USCPS
U.S. COMPOSITE PIPE SOUTH, LLC.

FLOWTITE

PRODUCT GUIDE

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W W W . U S C P S O U T H . C O M

Flowtite GRP Pipe Systems

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FLOWTITE™ Mission

The world's infrastructure is aging. Millions of miles of water and sewer pipe need replacement or rehabilitation.

What's the culprit? For the most part, corrosion is responsible for this problem.

- Internally, unprotected concrete sewer pipes are rapidly deteriorated by the presence of sulfuric acid in a sanitary sewer system, which is generated through the hydrogen sulfide cycle.

- Externally, soil conditions and stray electrical currents will deteriorate underground pipes. Metallic pipes can corrode when placed in poorly aerated and poorly drained soils of low resistivity. The presence of sulfate-reducing bacteria will accelerate this corrosion.

These problems can be significantly reduced, if not eliminated, by the careful selection of materials resistant to corrosion, or the incorporation of corrosion protection systems into the pipeline design. Unfortunately, in hopes of saving money, agencies will often forego the necessary corrosion protection, only to learn a few years later of the consequences. And corrosion is not a reversible process!

The remedy to this situation is very simple – Flowtite pipe.

Mission *(continued)*

Flowtite is a glass-reinforced polymer (GRP) pipe produced on the continuously advancing mandrel process, ensuring a consistently uniform product foot-by-foot. Immune to galvanic and electrolytic corrosion, Flowtite is the ideal pipe choice for water supply systems. Its proven resistance to the acidic environment found in a sanitary sewer speaks well for its use in waste water applications, too. In fact, Flowtite pipe has been the material of choice in many Middle East sewers, known to be the most aggressive in the world, for the past 20 years.

Flowtite pipe was first introduced in 1971. Flowtite pipe was manufactured in Conroe, Texas through the early 1980's. The technology was taken to Europe, the Middle East, Asia, Africa, and South America where Flowtite pipe became the material of choice in many countries. Flowtite Pipe is now, once again, available in the United States through U.S. Composite Pipe South (USCPS).

Technologies Yield Higher Performance at Lower Cost

Lightweight, corrosion resistant and manufactured under strict quality standards, Flowtite pipe is available in over five pressure classes and four stiffness classes. Diameters from 12 inch to 96 inch can be supplied and lengths up to 40 feet*

Growing awareness of the operational cost savings and superior corrosion resistance offered by Flowtite glass-reinforced plastic pipe has resulted in its widespread application for the following:

- Water transmission and distribution (potable and raw water)
- Sanitary sewerage collection systems and outfalls (direct bury and sliplining)
- Storm sewers
- Hydroelectric penstock lines
- Sea water intake and outfalls
- Circulating cooling water, make-up and blowdown lines for power plants
- Industrial applications

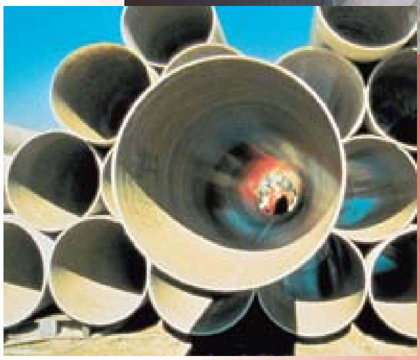
In replacing other materials, Flowtite pipe delivers long, effective service life with low operating and maintenance costs. And, Flowtite pipe is usually the lowest cost option up-front too!

* Diameter availability is dependent on manufacturing equipment. Check with the factory in your region for local diameter range.

Leadership Role

Flowtite Technology is committed to a leadership role when it comes to process and product improvements. We carry out basic materials research which has led to significant improvements.

We are also taking the leadership in GRP pipe specification development. Flowtite Technology personnel are in leadership positions for all significant global standardization organizations. This includes International Organization for Standardization (ISO), American Society For Testing Materials (ASTM), American Water Works Association (AWWA), and the Committee for European Normalization (CEN). In fact, it was Flowtite Technology personnel that carried out the basic research and chaired the ASTM committees responsible for revising the water and sewer pipe standards that exist today. Similar roles have been assumed in Europe for pipe.



Product Benefits

Flowtite Technology brings a product to market that can provide the low cost, long-term piping solution to customers around the world. The long list of features and benefits add up to provide the optimum installed and life-cycle cost system.

Features	Benefits
Advanced Technology Pipe Design	• Complies with stringent performance standards: ASTM, AWWA, ISO, etc... • Multiple pressure and stiffness classes to meet the design engineer's criteria • Pipe is hydrostatically tested to 2 times the pressure class • Lower wave celerity than other piping materials can mean less cost when designing for surge and water hammer pressures • High and consistent product quality worldwide which ensures reliable product performance
Corrosion-resistant Materials	• Long, effective service life • No need for linings, coatings, cathodic protection, wraps or other forms of corrosion protection • Low maintenance costs • Hydraulic characteristics essentially constant over time • Ideal pipe for rehabilitating corroded sewers
Lightweight (1/4 weight of ductile iron 1/10 weight of concrete)	• Low transport costs (nestable) • Eliminates need for expensive pipe handling equipment
Long Standard Lengths (10, 20 and 40 feet)	• Fewer joints reduce installation time • More pipe per transport vehicle means lower delivered cost
Superior Hydraulic Characteristics	• Extremely Smooth Bore • Hazen-Williams flow coefficient of approximately C=150 • Low friction means less pumping energy needed and lower operating costs • 0.009 Manning's "n" flow coefficient • Minimal slime build-up means lower cleaning costs • Excellent abrasion resistance
Precision Flowtite Coupling with Elastomeric REKA Gaskets	• Tight, efficient joints designed to eliminate infiltration or exfiltration • Ease of joining, reduces installation time • Accommodates small changes in line direction without fittings or differential settling
Flexible Manufacturing Process	• Custom diameters can be manufactured to provide maximum flow volumes with ease of installation for sliplining projects • Custom lengths can be manufactured to provide maximum flexibility for ease of direct bury or sliplining installation

Performance Standards

Standards developed by ASTM and AWWA are applied to a variety of fiberglass pipe applications including conveyance of sanitary sewage, water and industrial waste. A thread common to all of the product standards is that they are all performance based documents. This means that the required performance and testing of the pipe is specified.

ASTM

Currently, there are several ASTM product standards in use which apply to a variety of fiberglass pipe applications.

All product standards apply to pipe with diameter ranges of 12 inch to 96 inch and require the flexible joints to withstand hydrostatic testing in configurations (per ASTM D4161) that simulate exaggerated in-use conditions. These standards include many tough qualification and quality control tests. Flowtite pipe is designed to meet all of these ASTM standards.

ASTM	D3262	Gravity Sewer
ASTM	D3517	Pressure Pipe
ASTM	D3754	Pressure Sewer

AWWA

AWWA C950 is one of the most comprehensive product standards in existence for fiberglass pipe. This standard for pressure water applications has extensive requirements for pipe and joints, concentrating on quality control and prototype qualification testing. Like ASTM standards, this is a product performance standard. Flowtite pipe is designed to meet the performance requirements of this standard.

In addition to a pressure pipe product standard, AWWA has also published one of the most comprehensive design methods for a buried pipe. AWWA M45, Fiberglass Pipe Design covers load deflection, hoop tensile and flexural stress (strain) determination, as well as the combined loading effects of pressure and bending and buckling. All of the installation limitations presented for Flowtite pipe are based on this manual's guidelines.

AWWA M45 also covers the design of an above-ground fiberglass pipe installation.

AWWA	C950	Fiberglass Pressure Pipe
AWWA	M45	Fiberglass Pipe Design Manual

Control & Qualification Testing

Raw Materials

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.

Physical Properties

The manufactured pipe's hoop and axial load capacities are verified on a routine basis. In addition, pipe construction and composition are confirmed.

Finished Pipe

All pipes are subjected to the following control checks:

- Visual inspection
- Barcol hardness
- Wall thickness
- Section length
- Diameter
- Hydrostatic leak tightness tested to twice rated pressure

On a sampling basis, the following control checks are performed:

- Pipe stiffness
- Deflection without damage or structural failure
- Axial and circumferential tensile load capacity

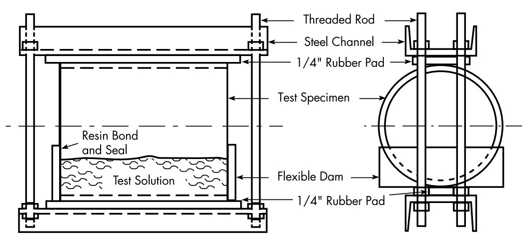


Figure 1 Strain Corrosion Test Apparatus

A common element shared by all standards is the need for a pipe manufacturer to demonstrate compliance with the standards' minimum performance requirements. In the case of GRP pipe, these minimum performance requirements fall into both short-term and long-term requirements. The most important of these, and generally specified at the same level of performance in all the previously defined standards, is joint, initial ring deflection, long-term ring bending, long-term pressure and strain corrosion capability. Flowtite pipe has been rigorously tested to verify conformance to the ASTM D3262, ASTM D3517, ASTM D3754 and AWWA C950 requirements.

Strain Corrosion Testing

A unique and important performance requirement for GRP gravity pipe used in sewer applications is the chemical testing of the pipe in a deflected or strained condition. This strain corrosion testing is carried out in accordance with ASTM D3681, and requires a minimum of 18 ring samples of the pipe to be deflected to various levels and held constant. These strained rings are then exposed at the invert of the interior surface to 1.0N (5% by weight) sulphuric acid (see Figure 1). This is intended to simulate a buried septic sewer condition. This has been shown to be representative of the worst sewer conditions where many Flowtite pipes have been successfully installed.

The time to failure (leakage) for each test sample is measured. The minimum extrapolated failure strain at 50 years, using a least squares regression analysis of the failure data, must equal the values shown for each stiffness class. The value achieved is then relatable to the pipe design to enable prediction of safe installation limitations for GRP pipe used for this type of service. Typically this is 5% in-ground long-term deflection.

Stiffness Class	Scv. Strain, %
SN18	.49 (t/D)
SN36	.41 (t/D)
SN46	.39 (t/D)
SN72	.34 (t/D)

Hydrostatic Design Basis – HDB

Another important qualification test is the establishment of the Hydrostatic Design Basis – HDB. This test is carried out in accordance with ASTM D2992 Procedure B and requires hydrostatic pressure testing to failure (leakage) of many pipe samples at a variety of very high constant pressure levels. As in the previously described strain corrosion test, the resulting data is evaluated on a log-log basis for pressure (or hoop tensile strain) vs. time to failure and, then, extrapolated to 50 years. The extrapolated failure pressure (strain) at 50 years, referred to as the hydrostatic design basis (strain) or HDB, must be at least 1.8 times the rated pressure class (strain at the rated pressure) (see Figure 2).

In other words, the design criteria requires that the average pipe be capable of withstanding a constant pressure of 1.8 times the maximum operating condition for 50 years. Due to combined loading considerations, which is the interaction of internal pressure and external soil loads; the actual long-term factor of safety against pressure failure alone is higher than 1.8. This qualification test helps assure the long-term performance of the pipe in pressure service.

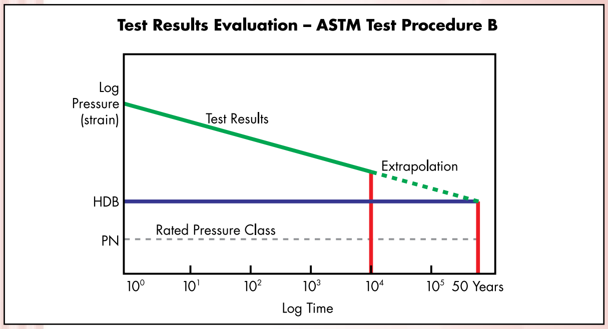


Figure 2
Test Results Evaluation – ASTM Test Procedure B

Joint Testing

This important qualification test is conducted on joint prototypes for elastomeric gasket sealed couplings. This is a severe test carried out 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. Pressures used are twice the pipe's pressure rating, or 29 psi for gravity flow pipe.

Joint configurations include straight alignment, maximum angular rotation and differential shear loading. A partial vacuum test and some cyclical pressure tests are also included.

Initial Ring Deflection

All pipes must meet the initial ring deflection levels of no visual evidence of cracking or crazing (Level A) and no structural damage to the pipe wall (Level B) when vertically deflected between two parallel flat plates or rods.

Deflection Level*	Stiffness Class			
	SN18	SN36	SN46	SN72
A	15%	12%	11%	9%
B	25%	20%	18%	15%

*Laboratory Test

Long-Term Ring Bending

A GRP pipe's long-term (50 year) ring deflection or ring bending (strain) capability, when exposed to an aqueous environment and under a constant load, must meet the Level A deflection level specified in the initial ring deflection test. AWWA C950 requires the test to be carried out, with the resulting 50-year predicted value used in the pipe's design. Flowtite pipe is tested using the guidelines of ASTM D5365 "Long-Term Ring Bending Strain of Fiberglass Pipe" and meets both requirements.

Potable Water Approvals

Flowtite pipe has been tested and approved for the conveyance of potable water meeting many of the world's leading authorities' and testing institutes' criteria, including:

- NSF (Standard No. 61) – United States
- DVGW – Germany
- Lyonnaise des Eaux
- Russia (Cert. No. 07700̈ 03515I04521A8)
- Oficina Técnia De Estudios Y Controles – Spain
- Pánstwowy Zaklad Higieny (National Institute of Hygiene) – Poland
- OVGW – Austria
- NBN.S. 29001 – Belgium

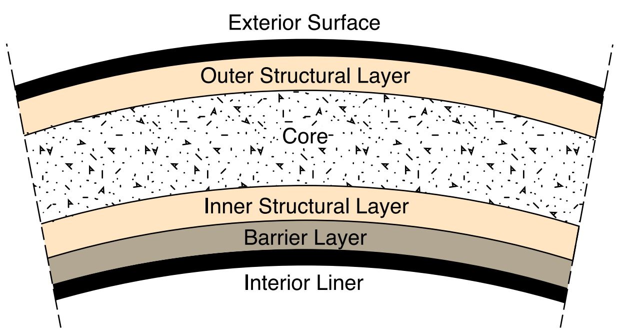
All copies of Flowtite Technology qualification test reports are available on our web site.

Materials

Flowtite pipe is manufactured using the continuous advancing mandrel process which represents the state of the art in GRP pipe production.

This process allows the use of continuous glass fiber 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 and not just chopped discontinuous roving such as in a centrifugal casting process, yields a higher performing product at lower cost.

Using technology developed by material specialists, a very dense laminate is created that maximizes the contribution from three basic raw materials. Both continuous glass fiber rovings and chopped roving are incorporated for high hoop strength and axial reinforcement. A sand fortifier is used to provide increased stiffness with placement near the neutral axis in the core. With the Flowtite dual resin delivery system, the equipment has the capability of applying a special inner resin liner for severe corrosive applications while utilizing a less costly resin for the structural and outer portion of the laminate. (See section on Environments for special resin applications.)



Product Scope – Technical Data

Diameters

Flowtite pipe can be supplied in the following nominal diameters. Larger and intermediate diameters are readily available on request.

- 12
- 16
- 18
- 20
- 24
- 30
- 36
- 42
- 48
- 54
- 60
- 63
- 72
- 78
- 84
- 90
- 96

Lengths

The standard length of Flowtite pipe is 20 feet. Lengths of 10 and 40 feet are also available. Flowtite pipe can also be supplied in other lengths for special orders.

Load Capacity Values

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

Hoop Tensile Load Capacity

Minimum initial hoop (circumferential) load, lbf per inch of width.

DN	PN50	PN100	PN150	PN200	PN250
12	1200	2400	3600	4800	6000
16	1600	3200	4800	6400	8000
18	1800	3600	5400	7200	9000
20	2000	4000	6000	8000	10000
24	2400	4800	7200	9600	12000
30	3000	6000	9000	12000	15000
36	3600	7200	10800	14400	18000
42	4200	8400	12600	16800	21000
48	4800	9600	14400	19200	24000
54	5400	10800	16200	21600	27000
60	6000	12000	18000	24000	30000
63	6300	12600	18900	25200	31500
72	7200	14400	21600	28800	36000
78	7800	15600	23400	31200	39000
84	8400	16800	25200	33600	42000
90	9000	18000	27000	36000	45000
96	9600	19200	28800	38400	48000

Fittings and Accessories

All commonly used fittings or accessories can be supplied such as bends, tees, wyes (gravity only) and reducers.

Stiffness Classes

Flowtite pipe can be supplied to the following standard pipe stiffnesses.

Stiffness Class

SN	psi
18	18
36	36
46	46
72	72

Custom-designed pipe with stiffness tailored to the needs of the project are also available.

Axial Tensile Load Capacity

Minimum initial axial (longitudinal) tensile strength, lbf per inch of circumference.

DN	PN50	PN100	PN150	PN200	PN250
12	580	580	644	697	871
16	580	580	859	929	1161
18	580	608	911	972	1215
20	580	675	1013	1080	1350
24	580	810	1215	1296	1620
30	580	952	1428	1499	1873
36	700	1142	1713	1798	2248
42	800	1332	1998	2098	2622
48	920	1393	2090	2268	2835
54	1040	1567	2351	2552	3189
60	1140	1742	2612	2835	3544
63	1197	1829	2742	2976	3721
72	1360	2090	3135	3402	4253
78	1480	2106	3159	3475	4344
84	1600	2268	3402	3742	4678
90	1720	2430	3645	4010	5012
96	1840	2592	3888	4277	5346

Pressure

Pressure classes of Flowtite pipe shall be selected from the series listed below. Not all pressure classes and stiffnesses are available in all diameters.

Pressure Class PN	Pressure Rating psi	Upper Diameter Limit, in.
PN50	50	96
PN100	100	96
PN150	150	96
PN200	200	84
PN250	250	78

The pipe's pressure ratings have been established in accordance with the design approach outlined in AWWA M-45, Fiberglass Pipe Design Manual. Flowtite pipe can also be designed for pressure ratings exceeding 250 psi upon request. Pipes are pressure rated at full operating pressure even when buried to the maximum depth recommended.

To insure the long service life for which Flowtite pipe is designed, the following capabilities should be noted and observed in service.

Hydrotesting

Maximum Factory (AWWA C950 & ASTM D3517) Test Pressure	2.0 x PN (Pressure Class)
Maximum Field Test Pressure	1.5 x PN (Pressure Class)*

Surge

Maximum Pressure	1.4 x PN (Pressure Class)

*Other structures must be designed to handle test pressures above PN.

Flow Velocity

Maximum recommended flow velocity is 10 ft/sec. Velocities of up to 13 ft/sec can be used if the water is clean and contains no abrasive material.

UV Resistance

There is no evidence to suggest that ultraviolet degradation is a factor that affects the long-term service life of Flowtite pipes. The outermost surface will be affected with discoloring of the surface observed. If so desired, the installing contractor may paint the exterior surface of Flowtite pipe with a two-part urethane paint compatible with GRP. However, this will then become an item requiring future maintenance.

Poisson's Ratio

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

Temperature

95°F and Below

For uses in accordance to the Flowtite environment list, no pressure rerating is required. Resin selection should be in accordance to the environment list. Please note that depending on the environment, further limitations on temperature may apply. See the environment list on page 21 and 22 for details.

96°F to 122°F

For uses in accordance to the Flowtite environment list, the following chart quantifies the magnitude of pressure derating to be applied:

Temp., °F	Derating, %
96 to 100	30
101 to 113	40
114 to 122	50

It is recommended that the next higher standard pressure class (PN) be used, after applying the derating to the system's design or operating pressure. For example, a pipeline intended to operate at 100 psi pressure, with a continuous operating temperature of 107°F, would result in a rerating of 166 psi [100/(1-0.4)]. The next higher standard pressure class to select would be PN200.

122°F to 158°F

For operating temperatures in this range, the design pressure of the pipe must be derated a minimum of 50%, and the entire pipe made with a vinylester resin. For further temperature limitations, depending on the environment, please see the guide on pages 21 and 22.

A further limitation is placed on the maximum operating pressure that Flowtite pipe can be used, dependent on the continuous operating temperature of the system, as shown in this chart:

Temp., °F	Max. Operating Pressure, psi
96 to 100	250
101 to 113	250
114 to 122	200

Thermal Coefficient

The thermal coefficient of axial expansion and contraction for Flowtite pipe is 13 to 17 x 10^{-6} in/in/°F.

Flow Coefficients

Based on tests carried out over a 3-year period on Flowtite pipe, the Colebrook-White coefficient may be taken as 9.5 x 10^{-5} ft. This corresponds to a Hazen-Williams flow coefficient of approximately C=150.

To assist the designer with estimating the head-loss associated with using Flowtite pipe, Figure 3.4 has been provided. When using this chart to estimate the head loss for pipes not specifically noted on the charts (due to slight inside diameter variances), the error will be less than 7% for flow velocities between 3 and 10 feet per second. Contact USCPS for more detailed information if needed.

Abrasion Resistance

Abrasion resistance can be related to the effects that sand or other similar material may have on the interior surface of the pipe. While there is no widely standardized testing procedure or ranking method, Flowtite pipe has been evaluated by using the Darmstadt Rocker method. Results will be highly influenced by the type of abrasive material used in the test. Using gravel which was obtained from the same source that used at Darmstadt University, the average abrasion loss of Flowtite pipe is 0.0133 inches at 100,000 cycles.

Joint Angular Deflection

The joint is extensively tested and qualified in accordance with ASTM D4161.

Maximum angular deflection (articulation) at each coupling joint, considering both combined vertical and horizontal, measured as the change in adjacent pipe center lines, must not exceed the amounts given in Table 3.1. The pipes must be joined in straight alignment, but not all the way to the home line, and thereafter, deflected angularly as required (Figure 3.3).

When the Flowtite pipe system will be operated at pressures exceeding 200 psi, the allowable angular joint deflection must be reduced to the levels noted in Table 3.2.

Table 3.1
Angular Deflection at Flowtite Coupling Joint

Nom. Pipe Diameter (in)	Max. Angle of Deflection (deg)	Max. Offset (in) Pipe Length			Min. Radius of Curvature (ft) Pipe Length		
		10ft	20ft	40ft	10ft	20ft	40ft
DN ≤ 20	3	6.3	12.5	25.1	190	383	763
20 < DN ≤ 36	2	4.2	8.3	16.7	286	573	1146
36 < DN ≤ 72	1	2.1	4.2	8.4	573	1146	2292
72 > DN	0.5	1.0	2.1	4.2	1146	2292	4586

Table 3.2
High Pressure (>200psi)

Nom. Pipe Diameter (in)	Max. Angle of Deflection (deg) PN250
DN ≤ 20	2.5
20 < DN ≤ 36	1.5
36 < DN ≤ 72	0.8

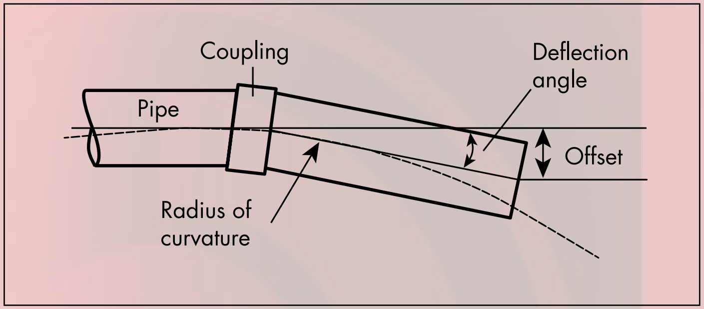
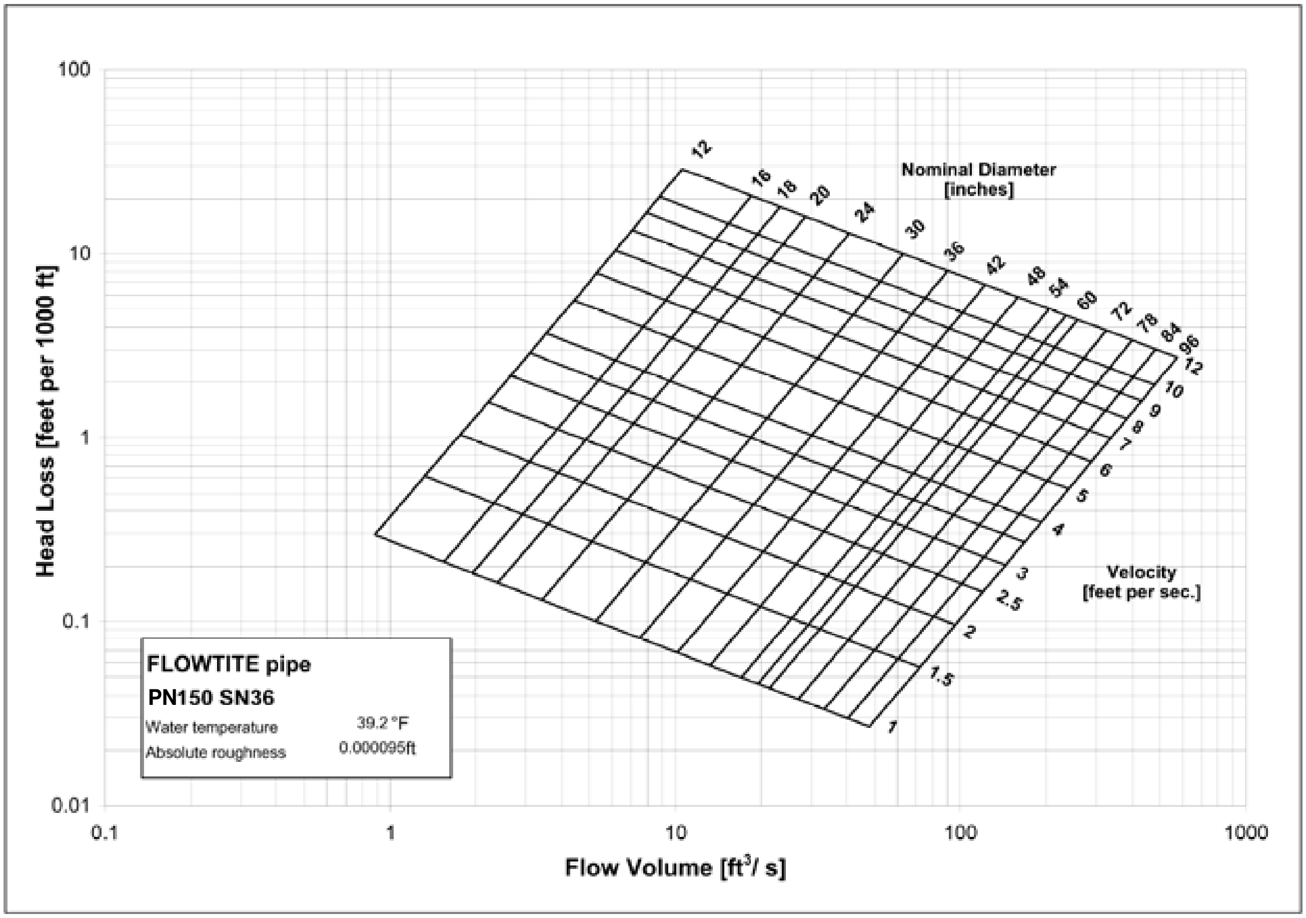


Figure 3.3
Double bell coupling, angular joint deflection



100
10
1
0.1
0.01
Head Loss [feet per 1000 ft]
0.1
1
10
100
1000
Flow Volume [ft³/ s]
Nominal Diameter
[inches]
12
16
18
20
24
30
36
42
48
54
60
72
78
84
96
Velocity
[feet per sec.]
12
10
9
8
7
6
5
4
3
2.5
2
1.5
1
FLOWTITE pipe
PN150 SN36
Water temperature 39.2 °F
Absolute roughness 0.000095ft

Figure 3.4

Pipe Classification Selection

The selection of Flowtite pipe is based on stiffness and pressure class requirements.

Stiffness

The stiffness of Flowtite pipe is selected from one of the four stiffness classes listed below. The stiffness class represents the pipe's minimum pipe stiffness (F/ΔY) in psi.

Stiffness Class

SN	psi
18	18
36	36
46	46
72	72

$(F/\Delta Y) = 53.69^{*}\ EI/D^3$

Stiffness is selected according to two parameters. These are: (1) burial conditions, which include native soil, type of backfill and cover depth and (2) negative pressure, if it exists.

The native soil characteristics are rated according to ASTM D1586 Standard Penetration Test. Some typical soil blow count values relative to soil types and density are given in Table 4.1.

A wide range of backfill soil types are offered in Table 4.2 to allow each installation to be customized providing the most economical installation. In many instances, the native trench soils can be used as pipe zone backfill.

Assuming standard trench construction, and an allowable long-term deflection of 5%, the maximum allowable cover depths, with consideration for traffic loads, for the four different stiffness classes in the five native soil groups are given in Table 4.4.

The correlation between the backfill soil modulus and different backfill soil types at four different levels of relative compaction may be found in Table 4.5.

The second parameter for pipe stiffness class selection is negative pressure, if it exists. Table 4.7 on page 15 of this brochure shows which stiffness to select for various amounts of negative pressure and burial depths for average native and backfill soil conditions.

The stiffness selected should be the higher of that determined to suit negative pressure and burial conditions.

Installation Types

The illustrations on page 15 show two standard installation types commonly used with Flowtite pipe.

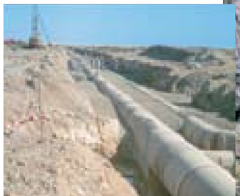
Alternate installations to accommodate a specific field condition include wider trenches, sheet piles, soil stabilization, geotextiles, etc. The *Flowtite Pipe Installation Guide For Buried Pipe* should be consulted for additional details.

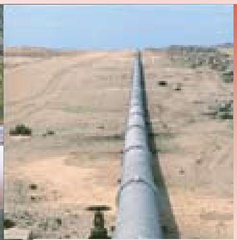
Flowtite pipe can be installed in a number of different situations including above ground, sub-aqueous, trenchless and sloped applications. These applications can require more initial planning and more care than the standard buried pipe installation; therefore, Flowtite Technology has developed specific instructions for these methods. Please contact your local USCPS representative for these detailed instructions.

Table 4.1: Native Soil Group Classification

			Non-Cohesive Soils		Cohesive Soils	
Native Soil Group	Blow Counts (#/ft)	E'n (psi)	Description	Friction Angle (degrees)	Description	Unconfined Comp. Strength (tons/ft^2)
1	> 15	5000	compact	33	very stiff	>2.0
2	8 – 15	3000	slightly compact	30	stiff	1.0 - 2.0
3	4 – 8	1500	loose	29	medium	0.5 – 1.0
4	2 – 4	700			soft	0.25 – 0.5
5	1 – 2	200	very loose	27	very soft	0.125 – 0.25

Note: Installations in native soils with SPT blow counts below 1 are possible, but generally require special design. Please consult USCPS for this condition.





General Installation

Long life and the good performance characteristics of Flowtite pipe can only be achieved by proper handling and installation of the pipe. It is important for the owner, engineer and contractor to understand that glass-reinforced plastic (GRP) pipe is designed to utilize the bedding and pipe zone backfill support that will result from recommended installation procedures. Engineers have found through considerable experience that properly compacted granular materials are ideal for backfilling GRP pipe. Together, the pipe and embedment material form a high-performance “pipe-soil system.” For complete installation instructions, consult the *Flowtite Pipe Installation Guide for Buried Pipe.*

The following information is a partial review of installation procedures; it is not intended to replace the installation instructions which must be followed for any project.

Trenching

Details of a standard trench installation are shown to the right. The trench must always be wide enough to permit placement and compaction of the pipe zone backfill materials and provide proper pipe support. The depth of cover charts presented in this brochure are based on an assumed trench width 1.75 times the pipe’s nominal diameter. Widths down to 1.5 times DN may be achievable, however the burial limits will be affected. Consult USCPS if your conditions will vary from these assumptions.

Bedding

The trench bed, of suitable material, should provide uniform and continuous support for the pipe.

Backfill Materials

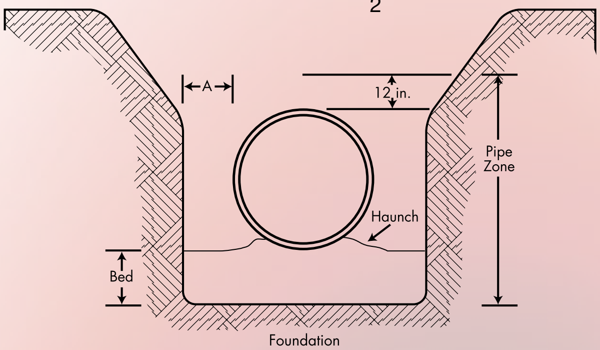
To ensure a satisfactory pipe-soil system, correct backfill material must be used. Most coarse grained soils (as classified by the Unified Soils Classification System) are acceptable bedding and pipe zone backfill material.

Where the instructions permit the use of native soil as backfill, care should be taken to ensure that the material does not include rocks, soil clumps, debris, frozen or organic material. Table 4.2 identifies acceptable backfill soils

Standard Trench Details

Minimum Width Trench

Dimension “A” is a minimum of $.75 * \frac{DN}{2}$



Bed[1] = DN/4, maximum 6 in.

1. Where rock, hard pan, soft, loose, unstable or highly expansive soils are encountered in the trench bottom, it may be necessary to increase the depth of the bedding layer to achieve adequate longitudinal support.
2. Dimension “A” must allow for adequate space to operate compaction equipment and ensure proper placement of backfill in the haunch region. This may require a wider trench than the minimum specified above, particularly for smaller diameters.

Checking the Installed Pipe

After installation of each pipe, the maximum diametrical vertical deflection must be checked. With Flowtite pipe, this procedure is fast and easy.

Installed Diametrical Deflection

The maximum allowable initial diametrical deflection (typically vertical) shall be 3%.

The maximum allowable long-term diametrical deflection shall be 5%. Those values will apply to all stiffness classes.

Bulges, flat areas or other abrupt changes of pipe wall curvature are not permitted. Pipe installed outside of these limitations may not perform as intended.

Table 4.2: Backfill Soil Type Classification

Category	Unified Soil Classification	Description
SC1		Crushed rock with ≤ 15% sand, < 5% fines
SC2	GW, GP, SW, SP, GW-GC, SP-SM	Coarse grained soils with little or no fines, ≤ 12% fines
SC3	GM, GC, SM, SC, GC–GM, GC/SC	Coarse grained soils with little or no fines, >12% fines
SC3	CL, ML, ML-CL, or ML/CL	Fine grained soils with medium to no plasticity, ≥ 30% coarse grained particles
SC4	CL, ML, ML-CL, or ML/CL	Fine grained soils with medium to no plasticity, < 30% coarse grained particles
SC5	CH, MH, OL, OH, PT, CH/MH	Highly compressible fine grained soils

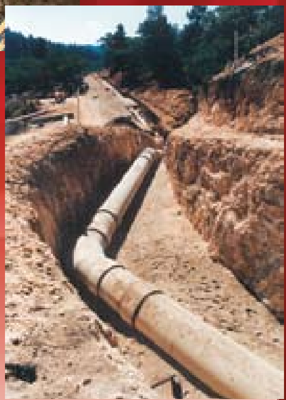
Table 4.4
Standard Trench – Type 1 Installation
Maximum Burial Depth – feet
With Traffic Load (AASHTO H20)

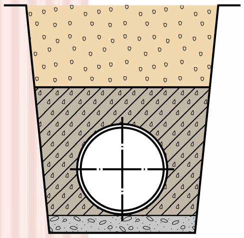
E'b psi	Native Soil Group 1	2	3	4	5
SN18					
3000	50.0	50.0	33.0	22.6	10.5
2000	50.0	48.6	30.0	15.1	8.9
1000	35.9	32.0	24.6	15.1	7.2
700	25.3	22.5	19.7	14.1	4.3
400	14.5	14.5	12.9	9.8	3.0
200	6.9	6.9	6.9	5.9	NA
SN36					
3000	50.0	50.0	33.8	23.5	11.4
2000	50.0	49.5	30.9	16.0	9.9
1000	36.8	32.8	25.5	16.0	8.2
700	26.1	23.4	20.6	15.0	5.6
400	15.4	15.4	13.8	10.7	4.4
200	7.9	7.9	7.9	7.0	3.7
SN46					
3000	50.0	50.0	34.3	24.0	11.9
2000	50.0	50.0	31.3	16.5	10.4
1000	37.2	33.3	25.9	16.5	8.8
700	26.6	23.9	21.1	15.5	6.2
400	15.9	15.9	14.3	11.2	5.1
200	8.4	8.4	8.4	7.6	4.5
SN72					
3000	50.0	50.0	35.5	25.2	13.2
2000	50.0	50.0	32.6	17.8	11.7
1000	38.5	34.6	27.2	17.8	10.1
700	27.9	25.1	22.3	16.8	7.7
400	17.2	17.2	15.6	12.5	6.7
200	9.8	9.8	9.8	9.0	6.2

Table 4.5
Backfill Modulus of Passive Resistance

Soil Category Type	E'b, psi Dumped	Slight	Moderate	High
SC1	1000	3000	3000	3000
SC2	200	1000	2000	3000
SC3	100	400	1000	2000
SC4	50	200	400	1000
SC5	Requires special engineering analysis			

Slight - <85% Proctor, <40% Relative density
Moderate - 85 - 95% Proctor 40 - 70% Relative density
High - >95% Proctor >70% Relative Density

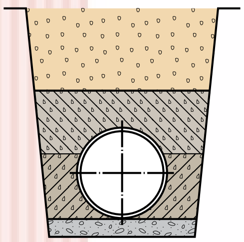




Installation Type 1

- Carefully constructed bed
- Backfill the pipe zone to 12 in. over the pipe crown with the specified backfill material compacted to the required relative compaction level.

Note: For low pressure (PN ≤ 150 psi) applications the requirement to compact the 12 inches over the pipe crown may be waived. Vacuum limitations will be the same as a Type 2 installation.



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 12 in. over the pipe crown with a relative compaction necessary to achieve a minimum soil modulus of 200 psi.

Traffic

All backfill should be compacted to grade when continuous traffic loads are present. Minimum cover restrictions may be reduced with special installations such as concrete encasement, concrete cover slabs, casings, etc. (See Table 4.6).

Table 4.6 Surface Loads

Load Type	Traffic (Wheel) Load lbs. Force	Minimum[(1)] Burial Depth feet
AASHTO HS20 (C)	16,000	3.0
Cooper E80	Railroad	10.0

[(1)] based on a minimum pipe zone backfill soil modulus of 1000 psi.

Negative Pressure

Allowable negative pressure is a function of pipe stiffness, burial depth, native soil and type of installation. In Table 4.7 are given maximum burial depths for four levels of negative vacuum, based on average native soil and backfill soil conditions.

Please refer to the *Flowtite Pipe Installation Guide For Buried Pipe* if your conditions vary from those assumed below.

Table 4.7 Negative Pressure

Native Soil Group 3 (E'n = 1500 psi)
Backfill Type SC3 at 90% SPD (E'b = 1000 psi)
Water Table at Grade
Standard Trench Installation

Vacuum	Depth Limits (ft) (Dry Conditions)			
(psi)	SN 18	SN 36	SN 46	SN72
-3.7	24.3	25.6	26.1	27.3
-7.3	17.7	25.6	26.1	27.3
-11.0	10.8	25.6	26.1	27.3
-14.7	3.8	25.4	26.1	27.3

High Pressure

High pressure (>200 psi) may require deeper bury to prevent uplift and movement. Pipes 12 inches and larger should have a minimum burial of 4 feet. Consult USCPS for further details.

High Water Table

A minimum of 0.75 diameter of earth cover (minimum dry soil bulk density of 120 lbs/ft^3) is required to prevent an empty submerged pipe from floating.

Alternatively, the installation may proceed by anchoring the pipes. If anchoring is proposed, restraining straps must be a flat material, minimum 1 inch wide, placed at maximum 10 foot intervals. Consult the manufacturer for details on anchoring and minimum cover depth with anchors.

Trenchless Technology

Today's growing urban areas may make it impractical to make open trench excavations and disrupt the surface conditions in order to install, replace or renovate underground piping systems. "Trenchless technology" includes the lining of existing pipes, called "sliplining," where a new pipe is installed inside the existing deteriorating pipe. It can also include the microtunneling process of boring a hole and pushing or "jacking" the new pipe into the created excavation. U.S. Composite Pipe South has products/technology to meet these new application needs.

Sliplining Capability

The Flowtite manufacturing process is unique in that it easily permits a custom product to be made to meet the specific project requirements. With the ability to make custom diameters, Flowtite can create the optimum pipe size to match the inside diameter of the existing pipeline. This will provide the maximum flow capabilities while still permitting ease of installation.

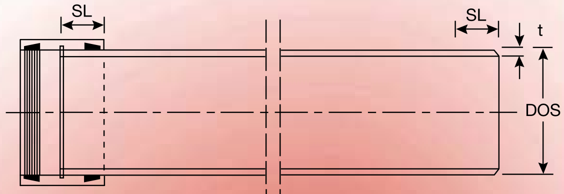
Standard Flowtite pipe can be assembled outside the deteriorated pipe and then pushed into place. This can be done even with low flows. For allowable pushing forces by pipe diameter, contact your local USCPS representative. This is especially important for rehabilitating pressure lines. For very large diameters (over 60 in.), the pipe can easily be carried using a light weight frame cart and assembled at it's final position.

The ability to manufacture variable lengths (standard length 10, 20 or 40 feet) can further help reduce installation time. Reduced installation time means lower installed costs and less "down-time" for the pipeline that is being rehabilitated.

Features	Benefits
Custom diameter capabilities	• Minimizes the loss of interior dimension of the existing pipe, maximizes flow capabilities
Custom lengths	• Easier, faster installation, less pipe line service down-time

Ideal pipe for rehabilitating corroded sewers

Pipe Dimensions

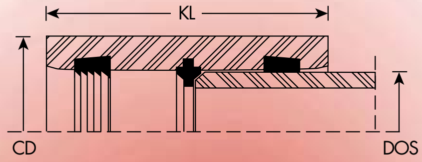


DN	SL	DOS max	DOS min	SN18 Wall Thickness (t), inches PN50	PN100	PN150	PN200	PN250	SN18 Weight* lbs./ft.	SN36 Wall Thickness (t), inches PN50	PN100	PN150	PN200	PN250	SN36 Weight* lbs./ft.
12	6.199	13.189	13.150	0.165	0.165	0.160	0.158	0.156	5.8	0.206	0.206	0.201	0.195	0.191	7.5
16	6.340	17.402	17.362	0.220	0.216	0.204	0.198	0.197	10.4	0.272	0.272	0.259	0.247	0.241	13.3
18	6.413	19.488	19.449	0.243	0.240	0.225	0.218	0.218	13.2	0.307	0.307	0.287	0.273	0.270	17.0
20	6.489	21.614	21.575	0.270	0.266	0.245	0.240	0.238	16.5	0.340	0.340	0.315	0.299	0.295	21.0
24	6.638	25.787	25.748	0.325	0.310	0.287	0.281	0.277	23.9	0.397	0.397	0.369	0.363	0.344	29.4
30	6.772	32.008	31.969	0.396	0.379	0.351	0.340	0.335	36.6	0.487	0.487	0.450	0.431	0.419	45.1
36	6.772	38.307	38.268	0.464	0.449	0.415	0.399	0.394	51.6	0.576	0.576	0.538	0.509	0.494	64.3
42	6.772	44.488	44.449	0.538	0.517	0.476	0.458	0.451	69.7	0.666	0.666	0.620	0.585	0.568	86.6
48	6.772	50.787	50.748	0.610	0.586	0.539	0.518	0.509	90.6	0.758	0.758	0.703	0.664	0.643	112.8
54	6.772	57.559	57.520	0.684	0.668	0.606	0.582	0.572	115.4	0.858	0.858	0.793	0.747	0.724	145.0
60	6.772	61.614	61.575	0.733	0.711	0.646	0.620	0.610	132.7	0.913	0.913	0.848	0.797	0.772	165.4
63	6.772	64.528	64.488	0.766	0.744	0.674	0.646	0.636	145.3	0.956	0.956	0.885	0.831	0.805	181.4
72	6.772	72.441	72.402	0.860	0.833	0.753	0.722	0.710	183.4	1.071	1.071	0.990	0.931	0.902	228.7
78	6.772	80.472	80.433	0.950	0.920	0.833	0.798	0.784	225.5	1.183	1.183	1.095	1.029	0.997	280.8
84	6.772	88.504	88.465	1.041	1.011	0.912	0.873	0.859	272.2	1.299	1.299	1.203	1.129	1.093	339.6
96	6.772	96.535	96.496	1.133	1.100	0.991	0.949	0.933	323.7	1.412	1.412	1.310	1.228	1.188	402.9

DN	SL	DOS max	DOS min	SN46 Wall Thickness (t), inches PN50	PN100	PN150	PN200	PN250	SN46 Weight* lbs./ft.	SN72 Wall Thickness (t), inches PN50	PN100	PN150	PN200	PN250	SN72 Weight* lbs./ft.
12	6.199	13.189	13.150	0.218	0.218	0.218	0.211	0.206	7.9	0.249	0.249	0.249	0.245	0.238	9.1
16	6.340	17.402	17.362	0.289	0.289	0.280	0.268	0.261	14.1	0.327	0.327	0.327	0.315	0.304	16.1
18	6.413	19.488	19.449	0.321	0.321	0.311	0.297	0.291	17.7	0.334	0.334	0.334	0.321	0.309	18.4
20	6.487	21.614	21.575	0.357	0.357	0.344	0.326	0.319	22.0	0.408	0.408	0.408	0.384	0.374	25.2
24	6.638	25.787	25.748	0.426	0.426	0.405	0.386	0.374	31.5	0.489	0.489	0.486	0.457	0.439	36.4
30	3.772	32.008	31.969	0.525	0.525	0.497	0.472	0.456	48.7	0.604	0.604	0.599	0.560	0.536	56.2
36	6.772	38.307	38.268	0.624	0.624	0.594	0.557	0.538	69.6	0.718	0.718	0.711	0.663	0.635	80.2
42	6.772	44.488	44.449	0.717	0.717	0.686	0.641	0.619	93.2	0.833	0.833	0.830	0.766	0.732	108.4
48	6.772	50.787	50.748	0.820	0.820	0.777	0.728	0.702	127.0	0.947	0.947	0.942	0.869	0.831	140.9
54	6.772	57.559	57.520	0.925	0.925	0.876	0.820	0.791	156.3	1.068	1.068	1.063	0.982	0.936	180.4
60	6.772	61.614	61.575	0.987	0.987	0.937	0.875	0.844	178.8	1.137	1.137	1.137	1.049	1.000	205.8
63	6.772	64.528	64.488	1.030	1.030	0.978	0.913	0.881	195.5	1.189	1.189	1.186	1.095	1.044	225.6
72	6.772	72.441	72.402	1.158	1.158	1.096	1.022	0.985	247.1	1.333	1.333	1.332	1.228	1.170	284.4
78	6.772	80.472	80.433	1.281	1.281	1.213	1.133	1.091	304.1	1.476	1.476	1.476	1.360	1.295	349.9
84	6.772	88.504	88.465	1.406	1.406	1.333	1.242	1.195	367.4	1.623	1.623	1.623	1.491	1.421	423.7
96	6.772	96.535	96.496	1.530	1.530	1.450	1.351	1.301	436.8	1.766	1.766	1.766	1.624	1.547	503.4

*Pipe weights are based primarily on PN50, which is the heaviest product.

Couplings



DN	DOS max	Coupling Outside Diameter CD PN50	PN100	PN150	PN200	PN250	Coupling length KL	Weight[1] lbs/ea.
12	13.19	14.97	14.97	14.99	15.05	15.11	10.63	28.5
16	17.40	19.15	19.15	19.18	19.22	19.27	10.63	36.0
18	19.49	21.22	21.22	21.25	21.28	21.34	10.63	39.5
20	21.61	23.36	23.36	23.37	23.41	23.46	10.63	43.4
24	25.79	27.80	27.80	27.82	27.86	27.96	12.99	78.9
30	32.01	34.00	34.00	34.09	34.21	34.33	12.99	98.7
36	38.31	40.33	40.33	40.48	40.61	40.67	12.99	119.7
42	44.49	46.55	46.55	46.66	46.88	46.97	12.99	146.2
48	50.79	52.85	52.85	53.02	53.33	53.39	12.99	174.7
54	57.56	59.66	59.66	59.86	60.04	60.50	12.99	225.9
60	61.61	63.73	63.73	63.95	64.16	64.68	12.99	253.2
63	64.53	66.66	66.66	66.89	67.18	67.68	12.99	271.8
72	72.44	74.61	74.61	74.86	75.29	75.76	12.99	322.8
78	80.47	82.68	82.68	82.97	83.48	83.92	12.99	372.3
84	88.50	90.76	90.76	91.15	91.61	92.03	12.99	418.7
96	96.54	98.83	98.83	99.27	99.72	100.13	12.99	466.0

Measurements in inches unless otherwise noted.

[1] Weights based on PN250 product.

Pipe Joining

Flowtite pipe sections are typically joined using GRP double bell couplings. Pipe is supplied from the factory with a coupling installed on one end. Pipe and couplings may also be supplied separately upon request. The Flowtite coupling utilizes an elastomeric REKA gasket for sealing. The gasket sits in a precision-machined groove in each end of the coupling and seats and seals against a spigot surface. The REKA gasket has been proven in use for more than 75 years.

Other Joining Methods

Flowtite pipes are dimensionally compatible with standard ductile iron pipe and fittings. Flowtite pipe may be joined utilizing flanges, flexible steel couplings, mechanical joints, or lay-up joints.

GRP Flanges

When connecting two GRP flanges over 12 inches in diameter, only one flange will have a gasket groove in the face. Standard bolt pattern to which flanges are manufactured is AWWA. Other bolting dimension systems such as ISO, ANSI, DIN and JIS can be supplied.

Flexible Steel Couplings

When connecting Flowtite pipe to other pipe materials with different diameters, flexible steel couplings are one of the preferred jointing methods. These couplings consist of a steel mantle with an interior rubber sealing sleeve. They may also be used to join Flowtite pipe sections together, for example, in a repair or for closure.

Three grades are commonly available:

A Epoxy or PVC-coated steel mantle
B Stainless steel mantle
C Hot dip galvanized steel mantle

Regardless of the corrosion protection applied to the steel mantle, the balance of the coupling needs to be corrosion protected as well. Typically, this involves the application of a shrink fit polyethylene sleeve over the installed coupling.

Control of the bolting torque of flexible steel couplings is important. Do not over torque as this may over stress the bolts or the pipe. Follow the coupling manufacturer's recommended assembly instructions, but with the pipe supplier's recommended bolt torque limits. Please consult the *Installation Guide for Buried Pipe* for further details.

Mechanical Steel Couplings

Mechanical joint couplings and fittings have been used to join pipes of different materials and diameters, and to adapt to flange outlets. Control of the bolting torque of mechanical joint couplings and fittings is important. Do not over torque as this may over stress the bolts or the pipe. Follow the coupling/fitting manufacturer's recommended assembly instructions, but with the Flowtite's recommended bolt torque limits. Please consult USCPS for further details.

Lay-up Joints

This joint is made from glass fiber reinforcements and polyester resin. It is typically used in situations where the pipe joint is required to transmit axial forces from internal pressure, or as a repair method. The length and thickness of the lay-up depends on diameter and pressure.

This type of joint requires clean, controlled conditions and skilled, trained personnel. Special instructions can be provided when this type of joint is required.

Surge and Water Hammer

Water hammer or pressure surge is the sudden rise or fall in pressure caused by an abrupt change in the fluid velocity within the pipe system. The usual cause of these flow changes is the rapid closing or opening of valves or sudden starting or stopping of pumps such as during a power failure. The most important factors which influence the water hammer pressure in a pipe system are the change in velocity of the fluid, rate of change of the velocity (valve closing time), compressibility of the fluid, stiffness of the pipe in the "hoop" direction, and physical layout of the pipe system.

The water hammer pressure expected for Flowtite pipe is approximately 50% of that for steel and ductile iron pipe, for similar conditions. Per AWWA C950, Flowtite pipe has a surge pressure allowance of 40% of the nominal pressure.

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

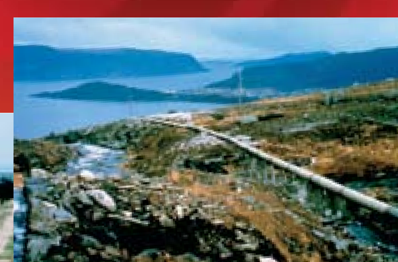
$\Delta H = (w\Delta v)/g$

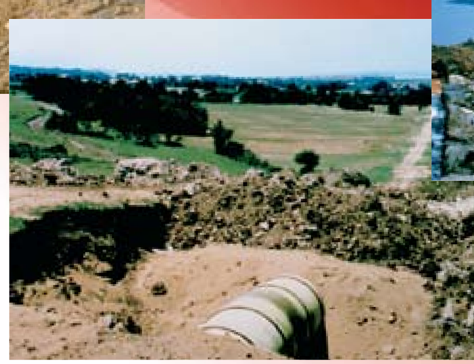
Where: ΔH = change in pressure (feet)
w = surge wave celerity (feet/sec)
Δv = change in water velocity (feet/sec)
g = acceleration due to gravity (feet/sec^2)

Surge Wave Celerity for Flowtite Pipes

DN	12	16-20	24-36	39-96
		Feet/Sec.		
SN18				
PN50	1335	1200	1115	1105
PN100	1335	1210	1180	1150
PN150	1445	1390	1365	1340
PN200	1565	1545	1510	1485
PN250	1690	1655	1630	1620
SN36				
PN50	1385	1270	1245	1225
PN100	1385	1270	1245	1225
PN150	1445	1400	1380	1345
PN200	1580	1545	1520	1495
PN250	1700	1660	1640	1620
SN46				
PN50	1460	1355	1285	1275
PN100	1460	1355	1285	1275
PN150	1460	1420	1390	1355
PN200	1575	1545	1525	1500
PN250	1700	1675	1645	1620
SN72				
PN50	1545	1450	1375	1360
PN100	1545	1450	1375	1360
PN150	1545	1450	1390	1365
PN200	1590	1550	1525	1505
PN250	1700	1670	1650	1625

NOTE: There has been some rounding, within 2%, in the above values. Please contact USCPS if more accurate values are required for a transient analysis.





Environmental Guide for Flowtite Pipe

Using this environment guide:

All materials listed in "green" can be used with our current standard pipe resin systems as well as vinyl ester lined pipes. All materials listed in "blue" or "green" can be used in pipes with a vinyl ester resin liner. All materials listed in "red" are not recommended and may not work in any type of Flowtite pipe system.

*Current EPDM type gasket (Nordel™) cannot be used. Use of FPM type gasket (Viton™) is recommended, or consult your local gasket supplier.

**No Flowtite Technology recommendation, consult your local gasket supplier for compatibility.

Maximum Temperature 125°F unless otherwise noted.

	Standard Pipe Resin or Vinyl Ester	Vinyl Ester Only	NR
Acetic Acid <20%		X	
Adipic Acid		X	
Alum (Aluminum Potassium Sulfate)	X		
Aluminum Chloride, Aqueous	X		
Ammonia, Aqueous <20%		X	
Ammonium Chloride, Aqueous (105°F)	X		
Ammonium Fluoride			X
Ammonium Nitrate, Aqueous (105°F)	X		
Ammonium Phosphate-Monobasic, Aqueous	X		
Ammonium Sulfate, Aqueous	X		
Aniline Hydrochloride		X	
Antimony Trichloride			X
Barium Carbonate		X	
Barium Chloride		X	
Barium Sulfate		X	
Beet Sugar Liquor		X	
Benzene Sulfonic Acid (10%)*		X	
Benzoic Acid*		X	
Black Liquor (Paper)		X	
Bleach			X
Borax		X	
Boric Acid		X	
Bromine, Aqueous 5%*		X	
Butyric Acid, < 25% (105°F)**		X	
Calcium Bisulfide**	X		
Calcium Carbonate	X		
Calcium Chlorate, Aqueous (105°F)	X		
Calcium Chloride (Saturated)	X		
Calcium Hydroxide, 100%		X	
Calcium Hypochlorite*		X	
Calcium Nitrate (105°F)	X		

	Standard Pipe Resin or Vinyl Ester	Vinyl Ester Only	NR
Calcium Sulfate NL AOC	X		
Cane Sugar Liquors		X	
Carbon Dioxide, Aqueous	X		
Carbon Tetrachloride			X
Casein	X		
Caustic Potash (KOH)			X
Chlorine, Dry Gas*		X	
Chlorine, Water*		X	
Chlorine, Wet Gas**		X	
Chlorocetic Acid			X
Citric Acid, Aqueous (105°F)			X
Copper Acetate, Aqueous (105°F)	X		
Copper Chloride, Aqueous	X		
Copper Cyanide (86°F)	X		
Copper Nitrate, Aqueous (105°F)	X		
Copper Sulfate, Aqueous (105°F)	X		
Crude Oil (Sour)*		X	
Crude Oil (Sweet)*		X	
Crude Oil, Salt Water (77°F)*		X	
Cyclohexane			X
Cyclohexanol			X
Dibutyl Sebacate**	X		
Dibutylphthalate**	X		
Diesel Fuel*	X		
Dioctyl Phthalate**	X		
Ethylene Glycol	X		
Ferric Chloride, Aqueous	X		
Ferric Nitrate, Aqueous	X		
Ferric Sulfate, Aqueous	X		
Ferrous Chloride	X		
Ferrous Nitrate, Aqueous**	X		
Ferrous Sulfate, Aqueous	X		
Formaldehyde			X
Fuel Oil*	X		
Gas, Natural, Methane			X
Gasoline, Ethyl*		X	
Glycerine		X	
Green Liquor, Paper			X
Hexane*		X	
Hydrobromic Acid			X
Hydrochloric Acid, Up To 15%	X		
Hydrofluoric Acid			X
Hydrogen Sulfide, Dry		X	
Kerosene*		X	
Lactic Acid, 10%	X		
Lactic Acid, 80% (77°F)	X		

Environmental Guide for Flowtite Pipe

(continued)

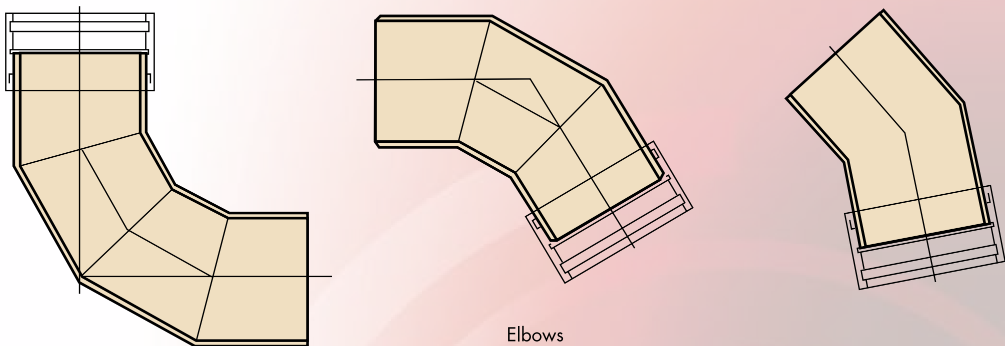
	Standard Pipe Resin or Vinyl Ester	Vinyl Ester Only	NR
Lauric Acid	X		
Lauryl Chloride		X	
Lauryl Sulfate**	X		
Lead Acetate, Aqueous	X		
Lead Nitrate, Aqueous (86°F)	X		
Lead Sulfate	X		
Linseed Oil*	X		
Lithium Bromide, Aqueous (105°F)**	X		
Lithium Chloride, Aqueous (105°F)**	X		
Magnesium Bicarbonate, Aqueous (105°F)**	X		
Magnesium Carbonate (105°F)*	X		
Magnesium Chloride, Aqueous (77°F)	X		
Magnesium Nitrate, Aqueous (105°F)	X		
Magnesium Sulfate	X		
Manganese Chloride, Aqueous (105°F)**	X		
Manganese Sulfate, Aqueous (105°F)**	X		
Mercuric Chloride, Aqueous**	X		
Mercurous Chloride, Aqueous	X		
Mineral Oils*	X		
n-Heptane*		X	
Naphthalene*		X	
Naptha*		X	
Nickel Chloride, Aqueous (77°F)	X		
Nickel Nitrate, Aqueous (105°F)	X		
Nickel Sulfate, Aqueous (105°F)	X		
Nitric Acid			X
Oleic Acid	X		
Oxalic Acid, Aqueous	X		
Ozone, Gas			X
Paraffin*	X		
Pentane			X
Perchloric Acid		X	
Petroleum, Refined & Sour*		X	
Phosphoric Acid		X	
Phosphoric Acid (105°F)	X		
Phthalic Acid (77°F)**		X	
Potassium Permanganate, 25%		X	
Potassium Bicarbonate**	X		
Potassium Bromide, Aqueous (105°F)	X		
Potassium Chloride, Aqueous	X		
Potassium Dichromate, Aqueous	X		
Potassium Ferrocyanide (86°F)**	X		
Potassium Ferrocyanide, Aqueous (86°F)**	X		
Potassium Nitrate, Aqueous	X		
Potassium Sulfate (105°F)	X		
Propylene Glycol (77°F)	X		

	Standard Pipe Resin or Vinyl Ester	Vinyl Ester Only	NR
Sea Water	X		
Sewage (125°F)	X		
Silicone Oil	X		
Silver Nitrate, Aqueous	X		
Sodium Bromide, Aqueous	X		
Sodium Chloride, Aqueous	X		
Sodium Dichromate		X	
Sodium Dihydrogen Phosphate**	X		
Sodium Ferrocyanide	X		
Sodium Hydroxide 10%		X	
Sodium Mono-Phosphate**	X		
Sodium Nitrate, Aqueous	X		
Sodium Nitrite, Aqueous**	X		
Sodium Silicate		X	
Sodium Sulfate, Aqueous	X		
Sodium Sulfide		X	
Sodium Tetraborate		X	
Stannic Chloride, Aqueous*	X		
Stannous Chloride, Aqueous	X		
Stearic Acid*	X		
Sulfur			X
Sulfuric Acid, <25%(105°F)*		X	
Tannic Acid, Aqueous	X		
Tartaric Acid		X	
Toluene Sulfonic Acid**		X	
Tributyl Phosphate			X
Triethanolamine			X
Triethylamine			X
Turpentine			X
Urea, (Aqueous)**		X	
Vinegar		X	
Water, Distilled		X	
Water, Sea	X		
Water, Tap	X		
Zinc Chloride, Aqueous	X		
Zinc Nitrate, Aqueous**	X		
Zinc Sulfate, Aqueous	X		
Zinc Sulfite, Aqueous (105°F)**	X		

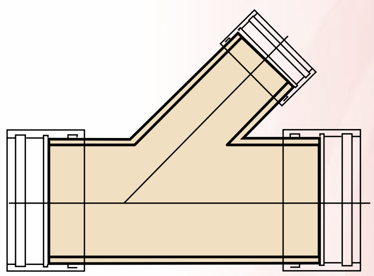
NOTE: This guide is intended to serve as a basic guide when considering Flowtite pipe. Final determination of the suitability of a particular resin system for a given environment is the responsibility of the customer. This list is based on information supplied by resin manufacturers who provide Flowtite producers with their material. Thus, this guide provides only general information and does not imply approval of any application as U.S. Composite Pipe South has no control over the conditions of usage nor any means of identifying environments to which the pipe may unintentionally have been exposed.

Fittings

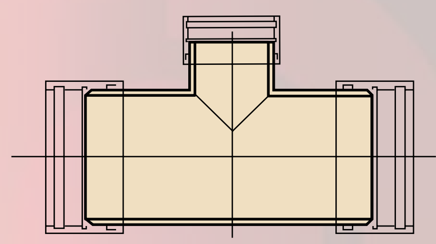
U.S. Composite Pipe South has created a standardized line of GRP fittings that are molded or fabricated using the same materials that are used to produce Flowtite pipe. One of the benefits of Flowtite pipe is the ability to fabricate a wide assortment of fittings, standard as well as non-standard. For a complete listing of our standard fittings with dimensions, contact your local USCPS representative.



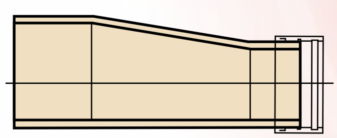
Elbows



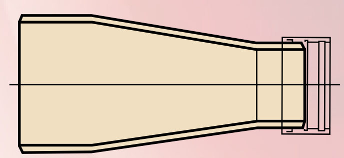
Wyes



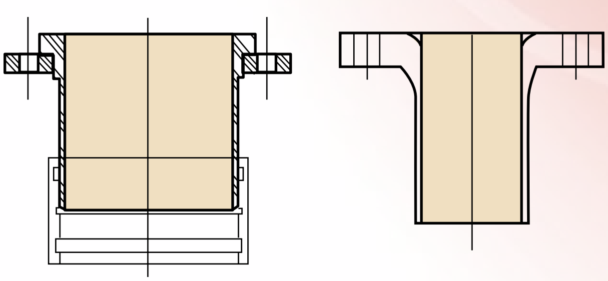
Tees



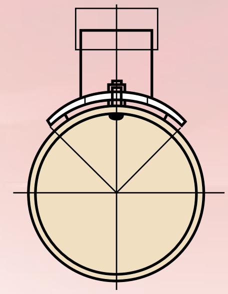
Eccentric Reducers



Concentric Reducers



Flanges



Saddles

Tapping Sleeves

Tapping is the process of connecting a branch to an existing pipeline. Care must be taken to ensure that a good seal is accomplished on the pipeline and that no damage is done to the pipe or tapping sleeve. Flexible stainless steel tapping sleeves have been proven to be the best suited for Flowtite pipes. The tapped assembly shall be able to resist a pressure of 2 x PN without leakage or damage to the pipe. It is essential that bolt torque shall be high enough to ensure no leakage, but not too high as to damage the pipe. It should be noted that the tapping sleeve manufacturer's recommended bolt torque values may be too high for GRP pipe. High stiffness, cast iron tapping sleeves have been found to cause too high stresses in a GRP pipe and their use should be avoided.

Tapping machines can be either manual or power driven and must be able to resist the internal pressure in the pipe if a "hot" tap is to be performed. The recommended forward feed should not exceed 0.02 inches per revolution. The cutter can be either steel or diamond coated and should have small, closely spaced teeth. Please consult the USCPS for detailed instructions and recommended brands of tapping sleeves.

Cleaning of Flowtite Sewer Pipe

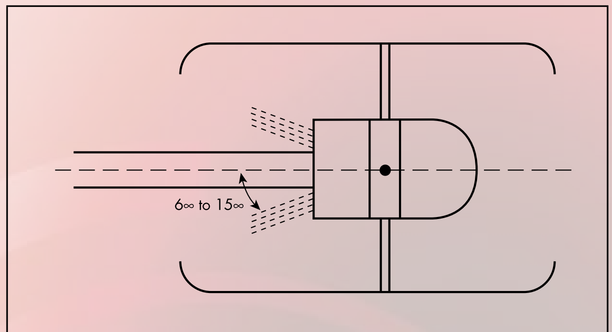
There are several methods used to clean gravity sewer lines, depending on diameter and the degree and nature of blockage. All of these methods use either mechanical or hydropneumatic force to clean the interior of the pipe. When mechanical means are employed, we recommend the use of plastic scrapers to avoid damage to the pipe's inner surface.

The use of high pressure water, emitted through jet nozzles, is a practice followed in some countries for cleaning sewer pipes. However, water emitted under high pressure through a jet nozzle can cause damage to most materials if not properly controlled. Based on experience gained with water jet cleaning of GRP sewer pipes, the following guidelines must be adhered to in order to avoid damage to the installed pipes:

1 Due to the smooth interior surface of GRP pipe, adequate cleaning and removal of blockages can normally be achieved below 1800 psi.

2 Jetting/swabbing sleds with several runners are to be used to elevate the jet nozzle off the pipe's inner surface.

3 The water discharge angle at the outlet nozzle must be between 6° and 15° relative to the pipe axis.



Water Jetting Sled

Although the utmost care has been taken to ensure the accuracy of the contents of this brochure, **US Composite Pipe South** does not accept liability for errors or omissions in this publication. Customers must satisfy themselves of the suitability of a given product supplied or manufactured by **US Composite Pipe South**.

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2010 Revision 1