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An American National Standard

Standard Specification for Billets made by Winding Molten Extruded Stress-Rated High Density Polyethylene (HDPE)[1]

This standard is issued under the fixed designation F3034; 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 billets made from stress-rated high-density polyethylene (HDPE) materials.

1.2 The billets are manufactured by application of molten extruded material onto a rotating mandrel to form a monolithic mass. Removal of the mandrel provides a billet in the approximate shape of a thick-walled cylindrical shell. Machining prior to dimensioning is acceptable.

NOTE 1—Although it is impossible to address all manufacturing details related to the fabrication of billets in this specification, successful heat fusion bonding of HDPE is obtained through controlled application of sufficient heat to cause melting in combination with applied force over a period of time.

1.3 The billets are intended for fabrication into pipe fittings such as flange adapters and reducers.

1.4 Requirements for and use of the fabricated pipe fittings shall be in accordance with an applicable product specification. This specification for billets does not include requirements for items fabricated from the billets.

1.5 This specification includes thermoplastic pipe material designation codes for selection of appropriate stress-rated material, together with performance requirements for billets and test methods for determining conformance with the requirements.

1.6 Minimum quality control measures are prescribed for manufacturers. See Annex A1 for quality control for billets conforming to this specification.

1.7 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.8 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin Based Pipe.

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***A Summary of Changes section appears at the end of this standard**

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing
D638 Test Method for Tensile Properties of Plastics
D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
D1600 Terminology for Abbreviated Terms Relating to Plastics
D1603 Test Method for Carbon Black Content in Olefin Plastics
D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
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
F412 Terminology Relating to Plastic Piping Systems

2.2 *NSF/ANSI Standards:*[3]

Standard No. 14 for Plastic Piping Components and Related Materials
Standard No. 61 for Drinking Water Systems Components—Health Effects

2.3 *PPI Standards:*[4]

PPI TR-3 Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe
PPI TR-4 HDB/SDB/PDB/MRS Listed Materials, PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

3. Terminology

3.1 Unless otherwise specified, definitions are in accordance with Terminology F412 and abbreviations are in accordance with Terminology D1600.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *average outside diameter, n*—the average distance following all forming and machining operations when measured in accordance with 6.3.1.

3.2.2 *billet, n*—a mass formed from a single polyethylene compound in the approximate shape of a thick-walled cylindrical shell.

3.2.3 *mid-wall, n*—the location half-way between the outside diameter and the inside diameter following all forming and machining operations.

3.2.4 *minimum wall thickness, n*—the minimum distance following all forming and machining operations when measured in accordance with 6.3.2.

4. Materials

4.1 *Polyethylene Compound*—Polyethylene compounds used in the manufacture of billet under this specification shall have thermoplastic pipe materials designation code PE3608, PE4608 or PE4710; shall have a minimum Specification D3350 cell classification of 333344C and shall meet all other requirements of Specification D3350.

4.1.1 *General*—The PE compound used to make billet shall be virgin PE compound or reworked PE compound (see 4.3) and shall have a hydrostatic design basis listed in Plastics Pipe Institute (PPI) TR-4.

4.1.2 *Color and Ultraviolet (UV) Stabilization*—Polyethylene compounds shall meet Specification D3350 code C. In addition, Code C polyethylene compounds shall have 2.0 to 3.0 percent carbon black.

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[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 NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48105, http://www.nsf.org.
[4] Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, http://www.plasticpipe.org.

4.1.3 *Hydrostatic Design Basis (HDB) Substantiation*—The HDB for PE compound at 73 °F (23 °C) shall be substantiated to be linear to 50 years as described in Substantiation of the HDB for Polyethylene Materials in Test Method D2837.

NOTE 2—This is 5.7 in the 2011 publication of Test Method D2837.

4.1.4 *Melt Flow Requirement*—Polyethylene compounds shall be tested in conformance with Test Method D1238 either at condition 190/2.16 or 190/21.6. When tested at condition 190/2.16, the resulting value shall be ≤0.15 g/10 min. When tested at condition 190/21.6, the resulting value shall be ≤20 g/10 min.

4.2 *Potable Water Requirement*—When required by the purchaser, billets intended for fabrication into products intended for contact with potable water shall utilize PE compounds certified for conformance with NSF/ANSI Standard No. 61 or the health effects portion of NSF/ANSI Standard No. 14 by an acceptable certifying organization.

4.3 *Rework Material*—Clean polyethylene compound from the manufacturer's own production that meets 4.1 and 4.2 of this specification as new compound is suitable for reextrusion into billet, when blended with new compound of the same thermoplastic pipe material designation code. Billet containing rework material shall meet the requirements of this specification.

5. Requirements

5.1 *Workmanship*—The billet shall be uniform in appearance and consistent throughout. The walls shall be free of cracks, holes, blisters, voids, foreign inclusion, or other defects that are visible to the naked eye and that affect the wall integrity (see Annex A1). A single hole deliberately placed in the center of the billet is required.

NOTE 3—Manufacturers should use appropriate quality assurance procedures to ensure that billets are free from injurious defects including laminations.

5.2 *Dimensions and Tolerances:* Requirements for dimensions shall only apply to a billet that is transferred from a seller to a buyer prior to being fabricated into one or more pipe fittings. When a billet is produced and fabricated into pipe fittings by a single manufacturer, there are no dimensional requirements specified for the billet by this Standard. All dimensional requirements for pipe fittings are as given in the applicable product standard.

5.2.1 *Average Outside Diameter and Minimum Wall Thickness*— The average outside diameter and minimum wall thickness shall fall within the range of acceptable values established in either Table 1 or Table 2 depending on nominal mandrel dimensions for billets manufactured to meet a standard size. When measured in accordance with Test Method D2122 conditioning is required according to Practice D618, Procedure A to standard temperature without regard to relative humidity.

5.2.2 *Length*—Any length shall be allowable, provided it is agreeable to both buyer and seller. When specified, the minimum length shall be measured following conditioning according to Practice D618, Procedure A to standard temperature without regard to relative humidity.

5.2.3 *Special Sizes*—Where existing system conditions or special local requirements make other average outside diameters or minimum wall thicknesses necessary, other average outside diameters or minimum wall thicknesses, or both, shall be acceptable when mutually agreed upon by the customer and the manufacturer, provided the billet meets all other requirements of this specification. For average outside diameters not shown in Table 1 or Table 2, the tolerance shall be the same percentage as that used in Table 1 or Table 2 for the next smaller listed average outside diameter. Maximum and minimum wall thicknesses for mandrel sizes not shown in Table 1 or Table 2 shall be determined by subtracting the mandrel size from the maximum and minimum average outside diameter, respectively, then dividing by 2 and, finally, by rounding the third decimal place of the resulting value to give the maximum or minimum wall thickness respectively.

5.3 *Thermal Stability*—The PE material shall contain sufficient antioxidant so that the minimum induction temperature for mid-wall, outside diameter and inside diameter shall each be 428°F (220°C) when tested in accordance with both Specification D3350 and 6.4 Thermal Stability Testing. Failure to meet this requirement shall be cause to reject the billet as unsuitable for this standard without allowance for retesting.

TABLE 1 Dimensions of Standard Billet Sizes up to Nominal Mandrel Size of 21

Nominal	Outside Diameter Dimensions				Nominal Mandrel Sizes															
	Min. OD		Max OD		6.625				8.625				10.75				12.75			
					Min.Wall		Max.Wall		Min.Wall		Max.Wall		Min.Wall		Max.Wall		Min.Wall		Max.Wall	
O.D.	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
13	12.922	328.22	13.078	332.18	3.149	79.98	3.227	81.95	2.149	54.57	2.227	56.55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	14.910	378.71	15.090	383.29	4.143	105.23	4.233	107.51	3.143	79.82	3.233	82.11	2.080	52.83	2.170	55.12	N/A	N/A	N/A	N/A
16	15.904	403.96	16.096	408.84	4.640	117.86	4.736	120.28	3.640	92.44	3.736	94.88	2.577	65.46	2.673	67.89	1.577	40.06	1.673	42.49
18	17.892	454.46	18.108	459.94	5.634	143.10	5.742	145.83	4.634	117.69	4.742	120.43	3.571	90.70	3.679	93.45	2.571	65.30	2.679	68.05
20	19.880	504.95	20.120	511.05	6.628	168.35	6.748	171.39	5.628	142.94	5.748	145.99	4.565	115.95	4.685	119.00	3.565	90.55	3.685	93.60
21	20.874	530.20	21.126	536.60	7.125	180.98	7.251	184.16	6.125	155.56	6.251	158.76	5.062	128.57	5.188	131.78	4.062	103.17	4.188	106.38
22	21.868	555.45	22.132	562.15	7.622	193.60	7.754	196.94	6.622	168.19	6.754	171.54	5.559	141.20	5.691	144.55	4.559	115.80	4.691	119.15
25	24.850	631.19	25.150	638.81	9.113	231.47	9.263	235.27	8.113	206.06	8.263	209.87	7.050	179.07	7.200	182.88	6.050	153.67	6.200	157.48
26	25.844	656.44	26.156	664.36	9.610	244.09	9.766	248.04	8.610	218.68	8.766	222.64	7.547	191.69	7.703	195.66	6.547	166.29	6.703	170.26
27	26.838	681.69	27.162	689.91	10.107	256.72	10.269	260.82	9.107	231.31	9.269	235.42	8.044	204.32	8.206	208.43	7.044	178.92	7.206	183.03
28	27.832	706.93	28.168	715.47	10.604	269.34	10.772	273.60	9.604	243.93	9.772	248.20	8.541	216.94	8.709	221.21	7.541	191.54	7.709	195.81
29	28.826	732.18	29.174	741.02	11.101	281.97	11.275	286.37	10.101	256.55	10.275	260.97	9.038	229.57	9.212	233.98	8.038	204.17	8.212	208.58
30	29.820	757.43	30.180	766.57	11.598	294.59	11.778	299.15	10.598	269.18	10.778	273.75	9.535	242.19	9.715	246.76	8.535	216.79	8.715	221.36
31	30.814	782.68	31.186	792.12	12.095	307.21	12.281	311.92	11.095	281.80	11.281	286.52	10.032	254.81	10.218	259.54	9.032	229.41	9.218	234.14
33	32.802	833.17	33.198	843.23	13.089	332.46	13.287	337.48	12.089	307.05	12.287	312.08	11.026	280.06	11.224	285.09	10.026	254.66	10.224	259.69
34	33.796	858.42	34.204	868.78	13.586	345.08	13.790	350.25	12.586	319.67	12.790	324.85	11.523	292.68	11.727	297.87	10.523	267.28	10.727	272.47
35	34.790	883.67	35.210	894.33	14.083	357.71	14.293	363.03	13.083	332.30	13.293	337.63	12.020	305.31	12.230	310.64	11.020	279.91	11.230	285.24
37	36.778	934.16	37.222	945.44	N/A	N/A	N/A	N/A	14.077	357.54	14.299	363.18	13.014	330.56	13.236	336.19	12.014	305.16	12.236	310.79
39	38.766	984.66	39.234	996.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14.008	355.80	14.242	361.75	13.008	330.40	13.242	336.35
40	39.760	1009.90	40.240	1022.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13.505	343.03	13.745	349.12
41.25	41.003	1041.48	41.498	1054.05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14.127	358.81	14.374	365.10
42	41.748	1060.40	42.252	1073.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
43	42.742	1085.65	43.258	1098.75	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
44	43.736	1110.89	44.264	1124.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
48	47.712	1211.88	48.288	1226.52	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
49	48.706	1237.13	49.294	1252.07	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 1 Dimensions of Standard Billet Sizes up to Nominal Mandrel Size of 21 *(continued)*

Nominal	Nominal Mandrel Sizes															
	14				16				18				21			
	Min.Wall		Max.Wall		Min.Wall		Max.Wall		Min.Wall		Max.Wall		Min.Wall		Max.Wall	
O.D.	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	1.946	49.43	2.054	52.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	2.940	74.68	3.060	77.72	1.940	49.28	2.060	52.32	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	3.437	87.30	3.563	90.50	2.437	61.90	2.563	65.10	1.437	36.50	1.563	39.70	N/A	N/A	N/A	N/A
22	3.934	99.92	4.066	103.28	2.934	74.52	3.066	77.88	1.934	49.12	2.066	52.48	N/A	N/A	N/A	N/A
25	5.425	137.80	5.575	141.61	4.425	112.40	4.575	116.21	3.425	87.00	3.575	90.81	1.925	48.90	2.075	52.71
26	5.922	150.42	6.078	154.38	4.922	125.02	5.078	128.98	3.922	99.62	4.078	103.58	2.422	61.52	2.578	65.48
27	6.419	163.04	6.581	167.16	5.419	137.64	5.581	141.76	4.419	112.24	4.581	116.36	2.919	74.14	3.081	78.26
28	6.916	175.67	7.084	179.93	5.916	150.27	6.084	154.53	4.916	124.87	5.084	129.13	3.416	86.77	3.584	91.03
29	7.413	188.29	7.587	192.71	6.413	162.89	6.587	167.31	5.413	137.49	5.587	141.91	3.913	99.39	4.087	103.81
30	7.910	200.91	8.090	205.49	6.910	175.51	7.090	180.09	5.910	150.11	6.090	154.69	4.410	112.01	4.590	116.59
31	8.407	213.54	8.593	218.26	7.407	188.14	7.593	192.86	6.407	162.74	6.593	167.46	4.907	124.64	5.093	129.36
33	9.401	238.79	9.599	243.81	8.401	213.39	8.599	218.41	7.401	187.99	7.599	193.01	5.901	149.89	6.099	154.91
34	9.898	251.41	10.102	256.59	8.898	226.01	9.102	231.19	7.898	200.61	8.102	205.79	6.398	162.51	6.602	167.69
35	10.395	264.03	10.605	269.37	9.395	238.63	9.605	243.97	8.395	213.23	8.605	218.57	6.895	175.13	7.105	180.47
37	11.389	289.28	11.611	294.92	10.389	263.88	10.611	269.52	9.389	238.48	9.611	244.12	7.889	200.38	8.111	206.02
39	12.383	314.53	12.617	320.47	11.383	289.13	11.617	295.07	10.383	263.73	10.617	269.67	8.883	225.63	9.117	231.57
40	12.880	327.15	13.120	333.25	11.880	301.75	12.120	307.85	10.880	276.35	11.120	282.45	9.380	238.25	9.620	244.35
41.25	13.502	342.94	13.749	349.22	12.502	317.54	12.749	323.82	11.502	292.14	11.749	298.42	10.002	254.04	10.249	260.32
42	13.874	352.40	14.126	358.80	12.874	327.00	13.126	333.40	11.874	301.60	12.126	308.00	10.374	263.50	10.626	269.90
43	14.371	365.02	14.629	371.58	13.371	339.62	13.629	346.18	12.371	314.22	12.629	320.78	10.871	276.12	11.129	282.68
44	14.868	377.65	15.132	384.35	13.868	352.25	14.132	358.95	12.868	326.85	13.132	333.55	11.368	288.75	11.632	295.45
48	N/A	N/A	N/A	N/A	15.856	402.74	16.144	410.06	14.856	377.34	15.144	384.66	13.356	339.24	13.644	346.56
49	N/A	N/A	N/A	N/A	16.535	415.37	16.647	422.83	15.353	389.97	15.647	397.43	13.852	351.87	14.147	359.33

TABLE 2 Dimensions of Standard Billet Sizes for Nominal Mandrel Sizes of 24 or Larger

Nominal	Outside Diameter Dimensions				Nominal Mandrel Sizes															
	Min. OD		Max OD		24				27				30				36			
					Min.Wall		Max.Wall		Min.Wall		Max.Wall		Min.Wall		Max.Wall		Min.Wall		Max.Wall	
O.D.	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
28	27.832	706.93	28.168	715.47	1.916	48.67	2.084	52.93	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	28.826	732.18	29.174	741.02	2.413	61.29	2.587	65.71	0.913	23.19	1.087	27.61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	29.820	757.43	30.180	766.57	2.910	73.91	3.090	78.49	1.410	35.81	1.590	40.39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
31	30.814	782.68	31.186	792.12	3.407	86.54	3.593	91.26	1.907	48.44	2.093	53.16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
33	32.802	833.17	33.198	843.23	4.401	111.79	4.599	116.81	2.901	73.69	3.099	78.71	1.401	35.59	1.599	40.61	N/A	N/A	N/A	N/A
34	33.796	858.42	34.204	868.78	4.898	124.41	5.102	129.59	3.398	86.31	3.602	91.49	1.898	48.21	2.102	53.39	N/A	N/A	N/A	N/A
35	34.790	883.67	35.210	894.33	5.395	137.03	5.605	142.37	3.895	98.93	4.105	104.27	2.395	60.83	2.605	66.17	N/A	N/A	N/A	N/A
37	36.778	934.16	37.222	945.44	6.389	162.28	6.611	167.92	4.889	124.18	5.111	129.82	3.389	86.08	3.611	91.72	N/A	N/A	N/A	N/A
39	38.766	984.66	39.234	996.54	7.383	187.53	7.617	193.47	5.883	149.43	6.117	155.37	4.383	111.33	4.617	117.27	1.383	35.13	1.617	41.07
40	39.760	1009.90	40.240	1022.10	7.880	200.15	8.120	206.25	6.380	162.05	6.620	168.15	4.880	123.95	5.120	130.05	1.880	47.75	2.120	53.85
41.25	41.003	1041.48	41.498	1054.05	8.502	215.94	8.749	222.22	7.002	177.84	7.249	184.12	5.502	139.74	5.749	146.02	2.502	63.54	2.749	69.82
42	41.748	1060.40	42.252	1073.20	8.874	225.40	9.126	231.80	7.374	187.30	7.626	193.70	5.874	149.20	6.126	155.60	2.874	73.00	3.126	79.40
43	42.742	1085.65	43.258	1098.75	9.371	238.02	9.629	244.58	7.871	199.92	8.129	206.48	6.371	161.82	6.629	168.38	3.371	85.62	3.629	92.18
44	43.736	1110.89	44.264	1124.31	9.868	250.65	10.132	257.35	8.368	212.55	8.632	219.25	6.868	174.45	7.132	181.15	3.868	98.25	4.132	104.95
48	47.712	1211.88	48.288	1226.52	11.856	301.14	12.144	308.46	10.356	263.04	10.644	270.36	8.856	224.94	9.144	232.26	5.856	148.74	6.144	156.06
49	48.706	1237.13	49.294	1252.07	12.353	313.77	12.647	321.23	10.853	275.67	11.147	283.13	9.353	237.57	9.647	245.03	6.353	161.37	6.647	168.83
56	55.664	1413.87	56.336	1430.93	15.832	402.13	16.168	410.67	14.332	364.03	14.668	372.57	12.832	325.93	13.168	334.47	9.832	249.73	10.168	258.27
60.63	60.266	1530.76	60.994	1549.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15.133	384.38	15.497	393.62	12.133	308.18	12.497	317.42
65	64.610	1641.09	65.390	1660.91	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14.305	363.35	14.695	373.25
69	68.586	1742.08	69.414	1763.12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16.293	413.84	16.707	424.36
72	71.568	1817.83	72.432	1839.77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
77	76.538	1944.07	77.462	1967.53	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 2 Dimensions of Standard Billet Sizes for Nominal Mandrel Sizes of 24 or Larger *(continued)*

Nominal	Nominal Mandrel Sizes															
	42				48				54				60			
	Min.Wall		Max.Wall		Min.Wall		Max.Wall		Min.Wall		Max.Wall		Min.Wall		Max.Wall	
O.D.	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
34	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
37	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
40	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
41.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
42	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
44	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
48	2.856	72.54	3.144	79.86	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
49	3.353	85.17	3.647	92.63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
56	6.832	173.53	7.168	182.07	3.832	97.33	4.168	105.87	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
60.63	9.133	231.98	9.497	241.22	6.133	155.78	6.497	165.02	3.133	79.58	3.497	88.82	N/A	N/A	N/A	N/A
65	11.305	287.15	11.695	297.05	8.305	210.95	8.695	220.85	5.305	134.75	5.695	144.65	2.305	58.55	2.695	68.45
69	13.293	337.64	13.707	348.16	10.293	261.44	10.707	271.96	7.293	185.24	7.707	195.76	4.293	109.04	4.707	119.56
72	14.784	375.51	15.216	386.49	11.784	299.31	12.216	310.29	8.784	223.11	9.216	234.09	5.784	146.91	6.216	157.89
77	N/A	N/A	N/A	N/A	14.269	362.43	14.731	374.17	11.269	286.23	11.731	297.97	8.269	210.03	8.731	221.77