Amiblu®
Sustainable Water Solutions

# Amiblu Product Guide

Sustainable pipe systems
engineered for the next 150 years

FLOWTITE®
HOBAS®

Amiblu Pipe Systems
**Engineered for the next 150 years**

# Contents

# 1 Advantages

## 1.1 Why engineers choose Amiblu GRP pipes

### Expected service life
Amiblu pipes have an expected service life of more than 150 years.

### Corrosion-free
Amiblu pipes need no coating or anti-corrosion treatment. The pipes are manufactured from inherently corrosion-resistant materials, thus outperforming steel, ductile iron, and steel-reinforced pipes that require corrosion protection.

### UV resistant
Amiblu pipes are resistant to UV light.

### Acid resistant
Amiblu pipes have an extraordinary resistance against acid and chemicals. The unique resistance of Amiblu pipes is ensured by careful consideration of all raw materials, the pipe design and production process. Amiblu pipes resist the sulfuric acids that build up in sewers. They resist the actions of ground salts and salty waters. Amiblu pipes may also be used in other chemically demanding applications. Please see the table on chemical resistance in the Appendix for more details.

### Lightweight design
Amiblu GRP pipes are lighter than ductile iron, steel, concrete and most non-reinforced plastic pipes. This makes transportation less expensive, and less expensive installation equipment can be used. Their light weight enables the pipes to be easily transported and handled in remote and hardly accessible areas. Amiblu pipes can be nested, meaning that smaller pipes can be transported inside larger pipes, thus reducing the cost of transportation.

## 1.2 Environmental impact of Amiblu pipes

Amiblu pipes have a low carbon footprint compared to other pipe materials. This has been confirmed by external bodies and universities.

### Comparison to other materials

An independent study conducted at the Norwegian University of Life Sciences in 2012 concludes that GRP pipes have a minimal negative environmental impact compared to other pipe materials. The main reason for this is the material efficiency.

### Energy-efficient in operation

The smooth bore and good flow characteristics of Amiblu pipes reduce the amount of energy used for pumping. In penstocks, it increases the energy output.

### Low energy consumption in production

The amount of energy used in the production of Amiblu pipes is less than what is required for most other pipe materials.

### Efficient transportation

Lightweight design combined with the fact that Amiblu pipes can be nested during transportation lead to lower carbon emissions from pipe transportation.

### Recyclable

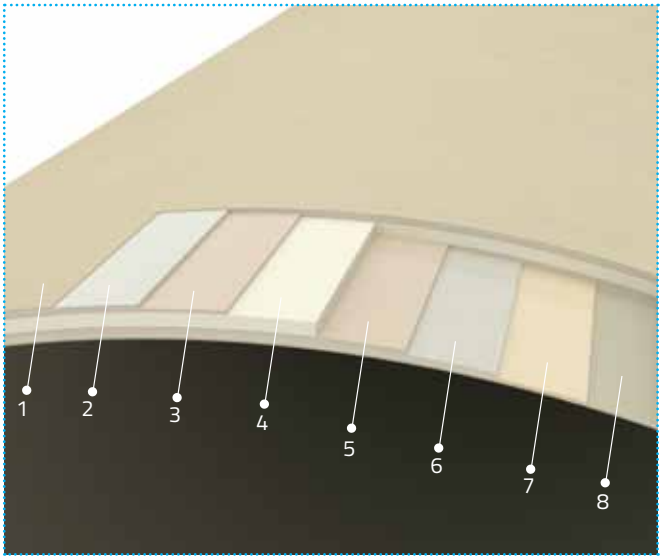
Amiblu pipes are recyclable. The Federation of Reinforced Plastics in Germany recommends that GRP pipes are used e.g. in cement production.

A full, third-party-verified Lifecycle Assessment has been conducted on Amiblu pipes according to ISO 14040. The information may be provided upon request by Amiblu.

# 2 Amiblu Circular Pipes

## 2.1 GRP pipes with Hobas technology

Amiblu pipes produced with the Hobas centrifugal casting technology are made of chopped glass fiber, thermosetting resins (e.g. unsaturated polyesters or vinyl ester resins), minerals, and silica sand. The pipes are circular with an even outer diameter.




**1** External protective layer
**2** Outer reinforced layer
**3** Transition layer
**4** Core layer
**5** Transition layer
**6** Inner reinforced layer
**7** Barrier layer
**8** Inner liner layer

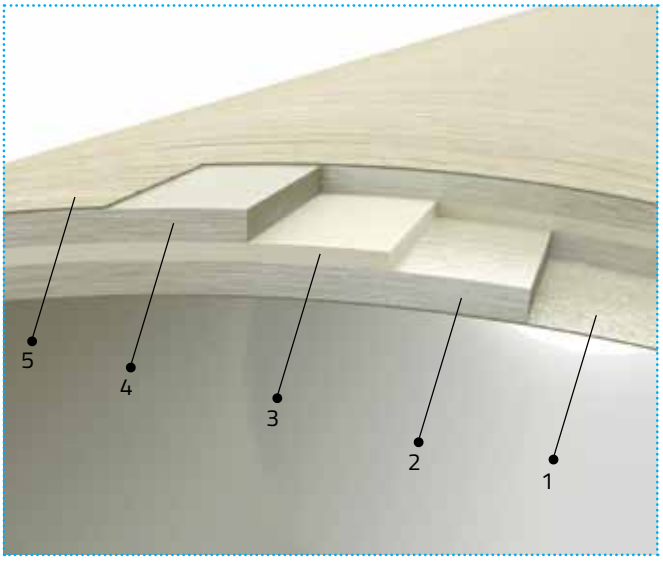
**Wall structure of centrifugally cast Amiblu pipe (Hobas technology)**

### Technical data Amiblu pipes with Hobas technology

| | |
|---|---|
| Main materials | Resin, glassfibers, sand |
| Operating temperature | -50 °C to +85 °C |
| Standard lengths | 6 m |
| Pressure range | PN 1 |
| Expected service life | more than 150 years |
| Corrosion protection | none needed |
| Hydraulic roughness | k = 0.01-0.016 mm (Colebrook-White) |

## 2.2 GRP pipes with Flowtite technology

Amiblu filament wound pipes are built as a structural sandwich, using the Flowtite continuous filament winding technology. The high-strength continuous glassfibers resist the hoop stresses from internal pressure, while the chopped fibers provide excellent resistance to axial stresses, impact, and handling loads. The structural laminate consists of heavily reinforced skins, separated by a compact, reinforced silica-filled core to provide optimal bending stiffness. Together with the protective layers, this construction provides capacity to resist high internal pressures and maintains excellent long-term stiffness.




**1** Inner liner layer
**2** Inner structural layer
**3** Core layer
**4** Outer structural layer
**5** Exterior surface

**Wall structure of filament wound Amiblu pipe (Flowtite technology)**

### Technical data Amiblu pipes with Flowtite technology

| | |
|---|---|
| Main materials | Resin, glassfibers, sand |
| Operating temperature | -50 °C to +70 °C |
| Standard lengths | 12 and 6 m |
| Pressure range | PN 1 – PN 32 |
| Expected service life | more than 150 years |
| Corrosion protection | none needed |
| Hydraulic roughness | k = 0.029 mm (Colebrook-White) |

## 2.3 Pressure pipes

### Flowtite Grey (FG)

Extra impact resistant, uniaxial pressure pipe with main reinforcement in the hoop direction. Used in hydropower, irrigation, water mains, and other pressure applications. Allows for backfill particle size up to 64 mm (sieve size). Flowtite pressure pipes > DN 100 without Flowtite Grey properties are available on request.

| | |
|---|---|
| Diameter range (DN) | 300-4 000 mm |
| Pressure (PN) | up to 32 bar |
| Nominal lengths | up to 12 m |
| Stiffness (SN) | 5 000 & 10 000 N/m² |

### Flowtite biaxial pipe (FB)

Flowtite pipe reinforced in the hoop and axial directions to resist pressure end thrust and bending loads. Common uses: cooling water, desalination, and other industrial above ground applications.

| | |
|---|---|
| Diameter range (DN) | 100-4 000 mm |
| Pressure (PN) | up to 20 bar |
| Nominal lengths | up to 12 m |
| Stiffness (SN) | 5 000 & 10 000 N/m² |

### Flowtite Orange (FO)

Extremely wear-resistant uniaxial pressure pipe that is designed e.g. for mining slurry pipelines. Can also be used in other applications with extreme wear exposure and high flow velocities.

| | |
|---|---|
| Diameter range (DN) | 300-4 000 mm |
| Pressure (PN) | up to 32 bar |
| Nominal lengths | up to 12 m |
| Stiffness (SN) | 2 500/5 000/10 000 N/m² |

## 2.4 Non-pressure pipes

### Hobas sewer pipe

Centrifugally cast Hobas pipe designed for exceptional acid resistance. Typically used for sewer, drainage, and storm water applications. Water jetting resistant according to DIN 19523.

| | |
|---|---|
| Diameter range (DN) | 200-3 600 mm |
| Pressure (PN) | 1 bar |
| Nominal lengths | 6 m |
| Stiffness (SN) | 10 000 N/m² |

### Flowtite sewer pipe

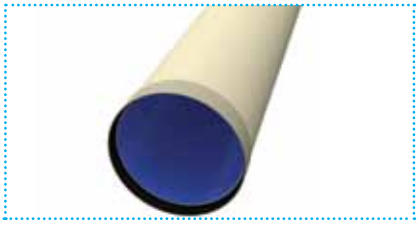
Filament wound Flowtite pipe designed for exceptional acid resistance. Typically used for sewer and storm water applications. Water jetting resistant according to DIN 19523.

| | |
|---|---|
| Diameter range (DN) | 100-4 000 mm |
| Pressure (PN) | 1 bar |
| Nominal lengths | 6 & 12 m |
| Stiffness (SN) | 10 000 N/m² |

### Hobas PU Line

Hobas pipe designed for exceptional wear resistance and low head loss. Typically used for sewer, drainage, and storm water applications. Water jetting resistant according to DIN 19523.

| | |
|---|---|
| Diameter range (DN) | 1 200-3 600 mm |
| Pressure (PN) | 1 bar |
| Nominal lengths | 6 m |
| Stiffness (SN) | 10 000 N/m² |



Custom lengths, diameters, pressure and stiffness classes are available on request.

## 2.5 Jacking pipes

### Hobas jacking pipes

Hobas pipe designed to withstand high jacking forces. Typically used for jacking under structures like roads and railways. Water jetting resistant according to DIN 19523.

| | |
|---|---|
| Diameter range (OD) | 272-3600 mm |
| Pressure (PN) | up to 16 bar |
| Nominal lengths | 1, 1.5, 2, 3, 6 m |
| Stiffness (SN) | 32000 up to 1000000 N/m² |

### Flowtite jacking pipes

Flowtite pipe designed to withstand high jacking forces. Typically used for jacking under structures like roads and railways. Custom diameters are available. Water jetting resistant according to DIN 19523.

| | |
|---|---|
| Diameter range (OD) | 300-3600 mm |
| Pressure (PN) | up to 16 bar |
| Nominal lengths | 1-6 m |
| Stiffness (SN) | 32000 up to 1000000 N/m² |

# 3 Joints and Couplings

## 3.1 Pressure and non-pressure couplings

### Hobas filament wound coupling (FWC)

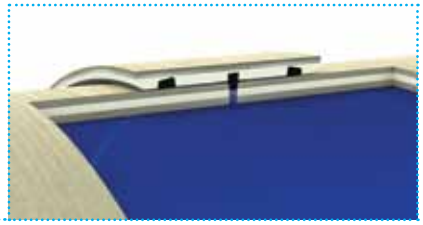
Used in pressure and non-pressure pipelines.

| | |
|---|---|
| Diameter range (DN) | 200-3600 mm |
| Pressure (PN) | < DN 1000: up to 32 bar<br>> DN 1000: max. 20 bar |
| Angular deflection* | up to 3° |

### Flowtite pressure coupling (FPC)

Commonly used for penstocks, water supply, irrigation and pressure sewer applications.

| | |
|---|---|
| Diameter range (DN) | 100-4000 mm |
| Pressure (PN) | up to 32 bar |
| Angular deflection* | up to 3° |



### Flowtite pressure coupling angled (FPCA)

Flowtite coupling for increased angular deflections up to 3 degrees.

| | |
|---|---|
| Diameter range (DN) | 300-2500 mm |
| Pressure (PN) | up to 16 bar |
| Angular deflection* | 3° |

### Flowtite lock joint (FLJC)

Biaxial joint used for applications where transfer of load between pipes is required.

| | |
|---|---|
| Diameter range (DN) | 300-2000 mm |
| Pressure (PN) | 6-16 bar |
| Angular deflection* | Not applicable |

### Flowtite non-pressure coupling (FSC)

Commonly used for sewers and storm water applications.

| | |
|---|---|
| Diameter range (DN) | 300-3000 mm |
| Pressure (PN) | 1 bar |
| Angular deflection* | up to 3° |

### Amiblu non-pressure coupling (ASC)

Commonly used for sewers and storm water applications with Hobas pipes.

| | |
|---|---|
| Diameter range (DN) | 200-3000 mm |
| Pressure (PN) | 1 bar |
| Angular deflection* | up to 3° |

Pressure systems (pipe and joints) can be either uniaxial or biaxial. A uniaxial joint will not transfer thrust load from one pipe section to the next, and consequently the pipe is not reinforced to carry such load. Biaxial joints are designed to carry full pressure thrust from one pipe section to the next and the pipe is reinforced to carry that load.
Other terms used:

- Uniaxial: non end-load bearing system, unrestraint system
- Biaxial: end-load bearing system, restraint system

* The degree of angular deflection is dependent on the pipe diameter. Contact your local supplier for more information.

## 3.2 Flush joints

### GRP sleeve

Commonly used for jacking and relining. Fits centrifugally cast and filament wound Amiblu pipes.

Diameter range (OD) 272-3 600 mm
Pressure (PN) up to 6 bar

### Stainless steel sleeve

Commonly used for jacking and relining. Fits centrifugally cast and filament wound Amiblu pipes.

Diameter range (OD) 272-3 600 mm
Pressure (PN) up to 6 bar

### Stainless steel & rubber sleeve

Commonly used for jacking and relining. Fits centrifugally cast and filament wound Amiblu pipes.

Diameter range (OD) 272-2 500 mm
Pressure (PN) up to 16 bar

## 3.3 Other joints and couplings

### Field joints for pressure & gravity applications

Laminated field joints are available in uniaxial and biaxial designs. Amiblu provides the necessary instructions or skilled personnel for butt-wrap joining in pressure and non-pressure applications. Technologies developed by Amiblu provide faster and more cost-efficient installations.

### Masonry couplings

The masonry coupling is used for connecting pipes to concrete shafts and walls. Masonry couplings are sanded for improved stability in concrete shafts. Masonry couplings can be delivered with pipe ring, and optionally with sealing tape. Lengths can be selected as required in consideration of the pipe joint data.

### Mechanical couplings

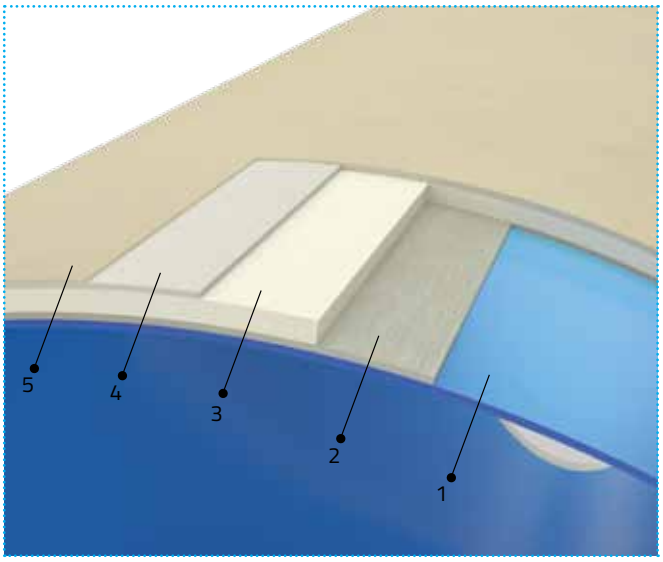
Amiblu pipes can be joined using steel couplings. Examples of steel couplings are the tangential bolt couplings of Straub, Tee-Kay and Arpol, and the axial bolt couplings of Viking Johnson, Helden, and Klamflex.

### Amiblu flanges

Amiblu manufactures and sells flanges in various designs and according to different standards and requirements. When connecting two GRP flanges, the standard bolt pattern to which flanges are manufactured is EN 1092. Other bolting dimension systems such as according to AWWA, ANSI, DIN, and JIS can be supplied.

# 4 Amiblu Non-Circular Pipes (NC Line)

Amiblu NC Line pipes with their non-circular cross-sections are ideal for relining old city sewers, culverts and channels that often hold non-circular shapes. Non-circular pipes are also used for open-trench applications. The non-circular profiles are produced using a filament winding technology. They can be customized according to customer demands and easily be adapted to different types of shapes and geometries. The remaining annular space between the host and liner pipes is usually filled with grout. This fixes the inserted pipe in its position and can take over the structural load. The product has a proven sealing system that allows excellent tightness and easy joining, also under angular deflection. Non-circular Amiblu pipes meet the requirements of ISO 16611.




**1** Inner liner layer
**2** Inner structural layer
**3** Core layer
**4** Outer structural layer
**5** Exterior surface

**Wall structure of Amiblu NC Line pipe**

## Technical data Amiblu NC Line pipes

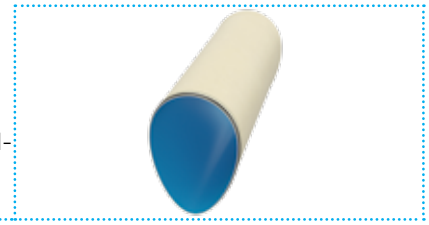
| | |
|---|---|
| Main materials | Resin, glassfibers, sand |
| Operating temperature | -50 °C to +50 °C |
| Standard length | 3 m |
| Diameter range | 400-4 000 mm |
| Pressure range | PN 1 |
| Expected service life | more than 150 years |
| Corrosion protection | none needed |
| Water jetting resistance | tested according to DIN 19523 |
| Estimated hydraulic roughness | k = 0.029 mm (Colebrook-White) |

## 4.1 Non-circular profiles

### NC Line egg profile

Commonly used for relining old stormwater sewers in cities, sanitary projects, and chemical sewers.

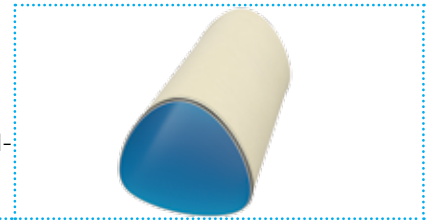
| | |
|---|---|
| Nominal size* | 400-4 000 mm |
| Pressure (PN) | 1 bar |
| Nominal lengths | 0.5, 1, 1.5 and 3 m |
| Thickness | Load-carrying or non load-carrying profiles available |



### NC Line mouth profile

Commonly used for relining old stormwater sewers in cities, sanitary projects, and chemical sewers.

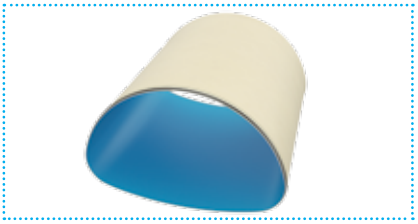
| | |
|---|---|
| Nominal size* | 400-4 000 mm |
| Pressure (PN) | 1 bar |
| Nominal lengths | 0.5, 1, 1.5 and 3 m |
| Thickness | Load-carrying or non load-carrying profiles available |



### NC Line arch profile

Commonly used for relining old stormwater sewers in cities, sanitary projects, and chemical sewers.

| | |
|---|---|
| Nominal size* | 400-4 000 mm |
| Pressure (PN) | 1 bar |
| Nominal lengths | 0.5, 1, 1.5 and 3 m |
| Thickness | Load-carrying or non load-carrying profiles available |



* Nominal size referring to ISO 16611, i.e., maximum inner height and breadth. The above-mentioned are the most commonly used profiles. Other profiles are available on request. Most profiles can be manufactured with a dry-weather channel.

## 4.2 Jointing of Amiblu NC Line pipes

### Bell & spigot elastomeric seal

| | |
|---|---|
| Diameter range (DN) | 400-4 000 mm |
| Pressure (PN) | 1 bar |

### Bell & spigot glued joint

| | |
|---|---|
| Diameter range (DN) | 400-4 000 mm |
| Pressure (PN) | 1 bar |

# 5 Fittings

Amiblu fittings can be produced in both standard and non-standard forms to customer specifications and are available for pressure and non-pressure applications. More than 200 000 standard Amiblu fittings designs are available for customers worldwide. They are designed based on an extensive research program and patented concepts, have a high stiffness, and are corrosion-free. Amiblu's researchers have rigorously analysed critical strains in bends, tees, and elbows.

## 5.1 Standard fittings

### Elbow

Diameter range (DN) 100-4 000 mm
Pressure (PN) up to 32 bar

### Reducer

Diameter range (DN) 100-4 000 mm
Pressure (PN) up to 32 bar

### Tee

Diameter range (DN) 100-4 000 mm
Pressure (PN) up to 32 bar

### Flange

Diameter range (DN) 100-4 000 mm
Pressure (PN) up to 32 bar

### Saddle

Diameter range (DN) 100-4 000 mm
Pressure (PN) 1 bar

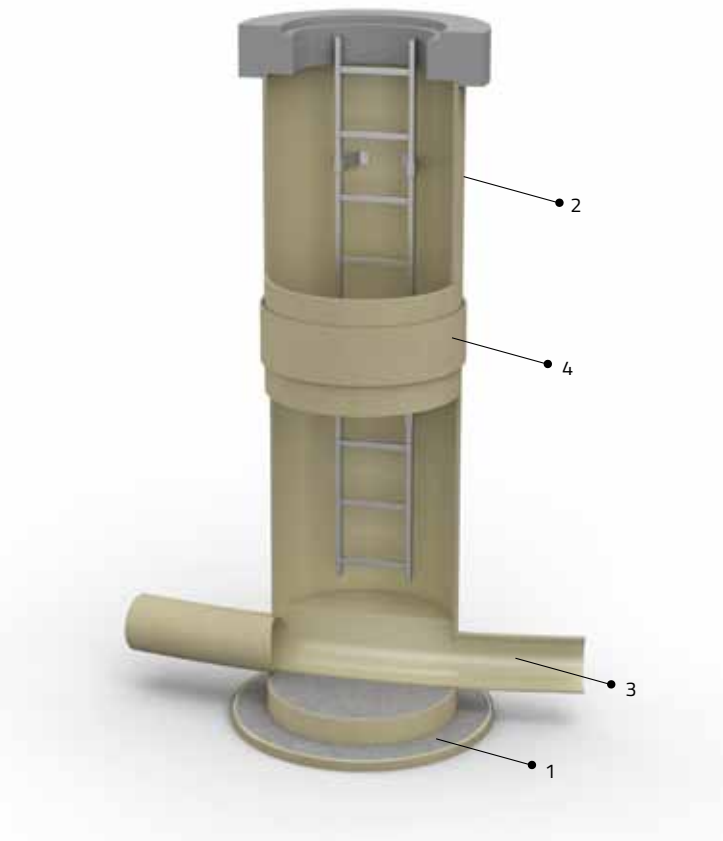
### Wye

Diameter range (DN) 100-4 000 mm
Pressure (PN) up to 10 bar

## 5.2 Manholes

Amiblu GRP manholes are made of glassfiber reinforced unsaturated polyester resin. They include a liner with glassfiber reinforcements for an expected higher chemical pollution of municipal wastewater. Shaft and chamber units comply with the requirements of EN14364 for underground drainage and sewage.

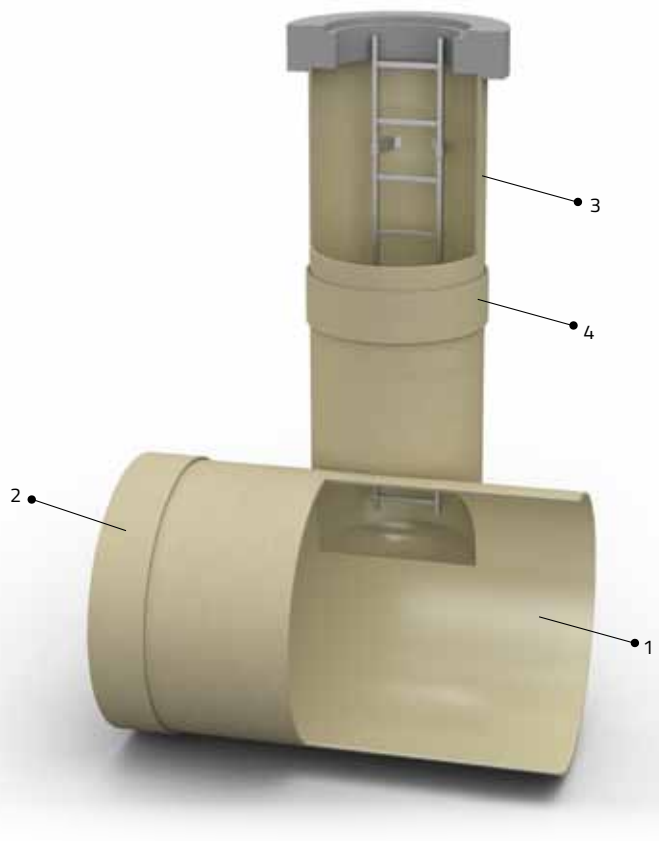
### Standard manhole




**1** Anti-buoyancy measure (GRP base plate or laminated concrete base plate)
**2** Shaft pipe
**3** Connecting branch
**4** Coupling on shaft pipe (for multi-unit designs)

| | |
|---|---|
| Diameter (DN) | 800-1 000 mm |
| Collector Diameter | 800-4 000 mm |

### Tangential manhole




**1** Main pipe (from DN 800)
**2** Coupling on main pipe
**3** Shaft pipe
**4** Coupling on manhole pipe (for multi-unit designs)

Manholes are commonly delivered with berm, ladder, and manhole cover. Other accessories are supplied on request. Standard Amiblu manholes meet the requirements of EN 15383.

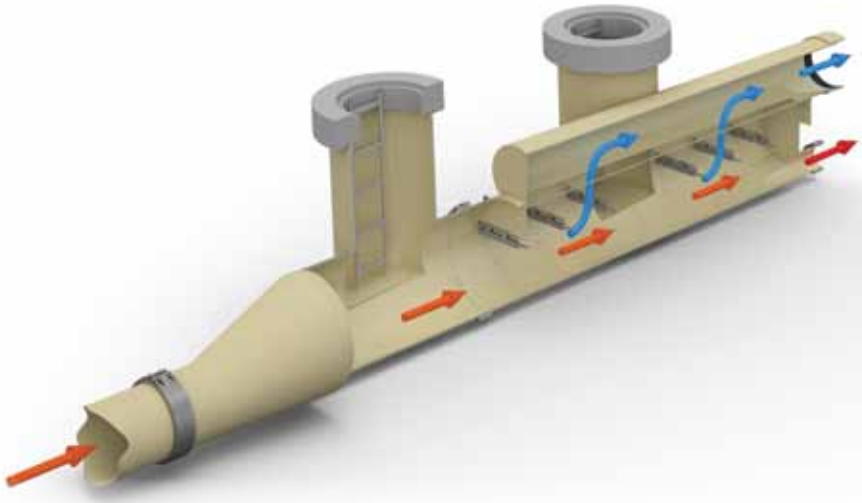
Amiblu manholes are custom-tailored to all sorts of operation requirements. In the case of deep installations as required e.g. on landfill sites, the manholes are designed with a bigger wall thickness to increase the structural stability.

## 5.3 Other engineered GRP solutions

### Amiscreen solids rejection system

Patented modular solution for filtering out solids and debris from storm water, storage function included.

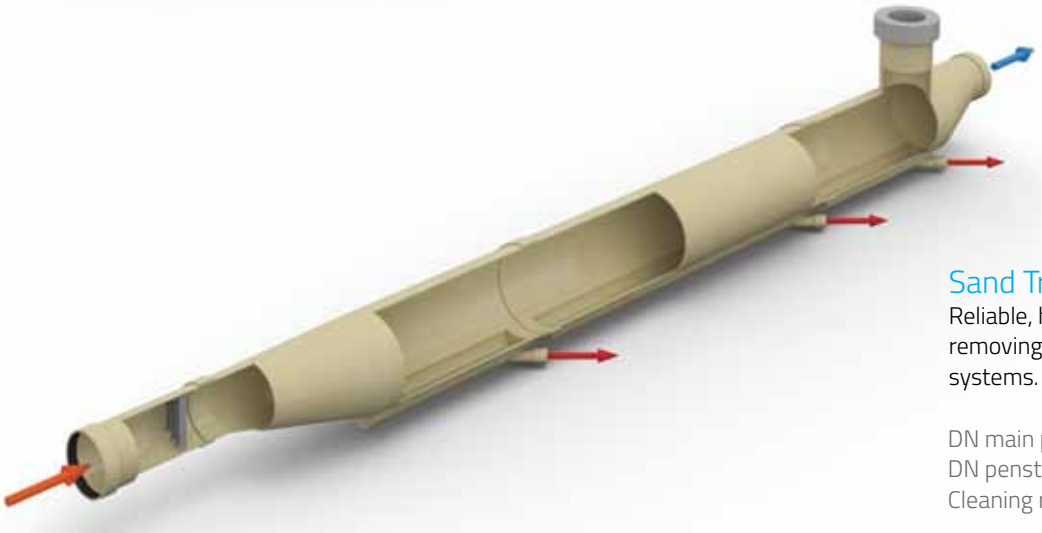
| | |
|---|---|
| DN main pipe | 1 800-3 600 mm |
| Filter size | 8 mm |
| Cleaning capacity | up to 4 000 l/s |
| Storage capacity | as specified (unlimited) |



### Combined Sewer Overflow (CSO) Chamber

Patented modular stormwater overflow system for combined sewers with low-maintenance solids separation and storage function.

| | |
|---|---|
| DN main pipe | 800-2 000 mm |
| Overflow amount | 800 l/s (DN 400-DN 1 000) |
| Filter size | 15-30 mm |



### Sand Trap

Reliable, highly efficient solution for removing solids in small hydropower systems. Protects the turbine from wear.

| | |
|---|---|
| DN main pipe | up to 3 600 mm |
| DN penstock | up to 2 800 mm |
| Cleaning rate | up to 0.5 $m^3/s$ |

## Storm water retention tank

Diameter (DN) up to 3600 mm
Storage capacity as specified (unlimited)

## Potable water tank

Diameter (DN) up to 3600 mm
Storage capacity as specified (unlimited)

# 6 Pipeline Design

Amiblu offers a range of tools to help engineers design pipelines. Tools include software, technical literature, case studies, and field service.

## Software tools

There are several pipeline tools that offer engineers the necessary support for designing Amiblu pipelines, for example static and hydraulic calculations. Some of these software tools are:

- Easypipe, Easymanhole, Easyliner IngSoft Software solutions
- PipeWorks Fischer Ingenieurtechnik
- Amitools
- Caesar 2

## Amiblu Technical Literature

A extensive collection of technical literature can be found on the websites www.amiblu.com, www.flowtite.com and www.hobas.com, including manuals, application brochures, references and case studies.

## Worldwide case studies

There are numerous case studies that provide ideas and data to support engineers as they design new pipelines. Please visit www.amiblu.com for more information.

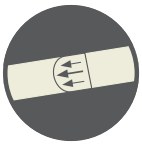
## Worldwide field service

Amiblu offers technical assistance and consultancy to designers and engineers both locally and worldwide. Here is a list of some of our services:

- Configuration of installation
- Burial analysis
- Hydraulic calculations
- Calculation of supports and anchorages
- Connection to other materials
- Stress and finite element analysis of installations
- Drawings of plants, isometrics, production sheets
- Field engineering services

## 6.1 Design considerations for Amiblu pipes

Experience and research have provided Amiblu with reliable and accurate knowledge of how to design pipelines. This chapter highlights the most important data to be considered by structural engineers.

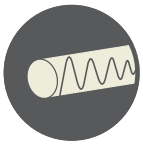


### Flow rate

The most economical flow velocity in pressure pipes is usually 2-3 m/s. This is also the case for Amiblu pipes. The maximum recommended flow velocity is 5 m/s. Amiblu pipelines sustain velocities of up to 8 or 10 m/s if the water is clean and contains no abrasive material. PU-lined pipes may sustain velocities up to 15 m/s, but only after validation by Amiblu.

### Hydraulic roughness

Pipe roughness influence the hydraulic properties of pipes. Amiblu pipes have an extremely smooth pipe interior, and remain consistently smooth over time. Please see the pipe overview in this brochure for hydraulic roughness of the Amiblu pipe range.



### Surge and water hammer

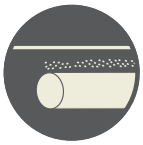
The most important factors influencing the water hammer pressure in a pipe system are the stiffness of the pipe in the hoop direction, the change in velocity of the fluid, the rate of change of the velocity (valve closing time), compressibility of the fluid, and physical layout of the pipe system. The maximum water hammer pressure expected for Amiblu pipes is approximately 1/2 of that for steel and ductile iron pipes in similar conditions.


### High pressure

High pressure (>16 bar) may require a deeper bury to prevent uplift and movement. The minimum burial should be 1.2 metres for pipes DN 300 and larger, and 0.8 metres for smaller diameters.

### Negative pressure (vacuum)

Negative pressure, or vacuum, may occur in pipelines. Amiblu recommends that a stiffer Amiblu pipe is used if high negative pressure is expected.



### High ground water table

A minimum of 0.75 times the diameter of earth cover with minimum dry soil bulk density of 19 kN/m$^3$ is required to prevent an empty submerged pipe from floating. Alternatively, the installation may proceed by anchoring the pipes. Consult your Amiblu manufacturer for details on anchoring

### 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, or casings.

## Chemical exposure

Standard Amiblu pipes sustain excellent properties in contact with clean and dirty water, including sea water. However, re-rating and material selection must be considered if the pipe is to be used in contact with chemicals, process water or contaminated ground waters, with and without elevated operating and design temperatures. Amiblu have special pipe designs for most chemicals, including process water from pulp and paper industry.

## Operating temperature

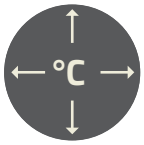
Amiblu pipes may be operated in the temperature ranges indicated in the pipe product overview in this brochure. Requirements in the international pipe standards require a consideration for pressure rerating above 35 °C. At temperatures above 50 °C, vinyl ester resins are often recommended. Amiblu pipes may be used up to operating temperatures of 85 °C with appropriate consideration to pipe design, materials usage, and gasket materials.

## Pipe wall diffusion

Amiblu pipes offer excellent resistance in grounds with diesel and gasoline contaminants. Amiblu pipes generally outperform PE-pipes with respect to diffusion of hydrocarbons through the pipe wall.

## Angular deflection on joints

The maximum angular deflection (turn) at each coupling joint, taking the combined vertical and horizontal deflection into consideration, and measured as the change in adjacent pipe centre lines, shall not exceed 3 degrees. The pipes shall be joined in straight alignment and then deflected angularly as required.




## Thermal coefficient

The thermal coefficient of axial expansion and contraction for Amiblu pipes is 24 to 30 x $10^{-6}$ mm/mm/°C.

# 7 Pipe Installation

Amiblu pipes are light-weight and easy to install. This chapter shows the most common installation types.

## Buried installation

Installation of buried flexible pipes takes advantage of the pipe and soil properties for optimal performance in terms of time and cost. The design and installation procedures are based on guidelines in international standards. The resulting installation procedures do not require any special considerations, just good contractor practice and workmanship, to ensure excellent long-term performance of the pipeline. Buried installations are usually done with uniaxial pipes. Unbalanced thrust requires either the use of thrust blocks, or the use of biaxial pipes close to where the thrust occurs. For complete installation instructions consult the Amiblu Installation guide.

The following information is a partial review of installation procedures:

| | |
|---|---|
| Installation types | Two installation types are most common: Type 1 for deep burials or heavy traffic loads, and Type 2 for less demanding installations, where cheaper backfill materials can be used. |
| Bedding | The trench bed should provide a uniform and continuous support for the pipe. Most granular soils are suited as bedding. The bed must be over-excavated at each joint location to ensure continuous support for the pipe. |
| Backfilling | For optimum pipe-soil interaction, the prescribed backfill material for the installation type must be used. Care should be taken to ensure that the material does not include rocks, soil clumps, debris, or frozen or organic material. |
| Checking the installed pipe | After the installation of each pipe, the maximum deflection shall be checked. With Amiblu pipes this is fast and easy. For typical installations the initial deflection will be 1-2 % and should be compared to the predicted value. The maximum allowable initial deflection is 3 % for diameters larger than DN 300. |

## Thrust-bearing pipe installation (biaxial system)

Thrust-bearing pipe systems carry the fluid pressure and are also able to transfer longitudinal forces or bending moments resulting from end thrust. The biaxial pipe and the joints have axial load-bearing capacity. Unbalanced thrusts can thereby be resisted by the piping system and thrust blocks are not necessary. The correct location of supports will ensure that the axial stress is below the allowable limits. Thrust-bearing piping systems require a detailed three-dimensional structural analysis. The piping engineer uses specialized computer software to determine all stresses and displacements, as well as support forces. Due to the inherent flexibility of Amiblu pipes, the force on components is usually considerably lower than in steel pipe installations.

## Non-thrust bearing pipe installation (uniaxial system)

Pipes are installed on supports or cradles and fastened with straps to ensure stability. The supports are usually concrete or steel; the fastening straps are made of steel. Non-thrust bearing pipe systems carry the fluid pressure but are not designed to transfer thrust forces and therefore require thrust blocks or other supports to resist unbalanced thrust. Amiblu has designed and analyzed the most common installations. The Amiblu Installation guide can provide you with more information about non-restrained joints.

## Jacking installation

With their high strength, Amiblu jacking pipes are well-suited for jacking installations. Amiblu pipe design for jacking and microtunneling takes advantage of non-corrodible materials. The smooth external surface and water repellency gives low friction during jacking.

## Relining installation

Amiblu relining installations are performed with non-circular or circular pipes. The pipe can be jointed outside the existing pipe, culvert or borehole and pushed in. Alternatively, the pipes can be brought in, pipe by pipe, and jointed inside. Low flows can be permitted during installation.

## Subaqueous installation

Amiblu pipes are excellent for subaqueous installations. Dimensions up to 4 meters in diameter are common for Amiblu subaqueous pipelines. Amiblu pipes do not float without end-caps. With a density of approximately twice as high as in water, pipes can be submerged steadily.

**Figures top down: Thrust-bearing pipe installation, non thrust-bearing pipe installation, jacking installation, subqueous installation**

# 8 Pipe production

Amiblu plants are modern, efficient, and located strategically across Europe. Furthermore, Amiblu licensees produce pipes on 5 continents of the world in more than 40 specialized production lines. Raw materials are delivered with vendor certification demonstrating their compliance with Amiblu quality requirements. In addition, all raw materials are sample tested prior to their use. These tests ensure that the pipe materials comply with the specifications as stated.

## 8.1 Centrifugal casting (Hobas technology)

Amiblu pipes with Hobas technology are produced by centrifugal casting in a 100 % computer-controlled process. The manufacturing machine's arm feeds all raw materials – chopped glass fibers, thermosetting plastics (unsaturated polyester or vinylester resins), and reinforcing agents – into a fast-rotating mold. Layer by layer, in a predefined process, the pipe wall is built up from the outside inwards. The material quantities inserted by the machine are monitored and compared to the desired design values in order to assure that each product is fully traceable with respect to its raw material types and quantities. Once all raw materials have been inserted into the mold, the speed of rotation is increased. High centrifugal forces of up to 75 *g* press the materials against the mold wall and condense them to a maximum, creating a high quality, very solid and void-free pipe wall. Cold water is used to cool the mold and after the pipe is removed, the pipe ends are trimmed and beveled. Finally, a coupling is mounted onto one end of each pipe.

The centrifugal casting process ensures that the pipes are circular, the wall thickness is uniform over the entire length at exact outer diameter, and the material displays a high longitudinal compressive strength that is particularly important for jacking. Thanks to the three-dimensional chemical bonding of the thermosetting resin, the pipe retains its stability even in very warm environments. The sandwich construction of the wall also ensures that the pipes can withstand high loading without any trouble and enables the pipe's strength to be customized to suit the specific load directions required.

**Left: Centrifugal casting process (Hobas technology). Right: Continuous filament winding process (Flowtite technology)**

## 8.2 Continuous filament winding (Flowtite technology)

Amiblu pipes with Flowtite technology are manufactured using a continuous advancing mandrel process. This process allows the use of continuous glassfiber reinforcements in the circumferential direction. For a pressure pipe or buried conduit the principle stress is in the circumferential direction, thus incorporating continuous reinforcements in this direction yields a higher performing product at lower cost. A very compressed laminate is created that maximizes the contribution from the three basic raw materials: Continuous glass fibre roving and choppable roving are incorporated for high hoop strength and axial reinforcement, and a sand fortifier provides increased stiffness by adding extra thickness. With the Flowtite dual resin delivery system, the equipment can apply a special inner resin liner for severely corrosive applications while using a standard type resin for the structural and outer portion of the laminate. Other materials such as a glass veil or a polyester veil can be used to enhance the abrasion, the chemical resistance, and the finishing of the pipe.

The filament winding manufacturing machine consists of a continuous steel band mandrel supported by beams in a cylindrical shape. As the beams turn, friction pulls the steel band around and a roller bearing allows the band to move longitudinally so that the entire mandrel moves continuously in a spiral path towards the exit assembly. As the mandrel rotates, all composite materials are continuously metered onto it in precise amounts with the help of electronic sensors. Firstly, mould release film, followed by various forms and patterns of glass fibres, embedded in a polyester resin matrix. The structural layers are made of glass and resin only, whereas the core layer includes pure silica. After the pipe has been formed on the mandrel, it is cured and later cut to the required length. The ends of the pipe stion are calibrated to fit the coupling.

## 8.3 Production quality control

Pipes are subjected to the following control checks:

- Visual inspection
- Wall thickness
- Pipe length
- Diameter
- Hydrostatic leak-tightness test to twice rated pressure for pressure pipes

The following control checks are performed on samples:

- Barcol hardness
- Pipe stiffness and deflection requirements
- Axial and circumferential tensile load capacity
- Material composition analysis

### Raw materials and product qualification

The suitability of raw materials for use in Amiblu pipes is carefully considered with reference to international standards and guidelines. Raw materials are tested using a combination of short-term testing in production and laboratory environments, as well as long-term testing extending over many months, even years. Only after materials are proven to perform well in all tests, they may be permitted for use in a Amiblu pipe.

The raw material and product tests of Amiblu meet the requirements of CEN/TS 14632 (assessment of conformity).

# 9 Performance Standards | Approvals | Assessment of Conformity

## ISO and EN standards

Common to all standards is the need for a pipe manufacturer to demonstrate its compliance with the standards' performance requirements. In the case of GRP pipes, these minimum performance requirements fall into both short-term and long-term requirements.

The International Standardization Organization (ISO) have, amongst others, the following standards: ISO 10639 for water supply, ISO 10467 for drainage and sewerage, and ISO 25780, which covers water supply as well as drainage and sewerage with GRP pipes installed by jacking. The European Standardization Organisation (CEN) issued the following standards: EN 1796 for water supply, EN 14364 for drainage and sewerage, and EN 15383 for manholes and inspection chambers. The CEN/TS 14632 standard provides a comprehensive basis for the assessment of product conformity and it provides a guideline for the quality test plans of the producer.

## ASTM & AWWA

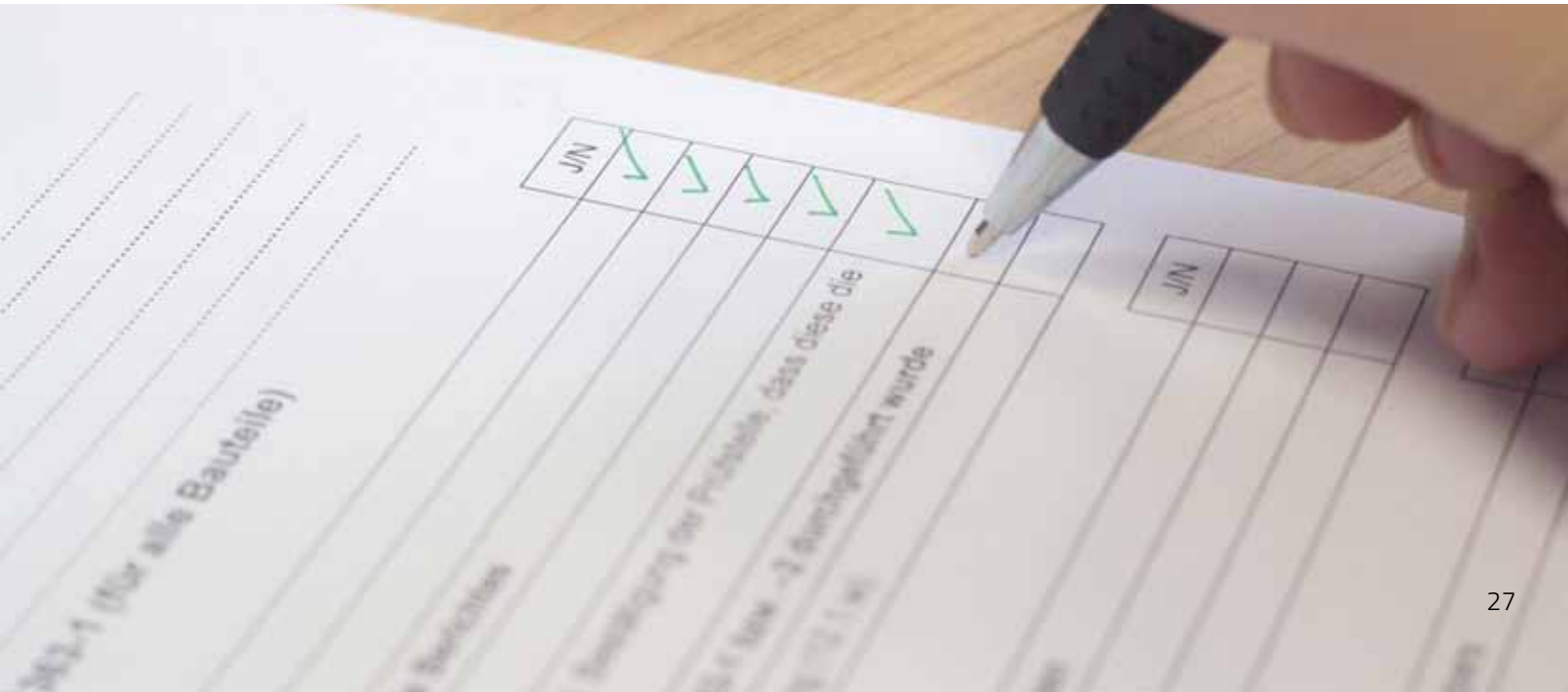
Three ASTM standards are commonly referred to: ASTM D3262 ("Fiberglass" [Glass-Fiber-Reinforced Thermosetting-Resin] Sewer Pipe), ASTM D3517 ("Fiberglass" [Glass-Fiber-Reinforced Thermosetting-Resin] Pressure Pipe), and ASTM D3754 ("Fiberglass" [Glass-Fiber-Reinforced Thermosetting-Resin] Sewer and Industrial Pressure Pipe). These product standards apply to GRP pipes and include many requirements for the product design, qualification, and quality assurance. AWWA C950 is a GRP piping standard which provides a good guidance for product performance and product testing. Together with AWWA M45 fiberglass pipe design manual it provides comprehensive information about design, requirements, and product testing.

## Assessment of conformity

Special attention shall be paid to Assessment of Conformity documents, e.g. CEN/TS 14632, which specify in detail the requirements for type testing, process verification tests as well as for the batch release. Requirements and procedures for the verification of changes in the raw materials, the design and the process shall be assessed using the different test methods.

## Potable water approvals

Amiblu has been tested and approved for the conveyance of potable water all over the world. They hold various third-party quality marks and certificates issued by prominent institutes and authorities e.g. BENOR, CARSO, CSTB, DVGW, IGH, ITC, KIWA, OFI, ÖNORM, ÖVGW, SVGW, and TÜV.



# 10 Research and Development

Research and development is the cornerstone of all industrial successes. The two merging companies, Hobas and Amiantit, have already been in the forefront of GRP research and development for more than 50 years. Amiblu can now draw on more resources than any other GRP producer in further developing the best GRP pipes in the world. The Amiblu laboratory in Norway is the world's largest certified GRP pipe testing laboratory.

## 10.1 Qualification tests

### Strain corrosion test

Amiblu has been subjecting pipes to strain corrosion tests continuously since 1978 in order to develop the world's best sewer pipes. Sewer pipes are exposed to sulphuric acid, which causes corrosion and eventually sewer leakage. The standards therefore demand that pipes are chemically tested while under strain for at least 10 000 hours. Amiblu pipes have been subjected to the Acid Test for more than 350 000 hours. At the time of writing, a test sample from 1978 is still in test at high strain level.

### Hydrostatic Design Basis (HDB)

To become and remain a world leader in composite pressure pipes, Amiblu has been conducting Hydrostatic Design Testing (HDB) since the 1970s. These tests have enabled Amiblu to design reliable pipes for penstocks, drinking water, and other pressure applications. The HDB testing verifies that the pipes will withstand 1.8 times the pressure to which they are rated over their certified lifetime.

### Long-term ring bending test

Amiblu pipes are designed to withstand loads from traffic, soil, and buildings. The pipe designs are therefore rigorously tested to make sure they will sustain these loads over the long term. The standards require the test to be carried out for at least 10 000 hours and the resulting 50-year predicted value is used in the pipes' design. Amiblu pipes have been tested up to 40 000 hours.

### Joint tests

Amiblu has an extensive testing programme to verify that Amiblu couplings will remain sealed and behave consistently under severe conditions. Joint prototypes for elastomeric gasket-sealed couplings are tested in accordance with EN 1119 and relevant ISO standards. They incorporate some of the most stringent joint performance requirements in the piping industry for pipe of any material within the pressure and size ranges of Amiblu pipe. These standards require the joints to withstand hydrostatic testing in configurations that simulate very severe in-use conditions. The pressures used are twice those rated. Joint configurations include straight alignment, maximum angular rotation and differential shear loading. A partial vacuum test and cyclical pressure tests are also included.

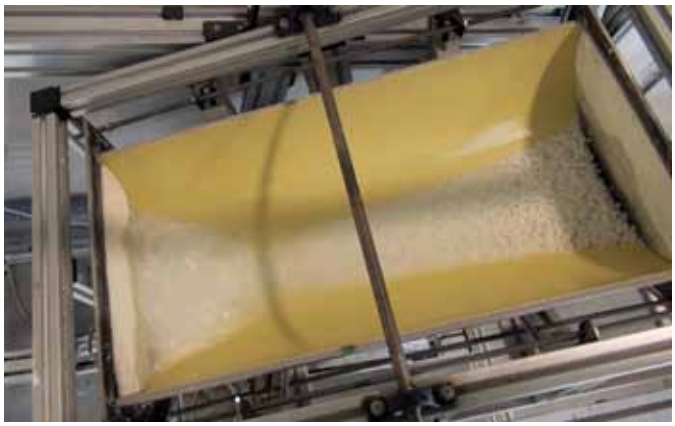

**Figures top down: Strain corrosion test, hydrostatic design base (HDB), long-term ring bending test, joint tests.**

## Abrasion resistance test

Amiblu pipes are used across the world in penstocks and other applications where substances such as gravel impact the inner surface of the pipe. The abrasion resistance of Amiblu pipes is evaluated using the Darmstadt Rocker method.

## Long-term ring stiffness test

The long-term stiffness of Flowtite pipes is higher than most other plastic pipes. Creep tests according to ISO 10468, lasting more than 10 000 hours, have demonstrated a 50-year stiffness between 60 % and 75 % of the initial.




**Above: Abrasion resistance test. Below: Long-term ring stiffness test.**

# 11 History

The history of Amiblu is the one of two companies coming together.

## Hobas

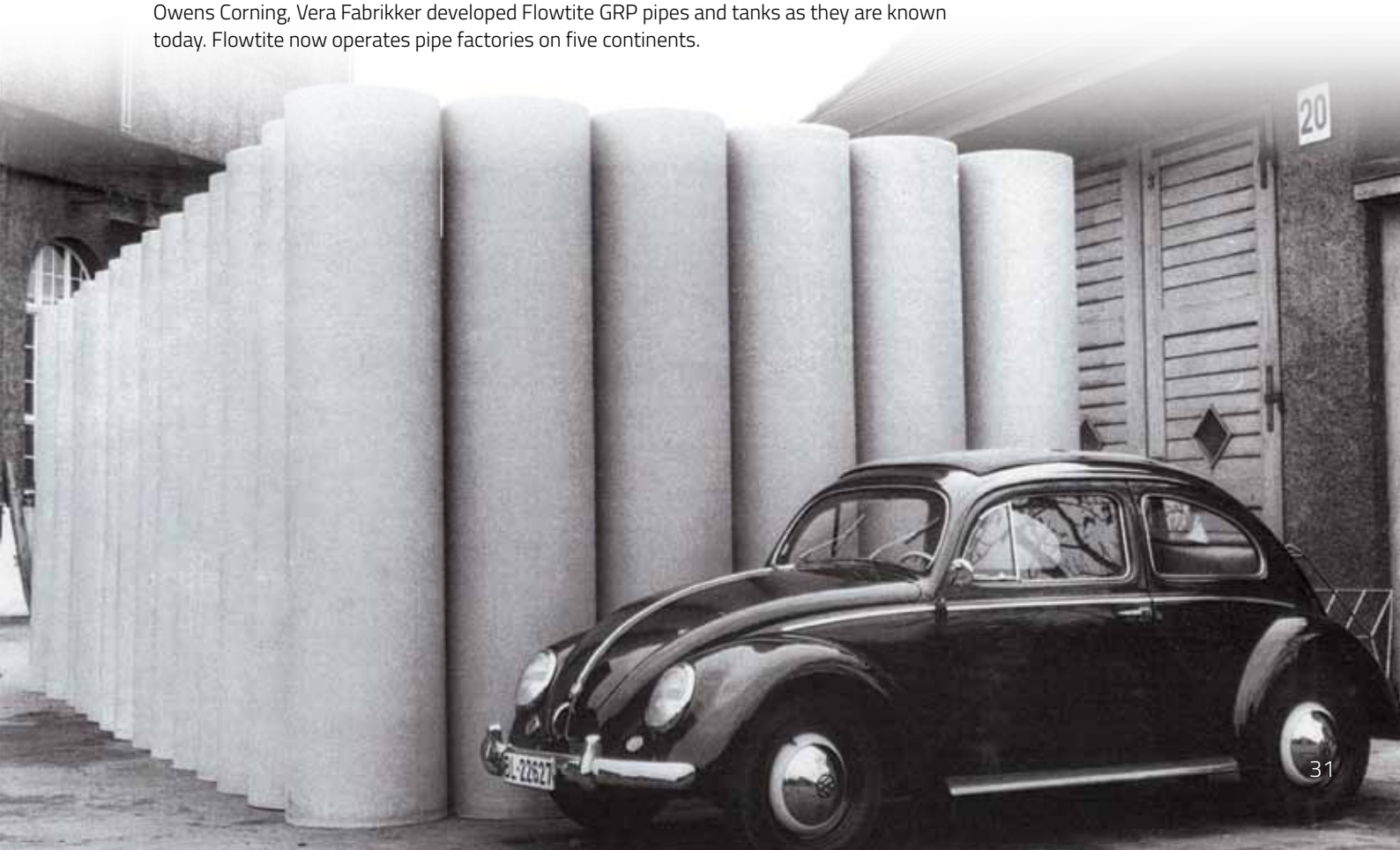
It all began quite modestly at the Basle Dye Works in 1957 where wooden cylinders were employed for the dyeing process. These kept splintering and deforming after some time putting the expensive textiles at risk. Seeking a suitable replacement for the cylinders, the factory's engineers developed a centrifugal casting method using glassfiber reinforced plastics (GRP). Thanks to the method and material, they achieved perfectly concentric cylinders with a precise outer diameter and smooth surface – just as required.

GRP had previously been used for shipbuilding, automobile and aircraft industry. However, its resistance to both corrosion and chemicals also made the material highly suitable for other applications. The Swiss, renowned for their vision and pioneering spirit, recognized its benefits and soon employed centrifugally cast pipes for conveying water – a new company was born: Hobas. The pipes laid at these early times are still in use today. Step by step, the products were improved, the manufacturing process was automated, the product range extended, and tailor-made fittings were added to the portfolio.

## Flowtite

In 1927, in Sandefjord, a small shipping town on the coast of Norway, Odd Gleditsch started a manufacturing plant for vegetable oils called Vera Fabrikker, this plant was the cradle of Flowtite pipes. Linseed oil was an ingredient he needed in the production of paint for the Jotun paint company. In 1965, a group of engineers at the plant started experimenting with polyester resin and glassfiber. Along with the Danish company Drostholm, they invented the continuous winding method for the manufacture of GRP pipes and tanks. The material was revolutionary – it did not corrode, it was light, and thanks to the GRP sandwich construction, it achieved strength, stability, and durability.

Owens Corning took over 100 % of the company from Jotun in 1993. In cooperation with Owens Corning, Vera Fabrikker developed Flowtite GRP pipes and tanks as they are known today. Flowtite now operates pipe factories on five continents.



## Timeline

| | |
|---|---|
| 1957 | First production of centrifugally cast GRP Pipes in Switzerland |
| 1968 | The Amiantit Group was established in Dammam, Saudi Arabia |
| 1968 | First production of continuously wound pipes at Vera Fabrikker (Jotun) in Norway |
| 1971 | Owens Corning buys GRP Technology from Vera Fabrikker |
| 1984 | Joint venture of Hobas and the Wietersdorfer Group |
| 1987 | Hobas opens pipe plant in the USA |
| 1988 | Owens Corning aquires 90% of the shares in Veroc Technology (later Flowtite Technology) |
| 2001 | Amiantit aquires Flowtite Technology |
| 2003 | First production of non-circular GRP profiles in Germany |
| 2007 | 50-year anniversary Hobas |
| 2016 | Hobas and Amiantit (Flowtite) announce the companies' intent to merge |
| 2017 | 50-year anniversary Flowtite |
| 2017 | EU Commission approves the merger |
| 2017 | Amiblu is established with ownership of Hobas and Flowtite technologies |

# 12 Appendix

# Pipe dimensions centrifugally cast pipes and couplings PN 1, SN 10 000, DN 200-1100

Non-pressure pipes (Hobas)

| DN | OD (mm) | Weigth (kg/m) | Wall Thick-ness (mm) |
|---|---|---|---|
| 200 | 220 | 7 | 5.2 |
| 250 | 272 | 11 | 6.3 |
| 300 | 324 | 15 | 7.5 |
| 350 | 376 | 20 | 8.6 |
| 400 | 427 | 26 | 9.3 |
| 450 | 478 | 30 | 10.0 |
| 500 | 530 | 39 | 10.7 |
| 550 | 550 | 42 | 11.2 |
| 600 | 616 | 53 | 12.6 |
| 650 | 650 | 59 | 13.3 |
| 700 | 718 | 72 | 14.7 |
| 750 | 752 | 79 | 15.5 |
| 800 | 820 | 94 | 16.9 |
| 860 | 860 | 103 | 17.7 |
| 900 | 924 | 119 | 18.5 |
| 960 | 960 | 129 | 19.3 |
| 1000 | 1026 | 148 | 20.9 |
| 1100 | 1099 | 170 | 22.4 |

Amiblu non-pressure couplings

| DN | OD max (mm) | Weight (kg/pc) |
|---|---|---|
| 200 | 255.2 | 4 |
| 250 | 303.6 | 6 |
| 300 | 356.1 | 7 |
| 350 | 408.0 | 8 |
| 400 | 458.6 | 9 |
| 450 | 509.6 | 10 |
| 500 | 561.5 | 11 |
| 550 | 581.2 | 12 |
| 600 | 648.6 | 13 |
| 650 | 682.0 | 14 |
| 700 | 752.0 | 16 |
| 750 | 785.6 | 17 |
| 800 | 855.0 | 19 |
| 860 | 895.1 | 20 |
| 900 | 959.8 | 22 |
| 960 | 995.3 | 23 |
| 1000 | 1062.9 | 25 |
| 1100 | 1136.6 | 27 |

Other stiffness classes are available on request.
Wall thicknesses and masses are guidelines (plus tolerances).
The standard pipe length is 6 m (+0/-60 mm). Shorter lengths are available on request.

# Pipe dimensions centrifugally cast pipes and couplings PN 1, SN 10 000, DN 1200-3600

Non-pressure pipes (Hobas)

| DN | OD (mm) | Weigth (kg/m) | Wall Thick-ness (mm) |
|---|---|---|---|
| 1200 | 1229 | 213 | 25.2 |
| 1280 | 1280 | 231 | 26.2 |
| 1400 | 1434 | 289 | 29.4 |
| 1500 | 1499 | 316 | 30.8 |
| 1535 | 1535 | 334 | 31.6 |
| 1600 | 1638 | 381 | 33.8 |
| 1720 | 1720 | 420 | 35.5 |
| 1800 | 1842 | 481 | 38.1 |
| 1940 | 1937 | 531 | 40.0 |
| 2000 | 2047 | 593 | 42.3 |
| 2160 | 2160 | 659 | 44.7 |
| 2200 | 2250 | 714 | 46.5 |
| 2400 | 2400 | 814 | 49.8 |
| 2400 | 2453 | 850 | 50.9 |
| 2555 | 2555 | 920 | 53.0 |
| 3000 | 3000 | 1263 | 62.1 |
| 3270 | 3270 | 1502 | 67.8 |
| 3600 | 3600 | 1817 | 74.6 |

Amiblu non-pressure couplings

| DN | OD max (mm) | Weight (kg/pc) |
|---|---|---|
| 1200 | 1266.8 | 30 |
| 1280 | 1333.2 | 51 |
| 1400 | 1487.7 | 58 |
| 1500 | 1552.8 | 61 |
| 1535 | 1590.6 | 63 |
| 1600 | 1692.5 | 67 |
| 1720 | 1773.5 | 71 |
| 1800 | 1897.2 | 78 |
| 1940 | 1992.8 | 81 |
| 2000 | 2102 | 87 |
| 2160 | 2212.7 | 92 |
| 2200 | 2306 | 96 |
| 2400 | 2453.3 | 104 |
| 2400 | 2508.7 | 106 |
| 2555 | 2616.4 | 124 |
| 3000 | 3076.2 | 195 |

Other stiffness classes are available on request.
Wall thicknesses and masses are guidelines (plus tolerances).
The standard pipe length is 6 m (+0/-60 mm). Shorter lengths are available on request.

# Pipe dimensions filament wound pipes and couplings PN 1, SN 10 000, DN 100-1300

Non-pressure pipes (Flowtite)

| DN | ID min (mm) | Weight (kg/m) |
|---|---|---|
| 100 | 108.7 | 2 |
| 125 | 133.5 | 3 |
| 150 | 158.3 | 4 |
| 200 | 207.9 | 7 |
| 250 | 258.9 | 11 |
| 300 | 309.2 | 15 |
| 350 | 358.9 | 21 |
| 400 | 407.5 | 27 |
| 450 | 456.7 | 33 |
| 500 | 506.2 | 41 |
| 600 | 590.5 | 53 |
| 700 | 688.6 | 72 |
| 800 | 786.5 | 95 |
| 900 | 884.9 | 118 |
| 1000 | 983.4 | 145 |
| 1100 | 1081.6 | 175 |
| 1200 | 1180 | 206 |
| 1300 | 1278.3 | 240 |

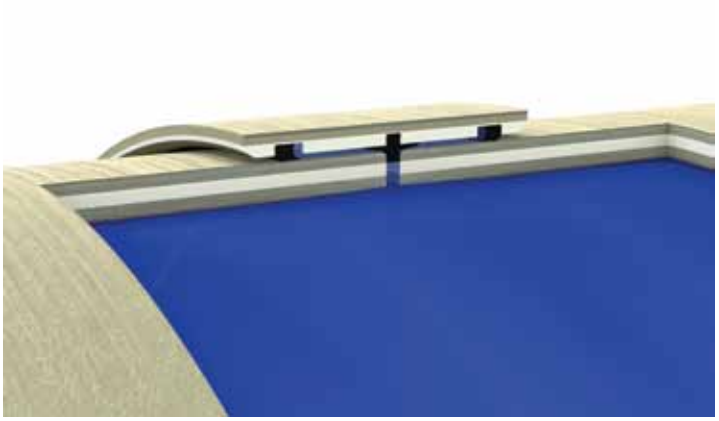
Flowtite non-pressure couplings

| DN | OD max (mm) | Weight (kg/pc) |
|---|---|---|
| 100 | 140.1 | 1 |
| 125 | 166.1 | 1 |
| 150 | 192.1 | 2 |
| 200 | 255.2 | 4 |
| 250 | 306.8 | 5 |
| 300 | 357.5 | 7 |
| 350 | 409.4 | 8 |
| 400 | 460.3 | 9 |
| 450 | 511.2 | 10 |
| 500 | 563.1 | 11 |
| 600 | 650.6 | 13 |
| 700 | 754 | 16 |
| 800 | 857 | 19 |
| 900 | 959.8 | 22 |
| 1000 | 1062.4 | 24 |
| 1100 | 1164.8 | 27 |
| 1200 | 1267.6 | 30 |
| 1300 | 1383.3 | 53 |

# Pipe dimensions filament wound pipes and couplings PN 1, SN 10 000, DN 1400-3000

Non-pressure pipes (Flowtite)

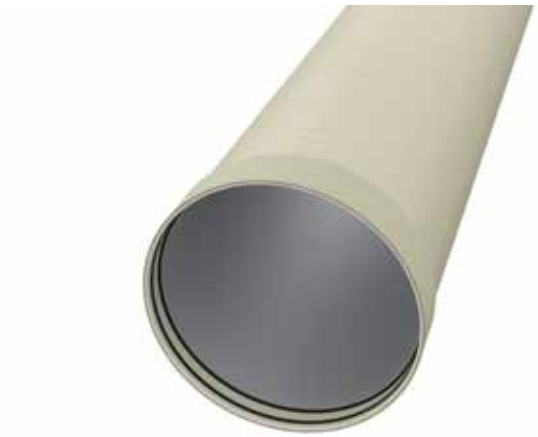
| DN | ID min (mm) | Weight (kg/m) |
|---|---|---|
| 1400 | 1376.3 | 279 |
| 1500 | 1474.8 | 318 |
| 1600 | 1573.1 | 360 |
| 1700 | 1671 | 408 |
| 1800 | 1769.7 | 454 |
| 1900 | 1868.1 | 503 |
| 2000 | 1966.5 | 555 |
| 2100 | 2064.9 | 611 |
| 2200 | 2162.8 | 671 |
| 2300 | 2261.2 | 732 |
| 2400 | 2359.2 | 798 |
| 2500 | 2459.7 | 821 |
| 2600 | 2558 | 888 |
| 2700 | 2656.4 | 956 |
| 2800 | 2754.7 | 1030 |
| 2900 | 2853.1 | 1100 |
| 3000 | 2951.5 | 1180 |



Flowtite non-pressure couplings

| DN | OD max (mm) | Weight (kg/pc) |
|---|---|---|
| 1400 | 1485.7 | 58 |
| 1500 | 1588.1 | 62 |
| 1600 | 1690.7 | 67 |
| 1700 | 1793.1 | 72 |
| 1800 | 1895.5 | 76 |
| 1900 | 1997.9 | 81 |
| 2000 | 2100.3 | 86 |
| 2100 | 2202.7 | 91 |
| 2200 | 2305.1 | 96 |
| 2300 | 2407.5 | 101 |
| 2400 | 2509.9 | 106 |
| 2500 | 2626.3 | 172 |
| 2600 | 2743.1 | 233 |
| 2700 | 2845.9 | 244 |
| 2800 | 2948.5 | 254 |
| 2900 | 3051.1 | 265 |
| 3000 | 3153.5 | 276 |

# Pipe dimensions filament wound pressure pipes (Flowtite Grey) SN 5 000, DN 300-2000

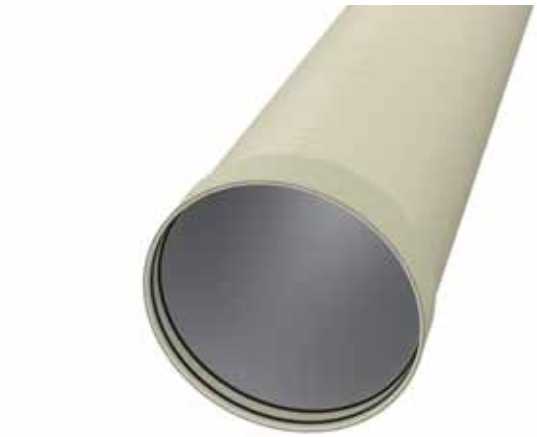


| DN | DOS max (mm) | ID min (mm) | | | | | | Weight Span (kg/m) | |
|---|---|---|---|---|---|---|---|---|---|
| | | PN 6 | PN 10 | PN 16 | PN 20 | PN 25 | PN 32 | from | to |
| 300 | 324.5 | 312.7 | 312.8 | 313.6 | 314.7 | 314.7 | 314.6 | 9 | 11 |
| 350 | 376.4 | 362.9 | 363.4 | 364.2 | 365.4 | 365.4 | 365.4 | 12 | 15 |
| 400 | 427.3 | 412.1 | 412.8 | 413.9 | 415 | 415.1 | 415.1 | 15 | 19 |
| 450 | 478.2 | 461.4 | 462.3 | 463.6 | 464.7 | 464.8 | 464.8 | 19 | 24 |
| 500 | 530.1 | 511.9 | 512.8 | 514 | 515.3 | 515.5 | 515.5 | 23 | 29 |
| 600 | 617 | 596.1 | 597.4 | 598.8 | 600.2 | 600.4 | 600.3 | 30 | 40 |
| 700 | 719 | 695.3 | 696.7 | 698.4 | 699.8 | 700 | 700.1 | 40 | 53 |
| 800 | 821 | 794.4 | 796 | 797.9 | 799.4 | 799.6 | 799.5 | 53 | 69 |
| 900 | 923 | 893.5 | 895.1 | 897.4 | 899 | 899.3 | 898.6 | 67 | 87 |
| 1000 | 1025 | 992.5 | 994.3 | 997 | 998.6 | 998.9 | 998.2 | 83 | 107 |
| 1100 | 1127 | 1091.7 | 1093.5 | 1096.5 | 1098.2 | 1098.5 | 1098.2 | 98 | 129 |
| 1200 | 1229 | 1190.8 | 1192.8 | 1196 | 1197.8 | 1198.2 | 1198.2 | 115 | 152 |
| 1300 | 1331 | 1289.7 | 1292.2 | 1295.6 | 1297.4 | 1297.8 | 1297.8 | 134 | 179 |
| 1400 | 1433 | 1388.6 | 1391.3 | 1395.1 | 1397 | 1397.4 | 1397.4 | 156 | 208 |
| 1500 | 1535 | 1487.8 | 1490.7 | 1494.7 | 1496.6 | 1497.1 | 1497 | 178 | 238 |
| 1600 | 1637 | 1586.8 | 1589.9 | 1594.2 | 1596.2 | 1596.7 | 1596.7 | 202 | 271 |
| 1700 | 1739 | 1685.8 | 1689.1 | 1693.8 | 1695.8 | 1696.3 | 1696.4 | 227 | 306 |
| 1800 | 1841 | 1784.9 | 1788.4 | 1793.3 | 1795.4 | 1795.9 | 1796 | 254 | 342 |
| 1900 | 1943 | 1884.1 | 1887.7 | 1892.8 | 1895 | 1895.6 | | 291 | 380 |
| 2000 | 2045 | 1983.2 | 1987 | 1992.3 | 1994.6 | 1995.2 | | 322 | 420 |

# Pipe dimensions filament wound pressure pipes (Flowtite Grey) SN 5000, DN 2100-4000

| DN | DOS max (mm) | ID min (mm) | | | | | | Weight Span (kg/m) | |
|---|---|---|---|---|---|---|---|---|---|
| | | PN 6 | PN 10 | PN 16 | PN 20 | PN 25 | PN 32 | from | to |
| 2100 | 2147 | 2082.2 | 2086.3 | 2091.9 | 2094.2 | 2094.8 | | 355 | 463 |
| 2200 | 2249 | 2181.3 | 2185.5 | 2191.4 | 2193.8 | 2194.5 | | 388 | 507 |
| 2300 | 2351 | 2280.4 | 2284.8 | 2291 | 2293.4 | 2294.1 | | 423 | 554 |
| 2400 | 2453 | 2379.5 | 2384 | 2390.5 | 2393 | 2393.7 | | 462 | 602 |
| 2500 | 2555 | 2478.5 | 2483.3 | 2490 | 2492.6 | | | 514 | 655 |
| 2600 | 2657 | 2577.6 | 2582.6 | 2589.6 | 2592.2 | | | 557 | 708 |
| 2700 | 2759 | 2676.7 | 2681.9 | 2689.1 | 2691.8 | | | 599 | 762 |
| 2800 | 2861 | 2775.7 | 2781.1 | 2788.7 | 2791.4 | | | 643 | 820 |
| 2900 | 2963 | 2874.8 | 2880.3 | 2888.2 | 2891 | | | 690 | 879 |
| 3000 | 3065 | 2974 | 2979.6 | 2987.7 | 2990.6 | | | 739 | 939 |
| 3100 | 3167 | 3073.1 | 3078.9 | 3087.3 | | | | 819 | 1000 |
| 3200 | 3269 | 3172.1 | 3178.2 | 3186.8 | | | | 873 | 1070 |
| 3300 | 3371 | 3271.1 | 3277.4 | 3286.3 | | | | 928 | 1140 |
| 3400 | 3473 | 3370.2 | 3376.7 | 3385.9 | | | | 984 | 1200 |
| 3500 | 3575 | 3469.4 | 3476 | | | | | 1180 | 1270 |
| 3600 | 3677 | 3568.4 | 3575.2 | | | | | 1250 | 1350 |
| 3700 | 3779 | 3667.5 | 3674.5 | | | | | 1320 | 1420 |
| 3800 | 3881 | 3766.5 | 3773.8 | | | | | 1400 | 1500 |
| 3900 | 3983 | | 3873.1 | | | | | 1470 | 1470 |
| 4000 | 4085 | | 3972.3 | | | | | 1540 | 1540 |

# Pipe dimensions filament wound pressure pipes (Flowtite Grey) SN 10 000, DN 300-2000



| DN | DOS max (mm) | ID min (mm) | | | | | | Weight Span (kg/m) | |
|---|---|---|---|---|---|---|---|---|---|
| | | PN 6 | PN 10 | PN 16 | PN 20 | PN 25 | PN 32 | from | to |
| 300 | 324.5 | 310 | 310 | 311 | 312.4 | 312.7 | 312.7 | 11 | 14 |
| 350 | 376.4 | 359.7 | 359.7 | 361.3 | 362.7 | 362.9 | 363.1 | 15 | 19 |
| 400 | 427.3 | 408.9 | 408.9 | 410.6 | 412 | 412.3 | 412.5 | 19 | 24 |
| 450 | 478.2 | 458 | 458 | 459.8 | 461.3 | 461.7 | 461.7 | 23 | 29 |
| 500 | 530.1 | 508 | 508 | 510.2 | 511.6 | 512 | 512.3 | 29 | 36 |
| 600 | 617 | 591.8 | 591.8 | 594.1 | 595.8 | 596.4 | 596.7 | 38 | 49 |
| 700 | 719 | 690.1 | 690.1 | 692.8 | 694.7 | 695.3 | 695.7 | 52 | 66 |
| 800 | 821 | 788.3 | 788.3 | 791.6 | 793.6 | 794.3 | 794.7 | 67 | 86 |
| 900 | 923 | 886.7 | 886.7 | 890.3 | 892.5 | 893.3 | 893.7 | 84 | 108 |
| 1000 | 1025 | 985 | 985 | 989 | 991.4 | 992.2 | 992.8 | 103 | 133 |
| 1100 | 1127 | 1083.2 | 1083.2 | 1087.8 | 1090.2 | 1091.2 | 1091.8 | 124 | 161 |
| 1200 | 1229 | 1181.5 | 1181.5 | 1186.5 | 1189.1 | 1190.2 | 1190.8 | 147 | 191 |
| 1300 | 1331 | 1279.9 | 1279.9 | 1285.3 | 1288 | 1289.1 | 1289.8 | 173 | 224 |
| 1400 | 1433 | 1378.2 | 1378.2 | 1384 | 1386.9 | 1388.1 | 1388.8 | 200 | 259 |
| 1500 | 1535 | 1476.5 | 1476.5 | 1482.8 | 1485.8 | 1487.1 | 1487.9 | 228 | 297 |
| 1600 | 1637 | 1574.8 | 1574.8 | 1581.5 | 1584.7 | 1586 | 1586.9 | 259 | 337 |
| 1700 | 1739 | 1673.1 | 1673.1 | 1680.3 | 1683.5 | 1685 | 1685.9 | 292 | 380 |
| 1800 | 1841 | 1771.5 | 1771.5 | 1779.1 | 1782.4 | 1784 | 1784.9 | 327 | 426 |
| 1900 | 1943 | 1869.8 | 1869.8 | 1877.8 | 1881.3 | 1882.9 | | 377 | 474 |
| 2000 | 2045 | 1968.3 | 1968.3 | 1976.5 | 1980.2 | 1981.9 | | 418 | 523 |

# Pipe dimensions filament wound pressure pipes (Flowtite Grey) SN 10 000, DN 2100-4000

| DN | DOS max (mm) | ID min (mm) | | | | | | Weight Span (kg/m) | |
|---|---|---|---|---|---|---|---|---|---|
| | | PN 6 | PN 10 | PN 16 | PN 20 | PN 25 | PN 32 | from | to |
| 2100 | 2147 | 2066.5 | 2066.5 | 2075.2 | 2079.1 | 2080.9 | | 460 | 577 |
| 2200 | 2249 | 2164.8 | 2164.8 | 2174 | 2178 | 2179.9 | | 504 | 633 |
| 2300 | 2351 | 2263.2 | 2263.2 | 2272.8 | 2276.8 | 2278.8 | | 550 | 691 |
| 2400 | 2453 | 2361.5 | 2361.5 | 2371.5 | 2375.7 | 2377.8 | | 598 | 752 |
| 2500 | 2555 | 2459.9 | 2459.9 | 2470.2 | 2474.6 | | | 678 | 816 |
| 2600 | 2657 | 2558.2 | 2558.2 | 2569 | 2573.5 | | | 732 | 882 |
| 2700 | 2759 | 2656.5 | 2656.5 | 2667.7 | 2672.3 | | | 787 | 951 |
| 2800 | 2861 | 2754.9 | 2754.9 | 2766.5 | 2771.2 | | | 847 | 1020 |
| 2900 | 2963 | 2853.1 | 2853.1 | 2865.3 | 2870.1 | | | 907 | 1100 |
| 3000 | 3065 | 2951.5 | 2951.5 | 2964 | 2969 | | | 972 | 1170 |
| 3100 | 3167 | 3049.9 | 3049.9 | 3062.8 | | | | 1090 | 1250 |
| 3200 | 3269 | 3148.2 | 3148.2 | 3161.4 | | | | 1160 | 1330 |
| 3300 | 3371 | 3246.5 | 3246.5 | 3260.2 | | | | 1240 | 1420 |
| 3400 | 3473 | 3344.8 | 3344.8 | 3358.9 | | | | 1310 | 1500 |
| 3500 | 3575 | | | | | | | | |
| 3600 | 3677 | | | | | | | | |
| 3700 | 3779 | | | | | | | | |
| 3800 | 3881 | | | | | | | | |
| 3900 | 3983 | | | | | | | | |
| 4000 | 4085 | | | | | | | | |

# Hobas FWC coupling
# DN 200-3600

| DN | OD (mm) | LC (mm) | DEC min (mm) |
|---|---|---|---|
| 200 | 220 | 173 | 239 |
| 250 | 272 | 173 | 291 |
| 300 | 324 | 173 | 343 |
| 350 | 376 | 173 | 394 |
| 400 | 401 | 230 | 419 |
| 400 | 427 | 230 | 445 |
| 450 | 478 | 230 | 496 |
| 500 | 501 | 230 | 518 |
| 500 | 530 | 230 | 548 |
| 550 | 550 | 230 | 568 |
| 600 | 616 | 230 | 635 |
| 650 | 650 | 230 | 668 |
| 700 | 718 | 230 | 736 |
| 750 | 752 | 230 | 770 |
| 800 | 820 | 230 | 841 |
| 860 | 860 | 230 | 880 |
| 900 | 924 | 230 | 944 |
| 960 | 960 | 230 | 980 |
| 1000 | 1026 | 230 | 1047 |
| 1100 | 1099 | 230 | 1120 |

| DN | OD (mm) | LC (mm) | DEC min (mm) |
|---|---|---|---|
| 1200 | 1229 | 230 | 1252 |
| 1280 | 1280 | 230 | 1303 |
| 1350 | 1348 | 230 | 1372 |
| 1400 | 1434 | 230 | 1459 |
| 1500 | 1499 | 310 | 1524 |
| 1535 | 1535 | 310 | 1563 |
| 1600 | 1638 | 310 | 1664 |
| 1720 | 1720 | 310 | 1746 |
| 1800 | 1842 | 310 | 1870 |
| 1940 | 1937 | 310 | 1968 |
| 2000 | 2047 | 310 | 2075 |
| 2160 | 2160 | 310 | 2189 |
| 2200 | 2250 | 310 | 2282 |
| 2400 | 2400 | 310 | 2431 |
| 2400 | 2453 | 310 | 2487 |
| 2555 | 2555 | 310 | 2591 |
| 3000 | 2999 | 350 | 3050 |
| 3270 | 3270 | 350 | 3321 |
| 3600 | 3600 | 350 | 3657 |

This coupling can be used in non-pressure applications as an alternative to the Amiblu non-pressure coupling (p. 34/35).

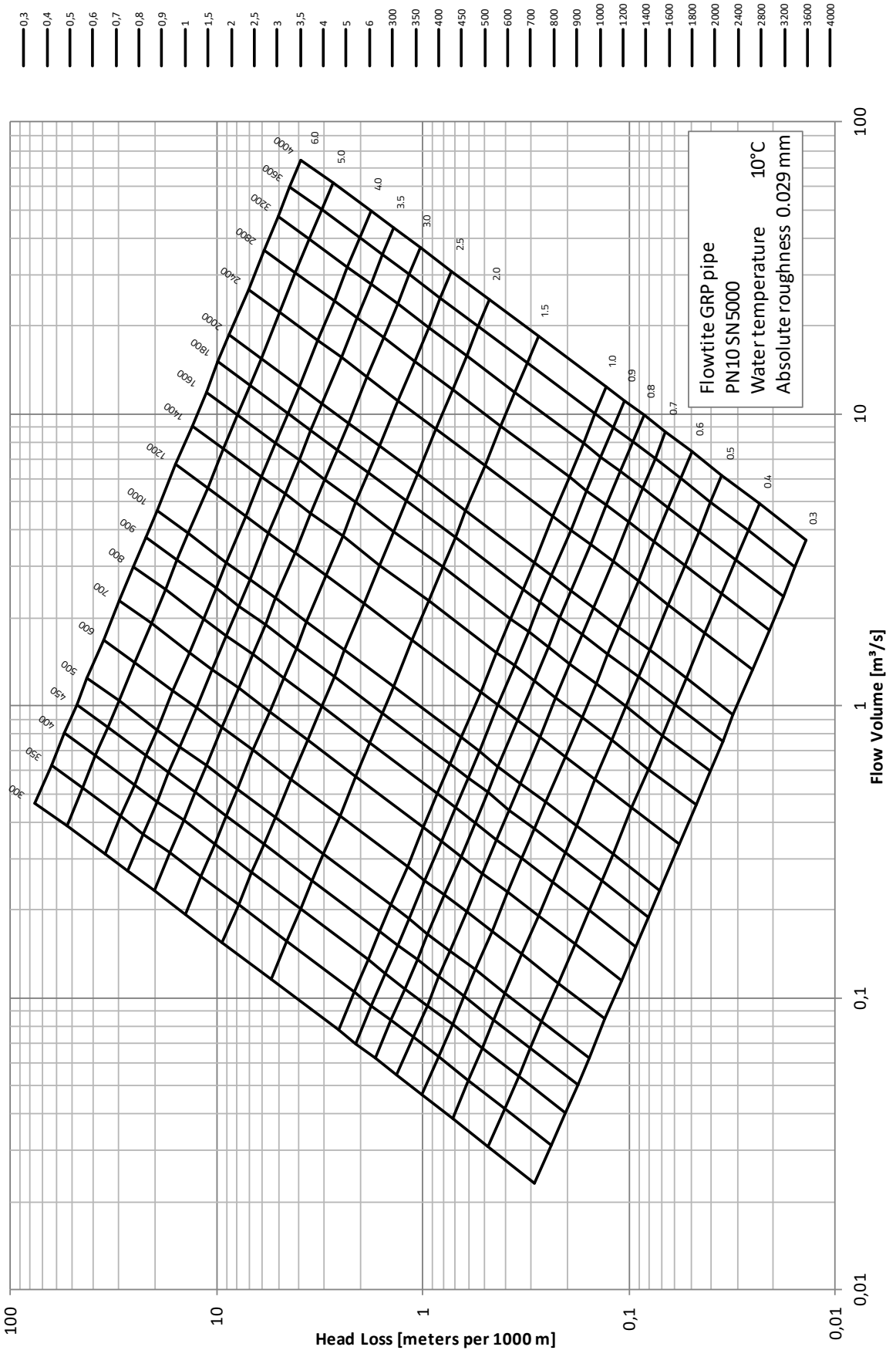
# Flowtite double bell coupling for pressure pipes DN 300-2000

| DN | DOS max (mm) | OD max (mm) | | | | | | Weight Span (kg/pc) | |
|---|---|---|---|---|---|---|---|---|---|
| | | PN 6 | PN 10 | PN 16 | PN 20 | PN 25 | PN 32 | from | to |
| 300 | 324.5 | 367.8 | 368.6 | 369.8 | 370.4 | 371 | 377.8 | 11 | 14 |
| 350 | 376.4 | 419.5 | 420.7 | 422.1 | 422.1 | 423.3 | 430.5 | 13 | 16 |
| 400 | 427.3 | 470.4 | 471.6 | 474.2 | 473.4 | 474.4 | 481.6 | 14 | 19 |
| 450 | 478.2 | 520.9 | 522.5 | 524.5 | 524.7 | 525.9 | 533.1 | 16 | 21 |
| 500 | 530.1 | 572.6 | 574.2 | 576 | 577.4 | 578.8 | 584.8 | 17 | 23 |
| 600 | 617.0 | 666.1 | 667.7 | 669.9 | 672.3 | 675.1 | 682.3 | 29 | 39 |
| 700 | 719.0 | 767.7 | 770.1 | 774.5 | 775.1 | 777.9 | 787.7 | 33 | 48 |
| 800 | 821.0 | 869.5 | 873.7 | 878.9 | 879.5 | 883.5 | 898.9 | 37 | 62 |
| 900 | 923.0 | 972.5 | 977.1 | 980.3 | 982.7 | 988.5 | 1005.3 | 43 | 74 |
| 1000 | 1025.0 | 1075.5 | 1080.3 | 1083.9 | 1086.9 | 1099.5 | 1116.1 | 49 | 91 |
| 1100 | 1127.0 | 1178.1 | 1183.5 | 1187.5 | 1192.3 | 1208.1 | 1224.3 | 54 | 107 |
| 1200 | 1229.0 | 1280.7 | 1286.5 | 1291.1 | 1300.1 | 1314.9 | 1331.1 | 60 | 122 |
| 1300 | 1331.0 | 1383.3 | 1389.3 | 1394.7 | 1406.3 | 1420.9 | 1436.7 | 65 | 137 |
| 1400 | 1433.0 | 1485.7 | 1491.9 | 1499.5 | 1511.9 | 1526.1 | 1541.5 | 71 | 151 |
| 1500 | 1535.0 | 1588.1 | 1594.7 | 1604.9 | 1616.9 | 1630.9 | 1645.9 | 76 | 165 |
| 1600 | 1637.0 | 1690.7 | 1697.5 | 1709.9 | 1721.5 | 1735.1 | 1749.7 | 82 | 179 |
| 1700 | 1739.0 | 1793.1 | 1800.3 | 1814.3 | 1825.5 | 1839.1 | 1853.3 | 88 | 193 |
| 1800 | 1841.0 | 1895.5 | 1902.9 | 1918.3 | 1929.5 | 1942.7 | 1956.7 | 93 | 206 |
| 1900 | 1943.0 | 1997.9 | 2006.5 | 2022.3 | 2033.1 | 2045.9 | | 99 | 192 |
| 2000 | 2045.0 | 2100.3 | 2110.1 | 2125.9 | 2136.7 | 2148.9 | | 105 | 204 |

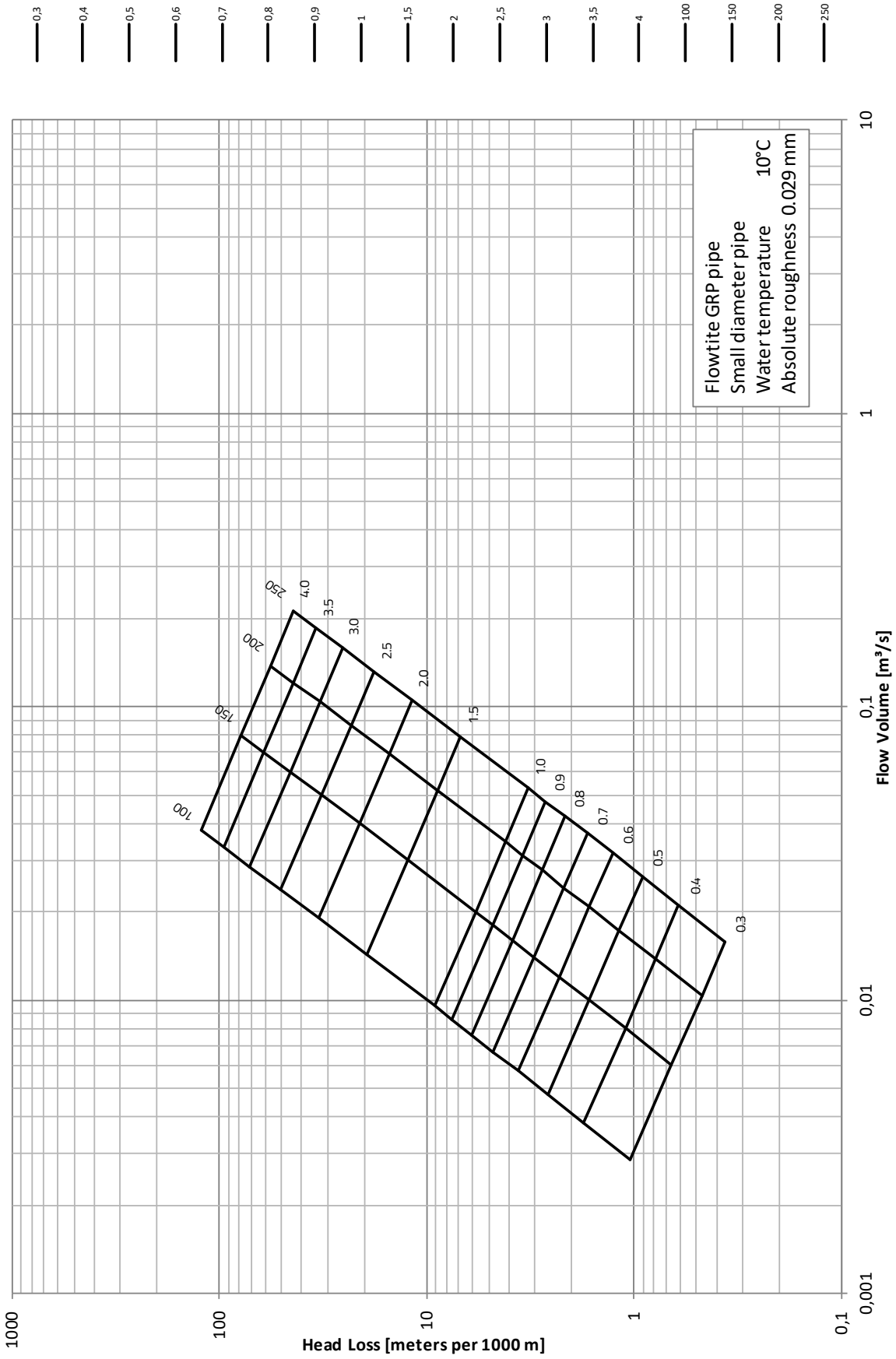
# Flowtite double bell coupling for pressure pipes DN 2100-4000

| DN | DOS max (mm) | OD max (mm) | | | | | | Weight Span (kg/pc) | |
|---|---|---|---|---|---|---|---|---|---|
| | | PN 6 | PN 10 | PN 16 | PN 20 | PN 25 | PN 32 | from | to |
| 2100 | 2147.0 | 2202.7 | 2213.7 | 2229.3 | 2239.9 | 2251.7 | | 111 | 215 |
| 2200 | 2249.0 | 2305.1 | 2316.9 | 2332.7 | 2343.3 | 2354.5 | | 118 | 227 |
| 2300 | 2351.0 | 2407.5 | 2420.1 | 2435.7 | 2446.3 | 2457.3 | | 124 | 239 |
| 2400 | 2453.0 | 2509.9 | 2523.3 | 2538.9 | 2549.3 | 2559.9 | | 130 | 251 |
| 2500 | 2555.0 | 2612.3 | 2626.3 | 2641.9 | 2651.9 | | | 136 | 235 |
| 2600 | 2657.0 | 2732.3 | 2743.1 | 2756.5 | 2769.9 | | | 201 | 306 |
| 2700 | 2759.0 | 2834.9 | 2845.9 | 2859.1 | 2874.1 | | | 211 | 324 |
| 2800 | 2861.0 | 2937.7 | 2948.5 | 2961.9 | 2978.5 | | | 221 | 343 |
| 2900 | 2963.0 | 3040.3 | 3051.1 | 3064.3 | 3082.7 | | | 230 | 363 |
| 3000 | 3065.0 | 3142.9 | 3153.5 | 3166.5 | 3187.1 | | | 240 | 383 |
| 3100 | 3167.0 | 3244.9 | 3255.7 | 3271.1 | | | | 262 | 353 |
| 3200 | 3269.0 | 3347.5 | 3358.3 | 3374.9 | | | | 272 | 371 |
| 3300 | 3371.0 | 3449.9 | 3460.9 | 3478.7 | | | | 282 | 390 |
| 3400 | 3473.0 | 3552.5 | 3563.3 | 3582.5 | | | | 293 | 413 |
| 3500 | 3575.0 | 3654.9 | 3665.7 | | | | | 303 | 348 |
| 3600 | 3677.0 | 3757.5 | 3768.3 | | | | | 315 | 360 |
| 3700 | 3779.0 | 3859.9 | 3870.7 | | | | | 325 | 371 |
| 3800 | 3881.0 | 3962.3 | 3973.1 | | | | | 335 | 383 |
| 3900 | 3983.0 | | 4075.5 | | | | | 395 | 395 |
| 4000 | 4085.0 | | 4177.9 | | | | | 407 | 407 |

# Head loss of large GRP pipes



# Head loss of small GRP pipes



# Surge wave celerity for pressure pipes

| SN 5000 | DN | | | | |
|---|---|---|---|---|---|
| | 300 | 400 | 450 | 800 | ≥ 900 |
| PN 6 | 430 | 410 | 400 | 380 | 380 |
| PN 10 | 440 | 430 | 430 | 420 | 410 |
| PN 16 | 520 | 500 | 510 | 490 | 490 |
| PN 20 | 550 | 540 | 540 | 530 | 520 |
| PN 25 | 590 | 580 | 580 | 570 | 560 |
| PN 32 | 630 | 630 | 620 | 620 | 620 |

| SN 10000 | DN | | | | |
|---|---|---|---|---|---|
| | 300 | 400 | 450 | 800 | ≥ 900 |
| PN 6 | 480 | 460 | 450 | 430 | 420 |
| PN 10 | 480 | 460 | 450 | 430 | 420 |
| PN 16 | 520 | 510 | 520 | 500 | 490 |
| PN 20 | 550 | 550 | 540 | 530 | 520 |
| PN 25 | 580 | 580 | 580 | 570 | 570 |
| PN 32 | 630 | 630 | 620 | 620 | 620 |

| SN 10000 | DN | | | |
|---|---|---|---|---|
| | 100 | 150 | 200 | 250 |
| PN 6 | 580 | 540 | 520 | 500 |
| PN 10 | 590 | 560 | 540 | 520 |
| PN 16 | 640 | 610 | 600 | 590 |

The values above are rounded. Please contact Amiblu if more accurate values are required for transient analysis.
The values above are valid for pipe with joints every 12 m. The effect of other pipe structures like surrounding soils, fittings, thrust blocks etc. has to be evaluated separately.
Celerity values are in m/s.

# Chemical resistance table

| | | Flowtite | | | | Hobas | | | NC Line | | Gaskets | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chemical | Conc % | Grey | Orange** | UPE | VE | UPE | VE | PU Line** | UPE | VE | EPDM | NBR |
| Acetic Acid | <20 | NR | 23 | NR | 90 | NR | * | * | NR | 90 | NR | NR |
| Adipic Acid | All | * | * | 30 | 80 | * | * | * | 30 | 80 | * | R |
| Alum (Aluminum Potassium Sulfate) | All | * | * | 45 | 90 | * | * | * | 45 | 90 | * | * |
| Aluminum Chloride, Aqueous | All | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |
| Ammonia, Aqueous | <20 | NR | 23 | NR | 65 | NR | * | * | NR | 65 | R | * |
| Ammonium Chloride, Aqueous | All | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |
| Aniline Hydrochloride | All | * | * | NR | 80 | * | * | * | NR | 80 | * | * |
| Beet Sugar Liquor | All | * | * | * | 80 | * | * | * | * | 80 | R | R |
| Benzene Sulfonic Acid | <10 | * | * | NR | 60 | * | * | * | NR | 60 | NR | NR |
| Benzoic Acid | All | 20 | * | 30 | 90 | 20 | * | * | 30 | 90 | NR | NR |
| Black Liquor (Paper) | All | * | * | NR | 80 | * | * | * | NR | 80 | * | * |
| Borax | All | * | * | 40 | 90 | * | * | * | 40 | 90 | R | R |
| Boric Acid | All | 30 | * | 30 | 90 | 30 | * | * | 30 | 90 | R | R |
| Calcium Bisulfite | All | * | * | * | 80 | * | * | * | * | 80 | NR | R |
| Calcium Carbonate | All | * | * | NR | 90 | * | 70 | * | NR | 90 | R | R |
| Calcium Chlorate, Aqueous | All | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | * | * |
| Calcium Chloride (Saturated) | Sat | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |
| Calcium Hydroxide | All | NR | * | NR | 50 | NR | * | * | NR | 50 | R | R |
| Calcium Hypochlorite | All | NR | * | NR | 50 | NR | * | * | NR | 50 | R | NR |
| Calcium Nitrate | All | * | * | 40 | 90 | * | 70 | * | 40 | 90 | R | R |
| Calcium Sulfate | All | * | * | 40 | 90 | * | 70 | * | 40 | 90 | R | R |
| Cane Sugar Liquors | All | * | * | * | 80 | * | * | * | * | 80 | R | R |
| Carbon Dioxide, Aqueous | All | * | * | 40 | 80 | * | * | * | 40 | 80 | * | * |
| Caustic Potash (KOH) | Sat | * | * | NR | 40 | * | * | * | NR | 40 | * | * |
| Chlorine, Dry Gas | 100 | NR | * | NR | 90 | NR | * | * | NR | 90 | NR | NR |
| Chlorine, Water | All | * | * | * | * | * | * | * | * | * | * | * |

* Consult your local technical service representative.
** As Flowtite Orange and Hobas PU Line are novel systems only limited data exist at the date of publishing.

# Chemical resistance table

| | | Flowtite | | | | Hobas | | | NC Line | | Gaskets | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chemical | Conc % | Grey | Orange** | UPE | VE | UPE | VE | PU Line** | UPE | VE | EPDM | NBR |
| Chlorine, Wet Gas | 100 | NR | * | NR | 90 | NR | * | * | NR | 90 | NR | NR |
| Citric Acid, Aqueous | All | 20 | * | NR | 90 | 20 | * | * | NR | 90 | R | R |
| Copper Acetate, Aqueous | All | * | * | 40 | 80 | * | * | * | 40 | 80 | R | R |
| Copper Nitrate, Aqueous | All | * | * | 40 | 90 | * | 70 | * | 40 | 90 | R | R |
| Copper Sulfate, Aqueous | All | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |
| Crude Oil (Sour) | 100 | 25 | * | 40 | 90 | 25 | * | * | 40 | 90 | * | * |
| Crude Oil (Sweet) | 100 | 25 | * | 40 | 90 | 25 | * | * | 40 | 90 | * | * |
| Cyclohexane | 100 | * | * | NR | 50 | * | * | * | NR | 50 | NR | R |
| Cyclohexanol | All | * | * | NR | 40 | * | * | * | NR | 40 | NR | * |
| Fuel Oil | 100 | 20 | 23 | 25 | 90 | 20 | * | * | 25 | 90 | NR | R |
| Gasoline | 100 | NR | 23 | * | * | NR | NR | * | * | * | NR | * |
| Glycerine | 100 | * | * | 30 | 90 | * | * | * | 30 | 90 | R | R |
| Green Liquor, Paper | | * | * | NR | 40 | * | * | * | NR | 40 | R | * |
| Kerosene | 100 | NR | * | * | 80 | NR | * | * | * | 80 | NR | R |
| Lactic Acid | <10 | 20 | * | 30 | 80 | 20 | * | * | 30 | 80 | R | R |
| Lead Acetate, Aqueous | All | 25 | * | 25 | 80 | 25 | * | * | 25 | 80 | R | R |
| Lead Nitrate, Aqueous | All | * | * | 25 | 90 | * | * | * | 25 | 90 | R | R |
| Linseed Oil | All | 30 | * | 60 | 90 | 30 | * | * | 60 | 90 | NR | R |
| Lithium Chloride, Aqueous | All | * | * | 40 | 90 | * | * | * | 40 | 90 | * | * |
| Magnesium Bicarbonate, Aqueous | All | * | * | 30 | 80 | * | * | * | 30 | 80 | * | * |
| Magnesium Carbonate | <15 | 20 | * | * | 90 | 20 | 70 | * | * | 90 | * | * |
| Mineral Oils | 100 | 25 | * | 50 | 90 | 25 | * | * | 50 | 90 | * | * |
| n-Heptane | 100 | * | * | 30 | 90 | * | * | * | 30 | 90 | * | * |
| Naphthalene | All | 25 | * | * | 60 | 25 | * | * | * | 60 | NR | NR |
| Naphtha | 100 | NR | * | * | 45 | NR | NR | * | * | 45 | NR | * |
| Oleic Acid | All | 30 | * | 25 | 90 | 30 | * | * | 25 | 90 | R | NR |

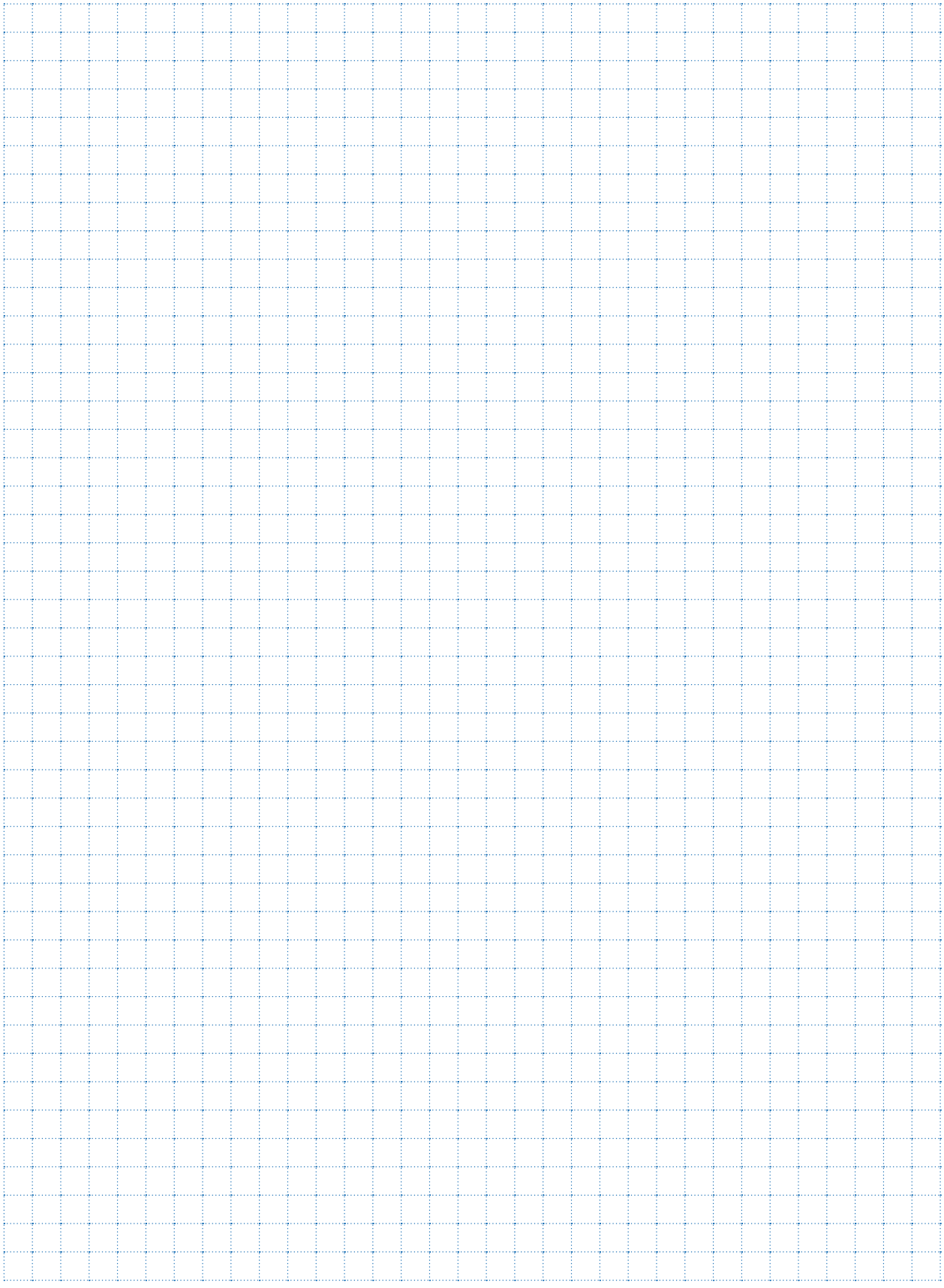
* Consult your local technical service representative.
** As Flowtite Orange and Hobas PU Line are novel systems only limited data exist at the date of publishing.

# Chemical resistance table

| | | Flowtite | | | | Hobas | | | NC Line | | Gaskets | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chemical | Conc % | Grey | Orange** | UPE | VE | UPE | VE | PU Line** | UPE | VE | EPDM | NBR |
| Oxalic Acid, Aqueous | Sat | NR | * | NR | 90 | NR | * | * | NR | 90 | R | * |
| Perchloric Acid | <30 | NR | * | NR | 35 | NR | * | * | NR | 35 | * | NR |
| Phosphoric Acid | <80 | NR | * | 30 | 90 | NR | 75 | * | 30 | 90 | R | NR |
| Potassium Nitrate, Aqueous | All | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |
| Potassium Sulfate | All | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |
| Propylene Glycol | All | 30 | * | 30 | 90 | 30 | * | * | 30 | 90 | R | R |
| Sewage | All | 50 | * | 50 | 90 | * | * | * | 50 | 90 | R | R |
| Silicone Oil | 100 | * | * | 40 | 90 | * | * | * | 40 | 90 | R | R |
| Silver Nitrate, Aqueous | All | * | * | 40 | 90 | * | * | * | 40 | 90 | R | R |
| Sodium Hydroxide | <10 | NR | NR | NR | 40 | NR | 45 | * | NR | 40 | R | R |
| Sodium Monophosphate | <10 | * | * | NR | 90 | * | * | * | NR | 90 | R | R |
| Sodium Nitrate, Aqueous | All | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |
| Sodium Nitrite, Aqueous | All | * | * | 40 | 90 | * | 70 | * | 40 | 90 | * | * |
| Sodium Silicate | 100 | NR | * | NR | 65 | NR | * | * | NR | 65 | R | R |
| Stannous Chloride, Aqueous | All | 30 | * | 40 | 90 | 30 | * | * | 40 | 90 | R | R |
| Stearic Acid | All | 20 | * | 40 | 90 | 20 | * | * | 40 | 90 | R | R |
| Sulfuric Acid | <25 | 20 | * | 30 | 90 | 20 | 75 | * | 30 | 90 | R | NR |
| Tannic Acid, Aqueous | All | 25 | * | 25 | 90 | 25 | * | * | 25 | 90 | R | R |
| Tartaric Acid | All | * | * | 30 | 90 | * | * | * | 30 | 90 | * | R |
| Triethylamine | All | NR | * | NR | 40 | NR | NR | * | NR | 40 | R | NR |
| Turpentine | | * | * | 25 | 65 | * | * | * | 25 | 65 | NR | R |
| Urea, Aqueous | <30 | * | * | 30 | 60 | * | * | * | 30 | 60 | R | * |
| Vinegar | All | * | * | 25 | 90 | * | * | * | 25 | 90 | R | * |
| Water, Distilled | 100 | 30 | * | 40 | 80 | 30 | 70 | * | 40 | 80 | R | R |
| Water, Sea | 100 | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |
| Water, Tap | | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |
| Zinc Chloride, Aqueous | All | 30 | * | 40 | 90 | 30 | 70 | * | 40 | 90 | R | R |

* Consult your local technical service representative.
** As Flowtite Orange and Hobas PU Line are novel systems only limited data exist at the date of publishing.

# Notes

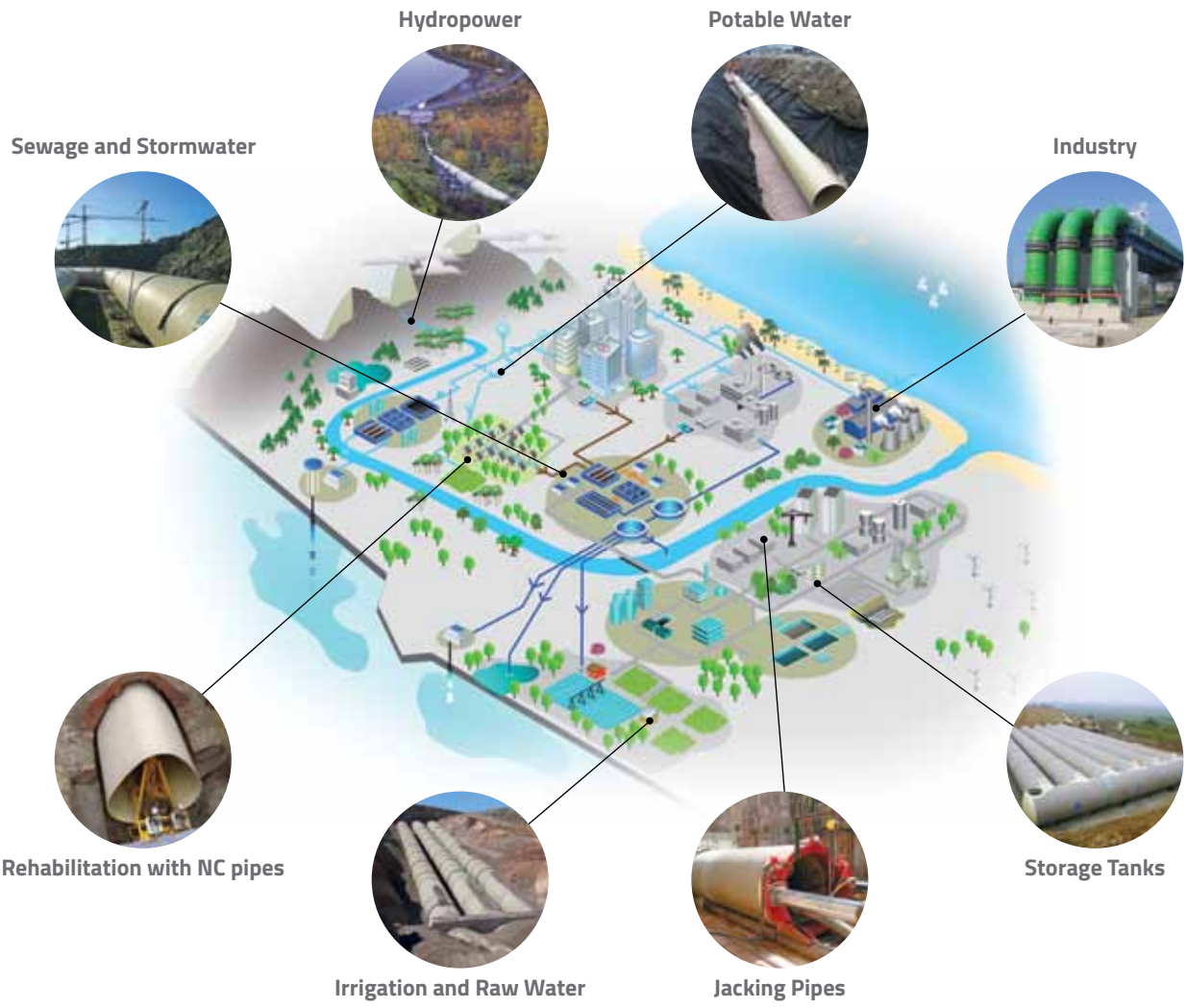


# Why there is nothing else like an Amiblu pipe system

Engineered for the next 150 years

Service-focused partners to solve your problems

Innovation to challenge the status quo

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