

P: 936-647-0420 F: 936-647-2366

April 21, 2022

City of Montgomery City Staff and/or Mayor and City Council 101 Old Plantersville Road Montgomery, TX 77356

RE: Variance request concerning use of HP pipe in lieu of RCP under roadways

The purpose of this letter is to formally request a variance which requires all storm sewer to be RCP under roadways due to the added strength needed for the additional traffic loads. The City of Montgomery requires compliance with the latest editions of the County or TXDOT requirements. Montgomery County Drainage Criteria Manual (MCDCM) Section 4.1.8 has certain structural specifications that are required to be met for storm sewer such as concrete pipe, box culverts, metal, etc. There is not a specific strength requirement for plastic pipe; however, Montgomery County has historically allowed plastic pipe, such as high density poly ethylene pipe (HDPE), outside of the roadway and reinforced concrete pipe (RCP) under the roadway.

In lieu of RCP, we are proposing to use high-performance polypropylene (HP storm sewer), as it has been recognized to have equivalent strength characteristics as RCP pipe. In North America, a growing number of corrugated polyolefin pipe specifications require a service life of 100 years (Florida DOT and Pennsylvania DOT are two examples). ADS HP Storm polypropylene pipe (our gray colored pipe) is approved for the 100-year service life by both DOTs. As such, polypropylene pipe is widely used under interstate highways. Many years of testing and evaluation were completed prior to approval of ADS HP Storm in these applications. In addition to the verified long-term performance of the plastic itself, there are many features of the pipe that make it an ideal solution for stormwater drainage. They include:

- 1. Watertight gasketed joint design (the sanitary sewer joint specification, ASTM D3212). The pipe is delivered to the jobsite with the gasket assembled and ready for installation. This joint assures leak proof performance.
- 2. 20-foot standard length. As compared to RCP, with a standard length of 8' (or less), HP Storm reduces the total number of joints by 60%. Fewer joints means:
 - a. Far less potential for leakage and far fewer joints needed under pavement.
 - b. Less opportunity for debris to catch in the joints and clog the pipe.
 - c. Faster and safer installation
 - d. If inspection is done by CCTV, fewer joints reduces the time and cost to inspect pipe and joints.
- 3. Chemically inert leaving no chance for material degradation over the life of the pipe.
- Highly impact resistant significantly reduces abrasion over time and reduces any potential damage during construction.
- 5. PP is required to meet the structural loading requirements of AASHTO DOT / LRFD standards. For PP, this is AASHTO M330. Our structural design analysis concludes with minimum and maximum covers for traditional highway loadings. The full summary of our structural analysis can be found in the Structural Section of our Handbook: Structures-Section-of-Drainage-Handbook.pdf (ads-pipe.com)
- 6. HP storm covers the entire range of cover heights. This is different than rigid pipe, such as RCP, because RCP is expected to carry the majority of the load and varies greatly based on the type of

installation/backfill. Conversely, the backfill and pipe share the load for flexible pipes. When the load increases (live or dead) and/or quality of installation type decreases , RCP must increase its strength to Class IV, or higher.

7. Joint design is arguably just as important as the structural design of the barrel section of the pipe. HP Storm is only offered in a watertight, sanitary sewer-level joint (ASTM D3212). With its elongated and gasket bell/spigot, there is a very high level of joint integrity over the life of the conduit.

ADS also utilizes 100-year design service life material properties when calculating minimum and maximum burial depths in accordance with AASHTO LRFD Section 12.12. These calculations include high safety factors that account for all potential failure modes of the pipe. The calculations have been completed for the Houston MSA by a third-party structural engineer, Simpson Gumpertz & Heger (SGH), in accordance with the City of Houston's standards revision published in July 2019. This further supports the ability for this pipe to provide long-term service to owners.

The local, regional, and national transition from RCP to HP Storm is similar to when PVC pipe was developed for sanitary sewer to replace clay and cast iron pipes. PVC offered better joints, faster and safer installation, and long-term performance. It was also being provided more reliable and less expensive than clay or cast iron pipe. Now, PVC is the standard for sanitary sewers.

The proposed design currently has approximately 596 linear feet (LF) of 18" HP pipe and 858 LF 48" HP pipe which would be considered under this variance, see attached site plan exhibit for details. This material has been accepted in the City of Houston, City of Willis and Harris County's specification manuals as an allowable alternative. Last year Montgomery County issued the attached letter to County Commissioner's Mett's office that allowed the use of HP pipe in Montgomery County for public infrastructure. As stated previously, the City of Montgomery defers to Montgomery County who has already accepted this material.

I have attached several documents which provides additional information for the product we are proposing. It is for the above-mentioned reasons that we feel the variance requests should be considered and approved. Please feel free to contact me at 936-647-0420 if you have any questions or concerns.

Thank you,

Jonathan White, PE L Squared Engineering Senior Project Manager, Partner 936-647-0420 Jwhite@L2engineering.com







Jeff Johnson, P.E. COUNTY ENGINEER

MEMORANDUM

April 16, 2021

To: Commissioner James Metts

From: Dan Wilds, P.E. Assistant County Engineer

Re: Polypropylene Pipe for Storm Sewer and Culvert Applications

We have reviewed the technical information on this pipe material. The material is more rigid than the HDPE pipe material already approved for use in Montgomery County and if installed in accordance with manufacturer's specifications should perform as well or better than that material. Please note that if this material is proposed for storm sewer applications in proposed rights of way subject to the County subdivision regulations, we will require mandrel testing prior to initial and final acceptance. Please feel free to contact me if you have any questions.

cc: File



COMMISSIONER JAMES METTS MONTGOMERY COUNTY PRECINCT 4 23628 Roberts Road • New Caney, TX 77357 P. O. Box 84 • New Caney, TX 77357 Phone: (281) 577-8919 Option 3

April 1, 2021

Attn:

Montgomery County Engineering

Assistant County Engineer- Dan Wilds, P.E.

Re: Corrugated Polypropylene Pipe Approval Letter

This letter is to inform that after product review Montgomery County approves the use of Corrugated Polypropylene Pipe and fittings for storm sewer drainage applications. Montgomery County will allow 12"-60" diameter pipe to be installed inside the county right of way including under roadways. The Polypropylene pipe and fittings shall be:

- Manufactured in accordance with ASTM F2881 or AASHTO M330: "Standard Specification for (12 in. to 60 in.) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications"
- Dual Wall pipe should consist of a smooth inner wall and annular exterior corrugations
- Pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2881 and ASHTO M330 and shall be watertight according to the requirements of ASTM D3212. Spigots shall have gaskets meeting the requirement of ASTM F477
- Installation shall be in accordance with ASTM D2321 and manufacturer recommended installation guidelines

Sincerely,

James Metts, Commissioner

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		18"	45"	21.0'		
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BACKFILL	(6	500mm) (1	321mm)	(5.0m)		
		30" 750mm) (1	60" 524mm)	18.5' (5.6m)		
SPRING INF		36"	78"	15.5'	1	
CEMENT PP PIPE (2555) CEMENT STABILIZED		42"	83"	15.0'	1	
BACKFILL	5	050mm) (2	2108mm)	(4.6m)		
	5	200mm) (3	90" 2286mm)	14.0 ⁻ (4.3m)		
4" FOR 18"- 24" PIPE	5	60" (3	103" 616mm)	13.0' (4.0m)		
OTES: 01-104 301-807 MPL RECOMMENDED SUITABLE FOUNDATION (SEE TABLE 1)					1	
ALL PIPE SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WTH ASTM D2321, "STANDARD PRACTICE FOR UN GRAVITY FLOW APPLICATIONS". LATEST ADDITION. NATIVE SOILS SHALL BE OF ADEQUATE STIFFNESS TO W (CSS) EMBEDMENT REQUIRES PLACEMENT IN MAXIMUM 6" (150mm) LIFTS COMPACTED TO A MINIMUM OF 95: CONTENT ON THE DRY SIDE OF OPTIMUM BUT SUFFICIENT FOR EFFECTIVE HYDRATION.	IDERGROUND INSTAI THSTAND A VERTICA 6 OF MAXIMUM DRY I	LLATION OF THER LL CUT WITHOUT I DENSITY IN ACCO	MOPLASTIC PI MATERIAL SLO RDANCE WITH	PE FOR SEWERS JGHING. CEMENT ASTM D558, WTH	AND OTHER -STABILIZED S/ MOISTURE	AND
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FINAL BACKFILL: THE CSS BACKFILL SHALL BE ALLOWED TO CURE AT LEAST 4 HOURS TO REACH AN INITIAL CURE TIME MAY BE REQUIRED BASED ON THE OVERALL FINAL FILL HEIGHT (SEE NOTE 9).	SET STRENGTH PRIC	IR TO PLACING SC	DIL ABOVE THE	PIPE EMBEDMEN	T. ADDITIONAL	
MINIMUM COVER: IN UNPAVED AREAS, MINIMUM COVER, H, IS 12" (300mm) FOR PIPES UP TO 48" (1200mm) IN MINIMUM COVER IS 24" (300mm) FOR PIPES UP TO 48" (1200mm) IN DIAMETER AND 30" (600mm) FOR 60" (1500 PAVEMENT OR TO TOP OF RIGID PAVEMENT, ASSUMING HL-93 LOADING.	DIAMETER AND 24" (6 ուտ) DIAMETER PIPE.	00mm) FOR 60" (' H IS MEASURED F	1500mm) DIAME ROM THE TOP	TER PIPE. IN PAV OF PIPE TO BOT	ED AREAS, OM OF FLEXIBI	Е
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	2 REVIS	ED PER SGH ANALYSI	s GGC	02/04/21 CKM		
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ED DRANAGE SYSTEMS. INC. (*DDS") HAS PREPARED THIS DETAIL BASED ON INFORMATION PROVIDED TO ADS. THIS DRAWING IS TO DEPICT THE COMPONENT'S AS REQUESTED, ADS HAS NOT PERFORMED ANY ENGINEERING OR DESIGN SERVICES FOR THIS ANGR HAS ADS INCEPENDENTLY VERIFIED THE INFORMATION SUPPLIED. THE INSTALLATION DEFINALS PROVIDED HEREIN ARE GENERAL.	P STORM TRENCH IN	NOLLETIELS		A640 TRUEM	N BLVD	CKM 8/14/18
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CITY OF HOUSTON HOUSTON PUBLIC WORKS

HOUSTON

STANDARD CONSTRUCTION SPECIFICATIONS FOR WASTEWATER COLLECTION SYSTEMS, WATER LINES, STORM DRAINAGE, N AND MEDIAN OPENING STREET PAVING, AND TRAFFIC

> CAROL ELLINGER HADDOCK, P.E. DIRECTOR

FIGURE 10.7

HOJIN LIM, P.E., CFM **CITY ENGINEER**

1911

10-17 10.02



CITY OF HOUSTO

2020 STANDARD SPECIFICATIONS

HOUSTON

Section 02510

POLYPROPYLENE (PP) CORRUGATED WALL PIPE

PART 1 GENERAL

- 1.01 SECTION INCLUDES
 - A. Polypropylene (PP) pipe for gravity sanitary sewers and drains, including fittings.
 - B. Polypropylene (PP) pipe for gravity storm sewers and culverts.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No separate payment will be made for PP pipe under this Section. Include cost in unit prices for work, as specified in following sections:
 - a. Section 02531 Gravity Sanitary Sewers
 - b. Section 02631 Storm Sewers
 - 2. Refer to Section 01270 Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.
- 1.03 REFERENCES
 - A. AASHTO M330 Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.
 - B. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - C. ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - D. ASTM F 477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - E. ASTM F 2764 Standard Specification for 6 to 60 in. [150 to 1500 mm] Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications.

F. ASTM F 2881- Standard Specification for 12 to 60 in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications.

1.04 SUBMITTALS

- A. Conform to requirements of Section 01330- Submittal Procedures.
- B. Submit shop drawings showing design of pipe and fittings indicating alignment and grade, pipe length, laying dimensions, fabrication, fittings, flanges, gasket material, and special details.
- C. Submit detailed calculations for pipe design per AASHTO LRFD Bridge Design Specifications.
- D. Submit details of Pipe Joints and jointing procedure for PP pipe.
- 1.05 QUALITY CONTROL
 - A. Provide manufacturer's certificate of conformance to Specifications.
 - B. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.
 - C. Project Manager reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.
 - 1. Manufacturer's Notification: Should Project Manager wish to witness manufacture of specific pipes, manufacturer shall provide Project Manager with minimum three weeks notice of when and where production of those specific pipes will take place.
 - 2. Failure to Inspect. Approval of products or tests is not implied by Project Manager's decision not to inspect manufacturing, testing, or finished pipes.
 - D. Pipe manufacturer to provide services of experienced, competent, and authorized representative to visit site to advise and consult Contractor during jointing and installation of pipe.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

CITY OF HOUSTON 2020 STANDARD SPECIFICATION

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide products manufactured by companies listed on the City of Houston Standard Product List.
- B. Furnish corrugated-wall gravity sanitary sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with dual elastomeric gaskets in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form a positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.
- C. Furnish corrugated-wall polypropylene (CPP) pipe for gravity storm sewer and storm sewer culvert pipe. Joints shall be installed such that connection of pipe sections will form continuous line free from irregularities in flow line. Suitable joints are:
 - 1. Integral Bell and Spigot with dual elastomeric gaskets. Bell shall overlap minimum of two corrugations of spigot end when fully engaged.
- D. Jointing:
 - 1. Gaskets:
 - a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both.
 - b. **PP** Pipes are Not allowed to be installed in potentially contaminated areas, unless approved by City Engineer.

CONTAMINANT	GASKET MATERIAL REQUIRED				
Petroleum (diesel, gasoline)	Nitrile Rubber				
Other Contaminants	As recommended by pipe manufacturer				

- 2. Lubricant. Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.
- 3. Diameters 12- through 60-inch shall have a reinforced bell with a polymer composite band installed by the manufacturer.

2.02 MATERIALS FOR SANITARY SEWER

A. Pipe and Fittings: Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F 2764.

2.03 MATERIALS FOR GRAVITY STORM SEWERS AND STORM SEWER CULVERTS

A. Pipe and Fittings: Polypropylene compound for pipe and fittings production shall be impact modified copolymer meeting the material requirements of ASTM F 2881 and AASHTO M330.

2.04 TEST METHODS FOR SANITARY SEWER

- A. Conditioning
 - 1. Conditioning of samples prior to and during tests is subject to approval by Project Manager. When referee tests are required, condition specimens in accordance with ASTM F 2764, section 7.1.1.
- B. Flattening
 - 1. Flatten three specimens of pipe, prepared in accordance with ASTM F 2764, section 7.5.
- C. Joint Tightness
 - 1. Test for joint tightness in accordance with ASTM D 3212.
- D. Purpose of Tests
 - 1. Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

2.05 TEST METHODS FOR GRAVITY STORM SEWERS AND STORM CULVERTS

- A. All testing and material requirements shall be in accordance with ASTM F 2881.
- B. MANDREL TESTING: use a mandrel to test flexible pipe for deflection. Refer to Section 02533 Acceptance Testing for Sanitary Sewers for the mandrel and test requirements.

2.06 MARKING

- A. Mark each standard and random length of pipe in compliance with these Specifications with following information:
 - 1. Pipe size.

02510-4

- 2. Pipe class.
- 3. Production code.
- 4. Material designation.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Conform to requirements of following Sections:
 - 1. Section 02550 Slip lining Sanitary Sewers.
 - 2. Section 02531 Gravity Sanitary Sewers.
 - 3. Section 02533 Acceptance Testing for Sanitary Sewers.
 - B. Install pipe in accordance with the manufacturers recommended installation procedure and ASTM D 2321
 - C. PP pipe is not approved in applications requiring gaugering of pipe.
 - D. Bedding and backfill: Conform to requirements of Section 02317 Excavation and Backfill for Utilities.
 - E. Use only workmen trained in the installation of PP Pipe.
 - F. Cutting pipe: Comply with pipe manufacturer's recommendations. After cutting, leave end pipe in accordance with manufacturer's recommendations.

END OF SECTION

SPECIAL SPECIFICATION

ITEM 9512

HIGH PERFORMANCE POLYPROPYLENE PIPE (HP STORM)

9512.1 Description. Corrugated Smooth Lined High Performance Polypropylene Pipe (HP Storm) shall conform to these specifications. The pipe shall be furnished on an "As needed basis" delivered F.O.B. to various locations within the Precinct. All materials shall be of the listed nominal diameter, supplied in standard lengths required and be in accordance with these specifications and conformity with the material requirements.

9512.2 Materials.

- A. Pipe Requirements
 - 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.
 - b. All corrugated Polypropylene Pipe shall have a smooth interior and annular exterior corrugations and meet or exceed ASTM F2881 and AASHTO M330.
- B. Joint Performance
 - a. Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2881.
 - b. 12-60 inch pipe shall be watertight according to the requirements of ASTM D3212. Spigots shall have gaskets meeting 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.
 - c. 12-60 inch pipe shall have an exterior bell wrap installed by the manufacturer.

C. Fittings

- a. Fittings shall conform to ASTM F2881 and AASHTO M330. Bell and spigot connections shall utilize a spun-on, welded or integral bell and spigots with gaskets meeting ASTM F477. Bell & spigot fittings joint shall meet the watertight joint performance requirements of ASTM D3212. Corrugated couplings shall be split collar, engaging at least 2 full corrugations.
- 9512.3 MEASUREMENT. Corrugated Smooth Lined High Performance Polypropylene Pipe (HP Storm) Pipe will be measured by the linear foot.

ltem 9512 Page -2 of 2

9512.4 PAYMENT. Corrugated Smooth Lined High Performance Polypropylene Pipe (HP Storm) measure and prescribed above, will be made at the Contract unit "Corrugated Smooth Lined High Performance Polypropylene (HP Storm)" price bid per linear foot for the various sizes of the material as indicated in the contract documents. The pipe shall be furnished F.O.B. on an "as needed basis" to various locations within the Precinct. Standard sizes and lengths are to be provided and shall be in conformity with the material requirements.

The descriptions and units for this item are:

Corrugated Smooth Lined High Performance Polypropylene Pipe (15")Linear FootCorrugated Smooth Lined High Performance Polypropylene Pipe (18")Linear Foot
Corrugated Smooth Lined High Performance Polypropylene Pipe (18") Linear Foot
Corrugated Smooth Lined High Performance Polypropylene Pipe (24") Linear Foot
Corrugated Smooth Lined High Performance Polypropylene Pipe (30") Linear Foot
Corrugated Smooth Lined High Performance Polypropylene Pipe (36") Linear Foot
Corrugated Smooth Lined High Performance Polypropylene Pipe (42") Linear Foot
Corrugated Smooth Lined High Performance Polypropylene Pipe (48") Linear Foot
Corrugated Smooth Lined High Performance Polypropylene Pipe (60") Linear Foot

END OF ITEM 9712



HP Storm Pipe 12"-60"





THE MOST ADVANCED NAME IN WATER MANAGEMENT SOLUTIONS[™]

HP STORM PIPE 12"-60" FOR STORM APPLICATIONS

Overview

An addition to our proven line of pipe products, 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.

Advanced Dual Wall Profile Construction

12"-60" (300 - 1500 mm) diameter HP Storm pipe utilizes an enhanced 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.





Interior View



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.

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" (300-750mm) mainline sizes. Standard branch laterals are designed to accept SDR-35 or SDR-26 pipe.

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.

DIAMETER	DIAMETER PROFILE TYPE		INSIDE DIAMETER	OUTSIDE DIAMETER	TRUCKLOAD FOOTAGE
12 in. (300 mm)	Dual Wall	20 ft. (6 m)	12.2 in. (310 mm)	14.5 in. (368 mm)	2400 ft. (731.5 m)
15 in. (375 mm)	Dual Wall	20 ft. (6 m)	15.1 in. (384 mm)	17.7 in. (450 mm)	1600 ft. (487.7 m)
18 in. (450 mm)	Dual Wall	20 ft. (6 m)	18.2 in. (462 mm)	21.4 in. (544 mm)	1120 ft. (341.4 m)
24 in. (600 mm)	Dual Wall	20 ft. (6 m)	24.1 in. (612 mm)	28.0 in. (711 mm)	600 ft. (182.9 m)
30 in. (750 mm)	Dual Wall	20 ft. (6 m)	30.2 in. (767 mm)	35.5 in. (902 mm)	360 ft. (109.7 m)
36 in. (900 mm)	Dual Wall	20 ft. (6 m)	36.0 in. (914 mm)	41.5 in. (1054 mm)	240 ft. (73.2 m)
42 in. (1050 mm)	Dual Wall	20 ft. (6 m)	42.0 in. (1067 mm)	47.4 in. (1204 mm)	160 ft. (48.8 m)
48 in. (1200 mm)	Dual Wall	20 ft. (6 m)	47.9 in. (1217 mm)	54.1 in. (1374 mm)	120 ft. (36.6 m)
60 in. (1500 mm)	Dual Wall	20 ft. (6 m)	59.9 in. (1521 mm)	67.1 in. (1704 mm)	80 ft. (24.4 m)



Extended Bell



Fabricated Wye Fitting



Fittings Available in PVC or PP

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 wide selection of connection options utilizing some of the most widely used manhole connectors on the market today from companies such as A-Lok[®], Trelleborg[®] and Press Seal[®] Gasket Corporation.

FILL VOID SPACE WITH ACCEPTABLE

WATERSTOP GASKET



Typical INSERTA TEE Tap



Repair Coupler



HP STORM

DUAL WALL

PIPE 12"-60"



Flexible Boot Connection

Pre-Cast Compression Gasket Connection



Pre-Cast Compression Gasket Connection





Manole Compression Gasket Connection with Corrugated Pipe Adapter



ADS 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

- 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 with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2881.

12– through 60–inch (300 to 1500 mm) shall be watertight according to the requirements of ASTM D3212. Spigots shall have gaskets meeting 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 and AASHTO M330. Bell and spigot connections shall utilize a spun-on, welded or integral bell and spigots with gaskets meeting ASTM F477. Bell & spigot fittings joint shall meet the watertight joint performance requirements of ASTM D3212. Corrugated couplings shall be split collar, engaging at least 2 full corrugations.

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 www.ads-pipe.com for a copy of the latest installation guidelines.

PIPE DIMENSIONS

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

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



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Polypropylene Pipe vs. RCP

Data based on 30-inch diameter ASTM F2881 polypropylene and ASTM C76, B-Wall reinforced concrete pipes

	Polypropylene Pipe (PP)	Reinforced Concrete Pipe (RCP)		
Joint Integrity	Extended bell and spigot joint with standard rubber gasket exceeds 25 feet of head pressure per ASTM D3212	Bell and spigot joints when gasket is specified exceeds 25 feet of head pressure per ASTM C1628. Unspecified joints normally are not leak resistant.		
Maximum Cover	Compacted Class I Backfill = 39 feet 95% SPD Class II Backfill = 27 feet 90% SPD Class II Backfill = 19 feet 90% SPD Class III Backfill = 15 feet 95% SPD Class IV Backfill = 14 feet (See Technical Note 2.04)	Type 1 Installation with Class IV Pipe = 35 feet Type 1 Installation with Class III Pipe = 23 feet Type 2 Installation with Class III Pipe = 17 feet Type 3 Installation with Class III Pipe = 14 feet (See ACPA Fill Height Tables, Resource #16-201 [Revised 08/13])		
Minimum Cover Height	95% SPD Class III Backfill - 1.0 feet (See Technical Note 2.04)	Type 1, 2, 3, 4 Installation - 1.0 feet (Class IV Pipe is required). (See ACPA Fill Height Tables, as above)		
Installation Rate	200 feet/day per RS Means	88 feet/day per RS Means		
Allowable Backfill	Based on installation requirements, Class I, II, III, or IV backfills may be used. High plasticity soils (MH & CH) are not recommended (See ASTM D2321).	Based on installation requirements, Category I, II, or III backfills may be used. High plasticity soils (MH & CH) are not recommended (See ASTM C1479).		
Number of Joints	9 joints per 200 linear feet of pipe (based on 20 feet standard pipe length, 13 foot lengths available upon request)	24 joints per 200 linear feet of pipe (based on 8 feet standard pipe length)		
Product Weight	370 pounds per 20 feet stick of pipe	3,320 pounds per 8 feet of pipe		
Corrosion ResistantUnaffected by salts, most chemicals, and "hot" soils (See Technical Note: 4.01)		Salt and chemicals, like hydrogen sulfide, can degrade steel and concrete (See Design Manual "Sulfide and Corrosion Prediction and Control)		
Design Service Life	100 years (Based on FDOT analysis)	100 years (Based on FDOT analysis)		



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National Specifications

Common ASTM and AASHTO Standards for PP and RCP Pipe

	Specifications	Descriptions			
Polypropylene (PP)	ASTM F2881	Material spec for 12" to 60" (300 to 1500 mm) dual wall polypropylene (PP) pipe with variable pipe stiffness for non-pressure storm sewer system applications			
Pipe Manufacturing Standards	AASHTO M330	12" to 60" (300 to 1500 mm) polypropylene (PP) pipe & fittings used in surface and subsurface drainage systems			
	ASTM F2764*	6" to 60" (750 to 1500 mm) polypropylene (PP) dual wall and triple wall pipe and fittings for non-pressure sanitary sewer applications*			
Both	ASTM F477	Descriptions Material spec for 12" to 60" (300 to 1500 mm) dual wall polypropylene (PP) pipe with variable pipe stiffness for non-pressure storm sewer system applications 12" to 60" (300 to 1500 mm) polypropylene (PP) pipe & fittings used in surface and subsurface drainage systems 6" to 60" (750 to 1500 mm) polypropylene (PP) dual wall and triple wall pipe and fittings for non-pressure sanitary sewer applications* Material specification for elastomeric seals (gaskets) for joining plastic pipe Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe Manufacture of Reinforced Concrete Sewer, Storm Drain and Culvert Pipe for Direct Design Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals (lab test) Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (lab test) Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets (new lab test) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications Thermoplastic Pipe - Installation Standard Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations Concrete Culverts - Installation Standard Standard Practice for Infiltration & Exfiltration Acceptance of Installed HDPE Pipe Standard Test Method for Installation Acceptance of Plastic Gr			
	ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe			
Reinforced	AASHTO M170	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe			
Concrete Pipe (RCP)	ASTM C361	Reinforced Concrete Low-Head Pressure Pipe			
Manufacturing	ASTM C655	Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe			
Standards	ASTM C1417	Manufacture of Reinforced Concrete Sewer, Storm Drain and Culvert Pipe for Direct Design			
PP Joints	ASTM D3212	Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals (lab test)			
	ASTM C443	Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (lab test)			
RCP Joints	ASTM C1628	Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets (new lab test)			
PP Installation	ASTM D2321	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications			
	AASHTO Sect. 30	Thermoplastic Pipe - Installation Standard			
RCP Installation	ASTM C1479	Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations			
	AASHTO Sect. 27	Concrete Culverts - Installation Standard			
DD In Field Inspection	ASTM F2487	Standard Practice for Infiltration & Exfiltration Acceptance of Installed HDPE Pipe			
PP In-riela inspection	ASTM F1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using Low-Pressure Air**			
RCP In-Field Inspection	ASTM C969	Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines			
_	ASTM C924	Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air**			

* ASTM F2736 has been incorporated into the latest version of ASTM F2764.

**Recommend use of rolling joint tester, unless pipes are cracked or porous. Testing full lengths of pipe using air pressure is extremely dangerous.

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TECHNICAL NOTE

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

TN 2.04 Decemebr 2016

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.

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-250, H-25, or HL-93

		Loud	
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)
30 (750)	1 (0.3)		

Notes:

 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.

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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 2ADS HP Storm Mechanical Properties

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





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Maximum Cover for ADS HP Storm Pipe with Uniform Backfill, ft (m)									
Diameter	Class 1		Class 2		Cla	ss 3	Class 4		
in (mm)	Compacted	95%	90%	85% ³	95%	90% ³	95% ³		
12 (200)	41	28	21	16	20	16	16		
12 (300)	(12.5)	(8.5)	(6.4)	(4.9)	(6.1)	(4.9)	(4.9)		
15 (275)	42	29	21	16	21	16	16		
15 (375)	(12.8)	(8.8)	(6.4)	(4.9)	(6.4)	(4.9)	(4.9)		
40 (450)	44	30	21	16	22	17	16		
18 (450)	(13.4)	(9.1)	(6.4)	(4.9)	(6.7)	(5.2)	(4.9)		
24 (600)	37	26	18	14	19	14	14		
24 (600)	(11.3)	(7.9)	(5.5)	(4.3)	(5.8)	(4.3)	(4.3)		
20 (750)	39	27	19	14	19	15	14		
30 (750)	(11.9)	(8.2)	(5.8)	(4.3)	(5.8)	(4.6)	(4.3)		
26 (000)	28	20	14	10	14	11	10		
30 (900)	(8.5)	(6.1)	(4.3)	(3.0)	(4.3)	(3.4)	(3.0)		
42 (1050)	30	21	14	10	15	11	10		
42 (1050)	(9.1)	(6.4)	(4.3)	(3.0)	(4.6)	(3.4)	(3.0)		
49 (1200)	29	20	14	9	14	10	10		
40 (1200)	(8.8)	(6.1)	(4.3)	(2.7)	(4.3)	(3.0)	(3.0)		
60 (1500)	29	20	14	9	14	10	9		
00 (1000)	(8.8)	(6.1)	(4.3)	(2.7)	(4.3)	(3.0)	(2.7)		

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

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/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.

8. See ADS Standard Detail STD-101D for additional details.