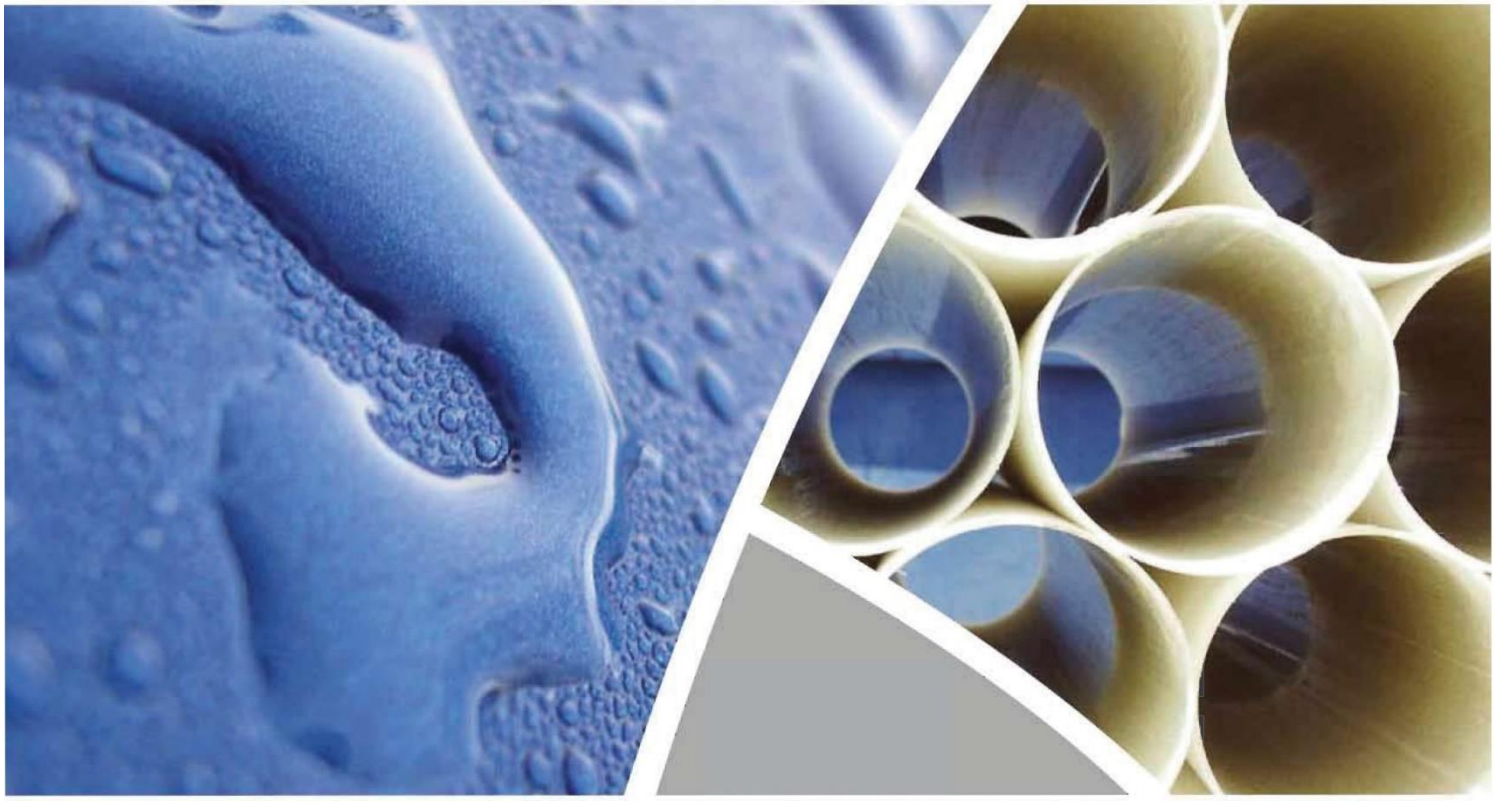
ADVANCED PIPING SOLUTIONS

حلـــول الأنابيب المتطـورة



GRP Product Guide

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1. INTRODUCTION

As a pioneer specializing in the manufacture and supply of water pipes, The Advanced Piping Solutions is focused on the future.

Employing advanced techniques coupled with the solutions. production lines and global standards, APS contributes to the development of pivotal infrastructure projects. we also offer water services to government water authorities and municipalities, in addition to reaching out to the world's industrial, agricultural and energy needs at local and international levels.

Catering to the needs of high-profile projects, APS supplies premium pipes (chiefly the main lines for transporting and distribution of drinking water of sewage and rainwater).

We also play a leading role in industrial and chemical residues projects and desalination plants, cooling systems, firefighting and irrigation systems. No matter how large or challenging a project is, we have the know-how and dedication to deliver viable Solutions.

Founded in 2007 as a limited liability company in the city of Riyadh, Kingdom of Saudi Arabia, Advanced Piping Solutions (APS) Previously Known as Arabian Company for Water Pipe Industry Ltd. (ACWAPIPE) is set to build a reputation for professionalism.

Taking a comprehensive approach, we manage a number of industrial complexes for pipe manufacturing in the Kingdom's Eastern and Western Provinces, and we produce Glass Reinforced Plastic Pipes (GRP), Glass Reinforced Epoxy (GRE) and Reinforced Concrete Pipes (RCP). And to provide our esteemed clientele with even more, we are set to expand our manufacturing capabilities to encompass other types of pipes.

2. APPLICATIONS

GRP products are designed for use in normal to aggressive environments with wide temperature range. The following are standard applications for GRP products:

- Raw and potable water
- Sea and brine water
- Sanitary and industrial sewerage
- Oily sewer
- Chemical transport
- Fire fighting
- Cooling water

3. BENEFITS

APS manufactures Glass-Reinforced Polyester (GRP) Pipes and fittings using the Continuous Filament Winding (CFW) process. GRP products are superior to conventional piping materials due to the following basic features and benefit:

3.1 Corrosion Resistant

GRP pipes are designed for long effective service life without any type of protection such as lining, coating, cathodic protection or any other form of corrosion protection which is required for traditional material. This enables the GRP pipe end users to achieve low maintenance costs.

3.2 Light weight and Long Pipe Sections

GRP pipe is one fourth of DI pipe and one tenth of Concrete pipe by weight, reducing transport and handling equipments costs. The standard pipe length is 12 meters and can be 18 meters reducing number of joints thereby reducing the installation time and cost.

3.3 Extremely Smooth Pipe Interior Surface

GRP pipe have very smooth bore which reduces fluid flow frictional losses thereby reducing pumping cost and this also helps in minimizing slime build up reducing total operational costs.

3.4 Flexible & Leak Tight Coupling Joint

GRP flexible joint with elastrometric rubber rings allows pipe line for small change in direction reducing fittings use.

The leak tight joint is designed to eliminate infiltration and exfiltration from the pipe line system. The joints can easily be assembled with pipes reducing the installation time.

3.5 Advanced Technology & Flexible Manufacturing

GRP pipes are manufactured using advance technology and CFW process which gives products of high quality. GRP pipes can be manufactured in custom diameters and in any required length.

This helps in easy installation especially in rehabilitation lining projects. GRP pipes produced with advance technology have lower wave celerity, which helps in reducing the surge and water hammer pressures.

4. MATERIALS

GRP composite products derive strength and other properties from the raw materials used. The mechanical strength of pipe and fittings depend upon the type, amount and positioning of glass fibers, while the desired chemical, thermal and mechanical properties of the product is based upon the resin matrix used.

GRP products use the best types and suitable size Tex of glass available in the market. For resins, we use polyester, epoxy and vinyl ester resins. Silica sand of the best quality is also used to provide stiffness to the mechanical pipe wall.

5. PRODUCTION PROCESS

APS, produces pipe and fittings using the continuous advancing mandrel method where glass filament reinforcements are wound continuously around a spiral steel band and aluminum beams called a mandrel. As the cylindrical mandrel rotates at designed speed, raw materials (resin, glass, silica sand) are machine-fed on it to form the structural wall of the product. The pipe then proceeds into the oven zone for curing and is cut to proper size by automatic saw units. All settings and feeds are automatically executed and monitored by an advanced PLC program.

6. QUALITY ASSURANCE

Each individual pipe and sleeve undergo rigorous series of tests which include visual, hydraulic, stiffness, hoop tensile, axial tensile and other tests in accordance with ASTM, AWWA, ISO and other international material testing standards. The APS quality control department implements a strict screening process to ensure that only products passing the highest quality standards reach our clients.

7. PIPE PRODUCT & DIMENSIONS

GRP pipe products are manufactured in different nominal diameters, across a variety of stiffness and pressure classes. The product range is shown below:

Pipe Size, Stiffness and Pressure Ratings

Characteristics	Range of GRP Pipe
Diameter, mm.	300 to 4000
Stiffness Class, Pascal	2,500 to 10,000
Nominal Pressure	Gravity to 32 bars

GRP pipes are sized in accordance with international standards. The metric nominal sizes (DN) and thickness for different pressure and stiffness classes are tabulated in **Appendix A.**

8. JOINTS

Coupling/Bell-and-Spigot

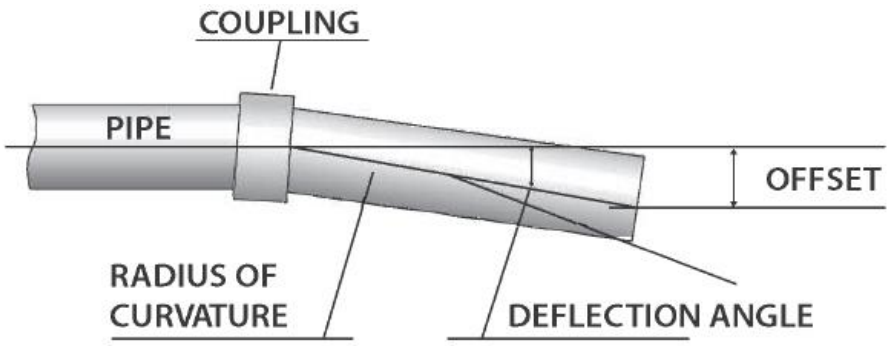
Couplings are unrestrained joints capable of withstanding internal pressure but not longitudinal tensile loads. Joints with two grooves in the bell to retain elastomeric gaskets that will be the sole element to provide watethighness.

To accomplish jointing requirements, GRP coupling are manufactured using the same GRP process. These couplings undergo same quality control test as that of pipes. Elastomeric rubber seals are employed to ensure water-tight joints

even at near-transient pressures. Couplings allow certain angular deflection for pipe flexibility as shown below:

Allowable Angular Deflection per GRP Joint

Nominal Pipe Diameter, mm.	Nominal Angular Deflection, degrees
< 500	3
>500 to < 900	2
> 900 to < 1800	1
> 1800	0.5



9. FITTINGS

To match the pipe specifications shown above, GRP fittings are also available in numerous types, and deflection angles and combinations to suit different field requirements. For detail dimension of standard fitting please refer to **Appendix B.**

Advanced Piping Solutions can produce fittings in all the sizes and different combinations based on the customer requirements. Some of the standard fittings are:

- Elbows- Different diameters and angles
- Tees- Equal or Unequal Tees of different diameters
- Reducers- Eccentric or Concentric of various diameters
- Flanges- Flanges of various diameters drilled to International Standard as per requirements
- Other Fittings- End Caps, Puddle Flanges, Dummy Supports or combination of any of the above.

10. APPLICABLE STANDARDS

To ensure that GRP pipes and fittings conform to universal specifications, exhibit the highest quality, performance, they are manufactured in accordance with the following international Standards and others:

- AWWA C950- AWWA Standard for Fiberglass Pressure Pipe
- AWWAM45- Fiberglass Pipe Design
- ASTM D 3262- Standard specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Sewer pipe
- ASTM D 3517- Standard Specification for “Fiberglass” (Glass-Fiber Reinforced Thermosetting Resin) pressure Pipe"
- ASTM D 3754- Standard Specification for "Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) sewer and industrial pressure pipe"
- BS 5480- Specification for "Glass Reinforced Plastics (GRP) pipes joints and fittings for use for water supply or sewerage"

11. QUALIFICATION TESTS

11.1 Hydrostatic Design Basis HDB

One of the important qualification tests is the establishment of the Hydrostatic Design Basis HDB. This test is carried out in accordance with ASTM02992 procedure B and requires hydrostatic testing to failure (leakage of several pipe samples at a variety of very high constant pressure (strain) levels.

These must result in failures varying from within minutes to at least 10,000 hours The resulting data is evaluated on a log-log bass for pressure (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 pressure (strain) caused by the rated pressure class.

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 This qualification test helps assure the long term performance of the pipe in pressure service.

11.2 Strain Corrosion Test

Pipe samples are deflected to different deflection levels in a standardized apparatus. These strained rings are then exposed at the invert of the interior surface to 1 ON (5% by weight) sulphuric acid.

This is intended to simulate a buried septic sewer condition This has to be shown to be representative of the worst sewer conditions including those found under the working conditions. The data acquired are used in calculating the predicted service life of the pipe product. The test is in accordance with ASTM D 3681.

11.3 Joint Testing

The third important qualification test is conducted on joint prototypes for elastomeric gasket sealed couplings.

This test is carried out in accordance with ASTM 04161. It incorporates some of the most stringent joint performance requirements.

This test requires flexible joints to withstand hydrostatic testing in configurations that simulate very severe in use conditions. Pressures used are twice those rated flow pressure. Joint configurations include straight alignment, maximum angular rotation and differential shear loading.

12. Quality Control Tests

Quality is of prime importance in the manufacture of GRP pipes. As soon as a single pipe comes out of the mandrel, it undergoes the following tests, among others, to determine the level of quality for each pipe product:

12.1 Hydrostatic Pressure Test

Each individual pipe is mounted on a hydraulic testing machine, filled with water and pressurized for 1.5 to 2.0 times the rated pressure based on standards requirement.

The pressure gages are monitored for at least 30 seconds to 3 minutes as required by specification without pressure drop.

Corresponding couplers are tested similarly in a specially-designed jig with elastomeric rubber rings in place.

12.2 Stiffness Test

In this test following BS 5480 and ASTM D 2412, a pipe sample from each production batch is tested for stiffness. The specimen is deflected to a strain level and the crushing force is noted. The results determine the representative stiffness class of the specimen. Below is a table for minimum required pipe stiffness as prescribed by ASTM and AWWA Standards:

Stiffness Class, STIS & Min. Required Pipe Stiffness

Stiffness Class		Specific Tangential Initial Stiffness STIS, ASTM D 2412	Minimum Required Pipe Stiffness (kPa),		
kPa	psi	Nominal Stiffness (SN), pascals	DN25 - 200	DN250	DN300 - 3600
124	18	2500	N.R.	124	124
248	36	5000	248	248	248
496	72	10000	496	496	496

12.3 Tensile Tests

Samples from each batch is taken to be tested for both axial and circumferential (hoop) tensile strengths. The specimens are loaded-to-break point using UTM and split disk respectively for axial and hoop tensile strength. These data are used to determine that axial and hoop tensile strengths of the batch have passed and exceeded the mandatory international standards requirements. The tables below show the minimum required values for each indicated pipe nominal sizes:

Axial Tensile Strength, (KN/m, circumference)

Size, mm	PN 6	PN 10	PN 16
300	102	113	142
400	102	150	189
500	114	177	219
600	132	213	264
700	142	239	296
800	150	250	305
1000	196	325	395
1200	223	366	460
1400	250	412	518
1600	292	480	605
1800	329	549	692
2000	341	553	706
2600	445	723	924

Source: AWWA C950, Standard for Fibe1glass Pressure Pipe.

Hoop Tensile Strength, SH (KN/m of width)

Size, mm	PN 6	PN 10	PN16
300	366	60	975
400	488	81	1299
500	609	1016	1624
600	731	121'9	1949
800	914	1523	2436
1000	1189	1981	3168
1200	1463	2437	3898
1400	1646	2742	4385
1600	1920	3199	5117
1800	2193	3656	5874
2000	2376	3961	6334
2600	3108	5179	8283
-	-	-	-

12.4 Other Tests

GRP pipes are also tested in terms of: loss on ignition, flexural strength, material hardness, short and long term ring bending, beam loading, and other tests in accordance with pertinent Material Testing Standards. The table below summarizes the basic tests for GRP pipes.

Type of Test	Testing Frequency	Standard Reference
Wall thickness	Each pipe	ASTM D3567
Outside diameter, spigot end	Each pipe	AWWA C950
Length	Each pipe	ASTM D3567
Visual inspection	Each pipe	ASTM D 2563
Hydrostatic pressure	Each pipe	ASTM D1599
Indentation hardness	Each pipe	ASTM D 2583
Pipe stiffness	Per batch	ASTM D2412
Axial tensile strength	Per batch	ASTM D 638
Hoop tensile strength	Per batch	ASTM D 2290
Loss on Ignition (LOI)	Per batch	ASTM D 2584

Raw materials are likewise tested before being used in the manufacturing of GRP products. These tests include viscosity, gel-time, styrene content, etc. for resin. Glass reinforcing fibers also undergo several tests. These tests ensure that the pipe materials comply with the specifications as stated.

13. ABOVE GROUND APPLICATION

GRP pipe products can also be designed specifically for above ground installation. For aboveground application of GRP pipes proper planning, care and detailed designing is required at the early stage of the project than the standard underground application.

Aboveground installation requires proper guides, anchors, cradles, expansion joints and expansion loops. Consult APS for aboveground or for application of GRP piping in any other situation. APS will provide project specific installation instruction.

14. INSTALLATION

Good performance and long life of GRP pipe can only be achieved by proper handling and installation of the pipe. It is important for the installation contractor, owner's engineer and consultants to understand that GRP pipe is designed to utilize the bedding and pipe zone backfill support.

The Contractor needs to understand that buried GRP pipes constitute a high-performance pipe-soil

system which requires proper installation. When the properly compacted backfill provides the necessary structural support, the pipe's unique properties can be harnessed to its full. For more details, refer to the Pipe Installation Manual.

For GRP pipes installed either in very shallow trenches or in road sections with excessive traffic loads or both, specially designed concrete slabs maybe required over the pipe at road level to dissipate loads and avoid over-deflection.

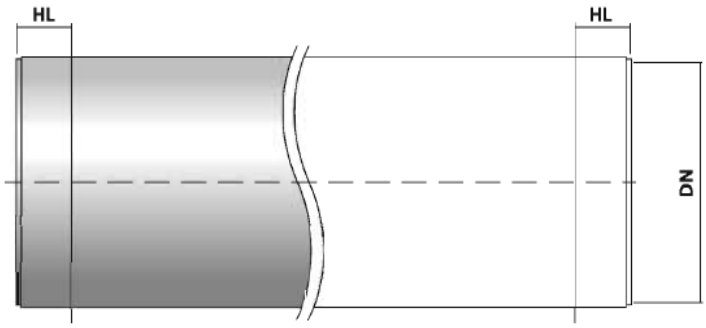
Consult the APS for specific installation instructions.

In underground micro tunnel installations, the pipe sections to be inserted may require special accessories such as wooden or plastic sleds to protect the pipes and couplers from excessive sliding damage.

Stoppers may also be needed to prevent pipes from over or under insertion into the sleeves. In Some instances, grouting may be required before the section is hydro tested. Refer to the Installation Manual for details.

Buried GRP pipes may indeed require some deliberate and careful attention to installation procedures. However, after proper installation is thoroughly done, the resulting pipeline is at once a flexible and a resilient fluid conveyor to last several years long continuous, maintenance-free operations and reliable performance.

APPENDIX A: GRP PIPE DIMENSIONS

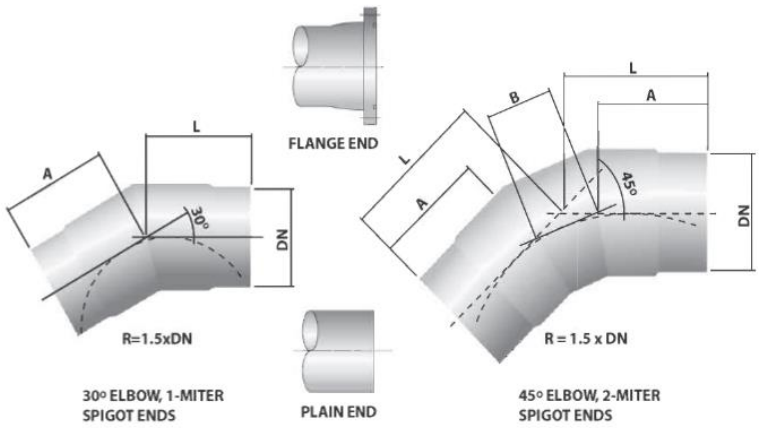


NOMINAL DIAMETER (DN) & THICKNESS FOR 10,000 / 5,000 /2,500 STIFFNESS

		10,000 STIFFNESS			5,000 STIFFNESS			2,500 STIFFNESS		
DN (mm)	HL (mm)	6 Bar (mm)	12 Bar (mm)	16 Bar (mm)	6 Bar (mm)	12 Bar (mm)	16 Bar (mm)	6 Bar (mm)	12 Bar (mm)	16 Bar (mm)
300	130	6.7	6.1	6.0	5.4	5.0	5.0	4.4	4.2	4.5
350	130	7.7	7.0	6.8	6.1	5.7	5.6	4.9	4.7	5.0
400	130	9.6	8.6	8.4	7.5	7.0	6.9	6.0	5.7	6.1
500	130	10.5	9.5	9.1	8.2	7.6	7.5	6.5	6.2	6.6
600	160	12.5	11.1	10.8	9.7	8.9	8.8	7.6	7.3	7.6
700	160	14.3	12.8	12.3	11.1	10.2	10.1	8.8	8.3	8.7
800	160	16.2	14.3	14.0	12.5	11.5	11.3	9.8	9.2	9.8
900	160	18.0	16.1	15.6	13.9	12.8	12.6	10.9	10.3	10.8
1000	160	19.9	17.7	17.2	15.3	14.1	13.8	12.0	11.3	11.9
1100	160	21.8	19.3	18.7	16.7	15.3	15.1	13.0	12.3	12.9
1200	160	23.7	21.0	20.3	18.1	16.6	16.3	14.1	13.4	14.0
1300	160	25.6	22.7	22.0	19.6	17.9	17.7	15.2	14.4	15.0
1400	160	27.4	24.3	23.6	20.9	19.3	18.9	16.3	15.4	16.1
1500	160	29.3	25.9	24.8	22.4	19.3	19.8	17.3	16.4	15.9
1600	160	31.1	27.5	26.4	23.9	20.6	21.0	18.4	17.5	16.8
1700	160	34.9	28.9	28.0	25.2	21.9	22.3	19.6	17.9	17.8
1800	160	36.7	30.5	29.6	26.7	22.6	23.5	20.5	19.0	18.8
1900	160	38.6	32.1	31.2	28.0	23.9	24.8	21.7	20.0	19.8
2000	160	40.4	33.6	32.8	29.5	25.2	26.0	22.7	21.0	20.8
2100	160	42.4	35.2	34.3	30.8	26.5	27.3	23.8	21.9	21.8
2200	160	44.2	37.0	35.9	32.2	27.8	28.4	24.9	22.8	22.8
2300	160	46.0	38.7	37.5	33.7	29.1	29.7	25.9	24.0	23.6
2400	160	48.1	40.3	39.1	35.1	30.2	30.9	27.1	24.9	24.7
2500	175	49.9	41.8	40.7	36.5	31.5	32.2	28.1	25.9	25.6
2600	175	52.0	43.4	42.2	37.9	32.7	33.4	29.2	26.9	26.7
2700	175	53.9	45.1	43.7	39.2	34.0	34.6	30.0	27.8	27.6
2800	175	-	46.6	45.3	40.7	35.2	35.8	31.1	28.9	28.6
3000	175	-	-	-	-	36.5	-	33.2	30.8	30.5
3200	175	-	-	-	-	-	-	35.3	32.8	32.4
3400	175	-	-	-	-	-	-	37.5	34.6	34.4
3500	175	-	-	-	-	-	-	38.5	35.7	35.4
3600	175	-	-	-	-	-	-	39.5	36.7	36.3
3700	175	-	-	-	-	-	-	40.6	37.7	37.3
3800	175	-	-	-	-	-	-	41.7	38.7	38.3
4000	175	-	-	-	-	-	-	43.9	40.7	40.3

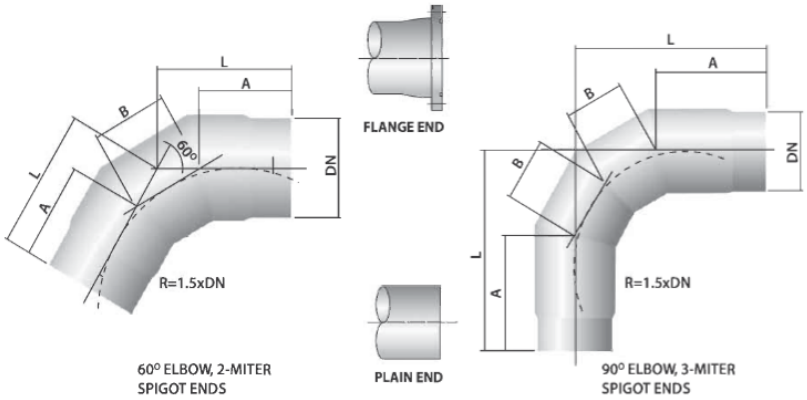
Note: The above is for coupling joint system, for restrain system (Lamination Joints) And aboveground application please consults APS for pipe thickness.

APPENDIX B: GRP FITTING DIMENSIONS



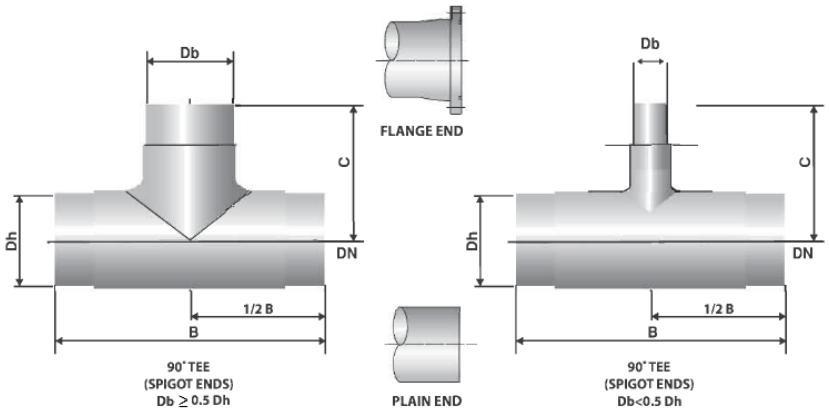
DN (mm)	A (mm)	L (mm)
25	350	350
40	350	350
50	350	350
65	350	350
80	350	350
100	350	350
150	350	350
200	350	350
250	350	350
300	350	350
350	350	350
400	400	400
450	400	400
500	450	450
600	500	500
700	550	550
800	600	600
900	650	650
1000	650	650
1100	650	650
1200	700	700
1300	750	750
1400	800	800
1500	900	900
1600	950	950
1700	1000	1000
1800	1050	1050
1900	1150	1150
2000	1200	1200
2100	1250	1250
2200	1300	1300
2300	1350	1350
2400	1450	1450
2500	1500	1500
2600	1700	1700
2700	1700	1700
2800	1700	1700
2900	1700	1700
3000	1700	1700
3100	1800	1800
3200	1800	1800
3300	1800	1800
3400	1800	1800
3500	1800	1800
3600	1900	1900
3700	1900	1900
3800	1900	1900
3900	1900	1900
4000	1900	1900

DN (mm))	A (mm)	B (mm)	L (mm)
25	350	15	358
40	350	24	363
50	350	30	366
65	400	39	421
80	400	48	426
100	400	60	432
150	400	90	448
200	400	119	465
250	400	149	481
300	400	179	497
350	400	209	513
400	400	239	529
450	400	269	545
500	450	298	611
600	500	358	694
700	550	418	776
800	600	477	858
900	650	537	941
1000	700	597	1023
1100	750	656	1105
1200	800	716	1188
1300	850	776	1270
1400	900	835	1352
1500	950	895	1434
1600	1000	955	1517
1700	1050	1014	1599
1800	1100	1074	1681
1900	1200	1134	1814
2000	1250	1193	1896
2100	1300	1253	1978
2200	1350	1313	2060
2300	1400	1372	2143
2400	1450	1432	2225
2500	1500	1492	2307
2600	1500	1552	2340
2700	1500	1611	2372
2800	1500	1671	2404
2900	1500	1731	2437
3000	1500	1790	2469
3100	1500	1850	2501
3200	1500	1910	2533
3300	1500	1969	2566
3400	1500	2029	2598
3500	1500	2089	2630
3600	1500	2148	2663
3700	1500	2208	2695
3800	1500	2268	2727
3900	1500	2327	2760
4000	1500	2387	2792



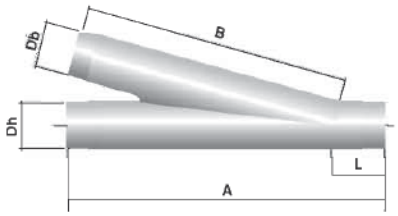
DN (mm)	A (mm)	B (mm)	L (mm)
25	350	20	362
40	350	32	369
50	350	40	373
65	350	52	430
80	400	64	437
100	400	81	446
150	400	121	470
200	400	161	493
250	400	201	516
300	400	241	539
350	400	281	562
400	400	322	586
450	400	362	609
500	450	402	682
600	500	482	778
700	550	563	875
800	600	643	971
900	650	723	1068
1000	700	804	1164
1100	750	884	1261
1200	800	965	1357
1300	900	1045	1503
1400	1000	1125	1650
1500	1100	1206	1796
1600	1200	1286	1943
1700	1300	1367	2089
1800	1400	1447	2235
1900	1500	1527	2382
2000	1600	1608	2528
2100	1650	1688	2625
2200	1750	1768	2771
2300	1850	1849	2917
2400	1900	1929	3014
2500	2000	2010	3160
2600	2000	2090	3207
2700	2000	2170	3253
2800	2000	2251	3299
2900	2000	2331	3346
3000	2000	2412	3392
3100	2000	2492	3439
3200	2000	2572	3485
3300	2000	2653	3532
3400	2000	2733	3578
3500	2000	2813	3624
3600	2000	2894	3671
3700	2000	2974	3717
3800	2000	3055	3764
3900	2000	3135	3810
4000	2000	3215	3856

DN (mm))	A (mm)	B (mm)	L (mm)
25	350	20	377
40	350	32	394
50	350	40	405
65	400	54	471
80	400	64	488
100	400	81	510
150	400	121	565
200	400	161	620
250	400	201	675
300	400	241	729
350	400	281	784
400	400	322	839
450	400	362	894
500	450	402	999
600	500	482	1159
700	550	563	1319
800	600	643	1478
900	650	723	1638
1000	700	804	1798
1100	750	884	1958
1200	800	965	2118
1300	900	1045	2327
1400	1000	1125	2537
1500	1100	1206	2747
1600	1200	1286	2957
1700	1300	1367	3167
1800	1400	1447	3377
1900	1500	1527	3586
2000	1600	1608	3796
2100	1650	1688	3956
2200	1750	1768	4166
2300	1850	1849	4376
2400	1900	1929	4535
2500	2000	2010	4745
2600	2000	2090	4855
2700	2000	2170	4965
2800	2000	2251	5075
2900	2000	2331	5184
3000	2000	2412	5294
3100	2000	2492	5404
3200	2000	2572	5514
3300	2000	2653	5624
3400	2000	2733	5733
3500	2000	2813	5843
3600	2000	2894	5953
3700	2000	2974	6063
3800	2000	3055	6173
3900	2000	3135	6282
4000	2000	3215	6392

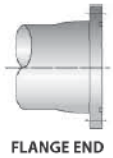


DN (mm)	B (mm)	C (mm)
25	500	300
40	500	300
50	600	300
65	700	500
80	800	500
100	900	500
150	1100	500
200	1200	600
250	1250	625
300	1300	650
350	1300	650
400	1400	700
450	1500	750
500	1600	800
600	1800	900
700	2050	1025
800	2300	1150
900	2550	1275
1000	2800	1400
1100	3050	1525
1200	3300	1650
1300	3550	1775
1400	3800	1900
1500	4050	2025
1600	4300	2150
1700	4550	2275
1800	4800	2400
1900	5050	2525
2000	5300	2650
2100	5550	2775
2200	5800	2900
2300	6050	3025
2400	6300	3150
2500	6550	3275
2600	6650	3325
2700	6750	3375
2800	6850	3425
2900	6950	3475
3000	7050	3525
3100	7150	3575
3200	7250	3625
3300	7350	3675
3400	7450	3725
3500	7550	3775
3600	7650	3825
3700	7750	3875
3800	7850	3925
3900	7950	3975
4000	8050	4025

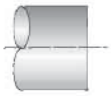
DN (mm)	B (mm)	C (mm)
25	500	300
40	500	300
50	600	300
65	700	500
80	800	500
100	900	500
150	1000	500
200	1000	500
250	1000	500
300	1000	550
350	1000	560
400	1000	570
450	1050	650
500	1080	670
600	1220	760
700	1350	850
800	1480	940
900	1650	1030
1000	1750	1130
1100	1880	1220
1200	2020	1310
1300	2150	1420
1400	2300	1490
1500	2420	1590
1600	2550	1680
1700	2700	1770
1800	2850	1860
1900	3000	1950
2000	3100	2050
2100	3210	2140
2200	3400	2230
2300	3500	2320
2400	3750	2420
2500	3800	2510
2600	3850	2575
2700	3900	2625
2800	3950	2675
2900	4000	2725
3000	4050	2775
3100	4100	2825
3200	4150	2875
3300	4200	2925
3400	4250	2975
3500	4300	3025
3600	4350	3075
3700	4400	3125
3800	4450	3175
3900	4500	3225
4000	4550	3275



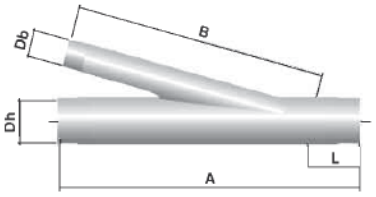
15° WYE, Db > 0.5Dh
SPIGOT ENDS



FLANGE END



PLAIN END

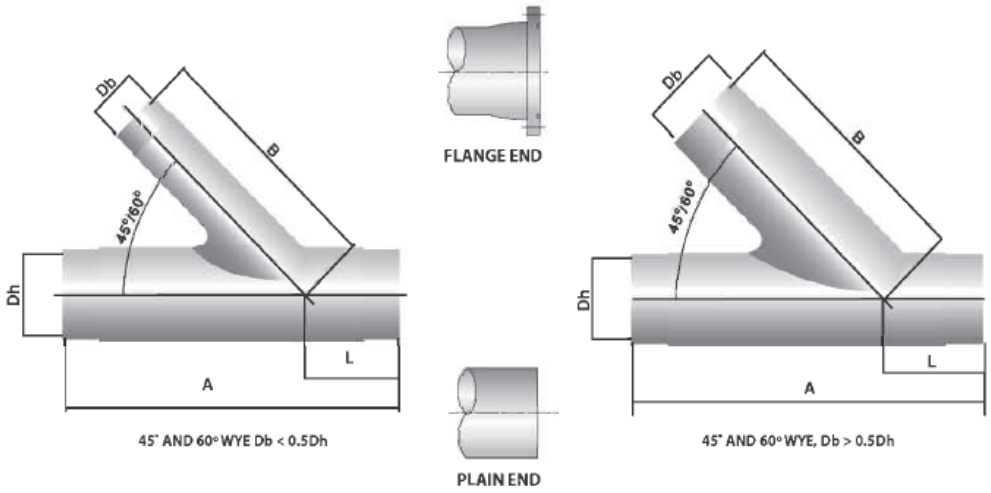


15° WYE, Db< 0.5 Dh
SPIGOT ENDS

DN (mm)	A (mm)	B (mm)	L (mm)
300	2900	1700	400
350	3200	2700	500
400	3500	2900	600
450	3800	3100	700
500	4100	3300	800
600	4550	3650	900
700	5000	4000	1000
800	5500	4400	1100
900	6000	4800	1200
1000	6500	5200	1300
1100	6950	5550	1400
1200	7450	5950	1500
1300	7900	6300	1600
1400	8400	6700	1700
1500	8900	7100	1800
1600	9350	7450	1900
1700	9850	8580	2000
1800	10300	9200	2100
1900	10800	9600	2200
2000	11300	10000	2300
2100	11750	10350	2400
2200	12250	10750	2500
2300	12700	11100	2600
2400	13200	11500	2700
2500	13650	11850	2800

DN (mm))	A (mm)	B (mm)	L (mm)
300	1900	1500	400
350	2200	1700	500
400	2500	1900	600
450	2800	2100	700
500	3100	2300	800
600	3550	2650	900
700	4000	3000	1000
800	4500	3400	1100
900	4900	3800	1200
1000	5100	4200	1300
1100	5700	4550	1400
1200	6200	4950	1500
1300	6700	5300	1600
1400	7200	5500	1700
1500	7700	5800	1800
1600	8350	6000	1900
1700	8550	6300	2000
1800	9300	6700	2100
1900	9800	7100	2200
2000	10300	7300	2300
2100	10750	8000	2400
2200	11250	8300	2500
2300	11700	8500	2600
2400	12200	8700	2700
2500	12650	8900	2800

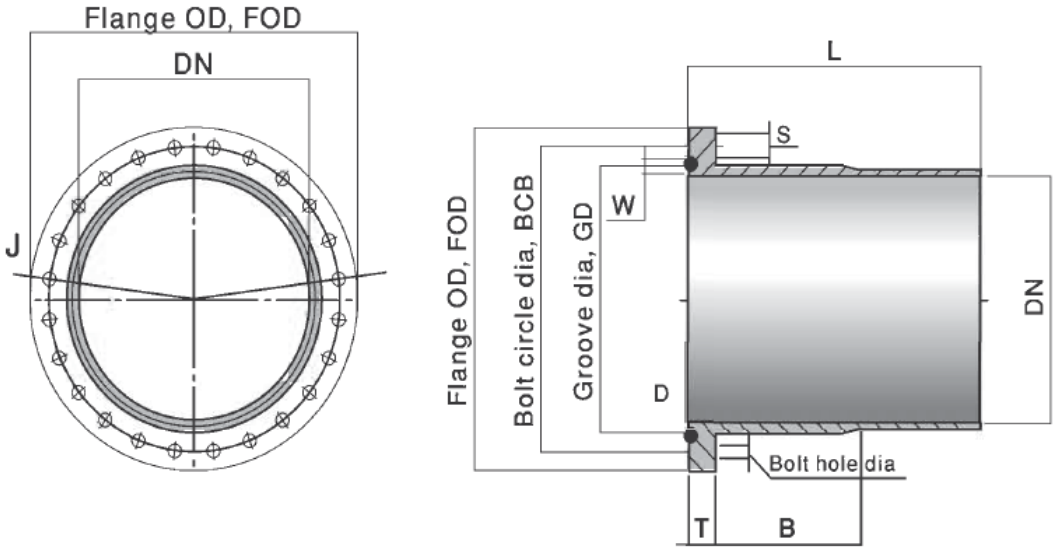
* Other end types like flange end also available as shown above.



DN (mm)	A (mm)	B (mm)	L (mm)
350	1000	800	300
400	1250	850	400
450	1500	900	500
500	1600	950	550
600	1750	1100	600
700	2050	1300	700
800	2350	1400	800
900	2550	1600	850
1000	2660	1700	900
1100	2950	1800	950
1200	3250	2000	1050
1300	3550	2200	1150
1400	3760	2400	1200
1500	3950	2600	1250
1600	4100	2700	1300
1700	4300	2800	1350
1800	4600	2900	1450
1900	4800	3000	1500
2000	5000	3100	1550
2100	5300	3200	1650
2200	5500	3300	1700
2300	5700	3400	1750
2400	5850	3600	1800
2500	6100	3700	1850

DN (mm))	A (mm)	B (mm)	L (mm)
350	1300	850	450
400	1550	1000	550
450	1700	1100	600
500	1800	1150	650
600	2050	1300	750
700	2350	1500	850
800	3650	1700	950
900	3950	1900	1050
1000	3250	2100	1150
1100	3550	2300	1250
1200	3850	2500	1350
1300	4150	2700	1450
1400	4450	2900	1550
1500	4750	3100	1650
1600	5050	3300	1750
1700	5350	3500	1850
1800	5650	3700	1950
1900	5950	3900	2050
2000	6250	4100	2150
2100	6550	4300	2250
2200	6850	4500	2350
2300	7150	4700	2450
2400	7450	4900	2350
2500	7750	5100	2650

* Other end types like flange end also available as shown above.



DN (mm)	Flange Thickness T (mm)	Flange OD (mm)	Groove Diameter (mm)	Drilling Standard *AWWA Class D		
				No. of Bolts	Bolt Hole Dia. (mm)	BCD (mm)
350	55	547	399.3	12	33.1	476.3
400	57	611	434.3	16	36.3	539.8
450	62	655	485.3	16	36.3	577.9
500	63	713	536.3	20	36.3	635.0
600	67	833	638.3	20	39.3	749.3
700	76	947	743.9	28	39.3	863.6
800	82	1074	845.9	28	45.6	977.9
900	88	1182	947.9	32	45.6	1085.9
1000	93	1297	1049.9	36	45.6	1200.2
1100	103	1411	1155.8	40	45.6	1314.5
1200	108	1519	1257.8	44	45.6	1422.4
1300	114	1646	1359.8	44	52.0	1536.7
1500	125	1868	1563.8	52	52.0	1579.0
1700	140	2040	1771.7	52	52.0	1930.4
1800	146	2204	1873.7	60	52.0	2095.5
2000	157	2383	2077.7	64	58.3	2260.6
2100	165	2547	2182.3	64	58.3	2425.7
2300	177	2725	2386.3	68	64.8	2590.8
2400	184	2890	2488.3	68	64.8	2755.9

*Other drilling standards available on request.

Auxiliary Products

1. GRP Structural Manholes.

Structural manholes are load-bearing manholes supplied with complete accessories made of fiber-glass to be installed in the foundation. The man-holes are supplied with the conical man way and FRP ladder, all laminated to the wall of the man-hole by glass and resin.

Structural Manholes are supplied in Two standard diameters, which are 1000 and 1200mm with standard 600 mm man-way. Other diameter can be manufactured based upon requirements.

2. Liners & Cover Slabs

Advanced Piping Solutions also manufacture/fabricate GRP Liners for concrete manholes with flat cover slab having opening of 600 mm. The standards Liners sizes are DN 1200 & DN 1600, however any size & thickness Liner up to 4m is possible.

GRP Tanks

Advanced Piping Solutions manufacture, GRP aboveground horizontal & vertical tanks up to 4 meter diameters for water and chemical applications.

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