HD100 / HD100EC PIPE
INSTALLATION GUIDE

Introduction

Photo illustrates single sling handling used for the smaller diameters, sloped trench walls to mitigate against the need of a trench box, and stone bedding above the trench foundation.

Installation of corrugated HDPE pipe follows typical procedures to those used for any given quality pipe installation. Since the strength of HDPE pipe is more fully mobilized when the passive resistance of the surrounding backfill material is at its greatest, installation guidelines for the proper selection, placement and compaction of embedment materials will help ensure good, sound performance and extended service life.

This guideline does not attempt to address installation practices common to all pipe types (e.g. line and grade, working in an upstream direction), but only those features that are important in securing pipe support from the embedment material. Consistent with that objective, no attempt is made herein to address safety concerns associated with the installation of corrugated HDPE pipe or underground construction in general. It is the responsibility of the user of this guide to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Overview

Deflections are minimized by proper backfill selection, appropriate construction practices, and increased installation inspection.[1] The failure to use suitable methods during backfill placement can increase deflections significantly above values predicted by structural analysis. Deflections are controlled more by installation practice than by design and it is the contractor's responsibility to ensure acceptable levels of deflection are maintained. The design process demonstrates that a pipe is structurally adequate at a predicted deflection and the contractor is then responsible for providing an installation commensurate with that analysis.

Construction practices that produce good pipe performance with minimal inspection and construction control are desirable. Key considerations are backfill material, placement methods, compaction procedures, and (on wet sites) control of ground water to allow proper placement and compaction of backfill.

Good performance of a pipe installation is more likely realized when the backfill materials are limited to well-graded, coarse-grained soils (sands and gravels) with less than 12% fines. Uniformly graded coarse-grained soils also ensure good performance when soil migration into the open voids is either unlikely or prevented. Uniform fine sands should be avoided. Coarse-grained soils with fines or fine-grained soils with at least 30% coarse-grained material provide good performance if placed and compacted properly, but increased inspection during installation is recommended. Backfill should be compacted to at least 95% of maximum standard Proctor density for applications in roadways.

Backfill placement procedures normally require density control to provide the desired backfill properties. Thus, it is common practice to relate soil properties to a given percentage of maximum density determined in accordance with the standard Proctor test (AASHTO T99, ASTM D 698). The ability of a given soil at a given density to resist deformation of a buried pipe is the key mechanism in controlling deflection.

Soil stiffness relates the ability of the backfill to provide structural support to a pipe installation. Coarse-grained backfill materials with 12% or less fines have the highest initial stiffness without compaction and reach the higher stiffnesses with the least compactive effort. Material testing shows that achieving a moderate level of stiffness may require three times more energy for the coarse-grained soils when the fine content is increased into the 12-20% range.

1. The term "installation inspection" in this guide refers to the traditional detailed approach of monitoring backfill selection, placement and compaction as a means of ensuring that installation is completed in accordance with defined parameters.

MAXIMUM COVER HEIGHTS

Maximum burial depths corresponding to the soil classification system of ASTM D2321 are shown in the table below, with the best results obtained using manufactured or processed aggregates (i.e. crushed rock).

LANE HD100/HD100EC PIPE – ALLOWABLE BURIAL DEPTHS (FT)

Diameter (in)	Class I		Class II		Class III	
	Compacted	Dumped	95%	90%	95%	90%
12	29	21	21	15	15	10
15	26	23	19	13	14	10
18	29	22	21	15	15	10
24	27	21	20	14	14	9
30	25	19	18	12	13	9
36	27	22	20	13	14	9
42	33	23	22	15	15	10
48	23	17	16	10	11	7
60	25	19	18	12	12	7

1. Installation in accordance with ASTM D2321.
2. Class I indicates a soil that generally provides the highest soil stiffness at any given percent compaction, and provides a given soil stiffness with the least compactive effort. Each higher-number soil class provides successively less soil stiffness at a given compaction and requires greater compactive effort to provide a given level of soil stiffness.
3. All acceptable backfill materials are not presented here. See ASTM D2321 for a complete listing of classifications.
4. Results based on the AASHTO LRFD design method using zero hydrostatic pressure and a soil density of 120 pcf. Greater cover heights are attainable with appropriate modifications to the design method - Contact Lane for further details.
5. Dumped Class I material is estimated at 90% maximum standard Proctor density.

MINIMUM COVER HEIGHTS FOR LIVE LOADS

Truck Loadings (H20, H25 or HL93)[1], 6 thru 48 inch dia..... 12 inches
Truck Loadings (H20, H25 or HL93)[1], 60 inch dia.............. 24 inches
Minimum Cover for E-80 (Rail Road) Loads...................... 24 inches
Temporary Cover for Construction Loads[2]........................ 2 to 4 feet

[1] May be subject to local or state agency minimum cover requirements.

[2] Cover for construction loads depends on pipe diameter and construction equipment (see table to right).

MINIMUM COVER FOR CONSTRUCTION LOADS (in)

Nominal Pipe Diameter (ft)	Axle Loads (kips)			
	18-50	50-75	75-110	110-150
2.0 - 3.0	24.0	30.0	36.0	36.0
3.5 - 5.0	36.0	36.0	42.0	48.0

Minimum cover shall be measured from the top of the pipe to the top of the maintained construction roadway surface.

NOTE: Information contained herein is meant as a discretionary guide and is not intended to supersede any governing specifications or requirements of record.

About Lane

As a full-line manufacturer of corrugated metal and plastic drainage products, Lane Enterprises, Inc. operates plants throughout the Northeastern, Mid-Atlantic, and South-Central states producing various types of buried structures for the construction industry.

For nearly 90 years, Lane has partnered with contractors, engineers, and municipalities to supply reliable products that provide the highest levels of service life, strength, versatility, and economy. Our focus on quality products, responsive customer service, and technical expertise has established a long, proven history of successful partnerships within the industries we serve.

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ASTM D2321 SOIL CLASSIFICATIONS

Soil classifications are grouped by typical soil stiffness when compacted. Class I indicates a soil that generally provides the highest soil stiffness at any given percent compaction, and provides a given soil stiffness with the least compactive effort. Each higher-number soil class provides successively less soil stiffness at a given percent compaction and requires greater compactive effort to provide a given level of soil stiffness.

Thermoplastic pipe installations develop structural stability from the strength and relative stiffness of the embedment material. It is the resulting soil-pipe interaction system that defines the ability of a flexible pipe to withstand service loads. Using the stiffer pipe embedment materials is key to minimizing pipe deflection and the need for detailed installation inspection and compaction testing. For these reasons only soil classifications I and II are presented here.

Succeeding soil classifications (III through V) may be appropriate for use but will require a more thorough analysis to determine suitability and optimum water content for compaction. Although reasonable levels of pipe support are provided when properly placed and compacted, these materials may not be suitable under the deeper fills, shallower covers, and instances where water conditions in the trench may prevent proper placement and compaction. Since these materials may represent native soils that bring an economy to the installation, the user is advised to consult ASTM D2321 directly as a guide to their appropriate use.

Class I materials provide maximum stability and pipe support for a given percent compaction. With minimum effort, these materials can be installed at relatively high stiffnesses over a wide range of moisture contents. Suitable compaction is typically achieved with a dumped placement provided material is worked into the haunch zone. Vibration or impact compaction methods will ensure the highest levels of stiffness for the deeper fills.

The high permeability of Class I materials may aid in the control of water, and these materials are often desirable for embedment in rock cuts where water is frequently encountered. However, when groundwater flow is anticipated, consideration should be given to the potential for migration of fines from adjacent materials into the open-graded Class I materials.

ASTM D2321 Soil Class I
Manufactured Aggregates

Crushed rock with angular, fractured particle faces.

100% passing the 1½" sieve

15% or less passing the #4 sieve

25% or less passing the ⅜" sieve

12% or less passing the #200 sieve

Open graded, high permeability
AASHTO No. 57 stone commonly used

CLASS I MATERIALS ADDENDUM

Densely-graded manufactured/processed aggregates were included as Class I materials in former editions of ASTM D2321 due to the high stiffnesses of these materials when compacted. The stone-sand mixtures of these materials are graded to minimize migration of adjacent soils and contain little or no fines. Since these materials do not flow as readily into the haunch region and require moderate compactive effort, these materials are now relegated to Class II. It should be noted that when properly placed and compacted, this material can provide an equivalent strength to Class I materials provided soil migration into adjacent soils is not a concern or has been addressed.

Class II materials provide a relatively high level of pipe support when moderately compacted with either vibration or impact compaction methods.

Class I materials have more stiffness than Class II materials, but data indicates that the stiffness of uncompacted Class I materials can be taken equivalent to Class II materials compacted to 95%, and the stiffness of compacted Class I materials can be taken equivalent to Class II materials compacted to 100%.

The open-graded groups within this classification may allow migration, and the particle size distributions should be reviewed for compatibility with adjacent material.

Uniform fine sands (SP) with more than 50% passing the #100 sieve behave like silts and are not considered Class II materials.

ASTM D2321 Soil Class II
Clean, Coarse-Grained Soils

Sands and gravels with 12% or less fines.

ASTM D2487 Soil Group
GW Well-graded gravels and gravel-sand mixtures

GP Poorly-graded gravels and gravel-sand mixtures

SW Well-graded sands and gravelly sands

SP Poorly-graded sands and gravelly sands

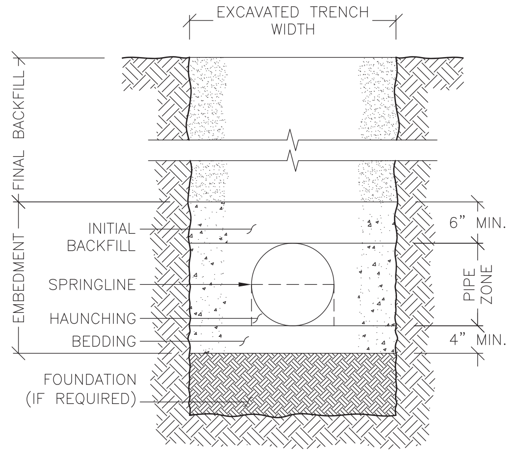
AASHTO M145 Soil Groups A1 and A3

EXCAVATED TRENCH WIDTH

Trench width should be sufficient to allow proper placement and compaction of the backfill. Narrower trench widths normally provide better pipe support and it is generally recommended to maintain the minimum width unless more clearance is needed to accommodate compaction equipment in use on the project. If the native soils forming the trench wall are unstable but can sustain a vertical cut, the trench width should be increased to provide one-half diameter width of structural backfill on either side of the pipe; otherwise, a full diameter should be provided on either side of the pipe.

Minimum Trench Width (T_{MIN})					
ID (in)	OD (in)	T_{MIN} (in)	ID (in)	OD (in)	T_{MIN} (in)
6	7.05	24	24	28.00	47
8	9.40	26	30	34.50	56
10	12.00	28	36	41.00	64
12	14.50	31	42	47.50	72
15	17.50	34	48	54.50	81
18	21.50	39	60	66.85	96

Minimum trench width per ASTM D2321 for stable trench walls is taken as the greater of the OD plus 16 inches or 1.25 times the OD plus 12 inches.



Embankment installations are typically conducted in the same manner as trench installations except that the embankment is constructed to a height corresponding to one foot above the top of pipe before the trench is cut. The trench width is then managed as if cut in unstable native soils.

TRENCH BOTTOM

The trench bottom should be firm and stable. Rock or unyielding material should be removed and replaced to provide at least a 6-inch cushion of bedding below the bottom of the pipe. An unstable foundation should be over-excavated and replaced with a suitable foundation or bedding material and compacted as necessary to ensure a firm and stable trench bottom.

BEDDING

Bedding under the pipe for the central one-third of the OD should be left uncompacted for a depth of 3 inches to cushion the pipe and mitigate the effects of poor haunching.

PIPE EMBEDMENT

Trenches must be free of water when placing and compacting backfill.

Use of trench boxes in the backfill zone at the side of the pipe should be avoided unless measures are taken to ensure the backfill is not disrupted or left with a void when the trench box is advanced.

Maximum stone size for embedment is generally limited to 1½". Smaller maximum sizes may be required to enhance placement around small diameter pipe and to prevent damage to the pipe wall.

Haunch filling is carried out on both sides simultaneously to avoid rolling the pipe, and controlling the compaction force will prevent the pipe from lifting off grade. Filling adjacent sidefill zones will provide lateral support for the haunch material during the process.

Material cannot be properly worked into the haunch zone and compacted if the pipe is backfilled to the springline on the first lift. Smaller lift thicknesses may therefore be necessary initially depending on the diameter of the pipe.

Lift thickness and compaction must be done evenly on each side of the pipe. The maximum difference in the sidefill surface elevations at any given time is generally limited to one lift thickness.

While 6-inch lifts are commonly specified, 12-inch lifts can produce good results with coarse-grained backfills provided placement and compaction practices are appropriate.

It may be beneficial to require a minimum number of compaction passes and to specify a minimum density. If the specified density is 95% of maximum standard Proctor density, then good pipe performance will result even if the compaction is slightly less than specified. An additional 6 inches of structural backfill over the top of the pipe provides a complete envelope that better locks underlying material together and protects the pipe from any damaging impacts from the final backfill.

FINAL BACKFILL

Final backfill does not directly support the pipe and is more appropriately dealt with in connection with the intended use at the surface. Selection, placement and compaction of final backfill is therefore directed by the design engineer. However, when final backfill contains large fragments or cobbles, the initial backfill cover levels may need to be increased accordingly to protect the pipe from any potential impact or point loading.