



Standard Specification for Dimensions and Tolerances for Plastic Bottles¹

This standard is issued under the fixed designation D2911/D2911M; 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 the thread configuration and dimensions for finishes for plastic bottles with screw-type closures, having a maximum capacity of 18.9 L (5 gal) and a maximum bottle dimension of 305 mm (12 in.). Included are tolerances for bottle capacity and body dimensions.

1.2 *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.

1.3 The following precautionary caveat pertains only to the test methods portion, Section 8 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.*

NOTE 1—There is no known ISO equivalent to this standard.

2. Referenced Documents

2.1 *ASTM Standards*:²

D618 Practice for Conditioning Plastics for Testing

D1898 Practice for Sampling of Plastics (Withdrawn 1998)³

3. Terminology

3.1 *Definitions*:

3.1.1 *bottle finish*—the configuration of the neck or opening of the bottle which serves to engage specific parts of the closure in order to securely attach it to the bottle.

¹ This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.19 on Film, Sheeting, and Molded Products.

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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 The last approved version of this historical standard is referenced on www.astm.org.

3.1.2 *bottle height*—the maximum dimension of a bottle in a plane perpendicular to the bottle base when the bottle is setting in its normal upright position.

3.1.3 *bottle thickness*—the smaller dimension in a plane parallel to the bottle base.

3.1.4 *bottle width*—the larger dimension in a plane parallel to the bottle base.

4. Dimensions and Recommended Variations

4.1 *Recommended Variations in Overflow Capacity*—In overflow capacity recommended variations of plastic bottles up to 18.9 L (5 gal) in size shall be in accordance with Table 1.

4.2 *Recommended Variations in Body Dimensions*—The recommended variations in the body dimensions of plastic bottles covered by this specification shall be in accordance with Table 2.

4.3 *Finish Dimensions and Design*—The bottle finish dimensions and design for the nine finishes covered by this specification shall be in accordance with Figs. 1-8 and Tables 3-10.

5. Sampling

5.1 A batch or lot shall be considered as a unit of manufacture.

5.2 Unless otherwise agreed upon between manufacturer and purchaser, the material shall be sampled in accordance with the procedure described in Section 9 of Practice D1898. Adequate statistical sampling prior to packaging shall be considered an acceptable alternative.

6. Conditioning

6.1 *Conditioning*—Condition the test specimens in accordance with Procedure A of Practice D618, unless otherwise specified by contract or the relevant ASTM material specification. Conditioning time is specified as a minimum. Temperature and humidity tolerances shall be in accordance with Section 7 of Practice D618, unless specified differently by contract or material specification.

6.2 *Test Conditions*—Conduct the tests at the same temperature and humidity used for conditioning with tolerances in

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

TABLE 1 Bottle Overflow Capacity Tolerances for Plastic Bottles

Fluid Ounces				Millilitres			
Bottle Overflow Capacity		Tolerance (\pm)		Bottle Overflow Capacity		Tolerance (\pm)	
0.75	less than	0.75	0.05	22	less than	22	1.5
1.2	and less than	1.2	0.07	35	and less than	35	2.0
1.6	and less than	1.6	0.08	47	and less than	47	2.5
2.1	and less than	2.1	0.10	62	and less than	62	3.0
2.8	and less than	2.8	0.12	83	and less than	83	3.5
3.9	and less than	3.9	0.14	115	and less than	115	4
5.4	and less than	5.4	0.17	159	and less than	159	5
7.4	and less than	7.4	0.20	218	and less than	218	6
9.8	and less than	9.8	0.24	289	and less than	289	7
13	and less than	13	0.30	384	and less than	384	9
18	and less than	18	0.37	531	and less than	531	11
26	and less than	26	0.44	767	and less than	767	13
37	and less than	37	0.51	1092	and less than	1092	15
51	and less than	51	0.68	1505	and less than	1505	20
72	and less than	72	0.81	2125	and less than	2125	24
98	and less than	98	1.01	2892	and less than	2892	30
119	and less than	119	1.30	3512	and less than	3512	38
139	and less than	139	1.50	4103	and less than	4103	44
160	and less than	160	1.80	4723	and less than	4723	53
180	and less than	180	2.00	5313	and less than	5313	59
210	and less than	210	2.20	6199	and less than	6199	65
	to 5 gallons		1 % of capacity		to 18.89 litres		1 % of capacity

TABLE 2 Body Dimensional Tolerance

Range of Specific Dimensions			Height Dimensions		Width and Depth Dimensions	
in.		mm	in.	mm	in.	mm
0 up to but not including	1	0 to 25.40	0.030	0.76	0.030	0.76
1 up to but not including	2	25.40 to 50.80	0.030	0.76	0.050	1.27
2 up to but not including	4	50.80 to 101.60	0.050	1.27	0.060	1.52
4 up to but not including	6	101.60 to 152.40	0.050	1.27	0.080	2.03
6 up to but not including	8	152.40 to 203.20	0.060	1.52	0.090	2.29
8 up to but not including	10	203.20 to 254.00	0.060	1.52	0.110	2.79
10 up to but not including	12	254.00 to 304.80	0.080	2.03	0.120	3.05
12 up to but not including	15	304.80 to 381.00	0.090	2.29	0.150	3.81
15 up to but not including	18	381.00 to 457.20	0.110	2.79	0.150	3.81

accordance with Section 7 of Practice **D618**, unless otherwise specified by contract or the relevant ASTM material specification.

7. Apparatus

7.1 For Determining Bottle Capacity:

7.1.1 *Balance*, having an accuracy of $\pm 0.1\%$ or better at rated capacity (full scale).

7.1.2 *Pipet, Graduated Cylinder, and Beaker*, as required.

7.1.3 Conditioned water at $23 \pm 2.0^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) containing a wetting agent sufficient to flatten the meniscus and eliminate air bubbles.

NOTE 2—It is acceptable to use any liquid detergent as the wetting agent.

7.1.4 *Stop Watch or Comparable Timing Device*.

7.2 For Determining Finish and Body Dimensions:

7.2.1 *Micrometers, Vernier Height Gages, Vernier Calipers, or Comparable Instruments* with an accuracy of $\pm 0.025\text{ mm}$ ($\pm 0.001\text{ in.}$).

7.2.2 *Internal Micrometers or Telescoping Gages* with an accuracy of $\pm 0.025\text{ mm}$ ($\pm 0.001\text{ in.}$).

7.2.3 *Commercial Scale*, calibrated in 1-mm or $\frac{1}{32}$ -in. increments.

8. Test Methods

8.1 Bottle Capacity:

8.1.1 Weigh the empty bottle and record the weight in grams.

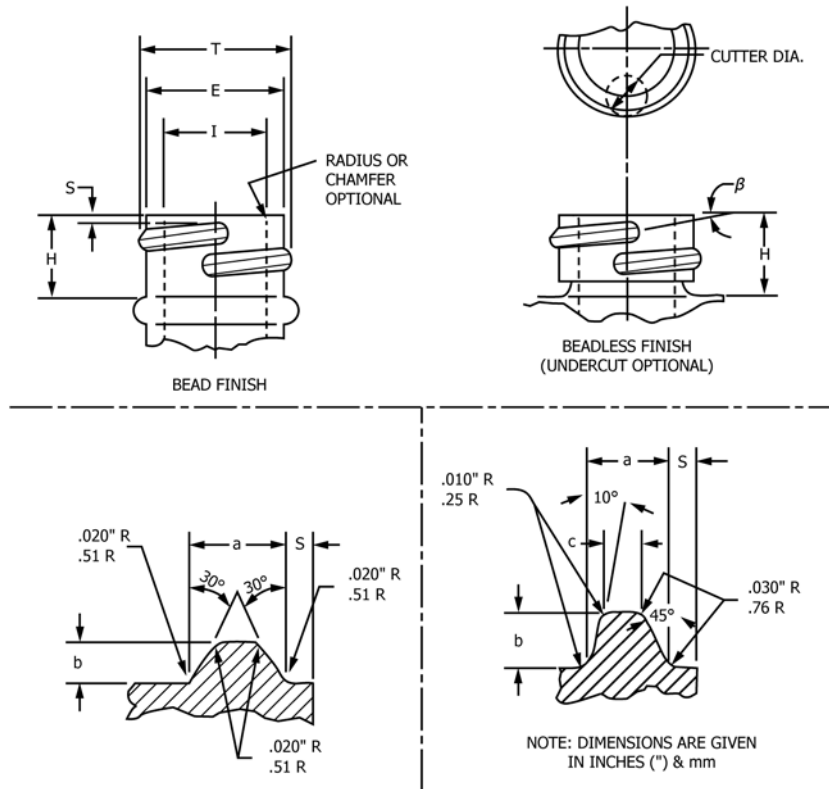
8.1.2 Fill the bottle to overflow capacity with conditioned water containing the wetting agent, adjusting the meniscus by use of a pipet, if necessary, until the meniscus is tangent to the top of the finish surface. No more than 2 min shall be allowed for filling the bottle and no additional water shall be added after the bottle is filled to overflow and free of air bubbles.

8.1.3 If the time exceeds 2 min, discard the sample and start over.

NOTE 3—The capacity of the container is somewhat time-dependent in that the force of the water in the container will cause the container sides to bulge with time and additional water will be needed to adjust to overflow capacity.

8.1.4 Weigh the filled bottle and record the weight in grams.

8.1.5 Calculate the bottle volume as follows:



"L" Style All-Purpose Thread (Plastic or Metal Closures)				"M" Style Modified Buttress Thread (Plastic Closures)					
Threads/in.		a	b	c	Threads/in.	a	b	c	
5	in.	0.120	0.060	0.051	5	in.	0.120	0.060	0.049
	mm	3.05	1.52	1.30		mm	3.05	1.52	1.24
6	in.	0.094	0.047	0.040	6	in.	0.094	0.047	0.039
	mm	2.39	1.19	1.02		mm	2.39	1.19	0.99
8	in.	0.084	0.042	0.036	8	in.	0.084	0.042	0.035
	mm	2.13	1.07	0.91		mm	2.13	1.07	0.89

Example Thread Nomenclature
 "L" Style: L28SP400
 "M" Style: M28SP400

NOTE 1—*T* and *E* dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.

NOTE 2—Dimension *H* is measured from the top of the finish to the point where diameter *T*, extended parallel to the centerline, intersects the bead or shoulder.

NOTE 3—Contour of bead, undercut or shoulder is optional.

NOTE 4—Unless otherwise specified, *I* min applies to the full length of the opening.

NOTE 5—Concentricity of *I* min with respect to diameters *T* and *E* is not included. *I* min is specified for filler tube only.

NOTE 6—A minimum of 1 full turn of thread shall be maintained.

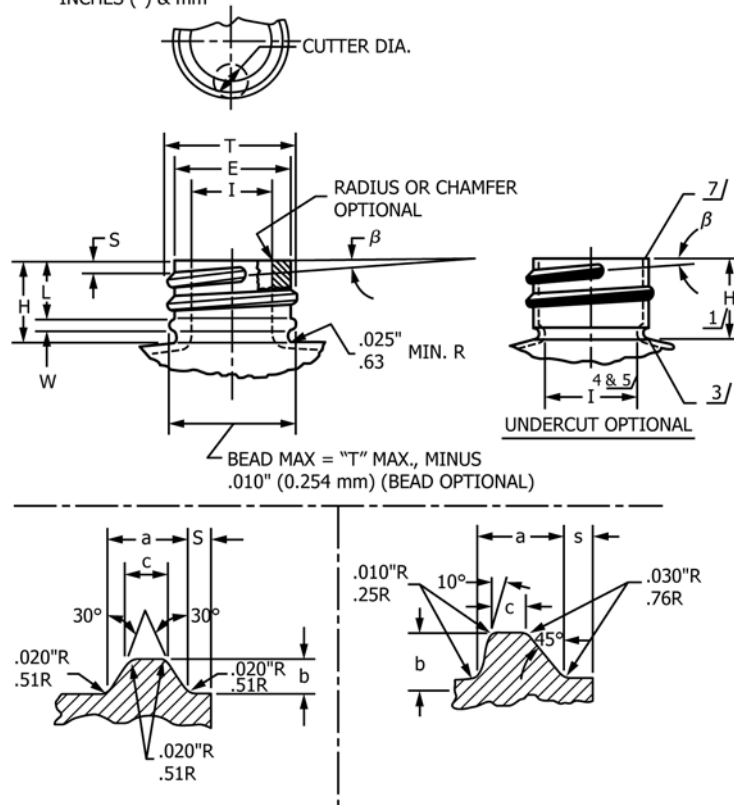
NOTE 7—Corresponding dimensions and finish details are shown in Table 3.

NOTE 8—Consideration must be given to the sealing surface width for the sealing system being used.

NOTE 9—Many child resistant closures, etc.

FIG. 1 SP 400 Finish Thread Cross Sections

NOTE: DIMENSIONS ARE GIVEN IN INCHES (") & mm



"L" Style All-Purpose Thread (Plastic or Metal Closures)				"M" Style Modified Buttress Thread (Plastic Closures)			
Threads/in.	a	b	c	Threads/in.	a	b	c
6	in. 0.094	0.047	0.040	6	in. 0.094	0.047	0.039
	mm 2.39	1.19	1.02		mm 2.39	1.19	0.99
8	in. 0.084	0.042	0.036	8	in. 0.084	0.042	0.035
	mm 2.13	1.07	0.91		mm 2.13	1.07	0.89

Example Thread Nomenclature:
 "L" Style: L22SP410
 "M" Style: M22SP410

- NOTE 1—Construction of neck from B to D must be held within the shaded area shown.
 NOTE 2—A minimum of 1½ turns of thread shall be maintained.
 NOTE 3—Unless otherwise specified, I min applies to the full length of the opening.
 NOTE 4—Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.
 NOTE 5—T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.
 NOTE 6—Consideration must be given to the sealing surface width for the sealing system being used.
 NOTE 7—When valve style closures are used with this finish, special consideration must be given to a specific controlled inside diameter. In addition, it is acceptable to vary the dimensions indicated with asterisk (*) to ensure adequate material for finishing the inside diameter.
 NOTE 8—Corresponding dimensions and details shown in Table 4.

FIG. 2 SP 410 Finish Thread Cross Sections

$$B_v \text{ (mL)} = (B_f - B_e)/0.997$$

where:

- B_v = volume of bottle, mL,
- B_f = weight of filled bottle, g,
- B_e = weight of empty bottle, g, and
- 0.997 = weight of water (g/mL) at $23 \pm 2.0^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$).

$$B_v \text{ (fluid oz)} = (B_f - B_e)/29.50$$

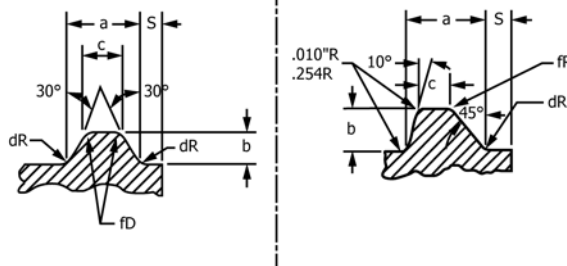
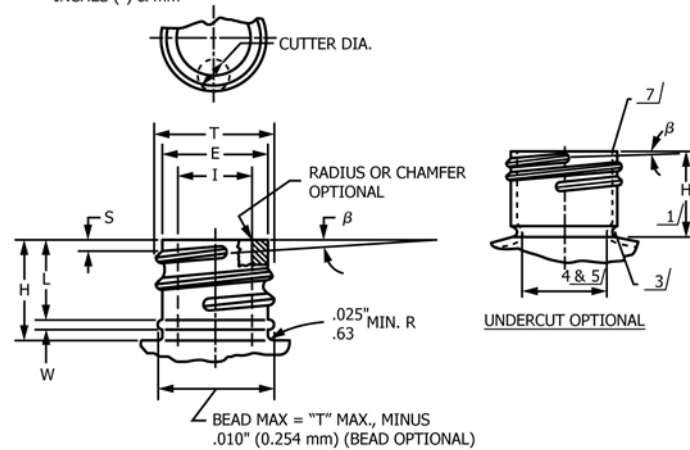
where: 29.50 = weight of water (g/fluid oz) at $23 \pm 2.0^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$).

8.1.6 Determine the volume in millilitres (fluid ounces) for each test specimen.

8.1.7 Report the arithmetic average volume of the specimens tested as the bottle capacity of the batch or lot from which the samples were chosen.

8.2 Body Dimensions:

NOTE: DIMENSIONS ARE GIVEN IN INCHES (") & mm



"L" Style All-Purpose Thread (Plastic or Metal Closures)						"M" Style Modified Buttress Thread (Plastic Closures)					
Threads/in.	a	b	c	d	f	Threads/in.	a	b	c	d	f
6	in. 0.094	0.047	0.040	0.020	0.020	6	in. 0.094	0.047	0.039	0.030	0.030
	mm 2.39	1.19	1.02	0.51	0.51		mm 2.39	1.19	0.99	0.76	0.76
8	in. 0.084	0.042	0.036	0.020	0.020	8	in. 0.084	0.042	0.035	0.030	0.030
	mm 2.13	1.07	0.91	0.51	0.51		mm 2.13	1.07	0.89	0.76	0.76
12	in. 0.045	0.030	0.011	0.015	0.005	12	in. 0.051	0.030	0.016	0.020	0.008
	mm 1.14	0.76	0.28	0.38	0.13		mm 1.29	0.76	0.41	0.51	0.22

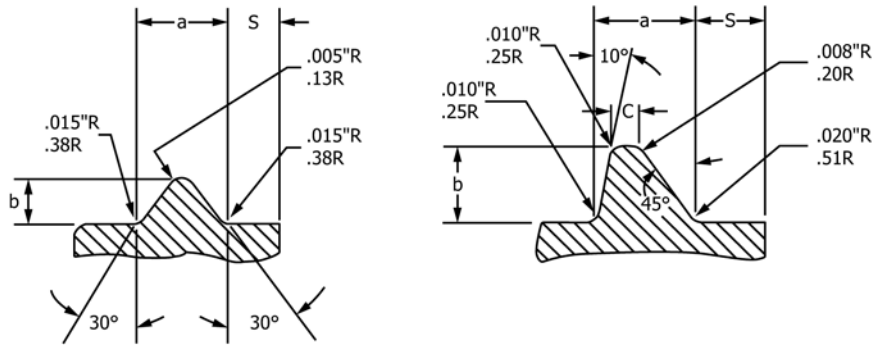
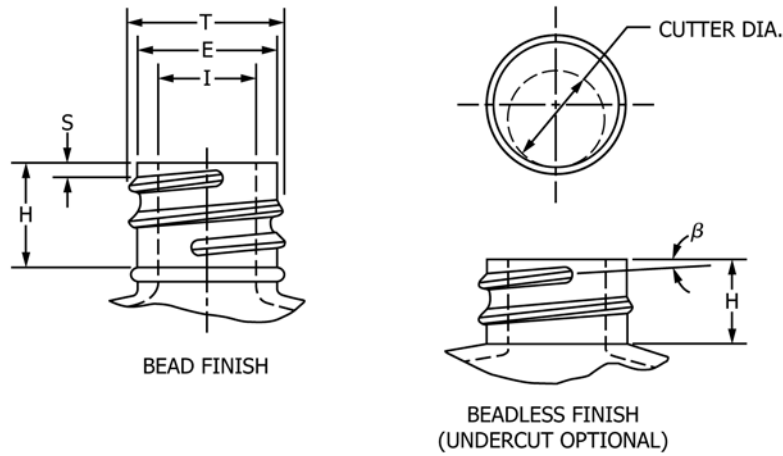
Example Thread Nomenclature:
 "L" Style: L22SP415
 "M" Style: M22SP415

- NOTE 1—Construction of neck from B to D must be held within the shaded area shown.
- NOTE 2—A minimum of 2 turns of thread shall be maintained.
- NOTE 3—Unless otherwise specified, I min applies to the full length of the opening.
- NOTE 4—Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.
- NOTE 5—T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.
- NOTE 6—Consideration must be given to the sealing surface width for the sealing system being used.
- NOTE 7—When valve style closures are used with this finish, special consideration must be given to a specific controlled inside diameter. In addition, it is acceptable to vary the dimensions indicated with asterisk (*) to ensure adequate material for finishing the inside diameter.
- NOTE 8—Corresponding dimensions and finish details are shown in Table 5.

FIG. 3 SP 415 Finish Thread Cross Sections

8.2.1 Using a suitable micrometer, a vernier height gauge, or a scale, measure the height of the bottle.
 8.2.1.1 If the top of the finish is parallel to the base of the container and the height must be measured from the top of the finish, and a commercial scale is used, one method is to place the bottle on a flat surface and a straightedge across the top of the bottle finish. Then measure the perpendicular distance

between the straightedge and the surface upon which the bottle is setting. Make four measurements, each 90° apart, and use the maximum as the bottle height.
 8.2.2 Using a suitable micrometer, vernier caliper, or comparable instrument measure the width and thickness of the bottle.



NOTE: DIMENSIONS ARE GIVEN IN INCHES (") & mm

NOTE 1—Contour of bead, undercut, or shoulder is optional.

"L" Style				"M" Style			
All-Purpose Thread (Plastic or Metal Closures)				Modified Buttress Thread (Plastic Closures)			
Threads/in.		a	b	Threads/in.	a	b	c
12	in.	0.045	0.030	12	in.	0.051	0.016
	mm	1.14	0.76		mm	1.29	0.41
12	in.	0.045	0.030	12	in.	0.051	0.016
	mm	1.14	0.76		mm	1.29	0.41

NOTE 2—Example Thread Nomenclature
 "L" Style: L15SP425 or "M" Style M15SP425

NOTE 3—Corresponding dimensions and finish details are shown in Table 6.

FIG. 4 SP 425 Finish Thread Cross Sections

8.2.2.1 In the case of a rectangular container, use the midpoints of the sides as the measuring points.

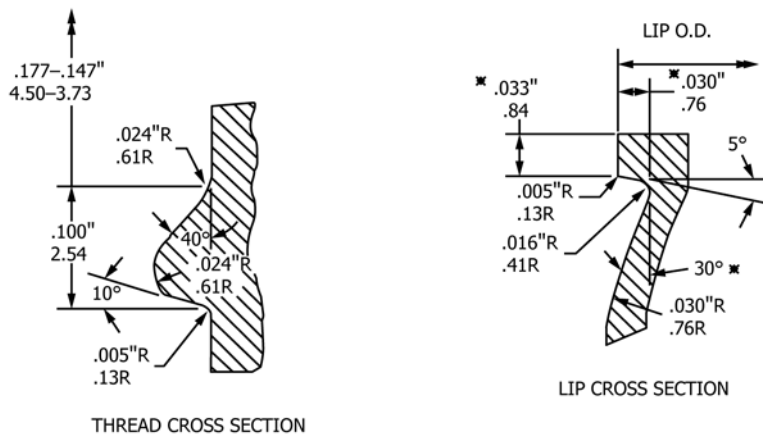
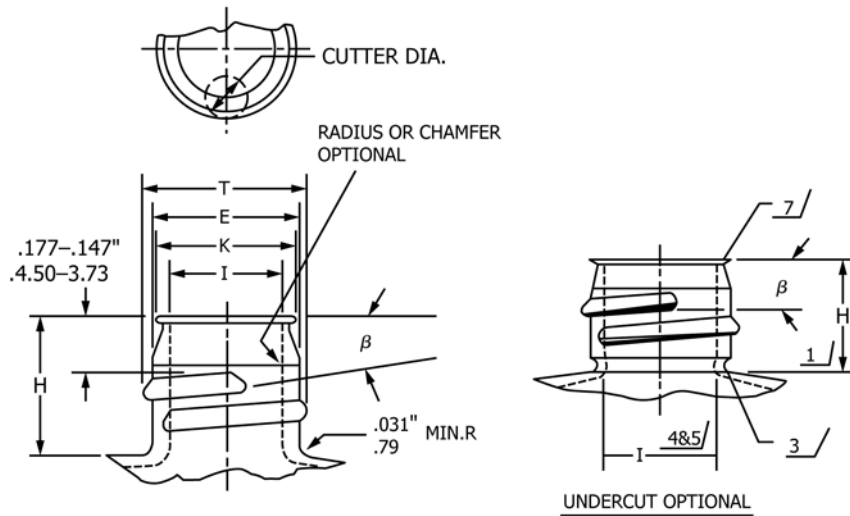
8.2.2.2 For a cylindrical container, make one measurement on the parting line and another measurement 90° from the parting line. Use the average of these two measurements as the container width.

(1) If, because of the shape of the container, there is some question about where the measurements are to be taken, agreement shall be reached between the purchaser and the seller.

8.3 Finish Dimensions—Using suitable micrometers, vernier calipers, or telescoping gages, measure the finish dimensions of the bottle.

9. Retest and Rejection

9.1 If the results of any test do not conform to the requirements of this specification, it is acceptable for retesting to determine conformity to be performed as agreed upon between the purchaser and the seller.

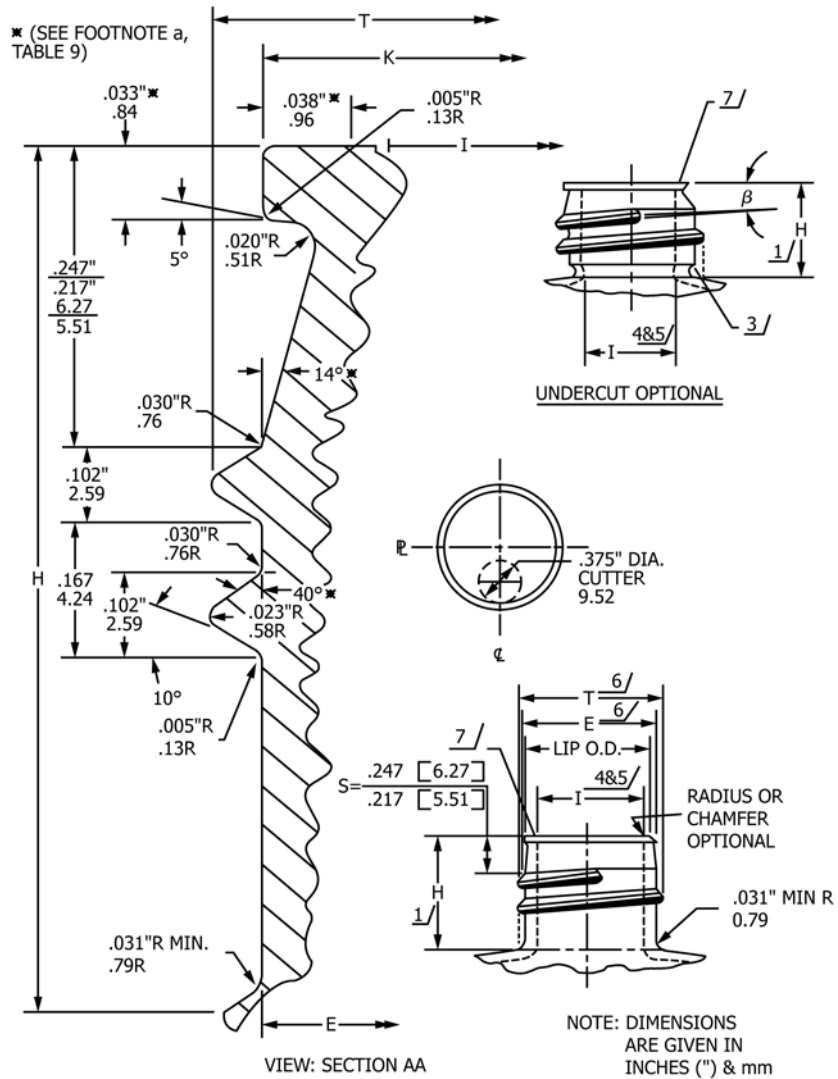


NOTE: DIMENSIONS ARE GIVEN IN INCHES (") & mm

*(See Footnote, e, Table 7 and Table 8)

- NOTE 1—Construction of neck from B to D must be held within the shaded area shown.
- NOTE 2—A minimum of 1½ turns of thread shall be maintained.
- NOTE 3—Unless otherwise specified, I min applies to the full length of the opening.
- NOTE 4—Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.
- NOTE 5—T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.
- NOTE 6—Consideration must be given to the sealing surface width for the scaling system being used.
- NOTE 7—When valve style closures are used with this finish, special consideration must be given to a specific controlled inside diameter. In addition, it is acceptable to vary the dimensions indicated with asterisk (*) to ensure adequate material for finishing the inside diameter.
- NOTE 8—Top dimension is shown in inches: bottom dimension in millimeters.
- NOTE 9—Corresponding dimensions and finish details are shown in Table 7 and Table 8.

FIG. 5 SP-103 Finish and SP-100 Finish, Thread and Lip Cross Section



View: Section AA

NOTE 1—Construction of neck from B to D must be held within the shaded area shown.

NOTE 2—A minimum of 1½ turns of thread shall be maintained.

NOTE 3—Unless otherwise specified, I min applies to the full length of the opening.

NOTE 4—Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.

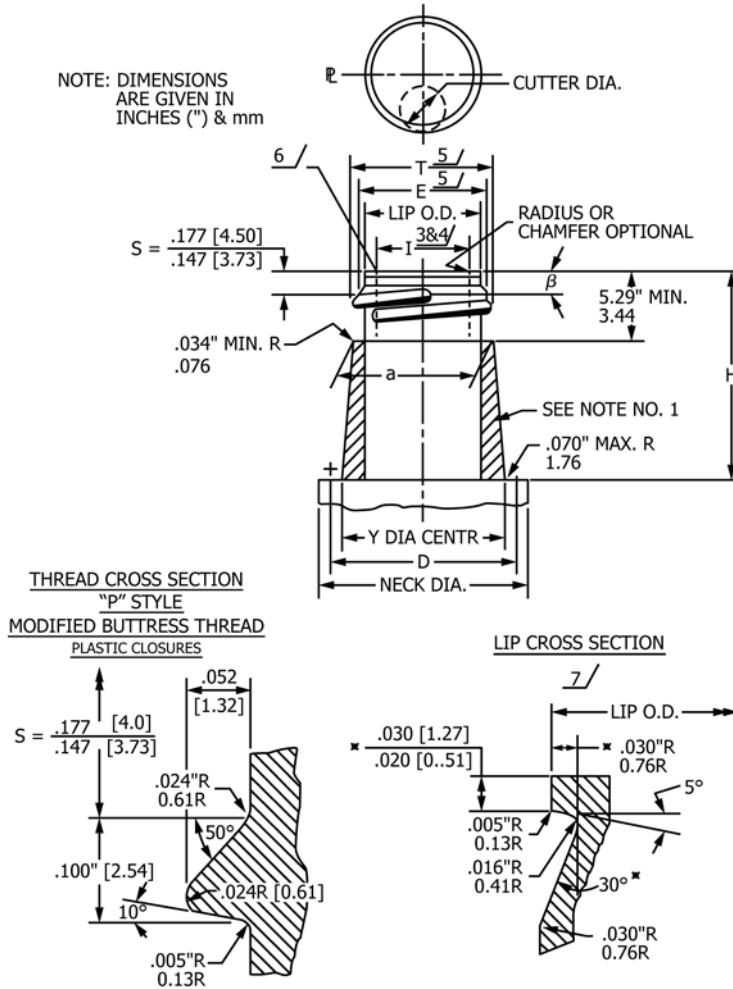
NOTE 5—T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.

NOTE 6—Consideration must be given to the sealing surface width for the sealing system being used.

NOTE 7—When valve style closures are used with this finish, special consideration must be given to a specific controlled inside diameter. In addition, it is acceptable to vary the dimensions indicated with asterisk (*) to ensure adequate material for finishing the inside diameter.

NOTE 8—Top dimension is shown in inches; bottom dimension in millimeters.

FIG. 6 SP-200 Finish, Thread and Lip Section



mm	T^A		E^A		LIP Outside Diameter		M		B	D	Y	$\beta^{B,C}$	Helix Angle	Cutter Diameter	Threads per Inch	Pitch
	max	min	max	min	max	min	max	min	max	max	construction	min				
28	1.088	1.068	0.984	0.964	0.974	0.954	1.700	1.670	1.062	1.320	1.188	0.735	2°13'	0.375	8	0.125
	27.63	27.13	24.99	24.49	24.74	24.23	43.10	42.42	26.97	33.53	30.17	18.67		9.52		3.18

^A T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.

^B Unless otherwise specified, I min applies to the full length of the opening.

^C Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.

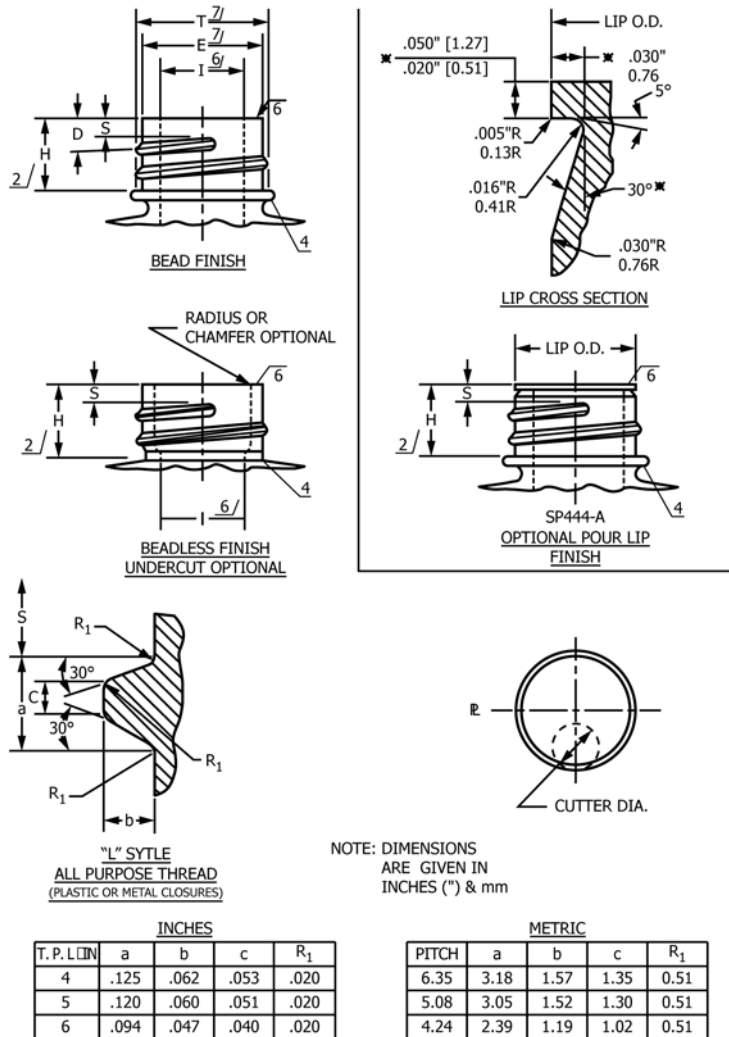
NOTE 1—Constriction of neck from B to D must be held within the shaded area shown.

NOTE 2—A minimum of $1\frac{1}{8}$ turns of thread shall be maintained.

NOTE 3—Consideration must be given to the sealing surface width for the sealing system being used.

NOTE 4—When valve style closures are used with this finish, special consideration must be given to a specific controlled inside diameter. In addition, it is acceptable to vary the dimensions indicated with asterisk (*) to ensure adequate material for finishing the inside diameter.

FIG. 7 SP-110 Finish



- NOTE 1—This finish drawing was established by PBI to provide plastic bottle finishes comparable to 445, 450, and 480 glass finishes.
- NOTE 2—Dimension *H* is measured from top of the finish to the point where diameter *T*, extended parallel to the centerline, intersects the shoulder or bead.
- NOTE 3—A minimum of 1½ turns of thread shall be maintained.
- NOTE 4—Contour of bead, undercut, or shoulder is optional.
- NOTE 5—Unless otherwise specified, *I* min applies to the full length of the opening.
- NOTE 6—Concentricity of *I* min with respect to diameters and *T* and *E* is not included. *I* min is specified for filler tube only.
- NOTE 7—*T* and *E* dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.
- NOTE 8—Consideration must be given to the sealing surface width for the sealing system being used.
- NOTE 9—When valve style closures are used with this finish, special consideration must be given to a specific controlled inside diameter. In addition, it is acceptable to vary the dimensions indicated with asterisk (*) to ensure adequate material for finishing the inside diameter.

FIG. 8 SP-444 Finish

TABLE 3 SP-400 Finish for Plastic Bottles

NOTE 1—Top dimension in each column shown in inches. Bottom dimension in each column shown in millimetres.

mm	T ^A		E ^{A, B}		H ^C		S		I ^{D,E}	Helix Angle, β	Cutter Diameter	Threads ^F per Inch
	max	min	max	min	max	min	max	min				
18	0.704	0.688	0.620	0.604	0.386	0.356	0.052	0.022	0.325	3°30'	0.375	8
	17.88	17.47	15.75	15.34	9.80	9.04	1.32	0.56	8.25		9.52	
20	0.783	0.767	0.699	0.683	0.386	0.356	0.052	0.022	0.404	3°7'	0.375	8
	19.89	19.48	17.75	17.35	9.80	9.04	1.32	0.56	10.26		9.52	
22	0.862	0.846	0.778	0.762	0.386	0.356	0.052	0.022	0.483	2°49'	0.375	8
	21.89	21.49	19.76	19.35	9.80	9.04	1.32	0.56	12.27		9.52	
24	0.940	0.924	0.856	0.840	0.415	0.385	0.061	0.031	0.516	2°34'	0.375	8
	23.88	23.47	21.74	21.34	10.54	9.78	1.55	0.79	13.11		12.70	
28	1.088	1.068	0.994	0.974	0.415	0.385	0.061	0.031	0.614	2°57'	0.500	6
	27.63	27.13	25.25	24.74	10.54	9.78	1.55	0.79	15.59		12.70	
30	1.127	1.107	1.033	1.013	0.418	0.388	0.061	0.031	0.653	2°51'	0.500	6
	28.62	28.12	26.24	25.73	10.62	9.85	1.55	0.79	16.59		12.70	
33	1.265	1.241	1.171	1.147	0.418	0.388	0.061	0.031	0.791	2°31'	0.500	6
	32.13	31.52	29.74	29.13	10.62	9.85	1.55	0.79	20.09		12.70	
35	1.364	1.340	1.270	1.246	0.418	0.388	0.061	0.031	0.875	2°21'	0.500	6
	34.64	34.04	32.26	31.65	10.62	9.85	1.55	0.79	22.22		12.70	
38	1.476	1.452	1.382	1.358	0.418	0.388	0.061	0.031	0.987	2°9'	0.500	6
	37.49	36.88	35.10	34.49	10.62	9.85	1.55	0.79	25.07		12.70	
40	1.580	1.550	1.486	1.456	0.418	0.388	0.061	0.031	1.091	2°0'	0.500	6
	40.13	39.37	37.74	36.98	10.62	9.85	1.55	0.79	27.71		12.70	
43	1.654	1.624	1.560	1.530	0.418	0.388	0.061	0.031	1.165	1°55'	0.500	6
	42.01	41.25	39.62	38.86	10.62	9.85	1.55	0.79	29.59		12.70	
45	1.740	1.710	1.646	1.616	0.418	0.388	0.061	0.031	1.251	1°49'	0.500	6
	44.20	43.43	41.81	41.05	10.62	9.85	1.55	0.79	31.77		12.70	
48	1.870	1.840	1.776	1.746	0.418	0.388	0.061	0.031	1.381	1°41'	0.500	6
	47.50	46.74	45.11	44.35	10.62	9.85	1.55	0.79	35.08		12.70	
51	1.968	1.933	1.874	1.839	0.423	0.393	0.061	0.031	1.479	1°36'	0.500	6
	49.99	49.10	47.60	46.71	10.74	9.98	1.55	0.79	37.57		12.70	
53	2.067	2.032	1.973	1.938	0.423	0.393	0.061	0.031	1.578	1°31'	0.500	6
	52.50	51.61	50.11	49.22	10.74	9.98	1.55	0.79	40.08		12.70	
58	2.224	2.189	2.130	2.095	0.423	0.393	0.061	0.031	1.735	1°25'	0.500	6
	56.49	55.60	54.10	53.21	10.74	9.98	1.55	0.79	44.07		12.70	
60	2.342	2.307	2.248	2.213	0.423	0.393	0.061	0.031	1.853	1°20'	0.500	6
	59.49	58.60	57.10	56.21	10.74	9.98	1.55	0.79	47.07		12.70	
63	2.461	2.426	2.367	2.332	0.423	0.393	0.061	0.031	1.972	1°16'	0.500	6
	62.51	61.62	60.12	59.23	10.74	9.98	1.55	0.79	50.09		12.70	
66	2.579	2.544	2.485	2.450	0.423	0.393	0.061	0.031	2.090	1°13'	0.500	6
	65.51	64.62	63.12	62.23	10.74	9.98	1.55	0.79	53.09		12.70	
70	2.736	2.701	2.642	2.607	0.423	0.393	0.061	0.031	2.247	1°8'	0.500	6
	69.49	68.60	67.11	66.22	10.74	9.98	1.55	0.79	57.07		12.70	
75	2.913	2.878	2.819	2.784	0.423	0.393	0.061	0.031	2.424	1°4'	0.500	6
	73.99	73.10	71.60	70.71	10.74	9.98	1.55	0.79	61.57		12.70	
77	3.035	3.000	2.941	2.906	0.502	0.472	0.075	0.045	2.546	1°1'	0.500	6
	77.09	76.20	74.70	73.81	12.75	11.99	1.90	1.14	64.67		12.70	
83	3.268	3.233	3.148	3.113	0.502	0.472	0.075	0.045	2.753	1°9'	0.500	5
	83.01	82.12	79.96	79.07	12.75	11.99	1.90	1.14	69.93		12.70	
89	3.511	3.476	3.391	3.356	0.550	0.520	0.075	0.045	2.918	1°4'	0.500	5
	89.18	88.29	86.13	85.24	13.79	13.21	1.90	1.14	74.12		12.70	
100	3.937	3.902	3.817	3.782	0.612	0.582	0.075	0.045	3.344	0°57'	0.500	5
	100.00	99.11	96.95	96.06	15.54	14.78	1.90	1.14	84.94		12.70	
110	4.331	4.296	4.211	4.176	0.612	0.582	0.075	0.045	3.737	0°51'	0.500	5
	110.01	109.12	106.96	106.07	15.54	14.78	1.90	1.14	94.92		12.70	
120	4.724	4.689	4.604	4.569	0.700	0.670	0.075	0.045	4.131	0°47'	0.500	5
	119.99	119.10	116.94	116.05	17.78	17.02	1.90	1.14	104.93		12.70	

^A T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and the container customer, as necessary.

^B Consideration must be given to the sealing surface width for the sealing system being used.

^C Dimension H is measured from the top of the finish to the point where diameter T, extended parallel to the centerline, intersects the bead or shoulder.

^D Unless otherwise specified, I minimum applies to the full length of the opening.

^E Concentricity of I minimum with respect to diameter T and E is not included. I minimum is specified for filler tube only.

^F A minimum of 1 full turn of thread shall be maintained.

TABLE 4 SP-410 Finish for Plastic Bottles

NOTE 1—Top dimension in each column shown in inches. Bottom dimension in each column shown in millimetres.

mm	T ^A		E ^{A, B}		H ^C		L ^D	S		I ^{E,F}	W	Helix Angle, β	Cutter Diameter	Threads ^G per Inch
	max	min	max	min	max	min	min	max	min	min	max			
18	0.704	0.688	0.620	0.604	0.538	0.508	0.361	0.052	0.022	0.325	0.084	3°30'	0.375	8
	17.88	17.47	15.75	15.34	13.66	12.90	9.17	1.32	0.56	8.25	2.13			
20	0.783	0.767	0.699	0.683	0.569	0.539	0.361	0.052	0.022	0.404	0.084	3°7'	0.375	8
	19.89	19.48	17.75	17.35	14.45	13.69	9.17	1.32	0.56	10.26	2.13			
22	0.862	0.846	0.778	0.762	0.600	0.570	0.376	0.052	0.022	0.483	0.084	2°49'	0.375	8
	21.89	21.49	19.76	19.35	15.24	14.48	9.55	1.32	0.56	12.27	2.13			
24	0.940	0.924	0.856	0.840	0.661	0.631	0.437	0.061	0.031	0.516	0.084	2°34'	0.375	8
	23.88	23.47	21.74	21.34	16.79	16.03	11.10	1.55	0.79	13.11	2.13			
28	1.088	1.068	0.994	0.974	0.723	0.693	0.463	0.061	0.031	0.614	0.094	2°57'	0.500	6
	27.63	27.13	25.25	24.74	18.36	17.60	11.76	1.55	0.79	15.59	2.39			

^A T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.

^B Consideration must be given to the sealing surface width for the sealing system being used.

^C Dimension H is measured from the top of the finish to the point where diameter T, extended parallel to the centerline, intersects the shoulder.

^D Contour of bead, undercut, or shoulder is optional. If bead is used, bead diameter and L min must be maintained.

^E Unless otherwise specified, I min applies to the full length of the opening.

^F Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.

^G A minimum of 1½ full turns of thread shall be maintained.

TABLE 5 SP-415 Finish for Plastic Bottles

NOTE 1—Top dimension in each column shown in inches. Bottom dimension in each column shown in millimetres.

mm	T ^A		E ^{A, B}		H ^C		L ^D	S		I ^{E,F}	W	Helix Angle, β	Cutter Diameter	Threads ^G per Inch
	max	min	max	min	max	min	min	max	min	min	max			
13	0.514	0.502	0.454	0.442	0.467	0.437	0.306	0.052	0.022	0.218	0.045	3°11'	0.375	12
	13.06	12.75	11.53	11.23	11.86	11.10	7.77	1.32	0.56	5.54	1.14			
15	0.581	0.569	0.521	0.509	0.572	0.542	0.348	0.052	0.022	0.258	0.045	2°48'	0.375	12
	14.76	14.45	13.23	12.93	14.53	13.77	8.84	1.32	0.56	6.55	1.14			
18	0.704	0.688	0.620	0.604	0.632	0.602	0.429	0.052	0.022	0.325	0.084	3°30'	0.375	8
	17.88	17.47	15.75	15.34	16.05	15.29	10.90	1.32	0.56	8.25	2.13			
20	0.783	0.767	0.699	0.683	0.757	0.727	0.456	0.052	0.022	0.404	0.084	3°7'	0.375	8
	19.89	19.48	17.75	17.35	19.23	18.47	11.58	1.32	0.56	10.26	2.13			
22	0.862	0.846	0.778	0.762	0.852	0.822	0.546	0.052	0.022	0.483	0.084	2°49'	0.375	8
	21.89	21.49	19.76	19.35	21.64	20.88	13.87	1.32	0.56	12.27	2.13			
24	0.940	0.924	0.856	0.840	0.972	0.942	0.561	0.061	0.031	0.516	0.084	2°34'	0.375	8
	23.88	23.47	21.74	21.34	24.69	23.93	14.25	1.55	0.79	13.11	2.13			
28	1.088	1.068	0.994	0.974	1.097	1.067	0.655	0.061	0.031	0.614	0.094	2°57'	0.500	6
	27.63	27.13	25.25	24.74	27.86	27.10	16.64	1.55	0.79	15.59	2.39			
33	1.265	1.241	1.171	1.147	1.289	1.259	0.772	0.061	0.031	0.791	0.094	2°31'	0.500	6
	32.13	31.52	29.74	29.13	32.74	31.98	19.61	1.55	0.79	20.09	2.39			

^A T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.

^B Consideration must be given to the sealing surface width for the sealing system being used.

^C Dimension H is measured from the top of the finish to the point where diameter T, extended parallel to the centerline, intersects the shoulder.

^D Contour of bead, undercut, or shoulder is optional. If bead is used, bead diameter and L min must be maintained.

^E Unless otherwise specified, I min applies to the full length of the opening.

^F Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.

^G A minimum of 2 full turns of thread shall be maintained.

TABLE 6 SP-425 Finish for Plastic Bottles

NOTE 1—Top dimension in each column shown in inches. Bottom dimension in each column shown in millimetres.

mm	T^A		$E^{A, B}$		H^C		S^D		$I^{E, F}$	Helix Angle β	Cutter Diameter	Threads ^G per Inch
	max	min	max	min	max	min	max	min	min			
13	0.514	0.502	0.454	0.442	0.325	0.295	0.052	0.022	0.218	3°11'	0.375	12
	13.06	12.75	11.53	11.23	8.25	7.49	1.32	0.56	5.54			
15	0.581	0.569	0.521	0.509	0.325	0.295	0.052	0.022	0.258	2°48'	0.375	12
	14.76	14.25	13.23	12.93	8.25	7.49	1.32	0.56	6.55			

^A T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.

^B Consideration must be given to the sealing surface width for the sealing system being used.

^C Dimension H is measured from the top of the finish to the point where diameter T , extended parallel to the centerline, intersects the shoulder.

^D Contour of bead, undercut, or shoulder is optional.

^E Unless otherwise specified, I min applies to the full length of the opening.

^F Concentricity of I min with respect to diameters T and E is not included in this standard. I min is specified for filler tube only.

^G A minimum of 2 full turns of thread shall be maintained on the bead finish. A minimum of 1½ full turns of thread shall be maintained on the beadless finish.

TABLE 7 SP-100 Finish for Plastic Bottles

NOTE 1—Top dimension in each column shown in inches. Bottom dimension in each column shown in millimetres.

mm	T^A		$E^{A, B}$		H^C		LIP Outside Diameter ^D		$I^{E, F, G}$	Helix Angle β	Cutter Diameter	Threads ^H per Inch
	max	min	max	min	max	min	max	min	min			
22	0.862	0.846	0.758	0.742	0.559	0.529	0.748	0.732	05.12	2°49'	0.375	8
	21.89	21.49	19.25	18.85	14.20	13.44	19.00	18.59	13.00			
24	0.940	0.924	0.836	0.820	0.559	0.529	0.826	0.810	0.590	2°34'	0.375	8
	23.88	23.47	21.23	20.83	14.20	13.44	20.98	20.57	14.99			
26	1.009	0.989	0.905	0.885	0.559	0.529	0.895	0.875	0.655	2°24'	0.375	8
	25.63	25.12	22.99	22.48	14.20	13.44	22.73	22.22	16.64			
28	1.088	1.068	0.984	0.964	0.559	0.529	0.974	0.954	0.735	2°13'	0.375	8
	27.63	27.13	24.99	24.49	14.20	13.44	24.74	24.23	18.67			
38	1.476	1.452	1.372	1.348	0.604	0.574	1.362	1.338	1.098	1°37'	0.375	8
	37.49	36.88	34.85	34.24	15.34	14.58	34.59	33.98	20.89			

^A T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer as necessary.

^B Consideration must be given to the sealing surface width for the sealing system being used.

^C Dimension H is measured from the top of the finish to the point where diameter T , extended parallel to the centerline, intersects the shoulder.

^D Contour of undercut or shoulder is optional.

^E Unless otherwise specified, I min applies to the full length of the opening.

^F Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.

^G When valve style closures are used with this finish, special consideration must be given to a specific controlled inside diameter. In addition, it is acceptable to vary the dimensions indicated with an asterisk (*) on Fig. 5 to ensure adequate material for finishing the inside diameter.

^H A minimum of 1½ turns of thread shall be maintained.

TABLE 8 SP-103 Finish for Plastic Bottles

NOTE 1—Top dimension in each column shown in inches. Bottom dimension in each column shown in millimetres.

mm	T^A		$E^{A, B}$		H^C		LIP Outside Diameter ^D		$I^{E, F, G}$	Helix Angle β	Cutter Diameter	Threads ^H per Inch
	max	min	max	min	max	min	max	min	min			
26	1.009	0.989	0.905	0.885	0.638	0.608	0.895	0.875	0.670	2°24'	0.375	8
	25.63	25.12	22.99	22.48	16.20	15.44	22.73	22.22	17.62			

^A T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer as necessary.

^B Consideration must be given to the sealing surface width for the sealing system being used.

^C Dimension H is measured from the top of the finish to the point where diameter T , extended parallel to the centerline, intersects the shoulder.

^D Contour of undercut or shoulder is optional.

^E Unless otherwise specified, I min applies to the full length of the opening.

^F Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.

^G When valve style closures are used with this finish, special consideration must be given to a specific controlled inside diameter. In addition, it is acceptable to vary the dimensions indicated with an asterisk (*) on Fig. 5 to ensure adequate material for finishing the inside diameter.

^H A minimum of 1½ turns of thread shall be maintained.

TABLE 9 SP-200 Finish for Plastic Bottles

NOTE 1—Top dimension in each column shown in inches. Bottom dimension in each column shown in millimetres.

mm	T^A		$E^{A, B}$		H^C		LIP Outside Diameter ^D		$I^{E, F, G}$	Helix Angle β	Cutter Diameter	Threads ^H per Inch
	max	min	max	min	max	min	max	min	min			
24	0.940	0.924	0.832	0.816	0.809	0.779	0.822	0.806	0.540	3°27'	0.375	6
28	23.88	23.47	21.13	20.73	20.55	19.79	20.88	20.47	13.72	2°53'	9.52	6
	1.118	1.098	1.010	0.990	0.809	0.779	1.000	0.980	0.710		0.375	
	28.40	27.89	25.65	25.15	20.55	19.79	25.40	24.89	18.03		9.52	

^A Alternate H dimensions are recognized and will be designated as SP200A:

Alt. H 24 mm, 0.789/0.759 20.04/19.28

Alt. H 28 mm, 0.823/0.793 20.90/20.14

T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.

^B Consideration must be given to the sealing surface width for the sealing system being used.

^C Dimension H is measured from the top of the finish to the point where diameter T , extended parallel to the centerline, intersects the shoulder.

^D Contour of undercut or shoulder is optional.

^E Unless otherwise specified, I min applies to the full length of the opening.

^F Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.

^G When valve style closures are used with this finish, special consideration must be given to a specific controlled inside diameter. In addition, it is acceptable to vary the dimensions indicated with asterisk (*) on Fig. 6 to ensure adequate material for finishing the inside diameter.

^H A minimum of 1½ turns of thread shall be maintained.



TABLE 10 SP-444 Finish for Plastic Bottles

Finish Identity	T ^A		E ^A		H ^B		S		I ^{C, D}		Helix Angle β	Cutter Diameter		Threads per Inch	Pitch		LIP Outside Diameter											
	max in.	min mm	max mm	min in.	max in.	min in.	max mm	min mm	max mm	min mm		min in.	in.		mm	max in.	min in.	max mm	min mm									
24	0.940	0.924	23.88	23.47	0.846	0.830	21.49	21.08	0.587	0.557	14.91	14.15	0.190	0.160	4.83	4.06	0.516	13.11	3°25'	0.375	9.52	6	0.167	4.24	0.836	0.820	21.23	20.83
28	1.088	1.068	27.63	27.13	0.994	0.974	25.25	24.74	0.802	0.572	15.29	14.53	0.190	0.160	4.83	4.06	0.614	15.59	2°57'	0.500	12.70	6	0.167	4.24	0.984	0.964	24.99	24.48
33	1.265	1.241	32.13	31.52	1.171	1.147	29.74	29.13	0.620	0.590	15.75	14.99	0.190	0.160	4.83	4.06	0.791	20.09	2°31'	0.500	12.70	6	0.167	4.24	1.161	1.137	29.49	28.88
38	1.476	1.452	37.49	36.88	1.382	1.358	35.10	34.49	0.671	0.641	17.04	16.28	0.190	0.160	4.83	4.06	0.987	25.07	2°9'	0.500	12.70	6	0.167	4.24	1.372	1.348	34.85	34.24
43	1.654	1.624	42.01	41.25	1.560	1.530	39.62	38.86	0.678	0.648	17.22	16.46	0.190	0.160	4.83	4.06	1.165	29.59	1°55'	0.500	12.70	6	0.167	4.24	1.550	1.520	39.37	38.61
45	1.740	1.710	44.20	43.43	1.646	1.616	41.81	41.05	0.678	0.648	17.22	16.46	0.190	0.160	4.83	4.06	1.251	31.77	1°49'	0.500	12.70	6	0.167	4.24	1.636	1.606	41.55	40.79
48	1.870	1.840	47.50	46.74	1.776	1.746	45.11	44.35	0.678	0.648	17.22	16.46	0.190	0.160	4.83	4.06	1.381	35.08	1°41'	0.500	12.70	6	0.167	4.24	1.766	1.736	44.86	44.09
53	2.067	2.032	52.50	51.61	1.973	1.938	50.11	49.22	0.678	0.648	17.22	16.46	0.190	0.160	4.83	4.06	1.578	40.08	1°31'	0.500	12.70	6	0.167	4.24	1.963	1.928	49.86	48.97
56	2.145	2.110	54.48	53.59	2.051	2.016	52.10	51.21	0.678	0.648	17.22	16.46	0.190	0.160	4.83	4.06	1.656	42.06	1°28'	0.500	12.70	6	0.167	4.24	2.041	2.006	51.84	50.95
58	2.224	2.189	56.49	55.60	2.130	2.095	54.10	53.21	0.678	0.648	17.22	16.46	0.190	0.160	4.83	4.06	1.735	44.07	1°25'	0.500	12.70	6	0.167	4.24	2.120	2.085	53.85	52.96
63	2.461	2.426	62.51	61.62	2.367	2.332	60.12	59.23	0.678	0.648	17.22	16.46	0.190	0.160	4.83	4.06	1.972	50.09	1°16'	0.500	12.70	6	0.167	4.24	2.357	2.322	59.87	58.98
70	2.770	2.735	70.36	69.47	2.645	2.610	67.18	66.29	0.678	0.648	17.22	16.46	0.109	0.079	2.77	2.01	2.247	57.07	1°42'	0.500	12.70	4	0.250	6.35	2.635	2.600	66.93	66.04
73	2.864	2.829	72.75	71.86	2.770	2.735	70.36	69.47	0.678	0.648	17.22	16.46	0.190	0.160	4.83	4.06	2.375	60.32	1°5'	0.500	12.70	6	0.167	4.24	2.760	2.725	70.10	69.21
75	2.913	2.878	73.99	73.10	2.819	2.784	71.60	70.71	0.678	0.648	17.22	16.46	0.190	0.160	4.83	4.06	2.424	61.57	1°4'	0.500	12.70	6	0.167	4.24	2.809	2.774	71.35	70.46
83	3.268	3.233	83.01	82.12	3.148	3.113	79.96	79.07	0.678	0.648	17.22	16.46	0.155	0.125	3.94	3.18	2.753	69.93	1°9'	0.500	12.70	5	0.200	5.08	3.138	3.103	79.70	78.82

^A T and E dimensions are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer, as necessary.

^B Dimension H is measured from top of the finish to the point where diameter, I, extended parallel to the centerline, intersects the shoulder or bead.

^C Unless otherwise specified, I min applies to the full length of the opening.

^D Concentricity of I min with respect to diameters T and E is not included. I min is specified for filler tube only.

APPENDIXES

(Nonmandatory Information)

X1. ESTABLISHING PLASTIC BOTTLE FINISHES

X1.1 Objective

X1.1.1 The following procedures are recommended as a guide for establishing plastic bottle finishes. The objective is to provide a basis of common understanding for all container suppliers that may be helpful to them in developing finish dimensions that fall outside the present range of finish dimensions developed and when converting glass finishes to plastic.

X1.2 Determination of Finish Dimensions

X1.2.1 *H Dimensions*—To determine *H*, use maximum *H* of closure minus compressed liner and add an amount for desirable clearance (preferably 0.015 in. or 0.38 mm). This will be minimum *H*. For maximum *H* dimensions, add 0.030 in. or 0.76 mm to minimum *H*. *H* dimension is measured from the top of the finish to the point where diameter *T* extended parallel to centerline intersects the bead or shoulder.

X1.2.2 *T and E Dimensions*—To determine *T* and *E* dimensions, maintain maximum SP finish dimensions as shown in **Tables 1-10**, using the SP finish tolerances with corresponding neck size (millimetres).

X1.2.3 *T and E Dimensions* are the average of two measurements across the major and minor axis. The limits of ovality will be determined by the container supplier and container customer.

X1.2.4 *I Minimum*—Minimum dimension must be specified. It should be recognized that this is for filler tube clearance only.

X1.2.5 *S Dimension*—All conventional continuous thread finishes use the SP-400 *S* Dimension. When a pour-out finish is involved, the SP-100 finish should be used as a guide.

X1.2.6 *L Dimension*—Refer to SP-410 and SP-415 finishes where a bead is used within an *H* dimension.

X1.2.7 *Use of Internal Fitments*—Special consideration should be given whenever controlled internal diameters are required because of use with internal fitments. The controlled internal diameter must provide the required interference to satisfy the functional need. Specified *T* and *E* dimensions should be maintained after insertion of the fitment. It should be noted that the fitment is not a part of container *S* or *H* dimension.

X1.2.8 *Thread Profile*—The SP-400 *L* style or *M* style profile should be utilized when continuous threads are required.

X1.2.9 A minimum of 1 full turn of thread should be maintained.

X2. DETERMINING INCREMENTAL LIQUID FILL LEVELS

X2.1 Objective

X2.1.1 Dry components are often packaged in plastic bottles and are subsequently diluted in the bottle prior to use. Fill levels for correct dilution levels are often molded into the bottle. The following procedure is recommended as a guide for determining the fill level as determined by the molded indicators on the bottle.

X2.1.2 Due to the wide range of applications, level tolerances are to be defined by the specific application.

X2.2 Determination of Liquid Fill Level

X2.2.1 *Bottle Capacity*:

X2.2.2 Weigh the empty bottle and record the weight in grams.

X2.2.3 Fill the bottle to the indicated fill level with conditioned water containing the wetting agent, adjusting the meniscus by use of a pipet, if necessary, until the meniscus is

tangent to the top of the fill level indicator. No more than 2 min shall be allowed for filling to this level and no additional water shall be added after the fill level has been reached and is free of air bubbles.

X2.2.4 If the time exceeds 2 min, discard the sample and start over.

X2.2.5 Weigh the bottle and record the weight in grams.

X2.2.6 Calculate the fill volume as follows:

$$B_v(\text{mL}) = (B_f - B_e)0.997 \quad (\text{X2.1})$$

where:

B_v = volume of the bottle at the fill level indicator, mL,
 B_f = weight of the bottle filled to the fill level indicator, g,
 B_e = weight of empty bottle, g, and
 0.997 = weight of water (g/mL) at $23 \pm 2.0^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$].

$$B_v(\text{fluid oz}) = (B_f - B_e)/29.50 \quad (\text{X2.2})$$

X2.2.8 Report the arithmetic average volume of the specimens tested as the fill level capacity of the batch or lot from which the samples were chosen.

where:

29.50 = weight of water (g/fluid oz) at $23 \pm 2.0^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$].

X2.2.7 Determine the volume in millilitres (fluid ounces) for each test specimen.

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D2911 - 10) that may impact the use of this standard. (April 1, 2016)

- (1) Revised **1.2**, Section **6**, **7.1.4**, **7.2.1**, **7.2.3**, and **8.2.2**. (2) Added **Appendix X2**.

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