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Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content[1]

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1. Scope

1.1 This specification has been published in response to the special circumstance of regulatory requirements regarding federal procurement guidelines for plastic pipe having recycled content.

1.2 This specification covers coextruded Poly(Vinyl Chloride) (PVC) plastic pipe with a center layer and concentric inner and outer solid layers. The pipe is produced using a multi-layer coextrusion die. The inner and outer layers are made of virgin PVC compound and the center layer has reprocessed-recycled PVC content. The pipe is for non-pressure use in three series:

1.2.1 Sewer-Drain series with a sewer-pipe outside diameter and a pipe stiffness of 46 psi (320 kPa),

1.2.2 IPS Schedule 40 series, and

1.2.3 IPS Pipe Stiffness (PS) series with pipe stiffnesses of 100 psi (690 kPa) and 120 psi (830 kPa).

1.3 Pipe that is outside-diameter controlled does not necessarily have an inside diameter suitable for use as a fitting socket.

1.4 All series may be perforated.

1.5 The values stated in inch-pound units are to be regarded as the standard. The SI values are provided for information only.

1.6 *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:*

D 883 Terminology Relating to Plastics[2]

D 1243 Test Method for Dilute Solution Viscosity for Vinyl Chloride Polymers[2]

D 1600 Terminology for Abbreviated Terms Relating to Plastics[2]

D 1784 Specification for Rigid Poly(Vinyl Chloride) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds[2]

D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings[3]

D 2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading[3]

D 2444 Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)[3]

D 2466 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40[3]

D 2665 Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings[3]

D 2855 Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings[3]

D 3034 Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings[3]

D 3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals[3]

D 4396 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (PVC) Compounds for Plastic Pipe and Fittings Used in Nonpressure Applications[4]

F 412 Terminology Relating to Plastic Piping Systems[3]

F 477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe[3]

F 512 Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation[3]

F 1336 Specification for Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings[3]

F 1365 Test Method for Water Infiltration Resistance of Plastic Underground Conduit Joints Which Use Flexible Elastomeric Seals[3]

2.2 *Plastic Pipe Institute Technical Report:*[5]

PPI-TR-7 Recommended Method for Calculation of Nominal Weight of Plastic Pipe

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminologies D 883, D 1600, and F 412, unless otherwise indicated.

3.1.1 *coextrusion*—a process whereby two or more plastic

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[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 08.04.

[4] *Annual Book of ASTM Standards*, Vol 08.03.

[5] Available from Plastic Pipe Institute, 1275 K Street NW, Suite 400, Washington, DC 20005.

material streams are forced through one or more shaping orifices and become one continuously formed piece.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *center-layer compound*—general description for "internal reprocessable material" (3.2.5), "external reprocessable material" (3.2.4), and "recycled material" (3.2.6). These materials can be used straight or blended with virgin materials to make a compound, in accordance with this specification.

3.2.2 *certificate of composition*—a certificate describing pertinent properties of an external reprocessable material or a recycled material.

3.2.2.1 *Discussion*—Examples include polymer, molecular weight, percentage of inorganic material, contamination type and level, tensile strength, modulus of elasticity, and izod impact.

3.2.3 *composition disclosure*—a document describing the formulation of an external reprocessable material.

3.2.4 *external reprocessable plastic material*—industrial rework generated by a different company from the company manufacturing to this specification. Composition is known by the industrial source of the material.

3.2.5 *internal reprocessable plastic material*—rework generated by the same company's production that is manufacturing to this specification. Composition of the material is known by the company manufacturing to this specification.

3.2.6 *recycled plastic material*—finished goods that have been purchased by the public, then returned to industry and reprocessed into raw materials. Identity of finished goods is known by the reprocessing company.

3.2.7 *thermoplastic coextruded pipe*—pipe consisting of two or more concentric thermoplastic layers formed through the process of coextrusion.

4. Classification

4.1 The pipes are produced in two diameter families: sewer-drain and IPS.

4.1.1 *Sewer-Drain Series*—Produced with a sewer pipe OD and a pipe stiffness of 46 psi (320 kPa). Sewer-drain pipe is intended for use outside of buildings as sewer, sewer connections, underground drain, and storm drain. Wall thicknesses shall be produced so that minimum pipe stiffnesses are met, but shall not be thinner than the minimum wall thickness requirements in Table 1 and Table 2.

NOTE 1—Base inside diameters will be slightly smaller than those calculated for SDR 35 sewer-drain series pipe when wall thicknesses are increased to ensure minimum 46 pipe stiffness.

4.1.2 *IPS Diameter Family*—Produced in a Schedule 40 series and a Pipe Stiffness (PS) series.

TABLE 1 Requirements for Sewer-Drain Pipe

Nominal Size, in.	Average, OD, in.	Tolerance on Average, in.	Minimum Wall Thickness, in.[A]	Impact Resistance, ft-lb
4	4.215	±0.009	0.120	150
6	6.275	±0.011	0.180	210
8	8.400	±0.012	0.240	210
10	10.500	±0.015	0.300	220
12	12.500	±0.018	0.360	220
15	15.300	±0.023	0.437	220

[A] The maximum wall thickness shall not be greater than 1.25 times the minimum wall thickness.

TABLE 2 SI Requirements for Sewer-Drain Pipe

Nominal Size, in.	Average OD, mm	Tolerance on Average, mm	Minimum Wall Thickness, mm[A]	Impact Resistance, J
4	107.06	±0.23	3.05	203
6	159.39	±0.28	4.57	284
8	213.36	±0.30	6.10	284
10	266.70	±0.38	7.62	299
12	317.50	±0.46	9.14	299
15	388.62	±0.58	11.10	299

[A] The maximum wall thickness shall not be greater than 1.25 times the minimum wall thickness.

4.1.2.1 *IPS Schedule 40 Series*—Produced to Schedule 40 wall thicknesses in accordance with Table 3 and Table 4. Schedule 40 pipe is intended for use as underground drain, DWV (drain, waste, and vent), sewer connections, and other non-pressure uses.

4.1.2.2 *IPS Pipe Stiffness Series*—Produced to pipe stiffness of 100 psi (690 kPa) or 120 psi (830 kPa). Intended uses include underground communications and electrical distribution. Wall thicknesses shall be produced so that minimum pipe stiffnesses are met, but shall not be thinner than the minimum wall thickness requirements in Table 5 and Table 6.

NOTE 2—The IPS Pipe Stiffness (PS) series having pipe stiffnesses of 100 psi (690 kPa) and 120 psi (830 kPa) is designed for direct burial (DB). Encasement in concrete is not necessary.

4.1.3 Before installing pipe for industrial waste disposal use, the approval of the code official having jurisdiction should be obtained, as conditions not commonly found in normal use may be encountered.

5. Material

5.1 *Center-layer Compounds*—Center-layer compounds (internal reprocessable, external reprocessable, and recycled plastic materials) shall be characterized as being PVC-polymer-based. Other PVC-compatible additives (such as lubricants, stabilizers, non-polyvinyl-chloride resin modifiers, pigments, and inorganic fillers) may be present in these materials. The three plastic material types may be used in the percentages specified in 5.1.1, 5.1.2, and 5.1.3, provided that the pipe produced meets all of the requirements of this specification.

5.1.1 *Internal Reprocessable Plastic Material*—May comprise up to 100 % of the center layer. This material shall not be used in the inner or outer layers.

TABLE 3 Requirements for IPS Schedule 40 Pipe

Nominal Size, in.	Average OD, in.	Tolerance on Average, in.	Out of Round, in.[A]	Minimum Wall Thickness, in.[B]	Pipe Stiffness, psi	Impact Resistance, ft-lb
1 ¼	1.660	±0.005	0.060	0.140	1100	60
1 ½	1.900	±0.006	0.060	0.145	800	60
2	2.375	±0.006	0.060	0.154	450	60
3	3.500	±0.008	0.060	0.216	400	80
4	4.500	±0.009	0.100	0.237	250	100
6	6.625	±0.011	0.100	0.280	120	120
8	8.625	±0.015	0.150	0.322	80	140
10	10.750	±0.015	0.150	0.365	60	160
12	12.750	±0.015	0.150	0.406	50	180

[A] "Out of Round" is defined as maximum diameter minus minimum diameter.
[B] The maximum wall thickness shall not be greater than 1.25 times the minimum wall thickness.

TABLE 4 SI Requirements for IPS Schedule 40 Pipe

Nominal Size, in.	Average OD, mm	Tolerance on Average, mm	Out of Round, mm[A]	Minimum Wall, mm[B]	Pipe Stiffness, kPa	Impact Resistance, J
1 ¼	42.16	±0.13	1.52	3.56	7600	80
1 ½	48.26	±0.15	1.52	3.68	5500	80
2	60.32	±0.15	1.52	3.91	3100	80
3	88.90	±0.20	1.52	5.49	2750	110
4	114.30	±0.23	2.54	6.02	1700	135
6	168.28	±0.28	2.54	7.11	830	160
8	219.08	±0.38	3.81	8.18	550	190
10	273.05	±0.38	3.81	9.27	415	220
12	323.85	±0.38	3.81	10.31	340	240

[A] "Out of Round" is defined as maximum diameter minus minimum diameter.
[B] The maximum wall thickness shall not be greater than 1.25 times the minimum wall thickness.

TABLE 5 Requirements for IPS Pipe-Stiffness Pipe

Nominal Size, in.	Average OD, in.	Tolerance on Average, in.	Out of Round, in.[A]	Minimum Wall Thickness, in.[BC]		Impact Resistance, ft-lb
				DB 100	DB 120	
4C	4.350[D]	±0.009	0.100	0.141	0.149	100
4	4.500	±0.009	0.100	0.145	0.154	100
5	5.563	±0.010	0.100	0.179	0.191	120
6	6.625	±0.011	0.100	0.213	0.227	150

[A] "Out of Round" is defined as maximum diameter minus minimum diameter.
[B] The maximum wall thickness shall not be greater than 1.25 times the minimum wall thickness.
[C] Minimum wall-thickness values are based on skin modulus of 400 000 psi combined with center-layer modulus of 500 000 psi.
[D] This is not an IPS OD, but is a standard-OD pipe-stiffness pipe used by communications utilities.

TABLE 6 SI Requirements for IPS Pipe-Stiffness Pipe

Nominal Size, in.	Average OD, mm	Tolerance on Average, mm	Out of Round, mm[A]	Minimum Wall Thickness, mm[B,C]		Impact Resistance, J
				DB 100	DB 120	
4C	110.49[D]	±0.23	2.54	3.58	3.78	135
4	114.30	±0.23	2.54	3.68	3.91	135
5	141.30	±0.25	2.54	4.55	4.85	165
6	168.28	±0.28	2.54	5.41	5.77	205

[A] "Out of Round" is defined as maximum diameter minus minimum diameter.
[B] The maximum wall thickness shall not be greater than 1.25 times the minimum wall thickness.
[C] Minimum wall-thickness values are based on skin modulus of 400 000 psi combined with center-layer modulus of 500 000 psi.
[D] This is not an IPS OD, but is a standard-OD pipe-stiffness pipe used by communications utilities.

5.1.2 *External Reprocessable Plastic Material*—May comprise up to 100 % of the center layer. This material shall not be used in the inner or outer layers.

5.1.3 *Recycled Plastic Material*—May comprise up to a maximum of 60 % by weight of center layer. This material shall not be used in the inner or outer layers.

NOTE 3—Recycled plastic material is limited to 60 % by weight of the center layer due to current technology. As more experience is gained with process and materials, this standard may be amended to increase the percentage.

5.1.4 When requested by the pipe manufacturer, the supplier shall provide with the external reprocessable and recycled materials a certificate of composition, a composition disclosure, or both.

5.1.5 Virgin PVC homopolymer having an inherent viscosity greater than 0.68 (*K*-value 57) may be blended with center-layer compounds and compounding ingredients (lubricants, stabilizers, non-polyvinyl-chloride resin modifiers, pigments, and inorganic fillers) for use in the center layer. Inherent viscosity shall be determined in accordance with Test Method D 1243.

5.2 Inner and outer layers shall be made of virgin homopolymer PVC. Rework materials are not allowed.

5.3 *Cell Classification*—Properties of the compounds used to manufacture pipe in accordance with this standard shall be categorized using the cell classification method. The required cell values are considered minimums; compounds having higher values than those listed are considered acceptable.

5.3.1 Material for the Sewer-Drain series shall be categorized using Specification D 1784. Compound for the inner and outer layers shall have a minimum cell class of 12454B, and for the center layer 12223C.

5.3.2 Material for the IPS Schedule 40 series shall be categorized using Specification D 4396. Compound for the inside and outside layers shall have a minimum cell class of 11432, and for the center layer 11211. Compound for all layers shall meet the chemical-resistance requirement of Specification D 4396 with a 130°F (55°C), 14-day immersion.

5.3.3 Material for the IPS Pipe Stiffness (PS) series shall be categorized using Specification D 1784. Compound for the inner and outer layers shall have a minimum cell class of 12234C, and for the center layer 12223C.

5.4 *Color*—The center layer for all series shall contrast in color with the inner and outer layers such that wall measurements may be taken.

6. Joining Systems

6.1 *Solvent-Cement Joints*—In the solvent cement joint, the pipe spigot wedges into the tapered socket and the surfaces fuse together. The tapered socket may be a portion of a molded fitting or it may be a belled end of the pipe section.

6.1.1 The assembly of joints shall be in accordance with the recommendations of pipe, solvent cement, and fitting manufacturers pertaining to the particular system being employed or, in their absence, the methods described in Practice D 2855.

6.2 *Elastomeric-Gasket Joints*—In this system an elastomeric seal is situated in the bell or molded fitting, lubrication is applied to the spigot/gasket, and the pipe spigot is pushed past the gasket and into the bell forming a watertight joint. The design and control of the dimensions of gasketed bells, fittings, and elastomeric seals are not controlled by this specification, but are the responsibility of the manufacturers of the pipe, fittings, and gaskets.

6.2.1 The assembly of the joints shall be in accordance with the pipe manufacturer's recommendation. The lubricant shall be that recommended by the pipe manufacturer. Elastomeric seals shall meet the requirements of Specification F 477.

NOTE 4—Straight alignment is essential when assembling gasketed pipe joints. Bar and block assembly is recommended. (The major advantage of this method is that the worker can feel the amount of force being used and whether the joint goes together smoothly. This helps ensure that gaskets remain properly seated.)

6.3 *Fittings*:

6.3.1 *Sewer-Drain Series Pipe*—May be joined using