Introduction

Sliplining is one of the oldest methods of trenchless rehabilitation where excavation of a damaged pipeline either isn't feasible or cost effective. Sliplining is also used on projects where a casing pipe is installed by directional boring or where a casing pipe is necessary to address specific structural needs. Site specific conditions and constraints can vary widely and while corrugated HDPE pipe may not be suitable for every application, it does provide a great solution for many cases. This technical note addresses the considerations and some limitations associated with the use of corrugated HDPE for sliplining applications. The method of installation discussed is applicable to Prinsco's ECOFLO® 100 and GOLDFLO®WT dual-wall, corrugated HDPE pipe.

Access to Casing Pipe

The casing or host pipe may be open on both ends, as in a culvert application or a highway crossing, may be open only on one end, or it may be accessible only through a manhole opening, as in a storm or sanitary sewer applications. Applications where at-least one end is open are the most appropriate application for corrugated HDPE pipe. Corrugated HDPE pipe is not suitable for applications that require the carrier pipe be bent or severely deflected, such as with projects where access is only available through manholes.

Diameter of the Host Pipe

The greater of either the outside diameter of the HDPE pipe or coupler should be compared to the inside diameter of the host pipe. This may be accomplished by attempting to pull a short section through the host pipe as a trial run. The host pipe should be clean and free from deflection to prevent undue resistance from sediment, debris, or host pipe deflection. Sliplining installations may be subject to thermal length changes and should be designed with a minimum of 10% clearance between the HDPE pipe's outside diameter and the host pipe inside diameter. The maximum outside diameters of Prinsco's ECOFLO 100 and GOLDFLO WT are shown in Table 1.

Table 1
GOLDFLO WT and ECOFLO 100 Pipe Dimensions

Nominal Diameter, (in)	Maximum Outside Diameter, (in)
4	4.9
6	7.2
8	9.6
10	12.5
12	14.9
15	17.7
18	21.7
24	28.6
30	35.1
36	41.1
42	48.0
48	54.7
60	67.1

Casing Pipe

The casing pipe shall be of sufficient strength to meet the loading conditions. Analysis for highway and pavement tunnels shall be based upon a continuous load carrying structure for the height of cover under HS-25 loading. Voids between the surrounding soil and the host pipe shall be pressure grouted to ensure structural integrity and resistance to thermal effects.

Installation of HDPE Liner

Corrugated HDPE pipe shall be supported by skids or runners to prevent the pipe corrugations and bells from snagging on the inside of the host pipe, to reduce friction, and to stabilize the pipe during the grouting procedure. Figure 1 illustrates the recommended skid configuration for corrugated HDPE pipe. Banding or other similar strapping

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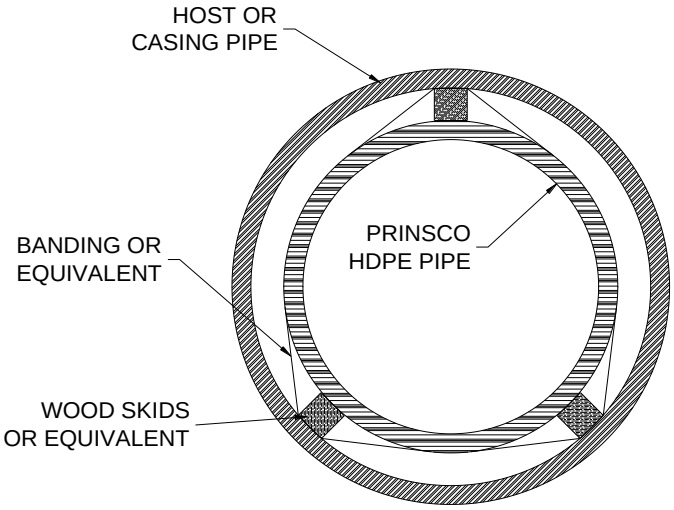
of sufficient strength and abrasion resistance should be used to secure the skids to the pipe to prevent dislocation during sliplining.

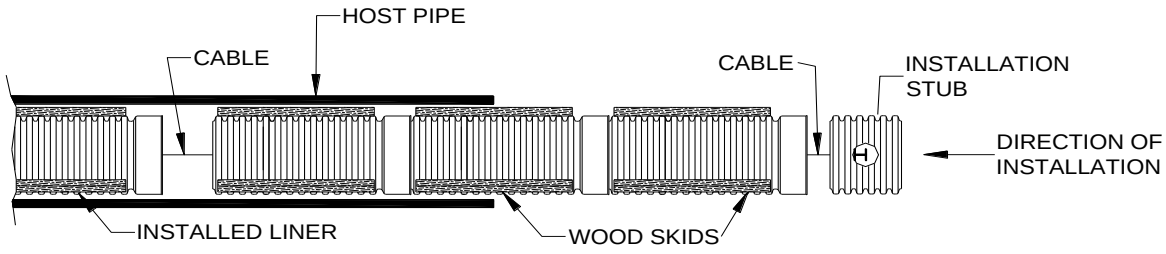
Figure 1
Example Skid Configuration for Corrugated HDPE Pipe



Wood skids should be hardwood or otherwise treated with a preservative to ensure suitable service life. The skids should extend the full length of each pipe with the exception of the bell and spigot area. Special precautions should be taken to prevent over-homing of the pipe joints. This can be accomplished by measuring the length of the bell and spigot engagement and applying that distance to the length the pipe is pulled.

For slipline lengths exceeding 100-feet, the HDPE pipe may be connected prior to insertion into the host pipe. The maximum length of pre-assembled pipe shall be no more than 3 full sticks. The pipe shall always be installed so that the spigots are inserted into the bells. Refer to Figure 2 for inserting the pre-connected pipe into the host pipe. This method of assembly will help to minimize the compressive forces applied when homing individual sticks of pipe within the casing and reduces the likelihood of bell and spigot damage. Joint pre-assembly also minimizes the risk of damage to the bell and spigot.

Figure 2
Inserting Liner into Host Pipe



A common method of pulling HDPE through the casing is with a winch and cable system attached to an installation stub shown in Figure 2. Installation stubs may be fabricated in the field from extra pipe. Installation stubs are used to avoid direct force applied to the bell end of the pipe. Insert a small section of steel I-beam, a 6" x 6" hardwood cross member, or equivalent through the installation stub and connect a suitable cable to the cross member. Once connected, the cable will run through to the opposite end of the host pipe. Once the HDPE pipe is pulled into place, the cable and installation stub assembly should be pulled back through the casing pipe as necessary for ongoing

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installation. The force necessary to pull the carrier pipe through the casing may be significant; the system used to pull the carrier pipe should be design to accommodate the anticipated loads. All personnel should maintain a safe working distance from the cable and pulling apparatus to avoid serious injury in the event of failure.

While this is one recommended example of how to accomplish sliplining, there are other suitable methods which may vary due to varying site conditions. Regardless of the method used, it is important to account for the special considerations listed above for sliplining with corrugated HDPE pipe.

Grouting Pressure and Application Process

To ensure maximum performance and service life of any sliplined system, it is necessary to fill the void between the casing and liner pipes. This will ensure loads are evenly distributed between both pipe structures and will enhance the structural performance of the system. During the grouting process, it is important to monitor and control the grout pressure to reduce the likelihood of damage to the liner or casing pipe or otherwise cause issues with liner pipe placement.

In most cases the limiting factor for grouting pressure are the pipe joints rather than the strength of the pipe wall. This is especially true for pipe joints assembled remotely. Prinsco recommends the maximum grout pressure not exceed 5 psi for ECOFLO 100 and GOLDFLO WT pipe.

The grout will have a tendency to float the liner pipe and cause misalignment. The application of skids as shown in Figure 1 along with placing the grout in lifts will help prevent pipe floatation and dislocation. Table 2 identifies the maximum recommended lift height which should be used. Each lift should be given time to set up between pours.

Table 2
Recommended Lift Heights for Grout Placement

Lift Number	Lift Height For 12"- 30" Pipe	Lift Height For 12"- 30" Pipe
1	1/4 O.D.	1/8 O.D.
2	1/4 O.D.	1/8 O.D.
3	1/4 O.D.	1/8 O.D.
4		1/4 O.D.
5		1/4 O.D.
Final	Fill entire void space remaining between liner and host pipes	

During the grout curing process, heat is generated and while this heat generally does not affect the pipe, the maximum temperature of the grout directly around the pipe should not exceed 140°Fahrenheit.

There are many methods of grout application, each of which may have specific advantages or limitations. One common method is to use vertical stacks evenly spaced throughout the run, where grout is injected at the ground surface. An alternative method incorporates the use of a suitably sized grout application tube (i.e. 2” PVC) to fit between the casing and liner pipe. The application tube may be extended to the entire length of the slipline and functions as a snout to apply the grout evenly throughout the run.

Summary

ECOFLO 100 and GOLDFLO WT are well suited for sliplining applications where access to the casing pipe is unobstructed and allows for insertion of the HDPE pipe without damage. Regardless of the product chosen as a liner for sliplining projects, it is necessary to review the project constraints and condition of the casing pipe to ensure trouble free installation and operation.

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