. Installation conditions 1-5 are outlined as typical. Detailed instructions may be found in Pipe Installation Manual Cpl01 issued by Poliester Cevi d.o.o. Priboj. For other installation types, consult our technical staff at all times.

INSTALLATION	ALLOWABLE NEGATIVE PRESSURE (KPa)			
	SN 1250	SN 2500	SN 5000	SN 10000
1	-50 -75 (up to 5 m) -100 (up to 3 m)	-100	-100	-100
2	-25 -50 (up to 4 m)	-75 -100 (up to 6 m)	-100	-100
3	NR	-25 -50 (up to 4 m)	-75 -100 (up to 6 m)	-100
4	-	-25	-50 -75 (up to 4 m)	-100
5	-	-	-	-100*

NOTE: Allowable negative pressures are given at maximum cover depths

1* - tamping by foot
NR - Not recommended

SELECTION AND INSTALLATION

TRAFFIC LOAD

In case of traffic loads all pipe zone backfill must be compacted. Minimum cover restrictions are given in the table below:

SPECIFIC LOAD	VEHICLE	MIN. COVER (m)
AASHTO H20	TRUCK	1,0
BS 153 HA	LORRY	1,5
COOPER E80 RR	RAILROAD	3,0

PRESSURE

The pressure class shall be the same or higher than the operating pressure. Pressure class is based on the pressure value which the pipe shall withstand during a 50-year life cycle and it is calculated by the following formula:

$$PN = \frac{HDB\ 50g.}{FS}$$

PN	pressure class
HDB 50 g.	pressure value to be sustained by the pipe when 50 years old
FS	safety factor <i>Taken as FS=1.8 during 50-year life cycle.</i>

PIPE INSTALLATION

A long lifetime and good properties in the usage of GRP pipes are only achieved through appropriate handling and installation. The pipe is designed to use bedding and the backfill zone as supports. Through experience, designers reached the conclusion that well-compacted granular soils are ideal for backfill. The pipe and backfill materials together form a high-performance pipe-soil system. For laying and installation of the pipes, our *Installation Manual Cpi01*, with details on handling and installation, is highly recommended.

The following data are a partial overview of the installation procedure.

TRENCH PREPARATION

In the pipe backfilling zone, the trench shall always be wide enough to enable placement and compaction of the pipe zone backfill materials (Fig.10). When rocks, harder material, and soft and loose or highly expansive soil are present at the bottom of the trench, the thickness of the bedding must be increased so as to provide adequate and uniform support for the pipe.

PIPE DIAMETER DN (mm)	MIN. WIDTH A (mm)
300	150
350-500	200
600-900	300
1000-1600	450
1800-2400	600

Dimension A has to allow for adequate space to operate with the compaction and pipe assembly equipment.

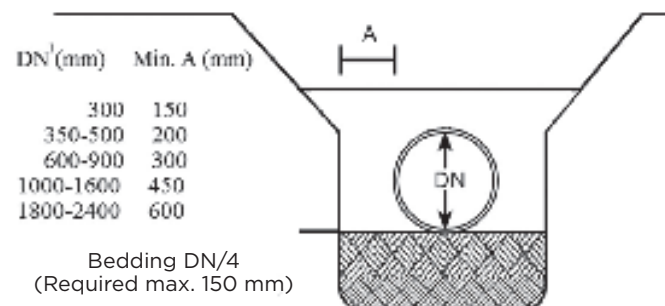


Figure 10 - Standard trench detail

BEDDING

Trench bedding of suitable material should provide uniform and continuous support for the pipes. Sand or gravel may be used as the bedding material. The bedding has to be compacted up to 90% standard density according to Proctor (70% max relative density for rubble and gravel). The finished bedding should be flat.

BACKFILL MATERIALS

To ensure a satisfactory pipe-soil system, adequate backfill material shall be used. Most coarse-grained soils (as classified by *The Unified Soils Classification System*) are considered acceptable bedding and pipe zone backfill material. Detailed instructions are provided during project negotiation.

PIPE ZONE BACKFILLING

The appropriate pipe zone backfill requirements are determined by native soil conditions and selected stiffness class. Quality material installation in the pipe zone is of vital importance for the proper functioning of a pipeline within the warranty period. Check if grained material is tucked fully under the pipe in order to accomplish full support (Figures 11 and 12.) A board or similar blunt tool may be used to push and compact the backfill material. Performing this procedure in detail is a crucial phase of pipe backfilling. When backfill has reached up to half of the pipe (half of the diameter), compress near the trench wall first, progressing towards the middle. All remaining details on backfilling are provided in our *Pipe Installation Manual Cpi01*.

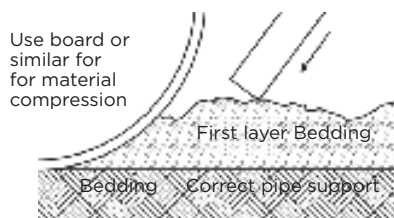


Figure 11 - Full pipe support

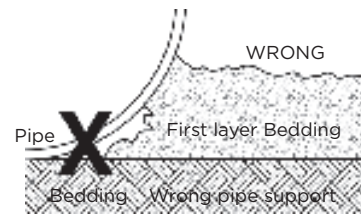


Figure 12 - Incorrect lateral support of pipe

PIPELINE DEFLECTION

Material which is used to produce GRP pipes has a relatively low elastic modulus; hence, the control of vertical deflection of pipe is the best indicator of the pipe installation quality. Pipe deflection should not exceed 5% nominal diameter long-term. Bulges, flattening or other sudden changes in the wall curve are not allowed. The deflection check should be performed as soon as the first installed pipe is buried and it continues periodically throughout the whole project. Maximum diameter deflection during installation should not exceed the values given in the table below.

Allowable initial vertical deflection during installation

NATIVE SOIL	SOIL GROUP			
	1	2	3	4
Allowable initial deflection during installation (% of diameter)	3,0	3,0	2,5	2,0

Classification of the native soil groups

SOIL GROUP	Classification of the native soil			
	1	2	3	4
Cohesive (fine graded)	Hard and very stiff	Stiff	Medium	Soft
Granular (rough graded)	Very dense and dense (compressed)	Medium	Incoherent	Very incoherent
Blow count	>30	16-30	6-15	3-5

SELECTION AND INSTALLATION

ANGULAR DEFLECTION

Maximum angular deflection for each coupling joint shall not exceed the values given in the table below. Also, the pipes shall be connected in a straight line, and then deflect under an angle, if necessary.

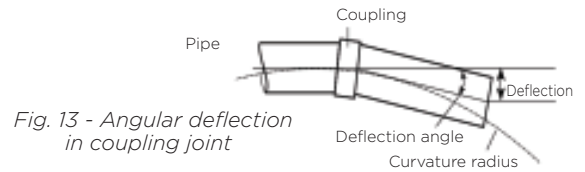


Fig. 13 - Angular deflection in coupling joint

Nominal pipe diameter (mm)	Nominal installation deflection, (°)	Nominal slope (mm)			Nominal curvature radius (m)		
		Section length (m)			Section length (m)		
		3	6	12	3	6	12
300 up to 600	3,0	157	314	628	57	115	229
700 up to 800	2,5	131	262	523	69	137	275
900 up to 1000	2,0	105	209	419	86	172	344
1100 up to 1300	1,5	79	157	314	115	229	458
1400 up to 1600	1,25	65	131	262	138	275	550
1800 up to 2400	1,0	52	105	209	172	344	688

Nominal pipe diameter (mm)	PRESSURE (bar)			
	up to 16	20	25	32
	Maximum deflection angle (°)			
DN ≤ 500	3	2,5	2,0	1,5
500 < DN ≤ 800	2	1,5	1,3	1,0
900 < DN ≤ 1800	1	0,8	0,5	0,5
DN > 1800	0,5	-	-	-

Maximum deflection angle for coupling joint under pressure

Nominal angular deflection for coupling joint

NOTE It is certain that the joints with angular deflection in the systems under pressure have certain limitations.

SUPERVISION ON SITE

Poliester Cevi d.o.o. shall provide a supervisor on site during pipe installation at customer's request. The scope of services shall vary from permanent attendance to occasional visits depending on work schedule on site, complexity of the location and the installation results. The supervising body for the GRP pipes on site shall advise the Contractor in order to achieve the prescribed and designed results for the installed pipes.

STANDARDS

Polyester pipes comply with specifications and standards worldwide, such as:

- EN;
- ASTM;
- AWWA;
- ISO;
- DIN.

Here follows the overview of standards applied in production, testing, and quality verification of polyester pipes.

1. STANDARDS APPLIED IN RAW MATERIAL CONTROL AND TESTING

Standards for control and testing of resin quality

1. **ISO 2555** -viscosity testing
2. **ISO 2535** -gel time testing
3. **ISO 2811** -density testing
4. **ISO 3251**- Styrene content determination
5. **ISO 2114**- Acid number determination
6. **ISO 584** -Resin reactivity

Standards for control and testing of reinforcement fibre

1. **ISO 1889**- Linear density determination (tex)
2. **ISO 3344**-Moister content determination
3. **ISO 1887**- Loss on ignition
4. **ISO 3268**-(OC R110)Tensile strengt and reduction factor
5. **ISO 2078**-Glass type
6. **SNO5320** - Resin soaking time.

Standards for control and testing of silica sand

1. **OC R 115**- Carbonate content
2. **OC R 114**-Moister content
3. **OC R 112**-Loss on ignition
4. **OC R 116**-Resin wet out time
5. **ASTM E11**-Granulation.

Standards for control and testing of styrene

1. **ASTM D2121**-Polymer content in styrene monomer

Standards for control and testing of methyl-ethyl-ketoneperoxide (MEKP) Co octoate.

1. **ISO 2555**- Viscosity testing
2. **ISO 2535**- Ignition time testing
3. **OC R111**- water content in MEKP



2. STANDARDS APPLIED IN PIPE CONTROL AND TESTING

1. **ASTM D3567** Standard procedure for determination of pipe and fitting dimension
2. **AWWA C950** Standard for high pressure pipes for water supply
3. **ASTM D3517** Standard specification for fibreglass pipes for high pressure
4. **ASTM D3754** Standard specification for fibreglass pipes for sewage and industrial waste water
5. **ASTM D3262** Standard specification for sewage pipes
6. **ASTM D2412** Pipe stiffness and deflection
7. **ASTM D2583** Hardness acc. Barcol
8. **ASTM D 790** Bending properties of plastic materials
9. **ASTM D2290** Circumferential tensile strength
10. **ASTM D 638** Elongation properties of plastic materials
11. **ASTM C 581** Standard procedure for determination of chemical resistance of resin used in structures with reinforcement of glass fibre purposed for transport of liquid
12. **ASTM D4161** Standard specification for joints of fibreglass with usage of flexible gaskets of elastomer
13. **EN ISO 1172** Laminate structure (pipe)
14. **ASTM D3839** Standard procedure for underground installation



APPROXIMATE WEIGHT OF PIPES AND COUPLINGS

NOMINAL DIAMETER DN (mm)	PIPE (kg/m)				COUPLING (kg)
	SN 1250	SN 2500	SN 5000	SN 10000	
100				2,6	
150				4,8	2,8
200				6	4,4
250				11	4,6
300	11	12	14	16	9
350	13	15	18	21	10
400	16	19	22	27	11
450	18	22	26	32	12
500	22	27	32	38	13
600	30	37	45	55	16
700	40	50	61	74	19
800	52	65	78	96	21
900	65	81	98	121	25
1000	80	100	120	149	29
1100	96	120	145	179	33
1200	113	141	172	213	38
1300	132	165	201	249	44
1400	153	191	233	288	50
1500	175	219	267	330	56
1600	199	249	303	358	62
1700	220	280	340	374	68
1800	250	312	382	390	74
1900	280	345	416	-	81
2000	308	378	451	-	88
2100	340	413	-	-	95
2200	370	448	-	-	103
2300	405	-	-	-	111
2400	440	-	-	-	120

REFERENCE LIST

Out of multiple projects, in the table hereinafter you can find some of the most remarkable ones.

It. NO	LOCATION	CLIENT	APPLICATION	DIAMETER (mm)	PRESSURE (bar)	QTY (m)
1.	PROBIŠTIP, NORTHERN MACEDONIA	JKP ILINDEN	POTABLE WATER	500	25	7000
2.	ČAČAK, SERBIA	UZ TRBUŠANI	POTABLE WATER	318	10	1850
3.	NOVI SAD, SERBIA	KANAL DTD	POTABLE WATER	318 600 800	10	700
4.	KONJIC, BIH	BUJICE D.O.O. KONJIC	POTABLE WATER	500	6	2250
5.	NOVI SAD, SERBIA	JKP VODOVOD I SEWERAGE	RAW WATER	900	6	4400
6.	GORNJI MILANOVAC, SERBIA	GIP GRADITELJ	POTABLE WATER	400	6	2200
7.	NOVI SAD, SERBIA	JKP VODOVOD I SEWERAGE	RAW WATER	800 500 700 400 600 318	10	650 300 550 390 450 500
8.	STOLAC, BIH	JKP STOLAC	POTABLE WATER	500	10	1600
9.	GOSTIVAR, NORTHERN MACEDONIA	JKP KOMUNALEC	POTABLE WATER	600	10	2000
10.	PRIZREN, SERBIA	DP ELAN	POTABLE WATER	318	6	3812
11.	ČAČAK, SERBIA	VP MORAVA	RAW WATER	500	10	2100
12.	BEOGRAD, SERBIA	IVAN MILUTINOVIČ-PIM	SEWERAGE	1200 1000 900	2,5	411 990 800
13.	KOSTOLAC, SERBIA	JP POVRŠINSKI KOPOVI KOSTOLAC	POTABLE WATER	400 500	10	1400 900
14.	OBRENOVAC, SERBIA	JP ZA IZGRADNJU OBRENOVCA	RAW WATER	600 400	10	4035 450
15.	TEMERIN, SERBIA	DP 23. OKTOBAR TEMERIN	SEWERAGE	800	2,5	2200
16.	ŠABAC, SERBIA	JKP VODOVOD ŠABAC	POTABLE WATER	300 500 700	10	1500 3601 7042
17.	ZRENJANIN, SERBIA	ZLATICA REMONT ZRENJANIN	POTABLE WATER	250 500	10	1989 944
18.	BEOČIN, SERBIA	CEMENTARA BEOČIN	POTABLE WATER	300	10	2035
19.	IVANJICA, SERBIA	KOPAONIK-BEOGRAD	POTABLE WATER	400	10	2200
20.	NOVI SAD, SERBIA	GP TVRĐAVA	RAW WATER	500 600 700	10	1688
21.	LOZNICA, SERBIA	VODOVOD I SEWERAGE LOZNICA	RAW WATER	500	6	1000
22.	APATIN, SERBIA	VODOVOD OPERATIVA PANČEVO	POTABLE WATER	400	10	1400
23.	NOVI SAD, SERBIA	JKP VODOVOD I KANALIZACIJA	POTABLE WATER	500	10 12 16	1680
24.	NOVI SAD, SERBIA	GP MOSTOGRADNJA	POTABLE WATER	600	6	1040
25.	LJUBOVIJA, SERBIA	JKP STANDARD	POTABLE WATER	300	16 10	8.805
26.	RUMA, SERBIA	JP VODOVOD	POTABLE WATER	500	10	1250
27.	BOGATIĆ, SERBIA	BOGATIĆ	SEWERAGE	500	2,5	5000
28.	ŠID, SERBIA	JKP VODOVOD	POTABLE WATER	400	10	3650
29.	PALE, BIH	BG VODOSNABDEVANJE	POTABLE WATER	300	10	2700
30.	VARVARIN, SERBIA	MPP JEDINSTVO	WATER SUPPLY	600	10	10000
31.	KOSTOLAC, SERBIA	JP POVRŠINSKI KOPOVI KOSTOLAC	WASTEWATER	300	16	3500
32.	POŽAREVAC, SERBIA	JP TOPLIFIKACIJA	HEAT MAIN RELINING	900 600 400	-	3000
33.	KOSTOLAC, SERBIA	JP POVRŠINSKI KOPOVI KOSTOLAC	WASTEWATER	700 800	1	890
				1000 1500	1	2100 1200
34.	BEOGRAD, SERBIA	GP PLANUM	SEWERAGE	400 500	1	3630
35.	NOVI SAD, SERBIA	DTD KANAL	WATER SUPPLY	600 800	10	1490

REFERENCE LIST

It. NO	LOCATION	CLIENT	APPLICATION	DIAMETER (mm)	PRESSURE (bar)	QTY (m)
36.	BEOGRAD, SERBIA	MPP PROJEKTOMONTAŽA	SEWERAGE	300 700 1000 1200	1	2180
37.	NOVI SAD, SERBIA	DS GRADNJA	SEWERAGE	250 500 300 600 400 800	1	2000
38.	BOGATIĆ, SERBIA	JKP BOGATIĆ	MAIN HEADER PIPE	500	2,5	5016
39.	APATIN, SERBIA	APATIN	POTABLE WATER PRIMARY SYSTEM	500	10	1400
40.	BEOGRAD, SERBIA	GP PLANUM	HEADER PIPE	300-1200	1	4340
41.	BEOGRAD, SERBIA	ENERGOPROJEKT	SEWERAGE	300 400	10	1340
42.	KOSTOLAC, SERBIA	JP POVRŠINSKI KOPOVI KOSTOLAC	SEWERAGE	1000 300	1 16	1050 3900
43.	UŽICE, SERBIA	MPP JEDINSTVO	POTABLE WATER	600 900 1000	10	6600 2900 3450 (900+1000)
44.	KOSTOLAC, SERBIA	JP POVRŠINSKI KOPOVI KOSTOLAC	POTABLE WATER	300	16	3500
45.	SREMSKA MITROVICA, SERBIA	NIKOL KOMERC	SEWERAGE	600 900 1000	1	1050 54
46.	PRIJEDOR, BIH	ARCELOR MITTAL	TECHNICAL WATER	300 500 400 600	1	1836
47.	BANJA LUKA, BIH	INTEGRAL	POTABLE WATER	700	16	1578
48.	EBERSCHWANG, AUSTRIA	AQUA SYSTEM TECHNOLOGIE GMBH	WASTEWATER POTABLE WATER MANUFACTURE OF TANKS	800 1800 1200 2000 1500 2400	1	150 220 120 150 70 1200
49.	LOGATEC, SLOVENIA	SISTEKO	SEWERAGE	150 700 200 800 250 1000 300 1200 400 1400 500 1600 600 2000	1 6	1000 1000 16600 11000 39500 16000 7000 1400 3400 200 3500 200 3000 200
50.	UŽICE, SERBIA	TEHNIX PRO	MANUFACTURE OF VARIOUS WASHING MACHINES	400	16	1000
51.	FRANCE	PLASTICON FRANCE S.A.	WASTEWATER FROM YACHTS (MARINE APPLICATION)	110 250 125 300 185	1	1200 1200 3400 500 5300
52.	GERMANY	HÖLLKO GMBH	SEWERAGE PIPE FOR GERMAN MARKET 2014-2022	600-2000	1	4100
53.	RIJEKA, CROATIA	COMPRA D.O.O. KARLOVAC	WASTEWATER	300 600 400 800 500	1	540 150 320 430 120
54.	CROATIA	HADVA OSIJEK	SEWERAGE	200 300 250 350	1	200 220 400 170
55.	VARAŽDIN, CROATIA	METEOR PROIZVODNJA D.O.O.	PUMPING STATIONS	2400	1	160
56.	BOR, SERBIA	SERBIA ZIJIN COPPER DOO	TECHNICAL WATER	200 500 600	16 20 25	11500 11400 2400
57.	SLOVENIA	GALL GRADNJE DOO	SEWERAGE	250-800	1	400
58.	SERBIA	KONVAR DOO	SEWERAGE	700	1	200
59.	ŠABAC, SERBIA	ELIXIR ZORKA MINERALNA ĐUBRIVA ŠABAC	PLANTS RECONSTRUCTION-GASSUCTION SYSTEMS	900 1800 1000 2200	1	250
60.	TRILJ, CROATIA	TABAK GRUPA	SEWERAGE	250	1	2700
61.	DUBROVNIK, CROATIA	HIDRO SAM	SUPPORT PILES	1000 1200	1	820 96
62.	METKOVIĆ, CROATIA	SICHEM	SEWERAGE	250	1	450
63.	OSIJEK, CROATIA	TEHNO-ELEKTRO	SEWERAGE	150-900	1	1200
64.	BIH	MHE „ERS“ LAKTAŠI, BIH	SHPP SUČESKA I	800 900	1-25	4100
65.	SEVERNA, NORTHERN MACEDONIA	MHE „GORNO BELIČKI IZVORI“ SKOPLJE	SHPP BELICA I, BELICA II	600 700	6-25	9950
66.	SEVERNA, NORTHERN MACEDONIA	MHE „EZERO“ SKOPLJE	SHPP OHRID I, OHRID II, OHRID III	300-600	1-32	3360
67.	BIH	„ROSE WOOD“ GORNJI VAKUF	SHPP	400-1000	6-32	6100

REFERENCE LIST

It. NO	LOCATION	CLIENT	APPLICATION	DIAMETER (mm)	PRESSURE (bar)	QTY (m)
68.	BIH	„PALOČ“ d.o.o. GORNJI VAKUF	SHPP	600-800	6-32	7150
69.	BIH	MHE „ZAGRADAČKA“ d.o.o. PROZOR	SHPP ZAGRADAČKA	500-600	10-25	1400
70.	BIH	„ELEKTRO GRUPA JAJCE“ JAJCE	SHPP VOLJEVAC	1500-1700	6	1420
71.	BIH	ADRIJA PRODUKT d.o.o. ZENICA	SHPP BISTRIČAK	900-1000	6-10	2100
72.	ROMANIA	ELKATA RUMUNIJA	SHPP ELKATA	350-1100	6-16	5835
73.	BIH	HIDRO KOP BANJA LUKA- BIH	SHPP PAKLENICA	400-500	10-16	4000
74.	BIH	MHE „ERS“ LAKTAŠI	SHPP SUČESKA II	500-600	6-30	4100
75.	SERBIA	MPP „JEDINSTVO“ SEVOJNO	SHPP DŽEP SERBIA	700-1000	10	2700
76.	SERBIA	MPP „JEDINSTVO“ SEVOJNO	SHPP LJUTI DO SERBIA	800	6-10	3580
77.	SERBIA	„ENERGO RAS“ KRALJEVO	SHPP BELCI	1700-1800	6	1850
78.	NORTHERN MACEDONIA	„FEROINVEST“ SKOPLJE	SHPP BRZA VODA	500-600	6-32	4500
79.	MONTENEGRO	„SYNERGY“ d.o.o. PODGORICA	SHPP VRELO	700	6-16	720
80.	BIH	„BIČAKČIĆ“ d.o.o. SARAJEVO	SHPP OTEŠA II	600-700	6-32	3860
81.	BIH	EKO ENERGY TEŠANJ	SHPP VAREŠ	1100-1200	6-10	2950
82.	MONTENEGRO	SISTEM MNE PODGORICA	SHPP BISTRICA	1600	6-16	3750
83.	BIH	EMY ZENICA	SHPP PEPELARI	600	6-16	3885
84.	BIH	EKO REM SARAJEVO	SHPP JABUKE	700	6-20	2975
85.	SERBIA	RATKO MITROVIĆ BEOGRAD	ODVODNJA PRISTUPNI PUT MOST ADA	100-200	1	2225
86.	SERBIA	INTERKOP ŠABAC d.o.o. AND MOSTOGRADNJA BEOGRAD	RAILWAY BRIDGE OBRENOVAC	150-300	1	850
87.	SERBIA	MBA MILJKOVIĆ BEOGRAD	KIJEVSKI POTOK BELGRADE BYPASS	150-350	1	620
88.	SERBIA	MOSTOGRADNJA BEOGRAD	BEŠKA BRIDGE	250-450	1	1700
89.	SERBIA	MPP JEDINSTVO SEVOJNO	CORRIDOR 11	200-500	1	2975
90.	SERBIA	TERNA OGRANAK SERBIA	CORRIDOR 10	150-300	1	520
91.	SERBIA	FERBILD BEOGRAD	CORRIDOR 10	150-300	1	380
92.	GERMANY	HÖLLKO GmbH	DRAINAGE PIPES FOR THE GERMAN MARKET 2014-2022	100-600	1	27950
93.	SERBIA	EUROPOLIS PLUS BEGRAD	CORRIDOR 10	200-400	1	3100
94.	SERBIA	MILLENNIUM TEAM BEOGRAD	BELGRADE WATERFRONT	500-1800	1	900
95.	SERBIA	AQUA PAN INŽENJERING ČAČAK	CORRIDOR 11	200-300	1	800
96.	SERBIA	KARIN KOMERC MD d.o.o. VETERNIK	OVERPASS 59	150-200	1	6997
97.	SERBIA	PUTEVI INVEST d.o.o. UŽICE	BRIDGE OVER KRIVAJA BRIDGE OVER SUŠICE	200-250	1	600
98.	POLAND	DWD SYSTEM SP. z o.o.	POLISH MARKET	150	1	1800
99.	BIH	INTEGRAL INŽENJERING AD	DRAINAGE OF A BRIDGE OVER SAVA RIVER NEAR GRADIŠKA	150-450	1	880
100.	CROATIA	HADVA DOO OSIJEK	BRIDGE DRAINAGE IN OSIJEK	250	1	400
101.	SERBIA	MDJ MOST-NS DOO NOVI SAD	BRIDGE IN TITEL	150	1	750
102.	GERMANY	MA PROTECT GmbH	GERMAN MARKET	150-250	1	1720
103.	SERBIA	BRICKEN	BRIDGE SUBOTICA	200	1	900
104.	GERMANY	TRAUTHWEIN	GERMAN MARKET	200-250	1	450
105.	SERBIA	BECHTEL ENKA	MORAVA CORRIDOR DRAINAGE	200 300 400 500	1	400 1900 1000 150

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ZAG

ISO 9011:2019

Slovensko tehnično soglasje STS-14/0023
Slovenian Technical Approval

Podejeto na podlagi določil Zakona o gradbenih proizvodih – ZGPro-1 (Uk. list RS, št. 82/2013) razrednjema gradbenima proizvoda.
On the basis of provisions of the Construction Products Act – ZGPro-1 (OG RS, no. 82/2013) granted to the following construction products:

Komercialno ime proizvoda: <i>Trade name</i>	Poliestrski revizijski jaški <i>Manholes and inspection chambers</i>
Imetnik soglasja / Proizvajalec: <i>Holder of approval / Manufacturer</i>	Poliester Cevi d.o.o. Priboj Ul. 4. Sandžačke bb 31330 PRIBOJ, Srbija
Vrsta in predvideni namen uporabe proizvoda: <i>Generic type and use of the product</i>	Jaški iz armiranega poliestra za drenažo in kanalizacijo pri globini podtalnice do 8 m <i>Manholes and inspection chambers, made of glass-reinforced thermosetting plastics (GRP), for drainage and sewerage, for ground-water depths of up to 8 m</i>
Veljavnost od (mesec) / Validity from (month)	13.06.2019 12.06.2024
Proizvodni obrat: <i>Manufacturing plant</i>	Poliester Cevi d.o.o. Priboj Ul. 4. Sandžačke bb 31330 Priboj, Srbija
Izdaja št.: <i>Issue No.</i>	2
To soglasje zamenjuje: <i>This Approval replaces</i>	STS-14/0023 veljavno od 13.06.2014 do 12.06.2019 STS-14/0023 validly from 13.06.2014 to 12.06.2019
To Slovensko tehnično soglasje obsega: <i>This Slovenian Technical Approval contains</i>	19 strani z vključno 5 prilogami <i>19 pages including 5 annexes</i>



Obš. P.11.31.001.719

StandCert issues
Certificate
No. ES-0265
which confirms that
Environmental Management System
of organization
Poliester Cevi
Poliester cevi d.o.o. Priboj
4. Sandžačke bb, Priboj, Serbia
is in compliance with standard
SRPS ISO 14001:2015
for the following scope of certification
Production of polyester pipes, couplings, tanks and other polyester products

Effective date of granting/recertification: 13.06.2020.
Recertification expiry date: 12.06.2024, exclusively in case of satisfactory execution of surveillance audits.
Edition: 02
Initial certification date: 13.06.2015

Director
M. Stanić
Mirjana Stanić, M.Sc.
StandCert, Bulevar vojaških 19/1a, Beograd, Serbia

StandCert issues
Certificate
No. OH-0201
which confirms that
Occupational Health and Safety Management System
of organization
Poliester Cevi
Poliester cevi d.o.o. Priboj
4. Sandžačke bb, Priboj, Serbia
is in compliance with standard
SRPS ISO 45001:2018
for the following scope of certification
Production of polyester pipes, couplings, tanks and other polyester products

Effective date of granting/recertification: 13.06.2020.
Recertification expiry date: 12.06.2024, exclusively in case of satisfactory execution of surveillance audits.
Edition: 02
Initial certification date: 13.06.2015

Director
M. Stanić
Mirjana Stanić, M.Sc.
StandCert, Bulevar vojaških 19/1a, Beograd, Serbia

StandCert issues
Certificate
No. QS-0140/3
which confirms that
Quality Management System
of organization
Poliester Cevi
Poliester cevi d.o.o. Priboj
4. Sandžačke bb, Priboj, Serbia
is in compliance with standard
SRPS ISO 9001:2015
for the following scope of certification
Production of polyester pipes, couplings, tanks and other polyester products

Effective date of granting/recertification: 13.06.2021.
Recertification expiry date: 12.06.2024, exclusively in case of satisfactory execution of surveillance audits.
Edition: 04
Initial certification date: 31.12.2011

Director
M. Stanić
Mirjana Stanić, M.Sc.
StandCert, Bulevar vojaških 19/1a, Beograd, Serbia

CERTIFICATES – the quality of pipes was tested and confirmed by the following institutions

Zavod za gradbeništvo Slovenije
Slovenian National Building and Civil
Engineering Institute

Dimičeva 12,
1000 Ljubljana, Slovenija
Tel.: +386 (0)1-2834 472, 280 45 37
Fax: +386 (0)1-283 44 84
E-pošta: info.za@zag.si
http://www.zag.si/si



ISSN: S 73403



Institut za ispitivanje materijala a.d. Beograd
Centralna laboratorija za ispitivanje materijala
Beograd, Bulevar vojvode Mišića 43
tel: (011) 26 50 322 fax: (011) 3692 772, 3692 752
www.imolab.rs

IGI INSTITUT GRAĐEVINARSTVA HRVATSKE d.d.
CIVIL ENGINEERING INSTITUTE OF CROATIA



Austrian Republic, 27 November 2016
Beauftragte gemäß § 2 Absatz 1

tgm³
Staatliche Versuchsanstalt
Kunststoff- und Metalltechnik

FEDERAL REPUBLIC OF AUSTRIA
FEDERAL TECHNICAL AND
ENVIRONMENTAL ENGINEERING

Prüfbericht
TGM - VA KU 26736

Erstprüfung Trinkwasserleitung gemäß DNORM B 5014-1:2016
Glasfaserverstärkte Röhre



MFPA Leipzig GmbH

Prof., Gewerbetriebe- und Zerkleinerungsstelle für
Bauteile, Baugewerke und Bauelemente
Gewerkschaft 01 - Bauteile Bauteile
Dr.-Ing. Peter Haase
Aufg. 111 - Bauteile Bauteile
Kgl.-Pfl.-St. 01
10405 Leipzig
Kontakt: 0341 3111-1000/101
kontakt@mfpa-leipzig.de

Prüfzeugnis Nr. PE 3.1/13-284.1

vom 4. September 2013
1. Ausfertigung

Auftraggeber: Polyester Cevi d.o.o. Priboj,
U. A. Sandžaka bb,
31330 Priboj,
Serbien

Auftraggeber: Prüfung auf Normalkernbrüche (Stoßenergie B2)
nach DIN 4102 Teil 1*, Ausgabe Mai 1999

Gegenstand: Glasfaserverstärkte Polyesterrohre (GFR)

Auftragdatum: 08.08.2013

Probeneingang: 07.08.2013 (Eingangsnr. 02.3.1/13-228)

Probenehmung: durch Auftraggeber

Kennzeichnung: ohne

Prüfdatum: 29.08.2013

Bearbeiter: Dipl.-Phys. Günter Brinkmann

Dieses Prüfzeugnis umfasst 4 Textseiten

Als unabhängiger Verleiher stellt dieses Prüfzeugnis die Grundlage für die vorgeschriebenen
Vermessungsmaßnahmen und ersetzt nicht das eigenverantwortliche Prüfzeugnis.
Dieses Bericht darf nur eingesehen werden, wenn die Verfertigung – nach Maßgabe des
vorliegenden schriftlichen Zustimmung der MFPA Leipzig GmbH. Als nichtverbindliche Form gilt die deutsche
Schreibweise mit Distanzstrichen und Ordinalzahlen deutscher Zehnerpotenzen.

Das gelten die Allgemeinen Geschäftsbedingungen (AGB) der MFPA Leipzig GmbH.

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Poliester
Cevi d.o.o.

ISO
ISO 9001
ISO 14001
ISO 45001

IGH INSTITUT IGH d.d.
IGH HTO
HTO 180

HRVATSKA TEHNIČKA OCJENA

HTO 23062

Nositelj ocjene: Polyester Cevi d.o.o. Priboj, ul. IV Sandžaka bb, 31330 Priboj,
Republika Srbija

Polovični papir: Polyester Cevi d.o.o. Priboj, ul. IV Sandžaka bb, 31330 Priboj,
Republika Srbija

Problemi ocjene: Poliesterska revidirano okno – standardni tip izrađeno iz staklenih
sječanih automera (GRP) na osnovi nezastarjanih poliesterskih
smola (UP), premjera DN50 od 420 mm do 2000 mm, nominalna
stodnevna brzina DN 2,5 km/h, DN 5 km/h i DN 10 km/h, za
ispregrnja do 8 m

Tipovači naziv: Poliesterska revidirano okno – standardni tip

Previdirano namjena: Odvodnja za sastave do 1 bara kod ojačalog (bicklatičkog) ili
pramenog opterećenja, za odvodnja na ostana, parkirska
postrojenja i odvodnja izvan grada

Valjanost od
do: 2000-08-21
2005-08-21

Ova hrvatska tehnička
ocjena sadrži: 2F stranica uključujući 5 priloga koji su sastavni dio ovog
dokumenta

Institut IGH d.d.
Jaska Patačić 1
10000 Zagreb
HRVATSKA
Tel: +385 1 4723 470
e-pošta: igh@igh.hr
http://www.igh.hr



HRVATSKA TEHNIČKA OCJENA HTO 23062, OD 1801-006, Poliesterska revidirano okno – standardni tip
DPT-021 stranica 1

Stranica 1 od 27



All the data and recommendations in this document are entered carefully and accurately. Due to the complexity of the issue at hand, the manufacturer does not undertake the liability for the difficulties of any kind that might occur as a result of potential mistakes in this document, and especially not so before consulting the manufacturer.

www.poliester.rs • office@poliester.rs

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**Poliester
Cevi** d.o.o.

ISO

ISO 9001
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ISO 45001

