HP Storm
Submittal Package

Package Contents

1. Brochure
2. Specification
3. Technical notes
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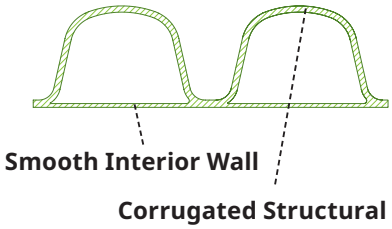
HP Storm Pipe

HP Storm Pipe 12”–60” for Storm Applications

Overview

HP Storm is a high-performance polypropylene (PP) pipe for gravity-flow storm drainage applications. HP Storm is the perfect choice when premium joint performance and/or greater pipe stiffness is required. HP Storm couples advanced polypropylene resin technology with a proven, dual-wall profile design for superior performance and durability.

Specify HP Storm with confidence based on national standards and approvals. This innovative product meets or exceeds ASTM F2881 and AASHTO M330. From a federal perspective, polypropylene pipe is approved for use by the Army Corps of Engineers for storm drainage applications under Section 33 40 00 (Unified Facilities Guide Specifications). The Federal Aviation Authority (FAA) permits polypropylene pipe under airfield pavements per Item D-701, Pipe for Storm Drains and Culverts in AC 150/5370-10G (Standards for Specifying Construction of Airports). Additionally, the American Railway Engineering and Maintence-of-Way Association (AREMA) approves polypropylene pipe in storm drainage applications under railroads.



Smooth Interior Wall

Advanced Dual Wall Profile Construction

HP Storm pipe utilizes a dual wall construction, providing increased pipe stiffness. The additional stiffness and beam strength enhances jobsite performance in stringent line and grade requirements. The pipe profile is completed with a smooth interior which provides additional strength and excellent flow characteristics.

Superior Polypropylene Material

Made from an engineered impact modified co-polymer compound, the superior strength and material properties of polypropylene offer robust pipe stiffness, excellent handling characteristics, and long service life when compared to traditional storm sewer products. It is highly resistant to chemical attack and is unaffected by soils or effluents with PH ranges 1.5 to 14. The unique light grey resin color provides immediate jobsite recognition as well as improving the pipe’s interior visibility during post-installation inspection.

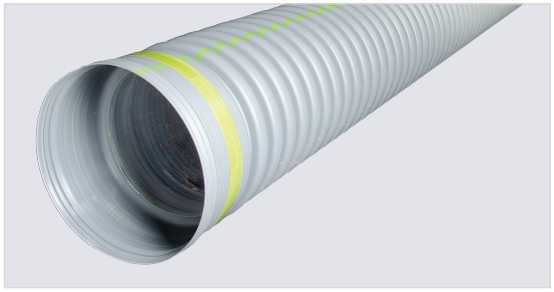
Polypropylene Resin

Superior Joint Performance

HP Storm pipe has an extended bell that adds an additional factor of safety within each joint. The joint performance meets or exceeds the 10.8 psi laboratory performance standards per ASTM D3212 requirements. Third party certification of joint performance is available upon request.

In the field, each section of HP Storm may be tested by a low pressure air test, according to ASTM F1417, which is a commonly used standard and specifies that 3.5 psi air pressure be held for a specified length of time based upon pipe diameter and length of run.

Where an infiltration/exfiltration test is preferred, ASTM F2487 specifies a simplistic method of verifying proper joint performance.



Extended Bell

Fittings

Both standard and custom fittings are available for the HP Storm product line. A complete line of standard Nyloplast PVC molded fittings are available in the 12”–30” (300-750 mm) mainline sizes.

Standard branch laterals are designed to accept SDR-35 or SDR-26 pipe.

Fabricated Wye Fitting

Diameter Range

HP Storm is currently manufactured in the 12”–60” (300-1500mm) size range and in 20-foot (6m) lengths. The 20-foot (6m) lengths aid in speed of installation and reduce the total number of joints.

Nominal Diameter in (mm)	Profile Type	Length ft (m)	Inside Diameter in (mm)	Outside Diameter in (mm)	Truckload Footage ft (m)
12 (300)	Dual Wall	20 (6)	12.2 (310)	14.5 (368)	2,400 (731.5)
15 (375)	Dual Wall	20 (6)	15.1 (384)	17.7 (450)	1,600 (487.7)
18 (450)	Dual Wall	20 (6)	18.2 (462)	21.4 (544)	1,120 (341.4)
24 (600)	Dual Wall	20 (6)	24.1 (612)	28.0 (711)	600 (182.9)
30 (750)	Dual Wall	20 (6)	30.2 (767)	35.5 (902)	360 (109.7)
36 (900)	Dual Wall	20 (6)	36.0 (914)	41.5 (1054)	240 (73.2)
42 (1050)	Dual Wall	20 (6)	42.0 (1067)	47.4 (1204)	160 (48.8)
48 (1200)	Dual Wall	20 (6)	47.9 (1217)	54.1 (1374)	120 (36.6)
60 (1500)	Dual Wall	20 (6)	59.9 (1521)	67.1 (1704)	80 (24.4)

Tap Connections

A standard tapping product, such as Inserta Tee®, is compatible with HP Storm.

Repair Couplers

Depending on local requirements, ADS offers a full range of repair coupling options. For soil-tight performance, split couplers and Mar Mac® repair bands are offered. Testable repair couplers are also available, which include stainless steel restraint bands and Nyloplast® PVC repair sleeves.

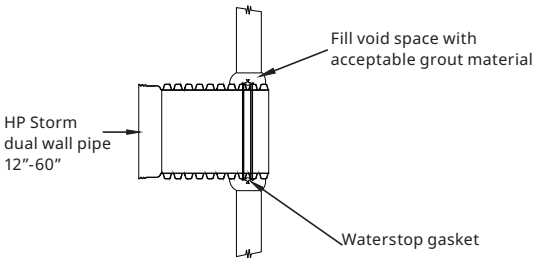
12”–60” Structure Connections

Storm sewer structure connection requirements vary greatly by region. For soil-tight performance, HP Storm exterior corrugations provide an effective profile for grouted connections. For watertight performance, ADS offers a selection of options utilizing some of the most widely used manhole connectors from companies such as A-Lok®, Trelleborg® and Press Seal® Gasket Corporation.

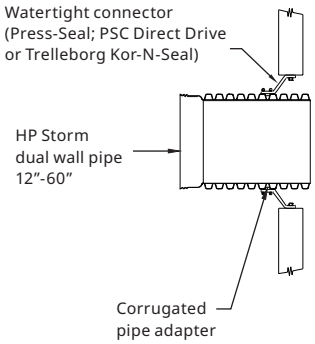
Typical Inserta Tee Tap

Repair Coupler

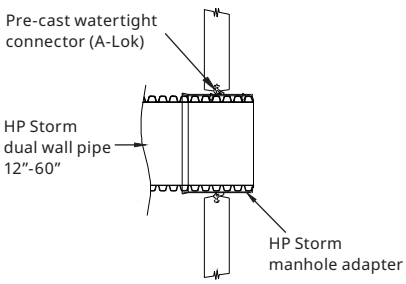
Grouted Waterstop Manhole Connection



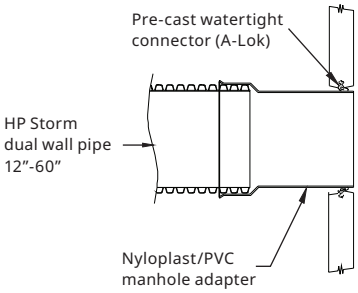
Flexible Boot Connection



Pre-Cast Compression Gasket Connection



Pre-Cast Compression Gasket Connection



HP Storm 12”–60” Pipe Specification

Scope

This specification describes 12– through 60–inch (300 to 1500 mm) ADS HP Storm pipe for use in gravity-flow storm drainage applications.

Pipe Requirements

ADS HP Storm pipe shall have a smooth interior and annular exterior corrugations.

- 12– through 60-inch (300 to 1500 mm) pipe shall have a smooth interior and annular exterior corrugations and meet or exceed ASTM F2881 and AASHTO M330.
- Manning’s “n” value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined using a bell and spigot joint meeting the requirements of ASTM F2881 or AASHTO M330. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during joint assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

Fittings

Fittings shall conform to ASTM F2881 or AASHTO M330. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

Field Pipe and Joint Performance

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or F2487. Appropriate safety precautions must be used when field testing any pipe material. Contact the manufacturer for recommended leakage rates.

Material Properties

Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M330, Section 6.1.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in traffic areas for 12– through 48–inch (300 to 1200 mm) diameters shall be one foot (0.3 m) and for 60–inch (1500 mm) diameters, the minimum cover shall be 2 feet (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1, Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.04. Contact your local ADS representative or visit our website at **adspipe.com** for a copy of the latest installation guidelines.

Build America, Buy America (BABA)

ADS HP Storm pipe, manufactured in accordance with ASTM F2881 or AASHTO M330, complies with the requirements in the Build America, Buy America (BABA) Act.

Pipe Dimensions

Nominal Diameter in (mm)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Average Pipe I.D. in (mm)	12.2 (310)	15.1 (384)	18.2 (462)	24.1 (612)	30.2 (767)	36.0 (914)	42.0 (1067)	47.9 (1217)	59.9 (1521)
Average Pipe O.D. in (mm)	14.5 (368)	17.7 (450)	21.4 (544)	28.0 (711)	35.5 (902)	41.5 (1054)	47.4 (1204)	54.1 (1374)	67.1 (1704)
Minimum Pipe Stiffness at 5% Deflection* #/in/in (kN/m^2)	75 (517)	60 (414)	56 (386)	50 (345)	46 (317)	40 (276)	35 (241)	35 (241)	30 (207)

* Minimum pipe stiffness values listed; contact a representative for maximum values.

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HP STORM 12”- 60” PIPE SPECIFICATION

Scope
This specification describes 12- through 60-inch (300 to 1500 mm) HP Storm pipe for use in gravity-flow storm drainage applications.

Pipe Requirements
HP Storm pipe shall have a smooth interior and annular exterior corrugations.
- 12- through 60-inch (300 to 1500 mm) pipe shall meet ASTM F2881 or AASHTO M330
- Manning’s “n” value for use in design shall be 0.012

Joint Performance
Pipe shall be joined using a bell & spigot joint meeting the requirements of ASTM F2881 or AASHTO M330. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

Fittings
Fittings shall conform to ASTM F2881 or AASHTO M330. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

Field Pipe and Joint Performance
To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

Material Properties
Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M330, Section 6.1.

Installation
Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in traffic areas for 12- through 48-inch (300 to 1200 mm) diameters shall be one foot (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD), or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.04. Contact your local ADS representative or visit our website at
www.adspipe.com for a copy of the latest installation guidelines.

Build America, Buy America (BABA)
HP Storm pipe (per AASHTO), manufactured in accordance with ASTM F2881 or AASHTO M330, complies with the requirements in the Build America, Buy America (BABA) Act.

Pipe Dimensions

Nominal Pipe I.D. in (mm)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Average Pipe I.D. in (mm)	12.2 (310)	15.1 (384)	18.2 (462)	24.1 (612)	30.2 (767)	36.0 (914)	42.0 (1067)	47.9 (1217)	59.9 (1521)
Average Pipe O.D. in (mm)	14.5 (368)	17.7 (450)	21.4 (544)	28.0 (711)	35.5 (902)	41.5 (1054)	47.4 (1204)	54.1 (1374)	67.1 (1704)
Minimum Pipe Stiffness * @ 5% Deflection #/in./in. (kN/m^2)	75 (517)	60 (414)	56 (386)	50 (345)	46 (317)	40 (276)	35 (241)	35 (241)	30 (207)

*Minimum pipe stiffness values listed; contact a representative for average values.

Technical Note

TN 2.04 Minimum and Maximum Cover Heights for HP Storm Pipe for Storm Drainage

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 12- through 48-inch (300-1200 mm) installed in traffic areas (AASHTO H-20, H-25, or HL-93 loads) must have at least one foot (0.3m) of cover over the pipe crown, while 60-inch (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 95% standard Proctor density or a Class II 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 to 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 HP Storm with AASHTO H-25, H-20, or HL-93 Load

Inside Diameter, ID, in.(mm)	Minimum Cover ft. (m)	Inside Diameter, ID, in.(mm)	Minimum Cover ft. (m)
12 (300)	1 (0.3)	36 (900)	1 (0.3)
15 (375)	1 (0.3)	42 (1050)	1 (0.3)
18 (450)	1 (0.3)	48 (1200)	1 (0.3)
24 (600)	1 (0.3)	60 (1500)	2 (0.6)

Notes:

1. *Minimum covers presented here were calculated assuming Class III backfill material compacted to 95% standard Proctor density or Class II backfill material compacted to 90% standard Proctor density around the pipe, 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.*
2. *The minimum covers specified do not include pavement thickness. A pavement section of 0.4' is typical.*
3. *Backfill materials and compaction levels not shown in the table may also be acceptable. Contact ADS for further detail.*
4. *Calculations assume no hydrostatic pressure and native soils that are as strong as the specified minimum backfill recommendations.*

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. Table 2 below shows the material properties consistent with the expected performance characteristics for HP Storm materials for a 100-year design life.

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 HP Storm use in storm drainage applications are shown in Tables 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 no hydrostatic load around the pipe, incorporate the maximum conservative AASHTO LRFD design factors represented in *Structures* section of the Drainage Handbook, use material properties consistent with the expected performance characteristics for HP Storm materials, as shown in Table 2, and assume the native (in-situ) soil is of adequate strength and suitable for installation. For applications requiring fill heights greater than those shown in Table 3 or where hydrostatic pressure due to groundwater is expected, contact an ADS Engineer.

Table 2
ADS HP Storm Mechanical Properties

Resin	ASTM Specification	Allowable Long Term Strain %	Initial		75-Year	
			Fu (psi)	E (psi)	Fu (psi)	E (psi)
Polypropylene, Impact-modified copolymer	ASTM F2881	3.7	3,500	175,000	1,000	28,000

Figure 1
ADS HP Storm Pipe Trench Detail with Uniform Backfill
(Traffic and Non-Traffic Applications)

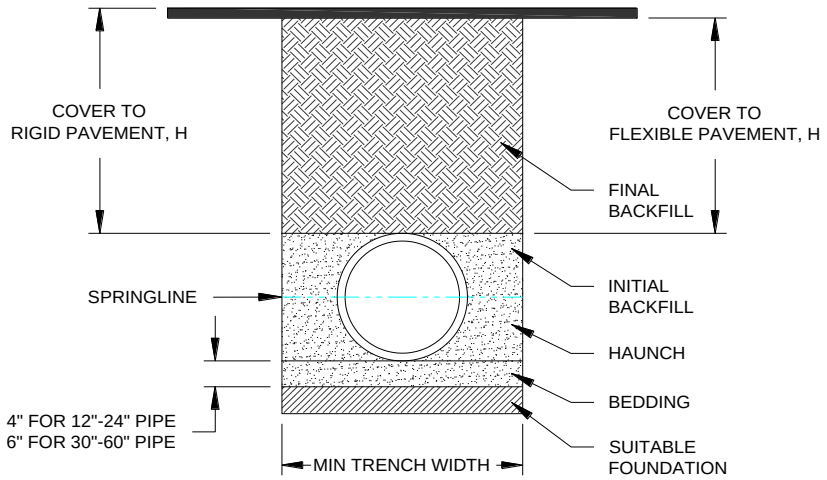

Table 3
Maximum Cover for ADS HP Storm Pipe with Uniform Backfill, ft (m)

Diameter	Class 1		Class 2			Class 3		Class 4
in (mm)	Compacted	Dumped	95%	90%	85% [3]	95%	90% [3]	95% [3]
12 (300)	41 (12.5)	21 (6.4)	28 (8.5)	21 (6.4)	16 (4.9)	20 (6.1)	16 (4.9)	16 (4.9)
15 (375)	42 (12.8)	21 (6.4)	29 (8.8)	21 (6.4)	16 (4.9)	21 (6.4)	16 (4.9)	16 (4.9)
18 (450)	44 (13.4)	21 (6.4)	30 (9.1)	21 (6.4)	16 (4.9)	22 (6.7)	17 (5.2)	16 (4.9)
24 (600)	30 (9.1)	15 (4.6)	21 (6.4)	15 (4.6)	11 (3.4)	16 (4.9)	11 (3.4)	11 (3.4)
30 (750)	39 (11.9)	19 (5.8)	27 (8.2)	19 (5.8)	14 (4.3)	19 (5.8)	15 (4.6)	14 (4.3)
36 (900)	28 (8.5)	14 (4.3)	20 (6.1)	14 (4.3)	10 (3.0)	14 (4.3)	11 (3.4)	10 (3.0)
42 (1050)	30 (9.1)	14 (4.3)	21 (6.4)	14 (4.3)	10 (3.0)	15 (4.6)	11 (3.4)	10 (3.0)
48 (1200)	29 (8.8)	14 (4.3)	20 (6.1)	14 (4.3)	9 (2.7)	14 (4.3)	10 (3.0)	10 (3.0)
60 (1500)	29 (8.8)	14 (4.3)	20 (6.1)	14 (4.3)	9 (2.7)	14 (4.3)	10 (3.0)	9 (2.7)

Notes:

1. *Results based on calculations shown in the Structures section of the ADS Drainage Handbook (v20.7). 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 installation 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. *See ADS Standard Detail STD-101D for additional details.*

Technical Note

TN 2.04A Minimum and Maximum Cover Heights for Alternate HP Storm Pipe Trench

Introduction

The information in this document is designed to provide answers regarding general cover heights questions regarding the alternative trench installation of ADS HP Storm pipe; the data provided is based on Culvert Analysis and Design (CANDE) with information presented in the *Structures* section (Section 2) of the Drainage Handbook and is not intended to be used for project design. Project specific properties should be included in analysis for specific project design.

Minimum Cover

Minimum cover for non-traffic rated applications (grass or landscape areas) is 12" (300mm) from top of pipe to ground surface, for all pipe diameters. Additional cover may be required to prevent flotation.

Maximum Cover

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 HP Storm utilized in non-traffic rated storm drainage applications; using different backfill materials (split backfill) in the backfill zone, as depicted in Figure 1, are shown in Table 2.

Table 2 was developed using CANDE modeling software. CANDE is a finite element analysis tool developed by Dr. Mike Katona under the sponsorship of the FHWA and AASHTO and is available for download. The AASHTO LRFD design method is not able to evaluate complex scenarios, such as changing backfill material. AASHTO LRFD load and resistance factors, shown in the *Structures* section of the Drainage Handbook, are utilized in the CANDE analysis. Additionally, the CANDE analysis assumes no hydrostatic load around the pipe, uses material properties consistent with the expected performance characteristics for HP Storm materials, as shown in Table 1 below, and assumes the native (in-situ) soil is of adequate strength and suitable for installation. For applications requiring fill heights greater than those shown in Table 2, contact an ADS Engineer.

It should be noted that while an installation condition as depicted in Figure 1 can be modeled in CANDE and other structural evaluation software, there are constructability and practical installation considerations that should be taken into account when a designer is determining the best backfill plan for a project.

1. Changing material types at the springline of the pipe requires accounting for the different soil confining strengths of the two materials. This variation in soil strengths can result in a reduced cover height when compared to an installation where a single material type is used for the entire pipe embedment. Where materials of differing strengths are used in the pipe embedment, susceptibility to pipe deflection can increase if the materials are not properly placed and compacted.
2. The fill heights shown in Table 2 are based upon a minimum compaction density of 85% being achieved for the native material above the pipe springline. When considering moisture content and compaction effort, adequate compaction of Class 3 and 4 materials can be more difficult to achieve compared to the effort of a Class 1 material used in the haunch zone of the pipe.
3. When materials of different gradation are placed adjacent to each other, filter fabric separation or properly graded material, under the guidance of a geotechnical engineer, is recommended in order to prevent the migration of fines into the open-graded material.

These considerations are not intended to explicitly allow or discourage the use of native materials above the pipe springline, but simply to state that such embedment can be successful when implemented correctly. While ADS supports that the product can perform well within these installation parameters, overall successful execution is dependent not only on the product, but on coordination, input and agreement between the owner, engineer and contractor, based on each party's needs.

Table 1
ADS HP Storm Mechanical Properties

Resin	ASTM Specification	Allowable Long Term Strain %	Initial		100-Year	
			Fu (psi)	E (psi)	Fu (psi)	E (psi)
Polypropylene, Impact-modified copolymer	ASTM F2881	3.7	3,500	175,000	1,000	27,000

Figure 1
ADS HP Storm Pipe Split Backfill Trench Detail
(Non-Traffic Applications)

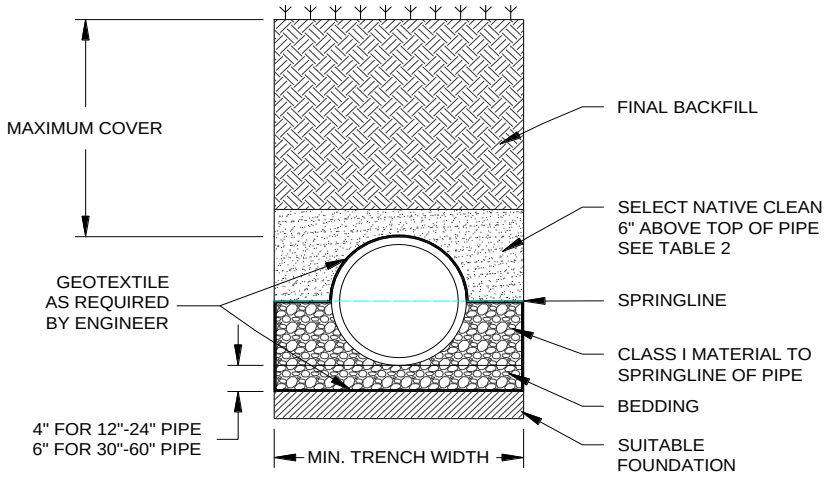

Table 2
Maximum Cover for ADS HP Storm Pipe with Split Backfill, ft (m)

Diameter in (mm)	Class 2	Class 3	Class 4
12 (300)	17 (5.2)	14 (4.3)	11 (3.4)
15 (375)	17 (5.2)	14 (4.3)	10 (3.0)
18 (450)	16 (4.9)	13 (4.0)	10 (3.0)
24 (600)	14 (4.3)	12 (3.7)	9 (2.7)
30 (750)	13 (4.0)	12 (3.7)	8 (2.4)
36 (900)	11 (3.4)	11 (3.4)	7 (2.1)
42 (1050)	11 (3.4)	11 (3.4)	7 (2.1)
48 (1200)	11 (3.4)	10 (3.0)	6 (1.8)
60 (1500)	11 (3.4)	10 (3.0)	6 (1.8)

Notes:

1. *Results based CANDE analysis. Calculations assume no hydrostatic pressure and a soil density of 120 pcf (1926 kg/m^3) for overburden material.*
2. *Backfill materials and compaction levels not shown in the table may also be acceptable. Contact ADS for further detail.*
3. *Class 1 material used below springline must be adequately "knifed" into haunch and in between corrugations. Unless otherwise noted by the engineer class I material must be compacted in 6-inch (200mm) lifts.*
4. *Select native clean backfill shall be well placed, moderately compacted (85% SPD) Class IV or better per ASTM D2321 with no foreign debris including rocks, large clumps of organic or frozen material.*
5. *For projects where cover exceeds the maximum values listed above, contact ADS for specific design considerations.*

Corrugated Plastic Pipe Storm Installation Guide

ADS™

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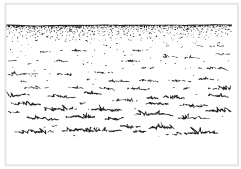
Job Site Handling and Receiving

Receiving Recommendations

Our distributors and customer service personnel make service and customer satisfaction their highest priority. If your order is incorrect, contact your distributor or our customer service personnel.

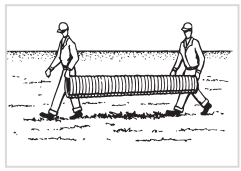


- Direct driver to a smooth, flat area, free of rocks and debris.
- Examine load quantities and quality immediately after unloading. Inspect pipe carefully for possible damage from transportation or unloading.
- Note damaged or missing items on delivery receipt.
- Shortages and damaged material are not automatically reshipped. Reorder replacement material.
- Do not dispose of damaged items. Check with driver for proper return method. If driver is unsure, contact our customer service personnel.

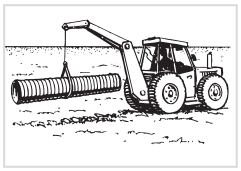
Handling Recommendations

To avoid damage to the pipe and fittings the following handling recommendations should be followed:

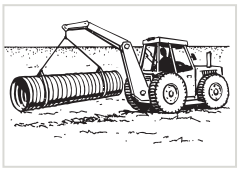
- OSHA safety requirements.
- Do not drop pipe.
- Avoid any impact to the bell or spigot.• 18” (450 mm) and smaller pipe can be moved by hand. Larger pipe requires a backhoe with a nylon sling.• Lift 36" (900 mm) and larger diameter pipe with a sling at two points, spaced approximately 10 feet (3 m) apart. Smaller diameters can use one lift point. Refer to Table 1 for recommended handling methods.



≤18" (450mm)



24"-30" (600-750mm)



≥36" (900mm)

- Contractor assistance is required to unload palletized pipe.
- Do not use a loading boom or forklift directly on or inside pipe.

Table 1: Recommended Pipe Handling Method

Diameter in (mm)	HDPE Approx. lb/ft (kg/m)	HP DW Approx. lb/ft (kg/m)	Handling Method
4” (100)	0.44 (.65)	n/a	Labor
6” (150)	0.85 (1.3)	n/a	Labor
8” (200)	1.5 (2.2)	n/a	Labor
10” (250)	2.1 (3.1)	n/a	Labor
12” (300)	3.2 (4.8)	3.6 (5.4)	Labor
15” (375)	4.6 (6.9)	5.3 (7.9)	Labor
18” (450)	6.4 (9.6)	7.1 (10.5)	Labor
24” (600)	11.0 (16.4)	11.9 (17.7)	Sling (1 point)
30” (750)	15.2 (22.6)	16.8 (24.9)	Sling (1 point)
36” (900)	19.8 (29.5)	20.3 (30.2)	Sling (2 points)
42” (1050)	24.3 (36.1)	25.1 (37.4)	Sling (2 points)
48” (1200)	30.9 (45.9)	32.4 (48.2)	Sling (2 points)
60” (1500)	44.5 (66.3)	49.6 (73.8)	Sling (2 points)

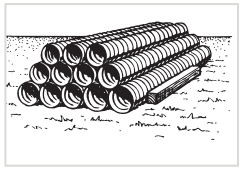
**Recommended handling methods are based on two laborers per pipe length, neither of which is carrying more than 100 lb. (45kg).*

Job Site Pipe Storage

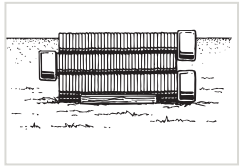
Storage Recommendations

To ensure that your delivered pipe products do not become damaged during job site storage, follow these simple guidelines:

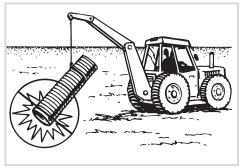
- Non-palletized pipe may be temporarily stockpiled on a flat, clear area.
- Use securing timbers (or blocks) to ensure the stockpile does not collapse.
- Failure to block pipe may result in stack collapsing, pipe damage, or personal injury.
- Stack pipe no higher than approximately 6 feet (1.8 m).



- While supporting lengths of pipe evenly, alternate bells for each row of pipe.

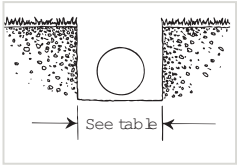


- To prevent damage to the bell or spigot when moving pipe sections, do not drag or strike pipe ends against anything.



Trench Construction

- Information provided in this pocket installation guide is intended as a quick reference only and does not supersede requirements specified on project plans.
- The trench or ditch should be wide enough to place and compact backfill around the entire pipe.



- Refer to Table 2 for recommended minimum trench widths. The design engineer may modify the trench width based on site specific conditions.

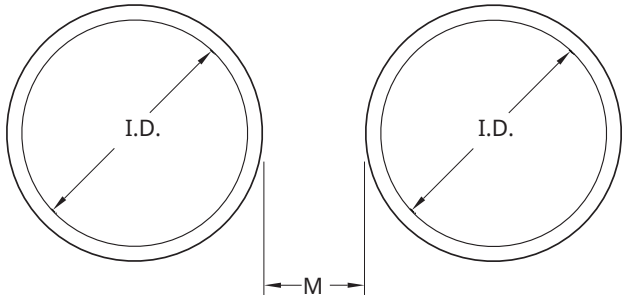
Table 2: Minimum Trench Widths

Pipe Diameter in (mm)	Trench Width in (mm)
4”-8” (100-200)	*
10” (250)	28” (711)
12” (300)	30” (762)
15” (375)	34” (863)
18” (450)	39” (990)
24” (600)	48” (1219)
30” (750)	56” (1422)
36” (900)	64” (1625)
42” (1050)	72” (1828)
48” (1200)	80” (2032)
60” (1500)	96” (2438)

**Usually dependent on smallest bucket size available.*

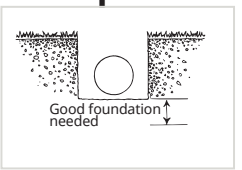
- For parallel pipe installations, allow space between pipes for proper compaction. Refer to Figure 1 for minimum pipe spacing. Spacing will differ for retention/ detention systems due to the intended use of this product.

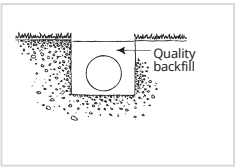
Figure 1: Parallel Pipe Installation

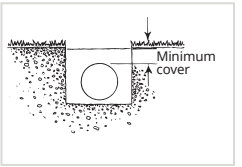


UP TO 24" (600MM) I.D.: M=12" (300MM)
MORE THAN 24" (600 mm) I.D.: M=1/2 I.D.

- Trench or ditch bottoms containing bedrock, soft muck or refuse, or other material unable to provide long-term uniform pipe support are **unacceptable**.
- All unsuitable foundation shall be excavated before pipe installation proceeds.
- Where the trench bottom is unstable, the contractor shall excavate to a depth required by the engineer and replace with suitable material as is specified by the engineer.







- If native soil can migrate into backfill, use synthetic fabric (geotextile) to separate native soil from backfill.

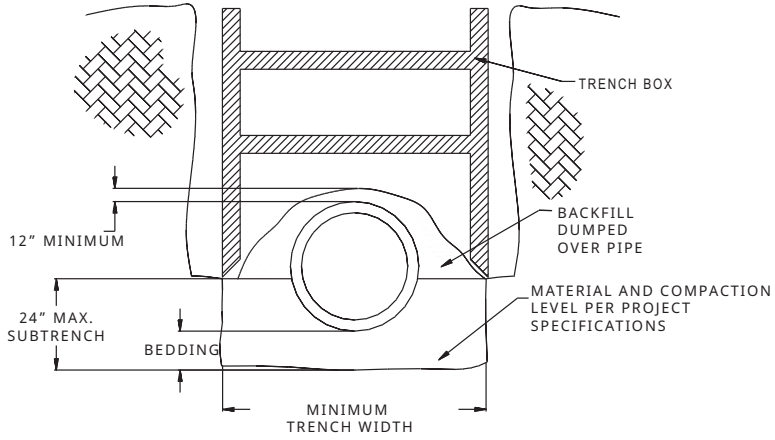
Trench Boxes

Trench boxes provide a safe work area to install pipe in deep trenches or in soils that have insufficient stability. **Always** follow OSHA requirements when using a trench box.

The length of the trench box should be suitable for the pipe length. Nominal length for pipe is 20 ft. (6.1 m) although shorter lengths can be supplied.

The most effective way to maintain a sound system is to provide a ‘subtrench’ within which to place the pipe and backfill. The subtrench shall not be greater than 24" (600 mm) above the bottom on the trench as shown in Figure 2. Backfill and compact according to the design specifications within the subtrench. The trench box can be pulled along the top edge of the subtrench without affecting the backfill in the pipe embedment zone.

Figure 2: Subtrench Installation

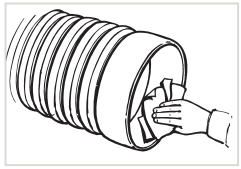


In installations not involving a subtrench, dragging a trench box should only be done if it does not damage the pipe or disrupt the backfill; otherwise, the box should be lifted vertically into its new position, again taking great care not to disturb the pipe or backfill.

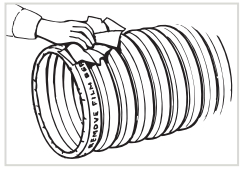
Bell & Spigot Joint Assembly

For pipe with a bell-and-spigot connection, it is imperative that the joint be assembled properly to ensure that the product performs to expectations. The steps that must be followed to obtain a quality joint are provided below. Failure to follow these instructions may cause the joint quality to be severely compromised.

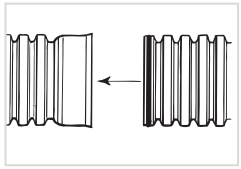
- Lower pipe into trench by hand, or use nylon straps and excavating equipment.
- Begin by inspecting the bell and remove any foreign matter.



- Use a clean rag or brush to lubricate bell of pipe lubricant.
- Clean spigot end of pipe.
- Remove protective wrap from gasket.



- Using clean rag or brush, lubricate exposed gasket with pipe lubricant.
- Do not allow lubricated section to touch dirt or backfill. Foreign matter could adhere to surface and compromise joint integrity.



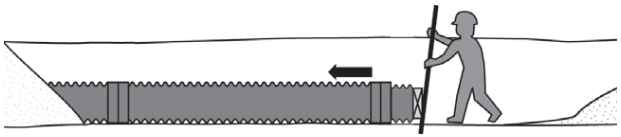
- Place spigot into bell and align.
  Note: It is recommended that one always lay pipe starting at the down stream end, pushing spigots into bells with the bells facing upstream. Always push spigot ends into bell, **not** bell end into spigot.

Assemble joint using one of the following methods. (For smaller diameters, pipe may be joined manually.)

- For all methods, ensure bell and spigot are adequately “homed” for proper installation and tight joining seal. If no homing mark is present, measure the depth of the bell and use a crayon or other material to place a homing mark on appropriate corrugation of the spigot end. Care should be taken to not over home the pipe during assembly.
- Installation stubs, mentioned in the assembly instructions, can be purchased or made following the information on page 15.
- Some high joint performance applications may require the joint to be held in place for a short time, immediately after insertion, to properly set the gasket.

Bar & Block Method

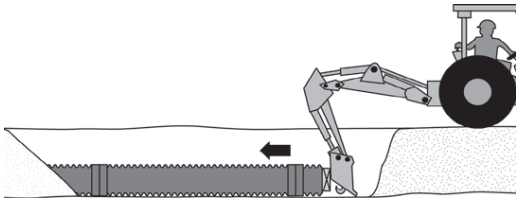
- Place installation stub into bell end of pipe.
- Place wooden block horizontally across end of installation stub.
- With a bar, push against wooden block until pipe is fully inserted into bell.



NOTE: This method requires use of installation stub. DO NOT push directly against pipe.

Backhoe Method

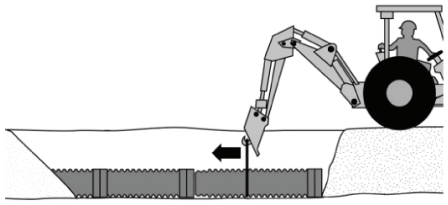
- Place installation stub into bell end of pipe.
- Place wooden block horizontally across installation stub.
- Carefully push back of backhoe bucket against block until pipe is fully inserted into bell.



NOTE: This method requires use of installation stub. DO NOT push backhoe directly against pipe.

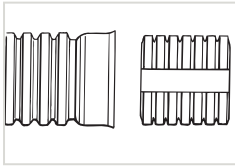
Backhoe and Sling Method

- Wrap nylon sling around pipe. Pipe 36" (900 mm) or larger should be picked up at two points approximately 10' (3m) apart.
- Hook other end of nylon sling to backhoe bucket.
- Operator should carefully push strap tight toward bell of downstream pipe until spigot is fully inserted into bell.
- Ensure pipe slides **squarely** into bell to avoid misalignment.
- **Keep pipe level**.



NOTE: Distance from bedding to bottom of pipe not to exceed 6" (150mm) for a 20' (6m) pipe.

Installation Stub Fabrication



To push “home” bell-and-spigot pipe, an installation stub can be used to prevent accidental damage to the bell. Installation stubs are not required if the bell is not pushed on directly. Installation stubs in all sizes are available from your distributor, or you can fabricate your own on site by following the proceeding steps:

- Cut a section of pipe five corrugations long in the center of the corrugation valley.
- Using a saw, remove a strip of pipe wall from the short stub of pipe (Figure 3). Note: Strip width depends on pipe size. See Table 3 for recommended widths.

Figure 3: Installation Stub

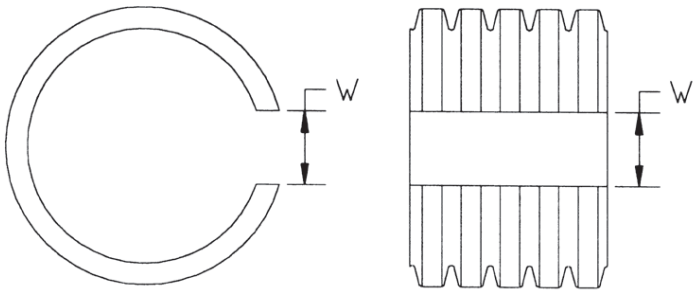
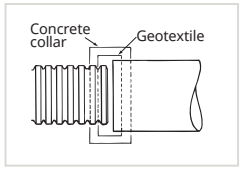


Table 3: Strip Width for Installation Stub

Pipe Diameter in (mm)	Trench Width in (mm)
4”-6” (100-150)	2 (51)
8” (200)	2.5” (64)
10”-12” (250-300)	4” (102)
15” (375)	5” (127)
18” (450)	6” (152)
24” (600)	7.5” (191)
30”-42” (750-1050)	10” (254)
48”-60” (1200-1500)	12” (305)

- To use stub, push on pipe walls to change O.D. of stub to I.D. of bell to be installed.

Joining Different Pipe Types or Sizes



Drainage systems often involve connecting pipes of different materials or sizes. Options to make these transitions are often limited by the joint quality required. One very common method of connecting different types of pipe of the same size, and in some cases different sizes, is through the use of a concrete collar. This generally provides a minimum silt-tight joint quality but the resulting quality ultimately depends on workmanship.

- A concrete collar is formed by butting the two pipe ends tightly together, wrapping the junction with a geotextile to keep out most soil and concrete, and then pouring a concrete collar that covers both pipe ends.

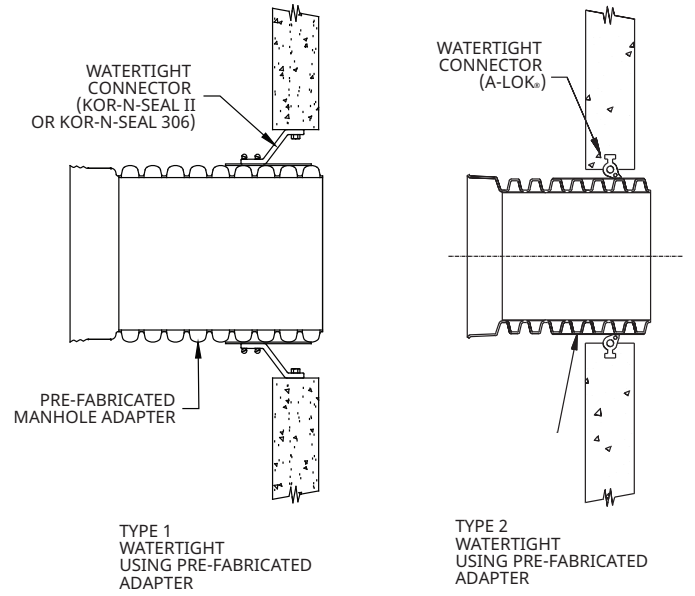
Another option may be using fittings or adapters specifically designed for this application. A selection of fittings designed to make the transition from one material directly to another is available. In other cases a fitting may need to be used in combination with another manufacturer’s gasket or coupler to complete the transition. Transitions made in this manner may provide for a higher performance joint than a concrete collar.

Manholes and Catch Basin/Connections

Manholes or catch basins can be used at changes in pipe material, size, grade, direction and elevation. Manholes and catch basins can be more costly than other alternatives but also allow grade and directional changes in addition to changes in pipe material and size.

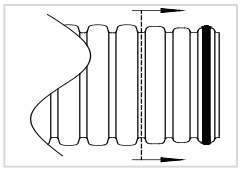
- Local regulations should be consulted to determine if manholes or catch basins are required at any or all pipe changes.
- Refer to Figure 4 for the acceptable methods of connecting plastic pipe to manholes or basins.
- See appendix for references to additional product specific resources applicable to connecting pipe to manholes.

Figure 4: Manhole Connection Product Details

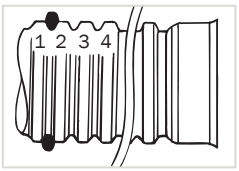


Field Gasket Assembly

When standard lengths of pipe must be cut to fit in a field application, the following instructions will ensure proper performing joints:



- For reduced spigot pipe ONLY, reducing spigot must be removed.
- Using a saw, cut in the center of the valley of the first full corrugation.
- Trim remaining plastic burrs from saw cut. *Note: Failure to smoothly trim burrs may compromise joint integrity.*
- Wipe clean first valley from end of pipe. *This is where gasket will be placed.*
- Hold gasket with both hands so printing is facing you.
- With printing on gasket face-up and toward spigot end of pipe, slide gasket into first corrugation valley, starting at bottom. *Note: It is easier to pull gasket up to conform to valley.*
- Slide gasket into first corrugation valley by hand.
- Ensure printing on gasket is face-up and toward spigot end of pipe.
- Vent tubes shall be appropriately scaled at joint where applicable, see *Technical Note 5.10: Integral Bell Transition for HDPE*.



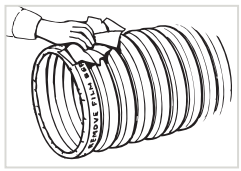
Gasket printing should be visible in this location when properly installed.

Fittings Assembly

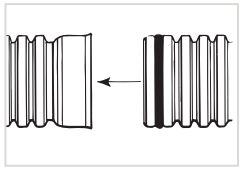
This section includes information necessary for:

1. Soil-tight belled fittings
2. Watertight fittings
3. Repair couplers

- Cut pipe to desired length in the center of the corrugation valley before placing in trench.
- Trim remaining polyethylene burrs from saw cut. Note: Failure to smoothly trim burrs may compromise joint integrity.
- Excavate bedding from around spigot end where fitting shall be used. A bell hole will help prevent dirt and debris from contaminating joint during assembly.
- Install gasket in accordance with gasket assembly procedure (page 19).
- Measure the depth of the bell and use a crayon or other material to place a homing mark on appropriate corrugation of the spigot end.
- Vent tubes shall be appropriately sealed at joint where applicable, see *Technical Note 5.10: Integral Bell Transition for HDPE*.
- Using clean rag or brush, lubricate exposed gasket with pipe lubricant.



- Do not let lubricated section touch dirt or backfill, as foreign material could adhere to surface and compromise joint integrity.
- Inspect fitting and remove any foreign matter.
- Align and center pipe.
- Lubricate inside of bell.
- Align fitting with pipe end.
- Use installation stub or blocking where required.

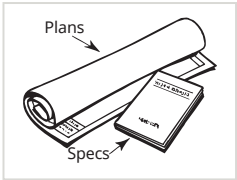


- Take care not to damage pipe or fittings.
- Ensure pipe is straight and bell reaches homing mark.
- Assemble other end of pipe or fitting as described in the pipe assembly section on page 12.
- Special care should be taken to replace and compact bedding material in bell hole to provide adequate support under the joint.

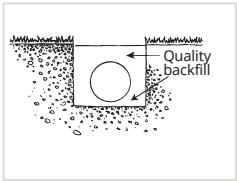
Backfill Recommendations

Plastic pipe and a well-constructed backfill envelope work together to support soil and traffic loads. Correct installation will ensure long-term trouble-free service for all types of pipe systems.

Backfill Material Selection



- Provided the plans meet minimum recommendations as stated in Table 4, they should take precedence.



- Locally available materials may be acceptable for backfill use, but must meet one of the acceptable soil classifications outlined in Table 4.
- Class I materials can be dumped around pipe. Voids must be eliminated by knifing under and around pipe or by some other technique.
- Non-cohesive sand, sand/gravel mixes and other Class II and III materials must be compacted to a minimum of 85% and 90% standard Proctor density, respectively.
- Inorganic silts, and gravelly, sandy or silty clays, and other Class IV materials are not permitted.
- Flowable fill is another acceptable backfill material. Misalignment or flotation may occur unless added precautions are taken, such as anchoring the pipe or pouring the flowable fill in lifts.
- See appendix for references to additional product specific resources that may be used when installing corrugated plastic pipe.

Table 4: Acceptable Backfill Material and Compaction Requirements

Description	Soil Classification			Minimum Standard Proctor Density %
	ASTM D2321	ASTM D2487	AASHTO M43	
Graded or crushed, crushed stone, gravel	Class I	-	5 56	Dumped
Well-graded sand, gravels and gravel/sand mixtures; poorly graded sand, gravels and gravel/sand mixtures; little or no fines	Class II	GW GP SW SP	57 6	85%
Silty or clayey gravels, gravel/sand/silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures	Class III	GM GC SM SC	Gravel and sand (<10% fines)	90%

* *Layer heights should not exceed ½ the pipe diameter. Layer heights may also need to be reduced to accommodate compaction method.*

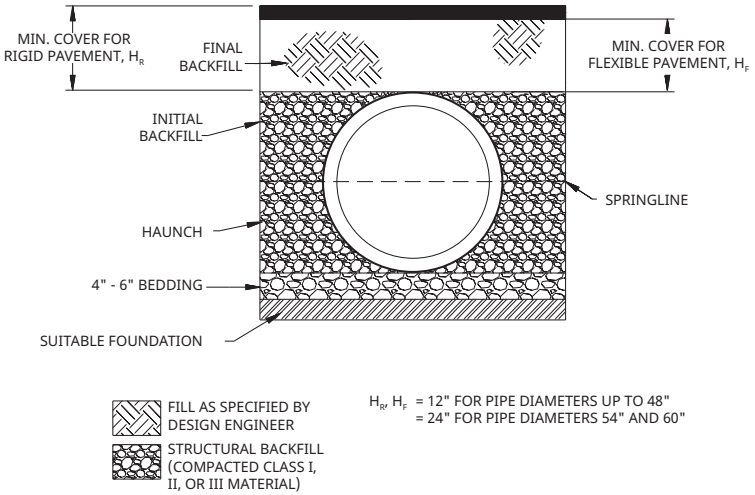
Groundwater or Surface Runoff

When groundwater or surface runoff is present in the work area, dewater to maintain stability of native and imported materials. Maintain water level below pipe foundation to provide a stable trench bottom.

Backfill Envelope Construction

- If native soil cannot carry load, import, compact and level adequate bedding material as in Figure 5.
- Figure 5 represents typical trench construction applicable to all products. See appendix for references to additional product specific resources.

Figure 5:

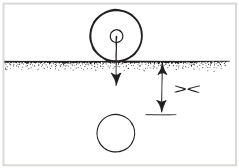


- Place and compact backfill in layers to meet requirements of Table 4 and project requirements. Note that the large diameter pipes may require layer heights less than those indicated in the table to achieve proper compaction.
- Avoid impacting pipe with compaction equipment.
- 4" - 48" (100-1200 mm) single pipe runs receiving H-25 traffic requires final backfill 12" (0.3 m) above initial backfill to provide at least 12" (0.3 m) of total cover as measured from the top of pipe to bottom of flexible pavement or to top of rigid pavement.
- 60" (1500 mm) single pipe runs receiving H-25 traffic require final backfill 24" (0.6 m) above initial backfill to provide at least 24" (0.6 m) of total cover as measured from top of the pipe to the bottom of flexible pavement or to top of rigid pavement.
- Minimum cover may be reduced in areas with no or infrequent light traffic. These situations must first be reviewed by the pipe manufacturer.

Other Installation Considerations

All unique situations cannot be anticipated; however, several common questions are answered in the following material.

Construction and Paving Traffic



- Some construction vehicles, such as many types of paving equipment, are not as heavy as the design load.
- For situations with relatively light construction vehicles, the 12" (0.3 m) and 24" (0.6 m) minimum covers criteria discussed earlier can be decreased during the construction phase.
- Table 5 presents the surface applied loads and the corresponding minimum cover that can be permitted on a temporary basis. *These criteria should only be employed during construction; finished projects should always have a minimum cover of at least 12" (0.3 m) for 4" - 48" (100-1200 mm) diameters and minimum cover of at least 24" (0.6 m) for 60" (1500 mm) diameters.*
- *Vehicles exceeding these criteria must not be permitted to drive over the installation.*
- Areas receiving heavy construction equipment traffic between 30 and 60 tons require at least 3 feet (0.9 m) of cover. Higher loads require cover greater than 3 feet (0.9 m), depending on the load.
- If sufficient cover is not provided, mound and compact material over pipe to provide minimum cover needed for load during construction.
- For heavy duty compaction equipment, such as a hoe-pack or equivalent type compactor, a minimum of 3 feet (0.9 m) of compacted backfill shall separate the pipe from the equipment.

Table 5: Temporary Cover Requirements for Light Construction Traffic

Type of Vehicle	Vehicular Load at Surface psi (kPa) ASTM D2321	Temporary Minimum Cover in (mm) for:	
		4”-48” (100-1200) Diameter Pipe	54”-60” (1350-1500) Diameter Pipe
Semi-tractor[1]	75 (517)	9 (230)	12 (300)
Loaded pick-up truck[2]	50 (345)	6 (150)	9 (230)
Skid steer loader[3]	25 (172)	3 (80)	6 (15)

1. Based on typical 3-axel day-trip tractor without trailer.
2. Chevy® 3500 series, fully loaded.
3. Bobcat® T180 model skid steer loader.

Table 6: Maximum Cover for ADS N-12, N-12 ST & N-12 WT Pipe (per AASHTO) ft (m)

Diameter in (mm)	Class 1		Class 2			Class 3	
	Compacted	Dumped	95%	90%	85%	95%	90%
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)	35 (10.7)	17 (5.2)	24 (7.3)	17 (5.2)	8 (2.4)	17 (5.2)	11 (3.4)
15" (375)	38 (11.6)	17 (5.2)	25 (7.6)	17 (5.2)	8 (2.4)	18 (5.5)	11 (3.4)
18" (450)	36 (11.0)	17 (5.2)	24 (7.3)	17 (5.2)	8 (2.4)	17 (5.2)	11 (3.4)
24" (600)	28 (8.5)	13 (4.0)	20 (6.1)	13 (4.0)	7 (2.1)	14 (4.3)	10 (3.0)
30" (750)	28 (8.5)	13 (4.0)	20 (6.1)	13 (4.0)	7 (2.1)	14 (4.3)	9 (2.7)
36" (900)	26 (7.9)	12 (3.7)	18 (5.5)	12 (3.7)	7 (2.1)	13 (4.0)	9 (2.7)
42" (1050)	23 (7.0)	11 (3.4)	16 (4.9)	11 (3.4)	7 (2.1)	11 (3.4)	7 (2.1)
48" (1200)	25 (7.6)	11 (3.4)	17 (5.2)	11 (3.4)	7 (2.1)	12 (3.7)	7 (2.1)
60" (1500)	25 (7.6)	11 (3.4)	17 (5.2)	11 (3.4)	6 (1.8)	12 (3.7)	7 (2.1)

Notes:

1) *Results based on calculations shown in the Structures section of the Drainage Handbook (v20.2). Calculations assume no hydrostatic pressure and a density of 120 pcf (1926 kg/m³) 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 hydrostratic 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.*

Maximum Cover

The maximum burial depth is highly influenced by the type of backfill installed around the pipe. Maximum cover limits for dual wall HDPE pipe made to the requirements of AASHTO M252, M294 and ASTM F2306 are shown in Table 6 for a variety of backfill conditions. Maximum cover limits for HP pipe made to the requirements of ASTM F2881 and AASHTO M330 are shown in Table 7. Greater cover heights may be possible but should be reviewed by the Engineering Department.

Table 7: Maximum Cover for ADS HP Storm Pipe with Uniform Backfill ft (m)

Diameter in (mm)	Class 1	Class 2			Class 3		Class 4
	Compacted	95%	90%	85%³	95%	90%³	95%³
12" (300)	41 (12.5)	28 (8.5)	21 (6.4)	16 (4.9)	20 (6.1)	16 (4.9)	16 (4.9)
15" (375)	42 (12.8)	29 (8.8)	21 (6.4)	16 (4.9)	21 (6.4)	16 (4.9)	16 (4.9)
18" (450)	44 (13.4)	30 (9.1)	21 (6.4)	16 (4.9)	22 (6.7)	17 (5.2)	16 (4.9)
24" (600)	37 (11.3)	26 (7.9)	18 (5.5)	14 (4.3)	19 (5.8)	14 (4.3)	14 (4.3)
30" (750)	39 (11.9)	27 (8.2)	19 (5.8)	14 (4.3)	19 (5.8)	15 (4.6)	14 (4.3)
36" (900)	28 (8.5)	20 (6.1)	14 (4.3)	10 (3.0)	14 (4.3)	11 (3.4)	10 (3.0)
42" (1050)	30 (9.1)	21 (6.4)	14 (4.3)	10 (3.0)	15 (4.6)	11 (3.4)	10 (3.0)
48" (1200)	29 (8.8)	20 (6.1)	14 (4.3)	9 (2.7)	14 (4.3)	10 (3.0)	10 (3.0)
60" (1500)	29 (8.8)	20 (6.1)	14 (4.3)	9 (2.7)	14 (4.3)	10 (3.0)	9 (2.7)

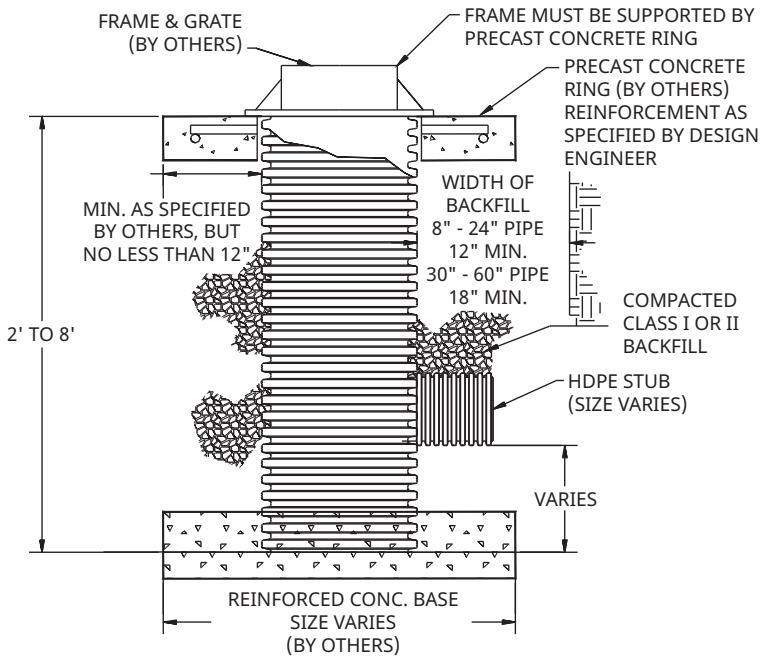
Notes:

1) *Results based on calculations shown in the Structures section of the Drainage Handbook (v20.7). Calculations assume no hydrostatic pressure and a density of 120 pcf (1926 kg/m³) 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 installation 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.*
9) *See ADS Standard Detail STD-101D for additional details.*

Vertical Installations

- Corrugated plastic pipe is sometimes installed vertically for use as catch basins or manholes, meter pits, and similar applications.
- Backfill should extend a minimum of 12" (300 mm) completely around the vertical structure.
- Backfill material recommendations are identical to those for a horizontal installation; compaction levels and maximum lift requirements must be strictly followed (refer to Table 4 for material selection).
- Height of the vertical structure must not exceed 8' (2.4 m), unless the Engineering Department reviews the design.
- If traffic will be driving over a vertical structure, a concrete collar similar to that shown in Figure 6 shall be used to transfer the load into the ground.
- Cast iron frames holding grates or lids must be seated on a concrete collar or similar structure so that the weight of the frame and grate or lid is transferred into the ground, *not* to the vertical pipe.
- There may also be other product performance limits depending on the application. Contact Engineering for further information.

Figure 6: Vertical Riser



Flotation

Table 8 shows minimum cover heights for various plastic pipe sizes to prevent flotation.

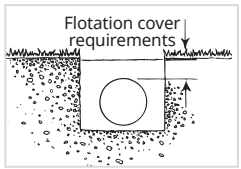
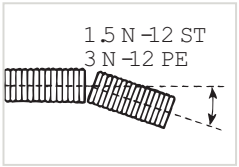


Table 8: Required Minimum Cover* to Prevent Flotation

Pipe Type	Nominal Diameter in (mm)	Minimum Cover in (mm)
Dual Wall HDPE & HP	4” (100)	3” (77)
	6” (150)	4” (102)
	8” (200)	5” (127)
	10” (250)	7” (178)
	12” (300)	9” (228)
	15” (375)	11” (280)
	18” (450)	13” (330)
	24” (600)	17” (432)
	30” (750)	22” (559)
	36” (900)	25” (635)
	42” (1050)	29” (737)
	48” (1200)	33” (838)
	60” (1500)	40” (1016)
Single Wall HDPE	3” (75)	2” (50)
	4” (100)	3” (77)
	6” (150)	4” (102)
	8” (200)	6” (152)
	10” (250)	7” (178)
	12” (300)	9” (228)
	15” (375)	11” (280)
	18” (450)	13” (330)
	24” (600)	17” (432)

**Based on the pipe being completely empty, water table at the ground surface, soil density of 130 pcf (2083 kg/m^3), and a soil friction angle appropriate for most sand/gravel mixtures. The average of the inside and outside diameters was used to determine soil and water displacement.*

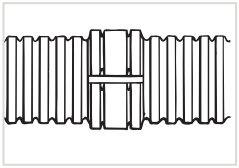
Bending Radius



A curved pipe alignment is sometimes desired in pipe systems so that they can be installed around buildings or utilities without the use of fittings. Plastic pipe can be angled slightly at the joints to create this curvature. Coupling bands allow approximately 3° of angular misalignment at each joint, while each bell-and-spigot joint can accommodate 1-1.5° and remain at its specified joint quality. Additional information can be obtained through your Sales Representative or the Engineering Department.

Soil Tight Repair Methods

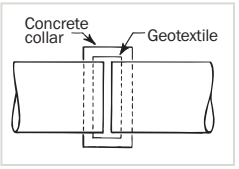
Option 1: Split Band Coupler



For repairs of 4" - 30" (100-750 mm) pipe with a damaged area less than 10% of the diameter of pipe in a non-trafficked area, use a split band coupler as described in the following steps:

- Center split band coupler around damaged section of pipe.
- Wrap the coupler around the pipe and tighten nylon straps.
- Carefully replace and compact bedding and backfill to provide proper support for pipe and coupler.

Option 2: Concrete Collar



For repairs of 4" - 60" (100-1500 mm) pipe with a damaged area less than 25% the diameter of pipe, use a concrete collar as described in the following steps:

- Excavate area beneath damaged section of pipe about 6" (0.15 m).
- Wrap the damaged area with a geotextile to completely cover the area to be repaired.
- Strut or brace damaged section as necessary.
- Encase damaged section of pipe with a concrete collar.
- Carefully replace bedding and backfill to provide proper support for pipe.

Option 3: Mastic Banding

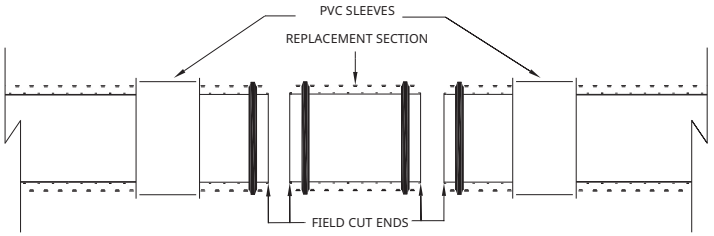
Typically with external sealing of 4" - 60" (100-1500 mm) pipe, a mastic material is used to wrap a small section of pipe. The use of the Mar-Mac® Polyseal Pipe Coupler by Mar-Mac Construction Products, Inc., or a comparable equal is recommended. This band is a self-adhering rubberized mastic that wraps around the damaged section or joint. A protective peelable paper is removed from the back of the band to expose a tacky mastic surface. The band is then adhered to the entire circumference of the pipe. Straps on the band tighten for a positive seal.

**Note: Mar-Mac bands shall be installed in accordance with manufacturer's recommendations.*

Watertight Repair Methods

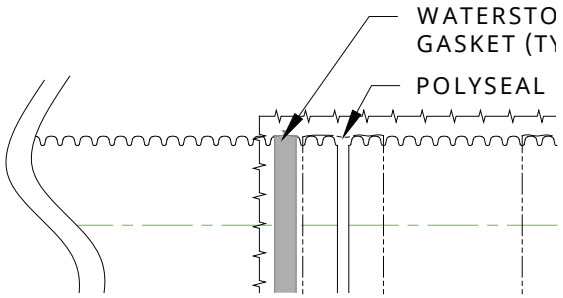
Option 1: PVC Slip Coupling

For repairs of 12" - 24" (300-600 mm) pipe, a PVC slip coupling is recommended. The PVC slip coupling is typically used when a damaged section of pipe is cut and removed in an existing line. Couplings provide a bell-bell connection to join the existing pipe to a replacement section of pipe or other end of the existing pipe. Installation of PVC slip coupling should follow recommendations listed on page 20.



Option 2: Concrete Collar

For 12” - 60” (300-1500 mm) pipe, a concrete collar can provide a water tight repair testable to most hydrostatic test with an appropriate leakage requirement. Installing a concrete collar involves building a form around the area to be repaired and encasing it in concrete. A *Mar Mac® Polyseal Pipe Coupler* is wrapped around the repair area or joint prior to pouring the collar to keep the concrete from seeping into the pipe. *WaterStop* gaskets are installed outside of the *Polyseal* coupler towards the outside edge of the concrete collar. Typically, approximately 6” (150 mm) is excavated beneath the pipe to allow for proper application of the Polyseal coupler and a concrete encasement. If the pipe itself is damaged, the damaged area shall be removed and a replacement pipe section spliced in prior to pouring the collar.



Option 3: Chemical Grouting

For repairs of 4" - 60" (100-1500 mm) pipe with improperly assembled joints, chemical grouting can be considered an optional repair method. Chemical grout creates a waterproof collar around leaking pipes and joints.

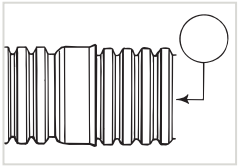
Option 4: Internal Sealing

For repairs of 18"-60" (450-1500 mm) pipe with a damaged area on the interior, a repair with internal sealing methods may be used. Internal mechanical sealing is usually comprised of a metal band with a rubber gasket, which expands to conform to the inner wall of the pipe. The feasibility of this repair method depends on the size of the damaged section or joint and available access into the pipe.

Recommendations for In-Field Testing

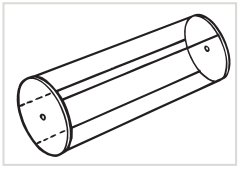
Normally, a visual inspection is all that is necessary to identify proper line and excessive deflection. If it is determined that additional in-field testing is necessary, the following criteria or methods should be used:

Leakage Testing (where applicable):



After watertight pipe has been installed, sections of pipe may be tested for leakage. When required, pipe shall be tested by water infiltration or by air pressure. The test method must be in accordance with ASTM F2487 for water and F1417 or F3058 for air.

Deflection Testing:



If considered necessary, pipe deflection can be tested within 30 days of installation by pulling a mandrel through the installed pipe. Testing 10% of the overall project should provide a reasonable indication of installation quality. Table 8 lists the inside diameters that result from common testing limits of 5% and 7.5% deflection. Mandrel tests yield only pass/fail results and can provide misleading results. Before excavating, further investigate to make sure the problem is not being caused by foreign material in the pipe, a slightly offset joint, or some other similar situation.

Table 9: HDPE Pipe Base Inside Diameters

Nominal Pipe Diameter in (mm)	Base Inside Diameter in (mm)	Base Inside Diameter with 5% Deflection in (mm)	Base Inside Diameter with 7.5% Deflection in (mm)
4” (100)	3.88 (99)	3.68 (93)	3.59 (91)
6” (150)	5.82 (148)	5.53 (140)	5.38 (137)
8” (200)	7.76 (197)	7.37 (187)	7.17 (182)
10” (250)	9.69 (246)	9.21 (234)	8.97 (228)
12” (300)	11.63 (295)	11.05 (281)	10.76 (273)
15” (375)	14.54 (369)	13.82 (351)	13.45 (342)
18” (450)	17.45 (443)	16.58 (421)	16.14 (410)
24” (600)	23.27 (591)	22.10 (561)	21.52 (547)
30” (750)	29.08 (739)	27.63 (702)	26.90 (683)
36” (900)	34.90 (886)	33.16 (842)	32.28 (820)
42” (1050)	40.72 (1034)	38.68 (982)	37.66 (957)
48” (1200)	46.54 (1182)	44.21 (1123)	43.05 (1093)
60” (1500)	58.17 (1478)	55.26 (1404)	53.81 (1367)

** Value is per AASHTO M252[1] (4”-10” diameter) and AASHTO M294[2] (12”-60” diameter). If designing to a specific standard, please review allowable minimum diameter.*

Appendix

All product specific resources are available from the manufacturer's web site: adspipe.com

- Drainage Handbook
- Technical Note 2.01 Minimum and Maximum Burial Depths for HDPE Pipe per AASHTO
- Technical Note 2.02 Minimum and Maximum Burial Depths for ASTM F2648 Pipe
- Technical Note 2.03 Minimum and Maximum Burial Depths for Single Wall HDPE
- Technical Note 2.04 Minimum and Maximum Burial Depths for HP Storm for Storm Drainage
- Technical Note 5.01 Recommended Use for Trench Boxes
- Technical Note 5.02 Flowable Fill Backfill for Thermoplastic Pipe
- Technical Note 5.03 HDPE Pipe Repair Options
- Technical Note 5.04 HDPE and HP Storm Connections to Manholes and Structures
- Technical Note 5.05 Pipe Flotation
- Technical Note 5.06 Culvert Sliplining with HDPE Pipe
- Technical Note 5.07 Post-Installation Testing for HDPE
- Technical Note 5.10 Integral Bell Transition
- Technical Note 5.11 Sliplining Extended Lengths with HDPE Pipe
- Technical Note 5.12 HP Storm Drainage Pipe Repair Options
- Technical Note 5.14 Culvert Sliplining with HP Pipe
- STD-100 series, Trench Installation Details for N-12, HP Storm and SaniTite HP
- STD-200 series, Manhole Connection Details for N-12, HP Storm and SaniTite HP
- STD-600 series, Adapting to Dissimiliar Materials

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