Weholite®

Sliplining Construction and Installation Guide

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Preface

This installation manual provides recommendations for the installation of 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 best of our knowledge.

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

Introduction

Weholite pipe is often used in culvert re-lining applications. Relining 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

Typically, the pipe size will have been determined from a consideration of flow capacity requirements. 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 in order to achieve ‘post lining’ flow characteristics that are closer to the ‘pre lining’ hydraulic characteristics.

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

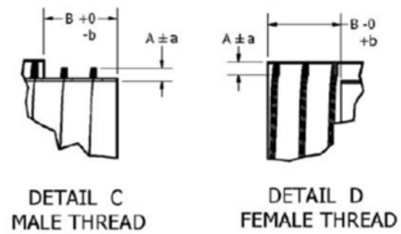
Traditionally, the selection of liner pipe stiffness class has often been that which is required to support direct burial loads (on the presumption that the host pipe will ultimately offer no structural support).

In other cases, it has been based on providing resistance to hydrostatic pressures that occur during grouting. However, the resistance to hydrostatic pressure is very dependent on the ovality and temperature of the liner during the grouting process. Please contact your local Infra Pipe Solutions representative if you have any further questions regarding 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 of the pipe. 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 (no leakage limit specified) applications. The threaded joint is sand and silt tight.



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

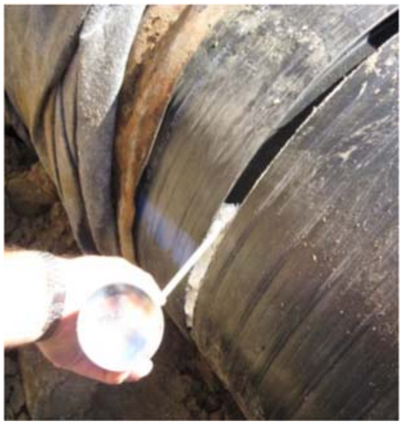
Step 2: Place pipes in straight alignment

Step 3: Use nylon slings with 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 the use of polyurethane spray foam just prior to completing the threading process and the other by the use of Wehoseal as supplied by Infra Pipe Solutions around the completed threaded joint.



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

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

Profile Cut Ends

All pipes to be welded shall be supplied with profile cut ends. When Weholite pipe is joined by extrusion welding, the surfaces to be joined must be heated at the weld bevel, and PE extrudate placed at the prepared bevel surface.

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

Infra Pipe Solutions internal weld procedures have been developed to describe in detail how manually and semi-manually executed extrusion welds are to be made. Contact Infra Pipe Solutions for a copy of the current procedures.

Profile Cut End.

The inner wall (IW) weld.

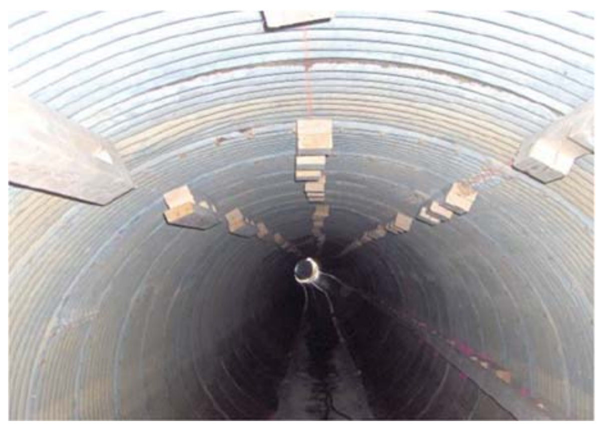
Establishing and Maintaining Liner Pipe Grade / Blocking

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 able to resist 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.

Wooden blocking that spans obvert of the pipe.

Wooden blocking at 10, 12 and 2 o'clock position.



A side rail wooden blocking to assist with the minor bends.

Where the blocking comes into contact with the pipe, the surface area of the blocking must be large enough to distribute the buoyancy force without distorting 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 there is additional weighting inside the liner pipe to offset the buoyant force, continuous 'blocking' between the host and liner pipe is recommended. Continuous 'bracing' inside the liner pipe may also be used to prevent liner deformation during grouting.

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 wholly) with water will counteract the buoyant force of the displaced grout. Grouting in lifts will also reduce this force.

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 bet 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. A strap could be used around the pipe and push in with 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 utilize various load distribution 'caps' made of steel or wood.

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 in 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 to reduce the friction between the host and liner pipe.


Puling heads designed by 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. The grouting of the annular space is extremely beneficial and has many advantages. They include:

- 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 the 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 wash-outs 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, pipe is prevented from floating off the desired grade, and deflection / collapse of the liner due to external ground water 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 outside of the annular space between the host and liner pipe. The grout should have adequate strength to provide proper support and load transfer to reline pipe. The selected grout shall be approved by the engineer of record to ensure that meets project requirements. Breaks in the host pipe (joint separation, corrosion of the pipe, etc.), are locations where the embedment materials surrounding the pipe may have washed away. Since the size of the perforations in the host pipe are 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 commonly used.

Cellular Grouts

Cellular grouts contain additives that improve the ability of the grout to flow and that reduce the density of the grout. 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 hydrostatic pressure limit of the liner pipe, 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^3) with a typical range between 35-45 pcf (560-720 kg/m^3), and a compressive strength (28 days) about 150 to 200 psi (1 to 1.37 Mpa).

Cement Grouts (Non Cellular)

Cement grouts are often used on culvert reline projects. However, they do not flow well in small annular spaces. ‘Close’ grout port spacing (or numerous grout wands) is required to ensure that the pipe annular space fills completely. 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^3) 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 at a level that is below the collapse resistance of the pipe. Pressure measurements in the annular space are difficult and the pressure measured at the discharge end of the pump is not a good indication of the pressure in the annular space. The experience of the grouting contractor is critical to achieving a successful grouting operation with these 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, flotation potential of the pipe 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 crown of the host pipe. 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 take care not to trap air in the annular space. Trapped air will prevent complete encirclement of the liner by the grout. 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 heat of 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
	90	2290	97.5	2477	98.8	2510	170	253
	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
RSC250	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	2337	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

	NPS		Unconstrained Pipe Wall Buckling (Grouting pressure)[1]		Cellular Grout 40 pcf / 640 kg/m³			Cement Grout 125 pcf / 2000 kg/m³		
					Lift Height		Number of Lifts[2]	Lift Height		Number of Lifts
	(in)	(mm)	kPa	psi	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
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

[1] 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.

[2] 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.