

# Weholite<sup>®</sup>

## Sliplining Construction and Installation Guide



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## PREFACE

This installation manual provides recommendations for installing Weholite® Structural Profile Wall HDPE slipline pipe used in culverts, sewers, and other gravity-flow applications. It is intended as a guide and is not to supersede the project specification and requirements. The information contained in this manual is accurate and reliable to the best of our knowledge.

This manual does not address all of the safety concerns associated with pipe installation. It is the end user's responsibility to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to installation. Infra Pipes reserves the right to update this manual without notice.

## INTRODUCTION

Weholite pipes are often used in culvert re-lining applications. Rehabilitation by slip-lining is a method of inserting a new pipe into an existing deteriorated culvert or sewer pipe by pushing, jacking, or pulling it in.



## SELECTING THE CORRECT WEHOLITE PIPE

For a detailed description of the methods used to assess the hydraulic capacity of culverts, the reader is directed to the *Hydraulic Design of Highway Culverts* issued by the Federal Highway Administration FHWA. In some cases, improvements to the inlet and outlet (e.g., headwalls, reducers) will have been incorporated into the design to achieve 'post lining' flow characteristics closer to the 'pre lining' hydraulic characteristics.

In addition to considering the effect that the relining may have on flow and velocity, the selection of liner size needs to account for the clearance required between the host and liner pipes to avoid physical conflicts between them and to provide sufficient space for grouting of the annular space.

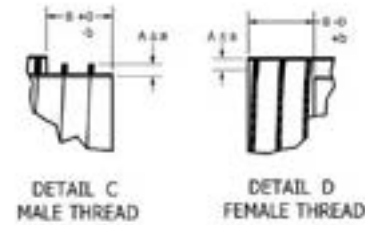
Traditionally, the selection of liner pipe stiffness class has often been based on the requirement to support direct burial loads (on the presumption that the host pipe will ultimately offer no structural support).

In other cases, it has been based on providing resistance to hydrostatic pressures that occur during grouting. Please contact your local Infra Pipes representative if you have any further questions regarding the selection of Weholite liner pipe.

## JOINING PIPE SELECTION

### Threaded Joint:

This is the most popular joint when slip-lining culverts with Weholite. The pipe is supplied with male and female threads on opposite ends. It can be assembled in the field by spinning the ends together. When used with a direct burial pipe, threaded joints are suitable for drainage applications (no leakage limit specified). The threaded joint is sand and silt-tight.



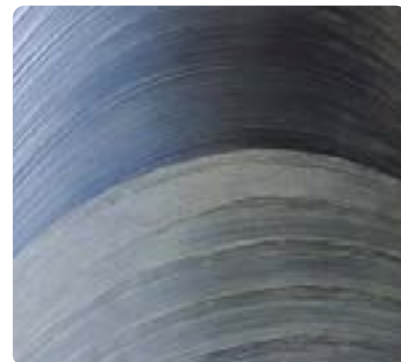
**Step 1:** Prior to threading the pipe, grease the threads to reduce the required threading force.



**Step 2:** Place pipes in straight alignment.



**Step 3:** Use nylon slings with a lever or excavator arm to rotate the pipe.



**Step 4:** Visually inspect the joint to ensure that male and female threads are engaged.

## Methods to Prevent Possible Grout Migration Through Weholite® Threaded Joints

There are two methods to prevent flowable cellular grout from potentially penetrating the threaded joint. One method is to use polyurethane spray foam just prior to completing the threading process, and the other is to use Wehoseal, as supplied by Infra Pipes, around the completed threaded joint.



**Method 1:** Using Polyurethane spray foam, spray foam in the joint around the entire circumference of the pipe. Wipe off excess foam if necessary.



**Method 2:** Wehoseal joint wrap may be used to seal a threaded connection. Installation is performed in the field using a propane torch and a hand roller.

## Profile Cut Ends

All pipes to be welded shall be supplied with profile cut ends. When a Weholite pipe is joined by extrusion welding, the pipe ends being joined must be prepared by beveling the end to receive the hot PE extrudate. The extrusion welding gun will preheat the joint surface to the correct temperature for extrusion welding.

The inner wall weld is preferred whenever the physical space inside the slip-line pipe is suitable. Generally, the pipe diameter must be 36"/900 mm or larger to provide sufficient room for a technician to work.

Infra Pipes' internal weld procedures describe in detail how manually executed extrusion welds are to be made. Contact Infra Pipes for a copy of the current procedures.



The inner wall weld

## ESTABLISHING AND MAINTAINING LINER PIPE GRADE / BLOCKING

Generally, the objective is to maintain the invert of the relined culvert as close as possible to the invert of the host pipe. When relining small culverts, allowing the liner to float to the top of the host pipe during grouting of the annular space may be acceptable. However, when there is sufficient space to place blocking, that is generally what is done.

The blocking must be structurally capable of resisting the buoyancy force. The buoyancy force is equal to the weight of the grout that is displaced by the liner. Higher-density grouts generate higher buoyancy forces.



Wodden blocking that spans obvert of the pipe



Wodden blocking at 10, 12, and 2 o'clock positions



A side rail wodden blocking to assist with the minor bends

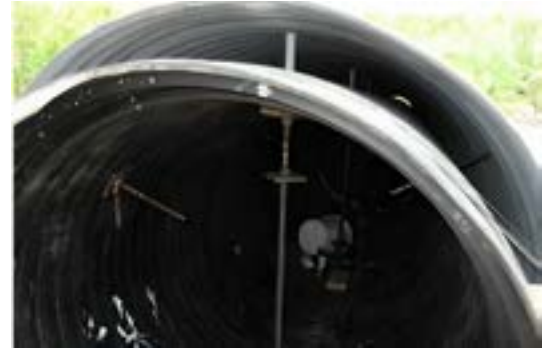


Where the blocking contacts the pipe, the blocking's surface area must be large enough to distribute the buoyancy force without point loading the pipe. When minor bends need to be navigated without the use of elbows, a side rail should be used to prevent the leading edge of the reline pipe from getting hung up on the host pipe while advancing the reline pipe.

Unless additional weighting within the liner pipe offsets buoyant force, continuous 'blocking' between the host and liner pipes is recommended.



Using jacks to hold the pipe down



The flotation force acting on a liner is proportional to the weight of the displaced grout. Flotation forces are much lower when using low-density cellular grouts. Filling the liner pipe (partially or fully) with water will counteract the buoyant force exerted by the displaced grout. The recommended lifts on page xx in this document must be followed

It is often desirable to place wood or metal rails along the bottom of the host pipe to enable the liner pipe to slide into position with reduced friction. The rails can be set at a height that establishes the appropriate grade for the liner, typically at the 5 & 7 o'clock position. These rails are usually mechanically attached to the host pipe.



Wooden rails



Wooden rails at the 5 and 7 o'clock position

## INSERTING THE LINER PIPE

The liner may be pulled or pushed into position. The excavator arm, or the bucket could be used to push on the end of the pipe. When pushing long lengths of larger-diameter pipe, contractors should use various load-distribution 'caps' made of steel or wood. A strap around the pipe can also be used to "slide"/"push" the pipe in using the movement of the excavator arm. For pulling, winches or other mechanical equipment may be used.



Different ways to inserting Weholite liner into the host pipe

A pulling head can be secured to the leading end of the liner pipe to distribute the pulling load to the entire pipe wall circumference. To ensure that the liner pipe is at the correct grade and alignment, a staging area is established from which the pipe can be inserted.

For most slip-lining projects, it is not necessary to eliminate the flow within the host pipe during insertion of the liner pipe. Some flow can assist in positioning this pipe by acting as a lubricant, reducing friction between the host and liner pipes.



Examples of pulling heads designed by the contractor

## GROUTING

During grouting, it is necessary to bypass or hold back the channel flow. The flow can be directed through the Weholite liner after 'annular space' bulkheads are installed. The annular space between the Weholite pipe and the existing pipe is usually filled with a cementitious grout. Grouting the annular space is highly recommended and offers many advantages. They include:

- Provides roadway load tranference from the road to the newly rehabilitatedculvert to prevenmt further settlement of the road and higher degree of traffic safety.
- Plastic pipes are flexible pipes that require an envelope of supporting material around the pipe to provide long-term stability and durability. Grouting provides this side support for the newly installed Weholite pipe.
- Grouting helps prevent the collapse or weakening of the existing (host) pipe. This prevents point loading and localized deflection of the Weholite liner pipe that may occur when the host pipe collapses.
- Grouting eliminates the flow of water through the annular space between the existing pipe and the Weholite pipe.
- Grouting can be used to fill voids in small washouts of the embedment soils surrounding the host pipe (eliminating the potential for settlement or collapse of above-ground structures).
- After grouting, the grade and alignment of the Weholite liner pipe is stable, the pipe is prevented from floating off the desired grade, and deflection OR collapse of the liner due to external groundwater pressure is prevented.



Grouting



Grouting tubes

## Selecting the Grout

The grout selected for a reline project should flow sufficiently to fill the annular space and any other voids between the host and liner pipes. The grout should have adequate strength to provide proper support and load transfer to the reline pipe. The selected grout shall be approved by the engineer of record to ensure that it meets project requirements. Breaks in the host pipe (unit separation, pipe corrosion, etc.) are locations where the embedment materials surrounding the pipe may have been washed away. Since the size of the perforations in the host pipe is usually not well known, and the characteristics of the voids outside the pipe (size and shape) are almost never well documented before the reline project takes place, cellular grouts are most used.

### *Cellular Grouts*

Cellular grouts contain additives that improve the grout's flowability and reduce its density. The spacing of grout ports, or the number of grout wands, can be reduced with cellular grouts. They are essentially 'self-leveling' over long distances. Since grout density is reduced, liner flotation is minimized. When, based on an assessment of the liner pipe's hydrostatic pressure limit, it is necessary to install the annular space grout in lifts, fewer lifts are required. The cellular grouts could have a density as low as 20 pcf (320 kg/m<sup>3</sup>) with a typical range between 35-45 pcf (560-720 kg/m<sup>3</sup>), and a compressive strength (28 days) of about 150 to 200 psi (1 to 1.37 Mpa).

### *Cement Grouts (Non Cellular)*

Cement grouts are often used on culvert relining projects. However, they do not flow well in small annular spaces. 'Close' grout port spacing (or numerous grout wands) is required to ensure the pipe annular space is completely filled. These grouts may have limited success in filling the voids outside of the host pipe. Non-cellular cement grouts have a density (e.g., 100 to 145 pcf ... 1600 to 2320 kg/m<sup>3</sup>) that is heavier than water, so they are effective at displacing water in the annular space. The pressure around the liner pipe must be maintained below the pipe's collapse resistance. Pressure measurements in the annular space are difficult, and the pressure measured at the pump discharge end is not a reliable indication of the pressure in the annular space. The grouting contractor's experience is critical to achieving a successful grouting operation with these grouts. More grout lifts may be required with non-cellular grouts.

### **Grouting Plan**

The size of the annular space, the length of the culvert, the characteristics of the grout, the hydrostatic collapse resistance of the liner, the pipe's flotation potential during placement, and the grout delivery system are all interrelated and must be considered by the contractor when developing the 'grouting plan'.

As an alternative to grout tubes or a grout wand, access holes can also be drilled through the host pipe crown. The size of access holes (in the host pipe) should allow sufficient room for observation and insertion of the grout hose. Extreme care must be taken to ensure that grout placed through these access holes is kept below the level associated with the allowable grouting pressure. It is very easy with this technique to allow a static head of grout to develop in the 'access hole' that exceeds the collapse resistance of the liner pipe. During the grouting process, the installer must avoid trapping air in the annular space. Trapped air will prevent the grout from completely encircling the liner. When the host pipe deteriorates further, point loads may be experienced.

When placing cementitious grout, adequate air circulation should be provided through the pipe. This is to dissipate the heat created by the hydration of the cement grout. If excessive hydration is anticipated, the Weholite pipe should be filled with water. The water in the pipe will act as a heat sink.

## WEHOLITE DIAMETERS, WEIGHTS, AND GROUTING PRESSURES

	NPS		OD ave		OD max		Shipping Weight	
	(in)	(mm)	(in)	(mm)	(in)	(mm)	(lbs/ft)	(kg/m)
RSC160	18	460	20.3	516	22.3	566	18	27
	19.5	495	22.0	559	23.9	607	20	30
	21	530	23.6	599	27.1	688	21	31
	24	610	26.9	683	30.4	772	24	36
	27	690	30.2	767	33.8	859	27	40
	30	760	33.5	851	37.0	940	30	45
	33	840	36.7	932	40.2	1021	38	57
	36	910	40.5	1029	41.0	1041	42	62
	40	1020	44.5	1130	45.1	1146	46	68
	42	1070	46.5	1181	47.1	1196	52	77
	48	1220	52.8	1341	53.5	1359	60	89
	54	1370	59.4	1509	60.2	1529	70	104
	60	1520	65.4	1661	66.2	1681	90	134
	66	1680	71.9	1826	72.8	1849	100	149
	72	1830	78.3	1989	79.3	2014	120	179
	78	1980	84.7	2151	85.8	2179	150	223
	84	2130	91.1	2314	92.3	2344	160	238
	RSC250	90	2290	97.5	2477	98.8	2510	170
96		2440	103.5	2629	104.8	2662	190	283
102		2590	110.0	2794	111.3	2827	215	320
108		2740	116.3	2954	117.8	2992	240	357
120		3050	129.1	3279	130.7	3320	280	417
132		3355	141.5	3594	143.2	3637	330	491
33		840	37.5	953	38.0	965	47	70
36		910	40.8	1036	41.4	1052	51	76
40		1020	44.8	1138	45.4	1153	60	89
42		1070	46.9	1191	47.6	1209	70	104
48		1220	53.4	1356	54.1	1374	80	119
54		1370	59.9	1521	60.7	1542	90	134
60		1520	66.3	1684	67.2	1707	100	149
66		1680	72.7	1847	73.7	1872	120	179
72		1830	79.1	2009	80.2	2037	150	223
78		1980	85.5	2172	86.6	2200	160	238
84		2130	92.0	2336	93.1	2365	190	283
90		2290	98.3	2497	99.6	2530	200	298
96	2440	104.7	2659	106.1	2695	230	342	
102	2590	111.1	2822	112.5	2858	250	372	
108	2740	117.5	2985	119.0	3023	270	402	
120	3050	130.2	3307	131.9	3350	330	491	
132	3355	142.6	3622	144.4	3668	370	551	

## WEHOLITE DIAMETERS, WEIGHTS, AND GROUTING PRESSURES

	NPS		Unconstrained Pipe Wall Buckling <sup>2</sup>		Cellular Grout 40 pcf / 640 kg/m <sup>3</sup>			Cement Grout 125 pcf / 2000 kg/m <sup>3</sup>		
	(in)	(mm)	kPa	psi	Lift Height		Number of Lifts <sup>2</sup>	Lift Height		Number of Lifts
					ft	m		ft	m	
RSC160	18	460	72	10.5	37.1	11.3	1	12.1	3.7	1
	19.5	495	67	9.7	34.1	10.4	1	11.1	3.4	1
	21	530	62	9.0	31.9	9.7	1	10.4	3.2	1
	24	610	55	7.9	28.0	8.5	1	9.1	2.8	1
	27	690	49	7.1	25.1	7.6	1	8.1	2.5	1
	30	760	43	6.2	21.8	6.6	1	7.1	2.2	1
	33	840	38	5.6	19.7	6.0	1	6.4	1.9	1
	36	910	46	6.7	23.7	7.2	1	7.7	2.3	1
	40	1020	34	5.0	17.6	5.4	1	5.7	1.7	1
	42	1070	30	4.3	15.3	4.7	1	5.0	1.5	1
	48	1220	24	3.5	12.6	3.8	1	4.1	1.2	1
	54	1370	25	3.6	12.8	3.9	1	4.1	1.3	2
	60	1520	18	2.7	9.4	2.9	1	3.1	0.9	2
	66	1680	18	2.6	9.1	2.8	1	2.9	0.9	2
	72	1830	17	2.5	8.7	2.7	1	2.8	0.9	3
	78	1980	16	2.3	8.3	2.5	1	2.7	0.8	3
	84	2130	16	2.3	8.0	2.4	1	2.6	0.8	3
	90	2290	15	2.2	7.6	2.3	1	2.5	0.8	4
96	2440	12	1.8	6.3	1.9	2	2.1	0.6	4	
102	2590	12	1.8	6.2	1.9	2	2.0	0.6	5	
108	2740	12	1.7	6.1	1.9	2	2.0	0.6	5	
120	3050	11	1.6	5.8	1.8	2	1.9	0.6	6	
132	3355	10	1.4	4.9	1.5	3	1.6	0.5	7	

<sup>1</sup>Factor of Safety used in calculations of unconstrained pipe wall buckling is 1.5. Pipe ovality is assumed not to exceed 2%. Poisson's ratio of 0.35 and 10 hr / 100° F material modulus of elasticity value of 46,900 psi has been used. Use PPI's Engineering Handbook, Chapter 6 to determine grouting pressure (unconstrained pipe wall buckling) characteristics at temperatures and load durations different from those indicated above.

<sup>2</sup>For convenience the number of grout lifts has been shown based on the case of the culvert pipe being essentially on a flat grade. Where there is a significant grade, the recommended grout lift height may increase the number of recommended grout lifts.

## WEHOLITE DIAMETERS, WEIGHTS, AND GROUTING PRESSURES

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	(in)	(mm)	kPa	psi	Lift Height		Number of Lifts <sup>2</sup>	Lift Height		Number of Lifts
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RSC250	33	840	59	8.6	30.3	9.2	1	9.8	3.0	1
	36	910	55	8.0	28.3	8.6	1	9.2	2.8	1
	40	1020	42	6.0	21.3	6.5	1	6.9	2.1	1
	42	1070	40	5.8	20.3	6.2	1	6.6	2.0	1
	48	1220	35	5.0	17.9	5.5	1	5.8	1.8	1
	54	1370	31	4.6	16.1	4.9	1	5.2	1.6	1
	60	1520	29	4.2	14.7	4.5	1	4.8	1.5	2
	66	1680	26	3.8	13.4	4.1	1	4.4	1.3	2
	72	1830	24	3.5	12.4	3.8	1	4.0	1.2	2
	78	1980	22	3.3	11.5	3.5	1	3.7	1.1	2
	84	2130	21	3.1	10.9	3.3	1	3.5	1.1	2
	90	2290	20	2.9	10.3	3.1	1	3.3	1.0	3
	96	2440	19	2.7	9.7	2.9	1	3.1	1.0	3
	102	2590	18	2.6	9.2	2.8	1	3.0	0.9	3
	108	2740	17	2.5	8.8	2.7	2	2.8	0.9	4
120	3050	16	2.3	8.1	2.5	2	2.6	0.8	4	
132	3355	15	2.1	7.5	2.3	2	2.4	0.7	5	

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