AMIANTIT QATAR PIPES CO. LTD

FLOWTITE™

GRP Pipe systems

for Water, Sewage and Industrial Applications

AMIANTIT PIPE SYSTEMS

Product Guide

Content

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Product Guide

1. Amiantit Group Of Companies

The Amiantit Group is an internationally operating organization with a track record of growth-oriented success. It´s mission is to provide customers throughout the world with pipe solutions for water, sewage, gas, oil and industrial applications as well as with pipe technologies, water management services and building materials of superior quality and value. The company has a convincing history of longterm growth and profitability and a competitive position thanks to the experience and commitment of our staff and our performance. Therefore they look forward with confidence to achieving their vision of global leadership.

1.1 Amiantit Qatar Pipe Co.

Amiantit Qatar Pipe Company (AQAP) was established in Doha, Qatar as a joint venture among Qatar Industrial manufacturing Co.(QIMC), Saudi Arabian Amiantit Co. (SAAC) and Trading & Agency Services Ltd. (TRAGS). The three partners amass among them 91yrs of experience in the pipes and industrial business.

AQAP Manufactures fiber reinforced Plastic (FRP) pipes & fittings commonly known as GRP, in sizes up to 4000 mm in diameter

1.2 Flowtite Technology Norway

Flowtite fibreglass pipes and fittings are used in many applications. They can be found in the transmission of drinking water, in fire-fighting, sea and desalinated water, in power plants, in chemical and industrial wastes as well as in sewage applications and irrigation. The use of ***Flowtite*** pipe systems is virtually unlimited. You find the products in siphon lines just as much as in sea-water outfalls, bridge dewatering, desalination projects and as protection lines for cables. If you have an interesting application, please do not hesitate to contact us.

The Amiantit Group manufactures Flowtite GRP pipes in many factories around the world. The facilities supply pipes and fittings in various designs, lengths and diameters, also specially customized to suit your application.

Flowtite products are available directly from all Amitech manufacturing sites as well as from the APS sales offices worldwide. If you would like to receive further details, please contact us. Address details can be found on the reverse of this brochure.

1.3 Our Mission

To be the leader in the manufacturing, engineering & after sales services of FRP (GRP) piping.

The above can only be achieved by our commitment towards the following :

- Fulfill the customers satisfaction and expectation.
- Ensure continuous improvement in all aspects.
- Enhancing “safety” as our first priority.

1.4 Introduction

The world’s infrastructure is aging. Millions of kilometers of water and saver pipe need rehabilitation. This dilemma is a Worldwide problem. And where an aging infrastructure is not a problem, it’s generally because there are no infrastructure - it remains to be constructed in many developing countries. However these Nations, too, are faced with difficult decisions about how to build and what materials to use in order to avoid what happened in the developed countries.
Who'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 saver system, which generated through the hydrogen sulfide cycle.

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

These problems can be significantly reduced, if not eliminated, by the careful selection of material resistant to 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.

Amiantit Qatar Pipes Co (FLOWTITE) Brand of Pipes AQAP Pipe is a glass- reinforced plastic (GRP) pipe produced on the continuously advancing mandrel process, ensuring a consistently uniform product meter to meter. Immune galvanic and electrolytic corrosion, AQAP Pipe is the ideal pipe choice for water supply systems. It's proven resistance to the acidic environment found in a sanitary sewer speaks, well for it's use in waste water application too. In fact, AQAP 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.

Technologies Yield Higher performance at Lower Cost

Light Weight, corrosion resistant and manufactured under strict quality standards, AQAP pipe is available in over size pressure classes and three stiffness classes. Diameters from 80 mm to 4000 mm can be supplied and lengths up to 18 meters. Growing awareness of the optional cost savings and superior corrosion resistance offered by glass-reinforced plastics pipe by AQAP operation has resulted in it's widespread application for the following:

- Water transmission and distribution (portable & raw water)
- Sanitary sewerage collection systems and treated water.
- Storm sewers.
- Sea water intake and cooling water lines.
- Circulating water, make-up and blowdown lines for power plants & desalination.
- Industrial and chemical waste.
- Irrigation
- Fire fighting

In replacing other material AQAP pipe delivers long, effective service life with low operation and maintenance costs. And AQAP pipe is usually the lowest cost option upfront too!

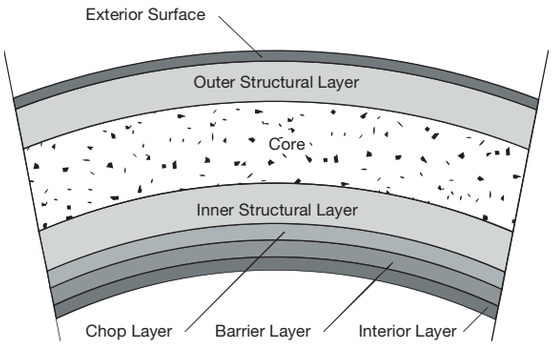
2. Product Benefits and Performance standards

Amiantit Qatar Pipe Company has been able to bring a product to market that can provide 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.

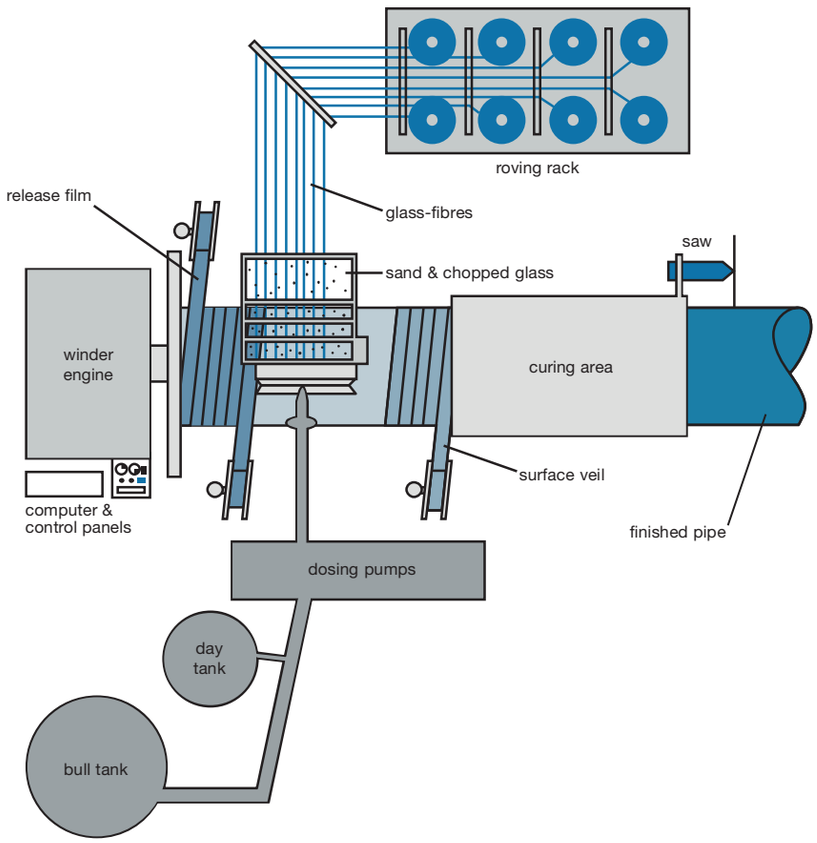
Features	Benefits
Corrosion-resistant material	• Long, effective service life • No need for lining, coatings, cathodic protection, wrap or other forms of corrosion protection. • Low maintenance costs • Hydraulic characteristics essentially constant overtime
Light weight (1/4 weight of ductile iron 1/10 weight of concrete)	• Low transport cost (nestable) • Eliminates needs for expensive pipe handling equipment
Long standard lengths (6,12 and 18 meters)	• Fewer joints reduce installation time • More pipe per transport vehicle means lower delivery cost
Extremely smooth bore	• Low friction loss means less pumping energy needed and lower operating costs • Minimum slim build-up can help lower cleaning costs
Precision FLOWTITE AQAP coupling with elastomeric REKA gaskets	• Tight efficient joint designed to eliminate infiltration and exfiltration • Ease of joining, reducing installation time • Accommodates small changes in line direction without fittings.
Flexible manufacturing process	• Custom diameters can be manufactured to provide maximum flow volumes with ease of installation lining projects
High technology pipe design	• Lower wave celerity than other piping material can mean less cost when design-ing for surge and water hummer pressure
High technology pipe manufacturing system producing pipe that complies to stringent performance standards (AWWA, ASTM, BS,etc…)	• High and consistent product quality world wide which ensure reliable product performance

The basic raw materials used in the ***FLOWTITE*** pipe's manufacturing are resin, fibreglass and silica sand. Usually unsaturated polyester resins are used since they give good performance for pressure sewer applications.

FLOWTITE pipes are 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 fibre reinforcements in the circumferential direction. For a in the circumferential direction, thus incorporating continuous reinforcements in this direction yields a higher performing product at a 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 fibre rovings and choppable roving are incorporated for high hoop strength and axial reinforcement. A sand fortifier is used to provide increased stiffness by adding extra thickness, placed 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 utilising a less costly resin for the structural and outer portion of the laminate. Taking advantage of the winding process, other materials, such as a glass veil or polyester veil can be used to enhance the abrasion resistance and the finishing of the pipe.



The figure above shows a typical cross section of a pipe laminate. This section, as well as the way of applying and placing different raw materials, can differ depending on the pipe application.



Standards developed by ASTM. AWWA, BS, and ISO are applied to a variety of fiber glass pipe application including conveyance of sanitary sewage, water and industrial waste. Other local approvals are also available, dependent on country specific requirements. Amiantit is participating in the development of all these standards with representatives of all the worldwide organisations, thereby ensuring performance requirements will result in reliable products.

ASTM / BS EN

Currently, there are several ASTM product standards in use which apply to a variety of fiber glass pipe with diameter ranges of 25 mm to 4000 mm and require the flexible, joint to withstand hydrostatic testing in configuration (per ASTM D4161) that simulate exaggerated in use conditions. These standard include many tough qualifications and quality control tests.

AQAP pipe is designed to meet all these ASTM, BS, EN, ISO, AWWA standards.

AWWA

C950 is one of the most comprehensive product standard in existence for fiberglass pipe. This standard for pressure water application has extensive requirement for pipe and joints, concentrating on quality control and prototype qualification testing. Like ASTM standards, this is a product performance standard. AQAP pipe is designed to meet the performance requirements of this standard. AWWA has recently issued a new standards manual, M-45, which includes several chapters on the design of GRP pipe for buried and abovegroup installations.

ASTM	D3262	Gravity sewer
ASTM	D3517	Pressure pipe(water)
ASTM	D3754	Pressure sewer
BS EN	1796	Water Supply
BS EN	14364	Drainage sewer

AWWA	C950 Fiberglass pressure pipe	
AWWA	M45	Fiberglass pipe design manual

3. Control Testing & Qualification Testing

3.1 Raw Materials

Raw materials are delivered with vendor certification demonstrating their compliance with AQAP quality requirements. In addition, all raw materials are sample tested prior their use. These tests ensure pipe materials compliance with the stated specifications.

Raw Materials used in pipe production are:

- Glass
- Resin
- Catalyst
- Sand
- Additives

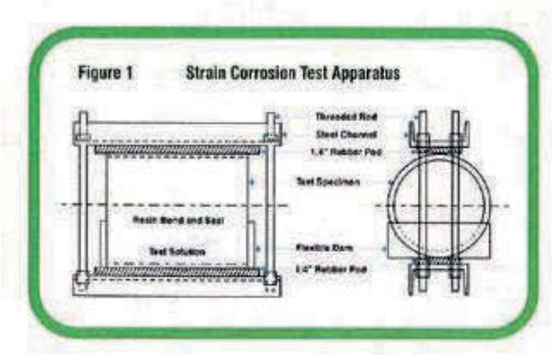
3.2 Finished pipe

All pipes are subjected to the following control checks:

- Visual inspection
- Barcol hardness
- Wall thickness
- Section length
- Diameter
- Hydrostatic leak tightness test to 2 times rated pressure (only for PNG bar and above)

3.3 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.



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

- Pipe stiffness
- Deflection without damage or structural failure
- Axial and circumferential tensile load capacity
- Loss of Ignition (LOI)

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

failure
- Axial and circumferential tensile load capacity
- Loss of Ignition (LOI)

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 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. AQAP pipe has been rigorously tested to verify conformance to the ASTM, BSEN, ISO and AWWA requirements.

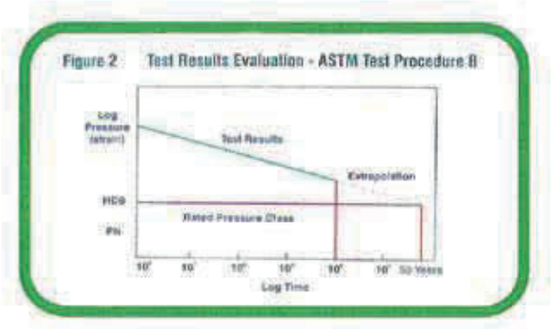
3.4 Strain corrosion Testing

A unique and important performance requirement for GRP gravity pipe used in sewer applications is the chemical testing of the pipe deflected or strained condition. This strain corrosion testing is carried out in accordance with ASTM D 3681, and requires minimum of 18 ring samples of the pipe to be deflected to various level 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 including those found in the Middle East. The time to failure (leakage) for each test sample is measured. The minimum extrapolated failure strain at 50 years, using a least square 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 limitation for GRP pipe used for this type of service. Typically this is 5% in ground long – term deflections.

3.5 Hydrostatic design basis – HDB

Another important qualification test is the establishment of 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 a very high constant, pressure level. 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) for HDB, must be at least 1.8 times the rated pressure class (strain at the rated pressure) (see Figure 2).In other words, 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, that 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.



3.6 Joint testing

This important qualification test is conducted on joint prototypes for elastomeric gasket sealed coupling. This is a severe test carried in accordance with ASTM D4161. It incorporates some of the most stringent join performance in the piping industry for pipe of any material within the pressure and size ranges of AQAP pipe. ASTM D4161 requires the flexible joints to withstand hydrostatic testing in configurations that stimulates every severe in-use conditions. Pressures used are twice those rated mid 100 kpa (1 bar) is used for gravity flow pipe. Joint configurations includes straight alignment, maximum angular rotation and differential shear loading. A partial vacuum test and some cyclical pressure test are also included.

3.7 Initial ring deflection:

All pipe 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	SN
	2500	5000	10000
A	15%	12%	9%
B	25%	20%	15%

3.8 Long-term ring bending

A GRP pipe's long-term (50 year) ring deflection of 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 design. AQAP pipe is tested using the guidelines of ASTM D5365 "long-term ring bending strain of fiber glass pipe" and meets both requirements.

4. Product scope-Technical Data

4.1 Diameters

AQAP pipe can be supplied in the following nominal diameters* (mm)

80	400	900	2000	2900	3500
100	450	1000	2400	3000	3600
150	500	1200	2500	3100	3700
200	600	1400	2600	3200	3800
250	700	1600	2700	3300	3900
300	800	1800	2800	3400	4000
350					

*other pipe ranges are available, consult Amiantit Qatar Pipe Company

4.2 Lengths

The standard length of AQAP is 12 meters for diameters over 300 mm. Lengths of 6 and 18 meters are also available.

4.3 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, N per mm of length. As shown in the table.

Axial Tensile Load Capacity

Minimum initial axial (longitudinal) load, N per mm of circumference. As shown in the table.

4.4 Fittings and Accessories

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

4.5 Stiffness Class

Flowtite pipe can be supplied to the following specific initial stiffilesses (EI/D^3)(STIS).

Stiffness Class	N/m^2
SN 2500	2500
SN 5000	5000
SN 10000	10000

Hoop Tensile Load Capacity								
DN/PN	gravity	6	10	12	16	20	25	32
80	N/B	96	160	192	256	320	400	512
100	N/A	120	200	240	320	400	500	640
150	N/A	180	300	360	480	600	750	960
200	N/A	240	400	480	640	800	1000	1280
250	N/A	300	500	600	800	100	1250	1600
300	N/A	360	600	720	960	1200	1500	1920
350	N/A	420	700	840	1120	1400	1750	2240
400	N/A	480	800	960	1280	1600	2000	2560
450	N/A	540	900	1080	1440	1800	2250	2880
500	N/A	600	1000	1200	1600	2000	2500	3200
600	N/A	720	1200	1440	1920	2400	3000	3840
700	N/A	840	1400	1680	2240	2800	3500	4480
800	N/A	960	1600	1920	2560	3200	4000	5120
900	N/A	1080	1800	2160	2880	3600	4500	5760
1000	N/A	1200	2000	2400	3200	4000	5000	6400
1100	N/A	1320	2200	2640	3520	4400	5500	7040
1200	N/A	1440	2400	2880	3840	4800	6000	7680
1300	N/A	1560	2600	3120	4160	5200	6500	8320
1400	N/A	1680	2800	3360	4480	5600	7000	8960
1500	N/A	1800	3000	3600	4800	6000	7500	9600
1600	N/A	1920	3200	3840	5120	6400	8000	10240
1700	N/A	2040	3400	4080	5440	6800	8500	10880
1800	N/A	2160	3600	4320	5760	7200	9000	11520
2000	N/A	2400	4000	4800	6400	8000	10000	12800
2200	N/A	2640	4400	5280	7040	8800	11000	14080
2300	N/A	2760	4600	5520	7360	9200	11500	14720
2400	N/A	2880	4800	5760	7680	9600	12000	15360
2600	N/A	3120	5200	6240	8320	10400	13000	16640
2800	N/A	3360	5600	6720	8960	11200	14000	17920
2900	N/A	3480	5800	6960	9280	11600	14500	18560
3000	N/A	3600	6000	7200	9600	12000	15000	19200
3200	N/A	3840	6400	7680	10240	12800	16000	20480
3400	N/A	4080	6800	8160	10880	13600	17000	21760
3600	N/A	4320	7200	8640	11520	14400	18000	23040
3800	N/A	4560	7600	9120	12160	15200	19000	24320
4000	N/A	4800	8000	9600	12800	16000	20000	25600

Axial Tensile Load Capacity								
DN/PN	gravity	6	10	12	16	20	25	32
80	63	63	63	63	63	63	63	63
100	70	75	80	85	90	99	110	125
150	80	85	100	105	100	119	130	145
200	102	102	110	115	120	120	140	155
250	102	105	125	130	135	150	169	197
300	102	115	140	145	150	169	192	236
350	105	123	150	155	168	193	224	276
400	105	130	160	165	185	216	255	315
450	110	140	175	183	207	242	287	355
500	115	150	190	200	228	268	319	394
600	125	165	220	235	273	322	383	473
700	135	180	250	265	296	356	431	532
800	150	200	280	300	325	380	450	545
900	165	215	310	330	394	474	574	709
1000	185	230	340	360	410	493	597	738
1100	195	245	360	388	457	549	666	823
1200	205	260	380	415	504	605	735	908
1300	215	275	400	440	486	629	764	944
1400	225	290	420	465	567	652	792	979
1500	238	305	440	493	607	707	855	1047
1600	250	320	460	520	646	761	917	1114
1700	263	342	486	550	686	816	980	1181
1800	275	366	511	580	725	870	1042	1248
2000	300	380	553	601	751	902	1094	1352
2200	325	410	596	675	810	927	1125	1390
2300	338	432	638	708	868	993	1196	1452
2400	350	454	681	740	925	1059	1267	1513
2600	375	482	723	786	982	1125	1346	1608
2800	400	511	766	832	1040	1192	1425	1702
2900	415	539	809	879	1098	1258	1506	1797
3000	430	567	851	925	1156	1324	1584	1891
3200	460	596	894	971	1214	1390	1663	1986
3400	490	624	936	1017	1271	1456	1741	2080
3600	520	681	1021	1110	1387	1589	1899	2270
3800	550	710	1064	1156	1445	1655	1979	2365
4000	580	738	1106	1202	1503	1721	2058	2459

4.6 Pressure

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

The pipe's pressure ratings have been established in accordance with the design approach outlined in AWWA M-45, Fiberglass Pipe Design Manual. Pipes are pressure rated at full operating pressure even when buried to the maximum depth recommended. To insure the long service life for which AQAP designed, the following capabilities should be noted and observed in service.

Diameter and Pressure

Pressure Class PN	Pressure Rating* Bar	Upper Diameter Limit, mm
1 (Gravity)	1	4000
6	6	4000
10	10	4000
16	16	2000
20	20	1400
25	25	1400
32	32	1400

*other pressure ratings are available, please consult Amiantit Qatar Pipes Co. Ltd

Hydrotesting	
Standard Factory Test Pressure	2X PN
Maximum Field	1.5 X PN(Pressure Class)
Surge	
Maximum Pressure	1.4 X PN(Pressure Class)

4.7 Flow Velocity

Maximum recommended flow velocity is 3.0m/sec. Velocities of up to 4m/sec. can be used if the water is clean and contains no abrasive material.

4.8 UV Resistance

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

4.9 Poisson's Ratio

Poisson's ratio is influenced by the pipe construction. For AQAP, 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.

4.10 Thermal Coefficient

The thermal coefficient of axial expansion and contraction for AQAP is 24 to 30 x10^{-} cm/cmjC.

5. Hydraulic Characteristics Of AQAP's FRP Pipe

Amiantit Qatar Pipes Ltd. (AQAP) produces FRP pipes by continuous filament winding machines, by reproducible processes. All these pipes are provided with resin rich interior layers, providing very smooth inner surfaces. This smooth interior surfaces results in very low fluid resistance.

For hydraulic analysis of the every piping system, pipe roughness is the concern. One of the FAQ by the Hydraulic Engineers/ Consultants/ Contractors/ Clients is what the value of FRP pipe roughness is.

This roughness is being used in various forms in various equations of hydraulic analysis. Find below the summary of the mean value based on the experimental studies.

These values are based on the experimental studies carried out by Owens Corning and SINTEFF from Norway. Complete report is available upon request.

In fact AWWA C-950 also recommends for the usage of similar values are in good agreement even with the international standards.

Apart from above, the interior pipe surfaces, typically remains smooth over time, in most fluid surfaces. Therefore, fluid resistance will not increase with age. This has been demonstrated, when few FRP pipes under operation over the decade were inspected and evaluated. Certificate from respective authorities is available upon request confirming no deterioration.

AQAP is capable of carrying out Hydraulic Calculations using state of the art commercially available software. As guide line to designer figure 1.1 and 1.2 will provide typical head losses for long diameter pipes and small diameter pipes.

Please consult AQAP for any additional Hydraulic requirements and clarifications and AQAP is happy to assist you in any way to suite your requirements.

5.1 Abrasion Resistance

Abrasion resistance can be related to the effects that send or other similar material may have on the interior surface of the pipe. While there is no widely standardized testing procedure or rating method, FLOWTITE AQAP has been evaluated by using the Dramastadt 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 as the used at Dramastadt University, the average abrasion loss of AQAP is 0.84 mm at 100.000 cycles.

Roughness Parameters (Men Values)			
Flow Rate (m^3/hr)	Cole Brooke- White E or K (mm)	Manning $M(m^{1/3}/s)$	Hazen - Williams $C(10^{-1}$ $m^{3}/s)$
410-2860	0.029	104	146

Fig. 1.1

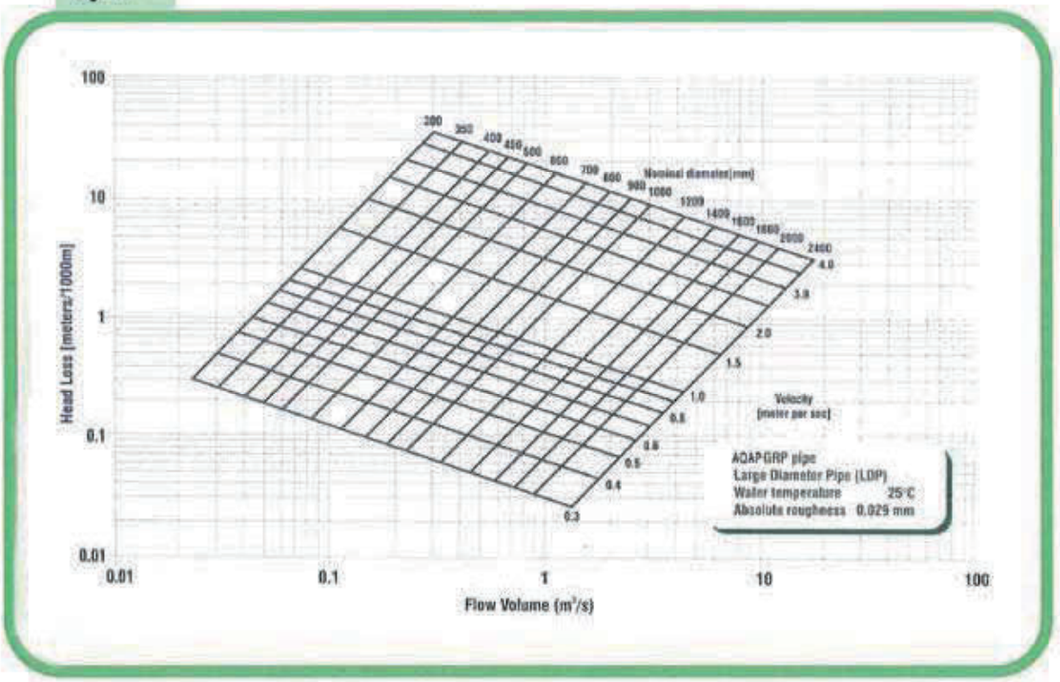
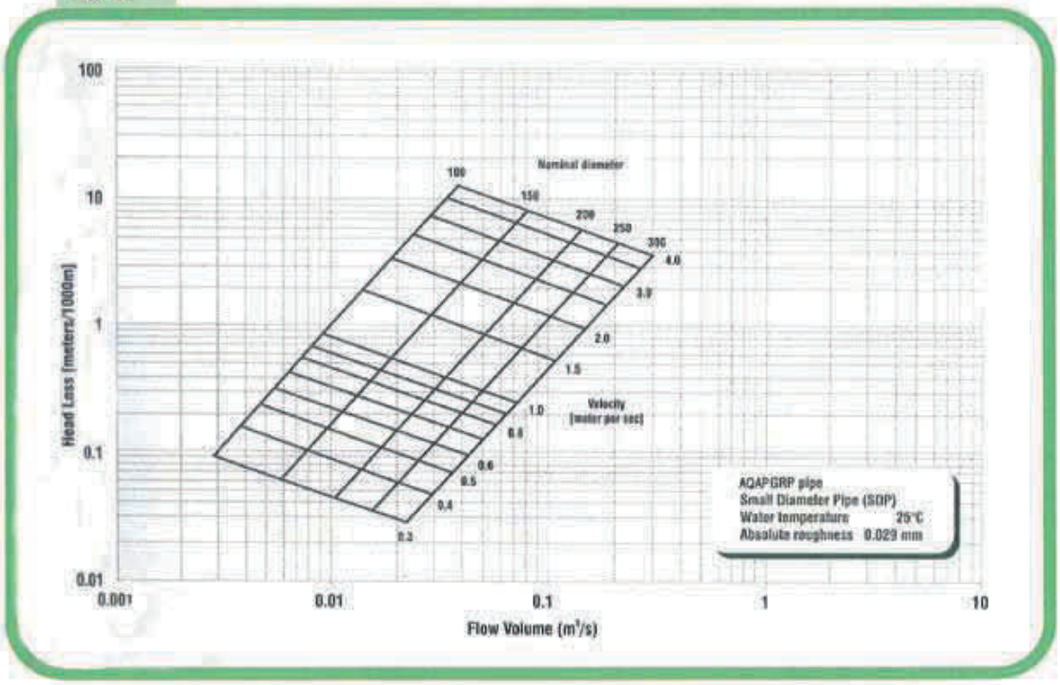

Head Loss (meters/1000m)
100
10
1
0.1
0.01
0.01
0.1
1
10
100
Flow Volume (m³/s)
Nominal diameter(mm)
200
350
400
450
600
650
700
800
900
1000
1200
1400
1600
1800
2000
2400
Velocity (meter per sec)
4.0
3.5
2.0
1.5
1.0
0.8
0.6
0.5
0.4
0.3
AQAPGRP pipe
Large Diameter Pipe (LDP)
Water temperature 25°C
Absolute roughness 0.029 mm

Fig. 1.2


Head Loss (meters/1000m)
100
10
1
0.1
0.01
0.001
0.01
0.1
1
10
Flow Volume (m³/s)
Nominal diameter
100
150
200
250
300
4.0
3.5
2.0
1.5
1.0
0.8
0.6
0.5
0.4
0.3
Velocity (meter per sec)
AQAPGRP pipe
Small Diameter Pipe (SDP)
Water temperature 25°C
Absolute roughness 0.029 mm

5.2 Surge & Water Hammers

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, hoop tensile modulus and physical layout of the pipe system

The water hammer pressure expected for AQAP is approximately 50% of that for steel and ductile, iron pipe, for similar conditions. AQAP 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 (m)

W = surge wave celerity (m/s)

ΔV = change in liquid velocity (m/s)

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

Surge Wave Celerity for AQAP Fiberglass Pipes

DN	350-400	450-800	900-2500
SN2500		Meters/Sec	
PN6	365	350	340
PN10	435	420	405
PN16	500	490	480

SN5000		Meters/Sec	
PN6	405	380	370
PN10	435	420	410
PN16	505	495	480
PN25	575	570	560

SN10000		Meters/Sec	
PN6	420	415	410
PN10	435	425	415
PN16	500	495	485
PN25	580	570	560
PN32	620	615	615

DN	80	100	150	200	250
SN 10000			Meters/Sec		
PN6	580	560	540	520	500
PN10	590	570	560	540	520
PN16	640	620	610	600	590

6. Pipe Classification Selection

6.1 Stiffness

The stiffness of AQAP is selected from one of the three stiffness classes listed below. The stiffness class represents the pipe's minimum initial specific stiffness (EI/D^3) in N/m^2 other stiffness classes (12500) Pa are available upon request.

Stiffness is selected according to two parameters.

Stiffness Class	N/m^2
SN 2500	2500
SN 5000	5000
SN 10000	10000

These are:

1.burial conditions, which include native soil, type of backfill, cover depth and

2.negative pressure, if it exists.

The native soil characteristics are rated according to ASTM D 1586 Standard Penetration Test. Some typical soil blow count values relative to soil types and density are given in Table 6.1.

Backfill soil types are offered in Table 6.2 (Page 15) 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% for pipe diameters 300 mm and large, and 4% for smaller diameters, the maximum allowable cover depths, with consideration for traffic loads, for the three different stiffness classes in the six native soil groups are given in Flowtite Installation Guide for Buried Pipes - AWWA, Table A-9.

The second parameter for pipe stiffness class selection is negative pressure, if it exists. Appendix B of Flowtite Installation Guide for Buried Pipes - AWWA 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.

The illustrations on Figure 6.3, page 15 show the standard installation types commonly used with AQAP. Alternate installations to accommodate a specific field condition include wider trenches, sheet piles, soil stabilization, geotextiles, etc. The Pipe installation instructions for Buried Pipe should be consulted for additional details.

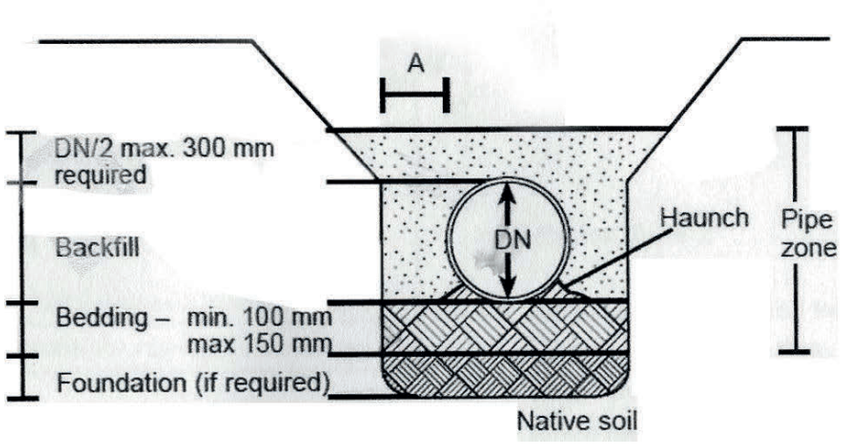
AQAP can be installed in a number of different situation including above ground, sub-aqueous, trenchless and sloped applications. These application can require more initial planning and more care than the standard buried pipe installation and therefore AQAP has developed specific instructions for these methods. Please contact Amiantit Qatar Pipe Co. for these detailed instructions.

Table 6.1

Native Soil Group Classification						
			Non-Cohesive Soils		Cohesive Soils	
Native soil Group	Blow Counts	E'n value (MPa)	Description	Friction Angle (degrees)	Description	Unconfined Comp Strength (kpa)
1	>15	34.5	compact	33	very stiff	192-384
2	8 - 15	20.7	slightly compact	30	stiff	76-192
3	4 - 8	10.3	loose	29	medium	48-96
4	2 - 4	4.8	very loose	28	soft	24-48
5	1 - 2	1.4	very loose	27	very soft	12-24
6	0 - 1	0.34	very, very loose	26	very, very soft	0-12

Table 6.2

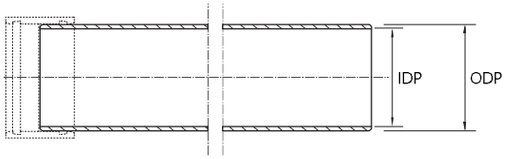
Backfill Soil Group	Description of Backfill Soils
SCI	Crushed rock with <15% sand, Maximum 25% passing the 10mm sieve and maximum 5% fines
SC2	Clean, coarse-grained soils with <12% fines
CS3	Clean, coarse-grained soils with 12% or more fines
	Sandy for fine-grained soils with less than 70% fines
SC4	Fine grained soils with more than 70% fines
(See Appendix D for further clarification and Appendix G for definitions)	



6.3 Typical underground Installation

7. Standard Pipe and Coupling Data Sheet

Our Flowtite pipe systems for pressure sewer applications are supplied in the standard diameter range, pressure and stiffness classes as listed below. Other diameters and pressure classes are available on request.



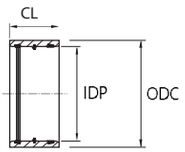
Small Dia Pipes

"B2" -OD Series	SN	10000			
	PN	6 / 10 / 16			
		DN	ODP	IDP	
		mm	mm	mm	kg/m*
		80	98	90	2.2
		100	118	110	2.6
		150	170.5	160	5
		200	221.6	210	7.3
		250	274	270	11.1
		300	325.2	310	14.4

*Approx. Weights

Table7.1 Small Pipe Diameters - Data & Weight

SN = Pipe stiffness, PN = Nominal Pressure, ODP = Outside diameter of pipe, IDP = Inside diameter of pipe.



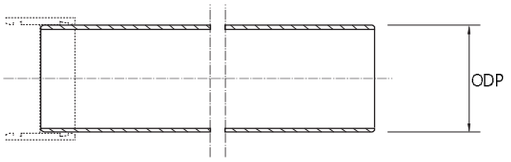
Small Dia Pipes Double Coupling FPC for LDP

	SN	10000				
	PN	10/16				
		DN	IDC	CL		ODC
		mm	mm	mm	kg/pc*	mm
		80	98	150	1.1	99.7
		100	118	150	1.3	116.7
		150	170.5	150	2.1	168.9
		200	221.6	175	4.2	222.4
		250	274	175	5.1	273.9
		300	325.2	175	6.0	326.5

*Approx. Weights

Table 7.2 Small Coupling Diameters - Data & Weight

SN = Pipe stiffness, PN = Nominal Pressure, ODC = outside diameter of coupling, IDC = Inside diameter of coupling, CL = Coupling length

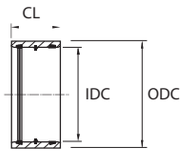


Large Dia Pipes (LDP)

	SN	5000		10000	
	PN	6	10	6	10
	ODP+/-0.5				
	DN mm	kg/m²	kg/m²	kg/m²	kg/m²
"B2"-OD Series	300 324.0	11.1	11.1	13.4	13.5
	350 375.9	14.8	14.8	18.3	18.3
	400 426.8	18.9	18.6	23.6	23.6
	450 477.7	23.2	23.2	29.4	29.4
	500 529.6	29.0	29.0	36.6	36.6
"B1"-OD Series	600 616.5	39.2	38.5	48.6	48.6
	700 718.5	52.9	48.9	65.5	64.4
	800 820.5	69.3	62.2	84.8	82.6
	900 922.5	86.8	77.4	106.6	102.7
	1000 1024.5	105.0	94.6	129.7	125.5
	1100 1126.5	125.5	113.2	154.6	150.9
	1200 1228.5	148.1	134.3	183.5	178.7
	1300 1330.0	172.6	157.0	212.8	208.4
	1400 1432.5	198.3	181.1	246.9	241.3
	1500 1534.5	227.4	207.3	281.0	276.1
	1600 1636.5	256.8	235.5	319.0	313.0
	1700 1738.5	290.1	264.8	359.2	353.0
	1800 1840.5	323.4	296.6	402.3	394.4
	1900 1962.0	362.2	332.8	451.3	443.1
	2000 2044.5	397.3	364.3	494.1	485.5
	2100 2146.5	437.1	401.1	543.8	534.7
	2200 2248.5	478.9	439.7	595.5	585.7
	2300 2350.5	522.1	479.3	648.9	640.5
	2400 2452.5	566.9	521.7	706.4	696.9
	2500 2554.5	614.8	564.9	764.9	754.6
	2600 2656.5	663.9	610.3	826.4	815.9
	2700 2758.5	715.6	658.1	891.4	879.4
	2800 2860.5	768.9	707.2	957.3	944.6
	2900 2962.5	822.6	757.2	1025.9	1013.0
	3000 3064.5	881.4	809.6	1096.6	1083.1
	3200 3263.5	991.6	924.5	12389	-
	3400 3472.5	1120.2	1042.1	1396.1	-
	3600 3676.5	1252.7	1168.6	1565.8	-
	3800 3880.5	1397.3	1302.0	1397.3	-
	4000 4100.5	1552.6	1447.6	1938.7	-

* Approx. Weights

Table 7.3 Large Pipe Diameters - Data & Weight



Double Bell Coupling FPC for LDP

	PN			6		10	
		Length CL	IDC +/-0.5	ODC		ODC	
	DN	mm	mm	mm	kg/pc*	mm	kg/pc*
"B2"-OD Series	300	270	326.0	367.8	10.9	368.6	11.1
	350	270	377.9	419.5	12.4	420.7	12.8
	400	270	428.8	470.4	14.0	471.6	14.5
	450	270	479.7	520.9	15.6	522.5	16.3
	500	270	531.6	572.6	17.2	574.2	17.9
"B1"-OD Series	600	330	619	666.1	28.6	667.7	29.6
	700	330	721	767.7	32.8	770.1	34.5
	800	330	823	869.5	37.1	873.7	40.6
	900	330	925	972.5	42.5	977.1	46.8
	1000	330	1027	1075.5	48.1	1080.3	53.1
	1100	330	1129	1178.1	53.5	1183.5	59.5
	1200	330	1231	1280.7	58.9	1286.5	65.9
	1300	330	1333	1380.8	64.4	1388.8	72.4
	1400	330	1435	1485.7	69.9	1491.9	78.7
	1500	330	1537	1587.6	75.4	1594.2	85.4
	1600	330	1639	1690.7	81.2	1697.5	92.3
	1700	330	1741	1790.1	86.9	1797.1	99.3
	1800	330	1843	1895.5	92.6	1902.9	106.2
	1900	330	1945	1995.3	98.5	2002.3	115.1
	2000	330	2047	2100.3	104.4	2110.1	124.4
	2100	330	2149	2199.9	110.4	2209.9	133. 8
	2200	330	2251	2305.1	116.4	2316.9	142.7
	2300	330	2353	2404.5	122.6	2415.5	151.8
	2400	330	2455	2509.9	128.8	2523.3	161.1
	2500	330	2557	2628.0	187.7	2646.4	224.7
	2600	360	2659	2733.5	208.8	2742.6	237.9
	2700	360	2761	2730.4	218.4	2845.2	248.6
	2800	360	2863	2938.7	228.2	2947.8	259.5
	2900	360	2965	3035.7	238.1	3050.4	270.6
	3000	360	3067	3143.9	248.2	3153.0	281.7
	3200	360	3271	3343	251.6	3353.6	289.8
	3400	360	3475	3548	270.9	3558.6	311. 4
	3600	360	2679	3753	290.5	3763.5	333. 3
	3800	360	3883	3957.8	309.9	3968.4	355.0
	4000	360	4103	4178.6	330.9	4189.2	378.5

* Approx. Weights

Table 7.4 Large Coupling Diameters - Data & Weight

Alternatively AQAP has B1 Series for DN 450 and 500

B1 Series for Pipes and Couplings

"B1" -OD Series	Pipe		Coupling	
		ODP+/-0.5	Length CL	IDC +/-0.5
	DN	mm	mm	mm
	450	463.5	270	466
	500	514.5	270	517

8. Pipe Joining

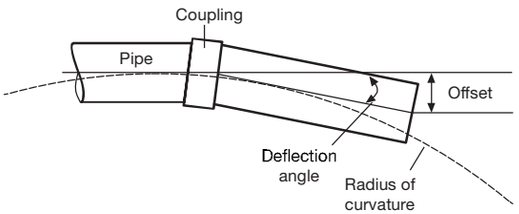
8.1 Double Bell Coupling (FPC)

FLOWTITE pipe sections are typically joined using FLOWTITE pressure couplings (FPC). Pipe and couplings may be supplied separately, or the pipe may be supplied with a coupling installed on one end. The FLOWTITE coupling utilises an elastomeric 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

*Note: Detailed installation instructions can be found in our separate publications for pipe installation.

8.2 Joint Angular Deflection

The joint is extensively tested and qualified in accordance with ASTM D4161, ISO DIS8639 and EN 1119. Maximum angular deflection (turn) at each coupling joint, measured as the change in adjacent pipe centre lines, must not exceed the amounts given in table below.



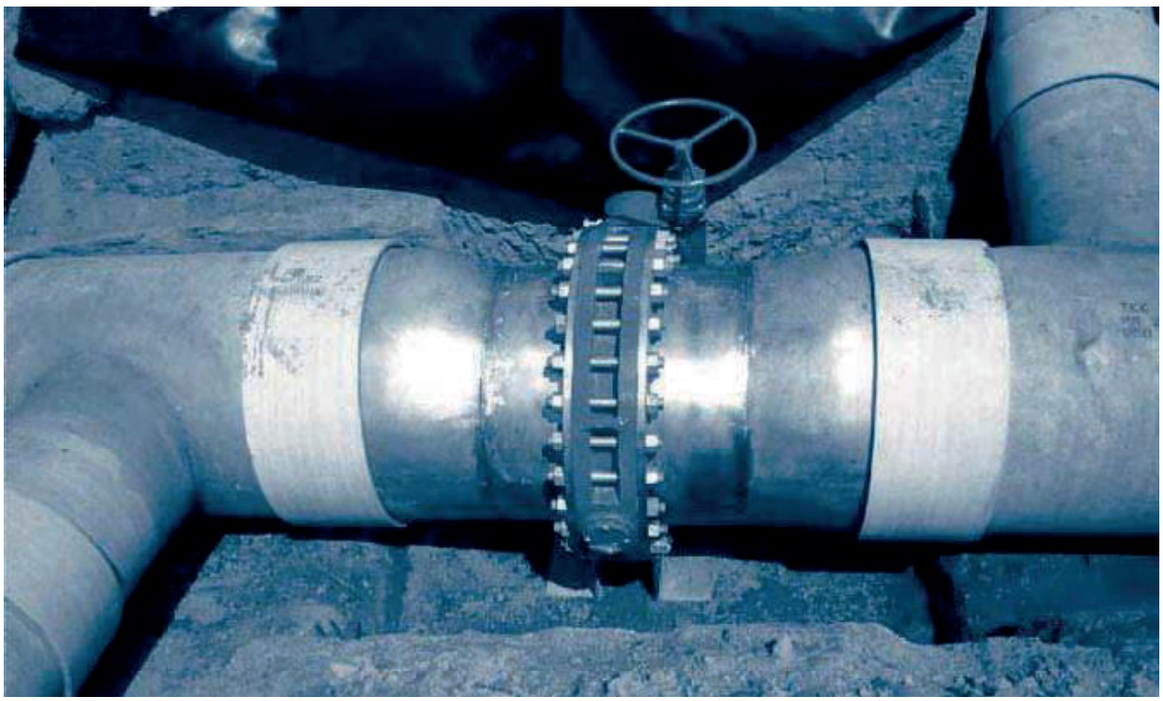
The pipes must be joined in a straight alignment, but not all the way to the home line, and thereafter deflected angularly as required.

Nom Pipe Diameter (mm)		Pressure (PN) in bars		
	Up to 16	20	25	32
		Max. Angle of Deflection (deg)		
DN < 500	3.0	2.5	2.0	1.5
500 < DN < 900	2.0	1.5	1.3	1.0
900 < DN < 1800	1.0	0.8	0.5	0.5
DN > 1800	0.5	NA	NA	NA

Table 8.1 Angular Deflection at Double coupling Joint

Angle of Deflection (deg)	Maximum Offset (mm) Pipe Length			Radius of Curvature (m) Pipe length		
	3 m	6 m	12 m	3 m	6 m	12 m
3.0	157	314	628	57	115	229
2.5	136	261	523	69	137	275
2.0	105	209	419	86	172	344
1.5	78	157	313	114	228	456
1.3	65	120	240	132	265	529
1.0	52	105	209	172	344	688
0.8	39	78	156	215	430	860
0.5	26	52	104	344	688	1376

Table 8.2 Offset and Radius of Curvature



8.3 Locked Joints

The FLOWTITE locked joint is a double bell with rubber gaskets and locking rods to transfer axial thrust from one pipe section to another. On each side, the coupling bell has a standard rubber gasket and a rod-groove system, through which the load is transferred via compressive and shear action. The pipe spigot for locked joints has a matching groove.

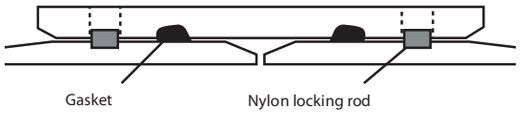


Figure 8.3 Locked Joint

The joint is assembled by using a similar procedure as the standard FLOWTITE coupling, except that there is no centre register.

8.4 GRP Flanges

The standard bolt pattern to which our flanges are manufactured is in accordance with ISO2084. Other bolting dimension systems such as AWWA, ANSI, DIN and JIS can also be supplied. Available are flange connections with fibreglass adhesives, as well as zinc steel loosetype flanges. Fibreglass tight flanges and loosetype flanges made of fibreglass can be delivered to order. Loose and fixed flanges are available for all pressure classes.

Contact moulded Flanged joints

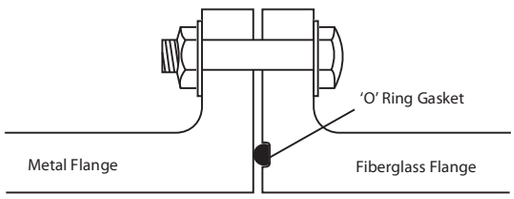


Figure 8.4 Flanged joint

Fixed Loose Flange joints:

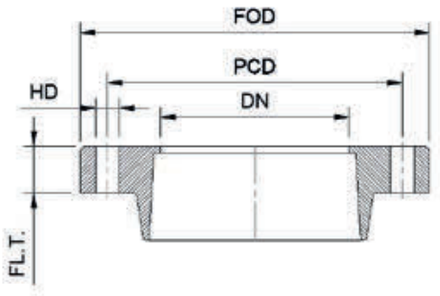


Figure 8.5 Loose Flange

8.5 Mechanical Steel Couplings

When connecting FLOWTITE pipe to other materials with different outside 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:

Coated steel mantle
Stainless steel mantle
Hot dip galvanized steel mantle

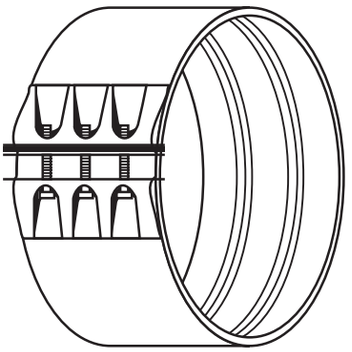


Figure 8.7 Flexible steel coupling

Mechanical couplings have been used to join pipes of different materials and diameters, and to adapt to flange outlets. FLOWTITE Technology has found a wide manufacturing variance in these couplings, including bolt size, number of bolts and gasket design which makes standardized recommendations impossible. If a mechanical joint is used to join FLOWTITE to another pipe material then a dual independent bolting system allows for the independent tightening of the FLOWTITEside which typically requires less torque than recommen-ded by the coupling manufacturer.

Consequently, we cannot recommend the general use of mechanical couplings with FLOWTITE pipe. If the installer intends to use a specific design (brand and model) of mechanical coupling, he is advised to consult with the local FLOWTITE pipe supplier prior to its purchase. The pipe supplier can then advise under what specific conditions, if any, this design might be suitable for use with FLOWTITE.

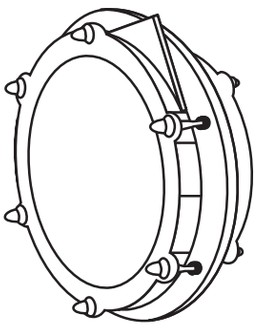


Figure 8.8 Dual bolt mechanical coupling

8.6 Laminated Joints (Butt strap)

Laminated Joints are typically where the transmission of axial forces from internal pressure is required, or as a repair method. The length and thickness of the lay-up depends on diameter and pressure.

Detailed information about the local availability of joints and joining systems can be requested from your local supplier, or is attached to this brochure.

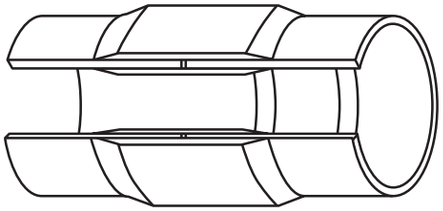
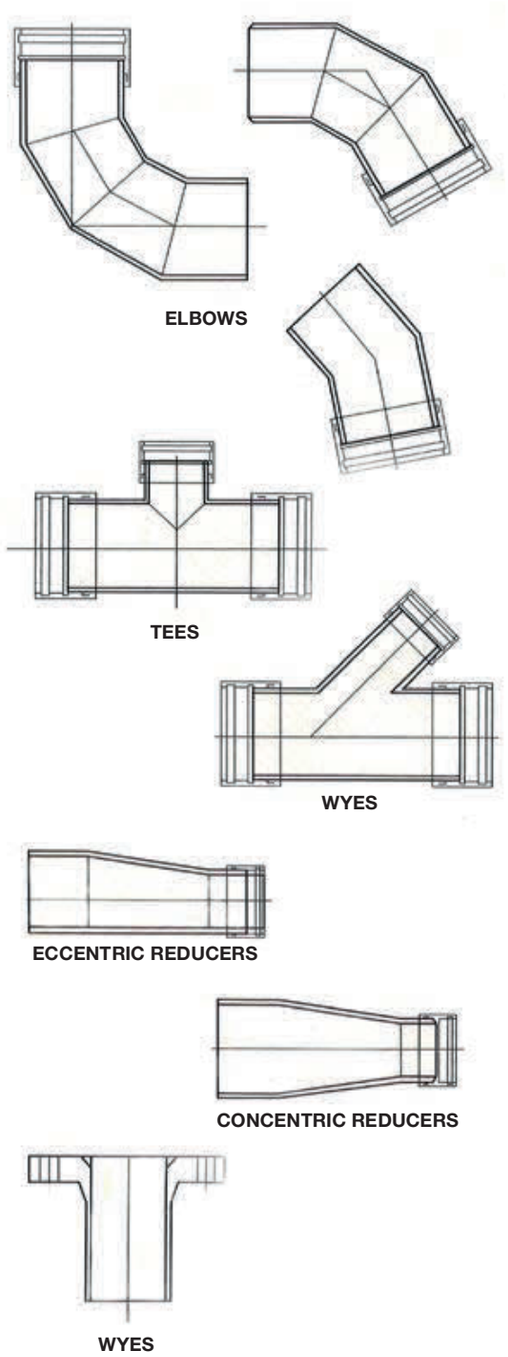


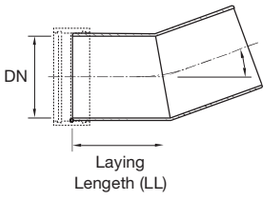
Figure 8.9 Laminated joint

9. Fittings

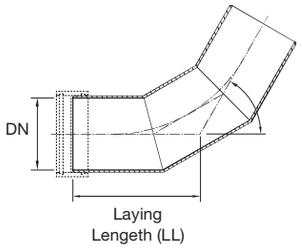
Amiantit Qatar Pipe Company has created a standardized line of GRP fitting that are moulded or fabricated using the same material that are used to produce AQAP pipe. One of the benefit of ***Flowtite*** AQAP pipe is the ability to fabricate as wide assortment of fittings, standard as well as non standard. The following table shows the standard dimensions of standard fittings with different ends configuration.



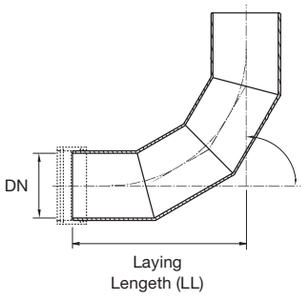
9.1 Segmented Bends



One Segmented Bend



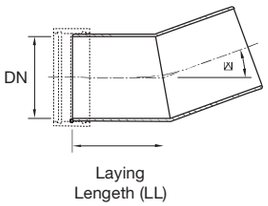
Two Segmented Bend



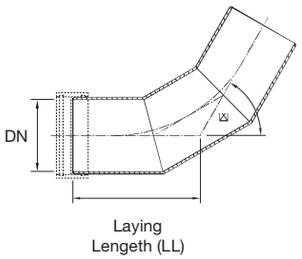
Three Segmented Bend

	Angle□						
"B2" OD Series	11.25°	15°	22.5°	30°	45°	60°	90°
DN	No. of Mitres with Laying Length (LL)						
mm	1	1	1	1	2	2	3
100	250	250	250	250	250	300	350
150	250	250	250	250	300	300	400
200	250	250	250	300	350	400	500
250	300	300	300	300	400	450	600
300	400	350	400	400	500	550	750
350	400	400	400	450	550	600	800
400	450	450	450	450	600	650	900
450	450	450	500	500	600	700	1000
500	450	450	500	500	650	750	1050

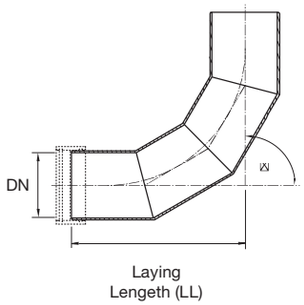
Table 9.1 Small Diameters - Laying Length LL in mm - Stiffness and Pressure Classes acc. to Section 4.5 and 4.6



One Segmented Bend



Two Segmented Bend

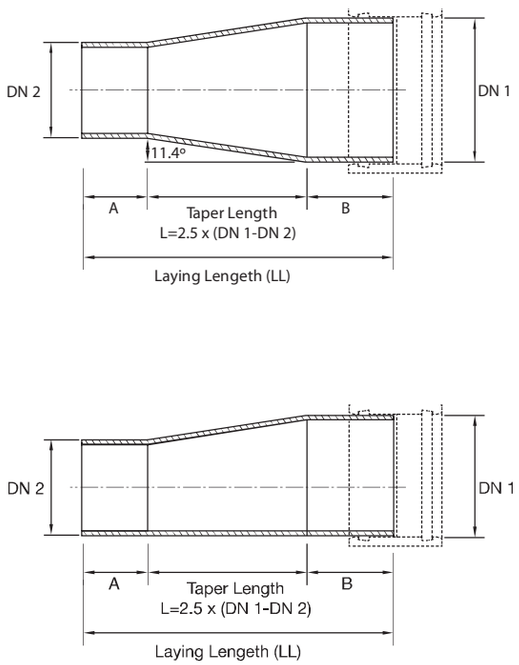


Three Segmented Bend

	Angle□						
"B1" OD Series	11.25°	15°	22.5°	30°	45°	60°	90°
DN	No. of Mitres with Laying Length (LL)						
mm	1	1	1	1	2	2	3
600	400	400	400	450	600	700	1100
700	400	400	450	450	650	800	1200
800	450	450	450	500	700	850	1350
900	450	450	500	550	800	950	1500
1000	450	500	500	550	850	1000	1650
1100	500	500	550	600	900	1100	1800
1200	500	550	600	600	950	1200	1950
1300	600	600	650	700	1050	1300	2100
1400	600	600	650	700	1100	1350	2250
1500	650	650	700	750	1200	1450	2400
1600	650	700	750	800	1250	1550	2550
1700	650	700	750	800	1300	1600	2700
1800	700	750	800	850	1350	1700	2850
1900	700	750	800	850	1400	1750	2950
2000	700	750	800	900	1450	1800	3100
2100	700	750	800	900	1500	1850	3200
2200	700	750	800	900	1550	1950	3350
2300	700	750	800	950	1550	2000	3450
2400	700	750	800	1000	1550	2100	3600
2500	700	750	800	1000	1600	2200	3750
2600	700	800	900	1000	1700	2200	3800
2700	800	800	900	1000	1800	2200	4000
2800	800	800	900	1000	1800	2300	4100
2900	800	800	900	1000	1900	2400	4200
3000	800	800	900	1100	1900	2400	4300

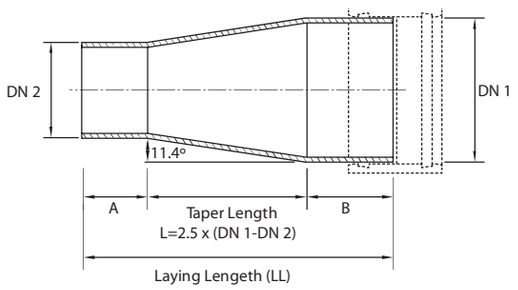
Table 9.2 Large Diameters - Laying Length LL in mm - Stiffness and Pressure Classes acc. to Section 4.5 and 4.6

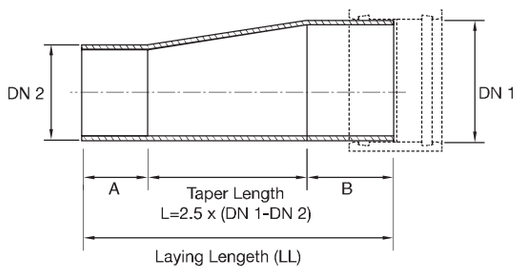
9.2 Segmented Reducers – Concentric –Eccentric



DN 1 [mm]	DN 2 [mm]	Taper Length L [mm]	Pipe Length A=B [mm]	Laying Length LL [mm]
150	100	125	300	725
200	100	250	300	850
200	150	125	300	725
250	150	250	300	850
250	200	125	300	725
300	200	250	400	1050
300	250	125	400	925
350	250	250	400	1050
350	300	125	400	925
400	300	250	400	1050
400	350	125	400	925
450	350	250	400	1050
450	400	125	400	925
500	400	250	400	1050
500	450	125	400	925
600	400	500	500	1300
600	450	375	400	1175
600	500	250	400	1050
700	500	500	400	1300
700	600	250	400	1050
800	600	500	400	1300
800	700	250	400	1050
900	700	500	400	1300
900	800	250	400	1050
1000	800	500	400	1300
1000	900	250	400	1050
1100	900	500	500	1500
1100	1000	250	500	1250
1200	800	1000	500	2000
1200	1000	500	500	1500
1200	1100	250	500	1250
1300	1100	500	500	1500
1300	1200	250	500	1250
1400	1200	500	500	1500
1400	1300	250	500	1250

Table 9.3 Concentric Reducers - Stiffness and Pressure Classes acc. to Section 4.5 and 4.6

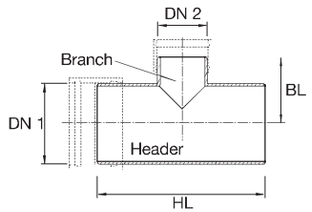




DN 1 [mm]	DN 2 [mm]	Taper Length L [mm]	Pipe Length A=B [mm]	Laying Length LL [mm]
1500	1300	500	600	1700
1500	1400	250	600	1450
1600	1200	1000	600	2200
1600	1400	500	600	1700
1600	1500	250	600	1450
1700	1500	500	600	1700
1700	1600	250	600	1450
1800	1600	500	600	1700
1800	1700	250	600	1450
1900	1700	500	600	1700
1900	1800	250	600	1450
2000	1800	500	600	1700
2000	1900	250	600	1450
2100	1900	500	600	1700
2100	2000	250	600	1450
2200	2000	500	600	1700
2200	2100	250	600	1450
2300	2100	500	600	1700
2300	2200	250	600	1450
2400	2200	500	600	1700
2400	2300	250	600	1450
2500	2300	500	600	1700
2500	2400	250	600	1450
2600	2200	1000	600	2200
2600	2400	500	600	1700
2700	2500	500	600	1700
2700	2600	250	600	1450
2800	2400	1000	600	2200
2800	2600	500	600	1700
2900	2700	500	600	1700
2900	2800	250	600	1450
3000	2600	1000	600	2200
3000	2800	500	600	1700

Table 9.4 Concentric Reducers - Stiffness and Pressure Classes acc. to Section 4.5 and 4.6

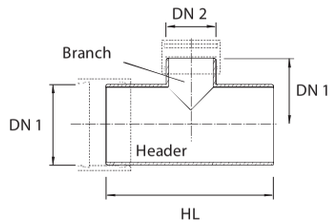
9.3 Segmented Tees
Pressure Class PN 6
DN2 = 100 - 1000 mm



DN 2 / DN 1	100		150		200		250		300		350		400		500		600		700		800		900		1000	
	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	350	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL
100	600	300	-	-	-	-	-	-	-	-	HL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	600	300	600	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	600	350	600	350	700	350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	600	350	600	350	700	350	700	350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	700	400	700	400	800	400	800	400	900	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	700	400	700	400	800	400	800	400	900	450	-	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	700	450	700	450	800	450	800	450	900	500	900	500	1000	500	-	-	-	-	-	-	-	-	-	-	-	-
500	700	500	700	500	800	500	800	500	900	550	1000	550	1000	550	1200	600	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	900	600	1000	-	1100	600	1200	600	1300	650	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	900	650	-	-	1100	650	1200	700	1300	700	1400	700	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	900	700	-	-	1100	700	1200	750	1400	750	1500	800	1600	800	-	-	-	-
900	-	-	-	-	-	-	-	-	900	750	-	-	1100	750	1200	800	1400	850	1500	850	1600	850	1700	850	-	-
1000	-	-	-	-	-	-	-	-	900	800	-	-	1100	800	1200	850	1400	900	1500	900	1600	900	1800	950	1900	950
1200	-	-	-	-	-	-	-	-	1000	900	-	-	1100	950	1200	950	1400	1000	1600	1000	1700	1050	1800	1050	1900	1100
1400	-	-	-	-	-	-	-	-	1000	1000	-	-	1100	1050	1300	1050	1400	1100	1500	1100	1700	1150	1900	1150	2000	1200
1600	-	-	-	-	-	-	-	-	1000	1150	-	-	1200	1150	1300	1200	1400	1200	1600	1250	1700	1250	1800	1300	2000	1300
1800	-	-	-	-	-	-	-	-	1000	1250	-	-	1200	1250	1300	1300	1400	1300	1600	1350	1700	1350	1800	1350	2100	1450
2000	-	-	-	-	-	-	-	-	1000	1350	-	-	1200	1400	1300	1400	1500	1450	1600	1450	1700	1450	1900	1500	2000	1500
2400	-	-	-	-	-	-	-	-	1100	1600	-	-	1200	1600	1400	1600	1500	1650	1700	1650	1800	1700	1900	1700	2100	1750
											-															

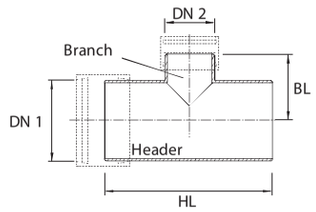
Table 9.5 Header- and Branch Lengths Segmented Tee Pipe Series in mm – PN 6 – Stiffness Classes acc. to Section 4.5

Segmented Tees
Pressure Class PN 6
DN2 = 1200 - 2400 mm



DN 2 / DN 1	1200		1400		1600		1800		2000		2400	
	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL
100	-	-	-	-	-	-	-	-	-	-	-	-
150	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-	-
250	-	-	-	-	-	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-	-	-	-	-	-
350	-	-	-	-	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-	-	-	-	-
500	-	-	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-	-	-	-
1000	-	-	-	-	-	-	-	-	-	-	-	-
1200	2200	1100	-	-	-	-	-	-	-	-	-	-
1400	2200	1200	2500	1250	-	-	-	-	-	-	-	-
1600	2300	1350	2500	1350	2800	1400	-	-	-	-	-	-
1800	2300	1450	2600	1500	2800	1500	3100	1550	-	-	-	-
2000	2400	1550	2600	1600	2900	1650	3100	1650	3400	1700	-	-
2400	2300	1750	2700	1850	2900	1850	3200	1900	3300	1900	3900	1950

Table 9.6 Header- and Branch Lengths Segmented Tee Pipe Series in mm – PN 6 – Stiffness Classes acc. to Section 4.5

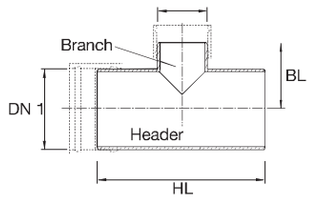


Segmented Tees
Pressure Class PN 6
DN2 = 100 - 1000 mm

DN 2	100		150		200		250		300		350		400		500		600		700		800		900		1000	
DN 1	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL
100	600	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	700	400	800	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	900	450	900	500	1000	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	800	500	1000	550	1100	600	1200	600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	1000	550	1200	650	1300	650	1300	650	1400	700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	1100	600	1100	600	1400	750	1400	750	1500	800	1600	800	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	1100	650	1200	700	1500	800	1500	800	1600	850	1700	850	1700	850	-	-	-	-	-	-	-	-	-	-	-	-
500	1300	800	1400	800	1400	850	1800	950	1800	1000	1900	1000	1900	1000	2000	1000	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	1100	700	-	-	1400	750	1500	750	1700	850	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	1200	750	-	-	1500	850	1600	850	1700	900	1900	900	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	1300	850	-	-	1400	850	1700	950	1800	1000	1900	1000	2100	1050	-	-	-	-
900	-	-	-	-	-	-	-	-	1400	950	-	-	1500	950	1700	1000	1900	1050	2000	1050	2100	1100	2300	1150	-	-
1000	-	-	-	-	-	-	-	-	1400	1000	-	-	1500	1000	1600	1000	1900	1150	2000	1150	2200	1200	2300	1200	2500	1250
1200	-	-	-	-	-	-	-	-	1500	1200	-	-	1600	1200	1700	1200	1800	1200	2200	1350	2300	1350	2400	1350	2500	1350
1400	-	-	-	-	-	-	-	-	1600	1350	-	-	1700	1350	1800	1350	2000	1400	2100	1400	2400	1500	2500	1500	2600	1500
1600	-	-	-	-	-	-	-	-	1700	1500	-	-	1800	1500	2000	1500	2100	1550	2200	1550	2300	1550	2700	1700	2800	1700

Table 9.7 Header- and Branch Lengths Segmented Tee Pipe Series in mm – PN 10 – Stiffness Classes acc. to Section 4.5

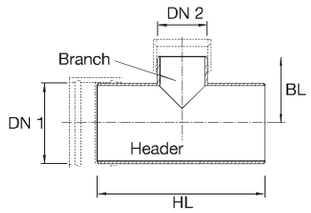
Segmented Tees
Pressure Class PN 10
DN2 = 1200 - 1600 mm



DN 2 / DN 1	1200		1400		1600	
	HL	BL	HL	BL	HL	BL
100	-	-	-	-	-	-
150	-	-	-	-	-	-
200	-	-	-	-	-	-
250	-	-	-	-	-	-
300	-	-	-	-	-	-
350	-	-	-	-	-	-
400	-	-	-	-	-	-
500	-	-	-	-	-	-
600	-	-	-	-	-	-
700	-	-	-	-	-	-
800	-	-	-	-	-	-
900	-	-	-	-	-	-
1000	-	-	-	-	-	-
1200	2800	1400	-	-	-	-
1400	2900	1550	3200	1600	-	-
1600	3100	1750	3400	1800	3600	1800

Table 9.8 Header- and Branch Lengths Segmented Tee Pipe Series in mm – PN 10 – Stiffness Classes acc. to Section 4.5

Segmented Tees
Pressure Class PN 10
DN2 = 100 - 1200 mm

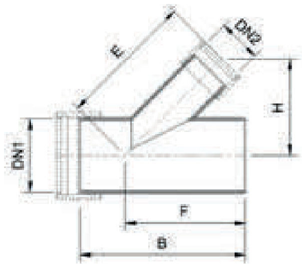


DN 2	100		150		200		250		300		350		400		500		600		700		800		900		1000		1200	
DN 1	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL	HL	BL
100	800	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	900	500	1000	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	1100	600	1200	600	1300	650	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	1100	600	1400	700	1400	750	1500	750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	1300	700	1600	850	1700	850	1700	850	1800	900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	1400	750	1500	800	1800	950	1900	950	2000	1000	2000	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	1500	850	1600	850	2000	1050	2100	1100	2100	1100	2200	1100	2300	1150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500	1700	1000	1800	1050	1900	1050	2400	1300	2500	1350	2600	1350	2700	1350	2700	1350	-	-	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	1400	800	-	-	1700	900	1800	900	1900	950	-	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	1500	900	-	-	1800	1000	1900	1000	2000	1050	2100	1050	-	-	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	1600	1000	-	-	1700	1000	2000	1150	2100	1150	2200	1150	2300	1150	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	1600	1100	-	-	1800	1100	2100	1250	2200	1300	2400	1300	2500	1300	2600	1300	-	-	-	-
1000	-	-	-	-	-	-	-	-	1700	1200	-	-	1800	1200	2000	1200	2400	1400	2500	1400	2600	1400	2800	1400	2900	1400	-	-
1200	-	-	-	-	-	-	-	-	1800	1350	-	-	2000	1350	2100	1350	2200	1400	2700	1600	2800	1600	2900	1600	3000	1600	3200	1600

Table 9.9 Header and Branch Lengths Segmented Tee Pipe Series in mm – PN 16 – Stiffness Classes acc. to Table 4.5

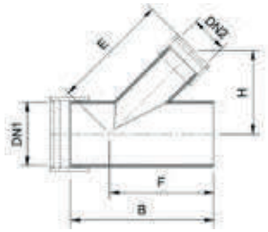
Other Diameters on Request

9.4 Wye Branch 45 degrees, for Gravity only



D2		100				150			200				250				300				350			400				450				500			600				700			800		
D1	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E
100	600	300	350	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	600	300	375	420	700	300	425	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	600	300	400	420	700	350	450	500	800	350	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	600	350	425	500	700	350	475	500	800	400	525	570	900	400	575	570	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	700	350	500	500	800	400	550	570	900	400	600	570	1000	450	650	640	1100	500	700	710	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	700	400	550	570	800	400	575	570	900	450	625	640	1000	450	675	640	1100	500	725	710	1200	550	775	780	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	700	400	550	570	800	450	600	640	900	450	650	640	1000	500	700	710	1100	550	750	780	1200	600	800	850	1300	600	850	850	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500	700	500	600	710	800	500	650	710	900	550	700	780	1000	550	750	780	1100	600	800	850	1200	650	850	920	1300	650	900	920	1500	700	1000	990	-	-	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1100	650	850	920	-	-	-	-	1300	700	950	990	1500	750	1050	1060	1600	800	1100	1130	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1100	700	900	990	-	-	-	-	1300	750	1000	1060	1500	800	1100	1130	1700	850	1200	1200	1900	900	1300	1270	-	-	-	-
800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1100	750	950	1060	-	-	-	-	1300	800	1050	1130	1500	850	1150	1200	1700	900	1250	1270	1900	950	1350	1340	2100	1000	1450	1410
900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1100	800	1000	1130	-	-	-	-	1300	850	1100	1200	1500	900	1200	1270	1700	1000	1300	1410	1900	1050	1400	1490	2100	1100	1500	1560
1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1100	850	1050	1200	-	-	-	-	1300	900	1150	1270	1500	950	1250	1340	1800	1050	1400	1490	1900	1100	1450	1560	2100	1150	1550	1630
1200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1200	950	1200	1340	-	-	-	-	1400	1000	1300	1410	1500	1050	1350	1490	1700	1100	1450	1560	2000	1200	1600	1700	2200	1250	1700	1770
1400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1200	1100	1300	1560	-	-	-	-	1400	1150	1400	1630	1600	1200	1500	1700	1800	1250	1600	1770	2000	1300	1700	1840	2200	1400	1800	1980
1600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1200	1200	1400	1700	-	-	-	-	1400	1250	1500	1770	1600	1300	1600	1840	1800	1350	1700	1910	2000	1400	1800	1980	2200	1450	1900	2050
1800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1300	1300	1550	1800	-	-	-	-	1500	1350	1650	1875	1700	1380	1750	1940	1800	1450	1800	2025	2000	1500	1900	2100	2200	1550	2000	2175
2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1300	1400	1650	1850	-	-	-	-	1500	1450	1750	1925	1700	1500	1850	2000	1900	1600	1950	2100	2100	1650	2050	2175	2300	1700	2150	2250
2400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1300	1600	1850	1950	-	-	-	-	1500	1650	1950	2025	1700	1750	2050	2125	1900	1800	2150	2200	2100	1850	2250	2275	2300	1900	2350	2350

Table 9.10 Header and Branch Lengths Segmented Wye Pipe Series in mm - Gravity



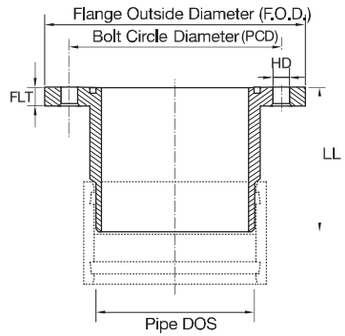
9.4 Wye Branch 45 degrees, for Gravity only

D2	800				900				1000				1200				1400				1600				1800				2000				2400			
D1	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E	B	H	F	E
100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
800	2100	1000	1450	1410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
900	2100	1100	1500	1560	2300	1150	1600	1630	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1000	2100	1150	1550	1630	2300	1200	1650	1700	2500	1250	1750	1770	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1200	2200	1250	1700	1770	2400	1300	1800	1840	2500	1350	1850	1910	2900	1450	2050	2050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1400	2200	1400	1800	1980	2400	1400	1900	1980	2600	1450	2000	2050	2900	1550	2150	2190	3300	1650	2350	2330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1600	2200	1450	1900	2050	2400	1550	2000	2190	2600	1600	2100	2260	3000	1700	2300	2400	3400	1800	2500	2550	3700	1900	2650	2750	-	-	-	-	-	-	-	-	-	-	-	-
1800	2200	1550	2000	2175	2400	1600	2200	2250	2700	1700	2250	2350	3100	1800	2450	2500	3400	1900	2600	2650	3800	2000	2800	2800	4100	2100	2950	2950	-	-	-	-	-	-	-	-
2000	2300	1700	2150	2250	2400	1750	2200	2325	2700	1800	2350	2400	3100	1900	2550	2550	3500	2000	2750	2700	3800	2100	2900	2850	4200	2200	3100	3000	4500	2300	3250	3150	-	-	-	-
2400	2300	1900	2350	2350	2500	1950	2450	2425	2700	2000	2550	2500	3000	2100	2700	2650	3600	2250	3000	2825	3900	2350	3150	2975	4300	2450	3350	3125	4500	2500	3450	3250	5200	2700	3800	3550

Table 9.11 Header and Branch Lengths Segmented Wye Pipe Series in mm - Gravity

9.5 Contact Moulded Flanges

The standard bolting pattern to which our flanges are manufactured is ISO 2084. Other bolting dimension systems such as AWWA, ANSI, DIN, JIS can be supplied. The table refers to fix flanges up to pressure class PN 10

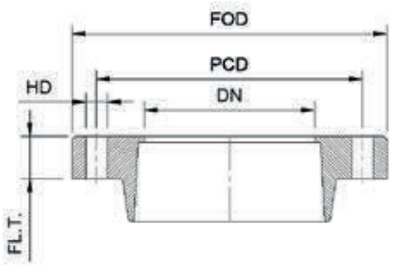


Pressure Classes PN 6 & PN 10

DN	Pipe DOS	FL.T	F.O.D.	LL	PCD			HD		
Nominal Diameter	O.D. [MM]	Flange Thickness [mm]	Flange Outside Diameter [mm]	Laying Length [mm]	Bolt Circle Diameter [mm]	Number of Holes	Bolt Size [mm]	Bold Hole Diameter [mm]	Washer Diameter [mm]	O-Ring Gasket Diameter [mm]
300	324.5	40	450	1000	400	12	M 20	26	36	12
350	376.4	45	525	1000	460	16	M 20	26	36	12
400	427.3	47	575	1000	515	16	M 24	30	44	12
450	478.2	52	625	1000	565	20	M 24	30	44	12
500	530.1	53	675	1000	620	20	M 24	30	44	12
600	617	55	800	1000	725	20	M 27	33	50	12
700	719	64	900	1000	840	24	M 27	33	50	19
800	821	69	1025	1000	950	24	M 30	36	56	19
900	923	74	1125	1000	1050	28	M 30	36	56	19
1000	1025	79	1250	1000	1160	28	M 33	39	60	19
1100	1127	88	1350	1000	1270	32	M 33	39	60	22
1200	1229	94	1475	1000	1380	32	M 36	42	68	22
1300	1331	97	1575	1000	1490	32	M 39	45	72	22
1400	1433	104	1700	1000	1590	36	M 39	45	72	22
1500	1535	107	1800	1000	1700	36	M 39	45	72	22
1600	1637	114	1925	1000	1820	40	M 45	51	85	22
The following flanges list the maximum pipe O.D. on which the flange can be fabricated without interference of bold hole and spot facing with the flange hub.										
1800	1815	128	2125	1000	2020	44	M 45	51	85	25
2000	2015	139	2350	1000	2230	48	M 45	51	85	25
2200	2200	153	2575	1000	2440	52	M 52	58	98	28
2400	2400	164	2775	1000	2650	56	M 52	58	98	28
2600	2588	176	2975	1000	2850	60	M 52	58	98	28
2800	2796	186	3200	1000	307 0	64	M 52	58	98	28
3000	2999	197	3425	1000	329 0	68	M 56	62	105	28

Table 9.10 Fix Flanges – Type A – PN 6 & PN 10 – for all Stiffness Classes

Bigger Dimensions on Request



Loose Flanges - PN 10 Drilling

DN	FL.T	F.O.D.	P.C.D.	No. of		H.D.
Nominal Diameter	Flange Thickness	Flange Outside Diameter	Bolt Circle Diameter	Holes	Bolt Size	Bolt Hole Diameter
[mm]	[mm]	[mm]	[mm]		[mm]	[mm]
15	30	95	65	4	M12	14
20	30	105	75	4	M12	14
25	30	115	85	4	M12	14
40	30	150	110	4	M16	18
50	35	165	125	4	M16	18
65	35	185	145	8	M16	18
80	40	200	160	8	M16	18
100	40	220	180	8	M16	18
150	45	285	240	8	M20	22
200	45	345	295	8	M20	22
250	55	400	350	12	M20	22
300	55	450	400	12	M20	22
Tolerances	-1.5/+4	-1/+4	±1			±1

PN16 Drilling

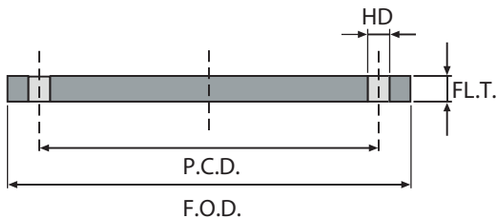
DN	FL.T	F.O.D.	P.C.D.	No. of		H.D.
Nominal Diameter	Flange Thickness	Flange Outside Diameter	Bolt Circle Diameter	Holes	Bolt Size	Bolt Hole Diameter
[mm]	[mm]	[mm]	[mm]		[mm]	[mm]
15	30	95	65	4	M12	14
20	30	105	75	4	M12	14
25	30	115	85	4	M12	14
40	30	150	110	4	M16	18
50	35	165	125	4	M16	18
65	35	185	145	8	M16	18
80	40	200	160	8	M16	18
100	40	220	180	8	M16	18
150	45	285	240	8	M20	22
200	45	345	295	12	M20	22
250	55	405	355	12	M20	26
300	55	475	410	12	M20	26
Tolerances	-1.5/+4	-1/+4	±1			±1

ASME / ANSI B16.5 #150 Drilling

DN	FL.T	F.O.D.	P.C.D.	No. of		H.D.
Nominal Diameter	Flange Thickness	Flange Outside Diameter	Bolt Circle Diameter	Holes	Bolt Size	Bolt Hole Diameter
[mm]	[mm]	[mm]	[mm]		[mm]	[mm]
DN	FL.T	Flg.OD	PCD	No Holes	Bolt Size	H.D
15	30	105	60.3	4	M12	15.8
20	30	108	69.8	4	M12	15.8
25	30	108	79.4	4	M12	15.8
40	30	130	98.4	4	M12	15.8
50	35	152.4	120.6	4	M16	19
65	35	172	139.7	4	M16	19
80	40	190.5	152.4	4	M16	19
100	40	228.5	190.5	8	M16	19
150	45	279.4	241.3	8	M20	22.2
200	45	342.9	298.4	8	M20	22.2
250	55	406.4	362	12	M24	25.4
300	55	482.6	431.8	12	M24	25.4
Tolerances	-1.5/+4	-1/+4	±1			±1

9.7 Blind Flanges

The standard bolting pattern to which our flanges are manufactured is ISO 2084. Other bolting dimension systems such as AWWA, ANSI, DIN, JIS can be supplied. The table refers to fixflanges up to pressure class PN 10.



Pressure Class PN 6

DN	F.O.D.		H.D	P.C.D.		FL.T.		No. of bolts	Weight* [kg/pc]
100	220	±2	20	170	±1,6	26	±2	4	1.39
150	285		20	225		32		8	2.58
200	340		20	280		34		8	3.84
250	405		20	335		38		12	5.69
300	460	±3	24	395		40		12	7.30
350	520		24	445		45		12	10.2 5
400	580		24	495		49		16	13.3 0
500	715		24	600		54		20	21.8 8
600	840	±5	28	705		60		20	32.5 5
700	910		28	810	±1,9 -0	70		24	42.4 9
800	1025		31	920		72		24	57.4 5

* Approx. Weights

Table 9.13 Blind Flanges PN 6

Pressure Class PN 10

DN	D [mm]		d_2[mm]	k [mm]		b_2[mm]		No. of bolts	Weight* [kg/pc]
100	220	±2	20	180	±1,6	26	±2	8	1.75
150	285		24	240		32		8	3.62
200	340		24	295		34		8	5.52
250	405		24	350		38		12	8.35
300	460	±3	24	400		40		12	11.47
350	520		24	460		45		16	15.55
400	580		28	515		49		16	20.46
500	715		28	620		54		20	36.30
600	840	±5	31	725		60		20	49.89
700	910		31	840	±1,9 -0	70		24	62.80
800	1025		34	950		72		24	84.99

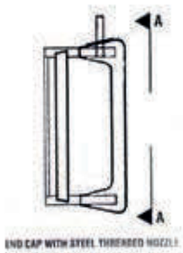
* Approx. Weights

Table 9.14 Blind Flanges PN 10

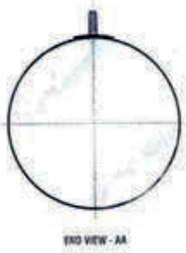
10. Special Fittings

End Cap

- End caps are used to close the end of the line for testing purposes.
- They are available in all AQAP Pipe sizes.
- End caps should be restrained to eliminate axial forces on pipes.

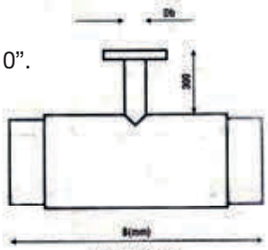


END CAP WITH STEEL THREADED NOZZLE


END VIEW - AA

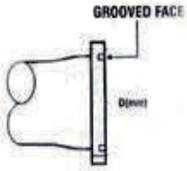
Flanged Nozzles

- Flanged nozzles are available in Diameters range 1", 2", 3", 4", 6", 8", & 10".
- Flanged nozzles are drilled to ANSI B 16.5.150lb. OR as required.
- Pipe Header diameter could vary from 300 mm. to 3000 mm.



(SPIGOT ENDS)

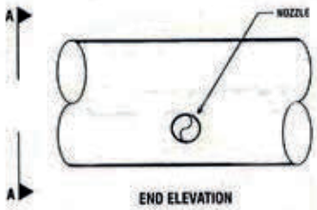
(PLAIN END)



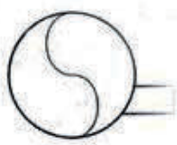
(FLANGE END)

Eccentric Tees

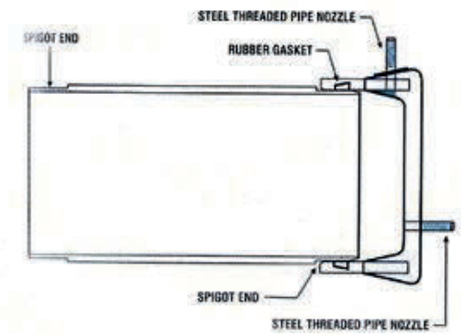
- Eccentric Tees can be manufactured upon request. The overall dimensions should be as per customer requirement but not less than of wyes dimensions table. It can be, PPlainnd, Spigot end, or Flanged end.
- Flanged Eccentric tees can be fabricated as per required drilling.

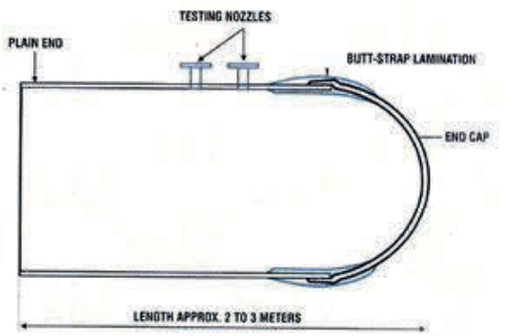


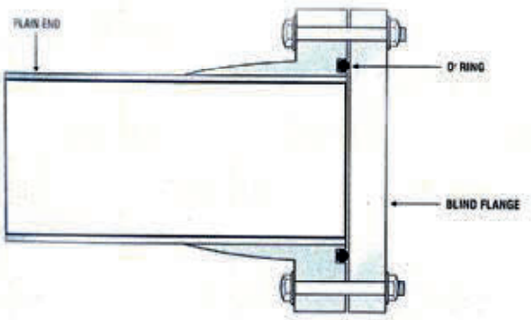
END ELEVATION

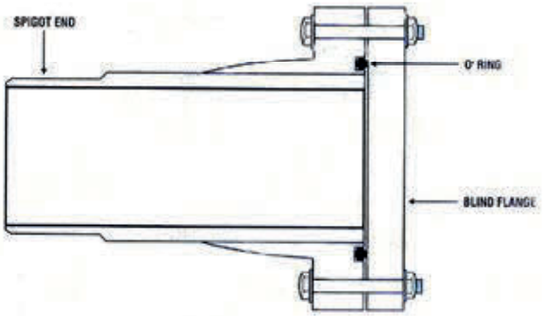

END VIEW-AA

11. Hydrotest Spool









12. Environmental Guide AQAP Pipe

All materials listed in “Black” can be used with our current standard pipe resin system as well as vinyl ester lined pipes. All trials listed in “blue” are in addition to the “Black” materials that can be used In pipes that use a vinyl ester resin liner. All trials listed in “red” are not recommended and may not work in any type of AQAP pipe system.

	Standard Pipe Resin Or Vinyl Ester	Vinyl Ester only	NR		Standard Pipe Resin Or Vinyl Ester	Vinyl Ester only	NR
Acetic Acid		X		Chlorine, Water		X	
Adipic Acid		X		Chlorine Wet Gas		X	
Alum (Aluminum Potassium Sulfate)	X			Chlorocetic Acid			X
Aluminum Chloride, Aqueous	X			Citric Acid, Aqueous(40jC)			X
Ammonia, Aqueous, 20%		X		Copper Acetate, Aqueous (40jC)	X		
Ammonium Chloride, Aquesous (40jC)	X			Copper Chloride, Aqueous	X		
Ammonium Fluoride			X	Copper Cyanide (30jC)	X		
Ammonium Nitrate, Aquesous (40jC)	X			Copper Nitrate, Aquesous (40jC)	X		
Ammonium Phosphate Monobasic, Aquesous	X			Copper Sulfate, Aqueous (40jC)	X		
Ammonim Sulfate, Aqueous	X			Crude Oil (Sour)		X	
Anilline Hydrochioride		X		Crude Oil (Sweet)	X		
Antimony Trichioride			X	Crude Oil, Salt Water (25jC)		X	
Barium Carbonate		X		Cyclohexane			X
Barium Chloride		X		Cyclohexanol			X
Barium Sulfate		X		Dibuty Sebacate	X		
Beet Sugar Liqour		X		Dibutyl phthalate	X		
Benzene Sulfonic Acid (100%)		X		Diesel Fuel	X		
Benzoic Acid		X		Dioctyl Phthalate	X		
Black Liquor (Paper)		X		Ethyience Glycol	X		
Bleach			X	Ferric Chloride, Aqueous	X		
Borax		X		Ferric Nitrate, Aqueous	X		
Boric Acid		X		Ferric Sulfate, Aqueous	X		
Bromine, Aqueous 5%		X		Ferrous Sulfate, Aqueous	X		
Butyric Acid, <25% (40jC)		X		Formaldehyde			X
Calcium Bisulfide	X			Fuel Oil	X		
Calcium Carbonate	X			Gas, Natural, Methane			X
Calcium Chloride (Saturated)	X			Gasoline, Ethyl		X	
Calcium Hydroxide, 100%	X			Glycerine		X	
Calcium Hypochlorite		X		Green Liquor, Pape		X	
Calcium Nitrate (40jC)		X		Hexane		X	
Calcium Sulfate NL AOC	X			Hydrobromic Acid			X
Cane Sugar Liquours	X			Hydrochloric Acid, up to 15%	X		
Carbon Dioxide, Aqueous	X			Hydroflouric Acid			X
Carbon Tetrachloride			X	Hydrogen Sulfide, Dry		X	
Casein	X			Kerosene		X	
Caustic Potash KOH)			X	Lactic Acid, 10%	X		
Chlorine, Dry Gas	X			Lactic Acid, 80% (25jC)	X		

Cont...

	Standard Pipe Resin Or Vinyl Ester	Vinyl Ester only	NR
Lauric Acid	X		
Lauryl Chloride		X	
Lauric Sulfate			
Lead Acetate, Aqueous	X		
Lead Nitrate	X		
Lead Sulfate	X		
Linseed Oil	X		
Lithium Bromide, Aqueous (40jC)	X		
Lithium Chloride, Aqueous (40jC)	X		
Magnesium Bicarbonate, Aqueous (40jC)	X		
Magnesium Carbonate (40jC)	X		
Magnesium Cloride, Aqueous (25jC)	X		
Magnesium Nitrate, Aqueous (40jC)	X		
Magnesium Sulfate	X		
Maganese Cloride, Aqueous (40jC)	X		
Maganese Sulfate, Aqueous (40jC)	X		
Mercuric Chloride, Aqueous	X		
Mercurous Chloride, Aqueous	X		
Mineral Oils	X		
n-Heptane		X	
Naphthalene		X	
Naptha		X	
Nickel Chloride, Aqueous (25jC)	X		
Nickel Nitrate, Aqueous (40jC)	X		
Nickel Sulfate, Aqueous (40jC)	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 (40jC)	X		
Phthalic Acid (25jC)		X	
Potassium Permanganate, 25%		X	
Potassium Bicarbonate	X		
Potassium Bromide, Aqueous (40jC)	X		
Potassium Chloride, Aqueous	X		
Potassium Dichromate, Aqueous	X		
Potassium Ferrocyanide (30jC)	X		
Potassium Ferrocyanide, Aqueous (30jC)	X		
Potassium Nitrate, Aqueous	X		
Potassium Sulfate (40jC)	X		

	Standard Pipe Resin Or Vinyl Ester	Vinyl Ester only	NR
Propylene Glycol (25%)	X		
Zinc Sulfite, Aqueous (40jC)	X		
Sea Water	X		
Sewage (50jC)	X		
Silicone Oil	X		
Silver Nitrate, Aqueous	X		
Sodium Bromoide, Aqueous	X		
Sodium Cloride, 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 Sulfhate, Aqueous	X		
Sodium Sulfide		X	
Sodium Tetraborate		X	
Stannic Cloride, Aqueous	X		
Stannous Cloride, Aqueous	X		
Stearic Acid	X		
Sulfur			X
Sulfuric Acid, 25% (40jC)		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 Cloride, Aqueous	X		
Zinc Nitrate, Aqueous	X		
Zinc Sulfate, Aqueous	X		

NOTE : This guide is intended to serve as a basic guide when considering AQAP 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 AQAP producers with their materials. Thus, this guide provides only general information and does not imply approval of any application as AQAP has no control of the conditions of usage nor any means of identifying environments to which the pipe may unintentionally have been exposed.

AQAP makes the difference

- We fulfil the customer needs
- We are experts in GRP
- We keep the environment

Utmost care has been taken to ensure that all contents of this brochure are accurate. However AQAP Co Ltd do not accept responsibilities for any problems, which may errors in this publication. Therefore, customers should make inquiries in to the potential product supplier and convince themselves of the suitability of any products supplied or manufactured by AQAP Co Ltd before using them.

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