GIGAPIPE

PIPELINE SYSTEM FOR CONSTRUCTION OF ROAD CULVERTS, RAIN AND WASTE WATER INFRASTRUCTURE

DN/ID 500, 600, 800 and 1000 mm

GIGAPIPE pipeline network system made from polypropylene (PP) with nominal ring stiffness class SN4, SN8, SN16

GIGAPIPE®

ID: BR.GP.LV-2.1V.17

GIGAPIPE CORRUGATED PIPELINE SOLUTIONS

The leading competence in corrugated pipes

For decades, experts have considered corrugated plastic pipes to be particularly suitable for collecting waste and rain water and channeling network infrastructure construction. Their market share is constantly growing, not just for large pipes, for example nominal size by internal diameter DN/ID series pipes up to 1500 mm, but also for medium and small diameter range DN/ID series pipes from 100 to 600 mm. GIGAPIPE pipes have a long operational life, modest maintenance and installation costs, excellent hydraulic properties and high mechanical strength (resistance to dynamic and static as well as point-type stresses impacting during exploitation), friction and chemical degrading. That is why GIGAPIPE pipes are suitable not only for all types (household, industrial and rainwater) of sewage systems, but also, e.g., planned construction melioration systems for road, rail, port, dock, airport and other construction infrastructure, as well as for construction of main pipeline network collectors for agricultural melioration systems. GIGAPIPE pipes are especially suited for constructing culverts for overcoming water barriers in road infrastructure.

In terms of sustainability, GIGAPIPE pipes enjoy significant advantages compared to other types of pipes. Efficient use of raw materials conserves resources, since production of GIGAPIPE pipes is three times more efficient than smooth polymer pipe system solutions.

The GIGAPIPE pipe system produced by EVOPIPES saves up to 60 % of polymer materials, while maintaining all static properties (e.g., the ring stiffness and ring flexibility). Thanks to the innovative design of the GIGAPIPE pipe walls and high production standards, completed pipe systems retain their outer and inner strength throughout their operational period, which is over 100 years.

GIGAPIPE pipes protect the environment from toxic substances leeching into the soil, as well as they protect utility pipeline infrastructure from hydraulic overload which can result from groundwater infiltration.

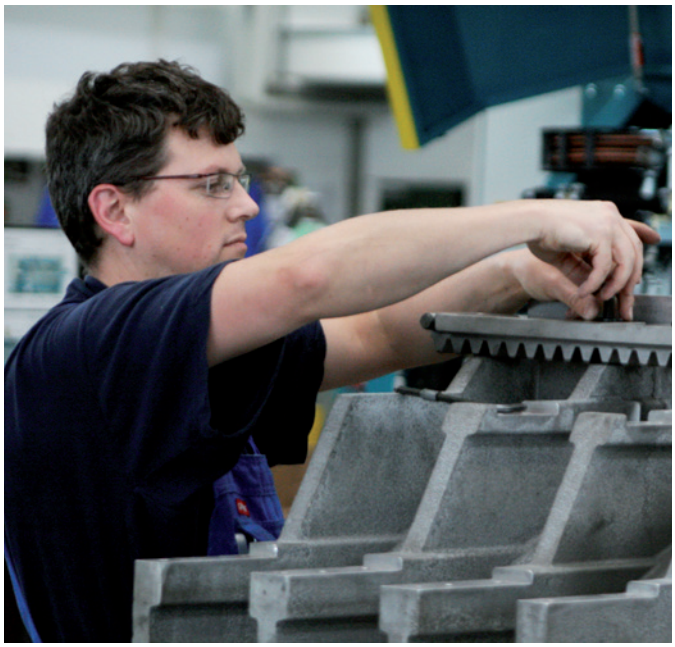
Today, GIGAPIPE is the only pipe system with decades of global experience in constructing and marketing modern corrugated pipes. For decades, the manufacturer DROSSBACH has researched, developed and accrued experience, which has been taken on board and is continued by EVOPIPES in production of GIGAPIPE pipes. EVOPIPES' contemporary experience is characterized by knowledge of production technology requirements and the practical application of technology as well as awareness and mastery of the future challenges for engineering science. In order to meet the complex, long-term challenges of the water management sector, DROSSBACH cooperates with its partner company EVOPIPES. The partnership between EVOPIPES and DROSSBACH is based on knowledge and experience.

SOLUTIONS FROM A SINGLE SOURCE

DROSSBACH is a world leader in developing corrugated pipe production technologies. The company's leading edge is based on modern, sustainable and cost-effective development, installation and production of pipe production equipment.

Today, DROSSBACH is in partnership with EVOPIPES, which offers DROSSBACH solutions for the construction market.

DROSSBACH and EVOPIPES offer a unified solution for the construction market — knowledge about equipment, main pipeline network systems and accessories, efficient production, distribution and expert knowledge in this field.



Currently, the finest result of our work, taking into account the market requirements of today and the future, is the unique corrugated (structured) pipe system GIGAPIPE, which offers the following four advantages:

- Complete pipe product range with nominal dimensions from DN/ID 500, 600, 800 1000 mm;
- Chambers for the GIGAPIPE pipe network system;
- Connecting, maintenance and turning elements for pipeline network systems;
- Pipes with integrated expanded coupling for flawlessly sealed and hermetic connections **SAFECONNEC.**

SAFECONNEC: reliable pipe connections ensuring long-term waterproofness and hermetic sealing to protect pipe system connections (see page 6 for a more detailed description).

GIGAPIPE gravity pipeline system

Pipe technology in its finest form!

GIGAPIPE corrugated plastic pipes are developed by the German company DROSSBACH. In the Baltic and Nordic region, GIGAPIPE pipe systems are produced by its partner company EVOPIPES. GIGAPIPE pipes are manufactured by DROSSBACH HD series equipment. The GIGAPIPE pipeline network system complies with standards (EN, ISO, INSTA CERT, DIN) for technical and physical mechanical requirements, as well as construction and operational technical regulations and standards for road and rail construction, water management, household and waste water management, melioration and waste processing site management (DWA). The high quality of the products is guaranteed thanks to supervision by accredited, independent external consultants as well as constant internal quality control (monitoring) during the manufacturing process and technical affirmation from responsible institutions (certificate or compliance affirmation/ report)) regarding the product's physical mechanical compliance with the requirements of product standards.

Scope of use:

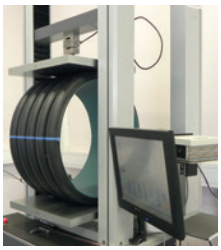
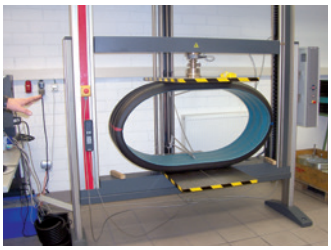
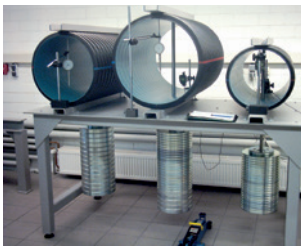
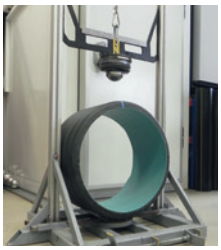
- Gravity lines of any kind
- Waste water networks, rain water systems
- Combined sewers
- Drainage systems for premises
- Special solutions for industry and communities
- Open-construction exchange and renewal procedures
- Extension of existing networks
- Special constructions for the management of rain and storm water and for industrial applications upon request

Standardisation

- The PP material guarantees a high modulus of elasticity and, combined with the especially developed profile geometry of the pipe, a high ring stiffness of ^{3} SN 8 in accordance with DIN ISO EN 9969.
- Approval on the basis of DIN EN 13476 and DIN 16961.
- Profile pipe series 5 according to DIN 16961 ^{3} 31.5 kN/m^{2}.
- Appropriate for all bedding materials according to DIN EN 1610.
- Appropriate for pressure tests according to DIN EN 1610.
- High-pressure cleaning methods according to CEN/TR 14920.
- Water tightness and root penetration resistance are proven by tests according to DIN 19537-2/DIN EN 681.
- Ring flexibility according to DIN EN ISO 19368, 30 % deformation without failure behavior.

Material

- Pipes, shaft constructions and fittings are uniformly made of low-temperature impact resistant polypropylene (PP-B).

Ring stiffness ≥ 8 kN/m^{2} **SN8**	**Ring flexibility** 30% deflection of OD **RF30**	**Creep Ratio** PP: ≤ 4 at 2 years extrapolation	**Impact resistance -10 °C** (straircase method) H50 ≥ 1000 mm
			
EN 9969	EN 1446	EN 9967	EN 1411

http://evopipes.lv/lv/lejupielades/certificates

STANDARDISATION OF TESTING PROCEDURES AND PRODUCT CERTIFICATION

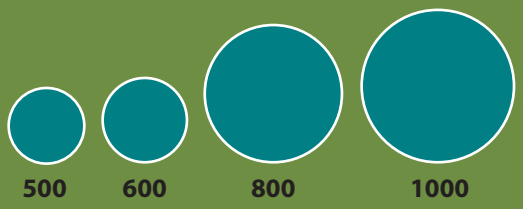
It is fully in line with DROSSBACH's and EVOPIPE's commitment to quality to guarantee the customer-oriented performance of all our products not only through our own quality management, but also by means of external quality control and third party certifications.

DIN **13476-3+A1**	DIN **16961-2** PROFILE PIPE SERIES 5	EN ISO **9969** **SN8**	EN **1446** **RF30**
LVS EN **1411**	LVS EN ISO **9967** Creep Ratio PP ≤ 4 at 2 years extrapolation	PP	IQNet
Nordic Poly Mark	DIBt	IMA DRESDEN	

Available pipe sizes (DN/ID) in mm by EVOPIPES

Corrugated plastic pipes of the GIGAPIPE series are available in all commercial sizes ranging from 500 to 1,000 mm DN/ID and thus therefore comprehensively cover all applications mentioned herein.

GIGAPIPE®



Quality requirements

- The Nordic Poly Mark quality mark guarantees that GIGAPIPE pipe products comply with Nordic quality requirements. Nordic Poly Mark quality mark license and INSTA – CERT product quality compliance certificate are issued as part of the auditing process by a certified, independent Swedish SP technical research institute, which performs checks of the EVOPIPES company encompassing:

✔ raw material sourcing and delivery as well as their storage procedures within the company;

✔ checking of product production technological processes;

✔ determining of visual, geometric and physical mechanical parameters of finished products and compliance testing (validation), as required under standards INSTA SBC EN 13476 and EN 13476-3+A1.

Physical properties

- The material's optimum resistance to abrasive wear and tear is calculated using the Darmstadt materials comparison test method (see page 9 for more details);
- The very smooth (without pores) material on the inner surface of the pipes hinders (delays) accretion of suspended light deposits and descendant on it.;
- The pipe's internal surface hydraulic coarseness average indicator in combination with excellent hydraulic functioning for internal pipe surfaces during operational life is (k = 0,25 mm);
- Well balanced pipe wall profile in relation to ring stiffness and ring elasticity allows conducting for DROSSBACH and EVOPIPES IGAPIPE SN8 (kN/m^2) class pipes of ring flexibility deformation up to 50 % of the pipe's outer diameter (RF50) and obtaining successful (positive) test results;

⇨ On request, EVOPIPES can offer GIGAPIPE pipes with nominal ring stiffness class SN ≥ 16 kN/m^2.

Chemical durability

- The durability of the pipes, components and sealing elements is guaranteed without restrictions within a range of pH2 (acidic environment) to pH12 (alkaline environment), in accordance with supplementary sheet 1 to standard DIN 8078;
- The durability of the GIGAPIPES pipe system against toxic (polluting) substances in waste water and soil has been proven in accordance with standard DIN 1986 and technical report ISO/TR 10358 which applies to polymer products and ISO/TR 7620 which applies to rubber sealing elements.

Thermal ranges

- All pipes and their elements are manufactured for use in a working environmental temperature range from -25 °C to +90 °C, moreover they comply with the thermal tensions stability requirements of standard EN 476.

Product identification marking

- Complies with EN 13476+A1 standard product requirements;
- The pipe's outer profile is black and the inner surface is turquoise, the optimum colour for CCTV inspection;

⇨ For the purpose of identifying construction requirements, GIGAPIPE pipes are divided by nominal ring stiffness using a co-extruding line-type linear marking: a white line is used for SN4 class pipes, blue is for SN8 class pipes and red is for SN16 class pipes.

Pipe nominal dimensions (DN) and lengths

- The GIGAPIPE system offered by EVOPIPES is available in the following nominal dimensions: 500, 600, 800 and 1000 mm (the pipe's nominal size applies to the inner diameter and aligns with the DN/ID series in accordance with standard EN 13476-3+A1 clause 7);
- Standard pipe length without extension: 6 m.

⇨ Special lengths are available on request.

- During construction, it is possible to cut (shorten) the pipes using basic tools (instruments), or to simply and safely extend them using a double nut and packing ring set.

Recycling

- All GIGAPIPE system pipes and components can be recycle without restrictions at the end of their life cycle.

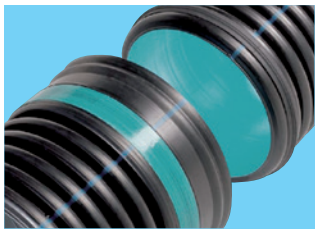
SAFECONNEC

A reliable, long-term hermetic solution!

A comprehensive and reliable local waste water collection and removal solution to protect human health and the environment and support existing infrastructure. This is a very important criteria for any waste water collection and removal system. Another important criteria is that the waste water network's pipe joints must remain hermetic throughout the system's operational life, without causing additional local stresses on the surrounding environment at point-type pollution sites.

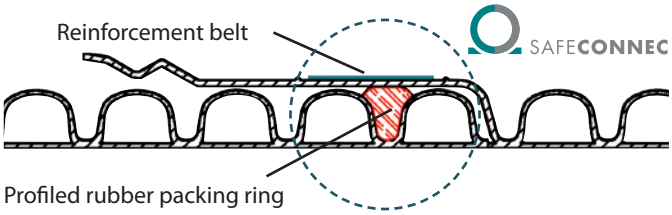
The GIGAPIPE pipe production process uses technology allowing simultaneous "online" manufacturing of homogenous (uninterrupted) pipe end extensions by using matrix-type forming. By using this method for manufacturing pipe extensions, we obtain GIGAPIPE system connections which during the operational life of the pipes prevent infiltration of underground water (groundwater), and prevents seepage of polluted waste water into the soil, thus preventing local point-type soil pollution. The assembly of the pipe components at the construction site is a simple matter of lubricating the end of the pipe with the rubber sealing ring then inserting the pipe extension, using basic tools. A tight fit for the pipes is achieved thanks to profiled EPDM rubber sealing rings, which guarantee the hermetic sealing of the connection points (pressure 0.5 bar).

SAFECONNEC is a unique type of DROSSBACH connection which optimises interaction between the extension and the rubber sealing ring, further improving the positive characteristics of the flexible pipe system. A high strength reinforcement belt for the ring is welded onto the outside of the extension at the exact point where the rubber seling ring sits on the extension walls. The reinforcement belt guards against separation (movement) of the joint even under extreme stress, thus ensuring that the pipe connections remain hermetic for over 100 years.



The same process is used for all EVOPIPES individually adapted and readymade products made in the factory from the pipes (for example, components, shafts and other elements).

- User friendly, simple to install.
- Complies with EN 13476-3+A1 and INSTA SBC EN 13476
- The welded high strength reinforcement belt allows highly efficient use of materials and energy.

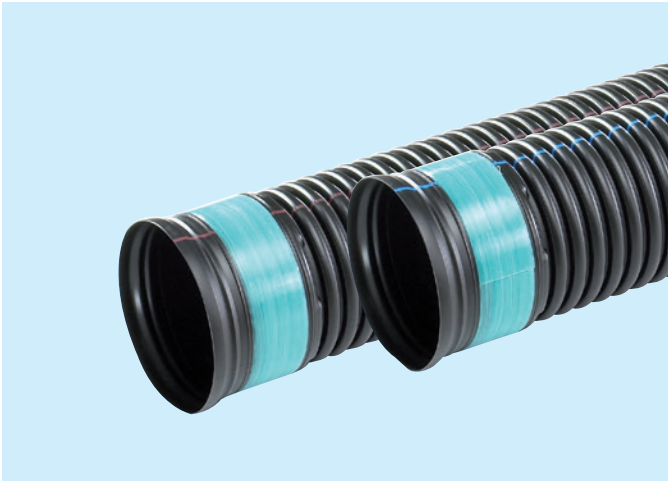


HERMETIC UNDER PRESSURE

All GIGAPIPE system pipes and components comply with high standards, ensuring permanent hermetic sealing with resistance to internal pressure of up to 0.5 bars and short-term overload up to 2.5 bars.

High pressure cleaning is permitted to 180 bars.

Thanks to SAFECONNEC elements, the GIGAPIPE system complies with DWA worksheet No 142 (33) without additional requirements, therefore it can be used without restrictions for construction in protected water territories and their adjacent areas and similar zones.



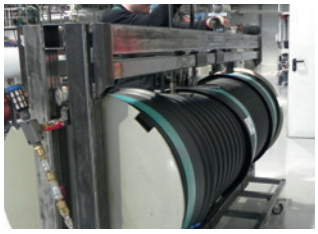
In accordance with table 17 of product standard EN 13476-3+A1, hermetic tests must be conducted on the pipe connection zones under pressures in accordance with Rules B and C of test LVS EN 1277.

Rule B - test the hermetic sealing of connection zones under pressure in accordance with the following conditions – deform the pipe in the connection zone for 10 % of its external diameter and coupling extension for 5 % of its external diameter.

Rule C - test the hermetic sealing of connection zones under pressure in accordance with the following conditions – the lengthwise angle bend of the connection zone for pipes with nominal dimensions DN/ID 500 mm – 1.5° and pipes with nominal dimensions DN/ID > 500 mm - 1°.

Nordic Poly Mark - **Nordic Quality Sign product marking in accordance with standard INSTA SBC EN 13476 sets additional requirements for the hermetic sealing of product connection zones under pressure, thus providing customers with additional guarantees of the system's capacity during its operational life.**

In accordance with the aforementioned additional product performance requirements, hermetic tests are performed on the connection zones of GIGAPIPE pipes under rues B and C of test method EN 1277, with these two rules combined into one for the connection zone vertical deformation with the lengthwise horizontal bend, additionally increasing the requirements under rule B for the vertical deformation of the pipe connection zone (the pipe's external diameter vertical deformation connection zone from 10 % to 15 % and the coupling integrated expansion's external diameter from 5 % to 10 %).



Connection zone tests in accordance with test method EN 1277 bringing together rules B and C.

Test parameters	Requirement	Result
With air pressure -0.3 bar/15 min	≤ -0,27 bar	✔
With water pressure 0.05 bar/15 min	no leakage	✔
With water pressure 0.5 bar/15 min	no leakage	✔

DURABLE AND FLEXIBLE

Maximum value on heavy workdays!

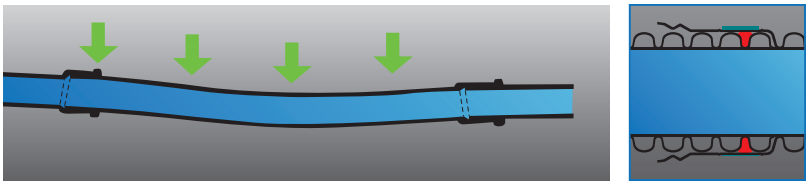
Static properties of the pipes

The construction geometry of the specially designed pipe walls and the material used, i.e. polypropylene (PP) ensures balance between ring stiffness and ring flexibility. Regular static tests demonstrate the suitability of GIGPIPE pipes for general traffic dynamic loads at depths of 0.5 to 6.0 metres. Moreover, there are also many testimonials of the multitude of uses of GIGAPIPE, e.g., under (high intensity traffic loads) heavy transport movement zones (motor transport load type traffic SLW 60), under aviation coverings and in rail traffic zones. E.g., GIGAPIPE is the ideal solution for highly dynamic loads and in case of embankment only 1.0 m high (e.g., airport runways). It is also suitable for embankments over 6.0 m thick.

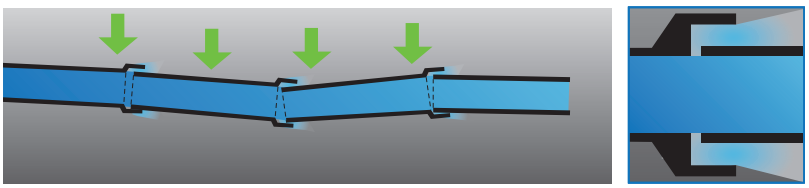
Flexibility

The flexibility of the GIGAPIPE system ensures that the pipes retain flexibility under conditions of changing loads and soil shifts, and as the pipe deforms the load tension is transferred lengthwise and crosswise to the surrounding soil. The relaxation properties of used polymer guarantee that tension arising from longtime system deformation can be almost completely reversed. In any case, short-term deformation is fully reversible.

Flexible pipes



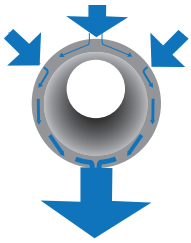
Rigid pipes



The illustrations demonstrate one of the main advantages of corrugated plastic pipes compared with traditional rigid (cast iron, steel, concrete) pipe systems: GIGAPIPE adjust to soil shifts with large tolerance and no problems, thereby balancing, e.g., increased load, mass transfer, ground settling or even mistakes in laying. The system remains unaffected and hermetic. In some seismically active regions of the world where earthquakes are possible, only corrugated plastic pipes ensuring GIGAPIPE quality are used.

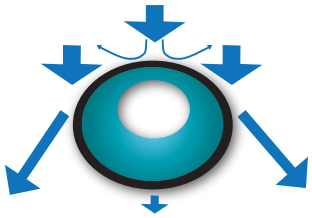
Comparison: load-bearing resistance and capacity of rigid pipes and the capacity of flexible pipes to absorb and transfer loads

RIGID PIPES



All loads (static and dynamic loads) are taken by the pipe structure. If the load limit for a pipe's material is exceeded, the pipe loses its strength (it loses its balance of forces, or in other words, it loses its resistance to external forces), which leads to cracking in the pipe's structure and ultimately to the collapse of the structure.

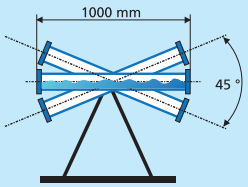
FLEXIBLE PIPES



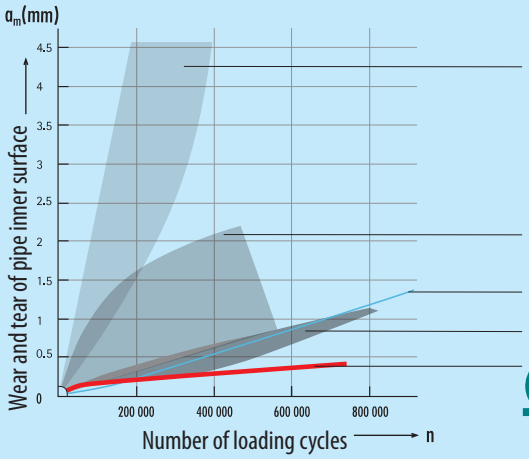
Thanks to the pipe's geometric double-wall design and the flexibility of the material, the force is absorbed, disbursed and transferred to the surrounding soil embracing it, thus preventing overloading of the material during the pipe's operating life. This protects the pipe structure from material overload, i.e. the pipe is freed of tension.

RESISTANCE TO WEAR AND TEAR

To test the pipe's resistance to mechanical wear and tear, incurred due to friction with abrasive substances against the internal surface of the pipe, the so-called Darmstadt test method is used in accordance with the in force standard testing method DIN 19565 and EN 295. Processing and analysis of test results (using the data processing comparative method) reveals that pipes made from polymer, especially polypropylene (PP), show the best resistance to abrasive wear and tear compared with pipes made from other materials. The GIGAPIPE pipe design geometric double wallstructure ensures optimum weight reduction and effective use of materials during the production process, which maximises the product's operational life.



Sketch of Darmstadt test method
Silicon sand/gravel/water mixture with 45 % silicon sand content/gravel particle dimension from 0 ÷ 30 mm



Pipe wear and tear in accordance with the Darmstadt test

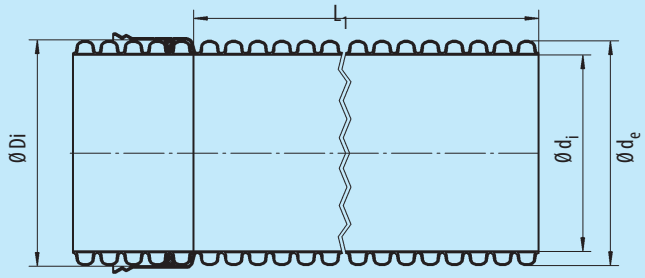
THE GIGAPIPE SYSTEM

Product range

The EVOPIPES GIGAPIPE system is a complete waste water and rain-water system with a broad range of accessories for all available nominal dimensions from DN/ID 500 to DN/ID 1000 mm.
Thanks to the quick and convenient assembly (installation) of all the system elements, you will save time and money on construction.

Dimensions shown without deviations (tolerance boundaries) are of an informative nature.

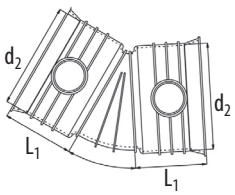
The product illustrations are of an informative nature. Original proportions may differ from illustrations.



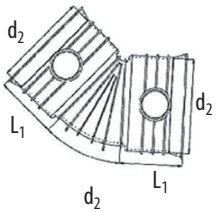
DN/ID series GIGAPIPE PP SN8 pipe dimensions				
DN/ID, mm	500	600	800	1000
Ø d_e, mm	565,7	678,9	906,3	1134,3
Ø d_i, mm	495,0	594,0	793,0	992,5
Ø di, mm	569,7	683,7	912,7	1143,7
L_1, mm	6046	6002	6076	6080

Transition to local pipelines is possible up to nominal dimensions DN 500.
GIGAPIPE pipes with structural nominal ring stiffness class SN4 and SN16, as well as other(L1) lengths, are available upon request.

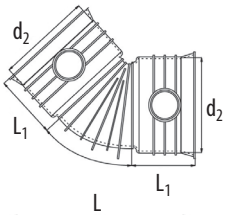
List of DN/ID series GIGAPIPE system fittings



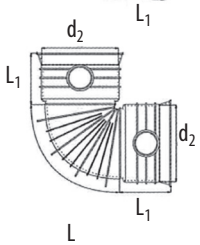
15° Bend				
DN/ID, mm	500	600	800	1000
d_2, mm	572	684	912	1143
L_1, mm	264	296	531	786



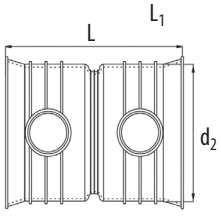
30° Bend				
DN/ID, mm	500	600	800	1000
d_2, mm	572	684	912	1143
L_1, mm	264	296	673	839



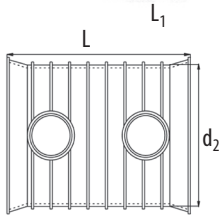
45° Bend				
DN/ID, mm	500	600	800	1000
d_2, mm	572	684	912	1143
L_1, mm	264	296	920	1227



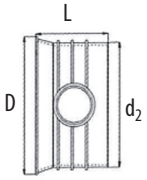
90° Bend				
DN/ID, mm	500	600	800	1000
d_2, mm	572	684	912	1143
L_1, mm	264	296	1213	1635



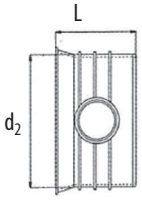
Double coupling				
DN/ID, mm	500	600	800	1000
d_2, mm	572	684	912,7	1143,7
L, mm	528	592	615	825



Sleeve coupling				
DN/ID, mm	500	600	800	1000
d_2, mm	572	684	912,7	1143,7
L, mm	528	592	615	825

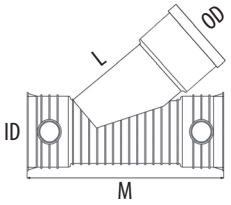


Protection coupling				
DN/ID, mm	500	600	800	1000
D, mm	643	740	956	1192
d_2, mm	572	684	912,7	1143,7
L, mm	264	296	307,5	412,5



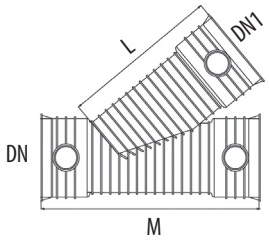
End cup				
DN/ID, mm	500	600	800	1000
d_2, mm	572	684	966,3	1200,0
L, mm	264	296	307,5	412,5

List of DN/ID series GIGAPIPE system fittings



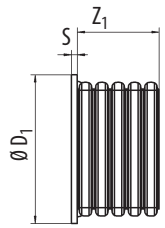
45° Reduction Tee with transition to DN/OD series smooth pipe with coupling Type KG

ID/OD, mm	500/200	600/200	800/160	1000/160
M, mm	750	942	400	400
L, mm	1520	1670	1462	1856



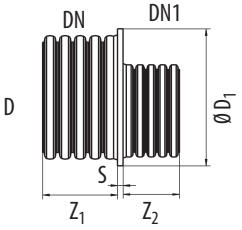
45° Tee

DN/DN1, mm	500/500	600/600	800/800	1000/1000
M, mm	942	1052	1365	1767
L, mm	1520	1670	2339	3075



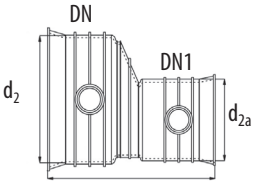
End cap for pipe socket

DN/ID, mm	500	600	800	1000
Ø D_1, mm	617,7	733,0	966,3	1200,0
Z_1, mm	304,8	343,0	390,0	487,6
S, mm	20	20	20	20



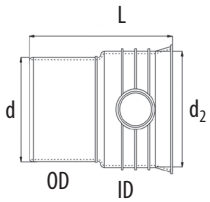
Pipe-type reduction (mountable on extension coupling Type SS)

DN/DN1, mm	600/500	800/600	1000/800
Ø D_1, mm	733,0	966,3	1200,0
Z_1, mm	343,0	390,0	487,6
Z_2, mm	304,8	343,0	390,0
S, mm	20	20	20



Coupling type reduction (mountable on pipe Type MM)

DN/DN1, mm	600/500	800/600	1000/800
d_2, mm	684	966	1200
d_{2a}, mm	572	684	966
L, mm	635	564	719

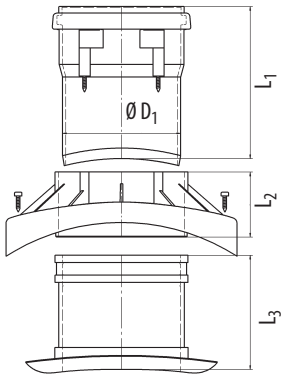


Transition from DN/OD series smooth pipe to DN/ID series GIGAPIPE pipe (Smooth pipe Type KG/Coupling Type M)

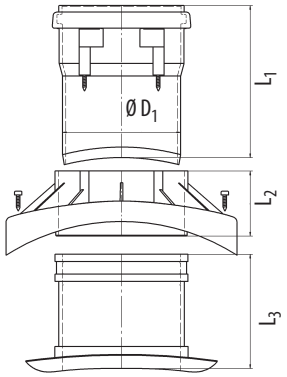
OD/ID, mm	500 KG/500 M
d, mm	500
d_2, mm	572
L, mm	440

Dimensions shown without deviations (tolerance boundaries) are of an informative nature.
The product illustrations are of an informative nature. Original proportions may differ from illustrations.

List of DN/ID series GIGAPIPE system fitings



Saddle-type connection with DN/ID series GIGAPIPES pipe (DN/OD 160 mm short pipe with extension Type KG)				
DN/ID, mm	500	600	800	1000
Ø D_1, mm	160,8	160,8	160,8	160,8
L_1, mm	205,9	205,9	205,9	205,9
L_2, mm	88,0	88,0	88,0	88,0
L_3, mm	155,0	155,0	155,0	155,0

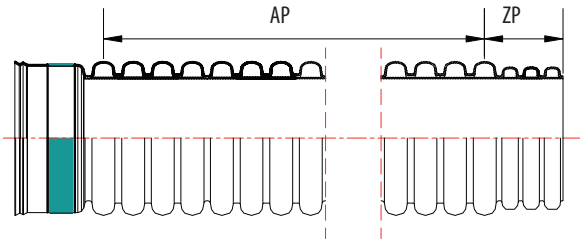


Saddle-type connection with DN/ID series GIGAPIPES pipe (DN/OD 200 mm series short pipe with extension Type KG)				
DN/ID, mm	500	600	800	1000
Ø D_1, mm	200	200	200	200
L_1, mm	205,9	205,9	205,9	205,9
L_2, mm	88,0	88,0	88,0	88,0
L_3, mm	155,0	155,0	155,0	155,0

Rubber sealing ring						
DN/ID, mm	500	600	800		1000	
DN, mm	500	600	800	800L	1000	1000L

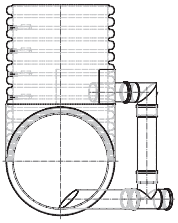
Rubber sealing ring usage zone applicable only to DN/ID 800 mm and DN/ID 1000 mm GIGAPIPES pipes

GIGAPIPES DN/ID 800 mm and DN/ID 1000 mm pipe profile structure



AP - Rubber sealing rings DN800L and DN1000L are intended for use in pipe zone with high profile
ZP - Rubber sealing rings DN800 and DN1000 are intended for use in pipe zone with low profile

EVOPIPES produce special connections and fittings on request.



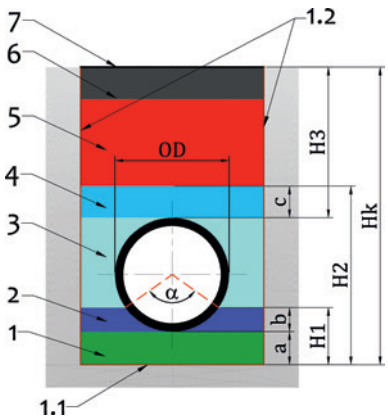
Dimensions shown without deviations (tolerance boundaries) are of an informative nature.
Product illustrations are of an informative nature. Original proportions may differ from illustrations.

THE GIGAPIPE SYSTEM

Installation and assembly of pipes

Before starting construction of the pipe trench, it is necessary to have a topographic plan indicating the locations of existing utilities and a geotechnical study of the planned construction area. After obtaining geotechnical data about depths of existing soil materials and their geophysical properties on the site of the planned pipeline a decision should be made about the technique for building the pipeline trench as well as the type of soil around the pipeline zone. To ensure optimal pipeline construction in the trench in accordance with standard EN 1610 point 3 a systematic construction structure for the trench foundation underlying and covering filling is required in accordance with the pipe trench cross-section diagram below.

Pipe trench cross-section diagram (in accordance with point 3 figure 1 of standard EN 1610).



DESIGNATIONS:

1.1 – Trench foundation;
1.2 – Trench wall or side props;
1 – Bottom foundation;
2 – Top foundation;
3 – Side filling;
4 – Initial (primary) filling;
5 – Foundation (main) filling;
6 – Road or rail grade structure section, if such exists at the pipeline construction site. The construction work in this section must be performed in accordance with the instructions of the road or rail infrastructure manager;
7 – Outside surface;

a – Thickness of bottom foundation filling layer;
b – Thickness of top foundation filling layer;
c – Thickness of initial (primary) foundation filling layer;
H1 – Total thickness of foundation filling layer;
H2 – Thickness around pipe of the filling level;
OD – Pipe outer diameter;
α – Top foundation filling mound layers support angle;
H3 – Thickness of level layer above pipe covering filling;
Hk – Trench depth.

Note:
Pipe trench digging and construction work must be performed in accordance with standards EN 1610 and CEN/TR 1046.

Pipe trench digging and reinforcement work must be performed in accordance with **points 5 and 6 of standard EN 1610**. The bottom **(1)** and top **(2)** foundation soil material filling layer provides support for the pipe. Before installing and assembling the pipe in the trench, forming of the bottom **(a)** foundation soil material filling layer must be performed in accordance with its cluttering up level. The pipe's bottom soil material layer **(a)** provides support for the pipe along its entire horizontal plane, ensuring the pipe's load-bearing capacity against vertical dynamic and static loads. Establishment of the pipe's bottom foundation layer **(a)** in the trench must be performed in accordance with **point 6.4 of standard EN 1610.**

After the pipe is laid and secured in the trench, **(a)** soil material top foundation filling layer **(b)** construction with an appropriate compacting level must be performed on the lower foundation layer of the trench. This ensures correct transfer of load from the top surface of the pipe to its sides, and the disbursement (absorption) of the transferred load to the sides of the top foundation layer of the trench **(b).** Correctly constructed soil material support for both the bottom **(1)** and top **(2)** foundation of the pipe reduces the possibility of the onset of internal forces which may cause undesirable overloads in the pipe structure during its operating life.

It is important to remember that careful work during the construction phase will ensure a long life for the system. The correct choice of thickness of the soil filling material for the foundations and around the pipes protects the system against static and dynamic loads which occur during its operational life.

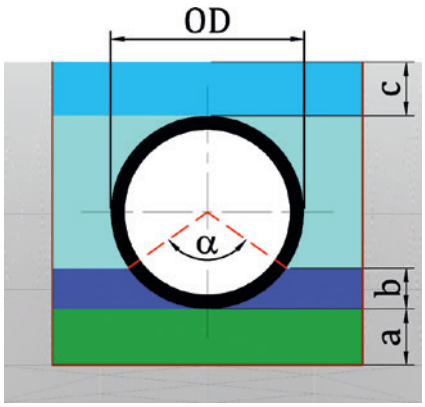
Therefore, during construction of the pipe in the trench, it is important to follow the construction procedures and supervise every stage of the construction cycle, for example the trench foundation soil material filling layer **(a)** and **(b)** thickness, its compacting level, as well as (in the initial mound above the pipe) the filling soil material layer's **(c)** construction thickness and compacting level, correctly selecting the filling layer **(c)** stamping (compacting) method for the soil material above the pipe zone, to prevent the onset of undesirable forces during construction which may lead to overpressure and overload in the pipes.

The thickness of the soil filling material layer around the filling material layer **(a)**, **(b)** and **(c)** and the level of compacting around the pipe is usually calculated based on the results of geotechnical studies of the soil in the pipe network construction area, as well as existing soil material resistance calculations and analyses. It is therefore important to commission a geotechnical study of the construction site in the initial stages of construction planning.

The trench foundation construction type is selected based on the results of the geotechnical study. The choice of the trench foundation construction type depends on the physical, mechanical, load-bearing properties of the soil material at the pipeline construction site.

In accordance with point 7.2. of standard EN 1610, EVOPIPES recommends using a type 1 pipe foundation reinforcing method. This is suitable for use for all soil material types found in constructing pipe networks which are listed in the classification groups stipulated in Annex A of standard CEN/TR 1046: **G1** – *non-binding soil material (e.g., sand, granite),* **G2** – *lightly binding soil material (e.g., binding sand, granite),* **G3** – *mixed binding soil material (e.g., coarse sand),* **G4** – *binding soil material (e.g., clay).*

Structure of reinforcement for type 1 pipe foundation in the trench, composed in accordance with point 7.2.1. figure 3 of standard EN 1610



In accordance with point 7.2.1. of standard EN 1610, the recommended minimum thickness for the bottom foundation filling layer **(a)**:

- ⇨ **in normal soil conditions 100 mm;**
- ⇨ **In mountain rock or hard soil conditions 150 mm.**

The top foundation filling layer thickness (height) **(b)** arises from the filling layer selected in the building plan or the top foundation mound support angle **(α),** which can also be expressed as **(b = k x OD),** see point 3 figure 1 in standard LVS EN 1610. Where **(k)** is a non-dimensional coefficient quantity (factor), which links the thickness of the top foundation filling layer with the pipe's external diameter **(OD).** This is expressed in some countries national standards taking into account the top foundation mound support angle **(α).**

In accordance with point 7.1. of standard EN 1610, the recommended initial thickness of the initial filling layer **(c):**

- ⇨ **Above the pipe along its entire length 150 mm;**
- ⇨ **Above the pipe's connection zone 100 mm.**

Note:
*The top foundation mound support angle **(α)** which is **(b = k x OD)** is not the foundation mound soil material filling layer reaction angle, which is used in the building planning stage for making static calculations for the pipes.*

These conditions are widely used and accurately describe the foundation soil material filling layer's **(b)** load-bearing capacity. The table below shows the relationship between the thickness of the top foundation layer **(b)** and the top foundation mound support angle **(α),** which EVOPIPES recommends for constructing the GIGAPIPES system in the trench.

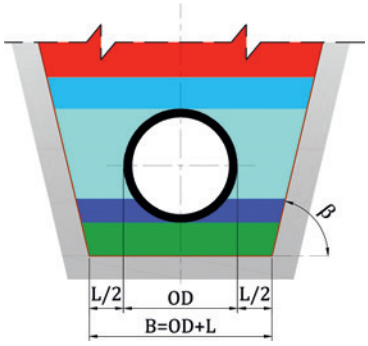
Table with recommended top foundation mound layer thickness (b) for the GIGAPIPES system

Standard nominal dimension DN		Top foundation mound support angle (α) which is (b = kn x OD)		
		90°	120°	180°
ID	OD	$k_{90} = 0,15$	$k_{120} = 0,25$	$k_{180} = 0,50$
mm	mm	mm	mm	mm
500	565	85	141	283
600	678	102	170	339
800	906	136	227	453
1000	1134	170	284	567

The static calculation equation principal is based on the force interaction principle. For example, if static calculations must be made for a particular stage of the pipe network, the following base values must be used for the calculations:

- Traffic load (if any);
- The road surface, e.g., asphalt or concrete;
- The territory's additional load on the pipe surface;
- Additional field load;
- The soil material to be used in the filling zone around the pipe;
- The soil material to be used in the side filling;
- The soil material to be used in the mound filling above the pipe;
- The soil material to be used in forming the bottom foundation wall layer;
- The angle of the trench (wall or side prop) slope or mound against the trench foundation's horizontal plane;
- The groundwater level in the anticipated construction area of the pipeline network trench.

Note:
Selection of the top foundation mound layer thickness (b) is an individual matter, as it depends on the load bearing properties of the soil at the construction site.



For the minimum trench width in relation to the pipe's standard nominal dimension (DN), as recommended by EVOPIPES, see the table below.
The table is based on table 1 of point 6.2.2. of standard EN 1610

Standard nominal dimension DN		Minimum trench width B = OD +L, m								
		Trench with support reinforcing walls			Trench without support reinforcing walls					
					β > 60°			β≤ 60°		
ID	OD	L/2	OD+L	B	L/2	OD+L	B	L/2	OD+L	B
mm	mm	m	m	m	m	m	m	m	m	m
500	565	0,35	0,565+0,70	1,265	0,35	0,565+0,70	1,265	0,20	0,565+0,40	0,965
600	678	0,35	0,678+0,70	1,378	0,35	0,678+0,70	1,378	0,20	0,678+0,40	1,078
800	906	0,425	0,906+0,85	1,756	0,425	0,906+0,85	1,756	0,20	0,906+0,40	1,306
1000	1134	0,425	1,134+0,85	1,984	0,425	1,134+0,85	1,984	0,20	1,134+0,40	1,534

The quantity L/2 *or* 0.5 x L *is equal to the minimum working space between the pipe and the trench wall (slope) of the trench wall reinforcement (support) base.*
Where: OD *– the pipe's external diameter;*
β *– is the angle of the trench wall (slope) without prop reinforcement, which is measured horizontally (the horizontal plane against the unreinforced wall slope of the trench).*

Soil material may be used for filling the trench if it complies with **the requirements for refillable soil material stipulated in table A1 of Annex A of standard CEN/TR 1046.** The soil compacting level depends on the material used to fill the trench as well as whether the pipeline will be built in an area with or without traffic load. This is necessary to ensure the required strength and stability for the pipe network structure during its lifetime. In accordance with **point 5.1.6.5. of standard CEN/TR 1046** for zones with traffic load it is recommended to select compacting class **W**, and for zones without traffic load it is recommended to select compacting class **N.** The soil material compacting class is determined in accordance with standard Proctor density **(SPD)**. The table below shows the standard Proctor density **(SPD)** by compacting class.

Soil compacting work in the trench must be performed in accordance with **table 6 of standard CEN/TR 1046.**

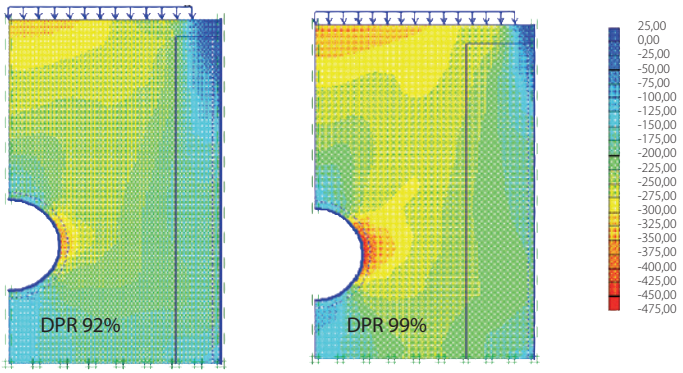
For recommendations and advice on selecting the appropriate compacting method to achieve the desired compacting class, see **point 5.1.6.4. of standard CEN/TR 1046.**

Quality control for soil compacting work must be performed in accordance with **point 5.1.7. of standard CEN/TR 1046.**

The soil ancillary materials group to be used for filling the trench.
(in accordance with the soil classification in Annex A of standard LVS CEN/TR 1046)

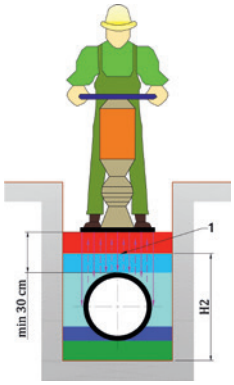
Compacting classes	G4	G3	G2	G1
	SPD, %	SPD, %	SPD, %	SPD, %
N (none)	75 ÷ 80	79 ÷ 85	84 ÷ 89	90 ÷ 94
M (average)	81 ÷ 89	86 ÷ 92	90 ÷ 95	95 ÷ 97
W (good)	90 ÷ 95	93 ÷ 896	96 ÷ 100	98 ÷ 100

Standard Proctor density (SPD) *is calculated in accordance with standard DIN 18127, which complies with standard EN 13286-2.*
G1 *– non-binding soil material (e.g., sand, gravel);*
G2 *– lightly binding soil material (e.g., binding sand, gravel);*
G3 *– binding mixed soil material (e.g., coarse sand);*
G4 *– binding soil material (e.g., clay).*



Performing a simulation of pipe installation with the soil compacting level at standard Proctor density **(SPD)** with **(SPD = Dpr 92 %)** and **(SPD = Dpr 99 %)** which was calculated using the **"final element method"**, it was found that soil compacting increased. This is caused by the impact of dynamic loads, and the maximum soil pressure on the pipe is found in the side arc prop section rather than the top arc surface field. In this side arc prop section, absorb load tension by distributing it through the highly compacted soil.

ATTENTION!



In performing material compacting foundation work and using heavy compacting equipment on the trench above the pipe zone (>0,60 kN) it is mandatory to observe the following: the zone above the pipe must have a surface layer of soil material ≥30 cm and in the zone above the pipe connection ≥20 cm thick.

DESIGNATIONS:
1 – covering layer surface zone above the pipe;
H2 – covering layer thickness zone around the pipe.

GENERAL INSTRUCTIONS AND STANDARDS FOR PIPE CONSTRUCTION AND ASSEMBLY

To receive technical support for construction and assembly instruction implementation please contact EVOPIPES sales department staff or distribution partners

Individual length pipes:

If during the construction stage the building plan require for shortening the pipe, it must be cut off before placement in the trench. Before shortening the pipe, remove the rubber sealing ring from the end of the pipe, measure the required length and mark it on the pipe. The cut spot must be located at the lowest point of the corrugation. When it is done make an even cut, then clean off the cut site and re-place the rubber sealing ring.

EN **752**	Rain and waste water and sewage systems outside the buildings
EN **1610**	Rain and waste water and sewage systems outside the buildings
CEN/TR **1046**	Plastic pipe and channel systems. Systems for water and sewerage removal which are located outside building structures. Recommendations for assembly underground
ATV - A **139**	Manufacturing standards for sewerage pipes and drains
DIN **1986**	Drainage systems for buildings and land in construction territories
ZTV A - StB **97**	Additional technical regulations and recommendations for digging work in traffic zones

For quicker and better quality GIGAPIPE system assembly, we recommend using the EVOPIPES pipe connection device.

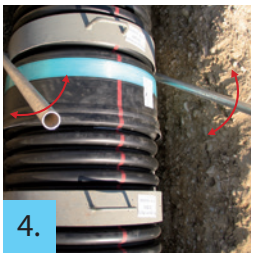
Assembly instructions:

1. Clean accumulated dirt and soil off the pipe joints. After this lubricate the inside of the pipe extension with industrial lubricant.
2. Place the rubber sealing ring on the end of the other pipe (the section of pipe which during assembly is placed inside the other pipe's extension). After this place the pipe against the extension of the other pipe at such a distance that the pipe connecting device can be inserted between them. Make sure that the marking line is on the top of the pipe and the pipes are placed facing each other so both ends can be connected thus forming an uninterrupted line. It is important to ensure that the related pipe connections are from the same nominal ring stiffness class. This can be determined by the marking lines as each nominal ring stiffness class has its own colour (page 6 of "Product identification markings"). **3.** The plug on one side of the GIGAPIPE pipe connection device is placed in the second corrugation of the pipe (from the pipe's extension). The plug on the other side of the pipe connection device is placed in the corrugation of the other pipe so that the pins fit from the side into the first opening. After this the shoulders of the lever are placed on the end of the pipe's extension.
4. Move the lever shoulders back and forth. This will push the end of the pipe into the extension.
5. The pipes are correctly connected when the pipe is inserted right to the end of the extension.


1.


2.


3.


4.


5.

THE GIGAPIPE SYSTEM

Chamber solutions

Spheres of use

- For any type of utility sewage and stormwater gravity pipeline network;
- For road culvert gravity pipe networks;
- For combined gravity sewage systems;
- For land drainage systems;
- For individual-type production (industrial) and special inhabited area solutions;
- For special utility structure construction solutions.

GIGAPIPE system pipes have a large diameter and building projects can be implemented using individualised polymer wells. On request individualised polymer wells with nominal standard dimensions **(DN) from 1000 mm up to 3200 mm can be ordered from the EVOPIPES range.**

THE GIGAPIPE SYSTEM

Hydraulic dimensioning (choice of sizes)

The main factors determining water flow in pipeline networks are the pipeline's constructed slope and the roughness of the pipe's internal surface. Thanks to an optimal technological production process EVOPIPES offers GIGAPIPES pipes with very smooth non-porous surfaces with absolute internal surface material roughness from 0.005 mm to 0.05 mm. This type of internal surface prevents the accretion of sediment inside the pipe as well as associated microbiological processes which result in a microbiological layer forming on the surface. When making hydraulic calculations for pipes the pipe connections sites, their branches, chambers and other factors which affect the hydraulic flow regime must be taken into account. Therefore, hydraulic parameter calculations must be made according to the hydraulic roughness coefficient 0.25 mm **(argumentation in specification ATV - DVWK – A 110 and point E.2. of standard EN 752)**. To make it easier to calculate hydraulic parameters, EVOPIPES has developed the GIGAPIPE DN/ID pipe hydraulic parameter diagram in accordance with the **Coolebrook - White** equation at full (100 %) pipe filling and hydraulic roughness coefficient 0.25 mm.

Diagram 1

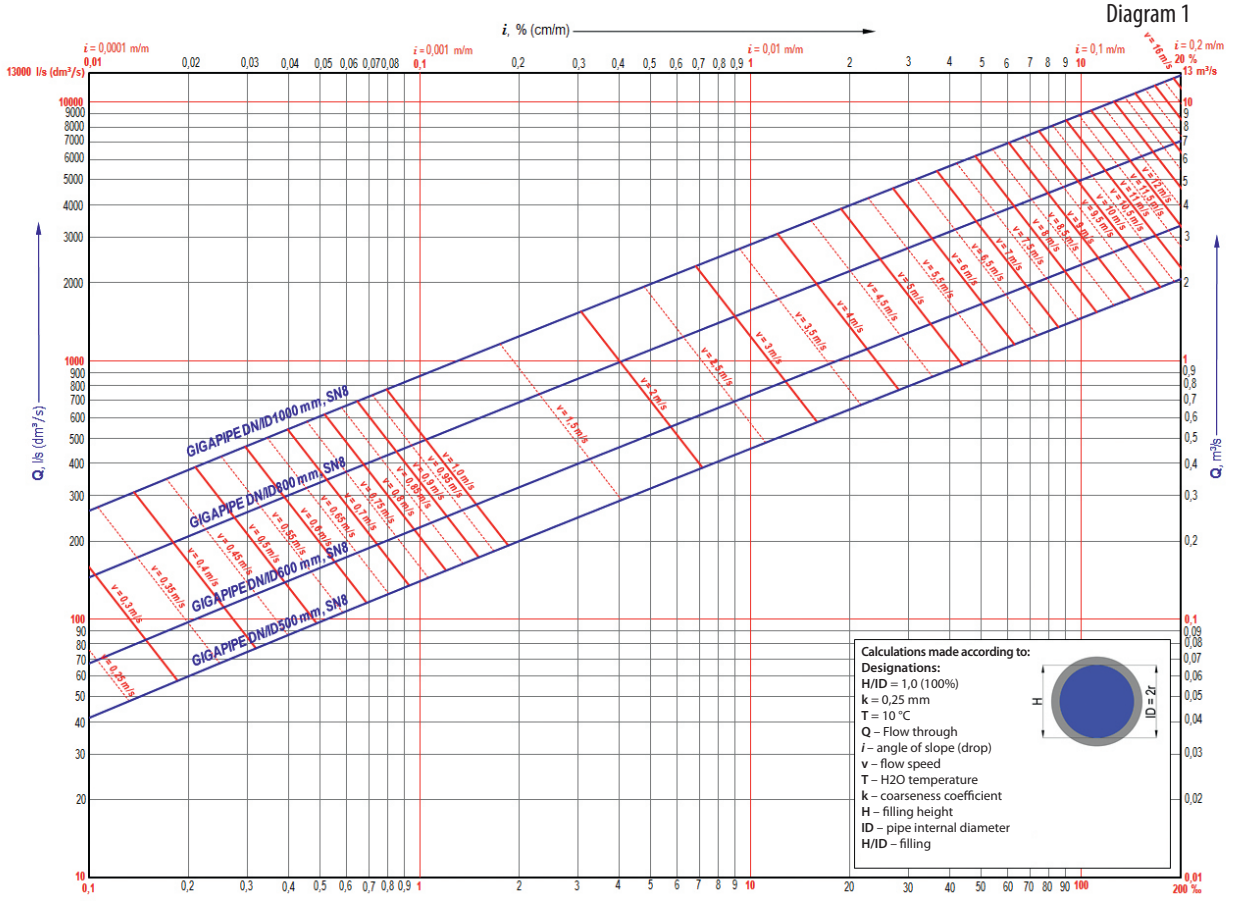
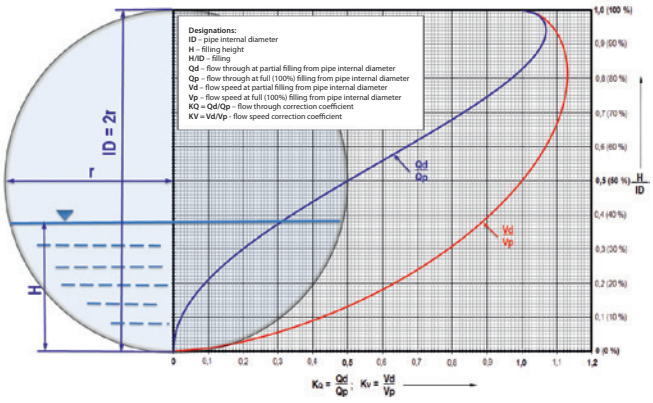


Diagram GIGAPIPE DN/ID pipeline flow-through at partial (non-full) fillings

Diagram 2



Hydraulic parameter calculation example for a GIGAPIPE DN/ID pipe at partial filling

It is necessary to calculate the hydraulic parameters for a GIGAPIPE DN/ID 800 mm pipe at filling H/ID = 0,6 (60 %) and construction slope i = 1,1 %. Diagram No 1. Shows the hydraulic parameters for a pipe at full filling H/ID = 1,0 (100 %):
Q100% = 1643,4 l/s un v100% = 3,33 m/s
Then from diagram No 2 at filling H/ID = 0,6 (60 %) read the flow correction formula and flow speed correction formula:
KQ = 0,67 and Kv = 1,07
Q60% = KQ x Q100% = 0,67 x 1643,4 = 1101,08 l/s
V60% = Kv x v100% = 1,07 x 3,33 = 3,56 m/s

ISO/TR 10358 summary of technical report on **GIGAPIPES PP DN/ID series pipes** resistance to various chemical substances. For more detailed information which is not covered below in the **technical report summary**, see the ISO/TR 10358 technical report.

Chemical substance or product	Temperature ℃	GIGAPIPE PP
Acetaldehyde, in water (40%)	40	®
Acetic acid (<10%)	40	®
Acetic acid (10%-85%)	60	®
Acetic acid (85%-95%)	40	®
Acetic acid (>95%)	20	®
Acetone (small quantity)	20	®
Ammonia, water liquid (20%)	40	®
Ammonia, dry gas	60	®
Ammonium chloride (20%)	20	d
Ammonium fluoride (2%)	20	d
Ammonium nitrate (20%)	20	d
Aniline (saturated liquid)	60	x
Arsenic acid (<20%)	60	®
Beer	60	®
Benzene	20	d
Bleaching agent (13%)	40	®
Hydroxide (saturated liquid)	60	®
Bromine acid, liquid(10%)	20	®
Butane, gas		x
Carbonic acid, dry	40	®
Carbonic acid, dry or damp	40	®
Coal tetrachloride	20	x
Coal disulphide	20	d
Caustic soda (<40%)	40	®
Caustic soda (40%-60%)	60	®
Cement, dry	20	®
Cement, mixture	20	®
Chlorine, dry or damp gas	20	d
Chlorine, water liquid	20	x
Chlorinated hydrocarbon		x
Chloric acid (100%)	20	d
Chromic acid, water liquid (<50%)	50	®
Chromic acid (20%)		d
Chrome-sulfuric acid (20%)		d
Citric acid, saturated liquid	60	®
Chloride, liquid (<90%)	45	d
Copper sulfate, saturated liquid	60	®
Copper chloride, saturated liquid	60	®
Diesel fuel	20	®
Photographic developing agents	40	®
Dextrine (18%)	20	®
Ester		x
Ethyl alcohol (<40%)	40	®
Ethyl ether	20	d
Butyric acid	20	d
Butyric acid	40	®
Fluorine chlorinated hydrocarbon		d
Formaldehyde, liquid	30	®
Formic acid (<30%)	40	®
Formic acid, concentrate	20	®

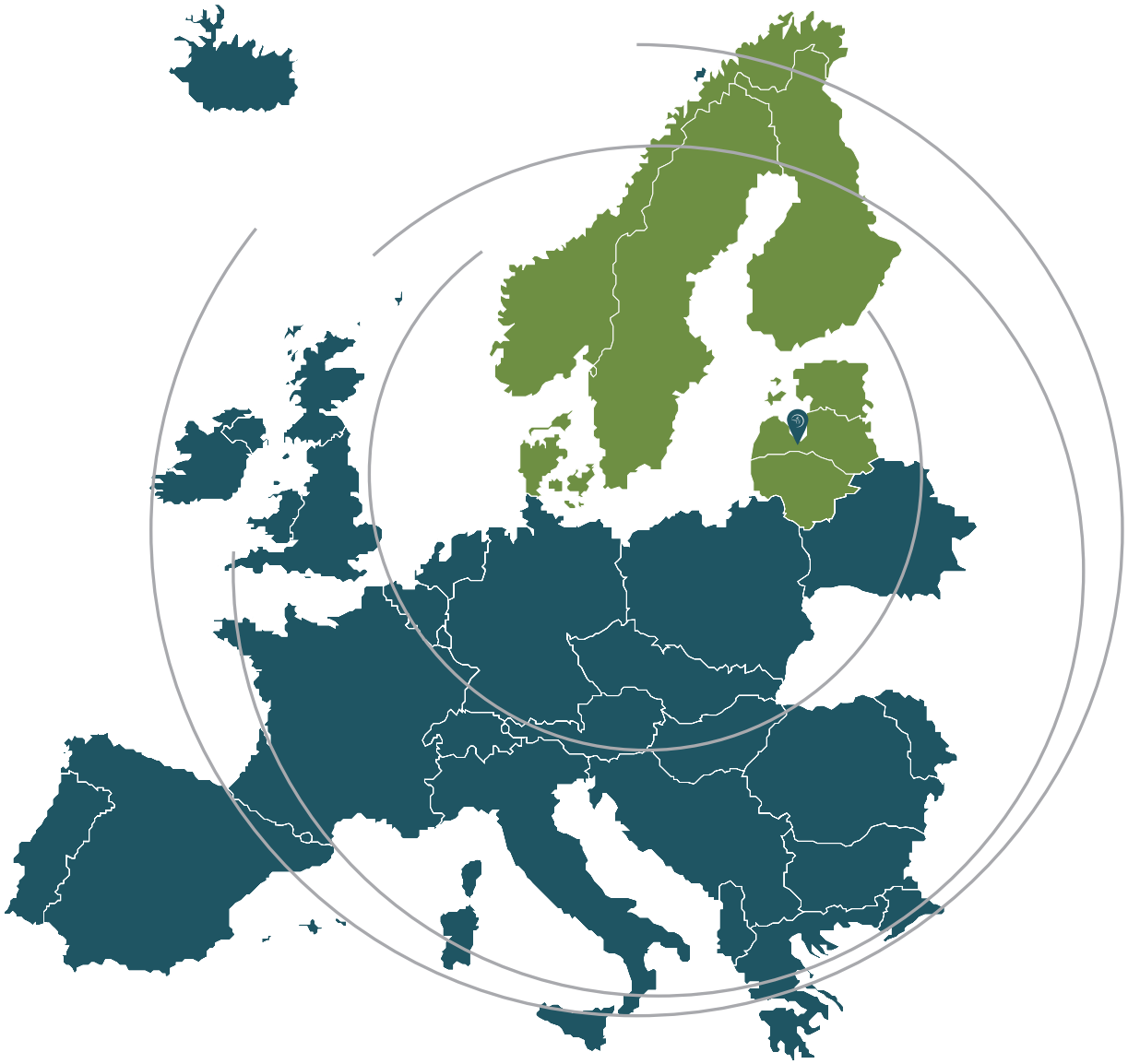
Chemical substance or product	Temperature ℃	GIGAPIPE PP
Glycerin, liquid	60	®
Hydrochloric acid, liquid	40	®
Hydrochloric acid, concentrate	60	®
Hydrofluoric acid (40%)	20	®
Hydrofluoric acid (60%)	20	®
Hydrofluoric acid (100%)	20	®
Hydrogen (100%)	60	®
Hydrogen peroxide (20%)	20	®
Hydrogen sulfide, dry or damp	60	®
Hydrogen sulfide, liquid	40	®
Fluoride		x
Lactic acid (10%-90%)	40	®
Methylated spirit, liquid	40	®
Mineral oil	20	®
Sodium chlorate, liquid	20	®
Sodium hydroxide(<10%)	20	®
Nitric acid (<30%)	40	®
Nitric acid (30%-45%)	45	®
Nitric acid (50%-60%)	20	d
Nitric gases, dry or damp	60	d
Oils and fats	60	®
Oxalic acid, liquid(10%)	40	®
Oxalic acid, liquid (concentrate)	60	®
Oxygen	60	®
Ozone	20	d
Perchloric acid (10%)	20	®
Perchloric acid (70%)	60	d
Permanganate (<6%)	20	®
Petrol	60	d
Crude oil	20	®
Phenol (<90%)	45	d
Orthophosphoric acid, liquid (<30%)	40	®
Orthophosphoric acid, liquid (>30%)	60	®
Potassium nitrate	60	®
Potassium chloride	60	®
Propane, liquid		x
Salt liquid	40	®
Seawater	40	®
Sulfur dioxide (in all states)	40	®
Sulfuric acid, liquid (<40%)	40	®
Sulfuric acid, liquid (40%-80%)	60	®
Sulfuric acid, liquid (80%-90%)	40	®
Sulfuric acid, liquid (90%-96%)	20	®
Common salt liquid (weak)	40	®
Tartaric acid (10%)	60	®
Urine	40	®
Water	60	®
Xylene(100%)	20	d
Zinc chloride, liquid (all types)	60	®
Zinc chloride, liquid (weak)	60	®

DESIGNATIONS:

® - are resistant to chemical substances;
d - are partially resistant to chemical substances;
x - are not resistant to chemical substances.

GIGAPIPE®

PIPELINE SYSTEM FOR CONSTRUCTION OF ROAD CULVERTS, RAIN AND WASTE WATER INFRASTRUCTURE



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