



Standard Specification for 30 to 60 in. [750 to 1500 mm] Triple Profile-Wall Polyethylene (PE) Pipe and Fittings for Sanitary Sewer Applications¹

This standard is issued under the fixed designation F2763; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers requirements and test methods for triple profile wall polyethylene pipe and fittings. The nominal inside diameters covered are 30 to 60 in. [750 to 1500 mm].

1.2 The requirements of this specification are intended to provide pipe and fittings suitable for underground use for non-pressure sanitary sewer systems. Pipe and fittings produced in accordance with this specification shall be installed in compliance with Practice D2321.

1.3 This specification covers pipe and fittings with an essentially smooth interior and exterior wall using an annular corrugated profile middle wall (Fig. 1).

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 The following precautionary caveat pertains only to the test method portion, Section 7, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- A666 Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- D618 Practice for Conditioning Plastics for Testing

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

D2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

D2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

D3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials

D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique

D4389 Specification for Finished Glass Fabrics Woven From Rovings

F412 Terminology Relating to Plastic Piping Systems

F477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F2136 Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe

2.2 AASHTO Standard:³

LRFD, Section 12 AASHTO LRFD Bridge Design Specifications Section 12 – Buried Structures and Tunnel Liners

2.3 Federal Standards:⁴

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)
MIL-STD-129 Marking for Shipment and Storage

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.62 on Sewer. Current edition approved Feb. 1, 2011. Published February 2011. DOI: 10.1520/F2763-11.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.transportation.org>.

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

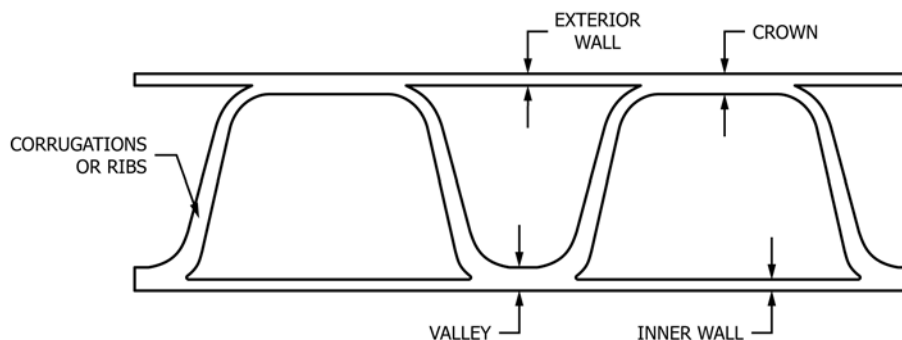


FIG. 1 Typical Triple Wall Pipe Profile

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F412 and abbreviations are in accordance with Terminology D1600, unless otherwise specified. The abbreviation for polyethylene is PE.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *triple wall, n*—In this case, the profile pipe wall construction provides an interior wall in the waterway, an exterior wall to the soil, and includes ribs, corrugations, or other shapes, which can be either solid or hollow, that helps brace the pipe against diametrical deformation.

4. Ordering Information

4.1 Orders for product made to this specification shall include the following information to adequately describe the desired product

- 4.1.1 This ASTM designation (F2763) and year of issue,
- 4.1.2 Diameters,
- 4.1.3 Total footage of each pipe diameter involved,
- 4.1.4 Pipe laying length,
- 4.1.5 Fitting type(s):
 - 4.1.5.1 Size and type of fittings, including mainline and branch diameters, and
 - 4.1.5.2 Number of fittings per diameter.

5. Materials and Manufacture

5.1 *Pipe and Fabricated Fittings*—The pipe and fabricated fittings shall be made of virgin PE material meeting the requirements of Specification D3350 with a minimum cell classification of 435400C, except that carbon black content

shall equal to or greater than 2.0% but not exceed 3.0 % when tested in accordance with D4218. Materials that have a higher cell classification in one or more properties shall be permitted provided all other product requirements are met.

5.2 *Rework Material*—Clean rework material generated from the manufacturer's own pipe and fittings production of this product shall be permitted to be used by the same manufacturer. Rework shall be the same cell classification as new PE compound with which it is blended and the pipe produced shall meet all the requirements of this specification.

6. General Requirements

6.1 *Workmanship*—The pipe and fittings shall be homogeneous throughout and be as uniform as commercially practical in color, opacity, and density. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusions, or other defects that are visible to the naked eye and that may affect the wall integrity. The ends shall be cut cleanly and squarely through valleys.

6.1.1 Visible defects, cracks, creases, splits, in pipe are not permissible.

6.2 Dimensions and Tolerance:

6.2.1 *Nominal Size*—The nominal size for the pipe and fittings shall be the inside diameter shown in Table 1.

NOTE 1—The outside diameters of products manufactured to this specification are not specified; therefore, compatibility between pipe and fittings made to this specification from different manufacturers must be verified.

TABLE 1 Pipe Stiffness and Pipe Dimensions

Pipe Inside Diameter		Minimum Inside Diameter ^A		Inside Diameter Tolerances		Minimum Pipe Stiffness at 5 % Deflection		Minimum Inner Liner Thickness		Minimum Outer Liner Thickness		Minimum Valley Thickness		Minimum Crown Thickness	
in.	[mm]	in.	[mm]	in.	[mm]	lb/in. /in.	[kPa]	in.	[mm]	in.	[mm]	in.	[mm]	in.	[mm]
30	[750]	29.62	[752]	+0.18/- 0.18	+4.6/-4.6	46	[317]	0.070	[1.8]	0.070	[1.8]	0.089	[2.3]	0.127	[3.2]
36	[900]	35.40	[899]	+0.21/- 0.21	+5.3/-5.3	46	[317]	0.095	[2.4]	0.095	[2.4]	0.120	[3.0]	0.182	[4.6]
42	[1050]	41.31	[1049]	+0.22/- 0.22	+5.6/-5.6	46	[317]	0.105	[2.7]	0.105	[2.7]	0.133	[3.4]	0.182	[4.6]
48	[1200]	47.31	[1201]	+0.27/- 0.27	+6.9/-6.9	46	[317]	0.105	[2.7]	0.105	[2.7]	0.139	[3.5]	0.187	[4.8]
54	[1350]	53.32	[1354]	+0.27/- 0.27	+6.9/-6.9	46	[317]	0.100	[2.8]	0.110	[2.8]	0.144	[3.7]	0.187	[4.8]
60	[1500]	59.30	[1506]	+0.31/- 0.31	+7.9/-7.9	46	[317]	0.115	[2.9]	0.115	[2.9]	0.151	[3.8]	0.231	[5.9]

^A The manufacturer's stated inside diameter is the diameter plus or minus the inside diameter tolerance. In no case shall the manufacturer's minimum diameter with the tolerance be less than the minimum as shown in Table 1.

6.2.2 *Minimum Inside Diameter*—The minimum inside diameter shall be as shown in **Table 1**, when measured in accordance with 7.3.1.

6.2.3 *Length*—The pipe shall be supplied in any length agreeable to both the owner and the manufacturer. Length shall not be less than 99 % of stated quantity when measured in accordance with 7.3.2.

6.2.4 *Minimum Wall, Crown, Valley and Liner Thickness*—The minimum thickness of the pipe wall, crown, valley and liners shall meet the requirements given in **Table 1** when measured in accordance with 7.3.3.

6.3 *Pipe Stiffness*—Minimum pipe stiffness at 5 % deflection shall meet the requirements given in **Table 1** when tested in accordance with 7.4.

NOTE 2—The 5 % deflection criterion, which was selected for testing convenience, is not a limitation with respect to in-use deflection. The engineer is responsible for establishing the acceptable deflection limit.

6.4 *Pipe Flattening*—There shall be no evidence of splitting, cracking, breaking, separation of seams, separation of the outer and inner wall, or combinations thereof, when conditioned in accordance with 7.2 and tested in accordance with 7.5.

6.5 *Pipe Impact Strength*—There shall be no evidence of splitting, cracking, breaking, separation of seams, separation of the outer and inner wall, or combinations thereof, when tested in accordance with 7.6 and examined under normal light and the unaided eye.

6.6 *Fittings and Joining Systems*:—

6.6.1 Only fittings fabricated from pipe made to this standard and supplied by the pipe manufacturer shall be used. Fittings shall be installed in accordance with the manufacturer's recommendations and must meet the same material and performance requirements as the pipe.

NOTE 3—The fittings may be fabricated from the pipe by a variety of processes including hot plate welding, spin welding or other processes.

6.6.2 The joining system(s) shall be of a design that preserves alignment during construction and prevents separation at the joints.

6.6.3 Pipe and fittings shall have a watertight bell/spigot joint that complies with the laboratory tests defined and described in Test Method **D3212** and utilizes a gasket that complies with the requirements of Specification **F477**. Note that special provisions must be taken in order to join field cut pipe that meets the requirements of Test Method **D3212**. Any component used in the joining material shall be resistant to effluents being carried in the pipe.

6.6.4 *Lubricant*—The lubricant used for assembly of gasketed joints shall have no detrimental effect on the gasket or on the pipe.

6.6.5 *Optional Bell Retaining Bands*—Bell retaining bands shall be made of corrosive resistant materials such as fiberglass (**D4389**) or stainless steel (**A666**).

6.6.5.1 The **D4389** fiberglass roving shall be an E type glass, free of any alkali, dirt or other impurities. The band shall consist of a continuous, overlapping filament fiber and not a fabric.

6.6.6 A joint proof-of-design analysis shall be conducted on the pipe joints using the method outlined in 7.8. Each joint proof of design pressure test shall be conducted by an independent third party, which provides written certification for each analysis or test. This test is a one-time validation test for the specific pipe diameter, profile geometry, gasket and joint configuration supplied by the manufacturer.

6.7 *Slow Crack Growth Resistance Pipe*—For slow crack-growth resistance, the pipe shall be evaluated using the notched constant ligament stress (NCLS) test according to the procedure described in 7.7. The average failure time of the five test specimens shall exceed 30 h with no single test specimen's failure time less than 21 h.

7. Test Methods

7.1 Conditioning:—

7.1.1 *Referee Testing*—When conditioning is required for referee tests, condition the specimens in accordance with Procedure A of Practice **D618** at $73.4 \pm 3.6^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$] for not less than 40 h prior to test. Conduct tests under the same conditions of temperature. The selection of the sample or samples of the pipe and fittings shall be as agreed upon between the owner and the seller. In case of no prior agreement, any sample selected by the testing laboratory shall be deemed permitted.

7.1.2 *Quality Control Testing*—Condition specimens for a minimum of 4 h prior to test in air or 1 h in water at $73.4 \pm 3.6^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$] without regard to relative humidity.

7.2 *Test Conditions*—Conduct tests other than those for routine quality control purposes in the standard laboratory atmosphere of $73.4 \pm 3.6^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$], in the referenced test method or in this specification.

7.3 Dimensions:

7.3.1 *Inside Diameter*—Measure the inside diameter in accordance with Test Method **D2122**.

7.3.2 *Length*—Measure pipe length in accordance with Test Method **D2122**. These measurements may be taken at ambient temperature.

7.3.3 *Minimum Wall, Crown, Valley and Liner Thickness*—Measure the thickness of each wall component in accordance with Test Method **D2122**. Each specimen shall be cut perpendicular to the seam line of the pipe. This circumferential cut shall be made directly through a corrugation allowing a plain view of the inner wall 360° around the circumference in order to obtain a minimum of eight measurements in accordance with Test Method **D2122**. Each specimen shall also be cut along the axis of the seam line to measure the longitudinal profiles for two full corrugation periods to obtain a minimum of eight measurements for each section thickness.

7.4 *Pipe Stiffness*—Select three pipe specimens and test for pipe stiffness in accordance with Test Method **D2412**, except for the following conditions:

7.4.1 The test specimens shall be at least 24 in. [609 mm] in length. However, the test specimen shall not be less than three full corrugations in length.

7.4.2 Each specimen shall be cut mid-valley to mid-valley (see **Fig. 1**) while still meeting or exceeding the minimum length requirement.

7.4.3 Determine the minimum inner wall thickness and locate the first specimen in the loading machine with the minimum inner wall thickness located at 9:00 or 3:00 when viewing the specimen from the end. The specimen shall lie flat on the plate within 0.125 in. [3 mm]. Use the first location as a reference point for rotation and testing the other specimen. Rotate the other specimen 45° and 90° from the original orientation. Test each specimen in only one position.

7.5 *Flattening*—Flatten the three test specimens from 7.4 between parallel plates until the pipe inside diameter is reduced by 40 %. The rate of loading shall be 2 in./min [50 mm/min]. The test specimens, when examined under normal light and the unaided eye, shall show no splitting, cracking, breaking or separation of the pipe walls.

7.6 *Impact Resistance*—Test pipe specimens in accordance with Test Method D2444, when conditioned in accordance with 7.2, except six specimens shall be tested, or six impacts shall be made on one specimen. In the latter case, successive impacts shall be separated by $60 \pm 10^\circ$ for impacts made on one circle, or at least 12 in. [305 mm] longitudinally for impacts made on one element. Impact points shall be at least 6 in. [150 mm] from the end of the specimen. Impact strength shall not be less than 140 ft·lbf [190 J]. Tests shall be conducted using either a 20 lb (9 kg) Tup B or 30 lb (15 kg) Tup B and a flat-plate specimen Holder B. Condition the specimens for 24 h at a temperature of $73 \pm 3^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$), and conduct all tests within 60 s of removal from this atmosphere. The center of the falling tup shall strike on a corrugation crown (crest) for all impacts. All specimens must pass.

7.6.1 Test specimens shall be cut valley-to-valley and equal in length to one-half of the nominal diameter but not less than 18-in. (457 mm).

7.7 *Slow-Crack Growth Resistance*— PE Pipe — Pipe test specimens shall be taken from the extruded pipe in the pipe liner area. Test 5 pipe specimens using the same protocol for molded bars in Test Method F2136 test, except for the following modifications:

7.7.1 The applied stress for the NCLS test shall be 600 psi [4138 kPa].

7.8 *Joint Proof-of-Design Pressure Test*:

7.8.1 This proof-of-design test shall be conducted on each pipe diameter and any that differs in joint design.

7.8.2 Prepare and test joints in accordance with 7.8.4. Pipe shall have a watertight bell/spigot joint that complies with the laboratory tests defined and described in Test Method D3212.

7.8.3 Failure of any of the specimens shall constitute failure of the test.

7.8.4 *Specimen Preparation*:

7.8.4.1 Condition assembled test specimens a minimum of 2 h at the test temperature to be used prior to initiating the test procedure.

7.8.4.2 Test joints shall be assembled on the appropriate size pipe in accordance with the manufacturer's joining procedure. Lubricate and assemble the joint according to the manufacturer's instructions with the associated F477 gasket in place.

7.8.4.3 Testing shall be conducted at standard laboratory temperature of $73.4 + 3.6^\circ\text{F}$ ($23 + 2^\circ\text{C}$) unless otherwise specified.

7.8.4.4 Maintain assembled joint configuration for a minimum of 1000 h under ambient temperature conditions $75 + 5^\circ\text{F}$ ($24 + 3^\circ\text{C}$). Upon completion of this hold time, conduct a full D3212 test on the assembled joint.

NOTE 4—For entire 1000 h hold time, joint shall remain undisturbed and fully assembled. Joint may not be disassembled and reassembled at any point prior to completion of full D3212 testing.

7.8.4.5 Aside from stiffeners that are part of the joint design being tested, no stiffeners may be used in the specimen.

8. Inspection

8.1 Inspection of the product shall be as agreed upon between the owner and the manufacturer as part of the purchase contract. Unless otherwise specified in the contract or purchase agreement, the manufacturer is responsible for the performance of all inspection and test requirements specified herein.

8.2 *Notification*—If inspection is specified by the owner, the manufacturer shall notify the owner in advance of the date, time, and place of testing of the pipe or fittings, or both, so that the purchaser may be represented at the test.

8.3 *Access*—The inspector shall have free access to those parts of the manufacturer's plant that are involved in work performed under this specification. The manufacturer shall afford the inspector all reasonable facilities for determining whether the pipe or fittings, or both, meet the requirements of this specification.

9. Rejection and Rehearing

9.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) shall be conducted again in accordance with an agreement between the owner and the manufacturer. There shall be no agreement to lower the minimum requirement of the specification by such means as omitting tests that are a part of the specification, substituting or modifying a test method, or by changing the specification limits. In retesting, the product requirements of this specification shall be met, and the test methods designated in this specification shall be followed. If, upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this specification.

10. Certification

10.1 When specified in the purchase order or contract, a manufacturer's or independent laboratory's certification shall be furnished to the owner that the products shipped, as identified by the lot description of 11.1 and 11.2, were manufactured, sampled, tested, and inspected at the time of manufacture in accordance with this specification and have been found to meet the requirements. When specified in the purchase order or contract, a report of the test results shall be furnished. Where requested, certified actual inside diameter, extrusion line and shift the pipe was produced shall be provided.

11. Markings

11.1 *Pipe*—Each length of pipe in compliance with this specification shall be clearly marked with the following information: this designation ASTM F2763, the nominal size, the legend PE, the manufacturer's name, trade name or trademark, plant location, and date of manufacture. The marking shall be applied at the time of manufacture to the pipe. It shall be placed, at least, at each end of each length of pipe or spaced at intervals of not more than 10 ft [3.0 m].

11.2 *Fittings*—Each fitting in compliance with this specification shall be clearly marked with the following information: this designation ASTM F2763, the nominal size, the legend PE, the manufacturer's name, trade name or trademark, plant location, and date of manufacture.

12. Packaging

12.1 All pipe and couplings and fittings shall, unless otherwise specified, be packaged for standard commercial shipment.

13. Quality Assurance

13.1 When the product is marked with this designation (ASTM F2763), the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

14. Keywords

14.1 fittings; interior liner; PE; pipe; polyethylene; profile wall; sanitary sewer

SUPPLEMENTARY REQUIREMENTS

These requirements apply only to federal/military procurement, not domestic sales or transfers.

S1. Responsibility for Inspection

S1.1 Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements specified herein. The manufacturer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless the owner disapproves. The owner shall have the right to perform any of the inspections and tests set forth in this specification, where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE S1—In U.S. federal contracts, the contractor is responsible for inspection.

S2. Packaging and Marking for U.S. Government Procurement

S2.1 *Packaging* —Unless otherwise specified in the contract, the materials shall be packaged in accordance with the manufacturer's standard practice in a manner ensuring arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules or National Motor Freight Classification rules.

Marking— Marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

NOTE S2—The inclusion of U.S. government procurement requirements shall not be construed as an indication that the U.S. government uses or endorses the products described in this document.

APPENDIXES

(Nonmandatory Information)

X1. AUTHORITIES

X1.1 Since this product has a wide variety of uses in sanitary sewer systems, approval for its use rests with various agencies. The installer should contact the relevant authority to obtain local installation guidelines.

X1.2 The pipe manufacturer(s) should be able to provide proof of product acceptance by specific agencies, when appropriate.

X2. STRUCTURAL DESIGN

X2.1 After the design engineer satisfies project requirements, such as deflection, local and global buckling, and bending stress, it is advisable to review conditions with particular respect to long-term strain. A long-term tensile strain limit of 5.0% is recommended for polyethylene pipe.

X2.2 When the pipe is buried deeply, where hydrostatic conditions exist or when excessive pipe deformations or deflections, or both, might develop, it is advisable to evaluate the strain and environmental conditions as indicated in the following sections.

X2.3 The following discussion is about tensile and compressive strains. It is presented in general form. The user is responsible for qualifying the pipe after reviewing the proposed conditions and the qualities of the manufacturer's product.

X2.3.1 Tensile Strain:

$$\varepsilon_T = \varepsilon_B - (\varepsilon_S + \varepsilon_H) \quad (X2.1)$$

where:

ε_C = total compressive strain

ε_T = total tensile strain

ε_B = tensile strain from pipe bending in either diametric, axial, or combined situations,

ε_S = compressive strain induced into the pipe walls by the soil weight above the pipe.

ε_H = external hydrostatic compressive strain.

X2.3.2 Compressive Strain—

$$\varepsilon_C = \varepsilon_B + \varepsilon_S + \varepsilon_H \quad (X2.2)$$

where:

ε_C = total compressive strain

NOTE X2.1—AASHTO LRFD Bridge Design Specifications, Section 12 is typically used for evaluation of structural design of thermoplastic pipe. Reference LRFD, Section 12 for additional information.

X2.4 A modulus of elasticity and tensile strength for the material rated at 50 years is often used in the calculations leading to the determination of strain and thrust capacity. This value will vary directly in proportion to the stress level.

X2.4.1 The following long-term properties are recommended for design based on a 500 psi stress level:

HDPE Engineering Properties	Short-Term – Initial* psi (MPa) ^A	Long-Term – 50-year psi (MPa)
Tensile Strength	3,000 (20.6)	900 (6.18)
Modulus of Elasticity	110,000 (755)	22,000 (151)

^AShort-term values are determined by the material's cell class designation in 5.1.

X3. MANHOLE CONNECTIONS

X3.1 Watertight connections to manholes require the exact outside dimensions of the pipe to properly size both the manhole opening as well as the resilient gasket connection between the manhole and pipe.

X3.2 The following table provides nominal outside dimensions for preliminary sizing of both the manhole as well as the associated resilient connection. The values in this table should not be used for design as these are only estimated dimensions. Actual pipe outside dimensions vary per manufacturer and this

material should be requested from the supplier prior to finalization of any sanitary sewer design or sizing.

Pipe Inside Diameter		Nominal Pipe Outside Diameter	
in.	[mm]	in.	[mm]
30	[750]	35	[889]
36	[900]	42	[1067]
42	[1050]	47	[1194]
48	[1200]	53	[1346]
54	[1350]	60	[1524]
60	[1500]	66	[1676]

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