



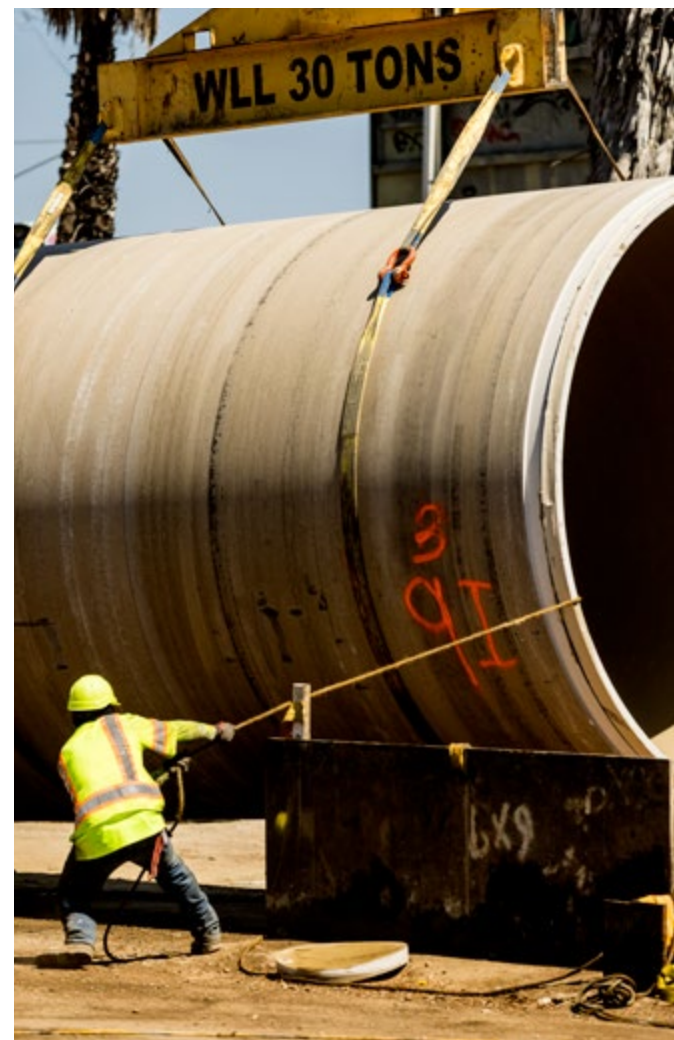
Hobas Pipe Product Guide

Manufacturers of Fiberglass Reinforced Polymer Mortar Pipe



Engineered to Endure™

V3



Hobas Pipe Product Guide

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Hobas 150-year Design Life Pipe

The Greenest Pipe is the Pipe
You Don't Have to Replace

Hobas Pipe— We Lay It Out for You

RELIABILITY

Hobas Pipe USA is the leading corrosion-resistant fiberglass reinforced polymer mortar (FRPM) pipe solution specified by municipalities throughout the U.S. and Canada. Hobas Pipe ensures that today's infrastructure solutions do not become tomorrow's problems.

EFFICIENCY

To serve the needs of future generations, Hobas Pipe solutions are innovatively designed for fast installation and efficient operation.

QUALITY

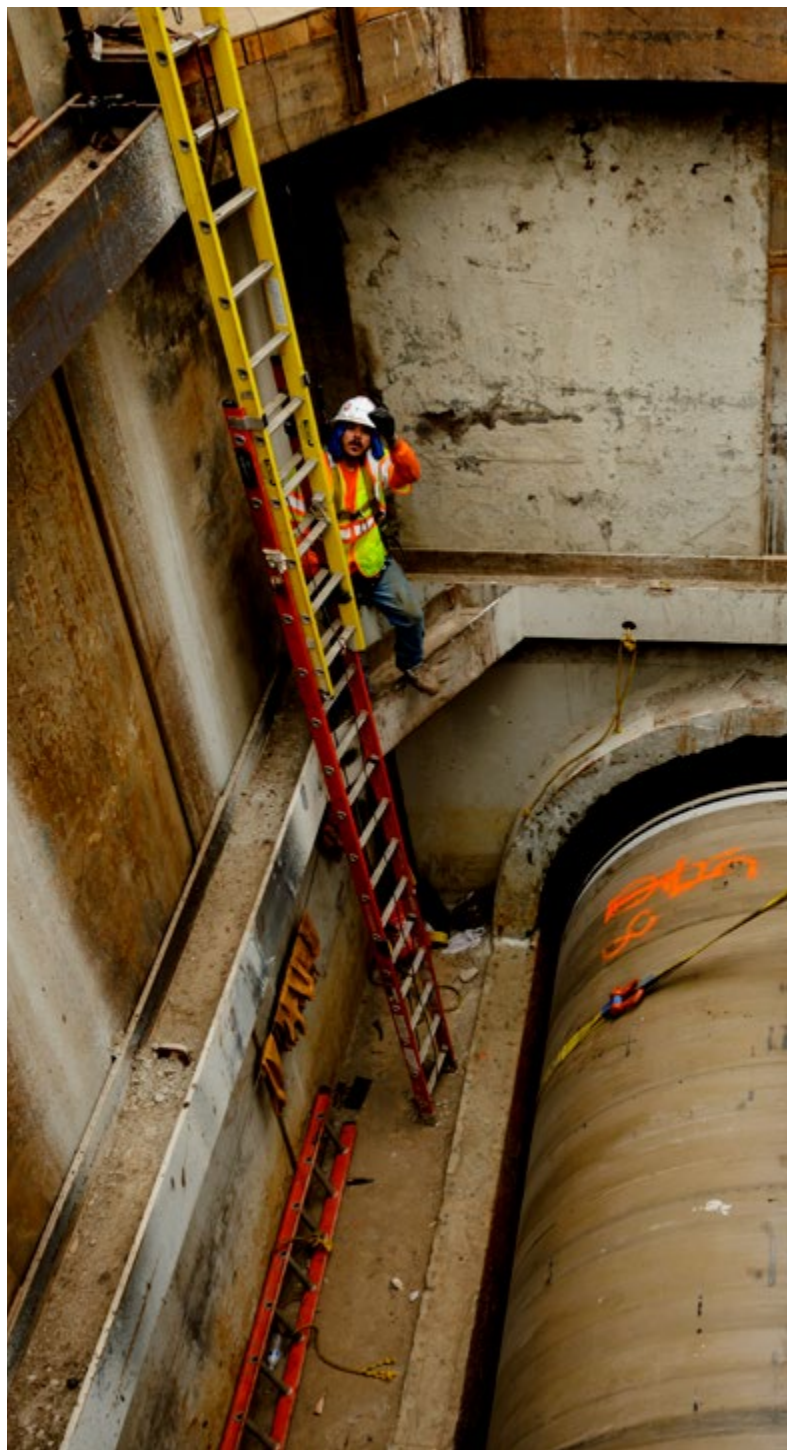
Hobas Pipes are manufactured with a precise, computer-controlled production process, ensuring consistent, high-density, resilient, abrasion-resistant, and high-flow capacity pipe.

PERFORMANCE

Hobas Pipe solutions are designed to outlast and outperform traditional materials like concrete, iron, and steel, meeting or exceeding AWWA and ASTM standards proven in sewer accelerated aging tests.

SUSTAINABILITY

Our manufacturing, transportation, and installation practices offer a trouble-free, long-term investment and cost-effective solution for all shareholders involved in a project. Our 150-year design life products ensure that our pipe solutions meet the demands and abilities of present and future generations.



Long-lasting Pipe You Can Count On

We Offer the Best Pipe, Engineering Support
and Experience for Your Job



Our Promise

Hobas Pipe produces world-class pipes and fittings to solve our customer's most challenging infrastructure problems with creative ideas, decades of experience, and modern materials that outperform existing solutions.

Since 1987, Hobas Pipe, a world-class leading producer of corrosion-resistant, fiberglass-reinforced polymer mortar pipe and fittings, has been supplying North America with reliable pipe solutions from its facility in Houston, Texas.

Our experience draws from over half a century of production and research. The process, patented in 1960, was first used to replace wood cylinders in the textile industry to manufacture dyed fabrics. Swiss engineers devised the centrifugally cast fiberglass reinforced polymer (FRP) cylinder that not only improved the textile process but was used to replace a deteriorated steel pipe in the Swiss mountainside in 1961, where it currently remains.

We believe in creating a foundation for a better tomorrow with environmentally sound, energy-efficient, innovative products that last a lifetime. We are experts in FRPM solutions for wastewater, stormwater, drinking water, irrigation, hydropower, and industrial applications.

OUR MISSION, VISION AND VALUES

Mission As the leader in fiberglass pipe systems that defy corrosion, Hobas strives to ensure today's solutions do not become tomorrow's problems.

Vision To provide peace of mind for future generations through safe and reliable infrastructure.

Better By Design

Hobas fiberglass-reinforced polymer mortar pipe is designed to last, matching traditional materials for strength, and beating them on corrosion resistance, weight, ease of handling, and longevity, all to ensure our water's secure transport and availability.

Hobas FRPM Pipe Features and Benefits

FEATURES	BENEFITS
Inherent Corrosion Resistance	<ul style="list-style-type: none">• Long maintenance-free service life• No costly add-on linings or coatings to damage, repair, inspect or maintain• No need for expensive cathode protection or polybags to install and monitor• Ideal pipe for economical relining of corroded pipelines• Hydraulic characteristics are virtually unchanged with time
High Stiffness Design	<ul style="list-style-type: none">• Easy to bury using methods routinely specified for traditional pipe• Performance is predictable and reliable• Deep covers are handled with ease• Pipes are versatile and long-lasting• Easy to grout annulus on sliplining and tunnel lining applications
Smooth Interior Surface / Oversize IDs	<ul style="list-style-type: none">• Deliver more fluid than any corrosion resistant pipe• Permit greatest recovery of flow in rehabilitated pipelines• Significant energy savings in pumped systems
Leak-free Joints	<ul style="list-style-type: none">• Zero infiltration/exfiltration• No extra treatment costs• No pollution of ground waters• Full delivery of pumped fluids• No wasted time or expense to find and seal leaking joints to pass acceptance tests• No undermining of above structures and infrastructure
Lightweight / Up to 40' Sections	<ul style="list-style-type: none">• Lighter, less expensive equipment needed for handling• Fewer joints to assemble
Push-on Coupling Joints / Angular Rotation Capability	<ul style="list-style-type: none">• Fool-proof, fast assembly• Requires no secondary treatments, diapers, bonding agents or other chemicals in the field• Lower joining costs• Radius curves possible without the need for fittings
Smooth Constant OD	<ul style="list-style-type: none">• Pipe may be cut anywhere and assembled with gasket joints, needing end chamfering only• Lower forces needed to insert pipe into casings or deteriorated pipelines for rehab• Allows longer distance bored tunnels and lower jacking loads to reduce shaft requirements and increase safety margins
Smooth Surface	<ul style="list-style-type: none">• Excellent abrasion resistance• High crack resistance
Computerized Manufacturing Process	<ul style="list-style-type: none">• Consistent, reproducible high quality pipes
Standardized Designs and Dimensions	<ul style="list-style-type: none">• Optimized design specific to application• Multiple pressure and stiffness classes to meet most project requirements• ODs compatible with standard ductile iron fittings
60+ Year History of Successful Applications	<ul style="list-style-type: none">• Service tested and time proven performance record

Quality Control

Ongoing improvement of quality performance is a key driver of our success. The constituent raw materials and the pipe production are routinely sampled and tested according to ASTM and AWWA standards to confirm that the desired properties and design performance are consistently maintained.

RAW MATERIALS

Our products are made of glass fiber, thermosetting resins, minerals, and silica sand. The raw composition of our pipes and fittings differs depending on the application.

Resin

All resin shipments have certified test results from the manufacturer and are checked for critical characteristics. Our laboratory verifies these parameters.

Glass Fibers

The lots are checked for moisture, yield, and sizing/ binder content.

Aggregate

Shipments are monitored for gradation, moisture content, and impurities.



Pipe quality is tested frequently to assure high performance.

PROCESS CONTROL

A multi-parameter computer program calculates all size, type, and pipe class process settings. The process operation, including materials placement and feed rates, is computer controlled to eliminate human errors. The quantities of materials fed for each pipe are measured automatically and compared to design minimums to ensure proper strengths and other characteristics are achieved.

FINISHED PIPE

The verification for all pipes includes pipe wall thickness, liner thickness, degree of cure, component materials' weights, length, and visual inspection of both surfaces for imperfections and other defects. Pipe production is periodically sampled per ASTM requirements at a rate of no less than one percent and tested for stiffness, deflection characteristics, and mechanical properties.



The highest quality raw materials are monitored and verified

Product Standards

INDUSTRY STANDARDS

Hobas Pipe USA manufactures pipes according to the applicable U.S. product standards as follows:

APPLICATION	STANDARD
Non-pressure Sanitary Sewers	ASTM D3262
Sewer Force Mains Industrial Effluents (Pressure)	ASTM D3754
Pressure Water Systems	AWWA C950 ASTM D3517
Fiberglass Pipe Design	AWWA M45

Our computer-controlled process ensures consistent, high-quality pipes meeting ASTM and AWWA standards covering most applications. Our routine pipe testing is conducted to ensure full compliance is maintained and includes:

- Workmanship
- Dimensions
- Pipe Stiffness
- Ring Deflection without Cracking
- Ring Deflection without Failure
- Hoop Tensile Strength
- Axial Tensile Strength



Each pipe and joint are monitored before leaving the plant.

REQUIRED TEST STANDARDS

Testing methods, shown in chart below, are used to measure our pipe's performance and characteristics.

Table 1. Pipe Tests and Purposes

Test Designation	Purpose
ASTM D638	Tensile Properties by Coupon
ASTM D695	Compression by Coupon
ASTM D1599	Quick Burst
ASTM D2290	Tensile Strength by Split Disk
ASTM D2412	Pipe Stiffness
ASTM D2992	HDB Procedure
ASTM D3567	Dimensions
ASTM D3681	Chemical Resistance - Deflected
ASTM D4161	Joint Test

LONG-TERM PERFORMANCE / DURABILITY

Long-term performance and durability are measured by extended pressure and ring bending tests that continue for a minimum of 10,000 hours. Test results are extrapolated by regression analysis per ASTM standards to determine the 150-year performance value. Safe operating limits are established by applying design factors in the AWWA Fiberglass Pipe Design Manual, M45.

CERTIFICATIONS AND APPROVALS

- ISO 9001
- ISO 14001
- NSF Standard 61
- BNQ Potable Water Approval
- AREMA American Rail-way Engineering and Maintenance-Of-Way Association
- AASHTO American Association of State Highway and Transportation Officials

Sustainability

THE HOBAS WAY

Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Our goal for successful sustainability is to impact the natural environment as lightly as possible.

The Hobas Pipe approach to sustainability is to offer an extremely long-life product to the market. It features a small footprint in production, low transport costs, and allows for fast installation and efficient operation.

BUILT TO SOLVE

Through corrosion and abrasion resistance, excellent leak-tightness, root infiltration resistance and buckling resistance, Hobas pipes preserve resources and protect the integrity of our water networks.

The FRPM Advantage

- Fully automated production process
- Fiberglass-reinforced polymer mortar's long lifetime makes it a sustainable, environmentally friendly solution
- Low weight for low transport costs, easy handling, and no need for heavy machinery on site
- Quick and easy pipe jointing without additional equipment or welding
- Compact wall thickness for less excavation material at the same inner diameter
- Outstanding hydraulic characteristics for same flow rate as other materials at smaller diameter
- Maintenance free service life



Hobas pipes: long-life, lightweight and tough

Our pipe products ensure the secure transport and availability of water; play a significant role in agriculture and industry (the biggest users of water); form leak-tight sewer networks, and help manage floods and droughts through water storage and retention tanks, as well as customized solutions for wastewater treatment plants.

Hobas pipes last for many generations, and at the end of their life cycle, FRPM waste can be shredded and transported to cement plants to be energetically recycled in a furnace, thus replacing fossil fuels.

The greenest pipe is the one you don't have to replace.

Experience Goes a Long Way

Count on Hobas' Products and Support
to Deliver on Your Jobs



Versatility in Design and Installation

Hobas addresses your project needs through our materials excellence, pipe installation versatility and the industry expertise of our Field Service Team.

Hobas Pipe USA FRPM pipes are designed to meet the requirements for each application whether pressure or non-pressure, and suitable for every type of installation. Our engineering department provides certified calculations for every application, which is engineered in accordance with existing applicable ASTM and AWWA Standards as well as AREMA and AASHTO. Our manufacturing facility is ISO certified, which ensures that exactly what is designed is what is manufactured and shipped to you. You can count on our field services department for excellent support and installation advice, ensuring project success from concept to commissioning.

DIRECT BURY

High Stiffness design allow for easy of burying with typical methods routinely specified for flexible pipe, saving time.

SLIPLINING

A cost-effective solution of replacing existing pipelines without flow reduction and significant energy savings for pressure systems, saving time and less disruption.

JACKING OR MICRO-TUNNELING

A pipe wall having incredible compressive loads yet both thin and lightweight which permits long distance drives, less shafts, less disruption, saving money.

ABOVE GROUND AND AERIAL

UV Resistant and high-strength, saving money and making for a simple and quick installation.

TUNNEL / CASING CARRIER

Larger diameter pipes installed with easy with a simple fool proof and fast assembly coupling.

APPLICATIONS

Hobas Pipe solutions are ideal for large-diameter corrosive piping applications in the most common environments.

- Potable Water
- Gravity Sanitary Sewers
- Storm Sewers
- Sewer Force Mains
- Raw Water
- Seawater
- Industrial Effluents
- Irrigation
- Penstocks
- Outfalls
- WWTP Piping
- Cooling Water

USA manufactured Hobas Pipes have been installed in nearly every U.S. State, including Canada, and Mexico. Most major USA Authorities, Utilities and Municipalities now have Hobas FRPM Pipe as part of their conveyance system.

Hobas Pipe Is Custom Pipe

Choose the Right Pipe For Your Job



Choosing the Right Pipe

Specifying the correct pipe for your project involves choosing the correct pipe diameter, minimum stiffness, and pressure class.

Pipe Diameter Selection (DN)

Hobas Pipe offers a range of fiberglass-reinforced pipes from 12 to 126 inches in diameter and up to 40-foot sections.

Pipe diameters are typically designed using a hydraulic analysis based on a limiting fluid velocity or allowable pressure loss per unit length of pipe. Since Hobas pipe's are manufactured to produce a glass smooth interior surface which will not deteriorate over time, the pipes can be designed smaller when compared to other pipe materials in gravity systems (Manning's 'n' of 0.009). In pumped pressure systems (Hazen-Williams 'C' of 155), it is normally more advantageous to maintain the same diameter and enjoy the benefit of 30% to 50% lower head loss versus traditional pipes. The reduced head loss translates into significant energy savings and lower pump horsepower requirements. The projected figures depend on the system operating conditions.

In pipe rehabilitation projects, it is common for Hobas pipes to increase the hydraulic capacity (>10%, varies per diameter) of the existing system despite a reduction in pipe diameter.

Stiffness Selection (SN)

Fiberglass pipes are flexible conduits in which the long-term performance is directly correlated to the surrounding support. In general, appropriate pipe stiffness selection is a function of both the loads imposed on the pipe and the pipe's external support.

In most cases, the pipe design loading conditions are the term loads coming from the soil, hydrostatic loads from external groundwater and the live loads from traffic conditions. In certain situations, like trenchless installations, higher short term loads due to grouting may need to be limited depending on the pipe's pipe chosen stiffness. Maximum safe (F of S \approx 2.0) grouting pressure (psi) without support bracing or counter pressurization is shown in Table 18.

The pipe's external support comes from the combination of the trench bedding material and the native soil for open trench installations. In trenchless installations most of the support is assumed to be coming from the native soil.

For direct bury installations, Table 16 relates loads and support assuming a minimum width trench. A stiffness class of 46 psi or 72 psi is appropriate in most cases. For shallow buried pipes with surface loads, see Traffic Load, Table 2 below for appropriate pipe stiffness for various installations and cover depths.

Table 2. Traffic Load

Embedment Condition ¹	Minimum Cover (ft.) for AASHTO HS-20 Load ²	
	SN 36 or 46	SN 72
1	3	2
2	4	3
3	5	4

Note

¹ See Figure 2 on page 35

² Installation in poor soil or at shallow cover depths is possible with improved pipe support such as cement stabilized sand or concrete encasement

³ Table assumes burials in native soils with SPT 2 bpf minimum

⁴ Installation in poor soils (<SPT 2 bpf) or at shallow cover depths is possible with improved pipe support such as cement, stabilized sand or concrete encasement

Choosing the Right Pipe

In cases where vacuum operating conditions may exist, the Allowable Negative Pressure table below shows the appropriate pipe stiffness for various installations and negative pressures.

Table 3. Aboveground Allowable Negative Pressure

Embedment Condition ¹		Allowable Negative Pressure	
		SN 36 or 46	SN 72
Buried ^{2,3}	1	100	100
	2	100	100
	3	50	100
Aboveground ⁴		50	100

¹ See Standard Embedment Conditions on Figure 2, page 35, in the Direct Bury Installation section.

² Allowable negative pressure may need to be reduced for burials with weak native soils ($q_u < 1$ tsf or SPT < 8 blows/ft).

³ Allowable negative pressure for buried pipe assumes a compacted pipe zone backfill of $\geq 95\%$ SPD or equivalent.

⁴ Max pipe temperature is at 75-deg F.

For most trenchless installations that use a flush joint, the stiffness is a by-product of the pipe's thickness needed to accommodate the flush joint and/or the pipe's axial compressive load capacity needed for installation. The latter one is more prevalent in jacking installations. For this reason, for jacking installations stiffness does not need to be specified but if necessary, 140 psi minimum stiffness is appropriate. For other trenchless installations like sliplining or tunnel carrier, a minimum stiffness of 36 psi is more commonly used. This stiffness may need to be increased slightly in very deep projects with high loading conditions. In rare cases that the annular space is not fully grouted, the pipe's support is significantly reduced resulting in a limit (based on stiffness) of external hydrostatic head (ft) show in Table 19.

Appropriate pipe stiffness for aboveground applications is a function of the pipe support scheme, pipe diameter, imposed loads and the level of negative pressure, if any. Table 3 on above-ground installation provides guidance on pipe support requirements for various pipe classes and diameters.

Pressure Class Selection (PN)

Pressure Class on Hobas pipes are independent of the pipe stiffness. The chosen pipe pressure class is the highest of the following parameters:

- Operating Pressure
- Transient Pressure (Operating + Surge Pressure) / 1.4
- Test Pressure / 1.5

Per ASTM and AWWA Fiberglass standards the pipe's pressure class is to have factors of safety that among others include a minimum burst pressure of 4 times the pressure class of the pipe. As a result additional factors of safety do not need to be included on a project basis.

The normal operating pressure can be obtained from a hydraulic analysis for that particular system. For Hobas pipes with a smooth interior, a reduction in friction or headloss typically results in a lower operating pressure when compared to other pipe products.

Choosing the Right Pipe

The surge pressure is the pressure above increase that is anticipated as a result of a change in velocity. This is a pipe material dependent load. In general, Hobas Pipe’s self-dampening properties result in a water hammer pressure which is approximately 50% less than typical metallic pipe products used in pressure applications.

Field testing pressure allowance is up to 1.5 times the pressure class of the pipe.

Table 4. Hydrostatic Pressure

Pressure Class (PN)	Maximum Sustained Operating Pressure ¹ (psi)	Maximum Transient Pressure (psi)	Maximum Field Test Pressure (psi)	Minimum Initial Burst Pressure (psi)
25	25	35	37	100
50	50	70	75	200
100	100	140	150	400
150	150	210	225	600
200	200	280	300	800
250	250	350	375	1000
300	300	420	450	1200
350	350	490	525	1400
400	400	560	600	1600
450	450	630	675	1800

¹ Maximum pressure may be reduced for buried pipes

Note Factory test per AWWA/ASTM Standards 1.5x PN >54 up to 96 and 2x PN for ≤54

Pipe Design

Design calculations to compute the performance of Hobas Pipe’s fiberglass-reinforced polymer mortar pipes in various conditions can be generated using the principles and equations of flexible conduit theory. These include Spangler’s deflection equation, Molin’s bending equation, and constrained buckling analysis.

Through extensive research on fiberglass pipes in the 1980s, these equations and others have been refined and combined into a complete design analysis procedure in the AWWA Fiberglass Pipe Design Manual, M45.

Hobas Pipe can provide design calculations to demonstrate the performance of our pipes in specific conditions on individual projects. This service is available upon request.

Choosing the Right Pipe

HYDRAULICS

Hobas pipes have smooth interior surfaces that will not deteriorate — due to chemical attack — because of their high corrosion resistance, resulting in significantly lower friction than other materials. Smooth wall pipes maintain superior flow performance over time due to fewer buildups and shorter slime lengths (sewers).

Characteristics

GRAVITY FLOW

Users have reported Manning's "n" flow coefficients for Hobas pipes of 0.0090 new and 0.0105 after several years of sanitary sewer service.

PRESSURE

Tests on an in-service Hobas pressure pipe system (approximately 100 psi) yielded an average Hazen-Williams "C" value of 155.

Flow Capacity

GRAVITY SYSTEM

For equal flow volumes on the same slope, Hobas pipes can be 13% smaller than pipes with an "n" value of 0.013. Depending on the condition of an existing (host) pipe, sliplining with Hobas pipe will frequently improve the renewed line's flow capacity.

PRESSURE

Hobas pipes may be slightly smaller for equal head loss than pipes with inferior flow characteristics. It is, however, more advantageous to maintain the same diameter to benefit from the 30% to 50% lower head loss versus traditional pipes. The reduced head loss translates into significant energy savings and lower pump horsepower requirements. The projected figures depend on the system's operating conditions. Please contact Hobas Pipe to compute the future savings possible with our pipes on your project.

Abrasion Resistance

Tests conducted on various types of pipes using sand, stones, and water, Hobas pipes exhibited superior abrasion resistance compared to other materials tested. The abrasion resistance (as measured in a rocking test) for all the plastic products, including the Hobas pipe, was three to ten times better than for cementitious materials such as RCP, CSC, asbestos-cement, and cement-lined ductile iron or steel.

Cleaning of FRP Pipes

Several methods are commonly used for the cleaning of pipelines. These cleaning methods are dependent on several factors, diameter, gravity or pressure applications, as well as the degree and nature of the debris. Methods generally used range from mechanical, to water jetting, to pigging, for the removal and clearing of debris from the interior of the pipe surface. Due to the inherent corrosion resistance as well as the resilient inner surface of the FRPM pipe light cleaning is in most situation is sufficient. If mechanical methods are used, it is recommended to use plastic scrapers to avoid damage to the pipes inner surface. If high-pressure water jetting is employed refer to our Technical Advice Sheet "Recommendations for Cleaning FRP Pipe" which is available on our website. If in doubt regarding cleaning, seek the advice from Hobas Pipe USA. Note: improper use of mechanical or pressure cleaning can or could over time cause damage to the pipe and pipe surface.

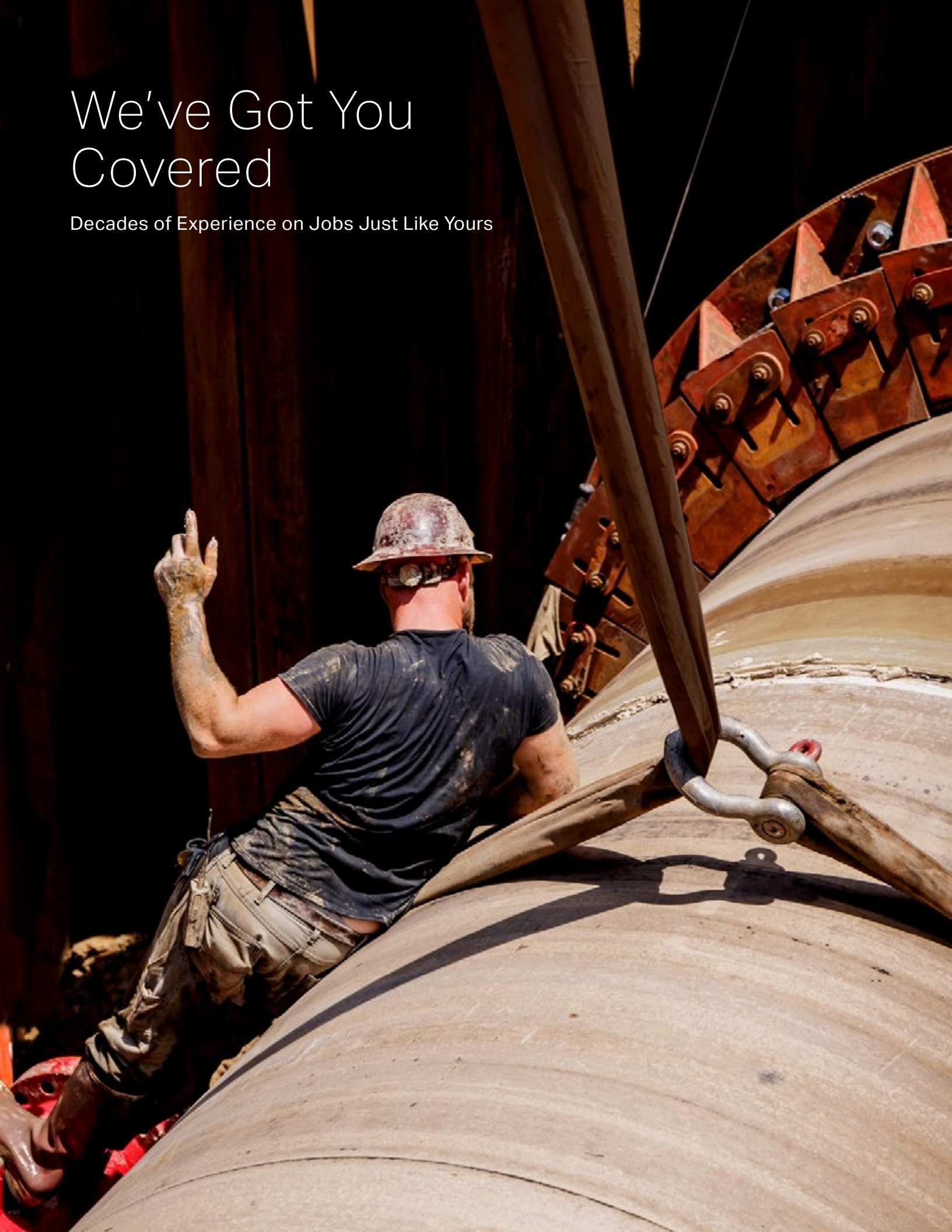
Choosing the Right Pipe

Table 5. Hobas Flow vs. Existing Flow (Q Hobas / Q Existing)

		Host Pipe Existing Flow Coefficient, n									
		0.013	0.014	0.015	0.016	0.017	0.018	0.020	0.022	0.024	
Hobas Relining Pipe Flow Coefficients, n	18	0.009	0.722	0.777	0.833	0.888	0.944	0.999	1.110	1.221	1.332
	into	0.010	0.649	0.699	0.749	0.799	0.849	0.899	0.999	1.099	1.199
	24	0.011	0.590	0.636	0.681	0.727	0.772	0.817	0.908	0.999	1.090
	20	0.009	0.961	1.035	1.109	1.183	1.257	1.331	1.479	1.627	1.774
	into	0.010	0.865	0.932	0.998	1.065	1.131	1.198	1.331	1.464	1.597
	24	0.011	0.786	0.847	0.907	0.968	1.028	1.089	1.210	1.331	1.452
	24	0.009	0.860	0.926	0.992	1.059	1.125	1.191	1.323	1.456	1.588
	into	0.010	0.774	0.834	0.893	0.953	1.012	1.072	1.191	1.310	1.429
	30	0.011	0.704	0.758	0.812	0.866	0.920	0.974	1.083	1.191	1.299
	30	0.009	0.945	1.017	1.090	1.163	1.235	1.308	1.453	1.599	1.744
	into	0.010	0.850	0.916	0.981	1.046	1.112	1.177	1.308	1.439	1.570
	36	0.011	0.773	0.832	0.892	0.951	1.011	1.070	1.189	1.308	1.427
	36	0.009	1.008	1.086	1.163	1.241	1.318	1.396	1.551	1.706	1.861
	into	0.010	0.907	0.977	1.047	1.117	1.186	1.256	1.396	1.535	1.675
	42	0.011	0.825	0.888	0.952	1.015	1.079	1.142	1.269	1.396	1.523
	42	0.009	1.057	1.139	1.220	1.301	1.383	1.464	1.627	1.789	1.952
	into	0.010	0.952	1.025	1.098	1.171	1.244	1.318	1.464	1.610	1.757
	48	0.011	0.865	0.932	0.998	1.065	1.131	1.198	1.331	1.464	1.597
	48	0.009	1.103	1.187	1.272	1.357	1.442	1.527	1.696	1.866	2.036
	into	0.010	0.992	1.069	1.145	1.221	1.298	1.374	1.527	1.679	1.832
	54	0.011	0.902	0.972	1.041	1.110	1.180	1.249	1.388	1.527	1.666
	54	0.009	1.140	1.227	1.315	1.403	1.490	1.578	1.754	1.929	2.104
	into	0.010	1.026	1.105	1.184	1.263	1.341	1.420	1.578	1.736	1.894
	60	0.011	0.933	1.004	1.076	1.148	1.219	1.291	1.435	1.578	1.722
	60	0.009	1.145	1.233	1.322	1.410	1.498	1.586	1.762	1.938	2.114
	into	0.010	1.031	1.110	1.189	1.269	1.348	1.427	1.586	1.744	1.903
	66	0.011	0.937	1.009	1.081	1.153	1.225	1.298	1.442	1.586	1.730
	66	0.009	1.173	1.264	1.354	1.444	1.534	1.625	1.805	1.986	2.166
into	0.010	1.056	1.137	1.218	1.300	1.381	1.462	1.625	1.787	1.949	
72	0.011	0.960	1.034	1.108	1.182	1.255	1.329	1.477	1.625	1.772	
72	0.009	1.193	1.285	1.376	1.468	1.560	1.652	1.835	2.019	2.202	
into	0.010	1.074	1.156	1.239	1.321	1.404	1.487	1.652	1.817	1.982	
78	0.011	0.976	1.051	1.126	1.201	1.276	1.351	1.502	1.652	1.802	
78	0.009	1.210	1.303	1.369	1.489	1.582	1.675	1.861	2.048	2.234	
into	0.010	1.089	1.173	1.256	1.340	1.424	1.508	1.675	1.843	2.010	
84	0.011	0.977	1.066	1.142	1.218	1.295	1.371	1.523	1.675	1.828	
84	0.009	1.194	1.286	1.378	1.470	1.562	1.653	1.837	2.021	2.204	
into	0.010	1.075	1.157	1.240	1.323	1.405	1.488	1.653	1.819	1.984	
90	0.011	0.977	1.052	1.127	1.202	1.278	1.353	1.503	1.653	1.804	
85	0.009	1.054	1.135	1.216	1.297	1.378	1.459	1.622	1.784	1.946	
into	0.010	0.949	1.022	1.095	1.168	1.240	1.313	1.459	1.605	1.751	
96	0.011	0.862	0.929	0.995	1.061	1.128	1.194	1.327	1.459	1.592	
96	0.009	1.225	1.320	1.414	1.508	1.602	1.697	1.885	2.074	2.262	
into	0.010	1.103	1.188	1.273	1.357	1.442	1.527	1.697	1.866	2.036	
102	0.011	1.003	1.080	1.157	1.234	1.311	1.388	1.542	1.697	1.851	
96	0.009	1.052	1.133	1.214	1.295	1.376	1.457	1.619	1.781	1.942	
into	0.010	0.947	1.020	1.093	1.165	1.238	1.311	1.457	1.603	1.748	
108	0.011	0.861	0.927	0.993	1.060	1.126	1.192	1.324	1.457	1.589	
104	0.009	1.134	1.221	1.308	1.395	1.483	1.570	1.744	1.919	2.093	
into	0.010	1.020	1.099	1.177	1.256	1.334	1.413	1.570	1.727	1.884	
114	0.011	0.928	0.999	1.070	1.142	1.213	1.284	1.427	1.570	1.712	
110	0.009	1.143	1.230	1.318	1.406	1.494	1.582	1.758	1.934	2.109	
into	0.010	1.028	1.107	1.187	1.266	1.345	1.424	1.582	1.740	1.898	
120	0.011	0.935	1.007	1.079	1.142	1.222	1.294	1.438	1.582	1.726	
120	0.009	1.152	1.240	1.329	1.417	1.506	1.595	1.772	1.949	1.126	
into	0.010	1.036	1.116	1.196	1.276	1.355	1.435	1.596	1.754	1.914	
132	0.011	0.942	1.015	1.087	1.160	1.232	1.305	1.450	1.596	1.740	

We've Got You Covered

Decades of Experience on Jobs Just Like Yours



Expertise You Can Count On

HOBAS FIELD SERVICE TEAM

Our Dedicated Team for Your Project

In addition to the incredible products Hobas Pipe USA, Inc. offers, we also have a robust field service team with extensive experience in the installation and repair of Hobas pipes. Our team members, which currently have over 130 years of combined experience, are routinely sent to job sites where Hobas products are being installed. This service generally provides two primary support functions for our customers: installation support and repairs – all contributing to the success of the installation and helping end users realize the long-life benefits of our products.

Installation support can encompass many aspects of providing assistance to an installing contractor. Pre-construction meetings or installation presentations can be provided before a job to verbally discuss best practices and review installation plans and methods. Job Startup visits can be provided to discuss best practices with contractor field personnel as they begin the work, observe initial pipe installation, and provide initial inspection of the first installed pipes. For jobs where safe man-entry can be made, inspection of installed pipes can be provided to help assess things like joint sealing functions, deflections, and damage.

Field repairs can cover a wide range of needs from an installing contractor. Since the Hobas pipe wall is fiberglass based material, fiberglass lamination can be utilized to do many things like fitting fabrication or adjustment, lateral connections, joint seals and minor surface damage. For gravity service, minor to moderate structural damage can also be repaired with fiberglass laminations, depending on the situation. However, not all field work involves laminating. For pipes that are not yet installed, grout fittings can be added through the pipe wall.

Visit our website at www.hobaspipe.com for more product and engineering information.



Hobas Field Service Team

Joins and Couplings

All Hobas Pipe solutions have proven joint and fittings solutions that secure the system through its service life. Our joints and fittings offer solutions for transitions to other materials supplied separately or pre-assembled at one of the female pipe ends.

JOINT SOLUTIONS

Several joint types are available to meet the requirements of many different applications for pressure and non-pressure systems. The FWC coupling is normally used for direct bury, aboveground, and other installations. Special joints are available for sliplining, jacking, and tunnel installations. Closure couplings for tie-ins are available. Coupling dimensions are shown in Appendix C.



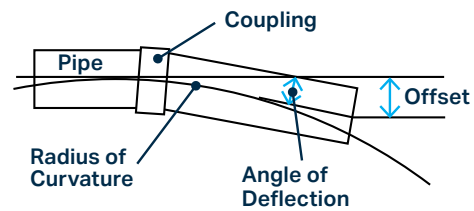
Hobas Tee fitting ready to install

Table 6. Coupling Selection

Installation	Application	
	Low-pressure	Pressure*
Direct Bury	FWC Coupling	FWC Coupling or Restrained Joint Types
Sliplining	Flush Bell-spigot	Wrapped FWC Coupling
Jacking	Flush Bell-spigot	Flush FWC Coupling
Aboveground	FWC Coupling	FWC Coupling
Tunnel Carrier	Flush Bell-spigot	FWC Coupling
Closure Connection	Stainless Steel Closure Coupling	Stainless Steel Closure Coupling

Note Low pressure < 40 psi

Figure 1. Joint Configuration



Note Always join pipes in "straight" alignment and then offset to the desired angle afterwards.

RESTRAINT COUPLING OPTIONS FOR PRESSURE* APPLICATIONS

1. Restrained FRP Coupling
2. Flange joint
3. Concrete – Flange joint and thrust blocks, thrust block information on page 31
4. Laminated joints
 - a. Internal only lamination after backfill
 - b. Internal and external lamination

Joists and Couplings

OUR FRP RESTRAINED COUPLING

For more than 63 years Hobas pressure pipe has been specified and successfully used in high pressure applications.

Hobas also offers FRP Restrained Couplings. The all inclusive joint manages the unbalanced thrust forces at pressurized fittings (elbows, tees, reducers).

Our coupling eliminates the need for external concrete restraints.

Your project just got a whole lot easier.

Figure 2. FRP Restrained Coupling

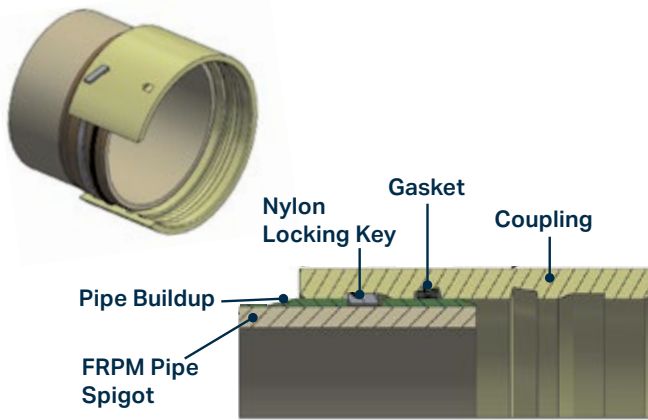


Figure 2 above, shows a restrained coupling option for 12 to 54-inch sizes with a maximum of 250 psi operating pressure. Unrestrained joints are managed based on pressure, pipe, and site parameters.



FRP restrained coupling

FRP Restrained Coupling Parameters

Hobas Pipe USA, Inc. offers mechanical restrained joints for pipes in 12” through 48” using a high strength nylon locking key between two FRP joint grooves on the spigot and bell.

All pipes are manufactured per ASTM D3754, D3517, D2992 or AWWA C950 for pressure water and wastewater conveyance systems. All products are US made. The restrained coupling will be tested to ASTM D4161.

The maximum allowable field test is 1.5 x PN. The maximum allowable surge is 1.4 x PN.

Table 7. Restrained Joint Coupling Range

Diameter (in)	150 PN	200 PN	250 PN
12-36			
42			
48-54			

Joins and Couplings

FWC COUPLING

Performance

The FWC coupling is a structural filament wound coupling that provides a gasket-sealed, lead-free connection. It is overwrapped and mechanically locked to an internal full-face elastomeric membrane. The sealing design includes lip and compression elements, making it suitable for both non-pressure and pressure service up to 450 psi and capable of higher than 150 psi external pressure.

The coupling is factory assembled to one end of each pipe for ease of use in the field. Per the performance requirements of ASTM D4161, the FWC joint will remain leak-free from twice the rated class pressure to a -0.8-atmosphere vacuum under pressure even when angularly turned and vertically deflected. Hobas pipes, because of their OD and smooth exterior surface, may be joined with the FWC coupling at any place along their entire length with no preparation or machining other than chamfering of the pipe ends.

Figure 3. FWC Coupling Plan View

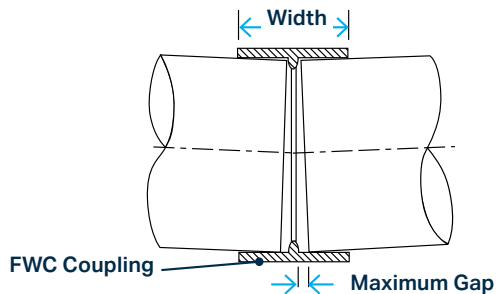
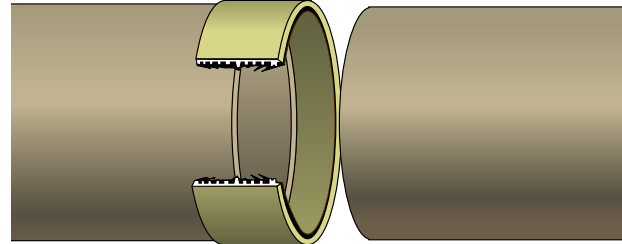


Table 8. FWC Coupling Joint Gap and Angular Deflection

Diameter (in)	Coupling Width (in)*	Joint Gap (in)	Max Deflection Angle (degrees)
12-20	8	1	3
24-33	10	1	2
36-42	10	1	1.5
44-54	10	1	1
57-60	11.5	1	1
63-78	11.5	1	0.75
84-126	13.75	1	0.5

*This is just a summary table. Contact Hobas for specific diameter capability. The gap is measured from center register to pipe end.

Figure 4. FWC Coupling



PRESSURE RELINING

The pressure relining joint is an overwrapped structural filament wound coupling mechanically locked to an internal full-face elastomeric membrane. Like the FWC coupling, the sealing design includes lip and compression elements, making it suitable for both non-pressure and pressure service up to 450 psi for sliplining installations.

Figure 5. Wrapped FWC Coupling

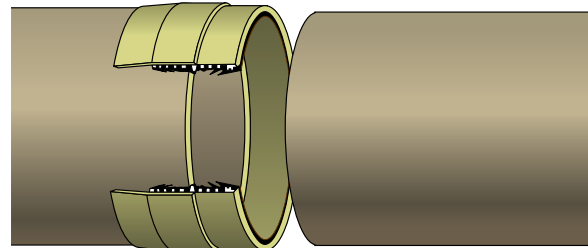


Table 9. Minimum Radius of Curvature for Various Deflected Joints

Max Deflected Angle in Degrees	Maximum Offset (in)			Min Radius of Curvature (ft)		
	Section Length (ft)			Section Length (ft)		
	5	10	20	5	10	20
3	3	6	12	95	191	382
2	2	4	8	143	285	573
1.75	1.75	3.5	7	164	327	655
1.5	1.5	3	6	191	382	764
1.25	1.25	2.5	5	229	458	917
1	1	2	4	286	573	1146
0.75	0.75	1.5	3	383	764	1528
0.5	0.5	1	2	573	1146	2292

Joints and Couplings

FLUSH BELL-SPIGOT

The flush bell-spigot joint is an integral straight bell fixed to one pipe end that seals to the spigot end of another pipe by compressing an elastomeric gasket contained in a groove on the spigot. The joint has approximately the same OD as the pipe, and when assembled, the joint is essentially flush with the pipe's outside surface. It is designed for low-pressure service in jacking and tunnel carrier installations, although it may be used in non-pressure relining applications.

Table 10. Flush Joint Gap

Nominal Diameter (in)	Gap (in)
18-28	0.60
30-44	0.70
45-63	1.36
66-126	2.00

Note

1. The corresponding angle for each allowable joint gap may be calculated by using the formula: deflection angle in degrees = arctan (gap in inches/OD in inches).
2. This joint gap is provided for sealing purposes only and does not address installation loads in the Sliplining section for installation information.
3. This is a summary table, contact Hobas for specific dia. capability.

Figure 6. Flush Bell-Spigot

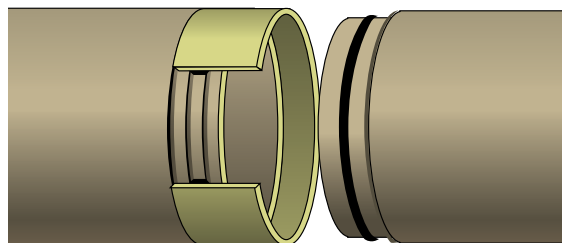


Table 11. Joining Forces for Hobas Couplings

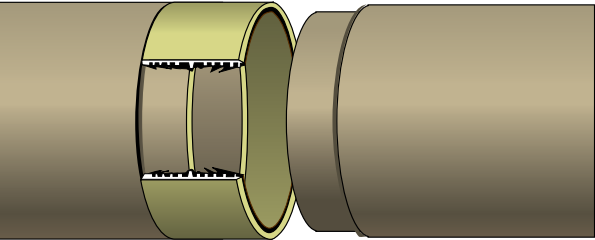
Approximate Average Straight Alignment (lbs)		
Pipe Size (in)	FWC Coupling (lbs)	Flush Bell Spigot (lbs)
18	3150	2150
20	3500	2350
24	4200	2850
27	4725	3200
28	4900	3300
30	5250	3550
33	5775	3900
36	6300	4250
41	7175	4800
42	7350	4950
44	7700	5150
45	7875	5300
48	8400	5650
51	8925	6000
54	9450	6350
57	9975	6700
60	10500	7050
63	11025	7400
66	11550	7750
69	12075	8100
72	12600	8450
78	13650	9150
84	14700	9850
85	14875	9950
90	15750	10550
96	16800	11250
104	18200	12200
110	19250	12850
120	21000	14050
126	22000	14700

Joints and Couplings

FLUSH FWC COUPLING

The flush FWC coupling, designed for pressure service greater than 40 psi in jacking installations, is a reduced diameter FWC coupling fixed to one pipe end (in a recess) that seals to another pipe's spigot (recessed) end by compressing the elastomeric gasket inside the coupling. The joint has approximately the same OD as a Hobas pipe, so when assembled, the joint is essentially flush with the pipe's outside surface. Allowable angular deflection limits and joining force are similar to the FWC coupling.

Figure 7. Flush FWC Coupling



FWC coupling being prepped for installation



Jacking pipes have rubber ring sealed flush bell-spigot coupling for quick assembly

Joints and Couplings

LAMINATED JOINTS

Leverage our years of experience in design, testing and manufacturing of FRPM pipe for your next high pressure, large diameter pipeline project.

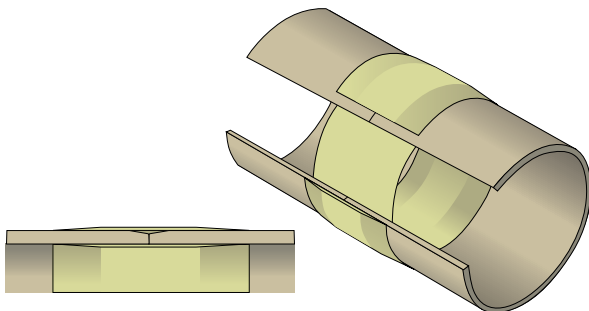
Hobas Pipe USA, Inc. offers Internal Laminated Joints that are complete with a Hobas FWC Coupling: This field applied internal laminated joint is constructed of hand-lay-up Reinforced Fiberglass and polyester resin. The Pipe, Coupling and Laminate (System) are specifically designed for pressure pipeline application over 48 inch in diameter (man entry) and accounts for both uniaxial and biaxial forces. The design of the laminate is dependent on the pipe diameter and operating conditions of the pipeline.

Laminated joints are customized, with many options available. The low profiled internal overlays are constructed of glass reinforcement fibers and thermoset (polyester) resin. Laminated joints are used when conventional restraint methods such as axial concrete, thrust blocks or restrained joints cannot be used.

Note Pressure pipe are also designed specifically to accept and address axial pressure thrust forces.

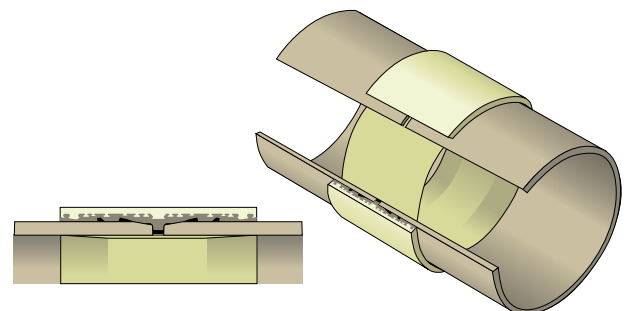
- Laminate design is based on operating and site conditions as well as application
- Laminate joint design is limited based on pipe diameters and pressure requirements
- Hobas laminated joint system, Figure 8, is designed based on pipeline pressure requirements
- The internal laminated system, Figure 9 is complete with our FWC Coupling to allow for quick pipeline installation, and generally available greater than 48" in diameter

Figure 8. Laminated Joints – fully customizable



Pipe detail showing laminated joint with FWC Coupling

Figure 9. FWC Coupling with Internal Laminate



Joints and Couplings

CLOSURE COUPLINGS

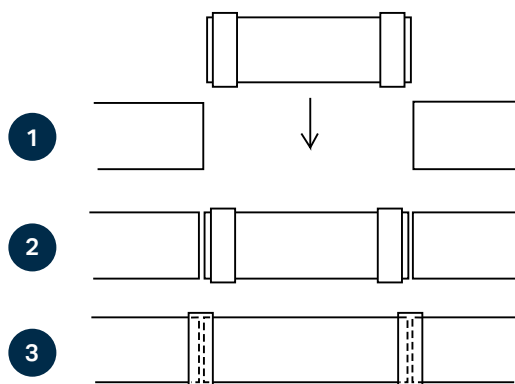
Our closure couplings help you extend, terminate, and rehabilitate your pipe run projects.

Closures are Stainless Steel Couplings with straight, loose collars and internal gasket systems. The joints are sealed by compressing the gaskets between the natural OD of any Hobas pipe and the inside of the collar. The typical assembly sequence is shown in Figure 10. The easiest assembly is with the pipes coupling in “straight” alignment with an adequate chamfer on the outside edge of the pipes to be joined.

Stainless Steel Coupling comprises a casing, gasket, and a lock part. The purpose of the casing is to house the gasket and press it onto the pipe surface when the lock part is closed. The lock part is designed to pull the two ends of the casing together circumferentially around the pipe. The coupling is labeled with torque to ensure the gasket is compressed sufficiently against the pipe surface.

Sold individually, a pair of couplings is typically used at each closure location.

Figure 10. Closure coupling installation and assembly



Stainless steel closure coupling

Pressure Systems

To effect closures in force mains, use Hobas stainless steel closure coupling or mechanical couplings (with appropriate corrosion protection) such as those manufactured by Dresser, JCM or Smith-Blair.

CONNECTIONS TO OTHER PIPE MATERIAL SYSTEMS

Several methods may accomplish connections to other pipe material systems. Because of compatible ODs, Hobas pipes, from 18 to 48 inches, may be joined directly with ductile iron pipes (or other ductile iron pipe size materials) using our couplings or ductile iron gasketed joints. In some diameters and applications, third-party mechanical couplings may be suitable.

Hobas Pipe can custom fabricate the mating bell or spigot for other gasket-sealed systems with the proper dimensions. Custom-fabricated mechanical couplings that connect pipes of different ODs may be used. The most expensive method, flanges built to ANSI or other drilling specs, is typically acceptable. Contact us regarding the suitability of or experience with other procedures.

Note When using mechanical joints, torque bolts to the minimum needed for sealing - maximum 25 ft.-lbs.



Fittings

Hobas fittings can be produced according to customer specifications in standard and non-standard forms and are available for pressure and non-pressure applications.

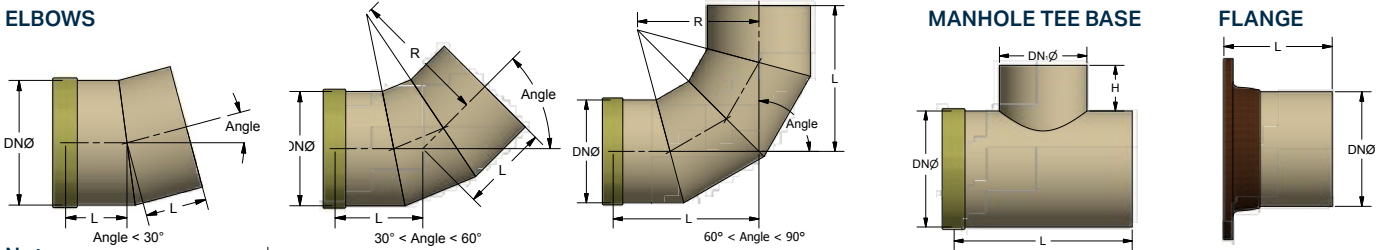
GENERAL

The general configuration and standard Hobas Pipe fittings are shown in Figure 11, although almost any mitered fitting can be constructed. These fittings are available for all non-pressure and for many pressure applications. All branch fittings (tees and wyes) must be prevented from deforming.

A concrete encasement can accomplish this. Pressure applications will require thrust restraints and may require full encasement in reinforced concrete to resist deformation due to internal pressure.

To determine details and requirements for your specific project, contact Hobas Pipe for assistance. Dimensions for standard fittings are given in Appendix E. Details are available upon request for diameter combinations and angles not shown or other fitting configurations.

Figure 11. Fittings



Note

Flange drilling dimensions are according to AWWA C207 Class D (150 psi) and ANSI B16.1 (125 psi).
Fiberglass reinforced polymer flanges are available for non-pressure and pressure applications.
Protected ductile iron, fusion bonded epoxy coated steel or stainless steel flanges may be used at any pressure.

COMPATIBILITY

Hobas pipes are dimensionally compatible with standard ductile iron fittings (12 to 48 inches). If used, corrosion protection consistent with project conditions should be added to the fittings. Stainless steel or fusion-bonded epoxy-coated steel fittings are also suitable.

INSTALLATION

Hobas Pipe's fiberglass fittings are designed to join our pipe using our standard FWC coupling, or one of our other gasket-sealed joints. Adequate thrust restraint(s) should be provided in pressure systems.



Hobas experience with FRPM pipe to RCP



Reference Appendix E for flange details, page 73



FRPM pipe with flange

Fittings

EXTERNAL RESTRAINTS

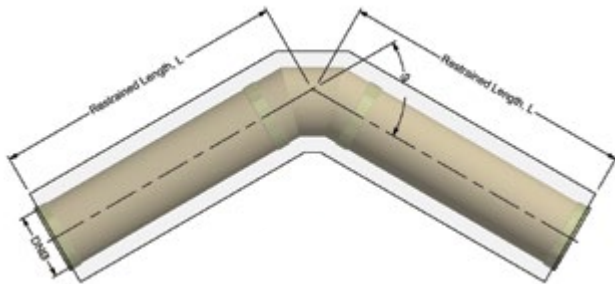
Based on your project parameters, some external restraints will work better than others. The following are a number of systems we recommend and some of the details that may define your choices

Axial Concrete

The axial concrete restraint system could also be used when limiting easement boundaries or other obstructions, resulting in the concrete encasement dimensions being less than those required by a thrust block.

Axial concrete uses the width of the trench as the width of the encasement. The length of the encasement is dependent on the thrust force, the friction support, and the bearing support. Axial concrete shall be placed against undisturbed earth.

Figure 12. Axial Concrete Plan View



Note

The thrust restraint shown in Figure 12 is an illustration, the exact shape and size will be dependent on design and project requirements.

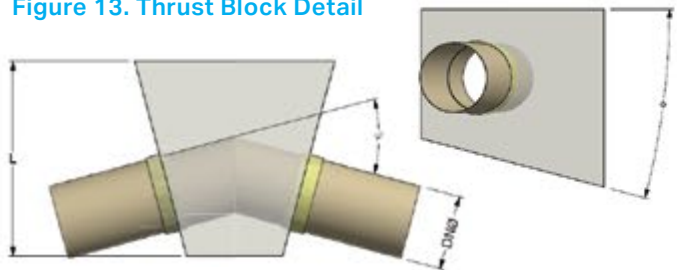
Thrust Blocks

The size of the thrust block bearing area is a function of the soil bearing capacity, thrust, and cover depth. Note that the block must be deep enough to avoid surface heaving and to achieve maximum restraint (resistance) – the typical minimum cover depth is at least one pipe diameter. The thrust block must surround the fitting and cover all the miters. Thrust blocks must be placed against undisturbed earth.



Axial concrete encasement

Figure 13. Thrust Block Detail



Note

The thrust restraint shown in Figure 13 are illustrations, the exact shape and size will be dependent on design and project requirements.



Completed NL Fitting Thrust Encasement

The Right Pipe for the Job

World-class Solutions Designed to Perform



Direct Bury– Installation

Installation of buried flexible pipes takes advantage of the pipe and soil properties for optimal performance. A combination of stiffness, native soil characteristics, cover depth, trench construction, and backfill materials all assist in achieving a proper pipe installation.

PRODUCT RANGE

Pipe Diameters and Lengths

Hobas Pipe offers a range of fiberglass-reinforced pipes from 12 to 126 inches and up to and including 40-foot sections, non-standard custom lengths, and even divisions of 40 feet.

Pressure Classes

Table 12. Pressure Ratings by Pipe Diameter

Nominal Diameter (in)	Pressure Rating (psi)									
	25	50	100	150	200	250	300	350	400	450
12-66										
69-72										
78-90										
96-118										
120-126										

Note
25 psi is our non-pressure application pipe

Features and Benefits

- No costly add-on linings, polybags, or coatings to repair, inspect or maintain
- No need for expensive cathodic protection to install, monitor or replace over time
- Buried using methods routinely specified for traditional pipe materials
- Deep cover handled with ease, pipes are rugged and durable
- Significant energy saving for pressure pipelines, delivering more fluid than traditional unlined pipe materials
- Push-on couplings provide ZERO infiltration / exfiltration – individual joints are designed to be field tested
- Lightweight and longer pipe sections allow for less joints to assemble and less expensive equipment required for handling
- Couplings allow for radius without the need for fittings
- Pressure applications pipes are designed to address operating and surge pressures as well as full vacuum
- Hydraulic characteristics are virtually unchanged with time

Flotation

A minimum of one-half to one diameter of cover is typically needed to prevent an empty submerged pipe from floating—depending on the density of the cover material—when full saturation to the surface exists. Other options may be acceptable to restrain the pipe against flotation.

Direct Bury – Installation

TRENCH CONSTRUCTION

Trench Width

The minimum trench width shall provide sufficient working room at the sides of the pipe to permit accurate placement and adequate compaction of the pipe zone backfill material. Suggested minimum trench dimensions are given in Table 13.

Wide Trenches

There is no maximum limit on trench width. However, it is required that the pipe zone backfill material be placed and compacted as specified for the full width of the trench or a distance of two diameters on each side of the pipe, whichever is less.

Supported Trench

When permanent or temporary trench shoring is used, the minimum width shall be noted in Trench Width above and Table 13. Care should be exercised not to disturb the pipe location, jointing, or embedment when using movable trench supports.

Removal of any trench protection below the top of the pipe and within two pipe diameters is not recommended after the pipe embedment has been compacted unless all voids created by sheeting removal are filled with properly densified embedment material and any loose soils at pipe zone elevation are properly compacted prior to loading the pipe with overburden. When possible, use movable trench supports on a shelf above the pipe with the pipe installed in a narrow, vertical wall subditch.

Dewatering

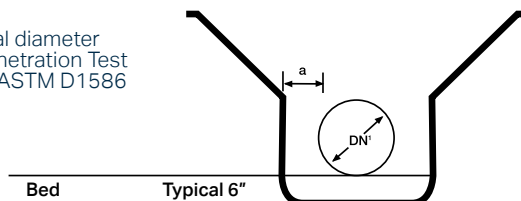
When running or standing water occurs in the trench bottom or the soil in the trench bottom displays a “quick” tendency, pumps and suitable means such as well points or underdrain bedding should remove the water. This system should be maintained in operation until the backfill has been placed at a sufficient height to prevent pipe flotation. Care should be taken that any underdrain is of proper gradation and thickness to prevent material migration between the underdrain, pipe embedment, and native soils in the trench, below, and at the sides of the pipe.

Table 13. Standard Trench Dimensions

DN (in)	Typical Minimum A (in)	
	SPT ² ≤ 8	SPT ² > 8
12-20	6	4
24-33	9	6
36-48	12	8
51-72	18	12
78-126	24	16

Note

- ¹ DN is nominal diameter
- ² Standard Penetration Test Blows/ft per ASTM D1586



Preparation of Trench Bottom

The trench bottom should be constructed to provide a firm, stable and uniform support for the full length of the pipe. Bell holes shown in Figure 14 should be provided at each joint to permit proper joint assembly and alignment. Any part of the trench bottom excavated below grade should be backfilled to grade and should be compacted as required to provide firm pipe support.

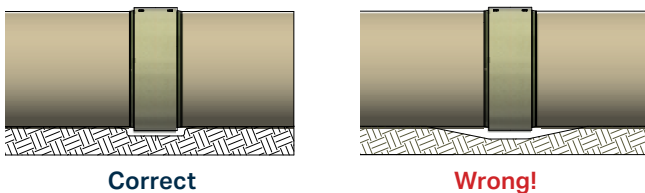
When an unstable subgrade condition is encountered, which will provide inadequate pipe support, additional trench depth should be excavated and refilled with a

Direct Bury – Installation

Preparation of Trench Bottom (cont.)

suitable foundation material. Special foundations may be required in severe conditions, such as wood pile or sheeting capped by a concrete mat, wood sheeting with keyed-in plank foundation, or foundation material processed with cement or chemical stabilizers. A cushion of acceptable bedding material should always be provided between any special foundation and the pipe. Large rocks and debris should be removed to provide four inches of soil cushion below the pipe and accessories.

Figure 14. Bell Holes

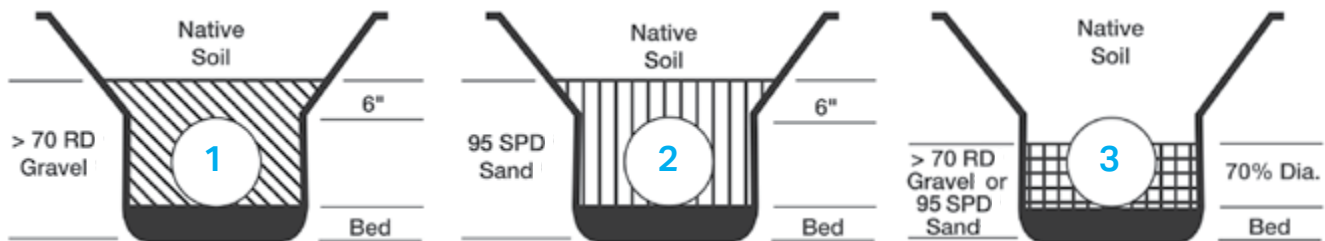


Note After joint assembly, fill the bell holes with bedding material and compact as required.

STANDARD EMBEDMENT CONDITIONS

Three standard embedment conditions are given in Figure 15. Other embedment conditions may be acceptable. Please consult us for advice and recommendations.

Figure 15. Standard Embedment Conditions



Note

RD is relative density per ASTM D4253.

SPD is standard proctor density per ASTM D698.

PIPE ZONE (EMBEDMENT) BACKFILL MATERIALS

Most coarse grained soils as classified by ASTM D2487, Classification of Soils for Engineering Purposes, are acceptable bedding and pipe zone (embedment) backfill materials as given in the table below.

Table 14. Backfill Materials

Specification	Definition	Symbols
Gravel	Gravel or crushed rock	GW, GP, GW-GC, GW-GM, GP-GC, GP-GM
Sand	Sand or sand-gravel mixtures	SW, SP, SW-SC, SW-SM, SP-SC, SP-SM

Maximum grain size should typically not exceed 1 to 1¹/₂ times the pipe wall thickness or 1¹/₂ inches whichever is smaller. Well graded materials that will minimize voids in the embedment materials should be used in cases where migration of fines in the trench wall material into the embedment can be anticipated. Alternatively, separate the open graded material from the non-cohesive soil with a filter fabric to prevent migration of the smaller grained soil into the open graded material. Such migration is undesirable since it would reduce the soil density near the pipe zone and thereby lessen the pipe support.

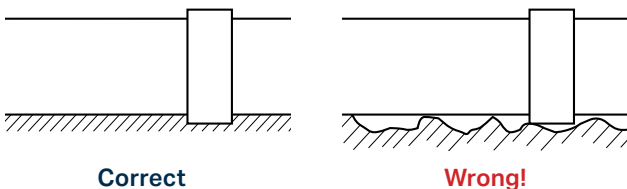
Embedment materials should contain no debris, foreign or frozen materials.

Direct Bury – Installation

BEDDING

A trench bed should provide firm, uniform, and continuous support for the pipe's entire length, see Figure 16. Bedding material should be as specified in Figure 15 and as noted in Pipe Zone (Embedment) Conditions. The bedding minimum depth should equal 25% of the nominal diameter or six inches, whichever is less, see Table 15.

Figure 16. Bedding



A firm trench bottom must be provided (as noted in Dewatering and Preparation of Trench Bottom).

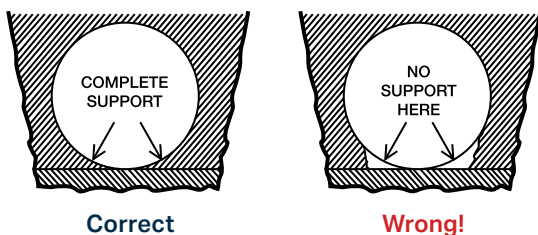
- Place and compact bedding to achieve 2/3 of the total bed thickness (normally four inches).
- Loosely place the remaining bedding material to achieve a uniform soft cushion to seat the pipe invert (bottom).
- After joining pipes, ensure all bell holes are filled with the appropriate embedment materials and compacted as specified.

NOTE Do not use blocking to adjust pipe grade.

HAUNCHING

Haunching materials and density are very important factor affecting pipe performance. The material should be placed and consolidated under the pipe, Figure 17, while avoiding vertical and lateral pipe displacement from proper grade and alignment.

Figure 17. Haunching



BACKFILLING

Pipe embedment conditions shall be as specified in Figure 15, on the previous page. It must be the same as the bedding material to prevent potential migration. Place and compact the embedment material in lifts to achieve the depths and densities specified in Figure 15. To avoid disturbing the embedded pipe, little or no tamping of the initial backfill directly over the top of the pipe.

The remaining backfill may be the native trench material provided clumps and boulders larger than three to four inches are not used until 12 inches of pipe cover has been achieved.

Maximum Cover Depth

Maximum recommended cover depth is given in Table 16.

Minimum Cover for Traffic Load Application

Minimum recommended cover depth of compacted fill above the pipe crown prior to application of vehicle loads is given in the above chart. Installation in poor soils or at shallower cover depths is possible by using a surface bridging slab or pipe encasement in concrete or similar.

Table 15. Minimum Cover Depths

Embedment Condition ¹	Minimum Cover (ft) for HS20 Load ²	
	SN 36 or 46	SN 72
1	3	2
2	4	3
3	5	4

Note

¹ See Figure 14.

² Installation in poor soils or at shallower cover depths is possible with improved pipe support such as cement stabilized sand or concrete encasement.

PIPE DEFLECTION

Pipe initial vertical cross-section deflection measured within the first 24 hours after completion of all backfilling and removal of dewatering systems, if used, shall not exceed 3% of the original pipe diameter.

Pipe deflection after 30 days should typically not exceed 4% of the original pipe diameter. Maximum long-term pipe deflection is 5% of the original pipe diameter. Max long-term deflection for pipes with vinyl ester resin liner is 4%.

Direct Bury – Installation

PIPE DEFLECTION (CONT)

For very high-stiffness pipes (approx. SN 120 and above), the maximum long-term deflection can be reduced, and the 24-hour and 30-day deflection limits decreased proportionally.

ALTERNATE INSTALLATIONS

As Table 16 indicates, alternate installations include cement-stabilized embedment, wide trenching, permanent sheeting, geofabrics, or combinations of these systems. Actual installation design should be engineered to satisfy the specific conditions and circumstances.

Figure 18. Determining Actual Deflection of Installed Pipe

Calculate Vertical Deflection

$$\% \text{ Deflection} = \frac{\text{Actual ID} - \text{Installed Vertical ID}}{\text{Actual ID}} \times 100$$

Actual ID may be verified or determined by measuring the diameters of a pipe not yet installed laying loose (no pipes stacked above) on a reasonably plain surface.

Calculate as follows:

$$\text{Actual ID} = \frac{\text{Vertical ID} + \text{Horizontal ID}}{2}$$

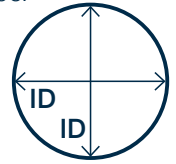


Table 16. Maximum Cover Depth¹

NATIVE SOIL ^{2,4}	COVER DEPTH ¹ (FT)	EMBEDMENT CONDITION ³		
		1	2	3
Rock	10 and <	SN 36		
Stiff to V. Hard Cohesive (Qu ≥ 1 Tsf)	>10 to 20	SN 36		SN 46
Compact to V. Dense	>20 to 30	SN 46		SN 72
Granular (SPT N ≥ 8 bpf)	>30 to 40	SN 72		Alternate Installation ⁵
	>40 to 50	SN 72		
	>50 to 60	SN 90		
	>60 to 70	SN 120		
Medium Cohesive (Qu ≥ 0.5 Tsf)	10 and <	SN 36		
Loose Granular (SPT N = 4 to 7 bpf)	>10 to 20	SN 36		SN 46
	>20 to 30	SN 46		SN 72
	>30 to 40	SN 72		Alternate Installation
Soft Cohesive (Qu ≥ 0.25 Tsf)	10 and <	SN 36		SN 72
V. Loose Granular (SPT N = 2 to 3 bpf)	>10 to 20	SN 46		Alternate Installation
	>20 to 30	SN 72		
V. Soft Cohesive (Qu ≥ 0.125 Tsf)	10 and <	SN 72		
V. V. Loose Granular (SPT N ~ 1 bpf)	>10 to 20	SN 72		

Stiffness Class Key

 SN 36	 SN 90
 SN 46	 SN 120
 SN 72	 Alternate Installation

¹ Assuming typ. 1.5 x OD Trench Width or as in Table 3

² Soils adjacent to pipe (pipe zone elevation)

³ Defined in Figure 2

⁴ SN is nominal stiffness in PSI

⁵ Alternate Installation per A8-Typ. SN 72 minimum

Note For zero blow (weight of hammer) soils, use Alt. Inst. and SN 72

Don't Replace, Rehabilitate

Extend the Life of Your Infrastructure by Using Hobas Pipe
to Slipline Your Existing Pipe



Sliplining – Installation

Sliplining rehabilitation offers a cost-effective solution for municipalities to make necessary repairs. Sliplining also offers municipalities to work through the challenging replacement of an existing pipeline to transition to a stronger, more reliable pipe solution.

PRODUCT RANGE

Pipe Diameters and Lengths

Hobas Pipe offers a range of fiberglass-reinforced pipes from 12 to 126 inches and up to and including 40-foot sections, non-standard custom lengths, and even divisions of 40 feet. We offer pipe in 20-126 inch diameters for use in sliplining applications. If you are seeking a smaller diameter pipe for sliplining applications, contact our engineering department at HobasPipe.com.

Features and Benefits

- Hydraulic characteristics are virtually unchanged with time
- Significant energy saving and lower pump horsepower requirements for pressure pipelines rehabilitation
- Less surface disruption and in most cases NO NEED for By-Passing of flow
- Allows for simple and easy grouting of the annules space
- Thinner pipe wall and smother inside surface permits greater recovery of flow
- Long push installations permit less access pits and less system and surface disruption
- Lightweight and longer pipe sections allow for less joints to assemble and less expensive equipment required for handling
- Long radius possible without the need for fittings
- Pipe is designed as a fully structural stand-alone pipe line replacement
- Pressure applications pipes are designed to address operating and surge pressures as well as full vacuum
- Ideal pipe for economical relining / replacement of corroded pipelines

Table 17. Sliplining Allowable Compressive Load

Nominal Diam (in)	OD (in)	Safe Compressive Load FS = 3.0 Pushing "Straight" (U.S. Tons)	Weight (lb/ft)
20	21.6	34	48
24	25.6	42	62
27	28.0	46	68
28	30.0	49	73
30	32.0	54	87
33	34.0	59	94
36	38.3	73	110
41	42.9	91	131
42	44.5	99	140
44	45.9	105	148
45	47.7	114	158
48	50.8	127	175
51	53.9	141	192
54	57.1	155	210
57	60.0	173	225
60	62.9	191	251
63	66.0	211	276
66	69.2	228	315
69	72.5	243	335
72	75.4	257	352
78	81.6	292	393
84	87.0	330	430
85	88.6	342	440
90	94.3	394	491
96	99.5	448	547
104	108.0	521	628
110	114.0	580	695
120	126.0	710	829
126	132.5	780	915

Note
Table information is applicable to pressure applications with service pressure up to 40 psi (2.8 bar) for sliplining flush bell spigot joints. Contact Hobas Engineering for higher pressure classes in slip lining installations..

Sliplining – Installation

SLIPLINING PIPE PREPARATION

The existing sewer may be maintained in operation during the relining process. Obstructions such as roots, large joint off-sets, rocks, or other debris that would prevent passage or damage to the liner pipe sections must be removed or repaired before installing the new pipe. Before starting the liner insertion, verify that the existing pipe diameter is sufficient by pulling a mandrel through the line.

It must be determined that the rehabilitated pipeline will be sufficient structurally to carry the overburden loads for the intended design life.

LINER PIPE INSERTION

Liner pipes may be pushed or pulled into the existing pipe. The pipes must be inserted spigot end first with the bell end trailing. The leading pipe spigot end is occasionally protected by a nose piece designed to ride up and over off-set joints and other minor inconsistencies or debris in the invert. Figure 19, shows that the pushing force must be applied evenly to the pipe wall end inside the bell.

DO NOT apply the pushing load to the end of the bell. Assure that the safe (F of S \approx 3) jacking loads given in Table 17 on page 39 are not exceeded. Adhere to grouting guidelines of Table 1 and Table 19 at right. For pipes with flush bell-spigot joints, see Table 17 for typical allowable push loads. Allowable safe jacking loads may be reduced by point loading (i.e., pushing through curves).

Maximum allowable joint angular deflection, for seal purposes only, is given on Tables 7 and 8.



Sliplining pipe greatly extends the life of the infrastructure

Table 18. Maximum Safe Grouting Pressure (psi)

Diam. Difference	Fluid Flow Level	None or Low	Over 1/2 to Full
$\leq 5\%$		SN \div 4	SN \div 3
$\leq 10\%$		SN \div 5	SN \div 4
$\leq 20\%$		SN \div 6	SN \div 5
$>20\%$		SN \div 7	SN \div 6

Table 19. Maximum Safe Long-term External Head (ft) for an UngROUTED Installation

Diam. Difference	Fluid Flow Level	All Flow Levels
$\leq 5\%$		SN \div 2
$\leq 10\%$		SN \div 2.5
$\leq 20\%$		SN \div 3
$>20\%$		SN \div 4

Note

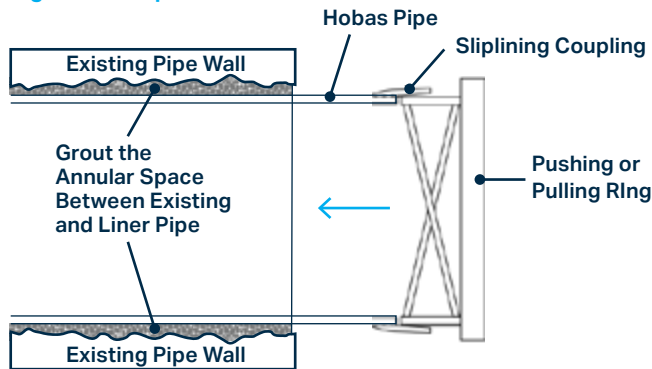
$$\text{Diameter Difference} = \frac{(\text{ID. Host Pipe} - \text{OD Liner Pipe})}{\text{OD Liner Pipe}} \times 100$$

SN is nominal pipe stiffness in psi

Sliplining – Installation

LINER PIPE INSERTION (CONT.)

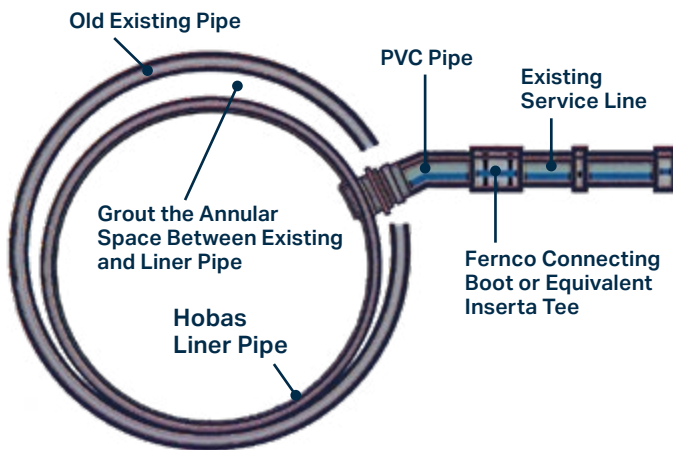
Figure 19. Pipe Insertion



LATERALS

Laterals may be reconnected to the new liner pipe using "Inserta Tees" or similar accessories.

Figure 20. Lateral Service Connection



Most pipeline rehabilitation projects for gravity applications by sliplining are completed without the need for by-pass pumping. (See page 39, bullet 3 of Features and Benefits section).

GROUTING

Grout the annular space between the OD of the installed liner pipe and the ID of the existing pipe with a cement or chemical based grout. Minimum compressive strength of the grout shall be as required to assure the structural adequacy of the rehabilitated pipe. During grout placement, assure that the safe (F of $S \approx 2$) grouting pressure given in Table 18 at left, is not exceeded and that the grout density, lift heights and sewage flow depth are coordinated to control the liner pipe flotation and deformation to within allowable limits.

Grout the annular space between the OD of the installed liner pipe and the ID of the existing pipe with a cement or chemical based grout. Minimum compressive strength of the grout shall be as required to assure the structural adequacy of the rehabilitated pipe. During grout placement, assure that the safe (F of $S \approx 2$) grouting pressure given in Table 18 on page 40, is not exceeded and that the grout density, lift heights and sewage flow depth are coordinated to control the liner pipe flotation and deformation to within allowable limits.



"Inserta Tee" installed in Hobas

Hobas Pipe is Hard Working Pipe

Project Constraints, Time Constraints, Hobas Pipe
Brings the Quality and Support to Make a Tough Job a Success



Jacking / Micro-tunneling – Installation

The jacking procedure enables the pipe to be installed as the tunnel is bored. There are two types of Jacking or Micro-tunneling applications: Non-Pressure and Pressure.

PRODUCT RANGE

Pipe Diameters and Lengths

Hobas Pipe offers a range of fiberglass-reinforced pipes from 24 to 126 inches and up to and including up to nominal 20 foot lengths for jacking pipe.

Features and Benefits

- Allows longer distance bored tunnels with lower jacking loads reducing shaft requirements.
- Pipes are rugged and durable allowing for deep cover handled with ease.
- Hydraulic characteristics are virtually unchanged with time.
- Lightweight pipe sections with high compressive loads along smooth exterior surface permits long distance installations with increase safety margins.

Pressure Classes

Hobas standard flush bell-spigot jacking pipes are capable of up to 50 psi service. Please contact Hobas Engineering for jacking or micro-tunneling applications with operating pressure greater than 50 psi.

Jacking / Micro-tunneling – Installation

A boring head begins the tunnel excavation from an access shaft and is pushed along by a hydraulic jacking unit that remains in the pit. The link to the boring head is maintained by adding a jacking pipe between the pushing unit and the head.

MAXIMUM ALLOWABLE SAFE JACKING LOAD

The jacking contractor must control the jacking loads within the safe limits for the pipe. For the allowable safe jacking loads (pushing “straight”) for a typical design, please see Table 20. However, the ultimate pipe load capacity is the choice and responsibility of the purchaser, and it can be affected by several factors, including:

- Anticipated loads
- Amount of steering, over-cut, and lubrication
- Pipe section length
- Distance of the jacking operation
- Point loading
- Curved alignments (Contact Hobas Engineering for evaluation of project specific curve geometry)

Note Pipes should be jacked with the bell trailing.

TUNNEL DIAMETER

To maximize jacking loads, overcut the tunnel diameter and lubricate the annular. Take care to control the external pressure to within the safe buckling capacity of the pipe.

JOINT AND PIPE DEFLECTION

For seal purposes only, the typical allowable joint angular deflection is between one and two degrees, depending on the spacer thickness and joint configuration. The maximum long-term pipe deflection is typically 3% of the original pipe diameter. For pipes with very high stiffness, a lower deflection limit normally applies.



Hobas jacking pipes have the lowest drive loads

Jacking / Micro-tunneling – Installation

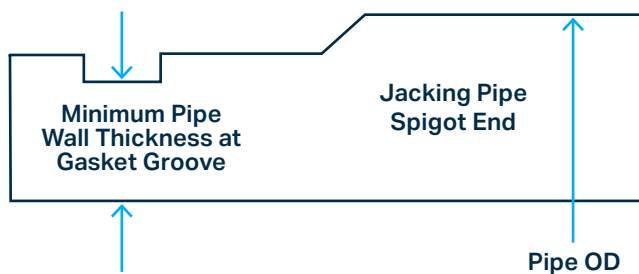
Table 20. Flush Bell-spigot Joint Allowable Compressive Load

Nominal Dia (in)	OD (in)	Nominal Inside Dia (in)	Minimum Pipe Wall Thickness (in)	Min Pipe Wall Thickness at Gasket Groove (in)	Allowable Safe Jacking Load Pushing "Straight" (U.S. Tons)		Weight (lb/ft)
					F of S = 3.0	F of S = 2.5	
24	25.8	22.7	1.40	0.99	125	150	107
27	28.0	24.8	1.47	1.06	145	175	120
28	30.0	26.6	1.53	1.12	166	200	137
30	32.0	28.3	1.71	1.21	191	230	159
33	34.0	30.1	1.80	1.29	216	260	179
36	38.3	34.3	1.85	1.31	250	300	208
41	42.9	38.7	1.91	1.32	283	340	245
42	44.5	40.3	1.93	1.33	295	355	255
44	45.9	41.7	1.95	1.34	308	370	263
45	47.7	43.4	1.98	1.35	325	390	280
48	50.8	46.4	2.03	1.37	350	420	306
51	53.9	49.4	2.07	1.38	375	450	333
54	57.1	52.5	2.10	1.39	400	480	361
57	60.0	55.4	2.13	1.40	425	510	380
60	62.9	58.2	2.16	1.41	450	540	408
63	66.0	61.2	2.20	1.42	475	570	438
66	69.2	64.2	2.31	1.43	500	600	478
69	72.5	67.4	2.38	1.47	541	650	512
72	75.4	70.1	2.46	1.52	583	700	553
78	81.6	76.0	2.58	1.60	667	800	634
84	87.0	81.2	2.70	1.68	750	900	701
85	88.6	82.8	2.73	1.69	770	925	727
90	94.3	88.2	2.85	1.76	854	1025	800
96	99.5	93.1	3.00	1.87	958	1150	886
104	108.0	101.3	3.13	1.94	1083	1300	1009
110	114.0	106.9	3.29	2.05	1208	1450	1129
120	126.0	118.4	3.58	2.25	1470	1765	1350
126	132.5	124.5	3.76	2.37	1600	1920	1500

Note

1. Please contact Hobas for jacking pipe stiffness
2. Alternate pipe designs are available on request.
3. Lead times may be lengthy, please inquire

Figure 21. Jacking Pipe Dimensions



Above Ground Pipeline

Efficient and reliable technology that gets the job done



Above Ground – Installation

Typically used for hydropower, irrigation, water mains, and other pressure applications. Above ground installations must be designed to allow for thrust forces and movement caused by thermal expansion and contraction with varying water temperatures.

PRODUCT RANGE

Pipe Diameters and Lengths

Hobas Pipe offers a range of fiberglass-reinforced pipes from 12 to 126 inches and up to and including 40-foot sections, non-standard custom lengths, and even divisions of 40 feet.

Pressure Classes

Table 21. Pressure Ratings by Pipe Diameter

Nominal Diameter (in)	Pressure Rating (psi)									
	25	50	100	150	200	250	300	350	400	450
12-66										
69-72										
78-90										
96-118										
120-126										

Thermal Expansion

Hobas pipe materials and flow factors are found in Appendix D.

Features and Benefits

- No need for expensive cathodic protection to install, monitor or replace over time
- Long, maintenance-free service life
- Hydraulic characteristics are virtually unchanged with time
- Pipe and couplings are designed to be 100% UV resistant
- Pipe installed on grade or partial buried, can be supported without cradles
- High axial design allows for less pipe supports
- Pressure applications pipes are designed to address operating and surge pressures as well as full vacuum
- Lightweight and longer pipe sections allow for less joints to assemble and less expensive equipment required for handling
- Long radius curves possible without the need for fittings

Above Ground – Installation

SUPPORT CONFIGURATION

Recommended pipe support configuration for ambient temperatures is shown on Table 22 and in Figures 22 and 23. Table 22 shows acceptable Pipe diameters and classes for Figure 21 – Scheme A support, which require only one support location per 20 ft. section. This is best accomplished by a single cradle support on each FWC coupling. These pipes may also be supported as shown in Figure 23 Scheme B with cradles on the pipe wall immediately adjacent to both sides of each coupling, however the mid-point support is not required.

Table 22 also shows acceptable pipe diameters and classes for Scheme B support, requiring 10 ft. on-center supports. This must include a double pipe wall cradle bridging each FWC coupling and a mid-span pipe wall cradle support.

Special pipe designs are available for elevated temperature applications or longer support spans.

Figure 22. – Scheme A

Pipe supported on pipe wall and anchored once per pipe

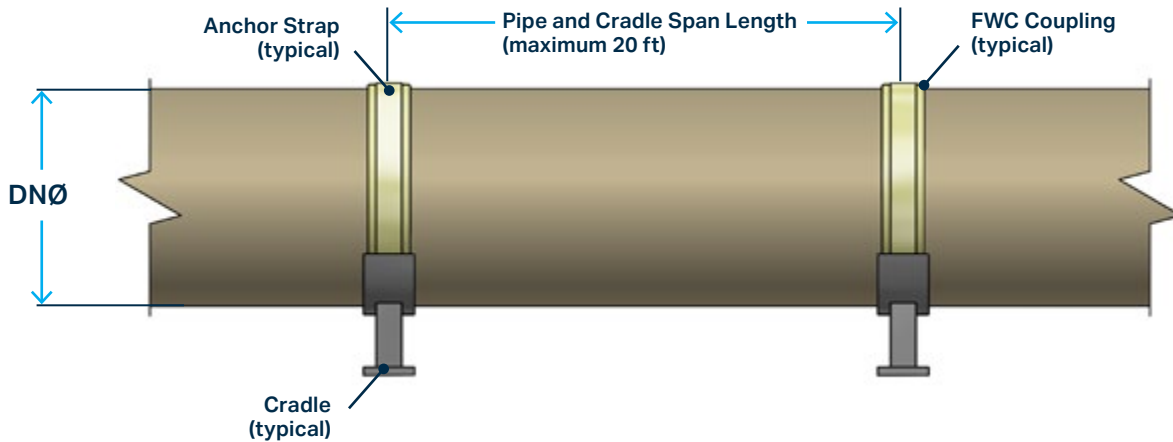
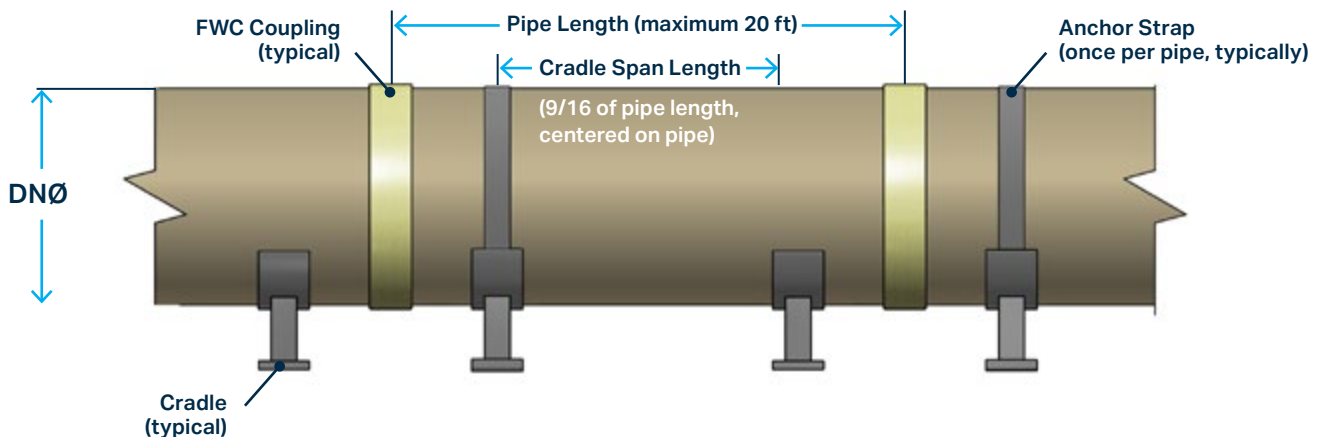


Figure 23. – Scheme B

Pipe supported on pipe wall and anchored once per pipe



Above Ground – Installation

Table 22. Pipe Support Configurations*

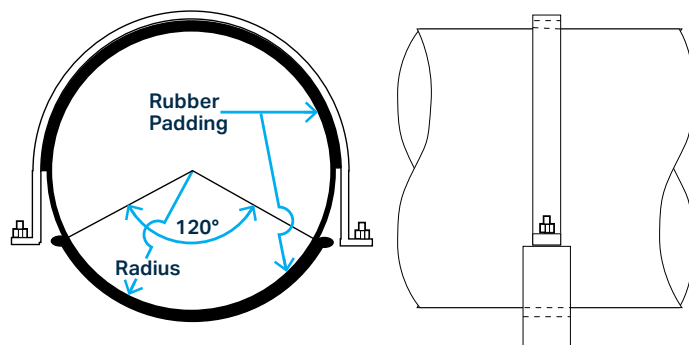
PN**	25 and 50	100	150	200	≥250
Diameter (in)	SN ⁺				
	36/46	≥72	≥36	≥36	≥72
12-20	Scheme A – 10" CC				
24-28	or				
30-36	Scheme B				
41-45			Scheme A		
48-51					
54-57					
60-63					
66-72					
78-126					Non-standard

Note
 1. At ambient temperature
 **PN is pipe pressure class in psi
 + SN is pipe stiffness class in psi

CRADLES

Cradles shall have a minimum 120° (degree) support arc and be dimensioned as shown in Figure 24. All cradles shall be faced with a 1/4" thick rubber padding (approx. 50 to 60 durometer).

Figure 24. Single Cradle with Anchor Detail



Note
 1. See Appendix B for pipe OD Dimensions
 2. See Appendix C for FWC OD Dimensions

ANCHORS

Both support schemes require one anchored cradle, see Figure 24, for each pipe section. The anchor strap over the pipe or coupling shall be padded with rubber to create maximum friction resistance to pipe movement. All cradle positions (support on FWC coupling) must be anchored in support Scheme A. In support Scheme B, one pipe wall cradle (near the FWC coupling) per section should be anchored, as shown in Figures 22 and 23. At the other cradle locations, the pipe may be restrained loosely to prevent lateral or vertical movement but should not be so fixed as to restrict axial sliding.

PIPE RESTRAINT

The pipe support and restraint system must be designed to withstand any unbalanced thrust forces at angularly deflected joints or fittings that may be developed due to pipe pressurization. Other loads caused by wind, temperature changes, fluid momentum, or other factors must also be considered.

Table 23. Single Cradle with Anchor Detail

Support Location	Cradle Radius to Rubber Face	Minimum Cradle Width (in)
On Pipe Wall Scheme B	Pipe OD */2	12-24 Dia. = 3
		27-44 Dia. = 4
		45-78 Dia. = 6
		84-126 Dia. = 8
On FWC Coupling Scheme A	FWC OD **/2	Width of FWC Coupling (8,10,11.5)

Tunnel / Casing Carrier Execution

We're Experts in Finding the Solution
to Your Pipe Challenges



Tunnel / Casing Carrier – Installation

A trenchless method, typical applications for carrier pipe include sanitary sewer interceptors, storm drainage, industrial effluents, culverts, potable water, seawater, sewer force mains, and other corrosive environments. Pipes can be placed in the tunnel one at a time or inserted in a continuous push.

PRODUCT RANGE

Pipe Diameters and Lengths

Hobas Pipe offers a range of fiberglass-reinforced pipes from 12 to 126 inches and up to and including 40-foot sections, non-standard custom lengths, and even divisions of 40 feet.

Pressure Classes

Table 24. Pressure Ratings by Pipe Diameter

Nominal Diameter (in)	Pressure Rating (psi)									
	25	50	100	150	200	250	300	350	400	450
12-66										
69-72										
78-90										
96-118										
120-126										

Table 25. Maximum Safe Grouting Pressure (psi)

Diam. Difference \ Fluid Flow Level	None or Low	Over 1/2 to Full
≤ 5%	SN÷4	SN÷3
≤ 10%	SN÷5	SN÷4
≤ 20%	SN÷6	SN÷5
>20%	SN÷7	SN÷6

Table 26. Maximum Safe Long-term External Head (ft) for an UngROUTED Installation

Diam. Difference \ Fluid Flow Level	All Flow Levels
≤ 5%	SN÷2
≤ 10%	SN÷2.5
≤ 20%	SN÷3
>20%	SN÷4

Note

$$\text{Diameter Difference} = \frac{(\text{ID. Host Pipe} - \text{OD Liner Pipe})}{\text{OD Liner Pipe}} \times 100$$

SN is nominal pipe stiffness in psi

Features and Benefits

- Push-on couplings provide ZERO infiltration/exfiltration – individual joints are designed to be field tested
- Lightweight and longer pipe sections allow for less joints to assemble and less expensive equipment required for handling
- Couplings allow for radius without the need for fittings
- Pressure applications pipes are designed to address operating and surge pressures as well as full vacuum
- Hydraulic characteristics are virtually unchanged with time
- High axial design allows for less pipe supports

Tunnel / Casing Carrier – Installation

Because the conditions and installation for tunnel projects tend to be unique, it is recommended that all criteria be checked for each application to verify the proper pipe stiffness. Check the following criteria:

- External loads and conditions
- Insertion compressive loads (multiple pipe pushing)
- Grouting pressure and deformation loads
- Blocking scheme

Typically, SN46 pipes have sufficient performance capability to withstand most controlled installations safely and are used most often.

Details of pressure service tunnel carrier pipes are available on a custom design basis depending on jacking loads, operating parameters, and installation conditions.

Casing Carrier installations are customized for each project. Please contact Hobas Engineering for details.

CARRIER PIPE INSERTION

Carrier pipes may be placed in the tunnel one at a time or may be inserted in a continuous push in straight alignments. The Hobas carrier pipes must be protected from excessive abrasion if the insertion method involves sliding. Normally, insert the carrier pipe's spigot end first with the pushing force, if used, applied to the pipe wall end inside of the bell, as shown in Figure 19. **DO NOT** apply the pushing load to the end of the bell. Assure that the allowable safe (F of $S \approx 3$) pushing load given in Table 20 is not exceeded.

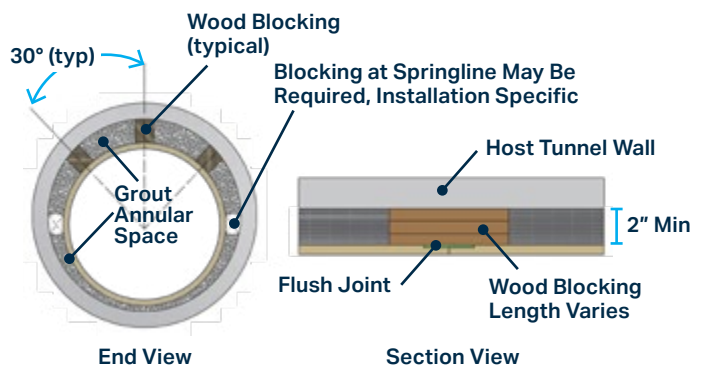
GROUTING

Grout the annular space between the tunnel ID and the carrier pipe OD with a cement or chemical-based grout. Minimum compressive strength of the grout shall be as required to assure the structural adequacy of the completed installation. During grout placement, ensure that both the safe (F of $S \approx 2$) grouting pressure of the carrier pipe (pipe stiffness $\div 5$) is not exceeded and that the grout density, lift heights, and blocking scheme are coordinated to control the carrier pipe deformation loads to within allowable limits.

BLOCKING SCHEMES

The carrier pipes must be blocked within the tunnel to fix line and grade and to aid in the control of deformation of the carrier pipes during grouting. A typical blocking scheme is shown in Figure 25. The actual blocking scheme must be designed so the uplift contact pressure of the blocks on the pipe wall does not exceed allowable limits (maximum contact pressure approximately equal to the pipe stiffness).

Figure 25. Typical Blocking Scheme at Each Joint





You're Good to Go

Our Manhole Installations are Hassle-free



Manhole – Installation

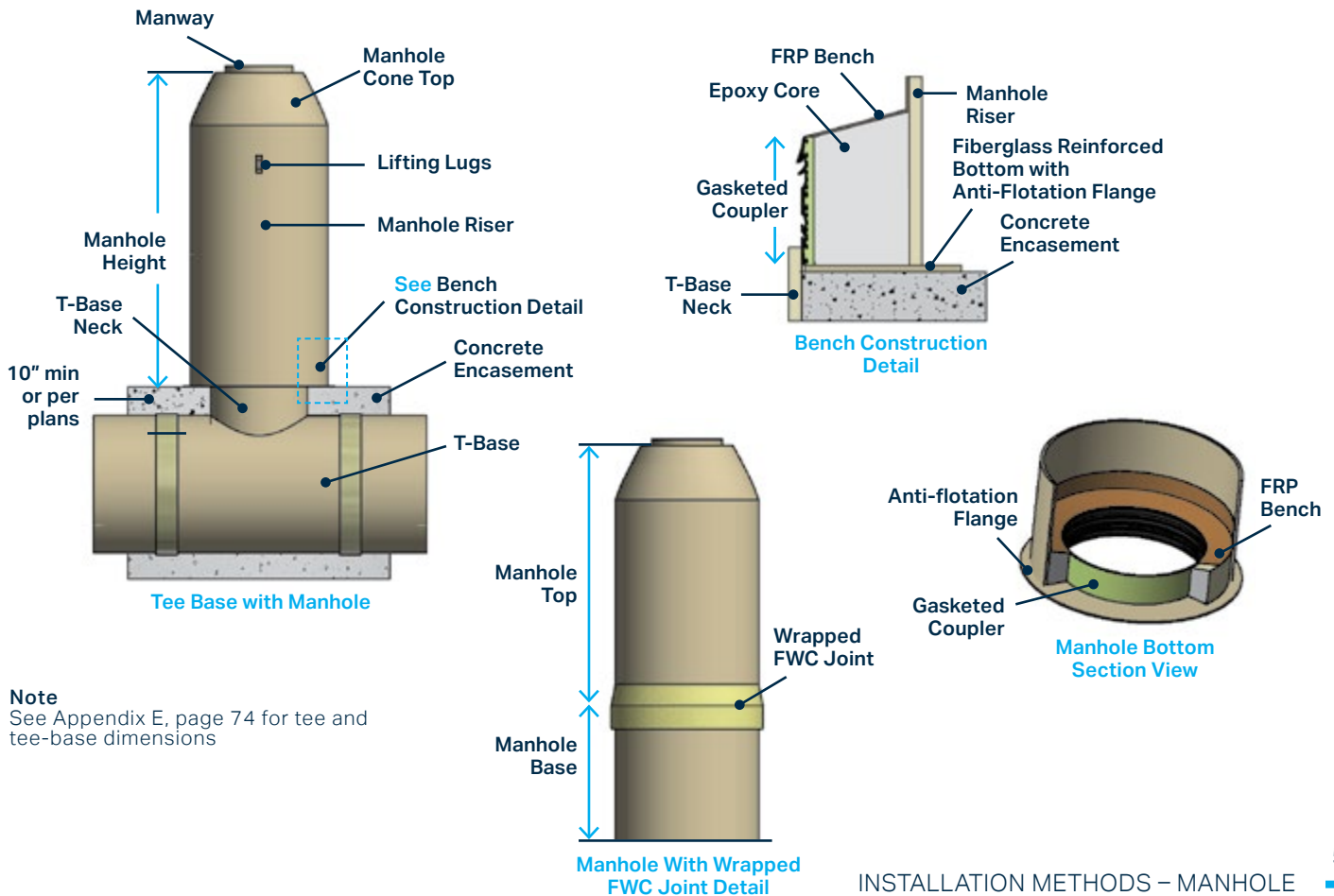
Hobas manhole solutions are made from the same material as the corrosion-resistant, leak-free pipe offering a maintenance-free life. Our manholes meet or exceed ASTM D3753 load rating and HS20/25 traffic rating. See Figure 26 for manhole details. Our complete watertight manhole solutions eliminate the cost and hassle of large cranes on standby, reduce trenching requirements (width) for the tee, minimize flow disruption, and are lightweight and easy to maintain.

PRODUCT RANGE

Features/Sizes

- Exceeds ASTM D3753 Load Rating
- Hobas riser complete with a cone section (standard stiffness of 46 or 72 psi)
- Installed FWC coupling
- Anti-flotation flange
- Hobas engineered cone top
- Hydraulic advantage due to minimal flow disruption
- Custom mitered angles for alignment changes
- Transition pieces from larger riser diameters allow reduction to a 48- or 60-inch riser cone
- Risers are available in 48- and 60-inch diameters with cone openings of 24-, 30- and 36-inches
- Light weight
- Maintenance free
- Complete corrosion-resistant manhole system

Figure 26. Hobas Manhole Riser System



Manhole – Installation

HOBAS MANHOLE SYSTEM

Manhole Risers

Risers are available in 48- or 60-inch in diameter with cone openings of 24-, 30-, and 36-inches and FRP sub outs. Both risers are embedded with FWC couplings and anti-flotation ring. See Table 27 for sizes. Stub outs must be at least two diameter sizes down from the riser diameter (i.e., 60-inch riser with 54-inch stub outs). A minimum height of 3.5 feet is recommended for manholes and three standard lifting lugs.

- 3.5 ft. minimum height for manholes
- 3 lifting lugs standard
- Meets D3753 and HS20/25 loading

Our risers come with embedded FWC coupling sizes (neck) from a minimum of 24 inches to a maximum of 54 inches.

Full Barrel Manhole Risers

Full barrel manholes with a concrete flat or cone top and flat bottom are available in 48- and 60-inch diameters, with a standard stiffness of 46 or 72 psi.

- This manhole option has FRP stub outs.
- Stub outs must be at least 2 diameter sizes down from the riser diameter (i.e. 60in riser with 54in stub outs)

Tee with Risers

Hobas tee base manholes are available in various sizes and configurations and for both traffic and non-traffic-rated designs to meet the requirements of your project. Our hydraulic efficiency means that the flow will remain uninterrupted through the Tee Base structures, minimizing odor emissions and release of hydrogen sulfide gases.

Table 27. 48" and 60" Manhole Risers with Hobas Tee Base

Riser Dia. (in)	Concentric Cone (in)	Eccentric Cone (in)	T-base Neck Size (in)
48	24, 30	n/a	24-42
60	24, 30, 36	30	30-54

Manhole – Installation

OUR RANGE OF OPTIONS MAKE INSTALLATION EASY

Our tee base is manufactured with a push-on, gasket-sealed FWC coupling. This allows for a quick and easy installation of the mainline sewer pipe and the Hobas fiberglass riser section. In most cases, a concrete encasement must be designed to support all riser loads and extend past the nearest couplings so that only the indicated length of the riser neck will remain exposed. Once the concrete around the tee base riser cures, the Hobas riser section can easily attach to the tee base riser with the FWC coupling.

MANHOLES

FEATURES AND BENEFITS

Structural

- Exceeds ASTM D3753 Load Rating by 50%
- AASHTO HS20/HS25 traffic rated
- SN46 or 72 psi pipe stiffness, 1500% higher than ASTM minimums
- Built-in anti-flotation flange when needed
- Concrete encased tee-base handles loads with added safety factor (by others)

Watertight

- Laminated cone to riser section
- Zero Infiltration/Exfiltration top to bottom
- 25 psi internal/100 psi external rating
- Embedded FWC coupling to seat the riser

Hydraulics

- No step-downs at the connection
- Tee is exact ID. as the pipe for minimal flow disruption with constant flow line across the manhole
- Reduced odor emissions with laminar flows
- Any angle turn and any lateral is possible
- 18"-126" Tee sizes
- 48" or 60" Manhole sizes
- 24", 30" and 36" standard manhole openings



Manhole installation in Boise, Idaho.

One Shape Does Not Fit All

Our Non-circular Pipes Solve a Wide Range
of Rehabilitation Challenges



Non-Circular Pipe

Our non-circular pipes can be used in many applications, but are highly desirable in rehabilitation projects, due to their structural capability and hydraulic benefits. Find the best pipe for your job within our wide range of shapes/sizes and leverage the expertise of our field service team and engineers.

Many US cities started building combined sewer systems in the late the 19th century. Still in service today, the large sewers with specially shaped cross sections are the result of great feats of engineering and construction. After such long periods in use, however, rehabilitation often becomes inevitable despite regular maintenance. Hobas NC profiles, with their non-circular cross sections, are ideal for rehabilitating these old sewers. The tight fit combined with the smoothness of our pipe generally results in an increase in hydraulic capacity of the sewer system.

MANUFACTURING METHOD

Hobas NC Pipes are manufactured via a computer controlled process in a steel mold to ensure tight joint tolerances and consistency from the first pipe to the last pipe. Pipe is specifically designed for each particular project to resist all loads, ignoring any support from the surrounding host. A true fully-structural design.

TYPICAL INSTALLATIONS

For rehabilitation projects, the pipes can either be pushed, pulled or carried in place inside the existing sewer and the remaining annular space between the host and NC pipe is filled with grout. This will ensure that all long term loads go directly to the pipe.

Hobas NC pipes are also able to be direct buried as new pipe systems in certain situations. This can be especially beneficial in projects with sections with very shallow cover or clearance issues due to overhead lines and structures.

PRODUCT RANGE

A wide range of sizes (18"-120"), and shapes are available to specifically address the most challenging projects. Not only are classic cross sections, such as elliptical, egg, or mouth are available but other custom shapes and sizes as needed. Having perfected the necessary manufacturing technologies, Hobas is regarded as a specialist for solving complex rehabilitation problems.



One of a selection of Hobas' non-circular pipe profiles.

Appendix A1 – Product Specs

Direct Bury Pipe Installation – Gravity Service

GENERAL

Fiberglass Reinforced Polymer Mortar (FRPM)

References

1. **ASTM D3262** – Standard Specification for “Fiberglass” (Glassfiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pipe.
2. **ASTM D4161** – Standard Specification for Fiberglass Pipe Joints Using Flexible Elastomeric Seals.
3. **ASTM D2412** – Standard Test Method for External Loading Characteristics of Plastic Pipe by Parallel Plate Loading.
4. **ASTM D3681** – Standard Test Method for Chemical Resistance of “Fiberglass” Pipe in a Deflected Condition.
5. **ASTM D638** – Test Method for Tensile Properties of Plastics.

Specifications

1. The specifications contained herein govern, unless otherwise agreed upon between the purchaser and supplier.

PRODUCTS

Materials

1. **Resin Systems** The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
2. **Glass Reinforcements** The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.
3. **Silica Sand** Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.
4. **Additives** Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the pipe.
5. **Elastomeric Gaskets** Gaskets shall meet ASTM F477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

Manufacture and Construction

1. **Pipes** Manufacture pipe utilizing a machine-made process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to sewer flow shall provide crack resistance and abrasion resistance. The exterior of the pipes shall be comprised of a sand/resin or resin/glass layer. Pipes shall be Type 1, Liner 1 or 2, Grade 1 or 3, per ASTM D3262.

Manufacture and Construction (cont.)

2. **Joints** Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed, may utilize gasket-sealed closure couplings.
3. **Fittings** Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glassfiber reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-coated steel and stainless steel fittings may also be used.
4. **Acceptable Manufacturer** Hobas Pipe USA, Inc.

Dimensions

1. **Diameters** The actual outside diameter (18” to 48”) of the pipes shall be in accordance with ASTM D3262. For other diameters, OD’s shall be per manufacturer’s literature.
2. **Lengths** Pipe shall be supplied in nominal lengths of 10-40 feet. Actual laying length shall be nominal +2, -2 inches. At least 90% of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.
3. **Wall Thickness** The minimum wall thickness shall be the stated design thickness.
4. **End Squareness** Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8”

Testing

1. **Pipes** Pipes shall be manufactured and tested in accordance with ASTM D3262.
2. **Joints** Coupling joints shall meet the requirements of ASTM D4161.
3. **Stiffness** Minimum pipe stiffness when tested in accordance with ASTM D2412 shall normally be 36 psi.

Customer Inspection

1. The owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.
2. **Manufacturer’s Notification to Customer:** Should the owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the owner with adequate advance notice of when and where the production of those pipes will take place.

Packaging, Handling, Shipping

1. Packaging, handling, and shipping shall be done in accordance with the manufacturer’s instructions.

EXECUTION

Installation

1. **Burial** The bedding and burial of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer’s requirements.
2. **Pipe Handling** Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.
3. **Joining**
 - a. Clean ends of pipe and coupling components.
 - b. Apply joint lubricant to pipe ends and the elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
 - c. Use suitable equipment and end protection to push or pull the pipes together.
 - d. Do not exceed forces recommended by the manufacturer for coupling pipe.
 - e. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.
4. **Field Tests**
 - a. **Infiltration / Exfiltration Test** – Maximum allowable leakage shall be per local specification requirements.
 - b. **Low Pressure Air Test** – Each reach may be tested with air pressure (max 5 psi). The system passes the test if the pressure drop due to leakage through the pipe or pipe joints is less than or equal to the specified amount over the prescribed time period.
 - c. **Individual Joint Testing** – For pipes large enough to enter, individual joints may be pressure tested with a portable tester to 5 psi max. with air or water in lieu of line infiltration, exfiltration or air testing.
 - d. **Deflection** – Maximum allowable long-term deflection is normally 5% of the initial diameter.
 - e. **Cleaning FRP Pipes** – Several methods of cleaning are possible with FRP pipes, consult the manufacturer prior to initiating cleaning. The improper use of mechanical, pressure cleaning or pigging can or could over time cause damage to the pipe and pipe surface.

Appendix A2 – Product Specs

Sliplining Pipe Installation – Gravity Service

GENERAL

Fiberglass Reinforced Polymer Mortar (FRPM)

References

1. **ASTM D3262** - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
2. **ASTM D4161** – Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
3. **ASTM D2412** – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
4. **ASTM D3681** – Standard Test Method for Chemical Resistance of "Fiber glass" Pipe in a Deflected Condition.
5. **ASTM D638** – Test Method for Tensile Properties of Plastics.

Specifications

1. The specifications contained herein govern, unless otherwise agreed upon between the purchaser and supplier.

PRODUCTS

Materials

1. **Resin Systems** The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
2. **Glass Reinforcements** The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.
3. **Silica Sand** Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.
4. **Additives** Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the product.
5. **Elastomeric Gaskets** Gaskets shall meet ASTM F 477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

Manufacture and Construction

1. **Pipes** Manufacture pipe utilizing a machine-made process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to sewer flow shall provide crack resistance and abrasion resistance. The exterior of the pipes shall be comprised of a sand/resin or resin/glass layer. Pipes shall be Type 1, Liner 1 or 2, Grade 1 or 3, per ASTM D3262.
 2. **Joints** Unless otherwise specified, the pipe shall be field connected with flush fiberglass bell-spigot or a wrapped FWC coupling, when the fit requires. Either joint shall utilize elastomeric sealing gaskets as the sole means to maintain joint water tightness and shall meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed, may utilize gasket-sealed closure couplings.
 3. **Fittings** Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glassfiber reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-coated steel and stainless steel fittings may also be used.
 4. **Acceptable Manufacturer** Hobas Pipe USA, Inc.
- #### Dimensions
1. **Diameters** The actual outside diameter (18" to 48") of the pipes shall be in accordance with AWWA D3262. For other diameters, OD's shall be per manufacturer's literature.
 2. **Lengths** Pipe shall be supplied in nominal lengths of 10-40 feet. When required by radius curves, pit size, sewer irregularities, etc., pipe shall be supplied in nominal lengths of 10 feet or other even divisions of 20 feet. Actual laying length shall be nominal +2, -2 inches. At least 90% of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.
 3. **Wall Thickness** The minimum wall thickness shall be the stated design thickness.
 4. **End Squareness** Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8"
- #### Testing
1. **Pipes** Pipes shall be manufactured and tested accordance with ASTM D3262.
 2. **Joints** Coupling joints shall meet the requirements of ASTM D4161.
 3. **Stiffness** Minimum pipe stiffness when tested in accordance with ASTM D2412 shall normally be 36 psi.

Customer Inspection

1. The Owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.
2. **Manufacturer's Notification to Customer** Should the Owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Owner with adequate advance notice of when and where the production of those pipes will take place.

Packaging, Handling, Shipping

1. Packaging, handling, and shipping shall be done in accordance with the manufacturer's instructions.

EXECUTION

Installation

1. **Installation** The installation of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer's requirements.
2. **Pipe Grouting** Annular space grouting shall not damage the liner and shall conform to the manufacturer's requirements.
3. **Pipe Handling** Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.
4. **Jointing**
 - a. Clean ends of pipe and coupling components.
 - b. Apply joint lubricant to pipe ends and the elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
 - c. Use suitable equipment and end protection to push or pull the pipes together.
 - d. Do not exceed forces recommended by the manufacturer for joining or pushing pipe.
 - e. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.
5. **Field Tests**
 - a. Acceptance of the installed liner shall be based on a videotaped TV inspection after grouting to assure all joints are properly assembled, no damage exists and that any leakage or deformation is within the allowable limits.
 - b. **Cleaning FRP Pipes** – Several methods of cleaning are possible with FRP pipes, consult the manufacturer prior to initiating cleaning. The improper use of mechanical, pressure cleaning or pigging can or could over time cause damage to the pipe and pipe surface.

Appendix A3 – Product Specs

Jacking Pipe Installation – Gravity Service

GENERAL

Fiberglass Reinforced Polymer Mortar (FRPM)

References

1. **ASTM D3262** - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
2. **ASTM D4161** – Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
3. **ASTM D2412** – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
4. **ASTM D3681** – Standard Test Method for Chemical Resistance of "Fiber glass" Pipe in a Deflected Condition.
5. **ASTM D638** – Test Method for Tensile Properties of Plastics.

Specifications

1. The specifications contained herein govern, unless otherwise agreed upon between the purchaser and supplier.

PRODUCTS

Materials

1. **Resin Systems** The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
2. **Glass Reinforcements** The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.
3. **Silica Sand** Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.
4. **Additives** Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the product.
5. **Elastomeric Gaskets** Gaskets shall meet ASTM F 477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

Manufacture and Construction

1. **Pipes** Manufacture pipe utilizing a machine-made process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to sewer flow shall provide crack resistance and abrasion resistance. The exterior surface of the pipes shall be comprised of a sand and resin layer which provides UV protection to the exterior. Pipes shall be Type 1, Liner 2, Grade 3 per ASTM D3262.
2. **Joints** Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. The joint shall have approximately the same OD as the pipe, so when the pipes are assembled, the joints are essentially flush with the pipe outside surface. Tie-ins, when needed, may utilize gasket-sealed mechanical couplings.
3. **Fittings** Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-coated steel and stainless steel fittings may also be used.
4. **Acceptable Manufacturer** Hobas Pipe USA, Inc.

Dimensions

1. **Diameters** The actual outside diameter (18" to 48") of the pipes shall be in accordance with AWWA D3262. For other diameters, OD's shall be per manufacturer's literature.
2. **Lengths** Per manufacturer.
3. **Wall Thickness** The minimum wall thickness shall be the stated design thickness, measured at the bottom of the spigot gasket groove where the wall cross-section has been reduced, is determined from the maximum jacking load. Minimum factor of safety against jacking force is 2.5 based on straight alignment.
4. **End Squareness** Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/16"

Testing

1. **Pipes** Pipes shall be manufactured accordance with ASTM 3236.
2. **Joints** Coupling joints shall meet the requirements of ASTM D4161.
3. **Stiffness** Minimum pipe stiffness when tested in accordance with ASTM D2412 shall normally be 140 psi.

Customer Inspection

1. The Owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.
2. **Manufacturer's Notification to Customer** Should the Owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Owner with adequate advance notice of when and where the production of those pipes will take place.

Packaging, Handling, Shipping

1. Packaging, handling, and shipping shall be done in accordance with the manufacturer's instructions.

EXECUTION

Installation

1. **Installation** The installation of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer's requirements.

2. **Pipe Handling** Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.

3. Jointing

- a. Clean ends of pipe and coupling components.
- b. Apply joint lubricant to pipe ends and the elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
- c. Use suitable equipment and end protection to push or pull the pipes together.
- d. Do not exceed forces recommended by the manufacturer for coupling pipe.

4. Field Tests

- a. **Infiltration / Exfiltration Test** – Maximum allowable leakage shall be per local specification requirements.
- b. **Low Pressure Air Test** – Each reach may be tested with air pressure (max 5 psi). The system passes the test if the pressure drop due to leakage through the pipe or pipe joints is less than or equal to the specified amount over the prescribed time period.
- c. **Individual Joint Testing** – For pipes large enough to enter, individual joints may be pressure tested with a portable tester to 5 psi max. with air or water in lieu of line infiltration, exfiltration or air testing.
- d. **Deflection** – Maximum allowable long-term deflection is 4% of the initial diameter for Hobas jacking pipes. Project specific long-term deflection based on jacking pipe diameter and pipe stiffness shall be provided in the project submittal and corresponding pipe calculations done in accordance with AWWA M45.
- e. **Cleaning FRP Pipes** – Several methods of cleaning are possible with FRP pipes, consult the manufacturer prior to initiating cleaning. The improper use of mechanical, pressure cleaning or pigging can or could over time cause damage to the pipe and pipe surface.

Appendix A4 – Product Specs

Above Ground Pipe Installation – Service

GENERAL

Fiberglass Reinforced Polymer Mortar (FRPM)

References

1. **ASTM D3262** – Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
2. **ASTM D4161** – Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
3. **ASTM D2412** – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
4. **ASTM D3681** – Standard Test Method for Chemical Resistance of “Fiberglass” Pipe in a Deflected Condition.
5. **ASTM D638** – Test Method for Tensile Properties of Plastics.

Specifications

1. The specifications contained herein govern, unless otherwise agreed upon between the purchaser and supplier.

PRODUCTS

Materials

1. **Resin Systems** The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
2. **Glass Reinforcements** The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.
3. **Silica Sand** Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.
4. **Additives** Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the pipe.
5. **Elastomeric Gaskets** Gaskets shall meet ASTM F 477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

Manufacture and Construction

1. **Pipes** Manufacture pipe utilizing a machine-made process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to sewer flow shall provide crack resistance and abrasion resistance. The exterior of the pipes shall be comprised of a sand/resin or resin/glass layer which provides UV protection. Pipes shall be Type 1, Liner 1 or 2, Grade 1 or 3, per ASTM D3262.
2. **Joints** Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed, may utilize gasket-sealed mechanical couplings.
3. **Fittings** Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glassfiber reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-coated steel and stainless steel fittings may also be used.
4. **Acceptable Manufacturer** Hobas Pipe USA, Inc.

Dimensions

1. **Diameters** The actual outside diameter (18” to 48”) of the pipes shall be in accordance with AWWA C950. For other diameters, OD’s shall be per manufacturer’s literature.
2. **Lengths** Per manufacturer.
3. **Wall Thickness** The minimum wall thickness shall be the stated design thickness.
4. **End Squareness** Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8”

Testing

1. **Pipes** Pipes shall be manufactured accordance with ASTM D3262.
2. **Joints** Coupling joints shall meet the requirements of ASTM D4161.
3. **Stiffness** Minimum pipe stiffness when tested in accordance with ASTM D2412 shall normally be 18 psi.

Customer Inspection

1. The Owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.
2. **Manufacturer’s Notification to Customer** Should the Owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Owner with adequate advance notice of when and where the production of those pipes will take place.

Packaging, Handling, Shipping

1. Packaging, handling, and shipping shall be done in accordance with the manufacturer’s instructions.

EXECUTION

Installation

1. **Installation** The installation of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer’s requirements.
2. **Pipe Handling** Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.
3. **Joining**
 - a. Clean ends of pipe and coupling components.
 - b. Apply joint lubricant to pipe ends and the elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
 - c. Use suitable equipment and end protection to push or pull the pipes together.
 - d. Do not exceed forces recommended by the manufacturer for coupling pipe.
 - e. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.
4. **Field Tests**
 - a. Infiltration / Exfiltration Test: Maximum allowable leakage shall be per local specification requirements.
 - b. Individual Joint Testing – For pipes large enough to enter, individual joints may be pressure tested with a portable tester to 5 psi max. with air or water in lieu of line infiltration, exfiltration or air testing.
 - c. Cleaning FRP Pipes – Several methods of cleaning are possible with FRP pipes, consult the manufacturer prior to initiating cleaning. The improper use of mechanical, pressure cleaning or pigging can or could over time cause damage to the pipe and pipe surface.

Appendix A5 – Product Specs

Tunnel / Casing Carrier Pipe Installation – Gravity Service

GENERAL

Fiberglass Reinforced Polymer Mortar (FRPM)

References

1. **ASTM D3262** - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
2. **ASTM D4161** – Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
3. **ASTM D2412** – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
4. **ASTM D3681** – Standard Test Method for Chemical Resistance of "Fiber glass" Pipe in a Deflected Condition.
5. **ASTM D638** – Test Method for Tensile Properties of Plastics.

Specifications

1. The specifications contained herein govern, unless otherwise agreed upon between the purchaser and supplier.

PRODUCTS

Materials

1. **Resin Systems** The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
2. **Glass Reinforcements** The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.
3. **Silica Sand** Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.
4. **Additives** Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the pipe.
5. **Elastomeric Gaskets** Gaskets shall meet ASTM F477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

Manufacture and Construction

1. **Pipes** Manufacture pipe utilizing a machine-made process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to sewer flow shall provide crack resistance and abrasion resistance. The exterior of the pipes shall be comprised of a sand/resin or resin/glass layer. Pipes shall be Type 1, Liner 1 or 2, Grade 1 or 3, per ASTM D3262.

Manufacture and Construction (cont.)

2. **Joints** Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings or bell-spigot joints, "flush" or "non-flush", that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed, may utilize gasket-sealed closure couplings.
3. **Fittings** Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-coated steel and stainless steel fittings may also be used.
4. **Acceptable Manufacturer** Hobas Pipe USA, Inc.

Dimensions

1. **Diameters** The actual outside diameter (18" to 48") of the pipes shall be in accordance with ASTM D3262. For other diameters, OD's shall be per manufacturer's literature.
2. **Lengths** Pipe shall be supplied in nominal lengths of 10-40 feet. When required by radius curves, pit size, or other limitations restrict the pipe to shorter lengths, nominal sections of 10 feet or other even divisions of 20 feet shall be used. Actual laying length shall be nominal +2, -2 inches. At least 90% of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.
3. **Wall Thickness** The minimum wall thickness shall be the stated design thickness.
4. **End Squareness** Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8"

Testing

1. **Pipes** Pipes shall be manufactured and tested in accordance with ASTM D3262.
2. **Joints** Coupling joints shall meet the requirements of ASTM D4161.
3. **Stiffness** Minimum pipe stiffness when tested in accordance with ASTM D2412 shall normally be 36 psi.

Customer Inspection

1. The owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.
2. **Manufacturer's Notification to Customer:** Should the owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the owner with adequate advance notice of when and where the production of those pipes will take place.

Packaging, Handling, Shipping

1. Packaging, handling, and shipping shall be done in accordance with the manufacturer's instructions.

EXECUTION

Installation

1. **Installation** The installation of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer's requirements.
2. **Pipe Grouting** Annular space grouting shall not damage the liner and shall conform to the manufacturer's requirements.
3. **Pipe Handling** Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.
4. **Joining**
 - a. Clean ends of pipe and coupling components.
 - b. Apply joint lubricant to pipe ends and the elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
 - c. Use suitable equipment and end protection to push or pull the pipes together.
 - d. Do not exceed forces recommended by the manufacturer for joining or pushing pipe.
 - e. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.
5. **Field Tests**
 - a. Infiltration / Exfiltration Test – Maximum allowable leakage shall be per local specification requirements.
 - b. Low Pressure Air Test – Each reach may be tested with air pressure (max 5 psi). The system passes the test if the pressure drop due to leakage through the pipe or pipe joints is less than or equal to the specified amount over the prescribed time period.
 - c. Individual Joint Testing – For pipes large enough to enter, individual joints may be pressure tested with a portable tester to 5 psi max. with air or water in lieu of line infiltration, exfiltration or air testing.
 - d. Deflection – Maximum allowable long-term deflection is normally 5% of the initial diameter.
 - e. Cleaning FRP Pipes – Several methods of cleaning are possible with FRP pipes, consult the manufacturer prior to initiating cleaning. The improper use of mechanical, pressure cleaning or pigging can or could over time cause damage to the pipe and pipe surface.

Appendix A6 – Product Specs

Fiberglass Manholes and Wetwells

SCOPE OF WORK

This specification shall govern for the furnishing of all work necessary to accomplish the installation of glass-fiber reinforced polyester Manholes and wetwells. Glassfiber Reinforced Polyester Manholes and Wetwells shall be designed unit constructed of glass-fiber reinforced, unsaturated commercial grade polyester resin. Fiberglass manholes and wetwells shall be manufactured in accordance with ASTM D3753 "Standard Specification for Glass-Fibered Reinforced Polyester Manholes", by Hobas Pipe USA, Houston, Texas.

References

- ASTM D3262** – Standard Specification for "Fiberglass (Glassfiber-Reinforced Thermosetting-Resin) Sewer Pipe 1, 2.
- ASTM D3753** – Standard Specification for Glass-Fiber-Reinforced Polyester Manholes 1.
- ASTM D2412** – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- ASTM D3681** – Standard Test Method for Chemical Resistance of "Fiberglass" (Glassfiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition 1.
- ASTM D695** – Standard Test Method for Compressive Properties of Rigid Plastics.
- ASTM D638** – Standard Test Method for Tensile Properties of Plastics.
- ISO 9001:2015** – Quality managements systems - Requirements.

GENERAL DESCRIPTION

Dimensions

1. The manholes shall be a circular cylinder, reduced at the top to a circular manway not smaller than 22 1/2" inside diameter. Manholes shall be produced in half-foot increments in lengths +/- 2". Nominal inside diameters shall be 42", 48", 54", 60", 66", 72" or larger diameters as agreed upon between purchaser and the manufacturer are covered by this section. Configuration may include reducer sections for larger diameter manholes (>60").

Manhole Top Configurations

1. Cone Sections

a. The manhole cone top must provide a bearing surface on which a standard ring and cover may be supplied and adjusted to grade. The cone top shall be concentric or eccentric and shall be joined to the barrel section at the factory with resin and glass fiber reinforcement, thus providing required monolithic design to prevent infiltration and/or exfiltration through the manhole.

2. Flat Tops (by others)

a. Reinforced concrete flat tops with integral FWC coupling and PVC or FRP corrosion barrier can be used for larger diameters where full barrel access is required or where FRP cone is not practical.

b. Class – The manhole shall be manufactured in one class of load rating This class shall have a minimum HS-20-wheel load (16,000 pounds dynamic wheel load).

2. Flat Tops by Others (Cont)

c. Connections and Stub outs

i. Inlet and outlets connections will be made of FRPM pipe material laminated to FRPM riser pipe and shipped with one spigot end (outlet) and one FWC coupling and (inlet) unless otherwise directed by the purchaser.

- Identified PVC or FRP branch connections will be cored and attached to the manhole riser with fiberglass laminations at the design engineer's flow line elevations, vertical and horizontal angles. All small diameters lateral stub-outs to be furnished as plain end (spigot).

- Field connections of 4"-15" PVC lines can be accomplished with Insert-a-Tee connectors, Boot-type-connectors, or similar.

d. Manhole Bottom

i. Resin and glass reinforced manhole bottoms will be provided with a glass reinforced bottom section with integral FWC coupling for watertight attachment to FRP tee-base riser neck.

ii. Full bench and invert manholes will have a bench manufactured utilizing non-corrosive materials encapsulated in fiberglass minimum 1/4" thick.

e. Marking and Identification – All manholes shall be marked with the following information:

- Manufacturer's name
- Riser vertical height
- ASTM D3753 Designation
- Station number or manhole ID, per project plans.

MATERIALS

1. **Resin** The resin used shall be a commercial grade unsaturated polyester resin or vinyl ester resin. Resins shall be suitable for the service environment intended (i.e. domestic sanitary wastewater).

2. **Reinforcing Materials** The reinforcing material shall be commercial grade fiberglass in the form of mat, chopped roving, roving fabric, or both, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

3. **Riser and Cone** Riser pipe shall be manufactured per ASTM D3262 with cone manufactured of similar materials.

4. **Interior Surfacing Material** The inner surface of the riser pipe exposed to the environment shall have a resin rich non-reinforced layer (nominal 40 mils in thickness) to resist abrasion and crack resistance.

5. **Fillers and Additives** Fillers, when used, shall be inert to the environment and manhole construction. Additives, such as thixotropic agents, catalyst, promoters, etc., may be added as required by the specific manufacturing process to be used to meet the requirements of the referenced ASTM standards.

MATERIALS (CONT)

6. **Height Adjustment** Fiberglass manholes shall be height adjustable using external grade rings or adjustment with an FWC coupling riser joint. Top riser sections can be cut for height adjustment and shall be rejoined with an FWC coupling.

7. **Ring and Cover Platform** Top of cone/reducer shall have a fiberglass support platform upon which grade rings may be installed to accept a typical cast iron ring and cover. Grade rings, ring and cover shall be placed over fiberglass neck (chimney) in a manner that evenly distribute loading onto grade rings only. No loading shall be placed onto fiberglass neck.

REQUIREMENTS

1. **Repairs** Any manhole repair is required to meet all requirements of this specification.

2. **Manhole Riser Lengths** Riser lengths shall be in whole or 1/2-foot increments +/- 2".

3. **Load Rating** The complete manhole riser shall have a minimum dynamic load rating of 16,000 lbf (71 172 N) when tested in accordance with ASTM D3753, 8.4. To establish this rating the complete manhole shall not leak, crack, or suffer other damage when load tested to 40,000 lbf (71 929 N) and shall not deflect vertically downward more than 0.25 in. (6.35 mm) at the point of load application when loaded to 24,000 lb. (106 757 N).

4. **Stiffness** The cylindrical portion of the manhole riser is to be tested in accordance with ASTM Method D2412. The riser cylinder shall have the minimum pipe-stiffness values shown in the table below, when tested in accordance with ASTM D3753, Section 8.5.

5. **Soundness** In order to determine soundness, an air or water test is to be applied to the manhole riser test sample. While holding the pressure between 3-5psi, the entire manhole riser must be inspected for leaks.

Any leakage through the laminate is cause for failure of the test. Refer to ASTM D3753, Sec. 8.6. Manufacturer to provide documentation of previous test per ASTM D3753 Sec. 8.6.

6. **Chemical Resistance** Manhole riser pipe shall meet the chemical testing outlined in ASTM D3262 when tested in accordance with ASTM D3681. Cones shall be manufactured with similar materials.

TEST METHODS

1. All test shall be performed as specified in ASTM D3753, Section 8, Titled "Test Methods". See ASTM D3753, Section 8, Note 5, for test method D790 and test method D-695.

QUALITY ASSURANCE/QUALITY CONTROL

1. **Examinations** Each Manhole riser component part shall be examined for dimensional requirements, hardness, and workmanship.

2. **Composition Control** Controls on glass and resin content shall be maintained for all manufacturing processes and for each portion of the manhole riser fabrication. Records shall be maintained for these control checks. Proper glass content may be shown by glass usage checks or glass and resin application rate checks, in accordance with the material composition test in ASTM D375.

Table 29. Pipe Stiffness Minimums

Minimum Riser Stiffness Values	
3'-6' Manhole Depth	46 psi
7'-12' Manhole Depth	46 psi
13'-20' Manhole Depth	46 psi
21'-25' Manhole Depth	46 psi
26'-45' Manhole Depth	46 psi

Appendix A7 – Product Specs

Fiberglass Reinforced Polymer Mortar (FRPM) Pipe – Pressure Service

GENERAL

Fiberglass Reinforced Polymer Mortar (FRPM) Pipe for Pressure Service

References

1. **ASTM D3754** – Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe.
2. **AWWA C950** – Standard for Fiberglass Pressure Pipe
3. **ASTM D3517** – Standard Specification for “Fiberglass” (Glassfiber-Reinforced Thermosetting-Resin) Pressure Pipe.
4. **ASTM D2412** – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
5. **ASTM D4161** – Standard Specification for “Fiberglass” (Glassfiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
6. **D2992** - Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for Fiberglass Pipe and Fittings.

Specifications

1. The specifications contained herein govern, unless otherwise agreed upon between the purchaser and supplier.

PRODUCTS

Materials

1. **Resin Systems** The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
2. **Glass Reinforcements** The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.
3. **Silica Sand** Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.
4. **Additives** Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the product.
5. **Elastomeric Gaskets** Gaskets shall meet ASTM F 477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

Manufacture and Construction

1. **Pipes** Manufacture pipe utilizing a machine-made process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The pipe nominal pressure class (PN) shall be equal to or greater than the maximum sustained operating pressure of the line. The maximum transient (operating plus surge) pressure of the line shall not exceed the pipe nominal pressure class by more than 40%.
2. **Joints** Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Tie-ins, when needed, may utilize gasket-sealed mechanical couplings.
3. **Fittings** Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glassfiber reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-coated steel and stainless steel fittings may also be used.
4. **Acceptable Manufacturer** Hobas Pipe USA, Inc.

Dimensions

1. **Diameters** The actual outside diameter (18” to 48”) of the pipes shall be in accordance with AWWA C950. For other diameters, OD’s shall be per manufacturer’s literature.
2. **Lengths** Per manufacturer.
3. **Wall Thickness** The minimum wall thickness shall be the stated design thickness.
4. **End Squareness** Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8”

Testing

1. **Pipes** Pipes shall be manufactured accordance with the applicable standard.
2. **Joints** Coupling joints shall meet the requirements of ASTM D4161.
3. **Stiffness** Minimum pipe stiffness when tested in accordance with ASTM D2412 shall normally be 36 psi.
4. **Tensile Strength** Pipe hoop tensile strength for pressure pipe shall be verified as specified in applicable standard (ASTM D3754, D3517 or AWWA C950) or by random burst testing at the same sampling frequency. All pipes shall be capable of withstanding a test pressure of two (2) times the maximum sustained operating pressure of the line for sizes ≥ 54 ”, and 1.5 times for > 54 ” up to 96” without leaking or cracking. For sizes greater than 96”, frequency and test pressure shall be as agreed to between purchaser and manufacturer. This performance shall be verified as agreed between the buyer and seller.

Customer Inspection

1. The Owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.
2. **Manufacturer’s Notification to Customer** Should the Owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Owner with adequate advance notice of when and where the production of those pipes will take place.

Packaging, Handling, Shipping

1. Packaging, handling, and shipping shall be done in accordance with the manufacturer’s instructions.

EXECUTION

Installation

1. **Installation** The installation of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer’s requirements.
2. **Pipe Handling** Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.
3. **Jointing**
 - a. Clean ends of pipe and coupling components.
 - b. Apply joint lubricant to pipe ends and the elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
 - c. Use suitable equipment and end protection to push or pull the pipes together.
 - d. Do not exceed forces recommended by the manufacturer for coupling pipe.
 - e. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.
4. **Field Tests**

- a. **Pressure Test** – Pressure pipes may be field tested after completion of the installation (including required thrust restraints) at a maximum pressure of 1.5 times the system operating pressure not to exceed $1.5 \times \text{PN}$. Prior to testing, assure that all work has been properly completed. When filling the line assure that all air is expelled to avoid dangerous build-up of compressed air potential energy. Pressurize the line slowly, so pressure surges exceeding test pressures are not developed. Check for leaks when the test pressure has stabilized.
- b. **Deflection** – Maximum Allowable long-term deflection is 5% of the initial diameter.
- c. **Cleaning FRP Pipes** – Several methods of cleaning are possible with FRP pipes, consult the manufacturer prior to initiating cleaning. The improper use of mechanical, pressure cleaning or pigging can or could over time cause damage to the pipe and pipe surface.

Appendix A8 – Product Specs

Fiberglass Reinforced Polymer Mortar (FRPM) Pipe – Non-pressure Service

GENERAL

Machine made fiberglass pipe for gravity flow service

References

1. **ASTM D3262** – Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pipe.
2. **ASTM D2412** – Standard Test Method for External Loading Characteristics of Plastic Pipe by Parallel Plate Loading.
3. **ASTM D4161** – Standard Specification for Fiberglass Pipe Joints Using Flexible Elastomeric Seals.
4. **ASTM D3681** – Standard Test Method for Chemical Resistance of “Fiberglass” Pipe in a Deflected Condition.

Specifications

1. The specifications contained herein govern, unless otherwise agreed upon between the purchaser and supplier.

PRODUCTS

Materials

1. **Resin Systems** The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
2. **Glass Reinforcements** The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.
3. **Silica Sand** Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.
4. **Additives** Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the pipe.
5. **Elastomeric Gaskets** Gaskets shall meet ASTM F477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

Manufacture and Construction

1. **Pipes** Manufacture pipe utilizing a machine-made process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to sewer flow shall provide crack resistance and abrasion resistance. Pipes shall be manufactured in accordance with ASTM D3262.

Manufacture and Construction (cont.)

2. **Joints** Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Tie-ins, when needed, may utilize gasket-sealed mechanical couplings.
3. **Fittings** Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glassfiber reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-coated steel and stainless steel fittings may also be used.
4. **Acceptable Manufacturer** Hobas Pipe USA, Inc.

Dimensions

1. **Diameters** The actual outside diameter (18” to 48”) of the pipes shall be in accordance with ASTM D3262. For other diameters, OD’s shall be per manufacturer’s literature.
2. **Lengths** Per manufacturer.
3. **Wall Thickness** The minimum wall thickness shall be the stated design thickness.
4. **End Squareness** Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8”

Testing

1. **Pipes** Pipes shall be manufactured and tested in accordance with ASTM D3262.
2. **Joints** Coupling joints shall meet the requirements of ASTM D4161.
3. **Stiffness** Minimum pipe stiffness when tested in accordance with ASTM D2412 shall normally be 36 psi.

Customer Inspection

1. The owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.
2. **Manufacturer’s Notification to Customer:** Should the owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the owner with adequate advance notice of when and where the production of those pipes will take place.

Packaging, Handling, Shipping

1. Packaging, handling, and shipping shall be done in accordance with the manufacturer’s instructions.

EXECUTION

Installation

1. **Installation** The installation of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer’s requirements.
2. **Pipe Handling** Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.
3. **Joining**
 - a. Clean ends of pipe and coupling components.
 - b. Apply joint lubricant to pipe ends and the elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
 - c. Use suitable equipment and end protection to push or pull the pipes together.
 - d. Do not exceed forces recommended by the manufacturer for coupling pipe.
 - e. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.
4. **Field Tests**
 - a. **Infiltration / Exfiltration Test** – Maximum allowable leakage shall be per local specification requirements.
 - b. **Low Pressure Air Test** – Each reach may be tested with air pressure (max 5 psi). The system passes the test if the pressure drop due to leakage through the pipe or pipe joints is less than or equal to the specified amount over the prescribed time period.
 - c. **Individual Joint Testing** – For pipes large enough to enter, individual joints may be pressure tested with a portable tester to 5 psi max. with air or water in lieu of line infiltration, exfiltration or air testing.
 - d. **Deflection** – Maximum allowable long-term deflection is normally 5% of the initial diameter.
 - e. **Cleaning FRP Pipes** – Several methods of cleaning are possible with FRP pipes, consult the manufacturer prior to initiating cleaning. The improper use of mechanical, pressure cleaning or pigging can or could over time cause damage to the pipe and pipe surface.

Appendix B – Pipe Dimensions and Weights

Table 30. Pipe Dimensions and Weights

Nominal Diameter (in)	Pipe OD (in)	SN 46		SN 72	
		Min Wall T (in)	Pipe Weight (lb/ft)	Min Wall T (in)	Pipe Weight (lb/ft)
12	13.2	0.21	11	0.24	13
14	15.3	0.24	16	0.28	18
16	17.4	0.28	20	0.32	23
18	19.5	0.31	25	0.36	28
20	21.6	0.34	30	0.39	34
24	25.8	0.41	42	0.47	47
27	28.0	0.44	49	0.51	55
28	30.0	0.47	55	0.55	63
30	32.0	0.50	63	0.58	71
33	34.0	0.53	70	0.62	80
36	38.3	0.60	88	0.70	101
41	42.9	0.67	109	0.78	125
42	44.5	0.70	117	0.81	134
44	45.9	0.72	124	0.83	142
45	47.7	0.75	135	0.86	153
48	50.8	0.80	151	0.92	173
51	53.9	0.84	171	0.98	195
54	57.1	0.89	190	1.03	217
57	60.0	0.94	209	1.09	239
60	62.9	0.98	228	1.14	263
63	66.0	1.03	252	1.19	288
66	69.2	1.08	277	1.25	317
69	72.5	1.13	301	1.31	348
72	75.4	1.18	328	1.36	375
78	81.6	1.28	380	1.48	437
84	87.0	1.36	432	1.57	495
85	88.6	1.38	448	1.60	515
90	94.3	1.47	506	1.71	581
96	99.5	1.55	562	1.80	646
104	108.0	1.69	660	1.95	758
108	112.6	1.76	687	2.04	831
110	114.0	1.78	710	2.06	817
118	120.7	1.88	785	2.18	920
120	126.0	1.97	863	2.27	992
126	132.5	2.07	975	2.44	1125

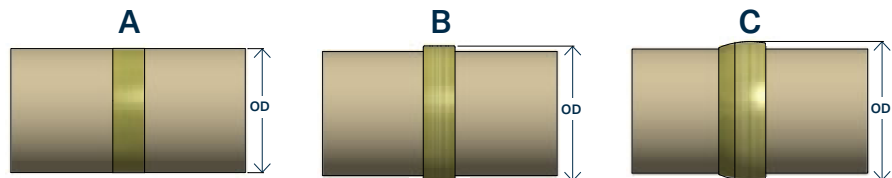
Appendix C – Coupling Dimensions and Weights

Table 31. Coupling Dimensions and Weights

Nominal Diameter (in)	NOMINAL OUTSIDE DIAMETER, OD (in)				
	Pipe OD (in)	FWC Coupling OD	FWC Coupling Weight (lb)	Flush Bell-spigot	Pressure Relining (in)
18	19.5	21.3	25	19.5	21.7
20	21.6	23.4	28	21.6	23.8
24	25.8	27.6	43	25.8	28
27	28.0	29.8	46	28.0	30.2
28	30.0	31.9	50	30.0	32.3
30	32.0	33.9	53	32.0	34.3
33	34.0	35.9	56	34.0	36.3
36	38.3	40.2	64	38.3	40.6
41	42.9	44.9	71	42.9	45.3
42	44.5	46.5	74	44.5	46.9
44	45.9	47.9	76	45.9	48.3
45	47.7	49.7	79	47.7	50
48	50.8	52.8	84	50.8	53.2
51	53.9	56.0	89	53.9	56.4
54	57.1	59.2	94	57.1	59.6
57	60.0	62.2	100	60.0	62.6
60	62.9	65.2	140	62.9	65.6
63	66.0	68.3	148	66.0	68.7
66	69.2	71.6	155	69.2	72
69	72.5	74.9	166	72.5	75.3
72	75.4	77.9	178	75.4	78.3
78	81.6	84.2	194	81.6	84.6
84	87.0	89.6	209	87.0	90
85	88.6	91.4	215	88.6	91.8
90	94.3	97.1	234	94.3	97.5
96	99.5	102.5	251	99.5	102.9
104	108.0	111.1	279	108.0	111.5
108	112.6	115.7	300	112.6	116.1
110	114.0	117.2	306	114.0	117.6
118	120.7	123.8	345	120.7	124.2
120	126.0	129.3	355	126.0	129.7
126	132.5	135.8	450	132.5	136.2

MEASURING PIPE OD

- A. Flush Bell-Spigot
- B. FWC Coupling
- C. Pressure Relining



Appendix D – Pipe Materials and Characteristics

HOBAS PIPE MATERIALS AND FLOW FACTORS

Material Properties

Hobas Pipe USA pipes exceed the requirements of ASTM D3262 for non-pressure applications and of AWWA C950 for pressure service. Actual properties vary depending on pressure and stiffness class. The following range of values covers most pipe constructions. For values specific to individual pipes contact Hobas Pipe USA.

PIPE PROPERTY	RANGE OF VALUES ¹	
E-Modulus¹ (106 psi):	Up to PN25	PN 50 to 450
* Circumferential Flexural	1.0 to 1.9	1.3 to 2.4
* Circumferential Tensile	–	0.5 to 2.8
* Axial Tensile	0.4 to 0.8	0.4 to 1.7
Strength¹ (103 psi):		
* Circumferential Tensile	–	7.0 to 33.0
* Axial Tensile	1.4 to 2.1	1.4 to 6.4
* Compressive	10.5	10.5
Thermal Coefficient of Linear Expansion (axial)	16 x 10 ⁻⁶	in/in/°F

Flow Factors

Flow factors vary somewhat with pipe diameter and flow rate. The following values have been found to be typically representative longterm and are commonly used.

* Hazen-Williams	"C" 155
* Manning's	"n" 0.009

Appendix E1 – Fitting Dimensions

FIBERGLASS ELBOWS

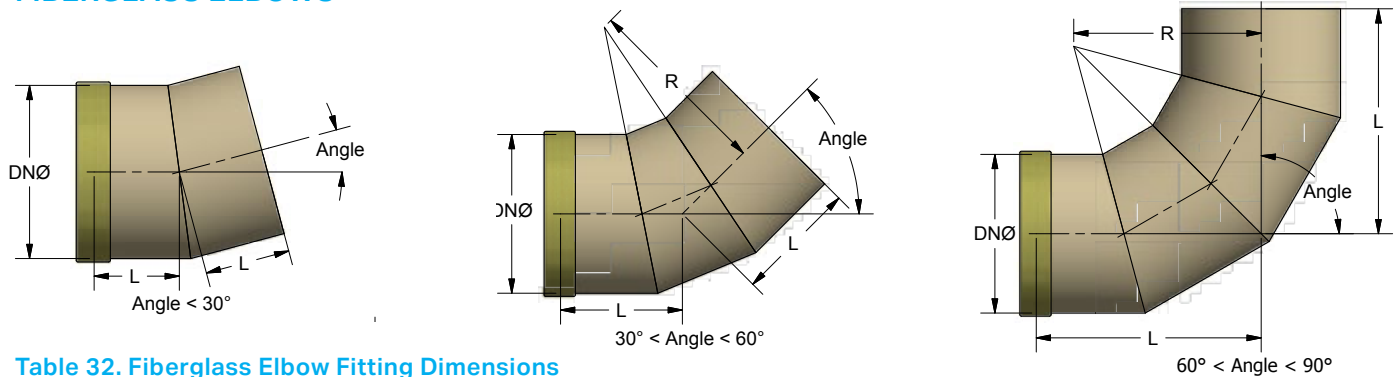


Table 32. Fiberglass Elbow Fitting Dimensions

DN (in)	R (in)	L (in) FOR OC					
		11 1/4°	22 1/2°	30°	45°	60°	90°
12	21	16	17	18	21	24	33
18	27	18	19	20	25	30	40
20	30	18	19	20	26	31	42
24	36	20	21	22	28	33	48
27	38	20	21	22	29	34	50
28	40	20	22	23	30	35	52
30	42	20	22	23	31	36	54
33	44	20	22	24	32	37	56
36	48	20	22	24	33	39	60
41	52	22	23	25	36	42	64
42	54	23	25	26	37	43	66
44	55	23	25	26	37	44	67
45	57	23	25	27	38	45	69
48	60	25	25	27	39	46	72
51	63	27	27	28	40	48	75
54	66	28	28	28	41	49	78
57	68	30	30	30	42	50	81
60	70	31	31	31	43	51	84
63	73	33	33	33	44	53	87
66	75	34	34	34	45	54	90
69	78	36	36	36	47	55	93
72	80	38	38	38	48	56	96
78	84	41	41	41	51	60	102
84	88	43	43	43	53	63	106
85	90	44	44	44	54	64	108
90	95	47	47	47	57	68	114
96	100	50	50	50	60	72	120
104	108	54	54	54	63	76	126
110	112	57	57	57	66	80	132
120	120	63	63	63	72	88	144
126	126	66	66	66	72	88	144

Note

1. L may need to be increased if the design pressure exceeds 50 PSI.
2. Dimensions for other angles or different turning radii are available upon request.

Appendix E2 – Fitting Dimensions

FIBERGLASS REDUCERS

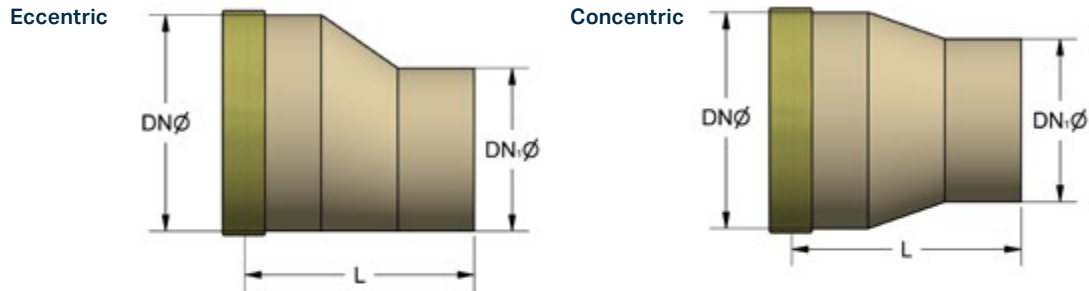


Table 35. Fiberglass Reducer Fitting Dimensions

DN (in)	DN1 ¹ (in)	L (in)	DN1 ¹ (in)	L (in)	DN1 ¹ (in)	L (in)	DN1 ¹ (in)	L (in)
20	18	48	-	-	-	-	-	-
24	20	54	18	57	-	-	-	-
27	24	54	20	60	18	63	-	-
28	24	54	20	60	18	63	-	-
30	24	57	20	63	18	66	-	-
33	30	54	24	63	20	69	18	72
36	30	57	24	66	20	72	18	75
41	36	57	30	66	24	75	20	81
42	36	57	30	66	24	75	20	81
44	36	60	30	69	24	78	20	84
45	42	54	36	63	30	72	24	81
48	42	57	36	66	30	75	24	84
51	48	54	42	63	36	72	30	81
54	48	57	42	66	36	75	30	84
57	54	60	48	63	42	72	36	81
60	54	63	48	66	42	75	36	84
63	60	66	54	66	48	72	42	81
66	60	69	54	69	48	75	42	84
69	66	72	60	72	54	72	48	81
72	66	75	60	75	54	75	48	84
78	72	81	66	81	60	81	54	84
84	78	87	72	87	66	87	60	87
85	78	90	72	90	66	90	60	90
90	84	96	78	96	72	96	66	96
96	90	99	84	99	78	99	72	99
104	96	108	90	108	84	108	78	108
110	104	114	96	114	90	114	85	114
120	110	126	104	126	96	126	90	126
126	120	132	110	132	104	132	96	132

Note

1. Dimensions for other combinations of DN and DN1 are available upon request.
2. L may need to be increased if the design pressure exceeds P.

Appendix E3 – Fitting Dimensions

FIBERGLASS FLANGES

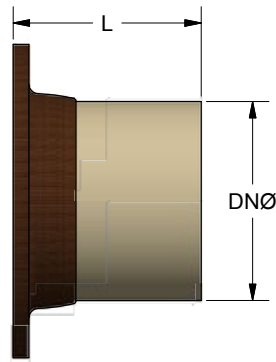


Table 36. Fiberglass Flange Fitting Dimensions

DN (in)	Minimum L (in)	Minimum OD of Flange (in)	Number of Bolts (in)	Bolt Circle Diameter (in)	Bolt Diameter (in)	Min Bolt Hole Diameter (in)
12	18	19.00	12	17.00	0.688	.8125
14	18	21.00	12	18.75	0.688	.8125
16	24	23.50	16	17.00	0.688	.8125
18	24	25.00	16	21.25	1.125	1.250
20	30	27.50	20	25.00	1.125	1.250
24	30	32.00	20	29.50	1.250	1.375
27	32	34.25	24	31.75	1.250	1.375
28	34	36.50	28	34.00	1.250	1.375
30	36	38.75	28	36.00	1.250	1.375
36	36	46.00	32	42.75	1.500	1.625
41	40	50.75	36	47.25	1.500	1.625
42	42	53.00	36	49.50	1.500	1.625
48	48	59.50	44	56.00	1.500	1.625
54	48	66.25	44	62.75	1.750	1.875
60	48	73.00	52	69.25	1.750	1.875
66	48	80.00	52	76.00	1.750	1.875
72	48	86.50	60	82.50	1.750	1.875
78	48	93.00	64	89.00	2.000	2.125
84	48	99.75	64	95.50	2.000	2.125
90	48	106.50	68	102.00	2.250	2.375
96	48	113.25	68	108.50	2.250	2.375
104	48	120.00	72	114.50	2.500	2.625
110	48	126.75	72	120.75	2.500	2.625
120	48	140.25	76	132.75	2.75	2.875
126	48	147.00	80	139.25	3.00	3.125

Note

1. Flange drilling dimensions are according to AWWA C207 Class D (150 psi) and ANSI B16.1 (125 psi)
2. Fiberglass reinforced polymer flanges are available for non-pressure and some pressure applications. Protected ductile iron, fusion bonded epoxy coated steel or stainless steel flanges may be used at any pressure.

Appendix E4 – Fitting Dimensions

FIBERGLASS MANHOLE FITTING DIMENSIONS

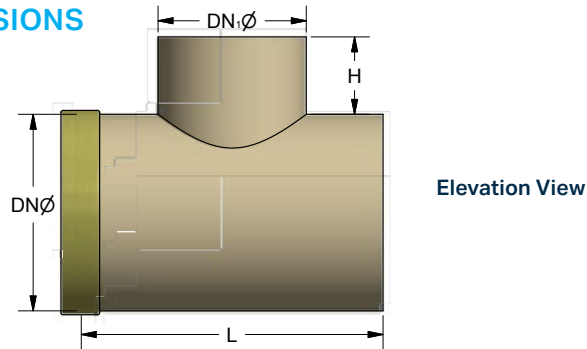


Table 37. Fitting Dimensions of Fiberglass Manhole Tee Bases

DN (in)	DN1' (in)	L (in)	H (in)	DN1' (in)	L (in)	H (in)	DN1' (in)	L (in)	H (in)
30	24	54	15	30	60	15	30	60	15
33	24	54	15	30	60	15	30	60	15
36	24	54	15	36	78	15	36	78	15
41	24	54	15	36	78	15	36	78	15
42	24	54	15	36	78	15	36	78	15
44	24	54	15	36	78	15	36	78	15
45	24	54	15	36	78	15	36	78	15
48	24	54	15	36	78	15	48	78	15
51	24	54	15	36	78	15	48	78	15
54	24	54	15	36	78	15	48	78	15
57	24	78	15	36	78	15	48	78	15
60	24	78	15	36	78	15	48	78	15
63	24	78	15	36	78	15	48	78	15
66	24	78	15	36	78	15	48	78	15
69	24	78	15	36	78	15	48	78	15
72	24	78	15	36	78	15	48	78	15
78	24	78	15	36	78	15	48	78	15
84	24	108	15	36	108	15	48	108	15
85	24	108	15	36	108	15	48	108	15
90	24	108	15	36	108	15	48	108	15
96	24	108	15	36	108	15	48	108	15
104	24	108	15	36	108	15	48	108	15
110	24	108	15	36	108	15	48	108	15
120	24	114	15	36	114	15	48	114	15
126	24	114	15	36	114	15	48	114	15

Note

1. Total lay length "L" shown above is typical for (DN1) branch diameter shown. Adjustment to "L" are available.
2. All tee bases to be concrete encased to prevent deformations. Concrete design by others.
3. Complete manhole design by others to include allowance for transfer of surface loads (HS-20) away from branch (DN1).
4. "H" dimension shown is typical, it can be adjusted to allow for specific encasement heights, service laterals, FRP riser connections with FWC couplings, etc.
5. Configurations shown (DN x DN1) can be adjusted to meet specific designs.
6. DN1 can change but must be less than or equal to DN for all tee base configurations.
7. Above dimensions are for straight thru (180 deg.) configurations. Tee bases with angles (PI's) are available, with increased L

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