TECHNICAL NOTE

Minimum and Maximum Burial Depth for Corrugated HDPE Pipe (per AASHTO)

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Introduction

The information in this document is designed to provide answers to general cover height questions; the data provided is not intended to be used for project design. The design procedure described in the *Structures* section (Section 2) of the Drainage Handbook provides detailed information for analyzing most common installation conditions. This procedure should be utilized for project specific designs.

The two common cover height concerns are minimum cover in areas exposed to vehicular traffic and maximum cover heights. Either may be considered "worst case" scenario from a loading perspective, depending on the project conditions.

Minimum Cover in Traffic Applications

Pipe diameters from 4- through 48-inch (100-1200 mm) installed in traffic areas (AASHTO H-25 or HS-25 loads) must have at least one foot (0.3m) of cover over the pipe crown, while 54- and 60-inch (1350 and 1500 mm) pipes must have at least 24 inches (0.6m) of cover. The backfill envelope must be constructed in accordance with the *Installation* section (Section 5) of the Drainage Handbook and the requirements of ASTM D2321. The backfill envelope must be of the type and compaction listed in Appendix A-5, Table A-5-2 of the Drainage Handbook. In Table 1 below, this condition is represented by a Class III material compacted to 90% standard Proctor density, although other material can provide similar strength at slightly lower levels of compaction. Structural backfill material should extend six inches (0.15m) over the crown of the pipe; the remaining cover should be appropriate for the installation and as specified by the design engineer. If settlement or rutting is a concern, it may be appropriate to extend the structural backfill to grade. Where pavement is involved, sub-base material can be considered in the minimum burial depth. While rigid pavements can be included in the minimum cover, the thickness of flexible pavements should not be included in the minimum cover.

Additional information that may affect the cover requirements is included in the *Installation* section (Section 5) of the Drainage Handbook. Some examples of what may need to be considered are temporary heavy equipment, construction loading , paving equipment and similar loads that are less than the design load, the potential of pipe flotation, and the type of surface treatment which will be installed over the pipe zone.

Table 1
Minimum Cover Requirements for ADS N-12®, N-12 ST, and N-12 WT (per AASHTO) with AASHTO H-25 or HS-25 Load

Inside Diameter, ID, in.(mm)	Minimum Cover ft. (m)	Inside Diameter, ID, in.(mm)	Minimum Cover ft. (m)
4 (100)	1 (0.3)	24 (600)	1 (0.3)
6 (150)	1 (0.3)	30 (750)	1 (0.3)
8 (200)	1 (0.3)	36 (900)	1 (0.3)
10 (250)	1 (0.3)	42 (1050)	1 (0.3)
12 (300)	1 (0.3)	48 (1200)	1 (0.3)
15 (375)	1 (0.3)	54 (1350)	2 (0.6)
18 (450)	1 (0.3)	60 (1500)	2 (0.6)

Note: Minimum covers presented here were calculated assuming Class III backfill material compacted to 90% standard Proctor density around the pipe and a minimum of 6-inches (0.15m) structural backfill over the pipe crown, as recommended in Section 5 of the Drainage Handbook, with an additional layer of compacted traffic lane sub-base for a total cover as required. In shallow traffic installations, especially where pavement is involved, a good quality compacted material to grade is required to prevent surface settlement and rutting.

City Standards require a minimum 3ft of cover over CPEP pipe (ref. City Stds 204.4(3)). The City is willing to allow minimum cover of 30in, but staff cannot support a further reduction based on City regulations. If it is still desired to use CPEP with less than 30in of cover, a formal Alternative Methods Request (AMR) application must be submitted for review and formal decision by the City Engineer. Please be aware that cost savings cannot be a justification to deviate from City Standards. [ADS Technical Sheet, Burial Depth of Corrugated HDPE Pipe]

Maximum Cover

Wall thrust generally governs the maximum cover a pipe can withstand and conservative maximum cover heights will result when using the information presented in the *Structures* section (Section 2) of the Drainage Handbook.

The maximum burial depth is highly influenced by the type of backfill and level of compaction around the pipe. General maximum cover limits for ADS N-12, N-12 ST, N-12 WT pipe, (ASTM F2306 and AASTHO M252/M294 Type S pipes) are shown in Table 3 for a variety of backfill conditions.

Table 3 was developed assuming pipe is installed in accordance with ASTM D2321 and the *Installation* section (Section 5) of the Drainage Handbook. Additionally, the calculations assume zero hydrostatic load, incorporate the maximum safety factors represented in Structures section of the Drainage Handbook, use material properties consistent with the expected performance characteristics for N-12 (per ASTM F2306) materials as shown in Table 2 below, and assume the native soil is of adequate strength and is suitable for installation. For applications requiring fill heights greater than those shown in Table 3 or where hydrostatic pressure due to groundwater is present, contact an ADS engineering representative.

Figure 1
ADS N-12®, N-12 ST, and N-12 WT (per AASHTO) Trench Detail Under Pavement

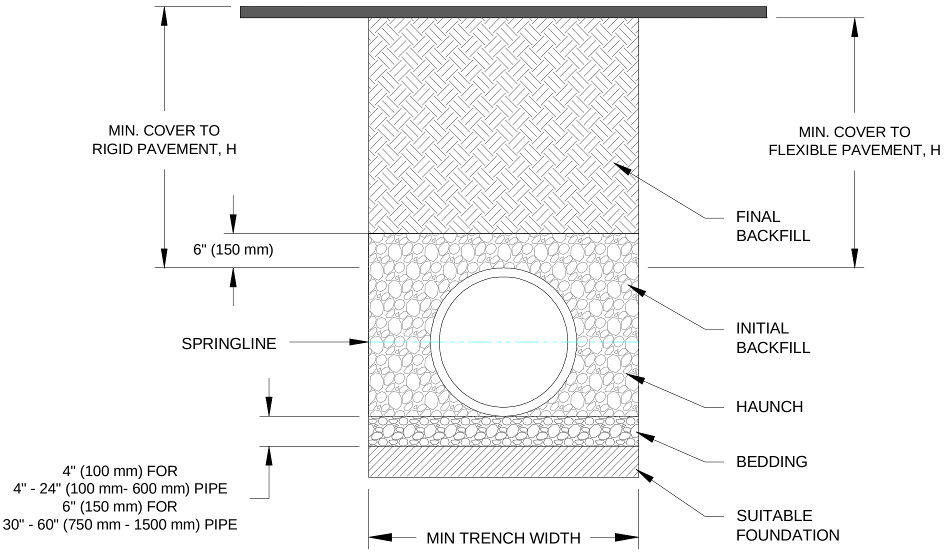

Table 2
ADS N-12 (per AASHTO) Mechanical Properties

Cell Class	Factored Compressive Strain (%)	Tension Strain (%)	Initial		75-Year	
			Fu (psi)	E (psi)	Fu (psi)	E (psi)
ASTM D3350 435400C	4.1	5.0	3,000	110,000	900	21,000

Table 3
Maximum Cover for ADS N-12, N-12 ST, and N-12 WT Pipe (per AASHTO), ft (m)

Diameter in. (mm)	Class One				Class Two						Class Three			
	Compacted		Dumped		95%		90%		85% [3]		95%		90% [3]	
4 (100)	37	(11.3)	18	(5.5)	25	(7.6)	18	(5.5)	12	(3.7)	18	(5.5)	13	(4.0)
6 (150)	44	(13.4)	20	(6.1)	29	(8.8)	20	(6.1)	14	(4.3)	21	(6.4)	15	(4.6)
8 (200)	32	(9.8)	15	(4.6)	22	(6.7)	15	(4.6)	10	(3.0)	16	(4.9)	11	(3.4)
10 (250)	38	(11.6)	18	(5.5)	26	(7.9)	18	(5.5)	12	(3.7)	18	(5.5)	13	(4.0)
12 (300)	38	(11.6)	18	(5.5)	26	(7.9)	18	(5.5)	13	(4.0)	19	(5.8)	14	(4.3)
15 (375)	42	(12.8)	20	(6.1)	28	(8.5)	20	(6.1)	14	(4.3)	20	(6.1)	15	(4.6)
18 (450)	35	(10.7)	17	(5.2)	24	(7.3)	17	(5.2)	12	(3.7)	17	(5.2)	12	(3.7)
24 (600)	30	(9.1)	15	(4.6)	21	(6.4)	15	(4.6)	10	(3.0)	15	(4.6)	11	(3.4)
30 (750)	25	(7.6)	12	(3.7)	18	(5.5)	12	(3.7)	8	(2.4)	13	(4.0)	9	(2.7)
36 (900)	29	(8.8)	13	(4.0)	20	(6.1)	13	(4.0)	9	(2.7)	14	(4.3)	9	(2.7)
42 (1050)	27	(8.2)	13	(4.0)	19	(5.8)	13	(4.0)	8	(2.4)	13	(4.0)	9	(2.7)
48 (1200)	25	(7.6)	12	(3.7)	17	(5.2)	12	(3.7)	7	(2.1)	12	(3.7)	8	(2.4)
54 (1350)	26	(7.9)	12	(3.7)	18	(5.5)	12	(3.7)	7	(2.1)	12	(3.7)	8	(2.4)
60 (1500)	29	(8.8)	13	(4.0)	20	(6.1)	13	(4.0)	8	(2.4)	14	(4.3)	9	(2.7)

Notes:

1. *Results based on calculations shown in the Structures section of the ADS Drainage Handbook (v20.2). Calculations assume no hydrostatic pressure and a density of 120 pcf (1926 kg/m^3) for overburden material.*
2. *Installation assumed to be in accordance with ASTM D2321 and the Installation section of the Drainage Handbook.*
3. *For installations using lower quality backfill materials or lower compaction efforts, pipe deflection may exceed the 5% design limit; however controlled deflection may not be a structurally limiting factor for the pipe. For installations where deflection is critical, pipe placement techniques or periodic deflection measurements may be required to ensure satisfactory pipe installation.*
4. *Backfill materials and compaction levels not shown in the table may also be acceptable. Contact ADS for further detail.*
5. *Material must be adequately "knifed" into haunch and in between corrugations. Compaction and backfill material is assumed uniform throughout entire backfill zone.*
6. *Compaction levels shown are for standard Proctor density.*
7. *For projects where cover exceeds the maximum values listed above, contact ADS for specific design considerations.*
8. *Calculations assume no hydrostatic pressure. Hydrostatic pressure will result in a reduction in allowable fill height. Reduction in allowable fill height must be assessed by the design engineer for the specific field conditions.*
9. *Fill height for dumped Class I material incorporate an additional degree of conservatism that is difficult to assess due to the large degree of variation in the consolidation of this material as it is dumped. There is limited analytical data on its performance. For this reason, values as shown are estimated to be conservatively equivalent to Class 2, 90% SPD.*

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