



HOBAS®

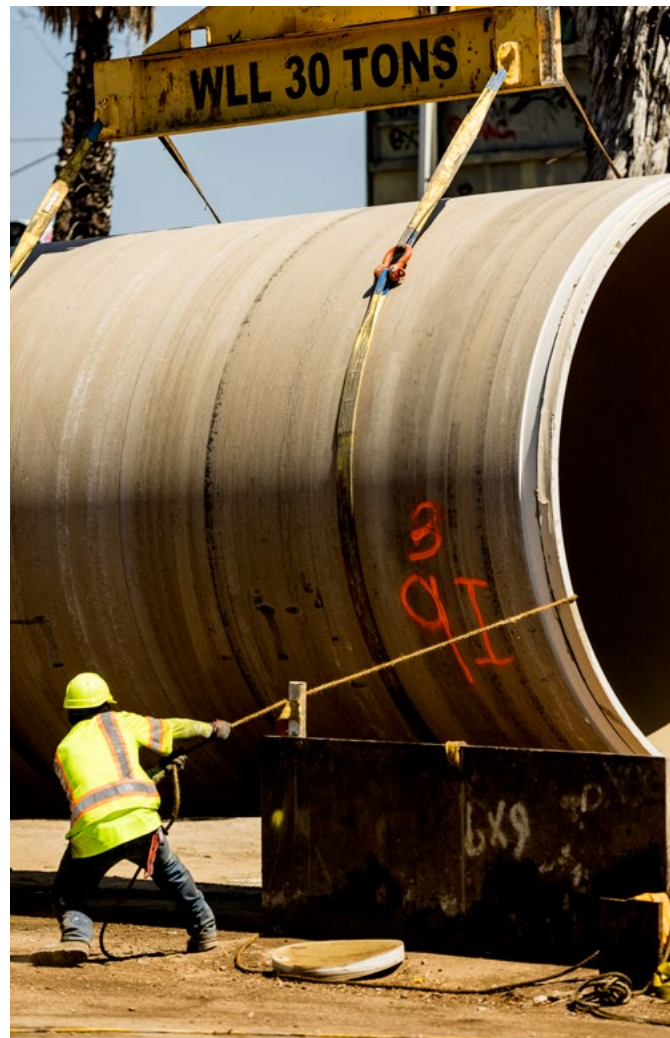


# Hobas Pipe Product Guide

Manufacturers of Fiberglass Reinforced Polymer Mortar Pipe



Engineered to Endure™



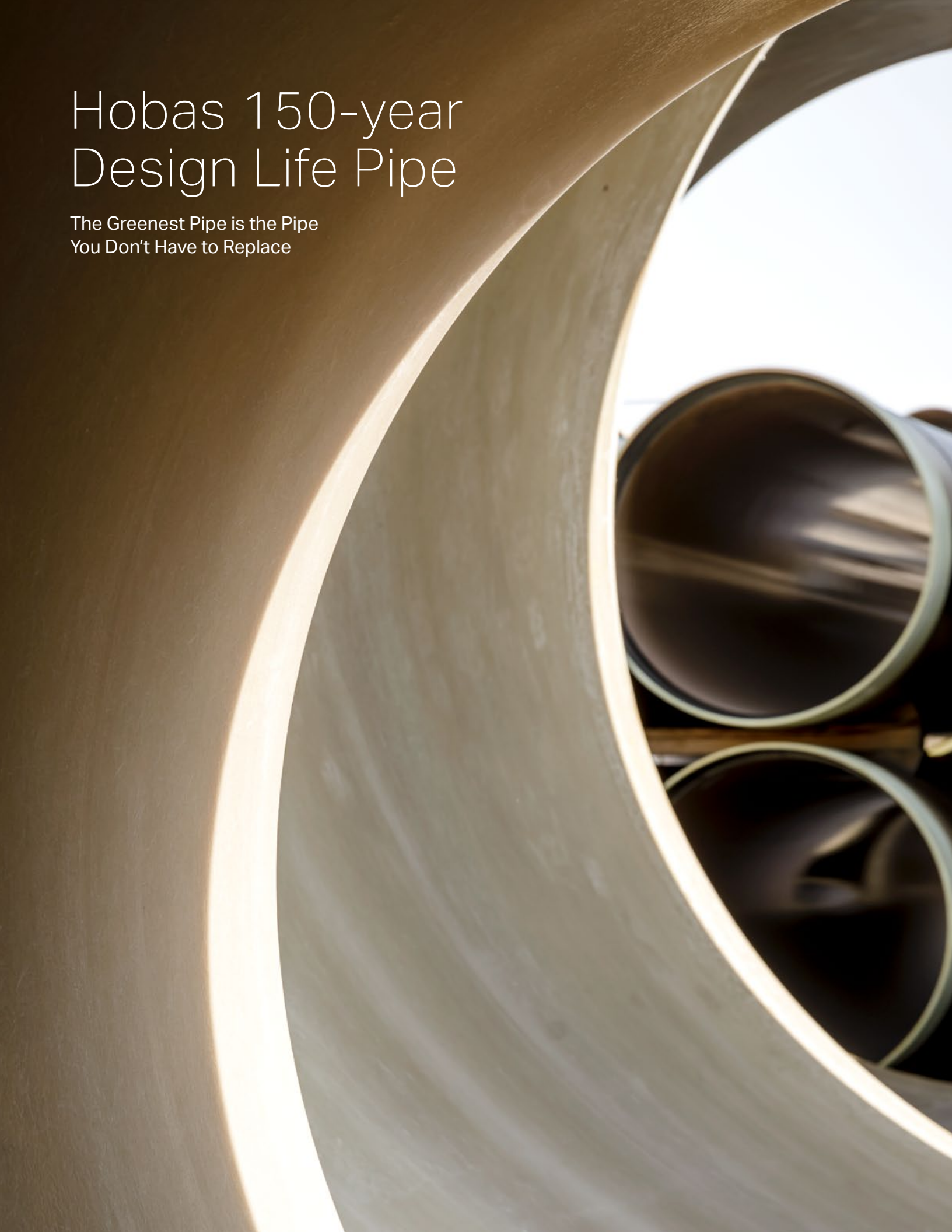
# Hobas Pipe Product Guide

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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

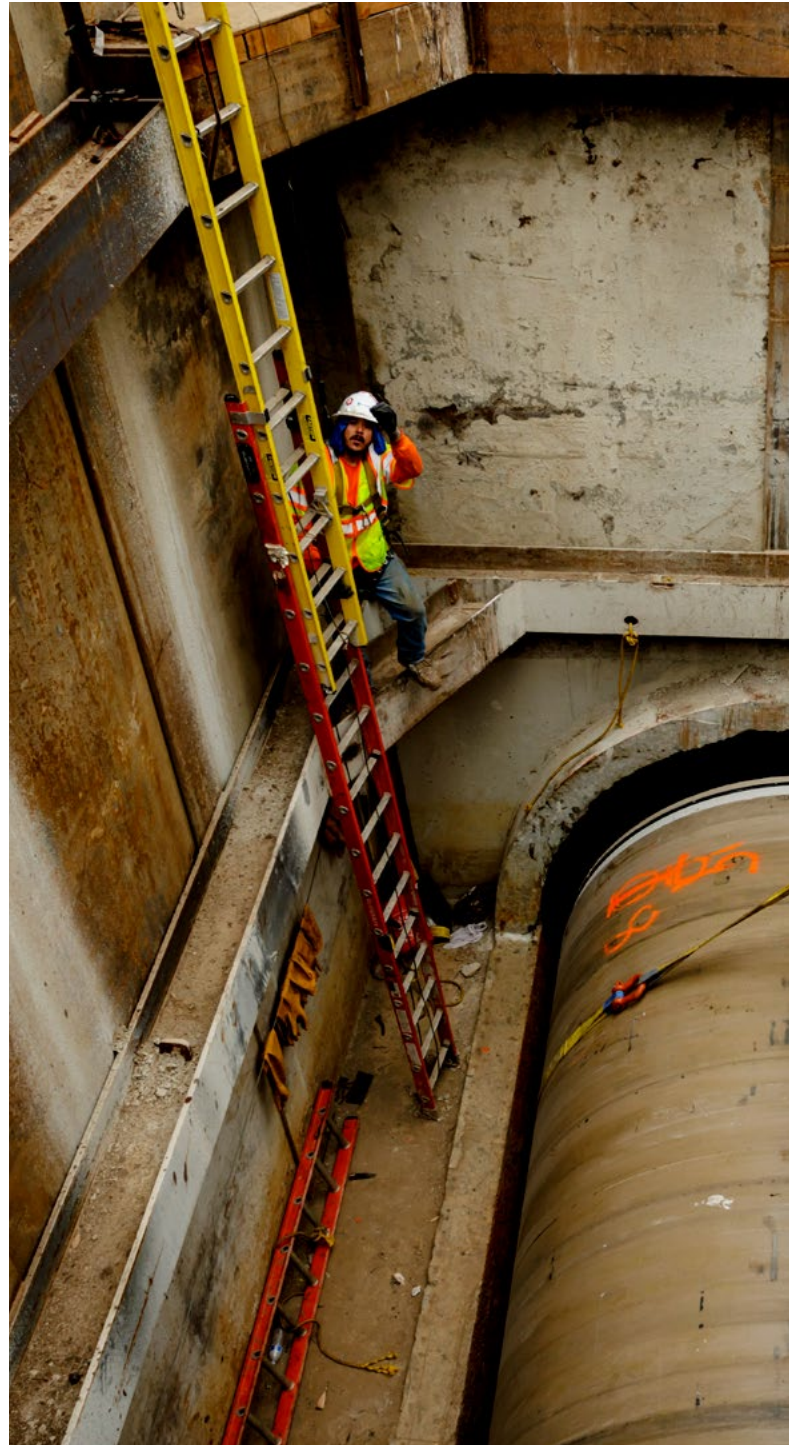
Hobas Pipes are manufactured with a precise, computer-controlled production process, ensuring consistent, high-density, resilient, abrasion-resistant, and high-flow capacity pipe.

## 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 1986, 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 plastic (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.

**Values** Own It / Bring Value / Uncover Better / Be the Spark

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



# 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 chopped 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 multiparameter 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
<b>Non-pressure Sanitary Sewers</b>	ASTM D3262
<b>Sewer Force Mains Industrial Effluents (Pressure)</b>	ASTM D3754
<b>Pressure Water Systems</b>	AWWA C950 ASTM D3517
<b>Fiberglass Pipe Design</b>	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

- ISO 9001
- ISO 14001
- NSF Standard 61
- BNQ Potable Water Approval

# 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 lifecycle, 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**

Lager 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 and up to and including 40-foot sections, non-standard custom lengths (such as 27", 33", 41", 45", etc.), and even divisions of 40 feet.

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 <sup>1</sup>	Minimum Cover (ft.) for AASHTO HS-20 Load <sup>2</sup>	
	SN 36 or 46	SN 72
1	3	2
2	4	3
3	5	4

**Note**

<sup>1</sup> See Figure 2 on page 17

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

<sup>3</sup> Table assumes burials in native soils with SPT 2 bpf minimum

<sup>4</sup> 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 <sup>1</sup>		Allowable Negative Pressure	
		SN 36 or 46	SN 72
Buried <sup>2,3</sup>	1	100	100
	2	100	100
	3	50	100
Aboveground <sup>4</sup>		50	100

<sup>1</sup> See Standard Embedment Conditions on Figure 2 in the Direct Bury Installation section.

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

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

<sup>4</sup> 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 <sup>1</sup> (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

<sup>1</sup> 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.



# 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.



*Hobas Field Service Team*

For any questions related to Hobas Field Service or the installation of Hobas products, the leaders of the Field Service team can be reached at

**[fieldservice@hobaspipe.com](mailto:fieldservice@hobaspipe.com)**

And for technical support, our Engineering Team can be reached at

**[engineering@hobaspipe.com](mailto:engineering@hobaspipe.com)**

# Joins

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 TYPES

Several joint types are available to meet the requirements of many different applications for pressure and non-pressure systems. The FRP sleeve 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.



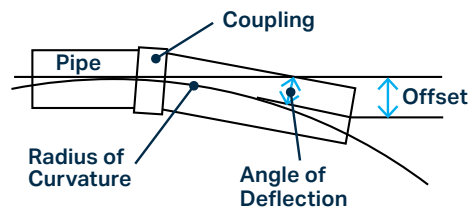
Hobas T-Joint connection ready to install

Table 5. Coupling Selection

Installation	Service	
	Low-pressure	Pressure
Direct Bury	FRP Coupling	FRP Coupling and Restrained Couplings
Sliplining	Flush Bell-spigot	Wrapped FRP Coupling
Jacking	Flush Bell-spigot	Flush FRP Coupling
Aboveground	FRP Coupling	FRP Coupling
Tunnel Carrier	Flush Bell-spigot FRP	FRP 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. Laminated joints
  - a. Internal only lamination after backfill
  - b. internal and external lamination
3. Epoxied joint
4. Concrete – axial concrete and thrust blocks

# Couplings

## INTRODUCING OUR FRP RESTRAINED COUPLING

For more than 60 years Hobas pressure pipe has been specified and successfully used in high pressure applications. Hobas FRP coupling joints (unrestrained joints) manage unbalanced thrust forces using external restraints.

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**

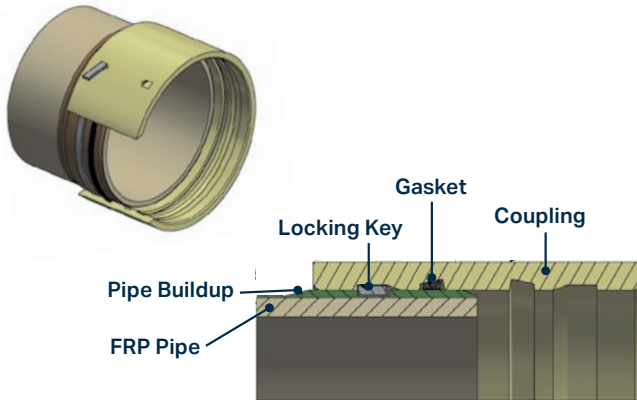


Figure 2 above, shows a restrained joint option for 18 to 48-inch sizes with a maximum of 150 psi operating pressure. Unrestrained joints are managed based on pressure, pipe, and site parameters.



*FRP restrained coupling*

### FRP Restrained Coupling Parameters

Hobas Pipe USA, Inc. offers mechanical restrained joints for pipes in 18" through 48" using a high strength nylon key locked between two FRP joint grooves on the spigot and bell.

All pipes are manufactured per ASTM D3754, D3517 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 6. Pressure Capability of the FRP Restrained Coupling**

Diameter DN (in)	Pressure Class (PN*) PSI	Field Test Pressure (1.5xPN) PSI
18-48	150	225

\* Higher PN classes and other diameters (DN) are available. Contact Hobas' Engineering team for details

# Couplings

## FRP SLEEVE COUPLING

### Performance

The FRP coupling is a structural filament wound sleeve 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 FRP 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 FRP coupling at any place along their entire length with no preparation or machining other than chamfering of the pipe ends.

Figure 3. FRP Sleeve Coupling Plan View

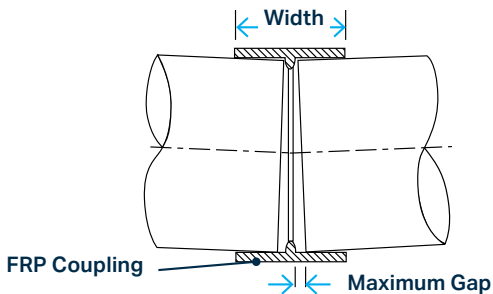
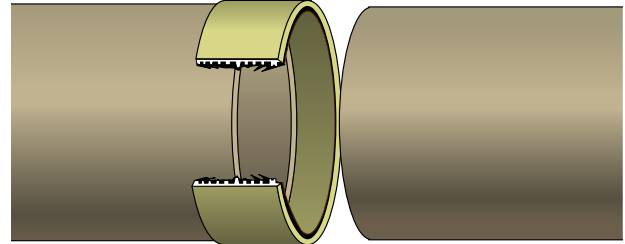


Table 7. FRP Coupling Joint Gap and Angular Deflection

Diameter (in)	Coupling Width (in)*	Joint Gap (in)	Max Deflection Angle (degrees)
18-20	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. FRP Coupling



## PRESSURE RELINING

The pressure relining joint is an overwrapped structural filament wound sleeve mechanically locked to an internal full-face elastomeric membrane. Like the FRP coupling, the sealing design includes lip and compression elements, making it suitable for both non-pressure and pressure service up to 250 psi for sliplining installations.

Figure 5. Wrapped Pressure Relining

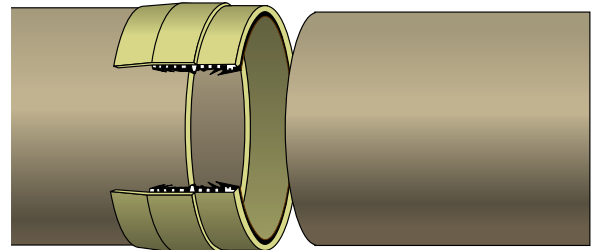


Table 8. Minimum Radius of Curvature for Various Deflected Joints

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



# 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 non-pressure service in jacking and tunnel carrier installations, although it may be used in non-pressure relining applications.

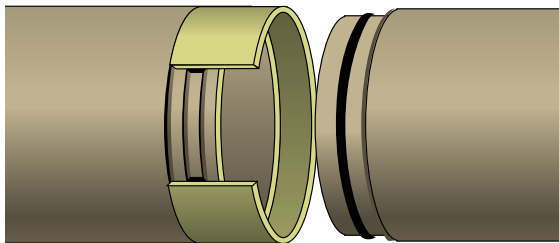
**Table 9. Flush Joint Gap**

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 10. Joining Forces for Hobas Couplings**

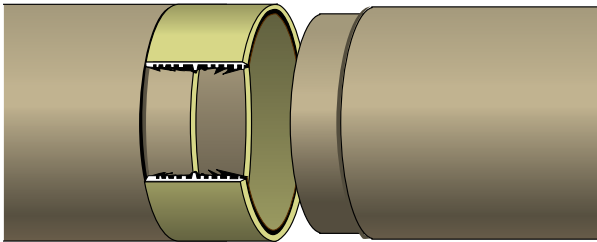
Approximate Average Straight Alignment (lbs)		
Pipe Size (in)	FRP Coupling (lbs)	Flush Bell Spigot (lbs)
18	3150	2150
20	3500	2350
24	4200	2850
27	4725	3200
28	4900	3300
30	5250	3550
33	5775	3900
36	6300	4250
41	7175	4800
42	7350	4950
44	7700	5150
45	7875	5300
48	8400	5650
51	8925	6000
54	9450	6350
57	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

# Couplings

## FLUSH FRP COUPLING

The flush FRP coupling, designed for pressure service greater than 40 psi in jacking installations, is a reduced-diameter FRP 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 FRP coupling.

Figure 7. Flush FRP Coupling



FRP coupling being prepped for installation



Stainless steel closure coupling

# Couplings

## CLOSURE COUPLINGS

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

### Gravity and Pressure Flow

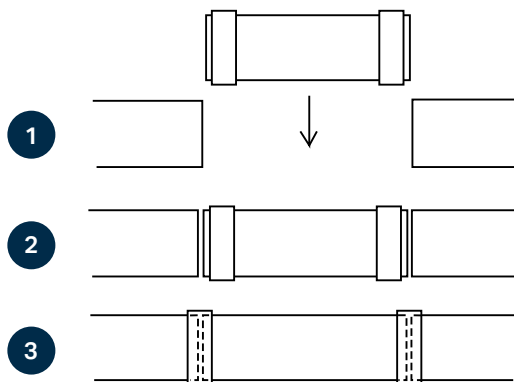
Closures are Stainless Steel Couplings with straight, loose collars and internal gasket systems. The joints are sealed by compressing the gaskets between the natural OD of any Hobas pipe and the inside of the collar. The typical assembly sequence is shown in Figure 8. The easiest assembly is with the pipes coupling in "straight" alignment with an adequate chamfer on the outside edge of the pipes to be joined.

### Stainless Steel Coupling

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 8. Closure coupling installation and assembly**



## 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.



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

## 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 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.

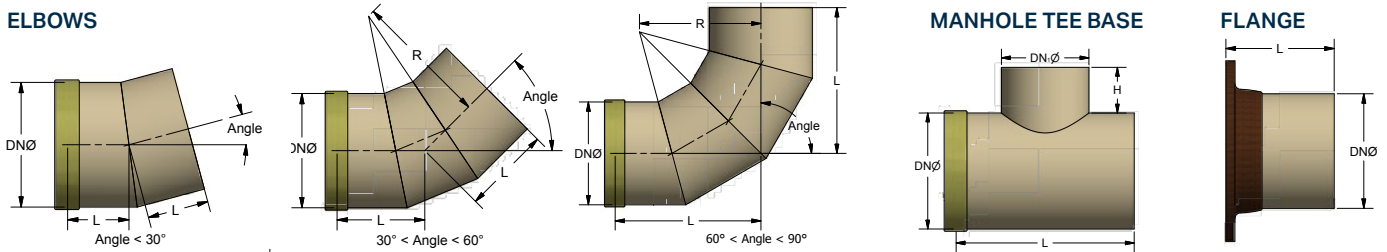
## GENERAL

The general configuration and standard Hobas Pipe fittings are shown in Figure 9, 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 9. 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 (18 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 FRP or FRP sleeve coupling, or one of our other gasket-sealed joints. Adequate thrust restraint(s) should be provided in pressure systems.

# 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

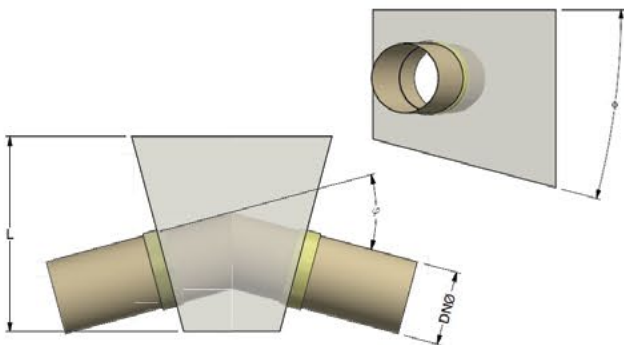
### Axial Concrete

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.

### 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 and be designed by a professional engineer licensed in the state where the project is located.

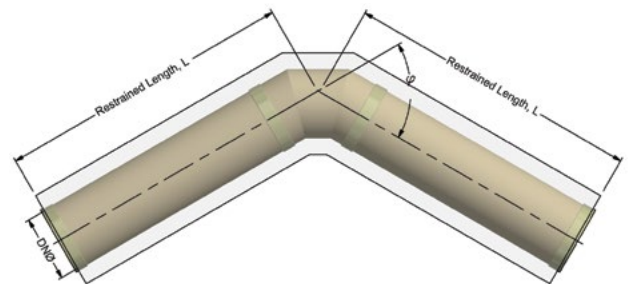
**Figure 10. Thrust Block Detail**



*Axial concrete encasement*

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 and be designed by a professional engineer licensed in the state where the project is located.

**Figure 11. Axial Concrete Plan View**



# 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 11. 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 un-lined 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 12.

### 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 12. 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

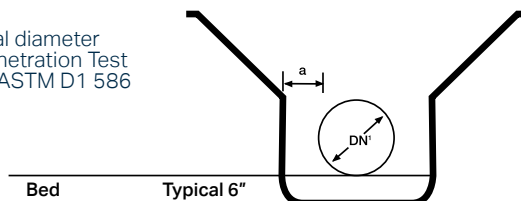
When running or standing water occurs in the trench bottom or the soil in the trench bottom displays a “quick” tendency, pumps and suitable means such as well points or underdrain bedding should remove the water. This system should be maintained in operation until the backfill has been placed at a sufficient 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 12. Standard Trench Dimensions**

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

**Note**

- <sup>1</sup> DN is nominal diameter
- <sup>2</sup> Standard Penetration Test Blows/ft per ASTM D1 586



### 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 13 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

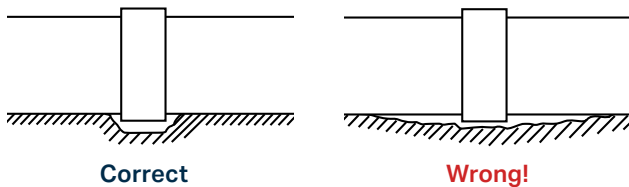


# Direct Bury – Installation

## 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 13. Bell Holes

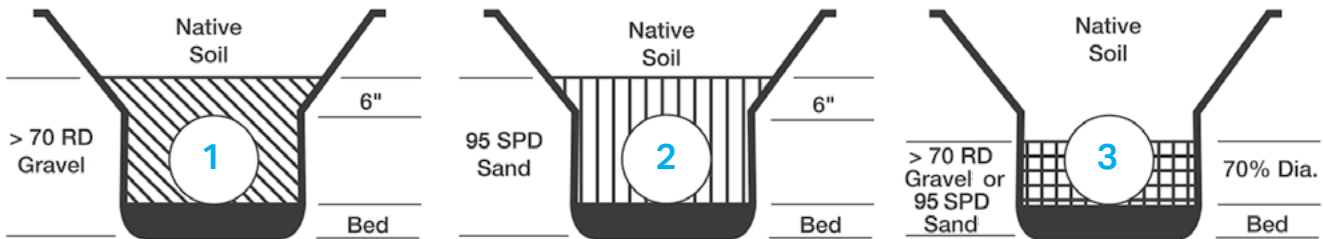


**Note** After joint assembly, fill the bell holes with bedding material and compact as required.

## STANDARD EMBEDMENT CONDITIONS

Three standard embedment conditions are given in Figure 14. Other embedment conditions may be acceptable. Please consult us for advice and recommendations.

Figure 14. 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 13. 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 1<sup>1</sup>/<sub>2</sub> times the pipe wall thickness or 1<sup>1</sup>/<sub>2</sub> 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.

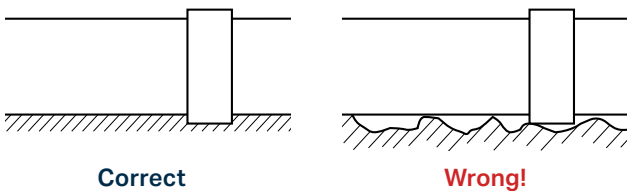
Embedment materials should contain no debris, foreign or frozen materials.

# Direct Bury – Installation

## BEDDING

A trench bed should provide firm, uniform, and continuous support for the pipe's entire length, see Figure 15. Bedding material should be as specified in Figure 14 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 14.

Figure 15. Bedding



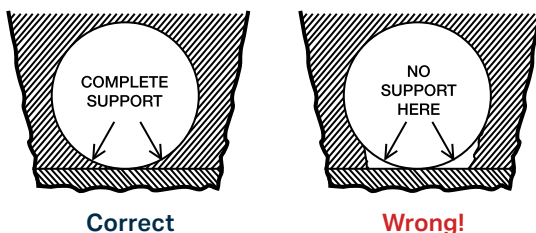
- A firm trench bottom must be provided (as noted in Dewatering and Preparation of Trench Bottom).
- Place and compact bedding to achieve 2/3 of the total bed thickness (normally four inches).
  - Loosely place the remaining bedding material to achieve a uniform soft cushion to seat the pipe invert (bottom).
  - 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 16, while avoiding vertical and lateral pipe displacement from proper grade and alignment.

Figure 16. Haunching



## BACKFILLING

Pipe embedment conditions shall be as specified in Figure 14, 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 14. 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 14. Minimum Cover Depths

Embedment Condition <sup>1</sup>	Minimum Cover (ft) for HS20 Load <sup>2</sup>		
	SN 18	SN 36 or 46	SN 72
1	4	3	2
2	5	4	3
3	-	5	4

**Note**

<sup>1</sup> See Figure 14.

<sup>2</sup> 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 17. Determining Actual Deflection of Installed Pipe**

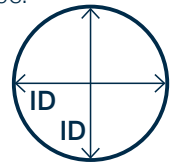
Calculate Vertical Deflection

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

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 Depth<sup>1</sup>**

NATIVE SOIL <sup>2,4</sup>	COVER DEPTH <sup>1</sup> (FT)	EMBEDMENT CONDITION <sup>3</sup>		
		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 <sup>5</sup>
	>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

<span style="display:inline-block; width:15px; height:15px; background-color:darkblue; border:1px solid black;"></span> SN 36	<span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> SN 90
<span style="display:inline-block; width:15px; height:15px; background-color:blue; border:1px solid black;"></span> SN 46	<span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> SN 120
<span style="display:inline-block; width:15px; height:15px; background-color:lightgreen; border:1px solid black;"></span> SN 72	<span style="display:inline-block; width:15px; height:15px; border:1px solid black;"></span> Alternate Installation

<sup>1</sup> Assuming typ. 1.5 x OD Trench Width or as in Table 3

<sup>2</sup> Soils adjacent to pipe (pipe zone elevation)

<sup>3</sup> Defined in Figure 2

<sup>4</sup> SN is nominal stiffness in PSI

<sup>5</sup> 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.

### 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.

## B2 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 18, 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 37 are not exceeded. Adhere to grouting guidelines of Table 18 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**

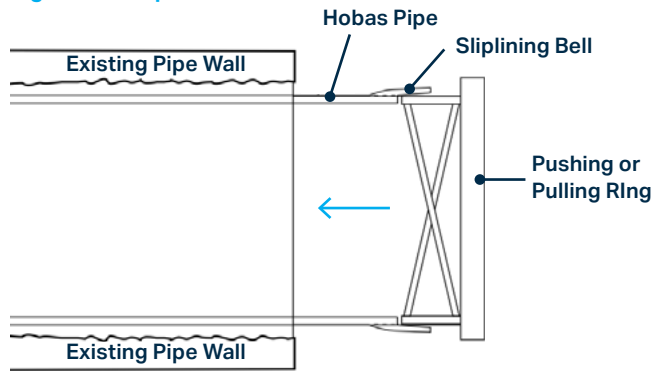
$$\text{Diameter Difference} = \frac{(\text{ID. Host Pipe} - \text{OD Liner Pipe})}{\text{OD Liner Pipe}} \times 100$$

SN is nominal pipe stiffness in psi

# Sliplining – Installation

## LINER PIPE INSERTION (CONT.)

Figure 18. Pipe Insertion



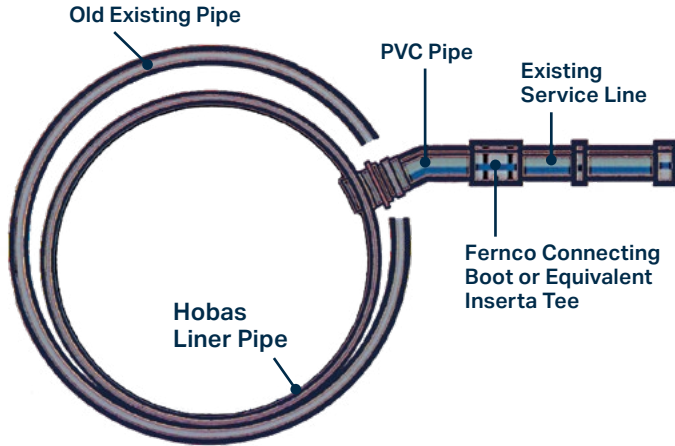
## GROUTING

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.

## LATERALS

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

Figure 19. Lateral Service Connection



"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, at right. 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

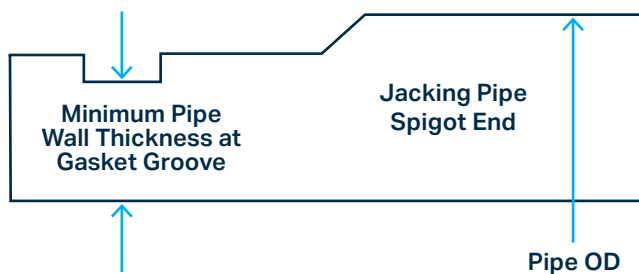
**Table 20. Flush Bell-spigot Joint Allowable Compressive Load**

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**

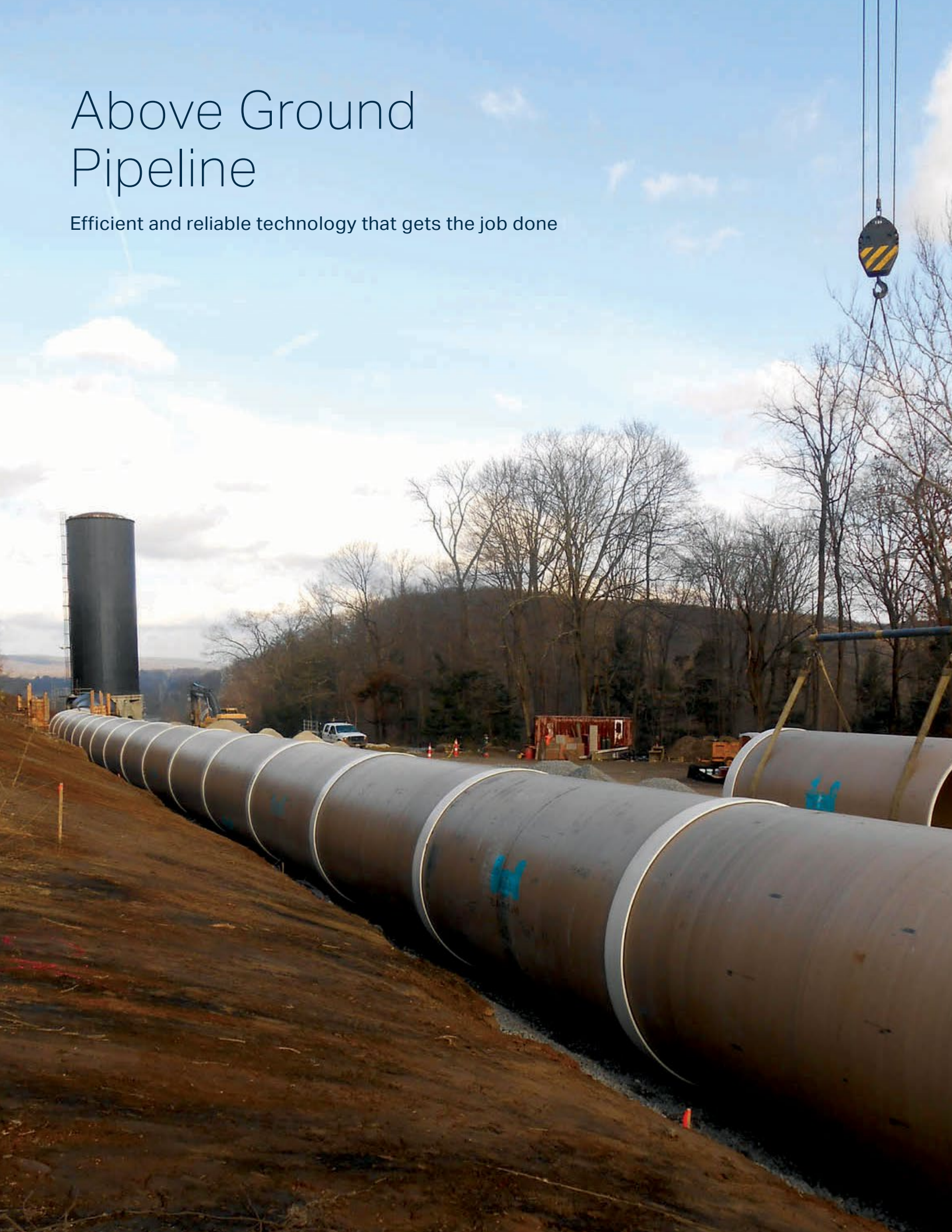
1. Please contact Hobas for jacking pipe stiffness
2. Alternate pipe designs are available on request.
3. Lead times may lengthy, please inquire

**Figure 20. 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

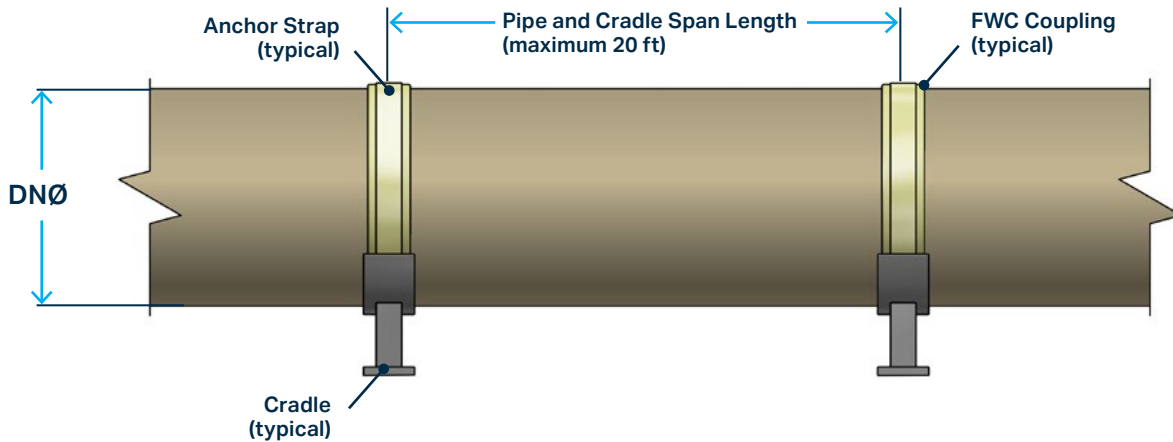
Recommended pipe support configuration for ambient temperatures is shown on Table 22 and in Figures 21 and 22. Table 22 shows acceptable Pipe diameters and classes for Figure 21 – Scheme A support, which require only one support location per 20 ft. section. This is best accomplished by a single cradle support on each FRP sleeve coupling. These pipes may also be supported as shown in Figure 22 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 FRP sleeve coupling and a mid-span pipe wall cradle support.

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

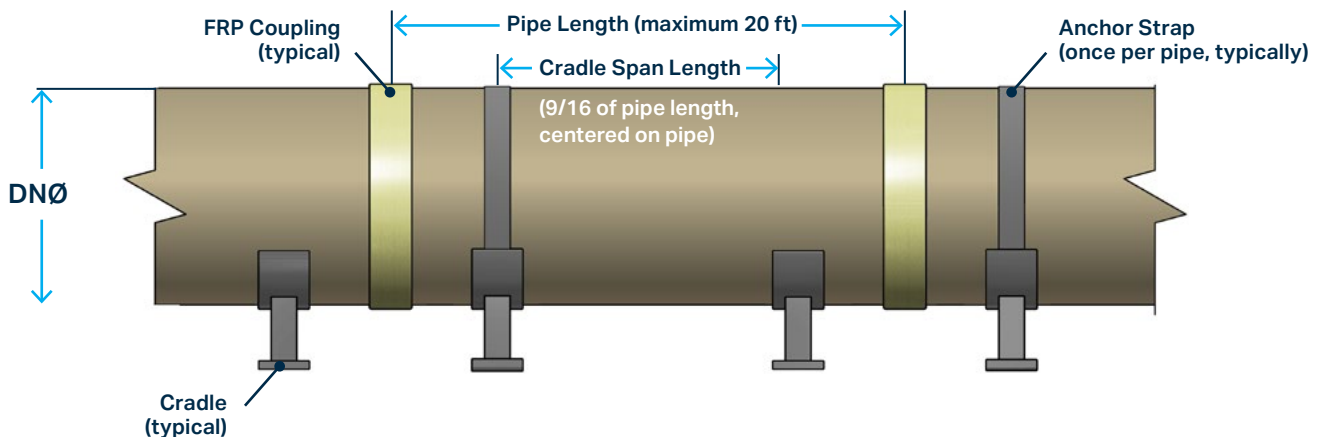
**Figure 21. – Scheme A**

Pipe supported on pipe wall and anchored once per pipe



**Figure 22. – 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 <sup>+</sup>				
	36/46	≥72	≥36	≥36	≥72
18 and 20	Scheme A – 10"CC				
24-28	or				
30-36	Scheme B				
41-45					
48 and 51	Scheme A				
54 and 57					
60-63					Non-standard
66-72					
78 -126					

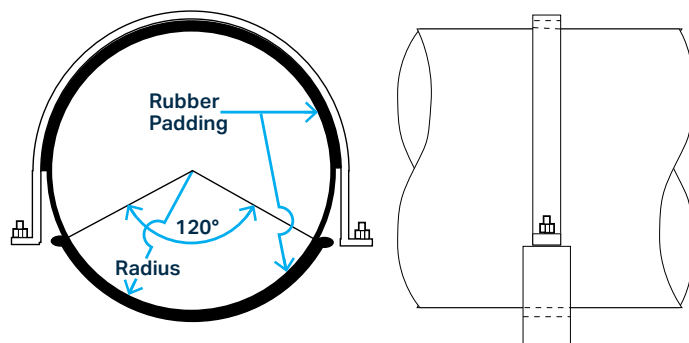
**Note**

- 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 23. All cradles shall be faced with a 1/4" thick rubber padding (approx. 50 to 60 durometer).

**Figure 23. 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 23, 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 FRP coupling) must be anchored in support Scheme A. In support Scheme B, one pipe wall cradle (near the FRP coupling) per section should be anchored, as shown in Figures 21 and 22. 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	18-24 Dia. = 3
		27-44 Dia. = 4
		45-78 Dia. = 6
		84-126 Dia. = 8
On FRP Coupling Scheme A	FRP OD **/2	Width of FRP 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 18. **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.

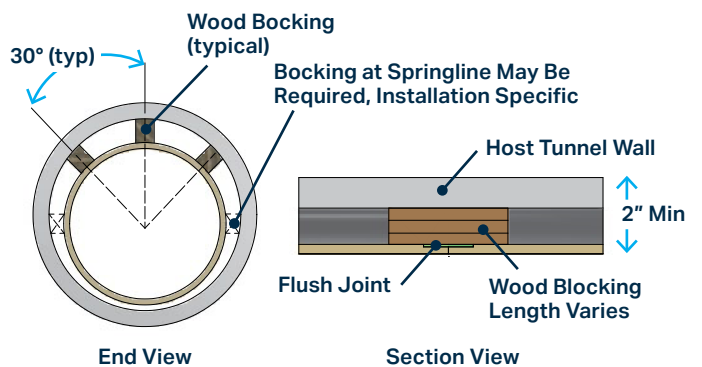
## GROUTING

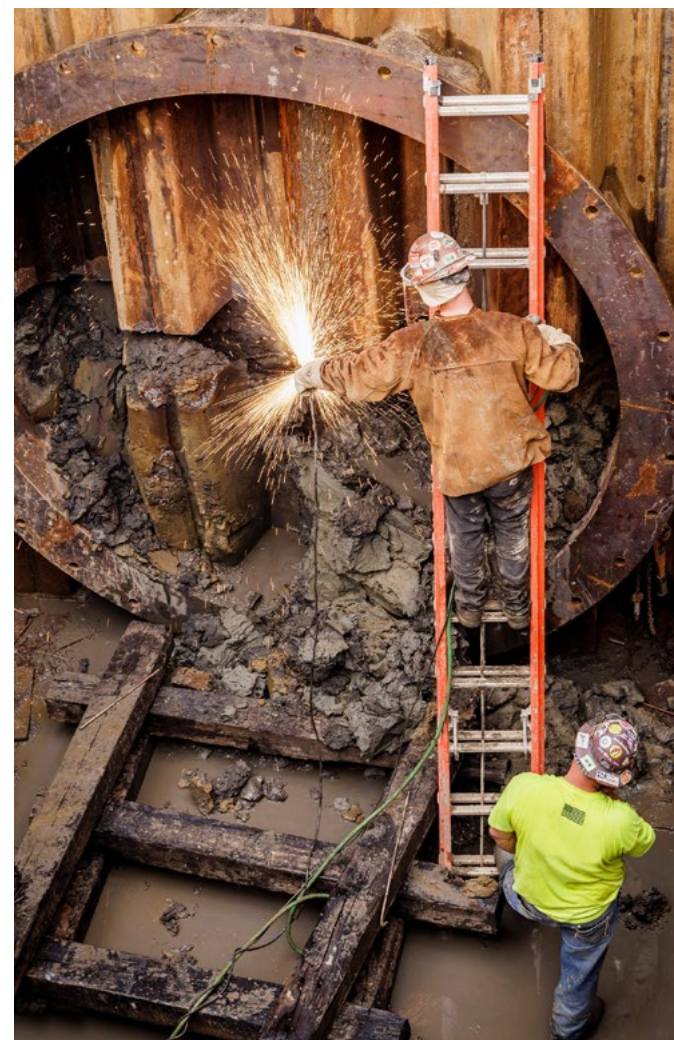
Grout the annular space between the tunnel ID and the carrier pipe OD with a cement or chemical-based grout. Minimum compressive strength of the grout shall be as required to assure the structural adequacy of the completed installation. During grout placement, ensure that both the safe ( $F$  of  $S \approx 2$ ) 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 24. 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 24. Typical Blocking Scheme at Each Joint





# You're Good to Go

Our Manhole Installations are Hassle-free



# Manhole – Installation

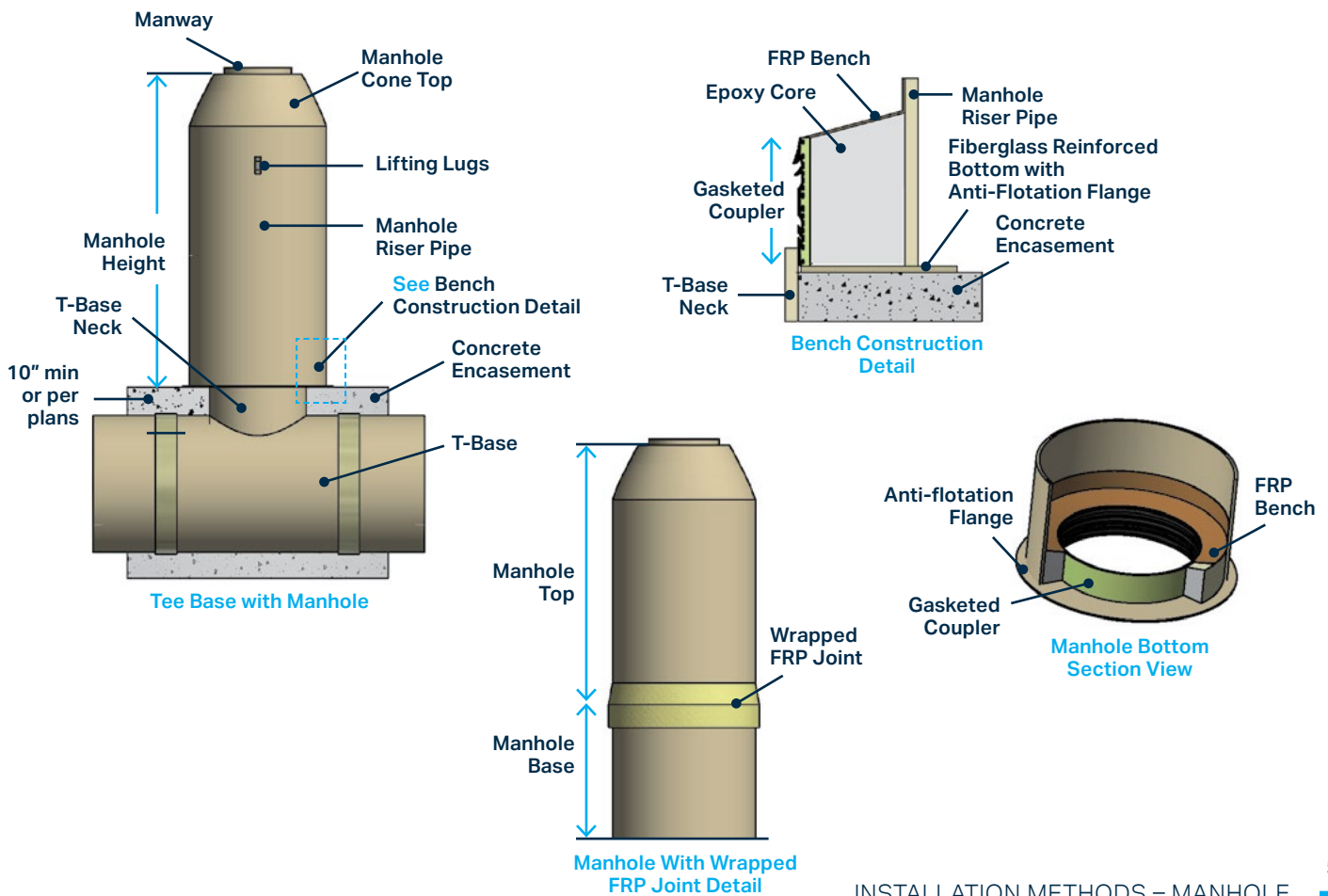
Hobas manhole solutions are made from the same material as the corrosion-resistant, leak-free pipe offering a maintenance-free life. Our manholes meet or exceed ASTM D3753 load rating and HS20/25 traffic rating. See Figures 25 and 26 for manhole details. Our complete watertight manhole solutions eliminate 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 FRP coupling
- Anti-flotation ring
- 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 25. 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 stub outs. Both risers are embedded with FRP 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 FRP 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 with a 24-inch minimum diameter are shown in Figure 26. They 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 FRP 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 FRP 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 ring when needed
- Concrete encased tee-base handles loads with added safety factor (by others)

#### Watertight

- Laminated/welded 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 pipe can be used in any application, but is especially expert in addressing complex or tight fitting pipe requirements in urban infrastructure projects. 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.**

## YEARS OF EXPERIENCE

Many US cities started building modern 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.

## MANUFACTURER

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.

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.

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 A – 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.

# Appendix A – 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 low-profile, fiberglass bell-spigot joints or flush fiberglass bell-spigot joints, 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. **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. 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.

# Appendix A – 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.

# Appendix A – 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.

# Appendix A – 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.

# Appendix A – 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

1. **ASTM D3262** – Standard Specification for "Fiberglass (Glassfiber-Reinforced Thermosetting-Resin) Sewer Pipe 1, 2.
2. **ASTM D3753** – Standard Specification for Glass-Fiber-Reinforced Polyester Manholes 1.
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" (Glassfiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition 1.
5. **ASTM D695** – Standard Test Method for Compressive Properties of Rigid Plastics.
6. **ASTM D638** – Standard Test Method for Tensile Properties of Plastics.
7. **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:

- i. Manufacturer's name
- ii. Riser vertical height
- iii. ASTM D3753 Designation
- iv. 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 Pipe 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 A – 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  $\geq 54$ ”, 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  $1.5 \times PN$ . 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.



# Appendix A – 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.

# 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

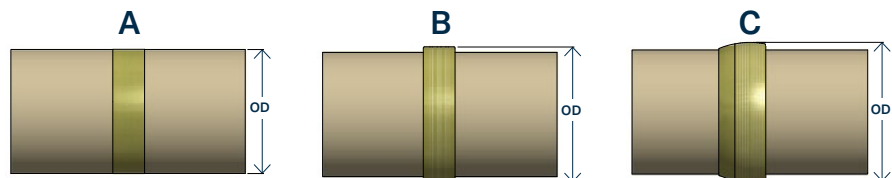
# Appendix C – Coupling Dimensions and Weights

Table 31. Coupling Dimensions and Weights

Nominal Diameter (in)	Pipe OD (in)	FRP COUPLING		FRP SLEEVE COUPLING		COUPLING OD	
		Coupling OD	Weight (lb)	Coupling OD	Weight (lb)	Flush Bell-spigot	Pressure Relining (in)
12	-	-	-	15.0	9	-	-
14	-	-	-	17.1	10	-	-
16	-	-	-	19.2	11	-	-
18	19.5	21.3	25	21.3	12	19.5	21.7
20	21.6	23.4	28	23.4	14	21.6	23.8
24	25.8	27.6	43	27.8	23	25.8	28
27	28.0	29.8	46	30.0	25	28.0	30.2
28	30.0	31.9	50	32.1	28	30.0	32.3
30	32.0	33.9	53	34.1	29	32.0	34.3
33	34.0	35.9	56	36.2	32	34.0	36.3
36	38.3	40.2	64	40.5	37	38.3	40.6
41	42.9	44.9	71	45.2	41	42.9	45.3
42	44.5	46.5	74	46.8	44	44.5	46.9
44	45.9	47.9	76	48.2	45	45.9	48.3
45	47.7	49.7	79	50.0	47	47.7	50
48	50.8	52.8	84	53.2	51	50.8	53.2
51	53.9	56.0	89	56.5	55	53.9	56.4
54	57.1	59.2	94	59.9	60	57.1	59.6
57	60.0	62.2	100	62.0	62	60.0	62.6
60	62.9	65.2	140	64.0	65	62.9	65.6
63	66.0	68.3	148	67.7	70	66.0	68.7
66	69.2	71.6	155	71.7	75	69.2	72
69	72.5	74.9	166	74.5	79	72.5	75.3
72	75.4	77.9	178	77.0	83	75.4	78.3
78	81.6	84.2	194	84.2	92	81.6	84.6
84	87.0	89.6	209	91.2	103	87.0	90
85	88.6	91.4	215	92.3	107	88.6	91.8
90	94.3	97.1	234	97.3	116	94.3	97.5
96	99.5	102.5	251	102.6	145	99.5	102.9
104	108.0	111.1	279	111.2	160	108.0	111.5
108	112.6	115.7	300	115.8	169	112.6	116.1
110	114.0	117.2	306	117.3	172	114.0	117.6
118	120.7	123.8	345	123.9	185	120.7	124.2
120	126.0	129.3	355	129.4	190	126.0	129.7
126	132.5	135.8	450	135.9	225	132.5	136.2

## MEASURING PIPE OD

- A. Flush Bell-Spigot
- B. FRP 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 <sup>1</sup>	
<b>E-Modulus<sup>1</sup> (10<sup>6</sup> psi):</b>	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
<b>Strength<sup>1</sup> (10<sup>3</sup> psi):</b>		
* Circumferential Tensile	–	7.0 to 33.0
* Axial Tensile	1.4 to 2.1	1.4 to 6.4
* Compressive	10.5	10.5
<b>Thermal Coefficient of Linear Expansion (axial)</b>	16 x 10 <sup>-6</sup>	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 E – Fitting Dimensions

## FIBERGLASS ELBOWS

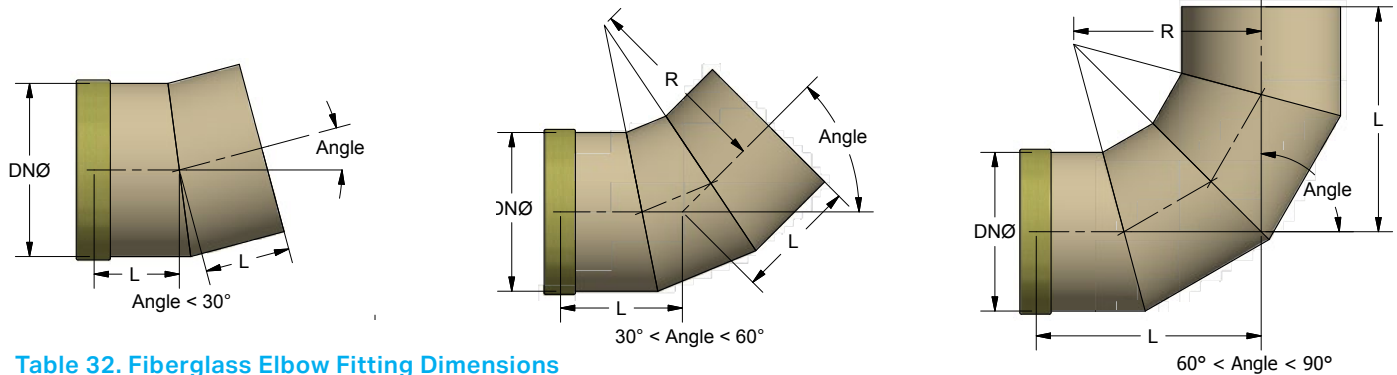


Table 32. Fiberglass Elbow Fitting Dimensions

DN (in)	R (in)	L (in) FOR OC					
		11 1/4°	22 1/2°	30°	45°	60°	90°
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 E – Fitting Dimensions

## FIBERGLASS REDUCERS

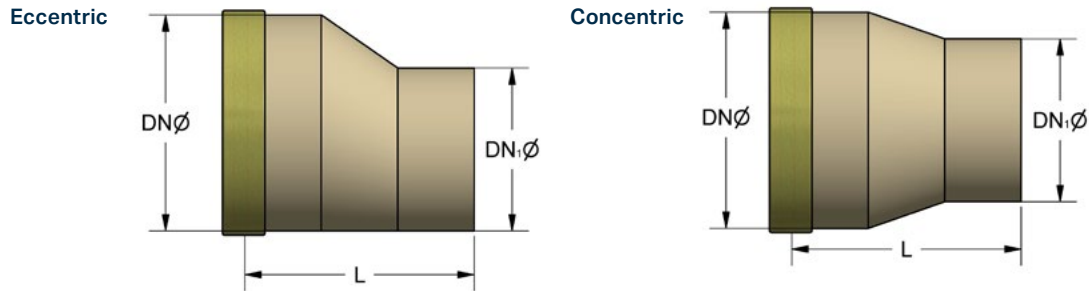


Table 35. Fiberglass Reducer Fitting Dimensions

DN (in)	DN1 <sup>1</sup> (in)	L (in)	DN1 <sup>1</sup> (in)	L (in)	DN1 <sup>1</sup> (in)	L (in)	DN1 <sup>1</sup> (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 E – Fitting Dimensions

## FIBERGLASS FLANGES

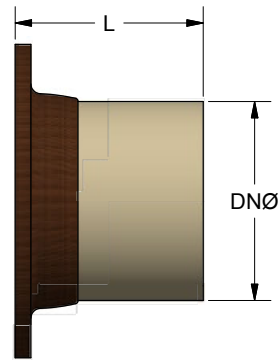


Table 36. Fiberglass Flange Fitting Dimensions

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.

## **Hobas Pipe USA, Inc.**

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