Amiblu®

FLOWTITE®

THE FIRST CHOICE OF ENGINEERS **WORLDWIDE**

English Version

FLOWTITE
THE GRP PIPE SYSTEM BUILT AROUND YOUR NEEDS

At Flowtite Technology, we design and manufacture the world's best piping systems to provide unique, sustainable piping solutions and maximise the health and well-being of people around the world. We do this by manufacturing Flowtite GRP Pipe Systems.

We maintain our technological lead by investing in the highest level of R&D, by listening to what engineers around the world want and being satisfied with no less than 100 % customer satisfaction. This has been the driving force behind our success. It is built into every pipe we manufacture.

We will change the world for the better a pipe at a time! Welcome to Flowtite. The GRP Pipe System.

THE FIRST CHOICE OF ENGINEERS. WORLDWIDE.

Agnar Gilbu, R&D Manager, and Tomas Andersson, Technology Director.

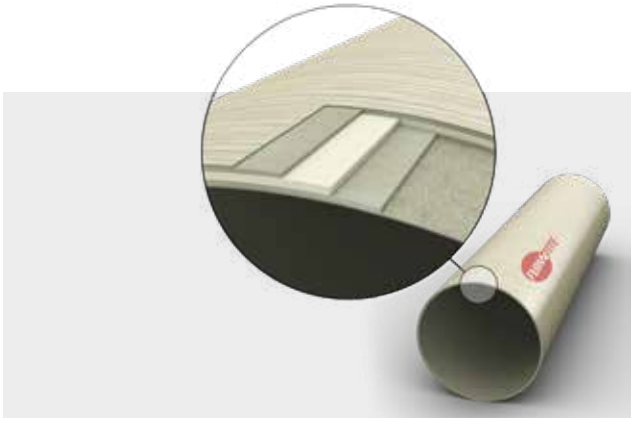
WHY FLOWTITE IS THE FIRST CHOICE OF ENGINEERS WORLDWIDE

LOWEST TOTAL COST

The cost of a project is more than the cost of a pipe. Flowtite has an excellent on-time delivery record, superior installation manuals, and experienced field technicians.

UNMATCHED SUSTAINABILITY

Our Flowtite products have an estimated lifetime of 150 years or more! No coating needed. No cathodic protection needed. This is how Flowtite offers unmatched sustainability!



BECAUSE IT'S MORE RELIABLE

6 million Flowtite couplings and more than 70 000 kilometres of Flowtite pipes transport water every day – worldwide. We have the world's largest certified laboratory for testing of GRP pipes. We never release a product without the most rigorous testing!

IT'S CARBON FRIENDLY

An independent study conducted at The Norwegian University of Life Sciences in 2012 concludes that GRP pipes have a minimal negative environmental impact.

WE REINVENT THE INDUSTRY

We reinvent the pipe industry – a pipe at a time. We pioneered and patented the GRP laminate in the 1970's. Our pipes are longer and lighter. Flowtite has been the driving force in the development of the GRP pipe.

FLOWTITE. FIRST CHOICE OF ENGINEERS.

CONTENT

WORLDWIDE.

Flowtite biaxial pipes were used on the world's largest desalination plant. More than 18 000 field joints were applied during the installation.

LOCATION:
Ras Al-Khair, Saudi Arabia

FLOWTITE
PIPES FOR YOUR EVERY NEED

TYPE / USE	PICTURE	DESCRIPTION
PRESSURE PIPES Flowtite pipe with main reinforcement in the hoop direction. Used in applications without pressure end thrust, for example penstocks and pressure mains.		• Diameter range (DN): 100 - 4 000 mm • Pressure (PN): up to 32 bar • Standard lengths: 6 & 12 m • Stiffness: 2 500, 5 000 and 10 000
SEWER PIPES Flowtite pipe designed for exceptional acid resistance. Typically used for sewer and storm water applications.		• Diameter range (DN): 80 - 4 000 mm • Pressure (PN): 1 bar • Standard lengths: 6 & 12 m • Stiffness: 2 500, 5 000 & 10 000
BIAXIAL PIPES Flowtite pipe reinforced in the hoop and axial directions to resist pressure end thrust and bending loads. Common uses are cooling water and desalination and similar above ground applications.		• Diameter range (DN): 80 - 4 000 mm • Pressure (PN): Up to 20 bar • Lengths: Up to 12 m • Stiffness: 2 500, 5 000 and 10 000
JACKING PIPES Flowtite pipe designed to withstand high jacking forces. Typically used for jacking under structures like roads and railways.		• Diameter range (DN): 80 - 3 500 mm • Pressure (PN): Up to 6 bar • Standard lengths: 1 - 12 m • Stiffness: 20 000 N/m^2 +

FLOWTITE PROPERTIES

TECHNICAL DATA FLOWTITE PIPES	
Main materials	Resin, glassfibre, sand
Operating temperatures	-50 °C - +70 °C
Standard lengths	12 & 6 m
Diameter range	DN 80 - DN 4000
Pressure range	PN 1 - PN 32
Estimated lifetime	More than 150 years
Corrosion protection	None needed
Hydraulic roughness	k = 0.029 mm (Colebrook-White)
Assessment of conformity	CEN TS 14632
International Pipe Standards	ASTM D3262, ASTM D3754, ASTM D3517 AWWA C950 ISO 10639, ISO 10467 EN 1796, EN 14634

Installation of Flowtite pressure pipes.

LOCATION:
Turkey

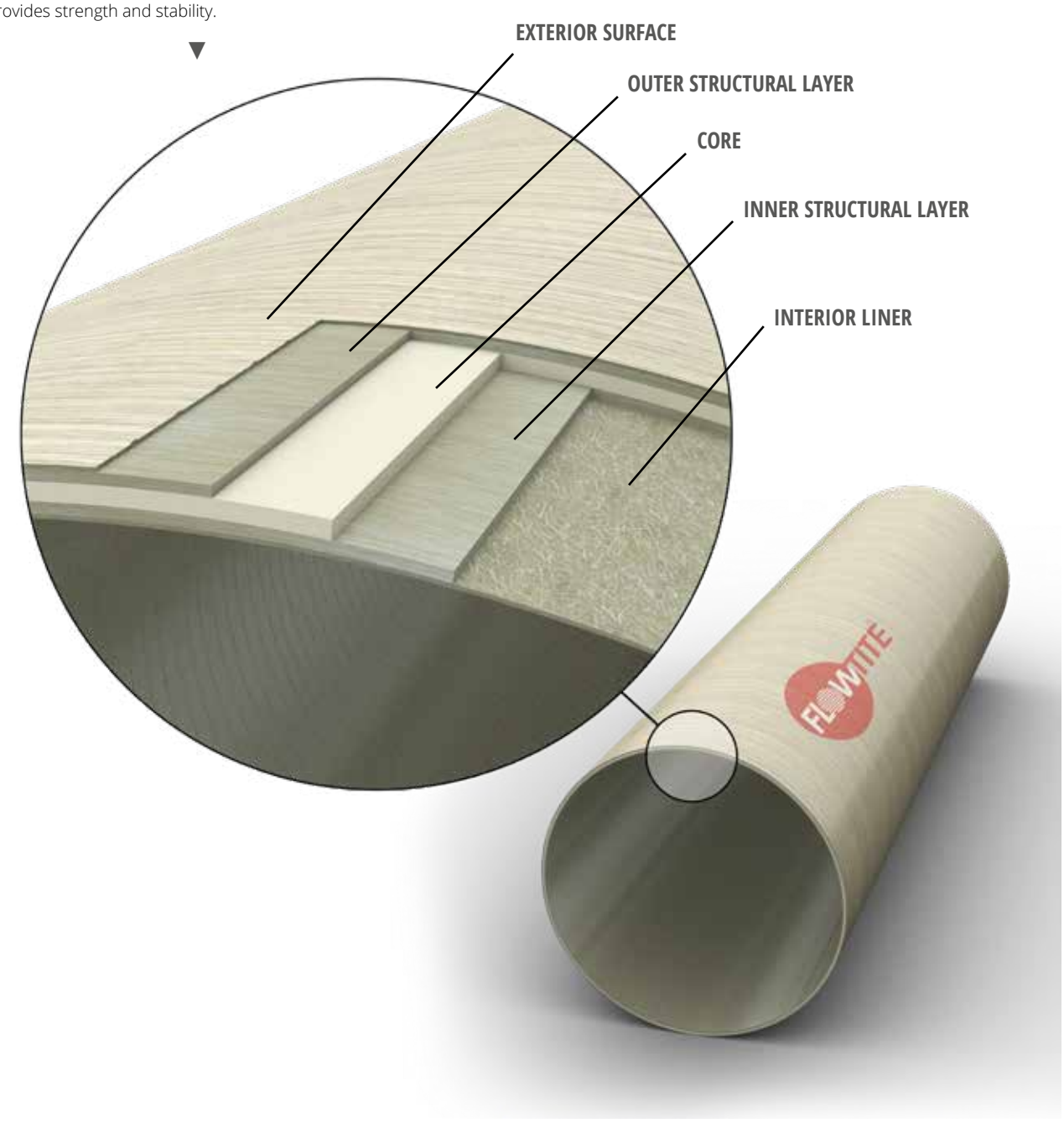
Contact your local supplier for special liners, customised dimensions or other requirements.

HOW STRONG DO YOU NEED YOUR FLOWTITE PIPE?

PIPE WALL CONSTRUCTION

The pipe wall is built as a structural sandwich, using the Flowtite continuous filament winding technology. The high strength continuous glass-fibres resist the hoop stresses from internal pressure, while the chopped fibres 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.

The sandwich construction provides strength and stability.



At a Flowtite manufacturing plant.

LOCATION: USA

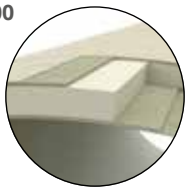
STANDARD STIFFNESS CLASSES

Flowtite pressure and sewer pipes are manufactured in three standard stiffness classes.

SN 2500

SN 5000

SN 10000



STANDARD PRESSURE RANGE

Flowtite pipes are manufactured in pressure classes ranging from PN 1 to PN 32

PN 1

PN 32

POISSON'S RATIO

► Poisson's ratio is influenced by the pipe construction. For Flowtite pipes, the ratio for hoop (circumferential) loads and axial response ranges from 0.22 to 0.29.

THERMAL COEFFICIENT

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

WHY ENGINEERS CHOOSE FLOWTITE PIPES

NO CORROSION

Flowtite pipes need no coating or anti-corrosion treatment. Flowtite pipes are manufactured with inherently corrosion-resistant materials, outperforming steel, ductile iron and steel-reinforced pipes that require corrosion protection.

Flowtite pipes solve corrosion problems and reduce costly maintenance.

LOCATION:
Hydropower installation in Sweden

UV RESISTANCE

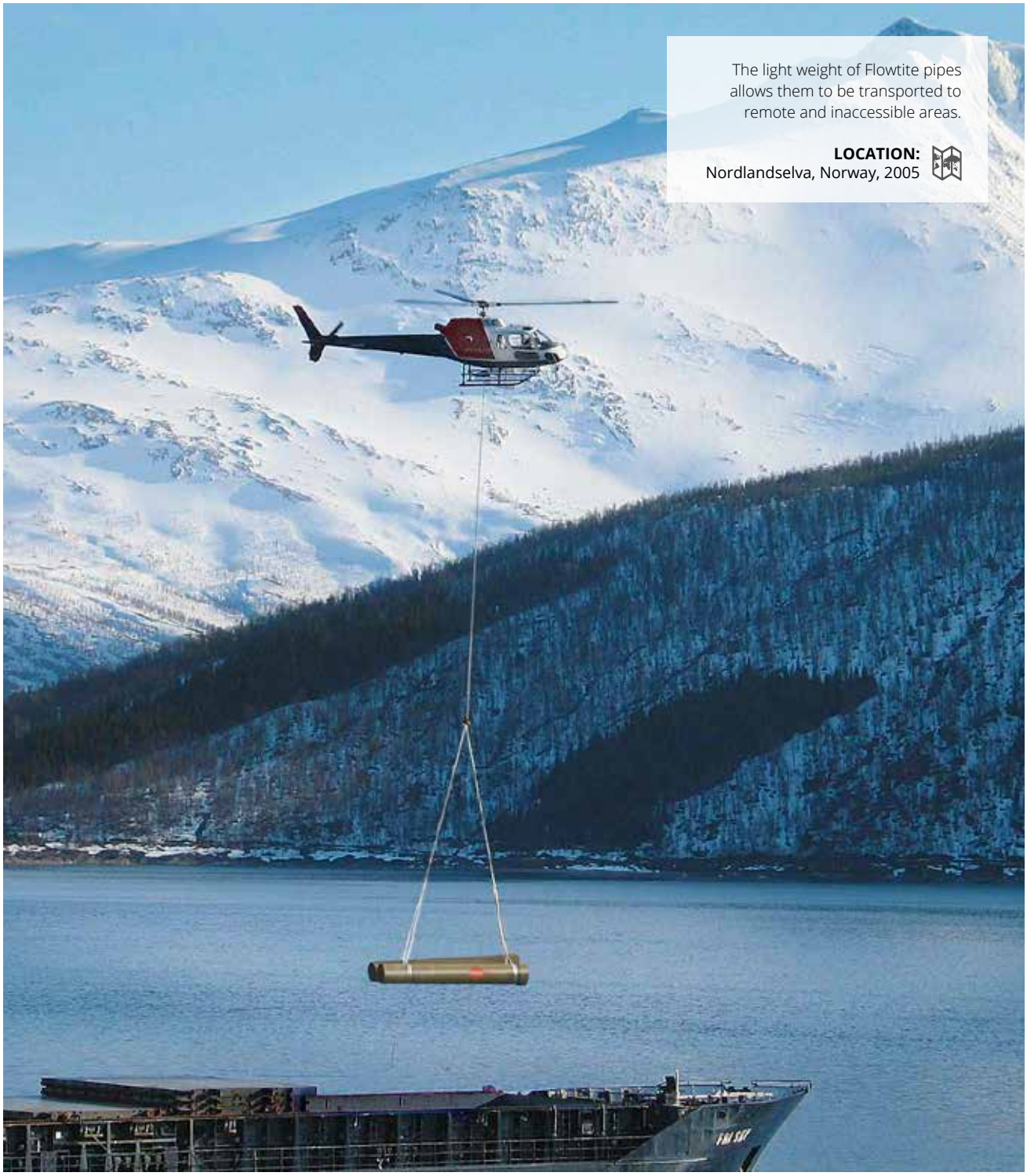
Flowtite pipes are resistant to UV light. For pipes installed above ground, the outside surface might see some change in colour which has no impact on the long-term performance of the pipes.

ACID- AND CHEMICAL RESISTANCE

Flowtite pipes have an extraordinary acid- and chemical resistance. The unique resistance of Flowtite pipes is ensured by careful consideration of all materials, pipe designs and production process. Flowtite pipes resist the sulfuric acids that build up in sewer applications. They resist the actions of ground salts and salty waters in desalination plants. Flowtite pipes may also be used in other chemically demanding applications. Please see the table on chemical resistance in the technical data section.

LIGHT WEIGHT

Flowtite pipes are lighter than ductile iron, steel, concrete and non-reinforced plastic pipes. That makes transportation less expensive, and less expensive installation equipment can be used. Their light weight enables the pipes to be transported and handled in remote and inaccessible areas. Flowtite pipes can be nested, meaning that smaller pipes can be transported inside larger pipes, thus reducing cost of transportation.



The light weight of Flowtite pipes allows them to be transported to remote and inaccessible areas.

LOCATION:
Nordlandselva, Norway, 2005

FLOWTITE
COUPLINGS AND JOINTS

MORE THAN SIX MILLION FLOWTITE DOUBLE BELL COUPLINGS ARE IN SERVICE WORLDWIDE.

Assembly of a Flowtite Double Bell Coupling.
The Flowtite Coupling uses a Reka elastomeric gasket.

FLOWTITE DOUBLE BELL COUPLINGS

The majority of buried Flowtite pipelines are assembled with the trusted Flowtite Double Bell Coupling. These have been used on all continents of the world since 1979.

The expected lifetime of Flowtite Couplings is more than 150 years. Therefore, the Double Bell Coupling is a preferred coupling for Flowtite installations. The Double Bell Coupling comes in four different versions: **(1) Pressure, (2) Sewer, (3) Biaxial Lockjoint and (4) Angled Coupling.**

TECHNICAL DATA
FLOWTITE DOUBLE BELL COUPLING

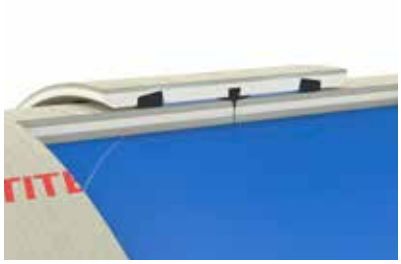
Operating pressure*:	Up to 32 bar
Main materials:	Resin, glass-fibre, sand
Estimated lifetime:	More than 150 years
External waterhead:	50 meter +
Operating temperature:	-50 °C, - +70 °C
Estimated gasket lifetime:	More than 150 years
Gasket:	EPDM, Reka

* The Flowtite coupling has been tested successfully to 96 bar!

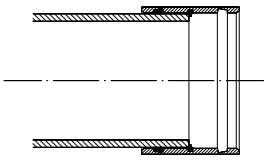
FLOWTITE DOUBLE BELL COUPLINGS

PRESSURE COUPLING

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

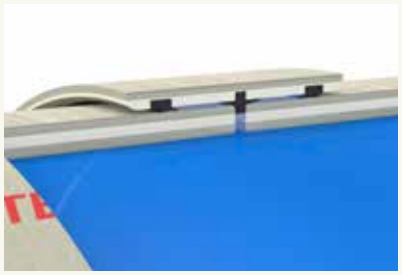


- Diameter range (DN): 100 - 4 000 mm
- Pressure (PN): up to 32 bar

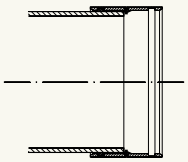


SEWER COUPLING

Commonly used for sewers and storm water.



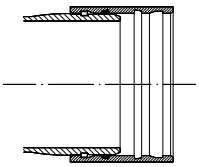
- Diameter range (DN): 100 - 4 000 mm
- Pressure (PN): 1 bar



BIAXIAL LOCK JOINT

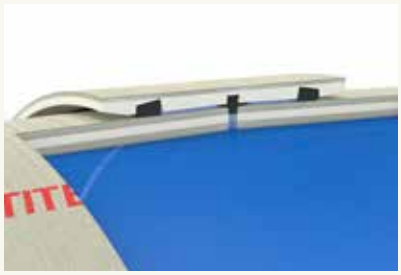
Used for applications where transfer of load between pipes is required. Commonly used on desalination and cooling applications.

- Diameter range (DN): 100 - 2 000 mm
- Pressure (PN): 3 - 16 bar

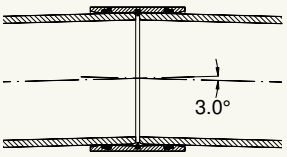


ANGLED COUPLING

Flowtite coupling for increased angular deflections up to 3 degrees



- Diameter range (DN): up to 4 000 mm
- Pressure (PN): up to 16 bar



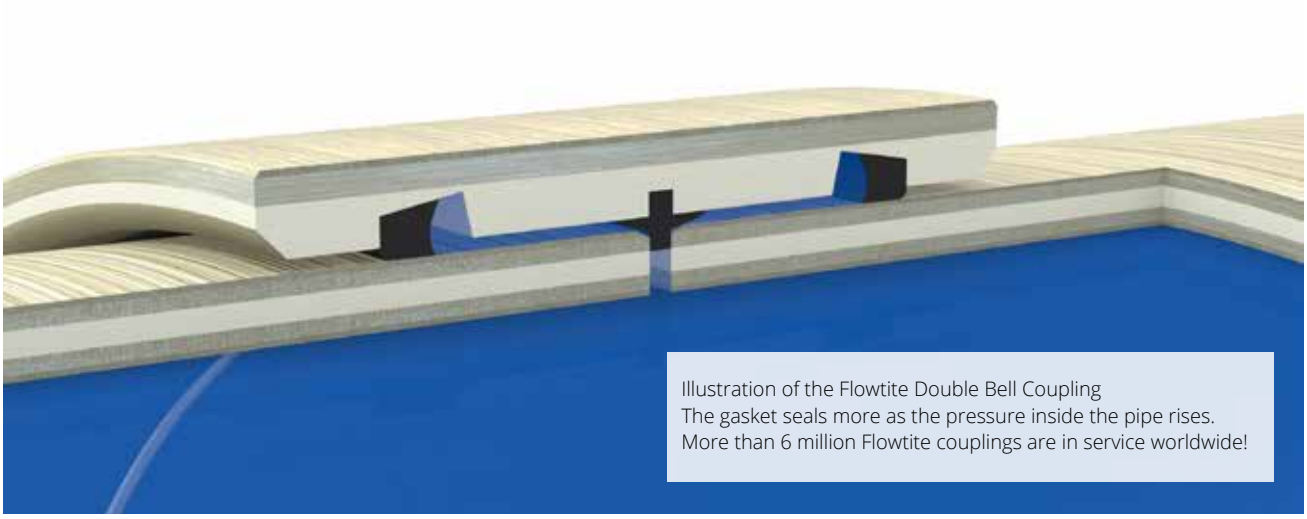


Illustration of the Flowtite Double Bell Coupling
The gasket seals more as the pressure inside the pipe rises.
More than 6 million Flowtite couplings are in service worldwide!

FLOWTITE PATENTED BUTT WRAPS

Flowtite provides the necessary instructions for butt-wrap joining according to Flowtite's patented butt-wrap technology. This patented technology provides faster and more cost-efficient installation.

Flowtite pipes may be joined using glass fibre reinforcement and resin. The butt-wrap joints are common in applications with axial thrust.

Butt-wrap joints used to join DN 4000 pipes in a desalination plant in Jubail, Saudi Arabia, 2007.

LOCATION: Jubail, Saudi Arabia, 2007

FLOWTITE FLANGES

Flowtite 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 ISO2084. Other bolting dimension systems such as AWWA, ANSI, DIN and JIS can be supplied.

Steel flanges connected to Flowtite flanges.

LOCATION: Venezuela

USING STEEL COUPLINGS TO JOIN FLOWTITE PIPES

Flowtite 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.

▲

Steel coupling used for field closure at Fall Hydropower Station.

LOCATION:
Norway

FLOWTITE FITTINGS

200 000 STANDARD FLOWTITE FITTINGS ARE AVAILABLE FOR YOUR APPLICATIONS.

Flowtite fittings are designed based on an extensive research programme and patented concepts. Flowtite's researchers have rigorously analysed critical strains in bends, tees and elbows. Flowtite fittings are moulded or fabricated using the same materials that are used to produce Flowtite pipes.

Tangential manhole on a novel aerial sewer installation.

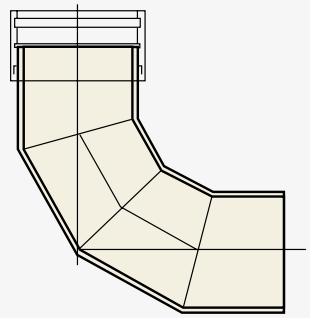
LOCATION: Germany

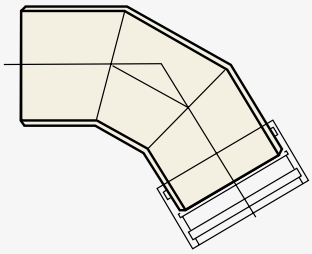
The possibilities for custom design are almost endless. Here is a sewage water retention system.

LOCATION:
Winterberg, Germany

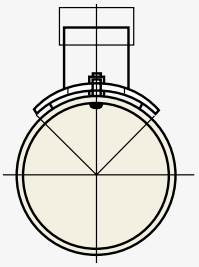
MOST COMMON FLOWTITE FITTINGS TYPES

ELBOWS

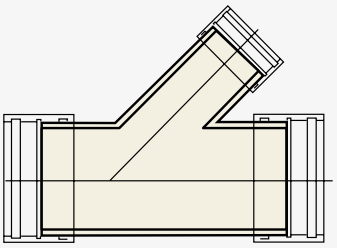




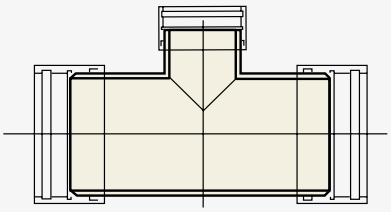
SADDLES



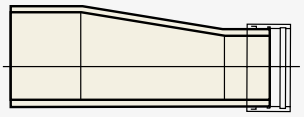
WYES



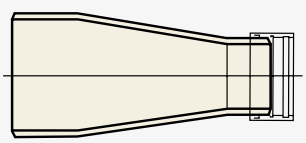
TEES



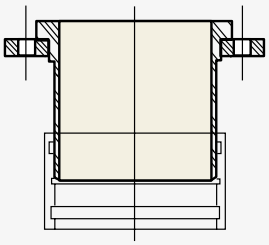
ECCENTRIC REDUCERS

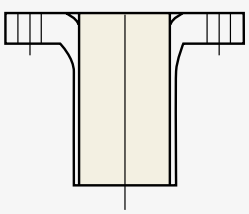


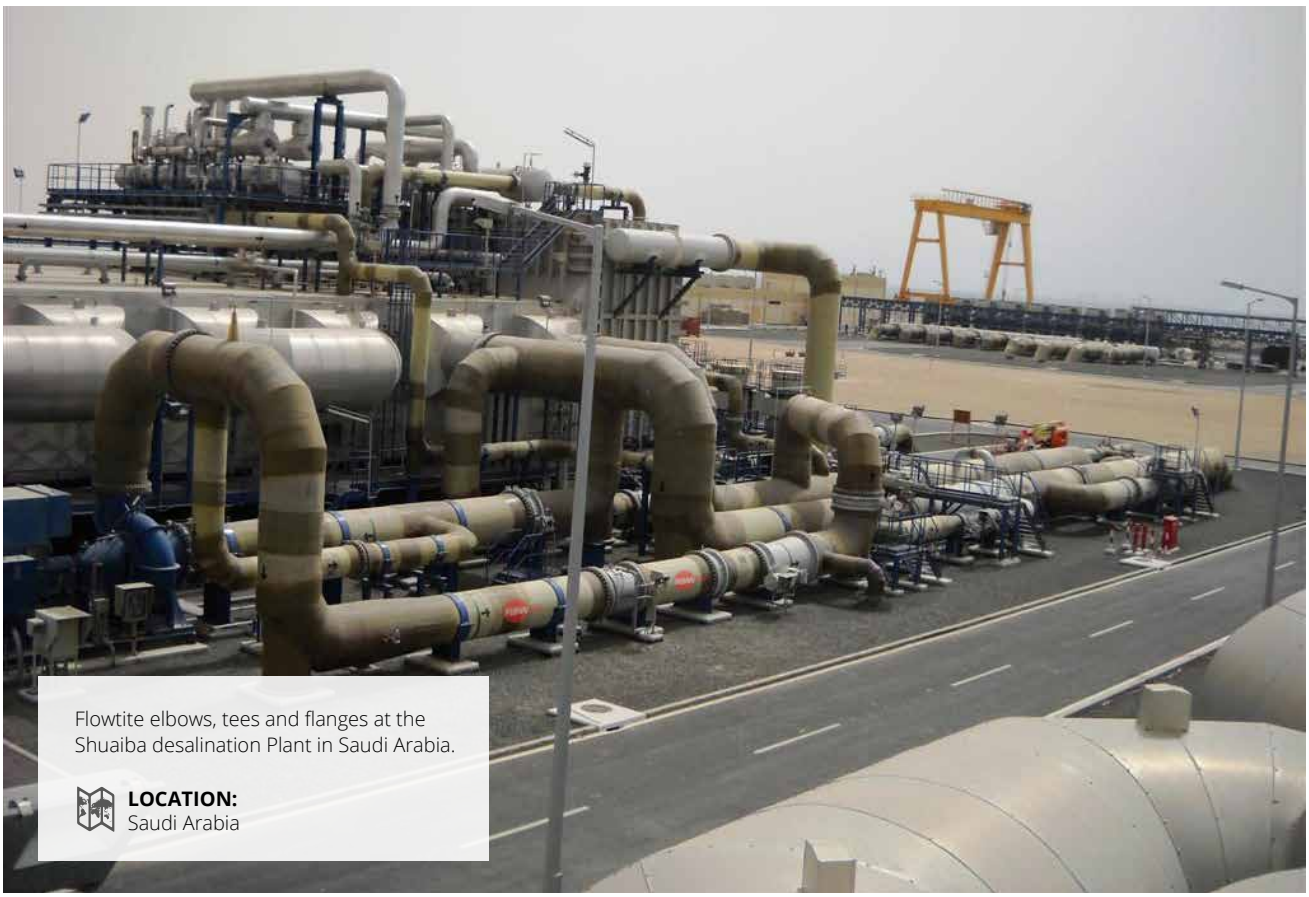
CONCENTRIC REDUCERS



FLANGES







Flowtite elbows, tees and flanges at the Shuaiba desalination Plant in Saudi Arabia.

LOCATION:
Saudi Arabia

CNC machine cuts fabrics for Flowtite fittings.

LOCATION:
Turkey

TOOLS
FOR THE ENGINEER

FLOWTITE PIPELINE DESIGN TOOLS GIVE THE ENGINEER THE NECESSARY SUPPORT FOR DESIGNING PIPELINES WORLDWIDE.

AMITOOLS PIPELINE DESIGN SOFTWARE

AMITOOLS is an online service offering software tools for static calculation of buried pipes and hydraulic calculation.

- Static calculation according to German (ATV 127), American (AWWA M45) and French (Fascicule 70) standards
- Hydraulic calculation
- Design of thrust blocks

The tools are free of charge, available in metric and imperial dimensions

Register and apply for your personal licence at www.ami-tools.net

Flowtite design tools should not be used for non-Flowtite manufactured pipes, as all calculations are based on Flowtite product design.

FLOWTITE TECHNICAL LITERATURE
An extensive library of technical literature can be found on www.flowtite.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.

WORLDWIDE FIELD SERVICE
Flowtite suppliers offer technical assistance and consultancy to designers and engineers both locally and worldwide.

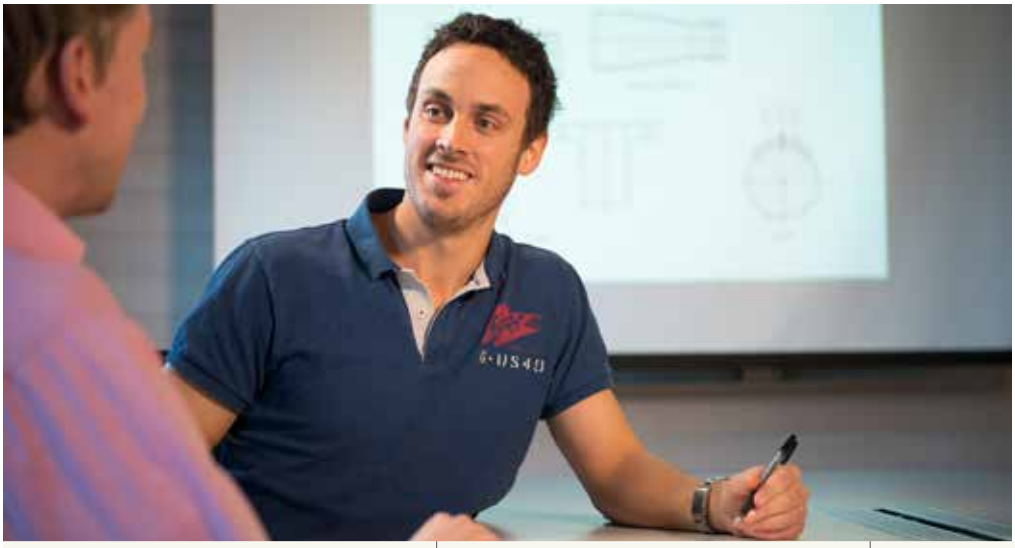
Here is a list of some of our services:

- Configuration of installation
- Burial analysis
- Hydraulic calculations
- Calculation of supports and anchorages
- Calculation of concrete thrust blocks
- Connection to other materials
- Stress and finite element analysis of installations
- Drawings of plants, isometrics and production sheets
- Field Engineering Services

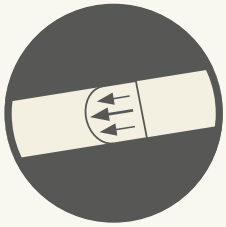
You can find your local Flowtite supplier on www.flowtite.com

CONSIDERATIONS FOR THE ENGINEER

EXPERIENCE, RESEARCH AND 70 000 KILOMETRES OF PIPELINE HAVE PROVIDED ENGINEERS WITH RELIABLE AND ACCURATE KNOWLEDGE OF DESIGNING PIPELINES.



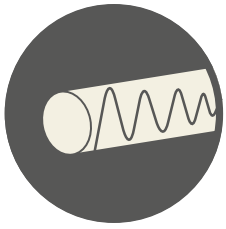
FLOW CALCULATIONS



The most economical flow velocity in pipes is usually 2 - 3 m/s. This is also the case for Flowtite pipes. The maximum recommended flow velocity is 5 m/s. Flowtite pipelines sustain velocities of up to 8 m/s if the water is clean and contains no abrasive material. Flowtite Amitools flow calculation will help engineers to estimate the appropriate pipe diameter.

Due to the larger inner diameter the headloss in Flowtite pipes is less than for most other pipe materials.

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 Flowtite pipes is approximately 50 % of that for steel and ductile iron pipes in similar conditions.

$$\Delta H = \frac{w \cdot \Delta V}{g}$$

Where:

ΔH = change in pressure (m)

w = surge wave celerity (m/s)

ΔV = change in water velocity $\left(\frac{m}{s}\right)$

g = acceleration due to gravity (m/s^2)

ANGULAR DEFLECTION ON JOINTS

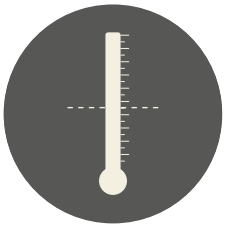
The maximum angular deflection (turn) at each coupling joint, taking the combined vertical and horizontal deflection into consideration, and measured as the change in adjacent pipe centre lines, shall not exceed 3 degrees. The pipes shall be joined in straight alignment and thereafter deflected angularly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

The table is valid for the Flowtite Angled Coupling up to PN 16. For all other joints, please find the details in the Flowtite Installation Guide for Buried Pipes.

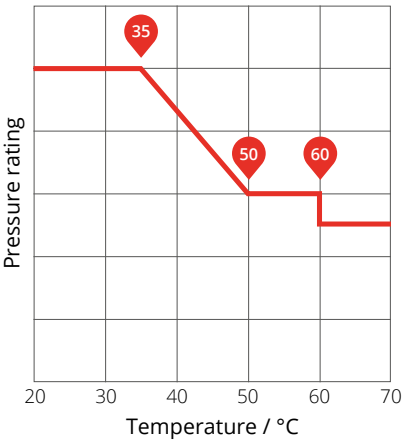
Minimum Radius of Curvature

Angle of Deflection	Pipe Length		
	3 m	6 m	12 m
3	57 m	115 m	229 m

OPERATING TEMPERATURE



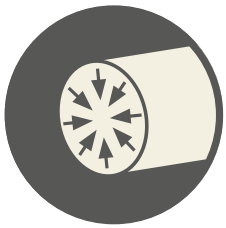
Flowtite pipes may be used with operating temperature from -50 to +70 °C. Requirements in the international pipe standards require a consideration for pressure rerating above 35 °C. At temperatures above 50 °C, vinyl ester resins are often recommended. Flowtite pipes may be used up to operating temperatures of 70 °C with appropriate consideration to pipe design, materials usage and gasket materials.



TRAFFIC LOADS

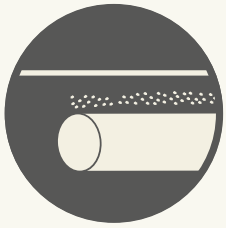
All backfill to grade should be compacted when continuous traffic loads are present. Minimum cover restrictions may be reduced with special installations such as concrete encasement, concrete cover slabs or casings.

NEGATIVE PRESSURE (VACUUM)



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

HIGH GROUND WATER TABLE



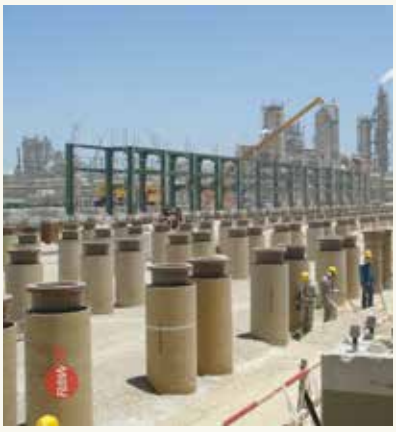
A minimum of 0.75 times the diameter of earth cover with minimum dry soil bulk density of 1 900 kg/m^3 is required to prevent an empty submerged pipe from floating. Alternatively, the installation may proceed by anchoring the pipes. Consult your Flowtite manufacturer for details on anchoring.

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.

CHEMICALS EXPOSURE

Standard Flowtite 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. Flowtite have special pipe designs for most chemicals, including process water from pulp and paper industry.



FLOWTITE
PIPE INSTALLATION

LIGHT AND LESS EXPENSIVE EQUIPMENT CAN BE USED INSTALLING FLOWTITE PIPES.

Buried installation of Flowtite pipes.

LOCATION:
Turkey

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 Amitools design software (see page 20) follows these 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.

For complete installation instructions consult the Flowtite Installation Guides.

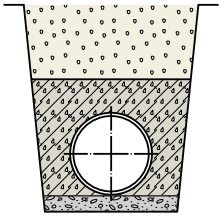
BURIED FLOWTITE INSTALLATION

The following information is a partial review of installation procedures and does not replace Flowtite Installation Guide for Buried Pipes on www.flowtite.com

1 **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.
2 **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.
3 **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.
4 **Checking the Installed Pipe**	After the installation of each pipe the maximum diametrical vertical deflection shall be checked. With Flowtite pipes this is fast and easy. For typical installations the initial deflection will be 1 - 2 %, and should be compared with the predicted value. The maximum allowable initial deflection is 3 % for diameters larger than DN 300.

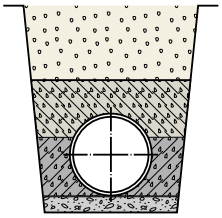
INSTALLATION TYPE 1

- Backfill the pipe zone to 300 mm over the pipe crown with the specified backfill material compacted to the required relative compaction level.



INSTALLATION TYPE 2

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



FLOWTITE THRUST-BEARING PIPE INSTALLATIONS

Desalination project.

LOCATION: Saudi Arabia

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

FLOWTITE NON-THRUST-BEARING PIPE INSTALLATIONS

Hydropower project.

LOCATION: Caruquia, Colombia.

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. Flowtite Technology has designed and analysed the most common installations. More information at Flowtite Installation Guide Above Ground with non-restrained Joints.

FLOWTITE JACKING AND SLIPLINING INSTALLATIONS

Jacking pipe during installation.

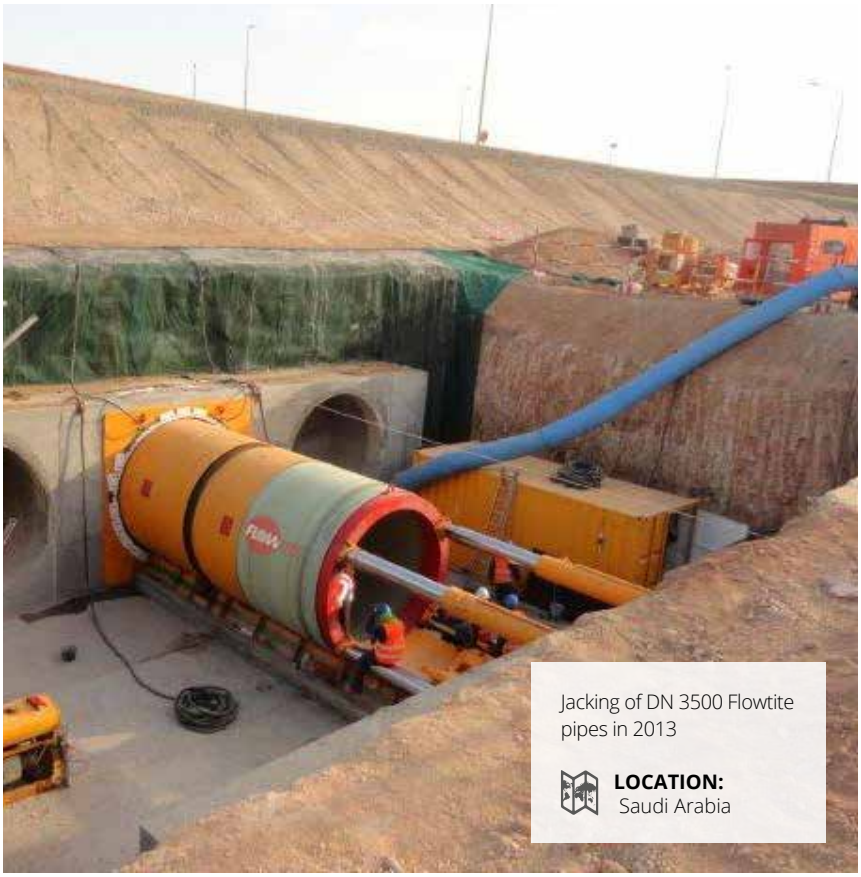
LOCATION:
New South Wales, Australia

With their high strength, Flowtite pipes are well suited for sliplining and jacking. For sliplining, 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.

Flowtite pipe design for jacking and micro-tunnelling takes advantage of non-corrodible materials. The smooth external surface and water repellency gives low friction during jacking.

LOCATION:
Oregon, USA, 2014

▼



Jacking of DN 3500 Flowtite pipes in 2013

LOCATION:
Saudi Arabia

FLOWTITE SUBAQUEOUS INSTALLATIONS

Subaqueous Installation.

LOCATION:
Turkey

Flowtite pipes are excellent for subaqueous installations. Dimensions up to 4 meters in diameter are common for Flowtite subaqueous pipelines. Flowtite pipes do not float.

FLOWTITE. THE BEST SOLUTION FOR THE ENVIRONMENT

FLOWTITE PIPES HAVE A LOW CARBON FOOTPRINT.

Studies conducted by Flowtite show that Flowtite pipes have a low carbon footprint. Flowtite have conducted both cradle-to-gate and cradle-to-grave studies.

MATERIAL EFFICIENCY

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.

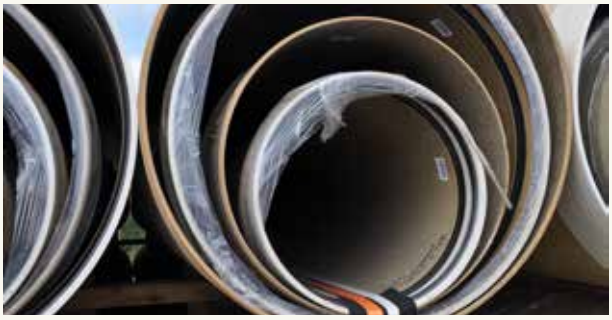
Used with permission from The Norwegian University of Life Science and the author Katrine Steen Fjeldhus. Photo: Gisle Bjørneby.

RECYCLABLE

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

TRANSPORTATION EFFICIENCY

Flowtite pipes can be nested during transportation, which means lower carbon emissions from pipe transportation.



LOW ENERGY PRODUCTION

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

EXCELLENT HYDRAULICS

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

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

FLOWTITE
WORLDWIDE PRODUCTION

FLOWTITE CLOSE TO YOU – ON FIVE CONTINENTS.

Flowtite pipes are produced worldwide by more than 40 specialized production lines. Flowtite plants are modern, efficient and reliable, located strategically on 5 continents of the world. Raw materials are delivered with vendor certification demonstrating their compliance with Flowtite 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.

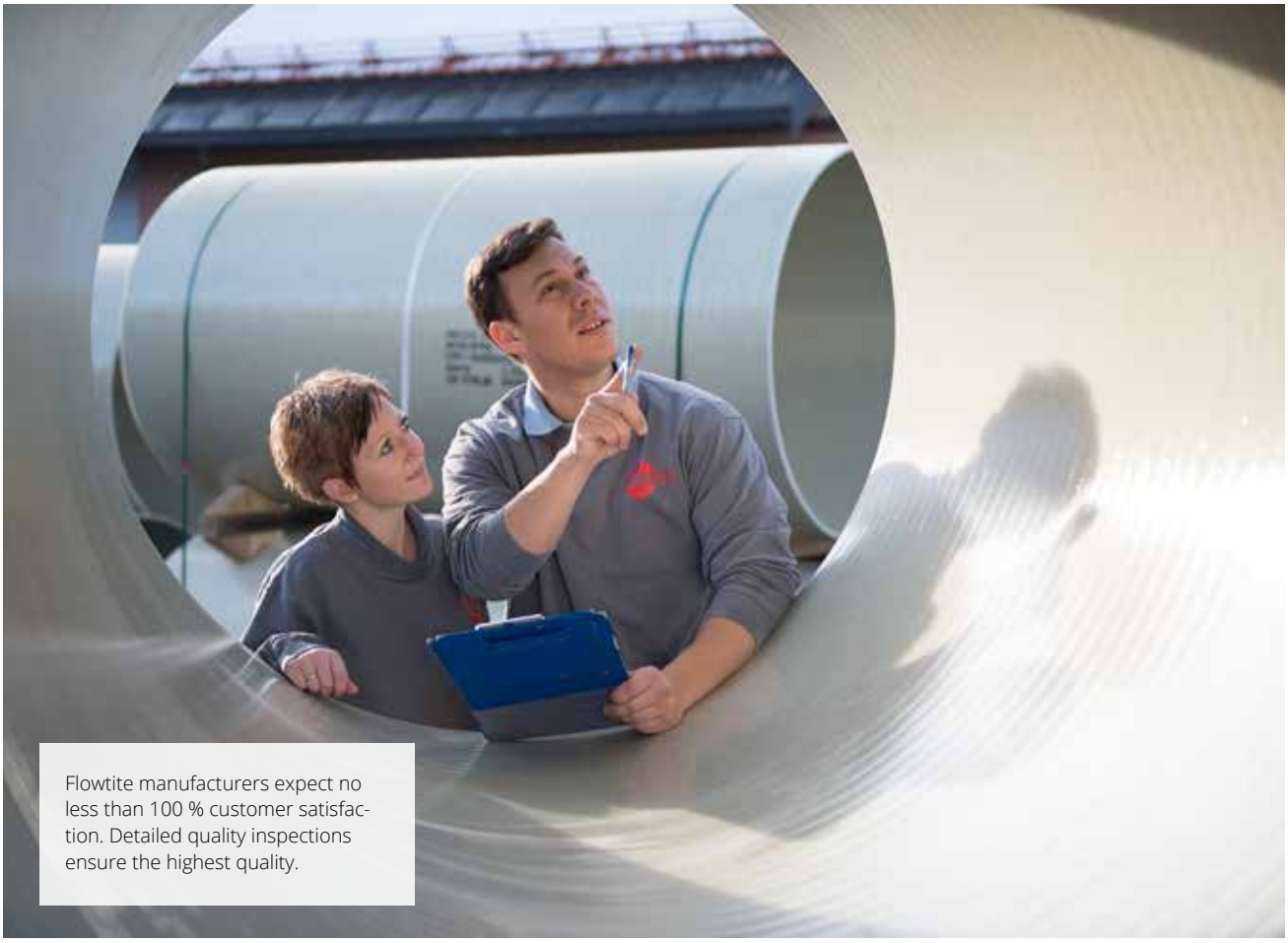
QUALITY CONTROL

The Flowtite quality control program contains a variety of tests. Pipes can be controlled with tests such as the ones below:

- Visual inspection
- Barcol hardness
- Wall thickness
- Section length
- Diameter
- Hydrostatic leak tightness test
- Pipe stiffness
- Deflection without damage or structural failure
- Axial and circumferential tensile load capacity
- Material composition analysis

ON-TIME DELIVERY
The picture shows special transport of 12 meter long and 4 meter wide pipes.

LOCATION:
Turkey



Flowtite manufacturers expect no less than 100 % customer satisfaction. Detailed quality inspections ensure the highest quality.

OVERVIEW OF FLOWTITE MANUFACTURING PLANTS

ARGENTINA
AUSTRALIA
BRAZIL
COLOMBIA
DUBAI
EGYPT
GERMANY
KAZAKHSTAN
LIBYA
MEXICO
MOROCCO
POLAND
QATAR
SAUDI ARABIA
SOUTH AFRICA
USA
SPAIN

► See the complete list and contact information for factories and sales offices on www.flowtite.com.


Poland
Germany
Spain
Morocco
Libya
Egypt
Qatar
Dubai
Saudi Arabia
Kazakhstan
South Africa
Australia

PERFORMANCE STANDARDS

FLOWTITE'S COMPLIANCE TO STANDARDS – YOUR REASSURANCE.

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 pipe, these minimum performance requirements fall into both short-term and long-term requirements.

POTABLE WATER APPROVALS

Flowtite has been tested and approved for the conveyance of potable water all over the world. Here is a list of the most prominent institutes and authorities:

Standard	Country of certifying body
NSF (Standard No. 61)	United States
DVGW	Germany
ACS - Carso	France
WRAS	United Kingdom
Russia 002389.10.12	Russia
PZH	Poland
OVGW	Austria
Belgaqua	Belgium
KIWA	Netherlands
ITA	Italy
EPAL	Portugal
OTECRIERA	Spain

For other more extensive information on potable water certifying bodies and local standards, please contact your local Flowtite supplier.

FLOWTITE PIPE HAS BEEN RIGOROUSLY TESTED TO VERIFY CONFORMANCE TO THE FOLLOWING INTERNATIONAL PERFORMANCE STANDARDS:

STANDARD	PURPOSE
AWWA C950	Water supply
AWWA M45	Design manual
ISO 10639	Water supply
ISO 10467	Sewer and drainage
EN 1796	Water supply
EN 14364	Sewer and drainage
ASTM D3262	Sewer
ASTM D3517	Water supply
ASTM D3754	Pressure sewer

Flowtite is in addition approved by most national standards

FLOWTITE MATERIAL AND PRODUCT QUALIFICATION

FLOWTITE PRODUCTS ARE KNOWN WORLDWIDE FOR THEIR RELIABILITY. THIS REPUTATION IS MAINTAINED BY AN EXTENSIVE MATERIAL AND PRODUCT QUALIFICATION PROGRAMME.

MATERIAL QUALIFICATION

The suitability of raw materials for use in Flowtite pressure 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 Flowtite pipe.

FLOWTITE THE WORLD'S LARGEST GRP LABORATORY

NORWEGIAN ACCREDITATION

FLOWTITE QUALIFICATIONS TESTS – YOUR REASSURANCE

STRAIN CORROSION TESTING

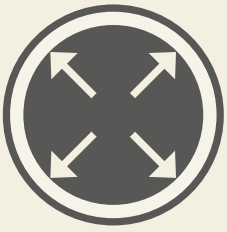
Flowtite has been subjecting pipes to strain corrosion tests continuously since 1978 in order to develop the world's best sewer pipes. Sewer pipes are exposed to sulphuric acid, which causes corrosion and eventually sewer leakage. ASTM D3681 therefore demands that pipes are chemically tested while under strain.

Flowtite pipes with extreme chemical resistance are the result of decades of continuous testing. Flowtite sewer pipes are popular in regions such as the Middle East where most other pipe materials fail.

◀ Flowtite Technology carries out strain corrosion testing in accordance with ASTM D3681. The standard requires a minimum of 18 ring samples of the pipe to be deflected to various levels and held constant.

HYDROSTATIC DESIGN BASIS – HDB

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



◀ Flowtite Technology performs HDB tests in accordance with ASTM D2992 Procedure B. The standard requires hydrostatic pressure testing of many pipe samples for failure (leakage) at a variety of high constant pressure levels.

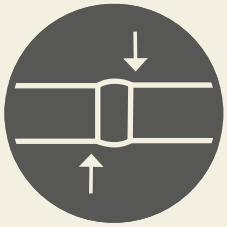
LONG-TERM RING BENDING

Flowtite pipes are designed to tolerate loads from traffic, landfill and buildings. The pipe designs are therefore rigorously tested to make sure they will sustain these elements – over the long term. AWWA C950 requires the test to be carried out and the resulting 50-year predicted value is used in the pipes' design. Flowtite pipes are tested using the guidelines of ASTM D5365 "Long-Term Ring Bending Strain of Fiberglass Pipe" and meets both requirements.

JOINT TESTING

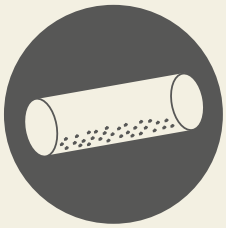
Flowtite has an extensive testing programme to verify that Flowtite couplings will remain sealed and behave consistently under severe conditions. Joint prototypes for elastomeric gasket-sealed couplings are tested in accordance with ASTM D4161. It incorporates some of the most stringent joint performance requirements in the piping industry for pipe of any material within the pressure and size ranges of Flowtite pipe.

ASTM D4161 requires these flexible 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.



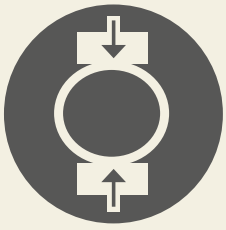
ABRASION RESISTANCE

Flowtite pipes are used across the world in penstocks and other applications where substances such as gravel impact the inner surface of the pipe. While there is no widely standardised testing procedure or ranking method, Flowtite abrasion resistance has been evaluated using the Darmstadt Rocker method. Using gravel obtained from the same source as that used at Darmstadt University, the average abrasion loss of Flowtite pipe is 0.34 mm per 100 000 cycles.



LONG-TERM STIFFNESS

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

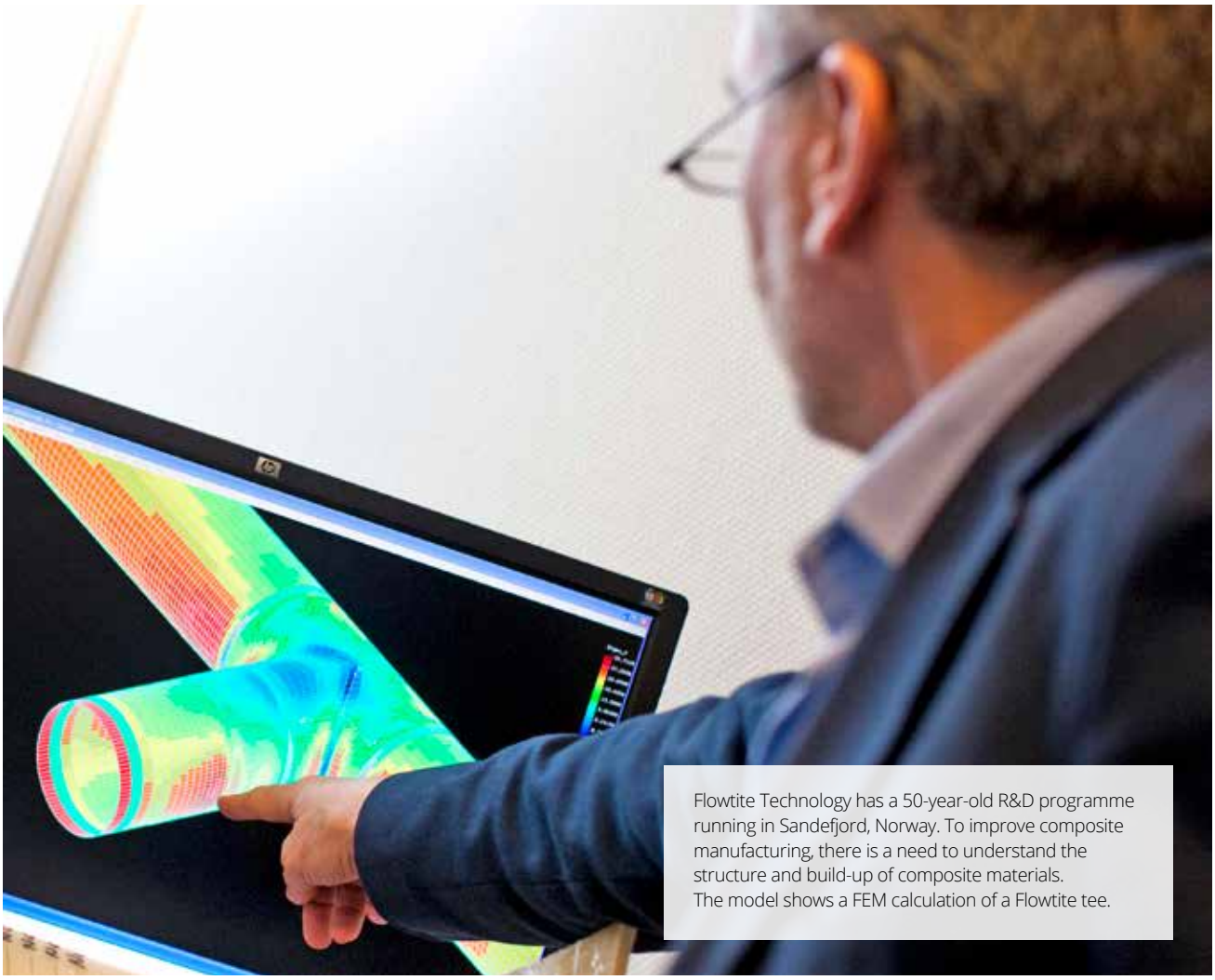


FLOWTITE
RESEARCH & DEVELOPMENT

FLOWTITE. BEST RESEARCH – BEST PIPES.

Research and development is the cornerstone of all industrial successes. The owners of Flowtite have used more resources than any other GRP producer, developing the best GRP pipes in the world. The largest GRP pipe laboratory in the world is the Flowtite laboratory in Norway. This is the best guarantee to any pipe customer!

Acid number titration for resin approvals
- a low acid number means good polyester.
All new resins are tested.



Flowtite Technology has a 50-year-old R&D programme running in Sandefjord, Norway. To improve composite manufacturing, there is a need to understand the structure and build-up of composite materials.
The model shows a FEM calculation of a Flowtite tee.

DECADES OF INNOVATIONS

1965 — The company Vera Fabrikker in Sandefjord started experimenting with the material later known as GRP for pipe production

1967 — The continuous filament winding process was invented and patented

1968 — Vera introduced the first tanks and pipes made by the continuous winding process

1973 — The DN 3600 Flowtite pipe was introduced, allowing pipes 3.6 metres wide and 18 metres long

1979 — The double bell coupling introduced

1996 — Special sewer pipe design introduced

2000 — New catalyst FC 100 (patented) introduced, increasing the Flowtite pipe production speed

2003 — Inventing the Flowtite butt wrap joint (patented)

2006 — New multiaxial fittings design based on Flowtite patent

2006 — Diameter range for 32 bar extended from DN 1400 to DN 1800

2009 — Flowtite reaches 200 000 standard fittings designs

2014 — Angled Joint introduced

THE HISTORY OF FLOWTITE PIPES

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 glass-fibre. 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 with 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 has now built pipe factories in five continents.

In 1927, in Sandefjord, a small shipping town on the Norwegian coast, Odd Gleditsch started a manufacturing plant called Vera Fabrikker, which later became a manufacturing plant for Flowtite pipes.

LOCATION:
Sandefjord, Norway

TIMELINE / A WORLDWIDE SUCCESS

1929 – Vera Fabrikker established

1965 – Started GRP activities

1968 – Produced the first GRP pipes and tanks

1970 – First GRP technology contract to Japan

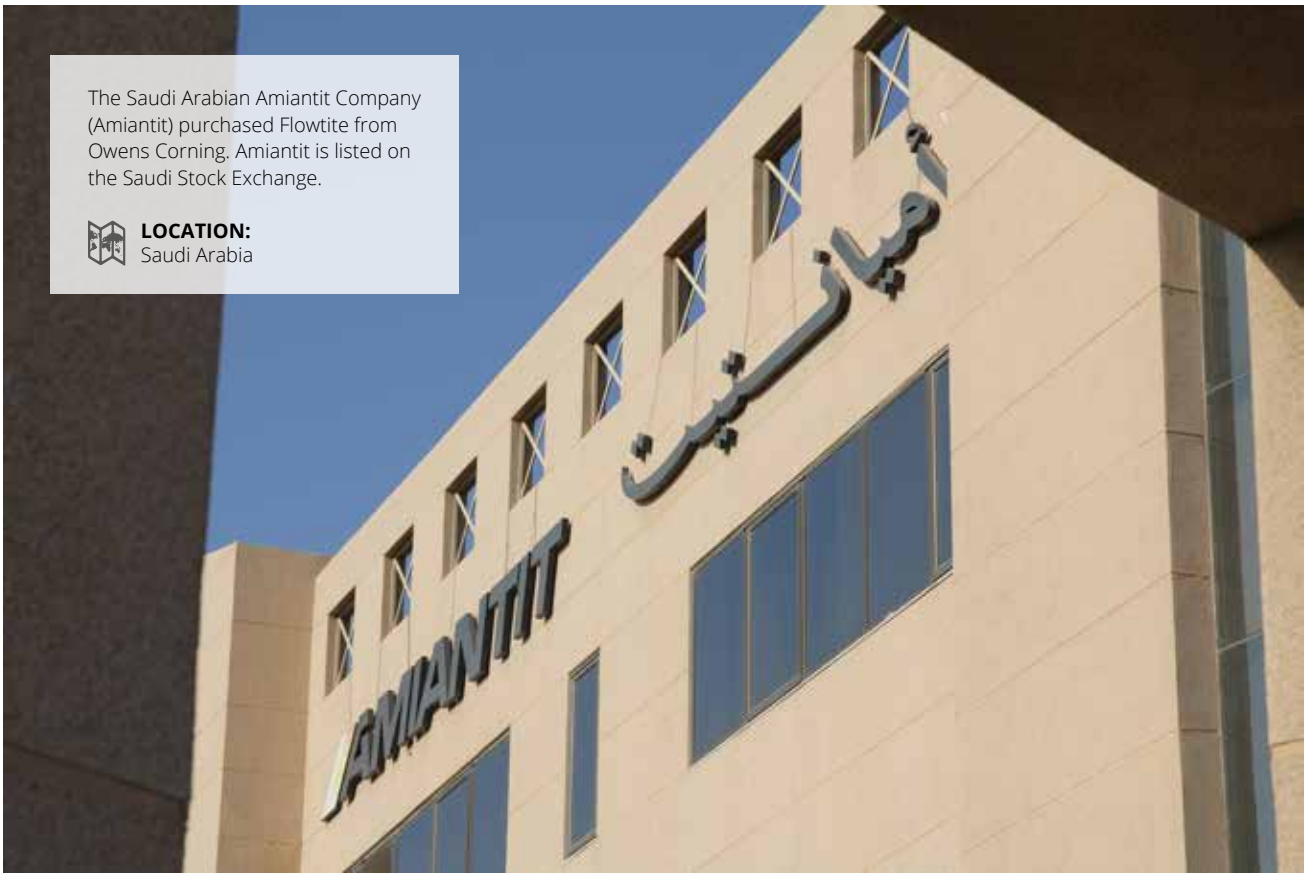
1971 – Owens Corning USA buys GRP technology from Vera Fabrikker

1977 – Veroc Technology established 50/50 between Jotun and Owens Corning for sale of technology

In 2001, the Saudi Arabian Amiantit Company (Amiantit) purchased Flowtite from Owens Corning. Amiantit markets a wider range of pipe products than any other pipe manufacturer, and provides a total solution to customer's fluid transfer needs, designed to optimise the applied technology and costs.

The Amiantit Group serves municipal, civil engineering, industrial, energy and agricultural markets worldwide, supporting global infrastructure development. The Group comprises 30 pipe system manufacturing plants, 6 pipe technologies and a number of supply and engineering subsidiaries around the globe. In addition,

an extensive sales and service network caters for the needs of customers in more than 70 countries. Amiantit is headquartered in the Kingdom of Saudi Arabia, where its shares are listed on the Saudi Stock Exchange.



The Saudi Arabian Amiantit Company (Amiantit) purchased Flowtite from Owens Corning. Amiantit is listed on the Saudi Stock Exchange.

LOCATION:
Saudi Arabia

1988 – Owens Corning takes over Veroc Technology 90 %

1993 – Owens Corning takes over Veroc Technology 100 %

1998 – Name changed to Flowtite Technology

2001 – Amiantit Group acquires Flowtite Technology

2006 – Flowtite Technology named the technology centre of Amiantit Group

2012 – A second technology centre is established in Dammam, Saudi Arabia

TECHNICAL DATA

The following tables provide a selection of technical data. Comprehensive information can be found in the relevant Flowtite literature, such as installation instructions, test reports, technical notes, and other documents.

The numbers in these tables are approximate, nominal values, and are subject to change without notice. For current, accurate values, please contact your local Flowtite supplier.

Units used in the tables below: SN = N/m^2; PN = bar; DN, DOSmax, ID MIN = mm; Weight = Kg/m

PIPE DIMENSIONS

SN 2500		FLOWTITE PIPE - ID MIN							WEIGHT SPAN	
DN	DOS max	Sewer	PN 6	PN 10	PN 16	PN 20	PN 25	PN 32	From	To
300	324.5	314.0	314.8	314.9	315.1	316.1	315.4		7.3	9.3
350	376.4	364.6	365.4	365.8	366.0	367.0	366.4		9.8	12.5
400	427.3	414.2	415.1	415.6	416.0	416.9	416.4		12.5	16.3
450	478.2	463.8	464.7	465.5	465.8	466.8	466.4		15.5	20.5
500	530.1	514.3	515.2	516.3	516.7	517.8	517.3		18.8	25.5
600	617.0	598.9	599.9	601.5	602.0	603.0	602.6		25.2	34.8
700	719.0	698.3	699.6	701.4	702.0	703.1	702.7		33.7	47.7
800	821.0	798.3	799.2	801.3	802.1	803.3	802.9		43.5	60.5
900	923.0	897.6	898.9	901.2	902.2	903.4	902.9		54.5	76.9
1000	1025.0	997.7	998.5	1001.1	1002.3	1003.5	1003.2		66.6	92.3
1100	1127.0	1097.2	1098.1	1101.1	1102.4	1103.6	1103.3		79.9	111.2
1200	1229.0	1196.1	1197.8	1201.0	1202.5	1203.7	1203.4		94.4	134.9
1300	1331.0	1296.1	1297.4	1301.0	1302.6	1303.8	1303.5		110.4	155.6
1400	1433.0	1395.5	1397.2	1400.9	1402.7	1403.9	1403.6		127.3	180.8
1500	1535.0	1495.1	1497.0	1501.0	1502.8	1504.1	1503.8		145.3	208.7
1600	1637.0	1595.1	1596.5	1600.8	1602.9	1604.2	1603.9		164.6	234.3
1700	1739.0	1694.3	1695.9	1700.8	1703.0	1704.3	1704.0		185.5	265.9
1800	1841.0	1794.3	1795.6	1800.8	1803.1	1804.4	1804.1		207.1	294.6
1900	1943.0	1893.9	1895.3	1900.8	1903.2	1904.5	1904.4		229.2	327.9
2000	2045.0	1993.8	1995.0	2000.7	2003.3	2004.6	2004.5		253.5	359.7
2100	2147.0	2093.1	2094.7	2100.6	2103.4	2104.8	2104.6		278.7	398.4
2200	2249.0	2193.1	2194.3	2200.6	2203.5	2204.9	2204.7		305.8	433.5
2300	2351.0	2292.7	2294.0	2300.5	2303.6	2305.0	2304.9		332.8	472.5
2400	2453.0	2392.4	2393.7	2400.6	2403.7	2405.1	2404.9		362.4	513.4
2500	2555.0	2491.8	2493.5	2500.5	2503.8	2505.2			410.5	558.3
2600	2657.0	2591.3	2593.0	2600.4	2603.8	2605.3			443.8	604.1
2700	2759.0	2691.3	2692.7	2700.4	2704.0	2705.5			477.7	647.0
2800	2861.0	2790.8	2792.5	2800.4	2804.0	2805.6			513.6	696.4
2900	2963.0	2890.8	2892.1	2900.3	2904.1	2905.7			549.8	742.4

SN 2500 STIS *continues*

SN 2500		FLOWTITE PIPE - ID MIN							WEIGHT SPAN	
DN	DOS max	Sewer	PN 6	PN 10	PN 16	PN 20	PN 25	PN 32	From	To
3000	3065.0	2990.0	2991.7	3000.3	3004.2	3005.8			588.6	798.0
3100	3167.0		3091.5	3100.3	3104.3				629.8	800.0
3200	3269.0		3191.2	3200.2	3204.4				668.4	852.9
3300	3371.0		3290.8	3300.2	3304.5				710.4	907.5
3400	3473.0		3390.5	3400.1	3404.6				753.7	962.0
3500	3575.0		3490.1	3500.1	3504.7				798.2	1019.5
3600	3677.0		3589.8	3600.0					930.5	1078.7
3700	3779.0		3689.4	3700.0					982.1	1139.0
3800	3881.0		3789.3	3799.9					1035.8	1198.8
3900	3983.0		3888.8	3899.9					1090.8	1263.8
4000	4085.0		3988.4	3999.9					1146.1	1330.1

PIPE DIMENSIONS

SN 5000		FLOWTITE PIPE - ID MIN							WEIGHT SPAN	
DN	DOS max	Sewer	PN 6	PN 10	PN 16	PN 20	PN 25	PN 32	From	To
300	324.5	311.9	312.8	312.8	313.4	314.5	314.5		9.1	11.7
350	376.4	362.1	363.0	363.3	364.0	365.2	365.1		12.1	15.9
400	427.3	411.3	412.3	412.9	413.7	414.7	414.8		15.4	20.7
450	478.2	460.5	461.5	462.4	463.4	464.4	464.5		19.1	26.2
500	530.1	510.5	511.8	512.9	513.8	515.1	515.2		23.3	32.7
600	617.0	595.1	596.1	597.5	598.6	599.9	600.1		31.1	43.3
700	719.0	694.2	695.2	696.8	698.1	699.5	699.7		41.8	57.8
800	821.0	793.5	794.3	796.1	797.7	799.1	799.3		54.1	74.1
900	923.0	892.3	893.4	895.1	897.2	898.7	899.0		67.8	93.8
1000	1025.0	990.6	992.5	994.3	996.7	998.3	998.6		83.3	117.6
1100	1127.0	1090.0	1091.6	1093.6	1096.3	1097.9	1098.2		100.3	139.8
1200	1229.0	1188.9	1190.8	1192.8	1195.8	1197.5	1197.8		118.7	167.6
1300	1331.0	1288.1	1289.6	1292.1	1295.4	1297.1	1297.5		138.7	194.5
1400	1433.0	1386.9	1388.7	1391.5	1394.9	1396.7	1397.1		160.4	225.6
1500	1535.0	1486.1	1487.6	1490.7	1494.4	1496.3	1496.7		183.6	256.7
1600	1637.0	1585.4	1586.8	1589.9	1594.0	1595.9	1596.4		208.4	289.9
1700	1739.0	1684.0	1685.8	1689.2	1693.5	1695.5	1696.0		234.6	328.4
1800	1841.0	1783.3	1784.8	1788.5	1793.1	1795.1	1795.6		263.0	365.9

SN 5000 STIS *continues*

SN 5000		FLOWTITE PIPE - ID MIN							WEIGHT SPAN	
DN	DOS max	Sewer	PN 6	PN 10	PN 16	PN 20	PN 25	PN 32	From	To
1900	1943.0	1882.2	1884.0	1887.8	1892.6	1894.7	1895.2		292.7	407.0
2000	2045.0	1981.4	1983.1	1987.0	1992.1	1994.3	1994.9		323.0	448.3
2100	2147.0	2080.2	2082.2	2086.3	2091.7	2093.9	2094.5		355.5	495.2
2200	2249.0	2179.5	2181.2	2185.6	2191.2	2193.5	2194.1		389.6	540.6
2300	2351.0	2278.3	2280.4	2284.8	2290.7	2293.1	2293.8		425.4	591.2
2400	2453.0	2377.6	2379.5	2384.1	2390.3	2392.7	2393.4		462.6	640.7
2500	2555.0	2476.9	2478.4	2483.3	2489.8	2492.3			516.0	691.0
2600	2657.0	2575.8	2577.5	2582.7	2589.3	2591.9			558.3	747.7
2700	2759.0	2675.1	2676.7	2681.9	2688.9	2691.5			600.6	803.2
2800	2861.0	2773.8	2775.7	2781.1	2788.4	2791.1			645.7	866.0
2900	2963.0	2873.1	2874.7	2880.5	2888.0	2890.7			692.0	925.7
3000	3065.0	2971.7	2973.9	2979.8	2987.5	2990.3			740.0	994.1
3100	3167.0		3073.0	3078.9	3087.0				821.1	1000.2
3200	3269.0		3172.1	3178.2	3186.6				874.3	1065.3
3300	3371.0		3271.1	3277.5	3286.1				929.2	1133.1
3400	3473.0		3370.1	3376.8	3385.6				986.1	1203.1
3500	3575.0		3469.3	3476.0	3485.2				1046.7	1272.9
3600	3677.0		3568.5	3575.3					1249.6	1345.0
3700	3779.0		3667.4	3674.5					1320.0	1423.0
3800	3881.0		3766.5	3773.8					1392.1	1500.3
3900	3983.0			3873.1					1465.7	1465.7
4000	4085.0									

PIPE DIMENSIONS

SN 10000		FLOWTITE PIPE - ID MIN							WEIGHT SPAN	
DN	DOS max	Sewer	PN 6	PN 10	PN 16	PN 20	PN 25	PN 32	From	To
300	324.5	309.2	310.7	310.7	311.0	312.3	312.5	312.5	11.2	14.9
350	376.4	358.9	360.6	360.6	361.2	362.6	362.7	362.9	14.9	20.3
400	427.3	407.5	409.6	409.6	410.5	411.8	412.1	412.3	19.0	26.6
450	478.2	456.7	458.6	458.6	460.1	461.1	461.5	461.7	23.6	32.7
500	530.1	506.2	508.5	508.5	510.0	511.4	511.8	512.0	28.8	40.8
600	617.0	590.5	592.0	592.0	593.9	595.7	596.1	596.4	38.5	53.2
700	719.0	688.6	690.0	690.0	692.7	694.5	695.1	695.4	51.9	72.0
800	821.0	786.5	788.3	788.3	791.5	793.4	794.0	794.4	67.2	94.4

SN 10000 STIS *continues*

SN 10000		FLOWTITE PIPE - ID MIN							WEIGHT SPAN	
DN	DOS max	Sewer	PN 6	PN 10	PN 16	PN 20	PN 25	PN 32	From	To
900	923.0	884.9	886.8	886.8	890.2	892.3	893.0	893.4	84.4	117.7
1000	1025.0	983.4	984.9	984.9	988.9	991.2	992.0	992.4	103.7	144.7
1100	1127.0	1081.6	1083.1	1083.1	1087.7	1090.1	1090.9	1091.5	124.8	174.1
1200	1229.0	1180.0	1181.5	1181.5	1186.4	1189.0	1189.9	1190.5	148.0	205.1
1300	1331.0	1278.3	1279.8	1279.8	1285.2	1287.8	1288.9	1289.5	173.1	239.4
1400	1433.0	1376.3	1378.1	1378.1	1383.9	1386.7	1387.8	1388.5	200.2	278.2
1500	1535.0	1474.8	1476.5	1476.5	1482.7	1485.6	1486.8	1487.5	229.3	317.3
1600	1637.0	1573.1	1574.7	1574.7	1581.4	1584.4	1585.8	1586.6	259.9	359.4
1700	1739.0	1671.0	1673.2	1673.2	1680.2	1683.3	1684.7	1685.6	293.8	407.3
1800	1841.0	1769.6	1771.4	1771.4	1778.9	1782.2	1783.7	1784.6	328.2	452.6
1900	1943.0	1868.1	1869.7	1869.7	1877.7	1881.1	1882.7		377.7	502.0
2000	2045.0	1966.5	1968.2	1968.2	1976.4	1980.0	1981.6		419.0	554.0
2100	2147.0	2064.8	2066.5	2066.5	2075.2	2078.9	2080.6		460.5	609.4
2200	2249.0	2162.8	2164.8	2164.8	2173.9	2177.8	2179.6		505.5	670.2
2300	2351.0	2261.2	2263.2	2263.2	2272.6	2276.6	2278.5		551.3	731.1
2400	2453.0	2359.2	2361.6	2361.6	2371.4	2375.5	2377.5		599.8	797.0
2500	2555.0	2458.1	2459.8	2459.8	2470.1	2474.4			677.7	857.9
2600	2657.0	2556.2	2558.1	2558.1	2568.9	2573.3			731.0	928.5
2700	2759.0	2654.5	2656.5	2656.5	2667.6	2672.1			788.2	999.8
2800	2861.0	2752.8	2754.8	2754.8	2766.4	2771.0			847.3	1074.4
2900	2963.0	2851.2	2853.3	2853.3	2865.1	2869.9			908.2	1149.9
3000	3065.0		2951.5	2951.5	2963.9	2968.8			971.6	1169.7
3100	3167.0		3049.9	3049.9	3062.7				1091.0	1247.9
3200	3269.0		3148.1	3148.1	3161.4				1162.7	1330.1
3300	3371.0				3260.1				1235.7	1235.7
3400	3473.0				3358.9				1311.6	1311.6
3500	3575.0				3457.6				1390.6	1390.6
3600	3677.0									
3700	3779.0									
3800	3881.0									
3900	3983.0									
4000	4085.0									

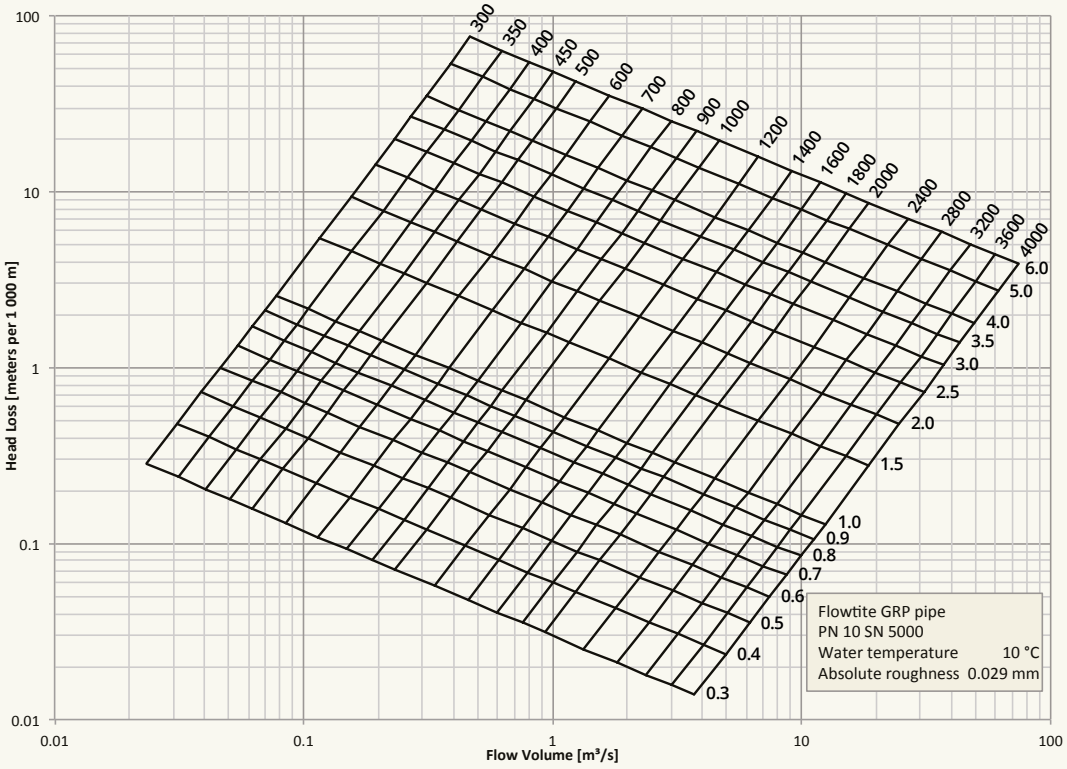
DOUBLE BELL STANDARD PRESSURE COUPLING

		DOUBLE BELL STANDARD PRESSURE COUPLING OD MAX							WEIGHT	
DN	DOS max	Sewer	PN 6	PN 10	PN 16	PN 20	PN 25	PN 32	From	To
300	324.5	357.5	367.8	368.6	369.8	370.4	371.0	377.8	5.9	13.9
350	376.4	409.4	419.5	420.7	422.1	422.1	423.3	430.5	6.9	16.1
400	427.3	460.3	470.4	471.6	474.2	473.4	474.4	481.6	8.0	18.4
450	478.2	511.2	520.9	522.5	524.5	524.7	525.9	533.1	9.0	20.8
500	530.1	563.1	572.6	574.2	576.0	577.4	578.8	584.8	10.0	22.9
600	617.0	650.6	666.1	667.7	669.9	672.3	675.1	682.3	11.0	39.4
700	719.0	754.0	767.7	770.1	774.5	775.1	777.9	787.7	13.1	47.8
800	821.0	857.0	869.5	873.7	878.9	879.5	883.5	898.9	15.9	62.3
900	923.0	959.8	972.5	977.1	980.3	982.7	988.5	1005.3	18.7	73.4
1000	1025.0	1062.4	1075.5	1080.3	1083.9	1086.9	1099.5	1116.1	21.5	90.6
1100	1127.0	1164.8	1178.1	1183.5	1187.5	1192.3	1208.1	1224.3	24.2	106.5
1200	1229.0	1267.6	1280.7	1286.5	1291.1	1300.1	1314.9	1331.1	26.9	121.9
1300	1331.0	1370.6	1383.3	1389.3	1394.7	1406.3	1420.9	1436.7	30.1	136.7
1400	1433.0	1473.4	1485.7	1491.9	1499.5	1511.9	1526.1	1541.5	33.5	151.0
1500	1535.0	1576.4	1588.1	1594.7	1604.9	1616.9	1630.9	1645.9	36.9	165.1
1600	1637.0	1679.2	1690.7	1697.5	1709.9	1721.5	1735.1	1749.7	40.5	178.8
1700	1739.0	1782.2	1793.1	1800.3	1814.3	1825.5	1839.1	1853.3	44.1	192.4
1800	1841.0	1885.4	1895.5	1902.9	1918.3	1929.5	1942.7	1956.7	48.0	205.9
1900	1943.0	1988.8	1997.9	2006.5	2022.3	2033.1	2045.9		52.5	191.4
2000	2045.0	2092.2	2100.3	2110.1	2125.9	2136.7	2148.9		57.2	203.3
2100	2147.0	2195.4	2202.7	2213.7	2229.3	2239.9	2251.7		62.3	215.2
2200	2249.0	2298.8	2305.1	2316.9	2332.7	2343.3	2354.5		67.3	226.9
2300	2351.0	2402.2	2407.5	2420.1	2435.7	2446.3	2457.3		72.7	238.8
2400	2453.0	2504.2	2509.9	2523.3	2538.9	2549.3	2559.9		78.3	250.3
2500	2555.0	2606.2	2612.3	2626.3	2641.9	2651.9			81.6	234.8
2600	2657.0	2708.2	2732.3	2743.1	2756.5	2769.9			85.0	314.0
2700	2759.0	2810.2	2834.9	2845.9	2859.1	2874.1			88.3	332.8
2800	2861.0	2912.2	2937.7	2948.5	2961.9	2978.5			91.7	352.5
2900	2963.0	3014.2	3040.3	3051.1	3064.3	3082.7			95.0	372.4
3000	3065.0	3116.2	3142.9	3153.5	3166.5	3187.1			98.4	393.1
3100	3167.0		3244.9	3255.7	3271.1				101.7	362.1
3200	3269.0		3347.5	3358.3	3374.9				279.4	380.7
3300	3371.0		3449.9	3460.9	3478.7				289.7	399.5
3400	3473.0		3552.5	3563.3	3582.5				300.7	423.5

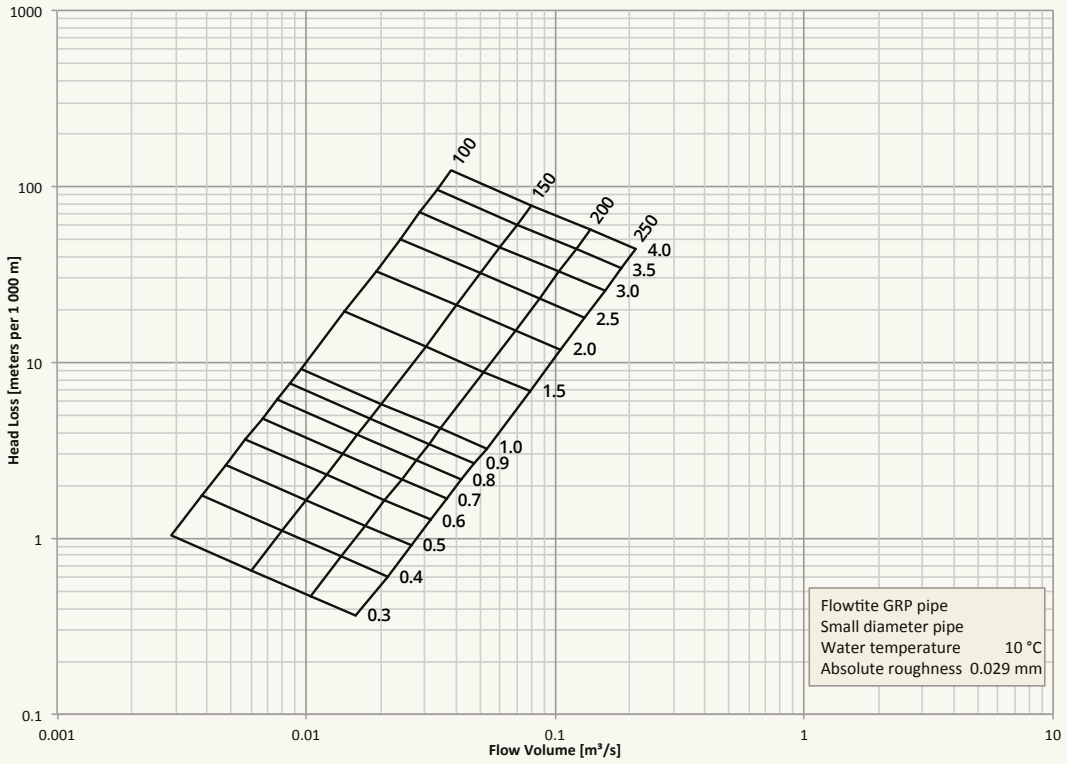
DOUBLE BELL STANDARD PRESSURE COUPLING *continues*

		DOUBLE BELL STANDARD PRESSURE COUPLING OD MAX							WEIGHT	
DN	**DOS max**	**Sewer**	**PN 6**	**PN 10**	**PN 16**	**PN 20**	**PN 25**	**PN 32**	**From**	**To**
3500	3575.0		3654.9	3665.7	3686.3				311.2	443.5
3600	3677.0		3757.5	3768.3					322.5	368.9
3700	3779.0		3859.9	3870.7					333.2	380.9
3800	3881.0		3962.3	3973.1					344.0	392.9
3900	3983.0		4064.7	4075.5					354.9	405.1
4000	4085.0		4167.1	4177.9					365.5	417.3

HEAD LOSS – LARGE DIAMETER FLOWTITE PIPE



HEAD LOSS – SMALL DIAMETER FLOWTITE PIPE



SURGE WAVE CELERITY FOR FLOWTITE PIPES

SN 2500					
DN	**300**	**400**	**450**	**800**	**≥900**
PN 6	420	380	370	350	340
PN 10	440	430	430	420	410
PN 16	510	500	500	490	480
PN 20	560	540	540	530	520
PN 25	590	580	580	570	560

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

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 your Flowtite supplier if more accurate values are required for transient analysis.
- The values above are valid for pipes with joints every 12 m. The effect on other pipe structures of surrounding soils, fittings, thrust blocks, etc. must be evaluated separately.

  Celerity values are in m/s.

GUIDELINES FOR PIPE STIFFNESS SELECTION

Type 1 Traffic Load AASHTO HS 20 – No Internal Vacuum – Ground Water to Level

DN ≥ 300

	Standard Trench. Bd/D = 1.8												Wide Trench. Bd/D = 3.0												
Backfill	**CL I**			**CL II**			**CL III**			**CL IV**			**CL I**			**CL II**			**CL III**			**CL IV**			
Burial Depth m	2500	5000	10000	2500	5000	10000	2500	5000	10000	2500	5000	10000	2500	5000	10000	2500	5000	10000	2500	5000	10000	2500	5000	10000	**Native soil**
1.0	D	D	D	85	85	85	90	85	85		95	95	D	D	D	85	85	85	90	90	85			95	1
1.5	D	D	D	85	85	85	85	85	85	95	95	95	D	D	D	85	85	85	90	85	85			95	
2.0	D	D	D	85	85	85	85	85	85	95	95	95	D	D	D	85	85	85	90	90	85			95	
3.0	D	D	D	85	85	85	90	85	85			95	D	D	D	85	85	85	90	90	90				
5.0	D	D	D	85	85	85	90	90	90				D	D	D	90	90	85	95	95	95				
8.0	D	D	D	90	90	90	95	95	95				D	D	D	90	90	90	95	95	95				
12.0	D	D	D	90	90	90	95	95	95				D	D	D	90	90	90							
20.0	D	D	D	95	90	90							D	D	D	95	95	95							
30.0	C	D	D	100	95	95							C	D	D	100	95	95							
1.0	D	D	D	85	85	85	90	85	85			95	D	D	D	85	85	85	90	90	85			95	4
1.5	D	D	D	85	85	85	85	85	85	95	95	95	D	D	D	85	85	85	90	90	85			95	
2.0	D	D	D	85	85	85	85	85	85	95	95	95	D	D	D	85	85	85	90	90	85			95	
3.0	D	D	D	85	85	85	90	90	85			95	D	D	D	85	85	85	90	90	90				
5.0	D	D	D	90	90	85	95	95	95				D	D	D	90	90	90	95	95	95				
8.0	D	D	D	95	95	90							D	D	D	90	90	90							
12.0	C	C	C	100	100	100							D	D	D	95	95	95							
20.0													C	D	D	100	95	95							
30.0														C	C		100	100							
1.0	D	D	D	95	95	90							D	D	D	90	90	85	95	95	90				6
1.5	D	D	D	95	90	90			95				D	D	D	90	85	85	95	95	90				
2.0	D	D	D	95	95	90			95				D	D	D	90	90	85	95	95	90				
3.0	D	D	D	95	95	95							D	D	D	90	90	85	95	95	95				
5.0			C			100							D	D	D	90	90	90			95				
8.0													D	D	D	95	95	95							
12.0													D	D	D	95	95	95							
20.0														C	C		100	100							
30.0																									

NATIVE SOIL CLASSIFICATION ACCORDING TO M45

Native in Situ Soils					
			Cohesive		
Granular			q_u		
Group	**Blows/ft* (0.3 m)**	**Description**	**ton/sf**	**kPa**	**Description**
1	>15	compact - very dense	2.0 -> 6.0	200 -> 600	very stiff-very hard
2	8-15	slightly compact	1.0-2.0	100-200	stiff
3	4-8	loose	0.50-1.0	50-100	medium
4	2-4		0.25-0.50	25-50	soft
5	1-2	very loose	0.125-0.25	13-25	very soft
6	>0-1	very, very loose	>0-0.125	0-13	very, very soft

* Standard penetration test per ASTM D1586
According to M45.

BACKFILL SOIL CLASSIFICATION ACCORDING TO M45

Soil Classes	Unified Soil Classification System Soil Groups*
CL I	Crushed rock: </= 15 % sand, maximum 25 % passing the 3/8-in. sieve and maximum 5 % passing No. 200 sieve
CL II	Clean, course-grained soils: SW, SP, GW, GP or any soil beginning with one of these symbols with 12 % or less passing No. 200 sieve
CL III	Coarse-grained soils with fines: GM, GC, SM, SC or any soil beginning with one of these symbols with more than 12 % fines
	Sandy or gravelly fine-grained soils: CL ML (or CL-ML, CL/ML, ML/CL) with 30 % or less retained on a No. 200 sieve
CL IV	Fine-grained soils: CL, ML (CL-ML, CL/ML, ML/CL) with 30 % or less retained on a No. 200 sieve

* ASTM D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

CHEMICAL RESISTANCE TABLE

	Standard Pipe Resin or Vinyl Ester	Vinyl Ester Only
Acetic Acid < 20 %*		X
Adipic Acid*		X
Alum (Aluminum Potassium Sulfate) (45 °C)	X	
Aluminum Chloride, Aqueous (40 °C)	X	
Ammonia, Aqueous < 20 %		X
Ammonium Chloride, Aqueous (40 °C)	X	
Aniline Hydrochloride		X
Beet Sugar Liquor		X
Benzene Sulfonic Acid (10 %)*		X
Benzoic Acid*		X
Black Liquor (Paper)		X
Borax (40 °C)	X	
Boric Acid		X
Calcium Bisulfite*		X
Calcium Carbonate		X
Calcium Chlorate, Aqueous (40 °C)*	X	
Calcium Chloride (Saturated) (40 °C)	X	
Calcium Hydroxide, 100 %		X
Calcium Hypochlorite		X
Calcium Nitrate (40 °C)	X	
Calcium Sulfate NL AOC (40 °C)	X	
Cane Sugar Liquors		X
Carbon Dioxide, Aqueous (40 °C)	X	
Casein	X	
Caustic Potash (KOH) (40 °C)		X
Chlorine, Dry Gas*		X
Chlorine, Water*		X
Chlorine, Wet Gas*		X
Citric Acid, Aqueous		X
Copper Acetate, Aqueous (40 °C)	X	
Copper Nitrate, Aqueous (40 °C)	X	
Copper Sulfate, Aqueous (40 °C)	X	
Crude Oil (Sour) (30 °C)*	X	
Crude Oil (Sweet) (30 °C)*	X	
Crude Oil, Salt Water (25 °C)*		X
Cyclohexane (40 °C)*		X

CHEMICAL RESISTANCE TABLE *continues*

	Standard Pipe Resin or Vinyl Ester	Vinyl Ester Only
Cyclohexanol (30 °C)*		X
Fuel Oil (25 °C)*	X	
Gasoline, Ethyl*		X
Glycerine		X
Green Liquor, Paper		X
Kerosene*		X
Lactic Acid, 10 % (30 °C)	X	
Lead Acetate, Aqueous (25 °C)	X	
Lead Nitrate, Aqueous (25 °C)	X	
Linseed Oil*	X	
Lithium Chloride, Aqueous (40 °C)*	X	
Magnesium Bicarbonate, Aqueous (30 °C)*	X	
Magnesium Carbonate (40 °C)*		X
Mineral Oils*	X	
n-Heptane (25 °C)*	X	
Naphthalene (30 °C)*	X	
Naptha*		X
Oleic Acid (40 °C)	X	
Oxalic Acid, Aqueous		X
Paraffin (30 °C)*	X	
Perchloric Acid (25 °C)		X
Petroleum, Refined & Sour*		X
Phosphoric Acid		X
Potassium Nitrate, Aqueous (40 °C)	X	
Potassium Sulfate (40 °C)	X	
Propylene Glycol (30 °C)	X	
Sea Water (40 °C)	X	
Sewage (50 °C)	X	
Silicone Oil (40 °C)	X	
Silver Nitrate, Aqueous (40 °C)	X	
Sodium Hydroxide 10 %		X
Sodium Mono-Phosphate		X
Sodium Nitrate, Aqueous (40 °C)	X	
Sodium Nitrite, Aqueous (40 °C)*	X	
Sodium Silicate		X
Stannous Chloride, Aqueous (40 °C)	X	

CHEMICAL RESISTANCE TABLE *continues*

	Standard Pipe Resin or Vinyl Ester	Vinyl Ester Only
Stearic Acid (40 °C)*	X	
Sulfuric Acid, < 25 % (25 °C)*	X	
Tannic Acid, Aqueous (35 °C)	X	
Tartaric Acid (30 °C)	X	
Triethylamine (40 °C)*		X
Turpentine*		X
Urea, Aqueous (30 °C)*	X	
Vinegar (25 °C)	X	
Water, Distilled (40 °C)	X	
Water, Tap (40 °C)	X	
Zinc Chloride, Aqueous (40 °C)	X	

* Current EPDM type gasket can not be used. Use of FPM type gasket is recommended, or consult your local gasket supplier.

Distributed by

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