



We Join The Cultures
By Water



2019
GENERAL PRESENTATION CATALOGUE

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I Water & Civilization	4
II General information	5
III GRP Composites	6
1 GRP Pipes	7
2 GRP Pipes Applications	8
3 Product properties & Advantages	9
4 Production Process	10
5 Performance Standards	11
6 Quality Criteria	13
7 Product Information	16
8 Joint Angular Deflection	24
9 Pipes Clasification	25
10 Installation of Buried pipes	28
11 Biaxial Pipes (Special Application Pipes)	34
12 Pipe Applications	36
13 Pipe Joining Mathods	38
14 Fittings	42
15 Surge Water and Water Hammer	62

The company CPS Distribution GmbH acts as an exclusive business representative of the company CPS distribution GmbH for the German market.

We have more than 20 years of experience in fields of sewer and drainage networks.

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technologized by



I Water and Civilization

Water management has a long history, going back to the attempts in prehistoric times in response to seasonal changes in water availability. Water management was crucial during the transition from hunting-gathering to farming, and became yet more important with the emergence of cities, industrial towns, and administrative centres. Water management has never solely been a matter of technical intervention. It is embedded within a great diversity of cultural, social and political arrangements.

Water embodies culture and civilization. Water is the most important vital item which together cultures and civilizations and joins as one part. Water is the symbol of abundance and purity. Objective of CPS distribution is to be inside of the projects which act a role to join cultures and civilization, to transmit its selfculture to regions where it reaches and to integrate the other cultures as flag carrier company.

By our products, Our aim is to contribute to be composed of the societies who know the value of water and use the water sources effectively

Therefore, the slogan of CPS distribution „We joint the cultures by water“

II General Information

The CPS distribution is a distributor of glass reinforced pipes and accessories for European market, produced on base of licence company Faratec pipe systems.

Faratec Pipe Systems has excellent experience in GRP pipe and composite sector for all kind of water transportation, special process application and petrochemical products transportation. Background of this long termly success is obtained by Faratec Technology Center that precisely performs technology and R & D studies.

CPS distribution products meet all requirements of global and local standards like TSE, DIN, ISO, AWWA, ASTM, BSI, CEN.

Product range of Toralit is as follows:

- » Diameter: DN 100 – 4000 mm
- » Pressure: PN 1 – 32 bar
- » Festigkeit: SN 1 250 – 10 000 N/m²

This product range covers Standard products. According to customer requests for non-standard applications, special designs are performed by Faratec Technology Center.

III GRP Composites

Glassfiber Reinforced Plastic (GRP) materials are classified as polymer matrix composites. GRP that can be used for several purposes is light, longeuous, strong structural composite material. It can be in different appearance (translucent opaque fully coloured), flattened or shaped, thick or thin. The main principle of GRP can be defined as a composite structure reinforced by glassfiber and fully combined by resin.

Accordance with utilisation area, economic factors; other material groups can be included in GRP composite structure together with these two main material groups.

Today, GRP composites are used in several disciplines like aerospace and aeronautical industry, medical, automotive industry, infrastructures. As summary it is very common to meet with GRP composites at the every field of life.



1 GRP Pipes

- 2 GRP Pipe Application
- 3 Product Properties & Advantages
- 4 Production Process
- 5 Performance Standards
- 6 Quality Criteria
- 7 Product Information
- 8 Joints Angular Deflection
- 9 Pipes Clasification
- 10 Installation of Buried Pipes
- 11 Biaxial Pipes (Special Application)
- 12 Pipe Dimensions
- 13 Pipe Joining Method
- 14 Fittings
- 15 Surge and Water Hammer

1 GRP pipes

When we consider today, easily it can be noticed that world's infrastructure is aged continuously and thousands of kilometers of pipelines need to be rehabilitated. This situation is one of the most priority problems that should be considered, in all over the world. The regions where aging infrastructure doesn't cause any problem are only noninfrastructured or new developing locations.

Communities are obliged to have right and difficult decisions how to construct new infrastructures, which pipes they will use not to re-face the same problems met in the past. Main reason of this problem is corrosion. Internally unprotected concrete sewer pipes are rapidly deteriorated by the presence of sulfuric acid in a sanitary sewer system. Externally, soil conditions and stray electrical currents can deteriorate underground pipes. Metallic pipes can corrode when placed in poorly aerated, poorly drained soils of low resistivity. The presence of sulfate-reducing bacteria will accelerate this corrosion.

These problems can be significantly reduced, if not eliminated, Precautions by corrosion-resistant material systems and corrosion protection systems will be caused to higher pipelines costs.

Corrosion is non-reversible process. There is one simple way to fully elimination of this problem: GRP Pipe.

1	GRP Pipes
2	GRP Pipe Application

3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

2 GRP Pipes Application

Growing awareness of the operational cost savings and superior corrosion resistance is resulted to world wide utilisation area for GRP pipe that emphasized strongly to related subject.GRP pipes are used wide spread application areas as follows:

- » Water transmission and distribution lines (potable water and raw water)
- » Sanitary Collection Systems
- » Storm Sewer Systems
- » Hydroelectric Penstock Lines
- » Sea water intake
- » Cooling water lines
- » Circulating water,make-up and blow downlines for power plants
- » Irrigation and drainage systems
- » Fire fighting Lines
- » Industrial Applications
- » Water reservoir lines and tanks

In replacing other materials Toralit GRP pipes delivers long, effective service life with low operating and maintenance costs.



1	GRP Pipes
2	GRP Pipe Application

3	Product Properties & Advantages
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4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

3 Product Properties & Advantages

Superior technology of Toralit GRP pipes has been able to bring a product to market that can provide the low cost, long term piping solutions to customers. The long list of properties and advantages is added up to provide the optimum installation and life cycle cost system.

Properties	Advantages
Corrosion Resistance	<ul style="list-style-type: none"> → Long and effective service life → No need for linings, coatings, cathodic protection, wraps or other forms of corrosion problems → Low maintenance cost → Hydraulic characteristics long term constant
Servis life of 50 year	More economical life at the same performance
Light Weight (At the same performance class, 75 % more light than ductile iron pipes, 90 % more light than concrete pipes)	<ul style="list-style-type: none"> → Low transport costs (nestable) → Elimination of need for expensive pipe handling equipments.
Long Standard Lengths (6 and 12 m are Standard pipe lengths. Pipe length can be provided up to 18 m accordance with customer request)	<ul style="list-style-type: none"> → Shortened installation time by fewer number of the joints → Lower delivery cost depending on more number of the pipes for each transport vehicle
Smooth Inner Surface	<ul style="list-style-type: none"> → Lower pumping energy need and lower operating costs due to low friction loss. → Lower cleaning costs due to minimum slime occurrence.
Precise Coupling With Elastomeric Gaskets For Underground Applications Adhesive Bonded Couplings For Aboveground Applications	<ul style="list-style-type: none"> → Tight and efficient joints designed to prevent infiltration and exfiltration → Shortened installation time resulted by ease of joining → Accommodation to small changes in line → Directions without fittings and differential settlements. → Thrust Resistant Joints
Flexible Manufacturing Process	Custom diameters can be manufactured to provide maximum flow volumes with ease of installation for special projects like rehabilitation lining projects
Advanced Technology Pipe Design	Lower wave celerity than other piping materials can mean less cost while designing surge and water hammer pressures.
Producing Pipe In Accordance With Local And International Standards like TSE,ASTM,AWWA, BSI,DIN,CEN etc	Producing Pipe In Accordance With Local And International Standards like TSE, ASTM, AWWA, BSI, DIN, CEN etc
Restrained Joining Systems	<ul style="list-style-type: none"> → No thrust blocks → Low installation cost

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

4 Production Process

Toralit GRP pipes are produced by using continuous advancing mandrel process that represents state-of-theart in GRP pipe production. Product range bu this method is 300 - 4000 mm diameter.

Main raw materials used in the process: Glass fiber, polyester resin and silica sand. Also surface mat, catalyst, chemical additives and accelerators are included inside of pipe structure.

Main principle of continuous advancing mandrel process is to use glass fiber reinforcements in the circumferential direction of pipe. Hoop rovings provide strength to GRP pipe against circumferential and external loads.Chop rovings inside of pipe structure empower the strength against longitudinal loads and multi direction loads. Silica sand used in sandwich structure of pipe is the main parameter to obtain exact pipe stiffness.Polyester resin used as main matrix of pipe is very important raw material that combines all pipe layers and effects chemical life. In some special cases, vinylester and other resins can be used instead of polyester resins.

Faratec Pipe Technology that is technology provider of CPS distribution supports multi-mandrel method which has similar principle with continuous advancing mandrel process for diameters upto 250 mm.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
5.1	ASTM
5.2	AWWA
5.3	Other Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

5 Performance Standards

Standards developed by ASTM, AWWA,ISO which are the leading Standard organisation in the world are referred to a variety of GRP pipe applications including conveyance of sanitary sewage, water and industrial waste. A thread common to all of the product standards is that they are all performance based documents. This means that required performance and testing of the pipes is specified based on pipe application.

5.1 ASTM (American Society for Testing and Materials)

Currently, there are several ASTM product standards in use which apply to a variety of GRP pipe applications. These standards include many tough qualification and quality control tests.Toralit GRP pipes are designed to meet all of these standards.

ASTM-Standards

ASTM D3262	Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D3517	Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe
ASTM D3754	Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe



1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
5.1	ASTM
5.2	AWWA
5.3	Other Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

5.2 AWWA (American Water Works Assosiation)

AWWA C950 is one of the most comprehensive product standards in existence for GRP pipes. This standard for pressure water applications has extensive requirements for pipe and joints, concentrating on quality control and prototype qualification testing. Like ASTM standards, this is a product performance Standard. Toralit GRP pipes are designed to meet performance requirements of this Standard. AWWA has also one design manual AWWAM45 which includes several chapters for design of GRP pipes, both for underground and aboveground applications.

AWWA Standards

ANSI / AWWA C950	Fiberglass Pressure Pipes
AWWA Manual M45	Fiberglass Pipe Design

5.3 Other Standards

Other Standard organisations such as ISO, CEN, BSI; DIN; TSE have also published performance specifications for GRP pipes. Toralit GRP pipes demonstrate compliance with these standards' performance requirements too, as long as it is not conflict with AWWA C950.

Some Other Standards

DIN 16868	Rohre aus glasfaserverstärktem Polyesterharz (UP-GF) GRP Pipes
BS 5480	British Standard Specification for Glass Reinforced Plastics (GRP) Pipes, Joints, Fittings For Use For Water Supply And Sewerage
ISO 10467	Plastics piping systems for pressure and non-pressure drainage and sewerage – Glassfiber reinforced plastics (GRP) systems based on unsaturated polyester (UP) resin
ISO 10639	Plastics piping systems for pressure and non-pressure water supply -- Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin
ISO 25780	Plastics piping systems for pressure and non-pressure water supply, irrigation, drainage or sewerage – Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin – Pipes with flexible joints intended to be installed using jacking techniques
EN 14364	Plastics piping systems for drainage and sewerage with or without pressure-Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP)-Specifications for pipes, fittings and joints
EN 1796	Plastic Pipe Systems Unsaturated Polyester Resin Based GRP - pressure or non-pressure, potable and usage water.).

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
6.1	Raw Material Quality Criteria
6.2	Finished Good Quality Criteria
6.3	Physical Properties
6.4	Long Term Performance Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

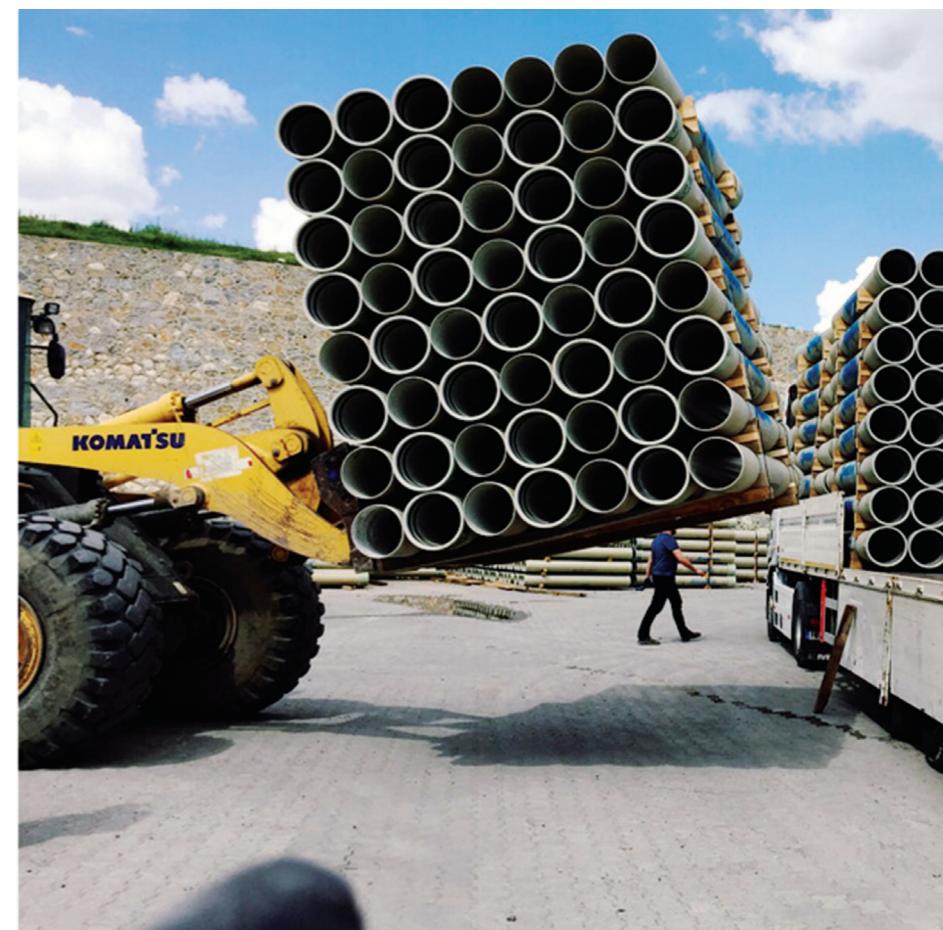
6 Quality Criteria

6.1 Raw Material Quality Criteria

Faratec determines quality criteria for all raw materials used. Raw materials are delivered with vendor certification demonstrating their compliance with acceptance criteria of Faratec. Additionally, all raw materials are tested as sampling base prior to their use. These tests ensure that pipe materials comply with specifications as stated.

Main raw material groups used in GRP pipe production are mentioned below:

- » Glass fiber
- » Resin
- » Catalyst (Hardener)
- » Filler (Silica sand)
- » Chemical Additives and Accelerators
- » Surface Mats



1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
	6.1 Raw Material Quality Criteria
	6.2 Finished Good Quality Criteria
	6.3 Physical Properties
	6.4 Long Term Performance Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

6.2 Finished Good Quality Criteria (GRP pipe)

All finished goods (GRP Pipes) are subjected to following control steps:

- » Visual Inspection
- » Barcol Hardness
(Barcol: Surface Hardness Unit used for generally GRP composites)
- » Wall Thickness
- » Length Measurement
- » Diameter Measurement
- » Hydrostatic Leak Tightness Test (Two times of nominal pressure)

On a sampling basis, following control steps are performed:

- » Pipe Stiffness
- » Inner surface control under the deflection load.
- » Structural failure control under the deflection load.
- » Composite Structure Analysis and Design Verification
- » Hoop (Circumferential) Tensile Strength
- » Axial (Longitudinal) Tensile Strength
- » Organoleptic Tests For Potable Water Pipes

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
	6.1 Raw Material Quality Criteria
	6.2 Finished Good Quality Criteria
	6.3 Physical Properties
	6.4 Long Term Performance Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

6.3 Physical Properties

Control steps based on sampling method define initial physical properties of pipes. Long term performances of the pipes are considered at following articles. These test are performed according to defined Faratec quality criteria. This criteria is determined by referring upper limits of local and international standards. Test results are the main parameters to get the quality in assurance for finished good pipes.

6.4 Long Term Performance Criteria

General requirement of whole standards is to obtain minimum performance criteria. In GRP pipe systems, long term performance is the main quality criteria beyond short term or initial performance. All quality criteria of Faratec are designed including long term performance.

Product design is usually based on the projected values of strength of materials for a period of 50 years. Over the years we collected a lot of results, based on ASTM test methods. Analysis of these data, it was found that standardized methods are quite conservative and that safety limits are shown to be higher than expected and can be achieved extrapolation to 150 years. GRP pipes made Faratec technologies that meet the requirements of some institutions, requiring a lifetime of more than 100 years. More important tests are given below.

- » Long Term Specific Ring Stiffness
- » Long Term Ring Bending Strain
- » Hydrostatic Design Basis (HDB)
- » Long Term Strain Corrosion

In addition to main performance criteris, Alkaþboru GRP pipes are tested for:

- » Ultraviolet (UV) Resistance
- » Abrasion Resistance
- » Flow Velocity
- » Resistance to Different Operating Temperature
- » By considering several operating conditions

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
	7.1 Diameter Class
	7.2 Pressure Class
	7.3 Stiffness Class
	7.4 Pipe Length
	7.5 Flow Velocity
	7.6 Poisson's Ratio
	7.7 Resistance to UV Radiation
	7.8 Load Capacity (Strength) Values
	7.9 Temperature Consideration
	7.10 Thermal Expansion
	7.11 Flow Coefficients
	7.12 Hydraulic Properties
	7.13 Abrassion Resistance
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

7 Product Information

7.1. Diameter Class

Fiberglass pipeline technologized by Faratec can be produced between 100 – 4000 mm diameter.

Standard diameters are given below (in mm)

Multi-Nandrel system				AdvancingContinous System					
100	150	200	250	300	350	400	450	500	600
				700	800	900	1000	1100	1200
				1400	1600	1800	2000	2200	2400
				2600	2800	3000	3200	3400	3600
				3800	4000				

According to customer request, other diameter can be produced between 100 - 4000 mm diameter.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
	7.1 Diameter Class
	7.2 Pressure Class
	7.3 Stiffness Class
	7.4 Pipe Length
	7.5 Flow Velocity
	7.6 Poisson's Ratio
	7.7 Resistance to UV Radiation
	7.8 Load Capacity (Strength) Values
	7.9 Temperature Consideration
	7.10 Thermal Expansion
	7.11 Flow Coefficients
	7.12 Hydraulic Properties
	7.13 Abrassion Resistance
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

7.2 Pressure Class

Toralit GRP pipes have standard pressure class range as shown below. Other pressure classes can be provided if necessary.

Pressure class (bar)	32	25	20	16	15	12	10	9	6
Diameter upper limit (mm)	1400	1400	1400	3000	3000	3000	4000	4000	4000

Pressure ratings of GRP pipes have been established in accordance with design approach outlined in AWWA M45 Fiberglass Pipe Design Manual. Pipes are pressure-rated at full operating pressure even buried to the maximum depth recommended.

To ensure the long service life for which our pipes are designed, following capabilities should be noted and observed in service.

7.2.1. Hydrostatic Test Pressure

Maximun Plant Test Pressure (AWWA C950, ASTM D 3571)	2,0 x PN (Nominal Pressure)
Maximum Field Test Pressure	1,5 x PN (Nominal Pressure)

For field test, other structures at pipeline must be designed to handle test pressure above PN.

7.2.2. Surge

Maximum Pressure	1,4 x PN (Nominal Pressure)
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1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
7.1	Diameter Class
7.2	Pressure Class
7.3	Stiffness Class
7.4	Pipe Length
7.5	Flow Velocity
7.6	Poisson's Ratio
7.7	Resistance to UV Radiation
7.8	Load Capacity (Strength) Values
7.9	Temperature Consideration
7.10	Thermal Expansion
7.11	Flow Coefficients
7.12	Hydraulic Properties
7.13	Abrasion Resistance
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

7.3 Pipe Stiffness

Definitions of GRP pipes' stiffness classes are provided in ISO and AWWA standards based on same principle with different coefficients. Mostly used definition is "initial specific ring 3 2 stiffness" included in ISO standard based on the formula EI/D , in N/m (Pa).

Stiffness class is selected according to two parameters. These are: (1) burial conditions which include native soil, type of backfill and cover depth and (2) negative pressure. The native soil characteristics are rated according to ASTM 1586 standard penetration test.

Toralit GRP pipes are produced based on following Standard stiffness classes.

Reference	Unit	Nominal Pipe Stiffness (SN)			
ISO	Pa	1250	2500	5000	10000
AWWA	kPa	62	124	248	496

Accordance with customer requests, Toralit GRP pipes can be produced more than 10.000 Pa and intermediate stiffness values.



1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
7.1	Diameter Class
7.2	Pressure Class
7.3	Stiffness Class
7.4	Pipe Length
7.5	Flow Velocity
7.6	Poisson's Ratio
7.7	Resistance to UV Radiation
7.8	Load Capacity (Strength) Values
7.9	Temperature Consideration
7.10	Thermal Expansion
7.11	Flow Coefficients
7.12	Hydraulic Properties
7.13	Abrasion Resistance
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

7.4 Pipe Length

Standard length of Toralit pipes is 12 for diameters over 300 mm. Smaller diameters are available in 6 meters Standard length. Toralit GRP pipes can be produced in the range of 0.30 - 18 m length for diameters over 300 mm.

7.5 Flow Velocity

Maximum recommended flow velocity is 3.0 m/sec. Velocities up to 5.0 m/sec can be used if water is clean and does not contain any abrasive material.

7.6 Poisson's Ratio

Poisson's ratio is influenced by pipe construction. For Alkabboru GRP pipes, ratio for hoop (circumferential) loads and axial response ranges from 0.22 to 0.29. For axial loading and circumferential response Poisson's ratio will be slightly less.

7.7 Resistance to Ultraviolet (UV) Radiation

Sunlight is the main ultraviolet radiation. Tests and researches done by Faratec Technology Center which is the technology provider of CPS distribution absolutely show that ultraviolet degradation is not considerable issue for long-term service life of GRP pipes produced by using Faratec Pipe Technology Know-How. Technologic background of Faratec Pipe Technology is fully capable to do custom designs where the customers request extra safety factors.



1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
7.1	Diameter Class
7.2	Pressure Class
7.3	Stiffness Class
7.4	Pipe Length
7.5	Flow Velocity
7.6	Poisson's Ratio
7.7	Resistance to UV Radiation
7.8	Load Capacity (Strength) Values
7.9	Temperature Consideration
7.10	Thermal Expansion
7.11	Flow Coefficients
7.12	Hydraulic Properties
7.13	Abrassion Resistance
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

7.8 Load Capacity (strength) Value

For design purposes the following values can be used for hoop tensile and axial tensile load capacity.

Hoop (Circumferential) Load Capacity (Strength), in N/mm of Circumference										
DN	PN6	PN10	PN16	PN20	PN25	PN32	DN	PN6	PN10	PN16
300	749	875	1207	1431	1730	2085	1700	2396	3752	5745
350	771	987	1372	1643	1942	2410	1800	3532	3954	6060
400	787	1048	1485	1823	2111	2603	1900	2679	4165	6413
450	809	1148	1643	1980	2351	2899	2000	2809	4399	6734
500	833	1260	1800	2169	3220	3228	2100	2945	4607	7068
600	914	1426	2130	2595	3099	3807	2200	3081	4821	7395
700	1049	1584	2458	2981	3590	4432	2300	3217	5047	7703
800	1185	1796	2812	3407	4095	5037	2400	3353	5273	8037
900	1316	2024	3113	3793	4567	5669	2500	3506	5468	8358
1000	1439	2255	3465	4218	5072	6254	2600	3645	5670	8640
1100	1562	2451	3767	4606	5564	6872	2700	3735	5895	9000
1200	1711	2677	4101	5029	6042	7478	2800	3915	6120	9360
1300	1841	2878	4455	5415	6554	8103	2900	4050	6300	9720
1400	1983	3092	4757	5801	7032	8701	3000	4185	6525	9900
1500	2143	3330	5078							
1600	2268	3520	5418							

Axial (Longitudinal) Load Capacity (Strength), in N/mm of Length										
DN	PN6	PN10	PN16	PN20	PN25	PN32	DN	PN6	PN10	PN16
300	156	163	187	207	228	262	1700	461	527	652
350	165	176	203	224	251	293	1800	483	553	685
400	171	185	215	236	267	311	1900	506	580	718
450	180	198	238	255	290	338	2000	528	605	753
500	189	211	258	274	313	368	2100	551	631	758
600	210	237	283	312	362	424	2200	573	667	820
700	232	263	318	350	408	482	2300	596	683	854
800	256	292	350	390	454	539	2400	618	711	887
900	278	317	384	428	502	599	2500	642	735	921
1000	300	343	418	466	546	653	2600	666	765	945
1100	322	369	451	504	593	712	2700	684	788	990
1200	345	396	484	543	641	769	2800	711	810	1017
1300	368	422	518	581	688	826	2900	729	842	1053
1400	382	448	619	619	734	883	3000	756	855	1080
1500	414	475	585							
1600	437	500	618							

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
7.1	Diameter Class
7.2	Pressure Class
7.3	Stiffness Class
7.4	Pipe Length
7.5	Flow Velocity
7.6	Poisson's Ratio
7.7	Resistance to UV Radiation
7.8	Load Capacity (Strength) Values
7.9	Temperature Consideration
7.10	Thermal Expansion
7.11	Flow Coefficients
7.12	Hydraulic Properties
7.13	Abrassion Resistance
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

7.9 Temperature Consideration

Maximum permitted temperature of fluent without pressure derating is 45 °C. Faratec Technology Center recommends that pressure rating should be dropped one class where operating temperatures are set between from 46 °C upto 60 °C (For example, a PN16 pipe with pressure rating of 16 bar would be used as a PN 10 rated product). Temperature resistance of GRP pipes can increase upto 100 °C by using appropriate types of resins.

7.10 Thermal Expansion

Thermal coefficient of axial expansion and contraction for Toralit GRP pipes technologized by Faratec is 24 – 30.10⁻⁶ 1/K.



1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
7.1	Diameter Class
7.2	Pressure Class
7.3	Stiffness Class
7.4	Pipe Length
7.5	Flow Velocity
7.6	Poisson's Ratio
7.7	Resistance to UV Radiation
7.8	Load Capacity (Strength) Values
7.9	Temperature Consideration
7.10	Thermal Expansion
7.11	Flow Coefficients
7.12	Hydraulic Properties
7.13	Abrasion Resistance
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

7.11 Flow Coefficients

Based on tests carried out over a 3 years period on GRP pipes technologized by Faratec, Colebrook White Coefficient can be taken as 0.029. This corresponds to a Hazen Williams Flow Coefficient approximately $C = 150 - 165$ and a Mannings Roughness Coefficient of $n=0.009$ and a Surface Roughness Number of 0.00518 in Darcy-Weisbach Equation.

To assist designer with estimating head loss associated using GRP pipes technologized by Faratec, some charts have been provided. When using these charts to estimate the head loss for pipes not specifically noted on the charts (due to slight inside diameter variances), the error will be less than 7 % for flow velocities between 1 - 3 m / sec.

For more information, please contact CPS distribution Product Engineering Department.

7.12 Hydraulic Properties

Due to special flow coefficients, GRP pipes have some specific characteristics:

Extremely smooth internal surface of GRP pipes decrease flow resistance and therefore required energy and cost of pumping are reduced.

Due to corrosion resistance of GRP pipes, pipe quality doesn't differ throughout time. Unlike concrete and steel pipes, flow coefficients of GRP pipes don't change during their service life.

For a specific discharge, a smaller diameter pipe can be chosen in comparison with other type of pipes.

Example:

We will see that instead of using 2000 mm steel pipe, we can transfer same amount of fluid at a same head-loss through a 1800 mm GRP pipe.

$$\text{Hazen Williams Equation: } HF = \frac{10.68 \times Q^{1.852} \times L}{C^{1.852} \times D^{4.87}}$$

HF – head loss in meter water
 Q – discharge in m³
 L – pipeline length
 C – roughness coefficient
 D – pipe diameter in m

HF (steel)=HF(GRP)
 Q (steel)=Q(GRP)
 L (steel)=L(GRP)
 C (steel)=110
 D (steel)= 2000 mm

$C (GRP)=150$

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
7.1	Diameter Class
7.2	Pressure Class
7.3	Stiffness Class
7.4	Pipe Length
7.5	Flow Velocity
7.6	Poisson's Ratio
7.7	Resistance to UV Radiation
7.8	Load Capacity (Strength) Values
7.9	Temperature Consideration
7.10	Thermal Expansion
7.11	Flow Coefficients
7.12	Hydraulic Properties
7.13	Abrasion Resistance
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

7.13 Abrasion Resistance

Abrasion resistance is related with effects of sand or similar granular materials which there are possibly interior surface of the pipe. Although there is no widely-used Standard test procedure or ranking method, GRP pipes technologized by Faratec has been evaluated by using Darmstadt Rocker Method that is mostly known in sector.

Using gravel, average abrasion loss of GRP pipes technologized by Faratec is 0.34 mm /100.000 cycles. Results can be varied depending on type of abrasive material used in test.



1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

8 Joints Angular Deflection

Coupling joints are extensively tested and qualified in accordance with ASTM D4161 and ISO 8639. Maximum angular deflection for each coupling joint measured as change in adjacent pipe center lines must not exceed the values given in table below.

Pipes must be joined in straight alignment but not all the way to home line and thereafter deflected angularly as required.

Nominal Pipe Diameter	Nom.Angle Deflection	Nominal Offset (mm)			Nom.Radius of Curvature (m)		
		Pipe Length			Pipe Length		
		(mm)	(Deg)	3(m)	6(m)	12(m)	3(m)
DN≤500	3	157	314	628	57	115	229
500<DN≤900	2	107	209	419	86	172	344
900<DN<1800	1	52	105	209	172	344	688
DN<1800	0,5	26	52	78	344	688	1376

When Toralit GRP pipe system will be operated at pressures exceeding 16 bar, allowable angular joint deflection should be reduced to levels noted in following table.

Nominal Pipe Diameter (mm)	Nominal Angle of Deflection (Deg)		
	20 bar	25 bar	32 bar
DN≤500	2,5	2,0	1,5
500<DN≤900	1,5	1,3	1,0
900<DN<1800	0,8	0,5	0,5

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection

9	Pipes Clasification
9.1 Definition of stiffness class	
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

9 Pipe Classification

Selection of Toralit GRP pipes is based on stiffness and pressure class requirements.

9.1 Definition of Stiffness Class

Stiffness of Toralit GRP pipes is selected from one of three stiffness classes listed 3 2 below. Stiffness class represents pipe's minimum initial specific stiffness as EI/D^3 v N/m².

	ISO	ASTM
SN	N/m ²	kN/m ²
2500	2500	124
5000	5000	248
10000	10000	496



1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
9.1 Definition of stiffness class	
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

Stiffness is defined according to two parameters. These are: (1) burial conditions, which include native soil, type of backfill and cover depth and (2) negative pressure, if it exist. Native soil characteristics are rated according to ASTM D1586 standard penetration test. Some typical soil blow count values relative to soil types and density are given following table.

Native soil Group	Bloé Counts	E Value (MPa)	Non-Cohesive Soils		Cohesive Soils	
			Description	Friction Angle (Degrees)	Description	Com. Strength (kPa)
1	>15	34,5	Compact	33	Very Stiff	>200
2	8 - 15	20,7	Slightly Compact	30	Stiff	100-200
3	4 - 8	10,3	Loose	29	Medium	50-100
4	2 - 4	4,8	Very Loose	28	Soft	25-50
5	1 - 2	1,4	Very Loose	24	Very Soft	13-25
6	0 - 1	0,34	Very Very Loose	26	Very Very Soft	0-12

A wide range of backfill soil types are offered in tables to allow each installation to be customized providing the most economical installation. In many instances, native trench soils can be used as pipe zone backfill. Maximum allowable cover depths for threee different stiffness classes in six native soils groups are illustrated in following table – assuming standard trench construction,an allowable long term deflection 5 % (DN 300 - 4000 mm) 4 % (DN 100 - 250 mm),with consideration of traffic loads.

Native Soil Group	SN 2500						SN 5000						SN 10000					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Backfill Soil Modulus (MPa)																		
20,7	23,0	18,0	11,0	7,0	-	-	23,0	18,0	12,0	7,0	3,0	-	23,0	18,0	11,0	7,0	-	-
13,8	18,0	15,0	10,0	6,0	-	-	18,0	15,0	10,0	6,5	2,4	-	18,0	15,0	10,0	6,0	-	-
10,3	15,0	13,0	9,0	5,5	-	-	15,0	13,0	9,0	6,0	2,4	-	15,0	13,0	9,0	5,5	-	-
6,9	11,0	10,0	7,5	5,0	-	-	11,0	10,0	8,0	5,0	-	-	11,0	10,0	7,5	5,0	-	-
4,8	8,5	7,5	6,0	4,0	-	-	8,5	7,5	6,5	4,5	-	-	8,5	7,5	6,0	4,0	-	-
3,4	6,0	5,5	5,0	3,5	-	-	6,0	6,0	5,0	4,0	-	-	6,0	5,5	5,0	3,5	-	-
2,1	3,5	3,5	3,5	-	-	-	4,0	4,0	3,5	3,2	-	-	3,5	3,5	3,5	-	-	-
1,4	-	-	-	-	-	-	2,4	2,4	2,2	-	-	-	-	-	-	-	-	-

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
9.1 Definition of stiffness class	
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

The second parameter for pipe stiffness class selection is negative pressure. If it exists, following tables show which stiffness to select for various amounts of negative pressure and burial depths for average native and backfill soil conditions. Stiffness selected should be higher than determined value to suit negative pressure and burial conditions.

Native Soil Group 3 ($E'n=10,3 \text{ MPa}$) Backfill Type C at 90% SPD ($E'b=14 \text{ MPa}$) Water Table Below Pipe Standard Trench Installation				For Saturated Soil Condition			
Vac (bar)	SN 2500	SN 5000	SN 10000	Vac (bar)	SN 2500	SN 5000	SN 10000
-0,25	10	10,0	11,0	-0,25	5,5	5,5	6,0
-0,50	8,5	10,0	11,0	-0,5	1,4	5,5	6,0
-0,75	6,5	10,0	11,0	-0,75	1,8	5,5	6,0
-1,00	4,0	10,0	11,0	-1,0	-	4,0	6,0



1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
	10.1 Installation Types
10.2	Trenching
10.3	Bedding
10.4	Backfill Material
10.5	Standards Trench Details
10.6	Checking Installed Pipes
10.7	Initial Deflection
10.8	Traffic loads
10.9	High Pressure Installation
10.10	High Water Table
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

10 Installation of Buried Pipes

Long life and good performance of Toralit GRP pipes can only be achieved by proper handling and installation of the pipes. For owners, engineers and contractors, it's important that GRP pipes can be obtained excellent performance when recommended installation procedures are applied by using suitable bedding and pipe backfill support. Engineers have found through considerable experience that compacted granular materials are ideal for backfilling GRP pipes. Together pipe and embedment material form a high performance pipe-soil system. For complete installation instructions, consult Toralit Installation Guide and CPS distribution Field Engineering Department.

10.1 Installation Types

Following illustrations show two Standard installation types commonly used with GRP pipes.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
	10.1 Installation Types
10.2	Trenching
10.3	Bedding
10.4	Backfill Material
10.5	Standards Trench Details
10.6	Checking Installed Pipes
10.7	Initial Deflection
10.8	Traffic loads
10.9	High Pressure Installation
10.10	High Water Table
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

10.1.1 Installation Type 1

- » Carefully constructed bed
- » Backfill pipe zone to 300 mm over pipe crown with specified backfill material compacted to required relative compaction level.

Note: For non-pressure applications, requirement to compact 300 mm over pipe crown is not applied.

10.1.2 Installation Type 2

- » Backfill to a level of 60 % pipe diameter with specified backfill material compacted to required relative compaction level.
- » Backfill from 60 % of diameter to 300 mm over pipe crown with a relative compaction necessary to achieve a minimum soil modulus of 1.4 MPa.

Note 1: Installation type 2 is not applicable to small diameters.

Note 2: Installation type 2 is not suitable for high traffic load conditions.

Alternative installations to accommodate a specific field condition include wider trenches, sheet piles, soil stabilization, geotextiles etc. CPS distribution installation instructions for buried pipe should be consulted for additional details.

Toralit GRP pipes can be installed in a number of different situations including aboveground, sub-aqueous, trenchless and sloped applications. These applications can require more initial planning and more care than standard buried pipe installation.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
10.1	Installation Types
10.2	Trenching
10.3	Bedding
10.4	Backfill Material
10.5	Standards Trench Details
10.6	Checking Installed Pipes
10.7	Initial Deflection
10.8	Traffic loads
10.9	High Pressure Installation
10.10	High Water Table
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

10.2 Trenching

Details of a Standard trench installation are shown on Page 27.

Trench must always be wide enough to permit placement and compaction of pipe zone backfill materials and provide proper pipe support. Depths of cover charts presented in this brochure are based on an assumed trench width 1.75 times the pipe's nominal diameter. Widths down to 1.5 times DN may be achievable, however burial limits will be affected.

10.3 Bedding

Trench bed, of suitable material, should provide uniform and continuous support for pipe

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
10.1	Installation Types
10.2	Trenching
10.3	Bedding
10.4	Backfill Material
10.5	Standards Trench Details
10.6	Checking Installed Pipes
10.7	Initial Deflection
10.8	Traffic loads
10.9	High Pressure Installation
10.10	High Water Table
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

10.4 Backfill Material

To ensure a satisfactory pipe-soil system, correct backfill material must be used. Most coarse grained soils (as classified by Unified Soils Classification System) are acceptable bedding and pipe zone backfill material. Where the instructions permit the use native soil as backfill, care organic material. Following table identifies acceptable backfill soils:

Soil Groups	Fractin	Symbol	Grain Size (mm)
Very coarse-grained	large boulder	LBo	> 630
	boulder	Bo	> 200 ≤ 630
	cobble	Co	> 63 ≤ 200
Coarse-grained	GRAVEL	Gr	> 2,0 ≤ 63
	coarse-grained gravel	CGr	> 20 ≤ 63
	medium-grained gravel	MGr	> 6,3 ≤ 20
	fine-grained gravel	FGr	> 2,0 ≤ 6,3
	SAND	Sa	> 0,063 ≤ 2,0
	coarse-grained sand	CSa	> 0,63 ≤ 2,0
	medium-grained sand	MSa	> 0,2 ≤ 0,63
Close grained	fine-grained sand	FSa	> 0,063 ≤ 0,2
	DUST	Si	> 0,002 ≤ 0,063
	coarse-grained dust	CSi	> 0,02 ≤ 0,063
	medium-grained dust	MSi	> 0,0063 ≤ 0,02
	fine-grained dust	FSi	> 0,002 ≤ 0,0063
	clay	Cl	< 0,002

10.5 Standard Trench Detail

A typical trench detail for GRP pipe canbe as following figure:

Dimension Ais a minimum 0,75 x (DN/2).

Where rock, hard pan, soft, loose, unstable or highly expansive soils are encountered in trench bottom, it may be necessary to increase depth of bedding layer to achieve adequate longitudinal support.

Dimension A must allow for adequate space to operate compaction equipment and ensure proper placement of backfill in haunch region. This may require a wide trench than minimum specified above (Particularly for smaller diameters).

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
10.1	Installation Types
10.2	Trenching
10.3	Bedding
10.4	Backfill Materiall
10.5	Standards Trench Details
10.6	Checking Installed Pipes
10.7	Initial Deflection
10.8	Traffic loads
10.9	High Pressure Installation
10.10	High Water Table
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

10.6. Checking Installed pipes

After installation of each pipe, maximum diametrical vertical deflection must be checked. For Toralit GRP pipes, this procedure is fast and easy.

10.7 Initial Deflection

Maximum allowable initial diametrical deflection (typically vertical) shall be as follows:

Maximum Initial Deformation	
DN ≤ 250	DN ≥ 300
2,5 %	3 %

Maximum allowable long-term diametrical deflection shall be 5 % for diameters 300 mm and larger and 4 % for smaller diameters. These values will apply to all stiffness classes. Bulges, flat areas or other abrupt changes of pipe wall curvature are not permitted. Pipe installed outside of these limitations may not perform as intended.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
10.1	Installation Types
10.2	Trenching
10.3	Bedding
10.4	Backfill Materiall
10.5	Standards Trench Details
10.6	Checking Installed Pipes
10.7	Initial Deflection
10.8	Traffic loads
10.9	High Pressure Installation
10.10	High Water Table
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

10.8 Traffic loads

All backfill to grade should be compacted when continuous traffic loads are present. Minimum cover restrictions may be reduced with special installations such as concrete encasement, concrete cover slabs, casing etc.

Traffic (wheel) Load			
Maximum Burial Depth	Foce (lbs)	Force (kN)	Load Type
1,0	16 000	72	AASHTO H20(C)
1,5	20 000	90	BS 153HA(C)
1,0	9 000	40	ATV LKW12(C)
1,0	11 000	50	ATV SLW(C)
1,5	22 000	100	ATV SLW 60(C)
3,0	railroad	-	Cooper E80

Based a minimum pipe zone backfill soil modulus 6.9 MPa

10.9 High Pressure Installation

High pressure more than 16 bar may require deeper burial depth to prevent uplift and movement. Pipes - DN 300 and larger - should have a minimum burial depth of 1.2 meters, and 0.8 meters for smaller diameters.

10.10 High Water Table

A minimum of 0.75 diameter of earth cover (minimum dry soil bulk density of 1900 kg/m³) is required to prevent an empty submerged pipe from floating. Alternatively, the installation may proceed by anchoring pipes. If anchoring is proposed, restraining straps must be a flat material minimum 25 mm wide, placed at maximum 4 meter intervals. Please advise Alkaþboru for details on anchoring and minimum cover depth with anchors.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes

11 Biaxial Pipes (Special Application Pipes)

11.1 Physical Properties

Raw materials, production techniques and properties of biaxial pipes could be different from underground pipes based on pipe applications. Biaxial pipes are made to resist forces in axial direction as well as circumferential direction. Therefore they are much stronger than pipes for underground purposes. Some physical characteristics of these pipes are mentioned below.

Biaxial pipes can be connected with eachother by using adhesive bonded couplings, by using restrained couplings or by butt-wrap joints. Biaxial pipes are generally preferred for aboveground applications.

11 Biaxial Pipes (Special Application)

11.1 Physical propertie

11.2 Stress Analysis Consideration

11.3 Supports

12 Pipe Dimensions

13 Pipe Joining Method

14 Fittings

15 Surge and Water Hammer

Circumferential	Axial	Butt-Wrap Joints		Mechanical Properties GRP Pipes Toralit
		Circumfer.	Axial	
20,0	13,1	-	10,3	Tensile Modulus E_T (GPa)
18,6	12	-	10,3	Flexural Modulus E_F (GPa)
380	158	-	138	Ultimate Tensile Stress σ (MPa)
0,2	0,25	-	0,3	Poisson's Ratio μ
9,0	12,6	-	27	Thermal Linear Coefficienent α ($\times 10^{-6}$ 1/K)
3,3	3,3	-	3,1	Shear Modulus G (GPa)
46,9	19,6	-	138	Ultimate Shear Stress T_{ULT} (MPa)
62,0	26,4	23	23	Tensile Allowable Stress (MPa)
62,0	26,4	23	23	Flexural Allowable Stress (MPa)
7,8	7,8	5,7	5,7	Shear Allowable Stress (MPa)

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes

11 Biaxial Pipes (Special Application)

11.1 Physical propertie

11.2 Stress Analysis Consideration

11.3 Supports

12 Pipe Dimensions

13 Pipe Joining Method

14 Fittings

15 Surge and Water Hammer

11.2 Stress Analysis Considerations

In most of aboveground biaxial pipe installations, joints are welded together to resist tensile forces acting on each pipe due to internal pressure. In these cases, thermal stresses are more effective than stresses related to weight and pressure. Thermal expansion coefficient of GRP pipes is nearly two times of steel pipes. But modulus of elasticity of GRP is less than steel. Thus, thermal load would be reduced. For compensating thermal expansion, Usage of expansion joints or expansion loops may be necessary.

11.3 Supports

Aboveground biaxial GRP pipes have their special supports. Spacing between supports can be calculated by flexibility analysis. Here, shape of typical support is presented.



1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
15	Surge and Water Hammer

12 Pipe Dimensions

Different dimensions of widerange of Toralit GRP pipes are shown in mm at following tables.

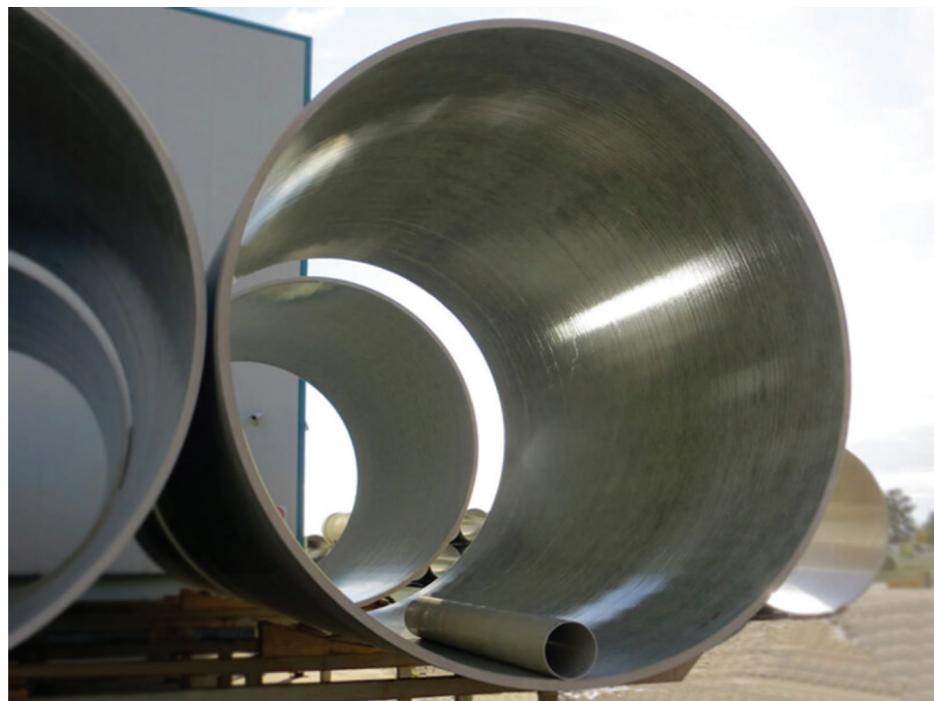


SN 5 000															
DN	DE max	e (mm)					m kg/m	DN	DE max	e (mm)					m kg/m
		PN6	PN10	PN16	PN20	PN25				PN6	PN10	PN16	PN20	PN25	
300	311	5,1	5,1	4,8	4,7	4,7	9,9	1600	1637	24,3	22,7	20,7	-	-	270
350	362	5,9	5,8	5,4	5,4	5,4	14,4	1700	1739	25,8	24,1	22	-	-	305
400	413	6,6	6,2	5,8	5,8	5,8	17,3	1800	1841	27,3	25,4	23,2	-	-	341
450	4464	7,3	6,9	6,5	6,4	6,4	22,1	1900	1943	28,7	26,8	24,4	-	-	374
500	515	8,1	7,6	7,1	7	7	27,5	2000	2045	30,1	28,2	25,6	-	-	420
600	617	9,6	8,9	8,4	8,2	8,2	39,5	2100	2147	31,6	29,5	26,9	-	-	462
700	719	11,1	10,3	9,6	9,3	9,3	53	2200	2249	33,1	32,3	28,1	-	-	507
800	820	12,5	11,6	10,9	10,5	10,5	69	2300	2351	34,5	32,9	29,3	-	-	553
900	923	14	13,2	12,1	11,8	11,8	87	2400	2453	36	33,7	30,6	-	-	602
1000	1025	15,4	14,5	13,3	12,9	12,9	106	2500	2555	37,5	35	31,8	-	-	654
1100	1127	16,9	15,9	14,6	14,2	14,2	129	2600	2657	-	36,5	33	-	-	700
1200	1229	18,3	17,3	15,8	15,3	15,3	152	2700	2759	-	38	34,5	-	-	765
1300	1331	19,9	18,6	17	16,5	16,5	179	2800	2861	-	39	35,5	-	-	830
1400	1433	21,4	20	18,3	17,8	17,8	207	2900	2963	-	40,5	37	-	-	870
1500	1535	22,9	21,3	19,5	-	-	238	3000	3065	-	42	,8	-	-	940

SN 2 500													
DN	DE max	e (mm)				m kg/m	DN	DE max	e (mm)				m kg/m
		PN6	PN10	PN16	PN20				PN6	PN10	PN19	PN20	
300	311	4,1	3,9	3,8	3,8	8	1600	1637	19,4	17,3	16,3	-	216
350	362	4,7	4,6	4,4	4,4	11	1700	1739	20,8	18,3	17,2	-	245
400	413	5,1	4,9	4,7	4,8	14	1800	1841	21,9	19,3	18,2	-	274
450	4464	5,8	5,4	5,3	5,2	17	1900	1943	23,0	20,3	19,1	-	304
500	515	6,4	5,9	5,8	5,7	22	2000	2045	24,2	21,4	20,1	-	337
600	617	7,8	7	6,7	6,7	31	2100	2147	25,4	22,4	21	-	271
700	719	8,9	8	7,7	7,6	42	2200	2249	26,5	23,4	22	-	407
800	820	10,1	9,1	8,6	8,6	55	2300	2351	27,7	24,4	22,9	-	444
900	923	11,3	10,1	9,6	9,5	66	2400	2453	28,9	25,4	23,9	-	483
1000	1025	12,5	11,1	10,5	10,5	86	2500	2555	30,0	26,5	24,9	-	523
1100	1127	13,7	12,2	11,5	11,4	104	2600	2657	31,2	27,5	25,9	-	565
1200	1229	14,8	13,3	12,5	12,3	122	2700	2759	32,5	28,5	26,8	-	610
1300	1331	16	14,2	13,4	13,3	144	2800	2861	33,7	29,5	27,6	-	660
1400	1433	17,1	15,2	14,4	14,2	166	2900	2963	35	30,5	28,6	-	700
1500	1535	18,2	16,2	15,3	-	190	3000	3065	36	31,7	29,7	-	750

SN 10 000																
DN	DE max	e (mm)						m kg/m	DN	DE max	e (mm)					m kg/m
		PN6	PN10	PN16	PN20	PN25	PN32				PN6	PN10	PN16	PN20		
300	311	6,2	6,2	6	5,8	5,7	5,7	12	1600	1637	30,3	30,3	27	-	-	337
350	362	7,2	7,2	6,8	6,7	6,6	6,5	17,5	1700	1739	32,1	32,1	28,6	-	-	379
400	413	7,8	7,8	7,4	7,2	7,1	7	21	1800	1841	34	34	30,3	-	-	425
450	4464	8,8	8,8	8,2	8	7,9	7,8	27	1900	1943	35,8	35,8	31,9	-	-	473
500	515	9,8	9,8	9	8,8	8,6	8,5	33	2000	2045	37,6	37,6	33,5	-	-	52

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
13.1	GRP Couplings
13.2	GRP Adhesive Bonded Couplings
13.3	GRP Flanges
13.4	Lay-up Joining
13.5	Special Couplings
14	Fittings
15	Surge and Water Hammer



13 Pipe Joining Methods

13.1. GRP Couplings

GRP pipes are typically joined by using GRP double-bell couplings. Pipes are standardly delivered on construction site with one-end couplings mounted, but couplings can be delivered to site separately. Elastomeric gaskets are used on GRP couplings for sealing. Gaskets are placed in precision-machined grooves in each end of the coupling. Gaskets have proven life more 75 years.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
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9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
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DN	DE Max (mm)	Coupling ID min. (mm)	DEC (mm)					CL (mm)
			PN6	PN10	PN16	PN20	PN25	
100	107,2	107,6	127,6	127,6	129,6	134,7	134,9	140,1
150	157,8	157,7	178,2	178,2	180,2	185,5	185,7	191,3
200	210	211,4	241,8	241,8	245,4	249,9	253,1	258,7
250	262,2	263,6	294	294	297,6	303,1	306,3	312,1
300	311	312,5	367,1	368,7	370,3	372,4	376,7	383,5
350	362	363,5	420,3	421,9	423,7	424,6	429,7	464,9
400	413	414,5	454,1	456,1	458,1	462,4	463,7	468,7
450	4464	465,5	504,9	506,5	508,7	513,0	513,9	519,3
500	515	516,5	555,7	557,7	559,3	563,4	564,3	571,1
600	617	618,5	664,1	665,9	668,1	673,2	675,9	683,7
700	719	720,5	765,9	768,3	772,5	778,2	781,1	792,1
800	820	822,5	867,7	871,6	876,7	882,8	883,7	896,9
900	923	924,5	970,7	975,1	980,9	984,8	988,7	1001,7
1000	1025	1026,5	1073,5	1078,5	1084,7	1089,2	1098,1	1106,5
1100	1127	1128,5	1176,3	1181,5	1188,3	1193,4	1208	1211,7
1200	1229	1230,5	1278,9	1284,5	1289,9	1299,4	1315,3	1316,7
1300	1331	1332,5	1381,3	1378,3	1393,3	1407,4	1421,1	1422,1
1400	1433	1434,5	1483,9	1490,1	1497,5	1515,6	1527,1	1527,1
1500	1535	1536,5	1586,3	1592,9	1602,5	1621,2	-	-
1600	1637	1638,5	1688,7	1695,5	1707,3	-	-	-
1700	1739	1740,5	1791,1	1798,3	1743,7	-	-	-
1800	1841	1842,5	1893,5	1900,9	1845,7	-	-	-
1900	1943	1944,5	1995,9	2003,3	1947,7	-	-	-
2000	2045	2046,5	2098,3	2105,9	2049,7	-	-	-
2100	2147	2148,5	2200,5	2208,9	2151,7	-	-	-
2200	2249	2250,5	2302,9	2311,9	2253,7	-	-	-
2300	2351	2352,5	2405,3	2417,7	2355,7	-	-	-
2400	2453	2454,5	2507,5	2517,9	2457,7	-	-	-
2500	2555	2556,5	2559,7	2259,7	2559,7	-	-	-
2600	2657	2658,5	2690	2695	2701	-	-	-
2700	2759	2760,5	2792,5	2797,8	2803,2	-	-	-
2800	2861	2862,5	2895	2900	2906,5	-	-	-
2900	2963	2964,5	2997,5	3002,2	3009,3	-	-	-
3000	3065	3066,5	3099,5	3104,4	3111,2	-	-	-

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3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
13.1	GRP Couplings
13.2	GRP Adhesive Bonded Couplings
13.3	GRP Flanges
13.4	Lay-up Joining
13.5	Special Couplings
14	Fittings
15	Surge and Water Hammer

13.2. GRP Adhesive Bonded Couplings

Restrained coupling made from GRP material is used to join pipes where is needed to resist axial thrust forces. In this coupling type, sealing is performed by two gaskets and epoxy adhesive glue for each pipe end. Adhesively bonded area by using epoxy glue between pipe and coupling obtains very strong joint which will be fully resisted against pipeline tensile forces.

13.3 GRP Flanges

In special cases, the tubes can be connected GRP flanges. The connection pipe flanges is possible for diameters from DN 150 to DN 2400, for pressure ranges from PN1 to PN16 This type of connection pipe is used when installing shut-off valves, gate valves, inspection openings, additional branch etc. The tightness of joints between the flanges ensures the gasket and sealing ring. Drilling of flanges is according to DIN or ASA.

13.4 Lay-up Joining

This joint is made from glass fiber reinforcements and polyester resin. It is typically used in situations where pipe joint is required to transmit axial forces from internal pressure or as a repair method. The length and thickness of lay-up depends on diameter and pressure. This type of joint requires clean, controlled conditions and skilled trained staff.CPS distribution can provides special instructions when this type of joint is required.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
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15	Surge and Water Hammer

13.5 Special couplings

Special couplings are used in cases where it is not possible to use standard couplings, especially during repairing pipes, connecting pipes with different outside diameters and connecting pipes of different materials whiich can't be Lay-up joints etc.

All-metal mechanical coupling

They are used for connecting pipes of different materials with nominal PN 1 up to PN 32 The joints are designed for joining pipes in diameters DN 100 to 4000 with a maximum difference of diameters of the connected pipes 9 mm.

Sleeve Couplings

The base of the sleeve coupling is elastomeric sleeve which is enveloped by tightening rings, or strips from stainless steel. It is a cheaper option for connecting various pipes to a maximum pressure of 2 bar. Using these couplings is possible to connect pipes with a larger diameter difference.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

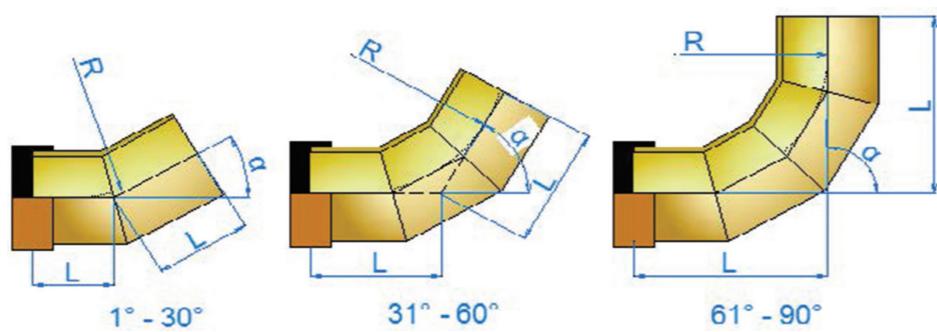
14 Fittings

CPS distribution use a standardized method for the production of GRP fittings which have similar techniques with GRP pipes, developed by Faratec Pipe Technology.

Technology of fittings production CPS distribution allows them to produce a wide range of standard fittings, and fittings according to customer requirements.

14.1 PN 1

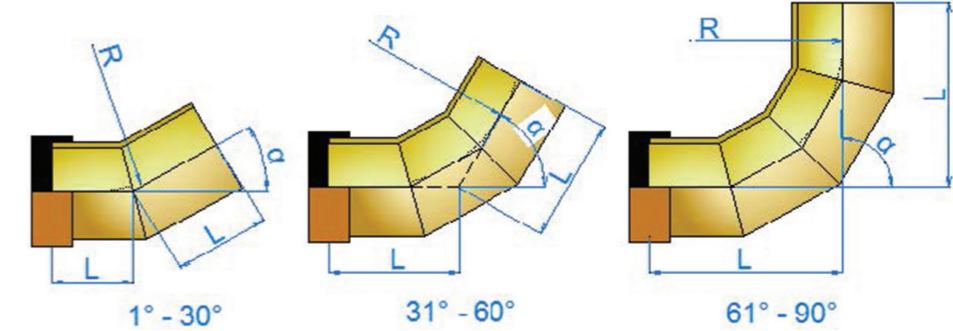
Elbows DN100 – DN1400



DN	R (mm)	Angle α							
		11,25°	15°	22,5°	30°	45°	60°	75°	90°
		Number of segments / Length L (mm)							
2	2	2	2	3	3	4	4	4	4
100	150	300	300	300	300	350	400	525	525
150	225	300	300	300	300	350	400	525	525
200	300	300	300	300	350	400	525	525	525
250	375	300	300	300	300	375	425	575	575
300	450	300	300	300	300	400	450	650	650
350	525	325	325	325	325	425	500	700	700
400	600	375	375	375	375	475	550	750	750
450	675	375	375	375	375	500	575	850	850
500	750	400	400	400	400	525	625	950	950
600	900	450	450	450	450	600	700	1075	1075
700	1050	475	475	475	475	650	775	1200	1200
800	1200	525	525	525	525	700	850	1350	1350
900	1350	550	550	550	550	725	785	1400	1400
1000	1270	575	575	575	575	750	925	1450	1450
1100	1320	600	600	600	600	825	1025	1600	1600
1200	1370	600	600	600	600	825	1025	1600	1600
1300	1450	650	650	650	650	850	1050	1650	1650
1400	1550	675	675	675	675	900	1100	1700	1700

1	GRP Pipes
2	GRP Pipe Application
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4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

Elbows DN 1500 - 4000

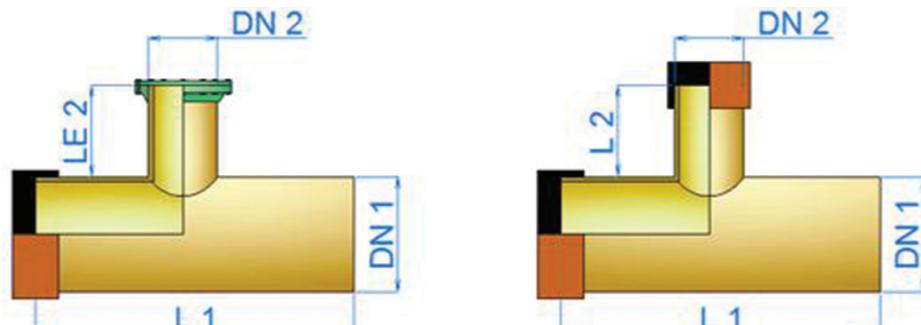


DN	R (mm)	Angle α							
		11,25°	15°	22,5°	30°	45°	60°	75°	90°
		Number of segments / Length L (mm)							
2	2	2	2	3	3	4	4	4	4
1500	1650	800	800	800	800	1100	1300	2000	2000
1600	1700	800	800	800	800	1100	1300	2000	2000
1700	1800	800	800	800	800	1200	1400	2200	2200
1800	1950	850	850	850	850	1200	1400	2200	2200
1900	2000	850	850	850	850	1300	1500	2300	2300
2000	2100	900	900	900	900	900	1300	1500	2400
2100	2170	900	900	900	900	900	1300	1500	2400
2200	2280	950	950	950	950	1400	1600	2600	2600
2300	2210	950	950	950	950	1500	1700	2600	2600
2400	2470	950	950	950	950	1500	1700	2600	2600
2500	2600	1000	1000	1000	1000	1500	1700	2600	2600
2600	2700	1000	1000	1000	1000	1500	1700	2600	2600
2700	2850	1000	1000	1000	1000	1600	1800	2800	2800
2800	2800	1000	1000	1000	1000	1600	1800	2800	2800
2900	2900	1000	1000	1000	1000	1700	1900	3000	3000
3000	3000	1000	1000	1000	1000	1800	2000	3000	3000
3200	3300	1000	1000	1000	1000	1800	2000	3000	3000
3400	3400	1000	1000	1000	1000	1800	2100	3300	3300
3600	3600	1100	1100	1100	1100	1900	2200	3700	3700
3800	3800	1200	1200	1200	1200	2100	2800	4000	4000
4000	4000	1400	1400	1400	1400	2200	3000	4200	4200

In the table below are the standard dimensions of elbows. On base of customer request can be produced elbows with other dimensions. Elbows are standardly fitted by one-end GRP couplings. According custome demand can be fitted flange connection. The presented data has informational purposes only and it should be for each shipment verified by the manufacturer. With regard to the transport requirements, it may modify the dimensions of individual elbows.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

T-pieces DN 100/100 – DN 3000/600



DN 2	100	150	200	250	300	350	400	450	500	600
L 2	250	250	250	250	250	250	300	300	300	300
DN 1	L 1 (mm)									
100	500									
150	500	750								
200	500	750	1000							
250	500	750	1000	1000						
300	500	750	1000	1000	1000					
350	500	750	1000	1000	1000	1000				
400	500	750	1000	1000	1000	1000	1500			
450	750	1000	1000	1000	1000	1000	1500	1500		
500	750	1000	1000	1000	1000	1000	1500	1500	1500	
600	750	1000	1000	1000	1000	1000	1500	1500	1500	1500
700	750	1000	1000	1000	1000	1000	1500	1500	1500	1500
800	750	1000	1000	1000	1000	1000	1500	1500	1500	1500
900	750	1000	1000	1000	1000	1500	1500	1500	1500	1500
1000	750	1000	1000	1000	1500	1500	1500	1500	1500	1500
1100	750	1000	1000	1000	1500	1500	1500	1500	1500	1500
1200	1000	1500	1500	1500	1500	1500	1500	1500	1500	1500
1300	1000	1500	1500	1500	1500	1500	1500	1500	1500	1500
1400	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
1500	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
1600	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
1700	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
1800	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
1900	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2000	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2100	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2200	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2300	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2400	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2500	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2600	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2700	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2800	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
2900	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000
3000	1000	1500	1500	1500	1500	1500	1500	1500	1500	2000

1 GRP Pipes

2 GRP Pipe Application

3 Product Properties & Advantages

4 Production Process

5 Performance Standards

6 Quality Criteria

7 Product Information

8 Joints Angular Deflection

9 Pipes Clasification

10 Installation of Buried Pipes

11 Biaxial Pipes (Special Application)

12 Pipe Dimensions

13 Pipe Joining Method

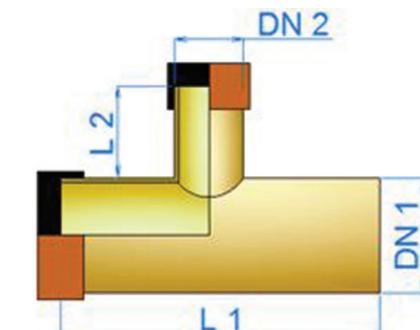
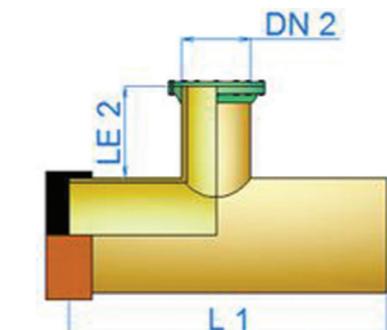
14 Fittings

14.1 PN 1

14.2 PN 6, PN 10

15 Surge and Water Hammer

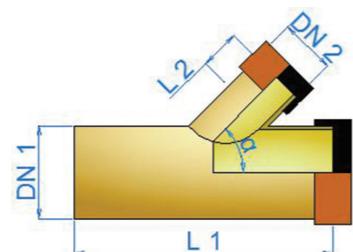
T-pieces DN 700/700- DN 4000/2000



DN 2	700	800	900	1000	1100	1200	1300	1400	1500	1600	1800	2000
L 2	350	350	350	350	400	400	400	400	400	500	500	500
DN 1	L 1 (mm)											
700	1500											
800	1500	1500										
900	1500	1500	2000									
1000	1500	2000	2000	2000								
1100	1500	2000	2000	2000	2000							
1200	1500	2000	2000	2000	2000	2500						
1300	1500	2000	2000	2000	2000	2500	2500					
1400	1500	2000	2000	2000	2000	2500	2500	2500				
1500	1500	2000	2000	2000	2000	2500	2500	2500	2500			
1600	1500	2000	2000	2000	2000	2500	2500	2500	2500	2500		
1700	1500	2000	2000	2000	2000	2500	2500	2500	2500	2500	2500	
1800	1500	2000	2000	2000	2000	2500	2500	2500	2500	2500	2500	2500
1900	1500	2000	2000	2000	2000	2500	2500	2500	2500	2500	2500	2500
2000	1500	2000	2000	2000	2000	2500	2500	2500	2500	2500	2500	2500

1	GRP Pipes
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5	Performance Standards
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8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

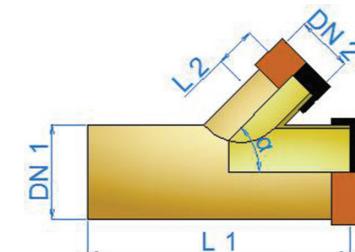
Y - pieces DN 100/100 – 4000/800



DN 2	100	150	200	250	300	350	400	450	500	600	700	800
L 2	250	250	250	250	250	300	300	300	300	350	350	350
DN 1	L 1 (mm)											
100	750											
150	750	750										
200	750	750	1000									
250	750	750	1000	1000								
300	750	750	1000	1000	1000							
350	750	750	1000	1000	1000	1000						
400	750	750	1000	1000	1000	1000	1200					
450	750	750	1000	1000	1000	1000	1200	1200				
500	1000	1000	1000	1000	1000	1200	1200	1500				
600	1000	1000	1000	1000	1000	1200	1200	1500	1500			
700	1000	1000	1000	1000	1000	1200	1200	1500	1500	1500		
800	1000	1000	1000	1000	1000	1200	1200	1500	1500	1500	2000	
900	1000	1000	1000	1000	1000	1500	1500	1500	1500	1500	1500	1500
1000	1000	1000	1000	1000	1000	1500	1500	1500	1500	1500	1500	1500
1100	1000	1000	1000	1000	1500	1500	1500	1500	1500	1500	1500	1500
1200	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
1300	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000
1400	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000
1500	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000
1600	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000
1700	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000
1800	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000
1900	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000
2000	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000
2100	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
2200	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
2300	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
2400	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
2500	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
2600	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
2700	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
2800	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
2900	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
3000	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
3200	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
3400	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
3600	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
3800	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000
4000	2500	2500	2500	2500	3000	3000	3000	3000	3000	3000	3500	4000

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

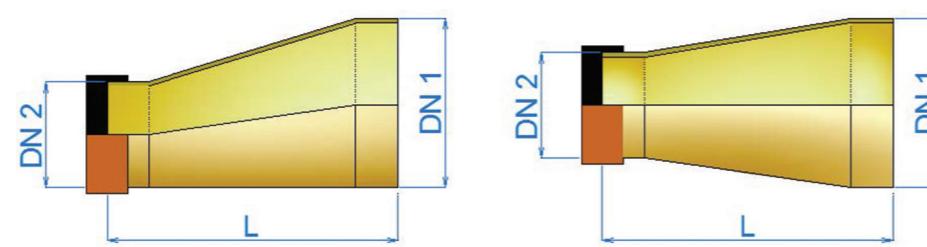
Y- pieces DN 900/900 – 4000/2400



DN 2	900	1000	1100	1200	1300	1400	1500	1600	1800	2000	2200	2400
L 2	350	350	400	400	400	400	400	450	450	500	500	500
DN 1	L 1 (mm)											
900	2000											
1000	2000	2000										
1100	2000	2000	2000									
1200	2000	2000	2000	2000								
1300	2500	2500	2500	2500	3000							
1400	2500	2500	2500	2500	3000	3000						
1500	2500	2500	2500	2500	3000	3000	3000					
1600	2500	2500	2500	2500	3000	3000	3000	3000				
170												

1	GRP Pipes
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3	Product Properties & Advantages
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7	Product Information
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9	Pipes Clasification
10	Installation of Buried Pipes
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14	Fittings
	14.1 PN 1
	14.2 PN 6, PN 10
15	Surge and Water Hammer

Reducers

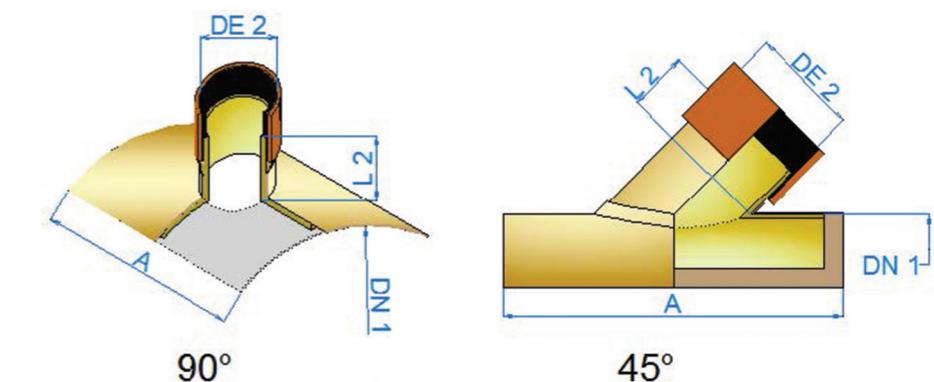


Reduction of other parameters of the request.
With regard to the transport requirements, may
modify the dimensions of individual reduction.

DN 1	DN 2	L(mm)						
150	100	750						
200	150	750	100	750				
250	200	750	150	750	100			
300	250	750	200	750	150	1000	100	1200
350	300	750	250	750	200	1000	150	1200
400	350	1000	300	1000	250	1000	200	1200
450	400	1000	350	1000	300	1000	250	1200
500	450	1000	400	1000	350	1000	300	1200
600	500	1000	450	1000	400	1200	350	1500
700	600	1000	500	1000	450	1200	400	1500
800	700	1100	600	1000	500	1200	450	1500
900	800	1100	700	1000	600	1200	500	1500
1000	900	1100	800	1200	700	1500	600	1750
1100	1000	1100	900	1200	800	1500	700	1750
1200	1100	1100	1000	1200	900	1500	800	1750
1300	1200	1200	1100	1200	1000	1750	900	2000
1400	1300	1200	1200	1200	1100	1750	1000	2000
1500	1400	1200	1300	1200	1200	1750	1100	2000
1600	1500	1200	1400	1200	1300	1750	1200	2000
1700	1600	1500	1500	1200	1400	1750	1300	2000
1800	1700	1500	1600	1500	1500	1750	1400	2000
1900	1800	1500	1700	1500	1600	1750	1500	2000
2000	1900	1500	1800	1500	1700	1750	1600	2000
2200	2100	1500	2000	1500	1900	1750	1800	2000
2400	2300	1500	2200	1500	2100	1750	2000	2000
2600	2500	1500	2400	1500	2300	1750	2200	2000
2800	2700	1500	2600	1500	2500	2000	2400	2500
3000	2800	1500	2600	1500	2400	2000	2200	3000
3200	3000	1500	2800	1500	2600	2000	2400	3000
3400	3200	1500	3000	1500	2800	2000	2600	3000
3600	3400	1500	3200	1500	3000	2000	2800	3000
3800	3600	1500	3400	1500	3200	2000	3000	3000
4000	3800	1500	3600	1500	3400	2000	3200	3000

1	GRP Pipes
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3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method

Glued Saddles



Main Line	Branche	L 2 ≈ 250mm			A (mm)	
		DE 2		Inlet	45°	90°
DN 1	DN 2	GRP	PVC	stoneware	45°	90°
200	150	158	160	186	400	400
250	150	158	160	186	400	400
	200	210	200	242	500	400
300	150	158	160	186	400	400
	200	210	200	242	500	400
	250	262	250	299	600	450
400	150	158	160	186	400	400
	200	210	200	242	500	400
	250	262	250	299	600	450
	300	327	315	355	650	500
500	150	158	160	186	400	400
	200	210	200	242	500	400
	250	262	250	299	600	450
	300	327	315	355	650	500
	400	413	400	486	850	650
600 ÷ 2000	150	158	160	186	400	400
	200	210	200	242	500	400
	250	262	250	299	600	450
	300	327	315	355	650	500
	400	413	400	486	850	650
	500	515	500	609	1050	750

A combination of other diameters and different angles connecting on request

1	GRP Pipes
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9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method

14 Fittings

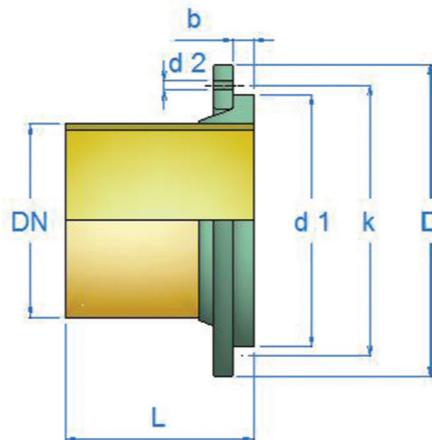
14.1 PN 1

14.2 PN 6, PN 10

15 Surge and Water Hammer

Flange Connections

Flange Connections with Backing Ring



DN	L (mm)	D (mm)	k (mm)	d 1 (mm)	d 2 (mm)	b (mm)	screws
150	400	285	240	214	22	23	8xM20
200	400	340	295	268	22	25	8xM20
250	400	395	350	320	22	28	12xM20
300	400	460	400	376	22	32	12xM20
350	400	520	460	436	22	36	16xM20
400	400	585	515	487	26	40	16xM24
450	400	640	565	535	26	44	20xM24
500	400	715	620	592	26	28	20xM24
600	400	840	725	693	30	34	20xM27
700	400	910	840	808	30	36	20xM27
800	500	1025	950	915	33	38	24xM30
900	500	1125	1050	1015	33	40	28xM30
1000	500	1255	1160	1122	36	45	28xM33
1200	500	1484	1380	1339	39	45	32xM36
1400	500	1685	1590	1535	42	60	36xM40

1 GRP Pipes

2 GRP Pipe Application

3 Product Properties & Advantages

4 Production Process

5 Performance Standards

6 Quality Criteria

7 Product Information

8 Joints Angular Deflection

9 Pipes Clasification

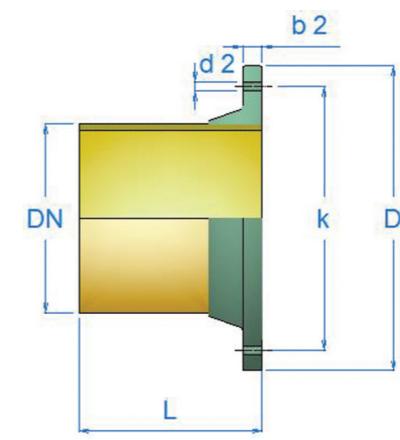
10 Installation of Buried Pipes

11 Biaxial Pipes (Special Application)

12 Pipe Dimensions

13 Pipe Joining Method

Flange Connection with Fixed Flange



DN	L (mm)	D (mm)	k (mm)	d 2 (mm)	b (mm)	screws
150	400	285	240	22	23	8xM20
200	400	340	295	22	25	8xM20
250	400	395	350	22	28	12xM20
300	400	460	400	22	32	12xM20
350	400	520	460	22	36	16xM20
400	400	585	515	26	40	16xM24
450	400	640	565	26	44	20xM24
500	400	715	620	26	28	20xM24
600	400	840	725	30	34	20xM27
700	400	910	840	30	36	24xM27
800	500	1025	950	33	38	24xM30
900	500	1125	1050	33	40	28xM30
1000	500	1255	1160	36	45	28xM33
1200	500	1484	1380	39	55	32xM36
1400	500	1685	1590	42	60	36xM40
1600	500	1930	1820	48	70	40xM45
1800	500	2130	2020	48	75	44xM45
2000	500	2345	2230	48	80	48xM45
2200	500	2555	2440	56	90	52xM52
2400	500	2760	2650	56	95	56xM52

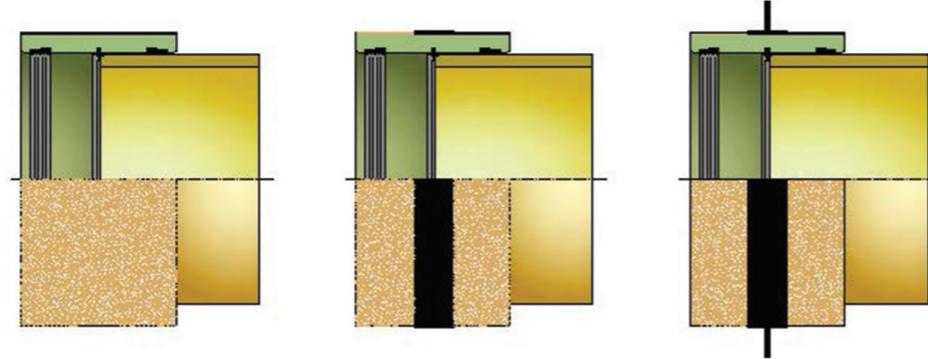
All the flange joints is performed by lay-up joining sleeve to the outer surface of the pipe. Backing rings are available with drilling for PN 6, 10 or 16, depending on DN, and as metrial can be used stainless steel, galvanized steel or GRP. Fixed flanges are made from GRP. On request can be supplied with a blind flange.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
	14.1 PN 1
	14.2 PN 6, PN 10
15	Surge and Water Hammer

Other Fittings

Masonry sleeves, couplings

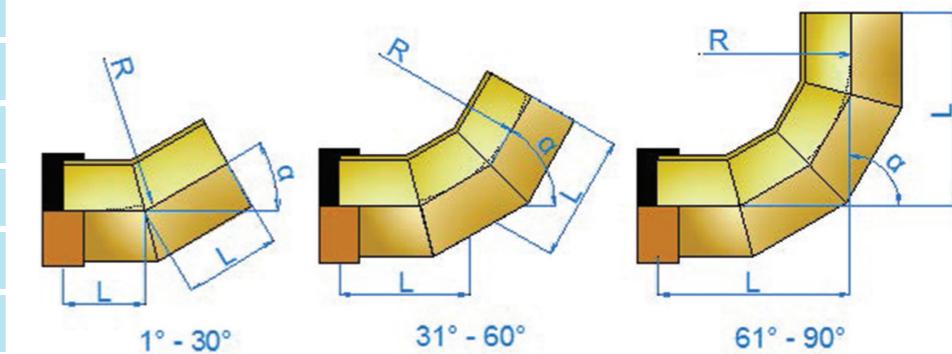
They are sanded couplings or pipes either separate or attached to a piece of pipe according to the width of the concrete wall or shaft. Masonry sleeves are on the surface sanded coarse-grained material, or may be provided with a bituminous strip or a collar for a better seal against water penetration.



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9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
	14.1 PN 1
	14.2 PN 6, PN 10
15	Surge and Water Hammer

14.2 PN 6, PN 10

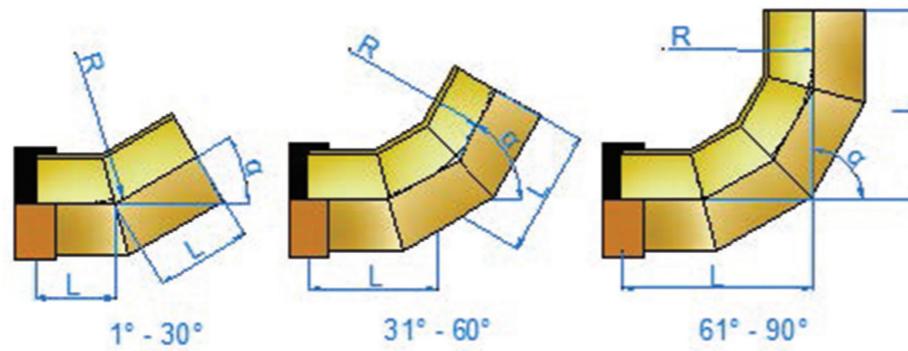
Elbows DN 100 – DN 1400 / PN 6



DN	R (mm)	Angle α							
		11,25°	15°	22,5°	30°	45°	60°	75°	90°
		Number of Segments / Length L (mm)							
		2	2	2	2	3	3	4	4
100	150	300	300	300	300	350	400	525	525
150	225	300	300	300	300	350	400	525	525
200	300	300	300	300	300	350	400	525	525
250	375	300	300	300	300	375	425	575	575
300	450	300	300	300	300	300	400	450	650
350	525	325	325	325	325	325	425	500	700
400	600	375	375	375	375	375	475	550	750
450	675	375	375	375	375	375	500	575	850
500	750	400	400	400	400	400	525	625	950
600	900	450	450	450	450	450	600	700	1075
700	1050	475	475	475	475	475	650	775	1200
800	1200	525	525	525	525	525	700	850	1350
900	1350	550	550	550	550	550	725	785	1400
1000	1270	575	575	575	575	575	750	925	1450
1100	1320	600	600	600	600	600	825	1025	1600
1200	1370	600	600	600	600	600	825	1025	1600
1300	1450	650	650	650	650	650	850	1050	1650
1400	1550	675	675	675	675	675	900	1100	1700

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

Elbows DN 1500 – DN 4000 / PN 6

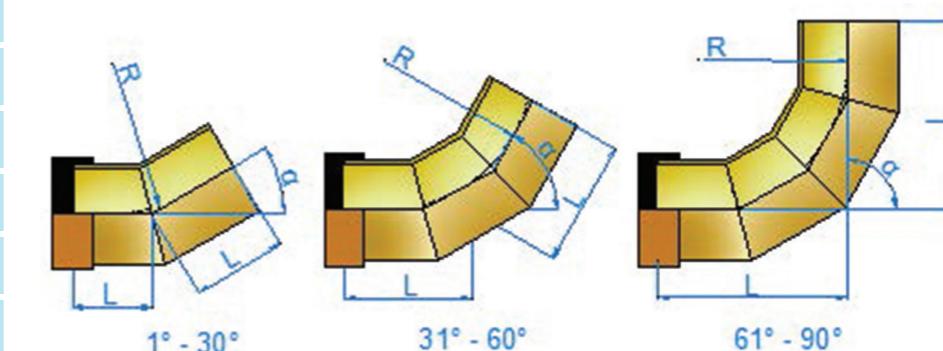


DN	R (mm)	Angle α							
		11,25°	15°	22,5°	30°	45°	60°	75°	90°
		Number of Segments / Length L (mm)							
		2	2	2	2	3	3	4	4
1500	1650	800	800	800	800	1100	1300	2000	2000
1600	1700	800	800	800	800	1100	1300	2000	2000
1700	1800	800	800	800	800	1200	1400	2200	2200
1800	1950	850	850	850	850	1200	1400	2200	2200
1900	2000	850	850	850	850	1300	1500	2300	2300
2000	2100	900	900	900	900	1300	1500	2400	2400
2100	2170	900	900	900	900	1300	1500	2400	2400
2200	2280	950	950	950	950	1400	1600	2600	2600
2300	2210	950	950	950	950	1500	1700	2600	2600
2400	2470	950	950	950	950	1500	1700	2600	2600
2500	2600	1000	1000	1000	1000	1500	1700	2600	2600
2600	2700	1000	1000	1000	1000	1500	1700	2600	2600
2700	2850	1000	1000	1000	1000	1600	1800	2800	2800
2800	2800	1000	1000	1000	1000	1600	1800	2800	2800
2900	2900	1000	1000	1000	1000	1700	1900	3000	3000
3000	3000	1000	1000	1000	1000	1800	2000	3000	3000
3200	3300	1000	1000	1000	1000	1800	2000	3000	3000
3400	3400	1000	1000	1000	1000	1800	2100	3300	3300
3600	3600	1100	1100	1100	1100	1900	2200	3700	3700
3800	3800	1200	1200	1200	1200	2100	2800	4000	4000
4000	4000	1400	1400	1400	1400	2200	3000	4200	4200

Elbows with other angles and lengths of the arms on request. With regard to the transport requirements, it may modify the dimensions of individual elbows.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

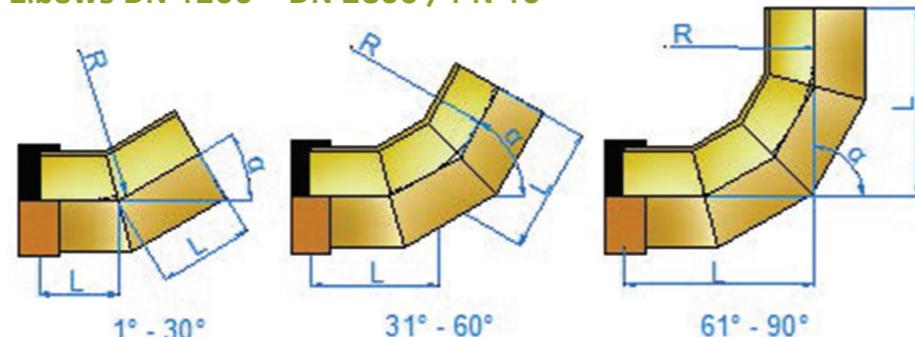
Elbows DN 100 – DN 1100 / PN 10



DN	R (mm)	Angle α							
		11,25°	15°	22,5°	30°	45°	60°	75°	90°
		Number of Segments / Length L (mm)							
		2	2	2	2	3	3	4	4
100	150	300	300	300	300	350	400	525	525
150	225	300	300	300	300	350	400	525	525
200	300	300	300	300	300	350	400	525	525
250	375	300	300	300	300	375	425	575	575
300	450	300	300	300	300	400	450	650	650
350	525	325	325	325	325	425	500	700	700
400	600	375	375	375	375	475	550	750	750
450	675	375	375	375	375	500	575	850	850
500	750	400	400	400	400	525	625	950	950
600	900	450	450	450	450	600	700	1075	1075
700	1050	475	475	475	475	650	775	1200	1200
800	1200	525	525	525	525	700	850	1350	1350
900	1350	550	550	550	550	725	785	1400	1400
1000	1270	575	575	575	575	750	925	1450	1450
1100	1320	600	600	600	600	825	1025	1600	1600

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

Elbows DN 1200 – DN 2600 / PN 10



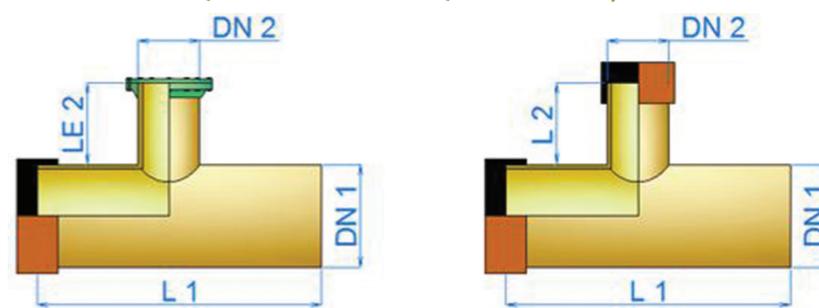
a	11,25°		15°		22,5°		30°	
DN	Number of Segments							
	2		2		2		2	
	R (mm)	L (mm)	R (mm)	L (mm)	R (mm)	L (mm)	R (mm)	L (mm)
1200	1370	600	1370	600	1370	600	1370	600
1300	1450	650	1450	650	1450	650	1450	650
1400	1550	675	1550	675	1550	675	1550	675
1500	1650	800	1650	800	1650	800	1650	800
1600	1700	800	1700	800	1700	800	1700	800
1700	1800	800	1800	800	1800	800	1800	800
1800	1950	850	1950	850	1950	850	1950	850
2000	2100	900	2100	900	2100	900	2100	900
2100	2170	900	2170	900	2170	900	2170	900
2200	2280	950	2280	950	2280	950	2280	950
2300	2400	1000	2400	1000	2400	1000	2400	1000
2400	2470	1000	2470	1000	2470	1000	2470	1000
2500	2600	1000	2600	1000	2600	1000	2600	1000
2600	2700	1000	2700	1000	2700	1000	2700	1000
2800	2900	1000	2900	1000	2900	1000	2900	1000
3000	3100	1000	3100	1000	3100	1000	3100	1000

a	45°		60°		75°		90°	
DN	Number of Segments							
	2		2		2		2	
	R (mm)	L (mm)	R (mm)	L (mm)	R (mm)	L (mm)	R (mm)	L (mm)
1200	1640	900	1400	1025	1500	1650	1500	1650
1300	1850	1000	1600	1050	1700	1800	1700	1800
1400	1900	1000	1700	1200	1800	2000	1800	2000
1500	2100	1100	1800	1300	1900	2100	1900	2100
1600	2200	1100	2000	1300	2000	2200	2000	2200
1700	2200	1200	2100	1500	2200	2300	2200	2300
1800	2200	1200	2200	1600	2300	2500	2300	2500
2000	2300	1200	2400	1800	2500	2700	2500	2700

Elbows with other angles and lengths, and PN> 10 on request. With regard to the transport requirements, it may modify the dimensions of individual elbows.

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

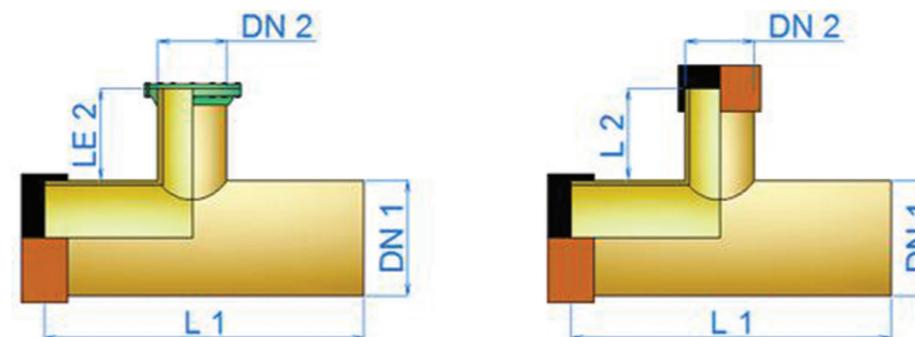
T - pieces DN 100/100 – DN 3000/600- PN 6, 10



DN 2	100	150	200	250	300	350	400	450	500	600
DN 1	4000	400	400	400	400	400	400	450	500	600
L 1 (mm)										
100	1000									
150	1000	1000								
200	1000	1000	1000							
250	1000	1000	1000	1000						
300	1000	1000	1000	1000	1000					
350	1000	1000	1000	1000	1000	1000				
400	1000	1000	1000	1000	1000	1000	1500			
450	1000	1000	1000	1000	1000	1000	1500	1500		
500	1000	1000	1000	1000	1000	1000	1500	1500	1500	
600	1000	1000	1000	1000	1000	1000	1500	1500	1500	1500
700	1000	1000	1000	1000	1000	1000	1500	1500	1500	2000
800	1000	1000	1000	1000	1000	1000	1500	1500	1500	2000
900	1000	1000	1000	1000	1000	1000	1500	1500	1500	2000
1000	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000
1100	1500	1500	1500	1500	1000	1000	1500	1500	2000	2000
1200	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000
1300	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000
1400	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000
1500	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000
1600	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000
1700	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000
1800	1500	1500	1500	1500	1500	1500	1500	1500	2000	2000
1900	1500	1500	1500	1500	1500	1500	1500	1500	2000	2500
2000	1500	1500	1500	1500	1500	1500	2000	2000	2000	2500
2100	1500	1500	1500							

1	GRP Pipes
2	GRP Pipe Application
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7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

T - pieces DN700/700 – DN 4000/600- PN 6, 10

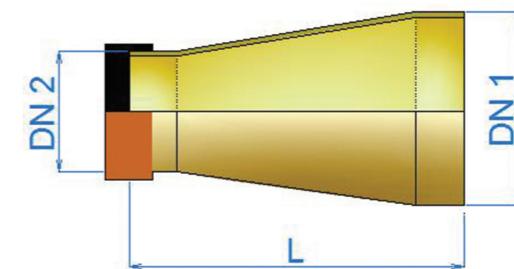


DN 2	700	800	900	1000	1100	1200	1300	1400	1500	1600
L 2	600	700	800	900	900	1000	1100	1100	1200	1300
DN 1	L 1 (mm)									
700	2000									
800	2000	2000								
900	2000	2000	2500							
1000	2000	2000	2500	2500						
1100	2000	2000	2500	2500	2500					
1200	2000	2500	2500	2500	2500	3000				
1300	2000	2500	2500	2500	2500	3000	3000			
1400	2000	2500	2500	2500	3000	3000	3000	3500		
1500	2000	2500	2500	2500	3000	3000	3000	3500	3500	
1600	2500	2500	2500	2500	3000	3000	3500	3500	3500	
1700	2500	2500	2500	3000	3000	3000	3500	3500	3500	
1800	2500	2500	2500	3000	3000	3000	3500	3500	3500	
1900	2500	2500	2500	3000	3000	3000	3500	3500	3500	
2000	2500	2500	2500	3000	3000	3000	3500	3500	3500	4000
2200	2500	2500	3000	3000	3000	3000	3500	3500	4000	4000
2400	2500	2500	3000	3000	3000	3500	3500	3500	4000	4000
2600	3000	3000	3000	3000	3500	3500	3500	4000	4000	4000
2800	3000	3000	3000	3000	3500	3500	3500	4000	4000	4000
3000	3000	3000	3000	3500	3500	3500	4000	4000	4000	4000
3200	3000	3000	3000	3500	3500	3500	4000	4000	4000	4000
3400	3000	3000	3500	3500	3500	4000	4000	4000	4000	4000
3600	3000	3500	3500	3500	4000	4000	4000	4000	4500	4500
3800	3000	3500	3500	3500	4000	4000	4000	4500	4500	4500
4000	3000	3500	3500	3500	4000	4000	4000	4500	4500	5000

The table shows the T-pieces with standard sizes for PN 6 and PN 10th. Other sizes are available on request. T-piece can be fitted with a standard coupling or flange connection. With regard to the transport requirements, it may modify the dimensions of individual T-pieces.

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7	Product Information
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10	Installation of Buried Pipes
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12	Pipe Dimensions
13	Pipe Joining Method
14	Fittings
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

Reducers PN 6, 10

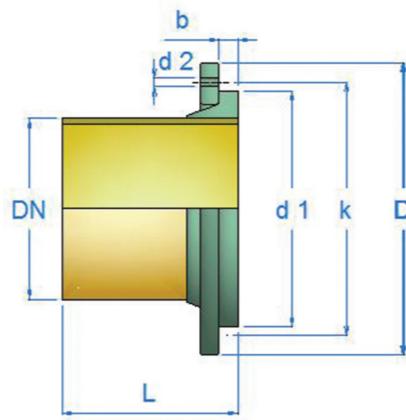


DN 1	DN 2	L(mm)						
150	100	750						
200	150	750	100	900				
250	200	750	150	900	100			
300	250	750	200	900	150	1000	100	1200
350	300	750	250	900	200	1000	150	1200
400	350	750	300	900	250	1000	200	1200
450	400	750	350	900	300	1000	250	1200
500	450	750	400	1000	350	1000	300	1200
600	500	750	450	1000	400	1000	350	1500
700	600	1000	500	1000	450	1500	400	1500
800	700	1000	600	1000	500	1500	450	1500
900	800	1000	700	1000	600	1500	500	1500
1000	900	1000	800	1500	700	1500	600	1750
1100	1000	1000	900	1500	800	1500	700	1750
1200	1100	1200	1000	1500	900	1500	800	1750
1300	1200	1200	1100	1500	1000	1750	900	2000
1400	1300	1200	1200	1500	1100	1750	1000	2000
1500	1400	1200	1300	1500	1200	1750	1100	2000
1600	1500	1200	1400	1500	1300	1750	1200	2000
1700	1600	1200	1500	1500	1400	1750	1300	2000
1800	1700	1200	1600	1500	1500	1750	1400	2000
1900	1800	1200	1700	1500	1600	1750	1500	2000
2000	1900	1200	1800	1500	1700	1750	1600	2000
2200	2100	1500	2000	1500	1900	2000	1800	2300
2400	2300	1500	2200	1800	2100	2000	2000	2300
2600	2500	1500	2400	1800	2300	2000	2200	2400
2800	2700	1800	2600	1800	2500	2200	2400	2500
3000	2800	1800	2600	2000	2400	2400	2200	3000

Other types on request

1	GRP Pipes
2	GRP Pipe Application
3	Product Properties & Advantages
4	Production Process
5	Performance Standards
6	Quality Criteria
7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
11	Biaxial Pipes (Special Application)
12	Pipe Dimensions
13	Pipe Joining Method
14 Fittings	
14.1	PN 1
14.2	PN 6, PN 10
15	Surge and Water Hammer

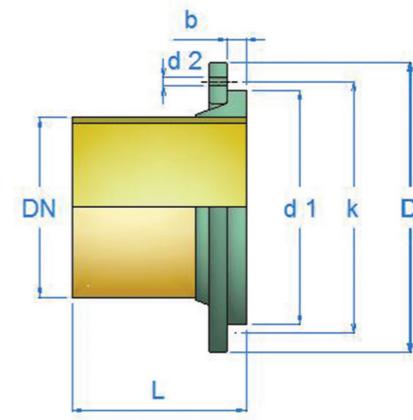
Flange Connection with Backing Ring – PN6, 10



DN	L (mm)	D (mm)	k (mm)	d 1 (mm)	d 2 (mm)	b (mm)	screws
150	400	285	240	214	22	23	8xM20
200	400	340	295	268	22	25	8xM20
250	400	395	350	320	22	28	12xM20
300	400	460	400	376	22	32	12xM20
350	400	520	460	436	22	36	16xM20
400	400	585	515	487	26	40	16xM24
450	400	640	565	535	26	44	20xM24
500	400	715	620	592	26	48	20xM24
600	400	840	725	693	30	54	20xM27
700	400	910	840	808	30	61	20xM27
800	500	1025	950	915	33	68	24xM30
900	500	1125	1050	1015	33	85	28xM30
1000	500	1255	1160	1122	36	90	28xM33
1200	500	1484	1380	1339	39	90	32xM36
1400	500	1685	1590	1535	42	115	36xM40

1	GRP Pipes
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10	Installation of Buried Pipes
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12	Pipe Dimensions
13	Pipe Joining Method
14 Fittings	
14.1	PN 1
14.2	PN 6, PN 10

Flange Connection with Fixed Flange - PN 6, PN 10



DN	L (mm)	D (mm)	k (mm)	d 2 (mm)	b (mm)	screws
150	400	285	240	22	23	8xM20
200	400	340	295	22	25	12xM20
250	400	395	355	26	28	12xM24
300	400	460	410	26	32	12xM24
350	400	520	470	26	36	16xM24
400	400	585	525	30	40	16xM27
450	400	640	585	30	44	20xM27
500	400	715	650	33	53	20xM30
600	500	840	770	36	62	20xM33
700	500	910	840	36	61	24xM33
800	500	1025	950	39	68	24xM36
900	500	1125	1050	39	60	29xM36
1000	500	1255	1160	42	90	28xM39
1200	750	1484	1380	48	95	23xM45
1400	750	1685	1590	48	80	36xM45
1600	750	1930	1820	56	90	40xM52
1800	750	2130	2020	56	100	44xM52
2000	750	2555	2230	62	110	48xM60
2200	750	2555	2440	62	120	52xM60

All the flange joints is performed by lay-up joining sleeve to the outer surface of the pipe. Backing rings are available with drilling for PN 6, 10 or 16, depending on DN, and as material can be used stainless steel, zinc coated steel or GRP. Fixed flanges are made from GRP, which are for pressure PN10 available up to DN 1200. Larger DN are for PN 6 only. On request can be supplied with a blind flange.

1	GRP Pipes
2	GRP Pipe Application
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7	Product Information
8	Joints Angular Deflection
9	Pipes Clasification
10	Installation of Buried Pipes
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12	Pipe Dimensions
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14	Fittings
15	Surge and Water Hammer

15 Surge and Water Hammer

Water hammer or pressure surge is sudden rise or fall in pressure causes by an abrupt change in fluid velocity with in pipe system. Usual cause of these flow changes is the rapid closing or opening of valves or sudden starting or stopping of pumps such as during a power failure. Most important factors which influence water hammer pressure in a pipe system are variation in fluid velocity, rate of change of the velocity (valve closing time), compressability of the fluid, stiffness of the pipe in hoop direction and physical lay-out of the pipe system.

Where similar conditions are considered for GRP, steel and ductile iron pipes, water hammer pressure assumed for GRP pipes is approximately 50 % less than the others. Toralit pipes have surge pressure allowance of 40 % of nominal pressure.

An approximate relationship for maximum pressure variation at a given point in a straight pipeline with negligible friction loss can be calculated from the Formula:

$$\Delta H = (W \cdot \Delta V)/g$$

ΔH = change in pressure (m)

W = surge wave celerity (m/s)

ΔV = change in liquid velocity (m/s)

g = acceleration due to gravity (m/s²)

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15 Surge and Water Hammer

Surge wave celerity for Toralit GRP pipes				
DN	300-400	450-800	900-2500	2600-3000
SN 2500				
PN 6	365	350	340	330
PN 10	435	420	405	390
PN 16	500	490	480	470
SN 5000				
PN 6	405	380	370	360
PN 10	435	420	410	
PN 16	505	495	485	
PN 25	575	570	560	
SN 10000				
PN 6	420	415	410	400
PN 10	435	425	415	
PN 16	500	495	485	
PN 25	580	570	560	
PN 32	620	615	615	
DN	100	125	150	200
SN 10000				
PN 6	580	560	540	520
PN 10	590	570	560	540
PN 16	640	620	610	600
DN	250			

Company CPS distribution Ltd. reserves the right to change any data listed in this catalog.



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