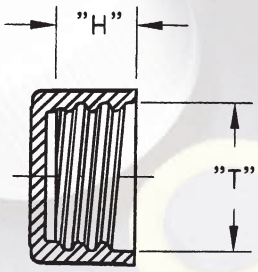
Determining a Cap's Thread Finish



The closure industry has not standardized on dimensions to the extent that the container industry has, and it is usually advantageous to buy both container and closure from the same supplier when possible. Similar to the container industry, when a closure finish is designated as 33-400, it means that the nominal diameter measured across the inside of the cap at the opening is approximately 33 mm. (See "T" dimension on illustration.) The 400 designates a specific style of thread. The thread finish of the cap and container must be the same. A container with a 33-400 thread finish should be used with a cap that has a 33-400 thread finish.

To determine the cap size, measure the cap opening from one side of the inner wall to the opposite side of the inner wall. Compare this number to the numbers found in the "T" dimension columns in Table 2a or 2b. Once this number is found in the table, follow the row to the far left to find the "Nominal Diameter" of the cap (33 in the above example).

To determine the specific style of thread, measure the depth of the cap from the liner surface to the outside edge of the cap. Compare this number to the numbers found in the "H" dimension columns in Table 2a or 2b that appear in the same row as the Nominal Diameter of the cap. Once this number is found in the table, follow the column to the top to find the specific style number (400 in the above example). The dimensions in the tables are approximate and will probably be slightly different from what is measured (especially the "H" dimension due to variations in liner thickness), but should be close enough to allow for the proper determination of the cap size.

Suggested Torque for Screw Caps

The integrity of the cap-to-container seal is dependent upon a number of variables, such as the materials of the cap, liner, and container, the sealing surface of the container, and the application torque applied to the closure. The most important of these is the application torque. If the cap is applied too loosely, the contents could leak (especially during shipping). If the cap is applied too tightly, it may be too difficult to remove the cap, or the container could break during application.

Table 1 offers some suggested torques that should provide an adequate seal for most applications. It is recommended that proper tests be performed to determine the optimum torque for the application. The most practical way to check the tightness is to measure the removal torque after the cap has been on the container for about 5 minutes. The removal torque should closely approximate the application torque. The minimum removal torque noted in the table should be maintained after a 24 hour period.

Table 1. Suggested Torques for Closures (in-lb)

	Phenolic/Urea Cap on Glass Container		Phenolic/Urea Cap on Plastic Container		PP/PE Cap on Glass Container		PP/PE Cap on Plastic Container	
Cap mm	Application Torque	Min Removal Torque	Application Torque	Min Removal Torque	Application Torque	Min Removal Torque	Application Torque	Min Removal Torque
15	8	4	6	3	12	7	8	4
18	9	5	7	4	13	8	9	5
20	10	5	8	4	15	9	10	5
22	11	6	9	5	17	10	11	5
24	12	6	10	5	18	11	12	6
28	14	7	12	6	21	12	14	7
33	18	9	15	7	24	14	17	8
38	20	10	17	7	29	17	19	9
43	22	11	18	9	33	20	22	11
48	24	12	20	10	36	22	24	12
58	28	14	24	12	44	26	29	14
70	35	18	28	14	52	32	35	17
89	45	22	36	18	65	40	45	22
100	50	25	40	20	75	38	50	25

Although the information in this chart was acquired from reputable sources, it should only be used as a guide in determining the proper application torque. Wheaton accepts no responsibility for the accuracy of this data or for any consequences resulting from its use.

For a complete selection of **Wheaton closures** see the Cap & Closure Section on pages 31-42.
If you need additional assistance on closures contact our Technical Service Department.

Table 2a. Cap Thread Finish Dimensions (Dimensions are in inches)

Nominal Dia (mm)	400		410		415		425		430	
	"T"	"H"	"T"	"H"	"T"	"H"	"T"	"H"	"T"	"H"
8	—	—	—	—	—	—	0.360	0.245	—	—
10	—	—	—	—	—	—	0.415	0.255	—	—
13	—	—	—	—	0.520	0.430	0.520	0.280	—	—
15	—	—	—	—	0.585	0.535	0.585	0.280	—	—
18	0.790	0.360	0.710	0.500	0.710	0.595	—	—	0.710	0.605
20	0.790	0.360	0.790	0.530	0.790	0.720	—	—	0.790	0.605
22	0.870	0.360	0.870	0.560	0.870	0.815	—	—	0.870	0.605
24	0.945	0.390	0.945	0.620	0.945	0.935	—	—	0.945	0.650
28	1.095	0.390	1.095	0.685	1.095	1.060	—	—	1.095	0.725
30	1.130	0.390	—	—	—	—	—	—	1.130	0.760
33	1.270	0.390	—	—	—	—	—	—	1.270	0.775
35	1.370	0.390	—	—	—	—	—	—	—	—
38	1.480	0.390	—	—	—	—	—	—	1.480	0.940
40	1.590	0.390	—	—	—	—	—	—	—	—
43	1.660	0.390	—	—	—	—	—	—	—	—
45	1.750	0.390	—	—	—	—	—	—	—	—
48	1.875	0.390	—	—	—	—	—	—	—	—
51	1.975	0.390	—	—	—	—	—	—	—	—
53	2.075	0.390	—	—	—	—	—	—	—	—
58	2.230	0.390	—	—	—	—	—	—	—	—
60	2.350	0.390	—	—	—	—	—	—	—	—
63	2.470	0.390	—	—	—	—	—	—	—	—
66	2.585	0.390	—	—	—	—	—	—	—	—
70	2.745	0.390	—	—	—	—	—	—	—	—
75	2.920	0.390	—	—	—	—	—	—	—	—
77	3.040	0.470	—	—	—	—	—	—	—	—
83	3.275	0.470	—	—	—	—	—	—	—	—
89	3.520	0.515	—	—	—	—	—	—	—	—
100	3.945	0.580	—	—	—	—	—	—	—	—
110	4.340	0.580	—	—	—	—	—	—	—	—
120	4.735	0.675	—	—	—	—	—	—	—	—

Table 2b. Cap Thread Finish Dimensions (Dimensions are in millimeters)

Nominal Dia (mm)	400		410		415		425		430	
	"T"	"H"	"T"	"H"	"T"	"H"	"T"	"H"	"T"	"H"
8	—	—	—	—	—	—	9.14	6.22	—	—
10	—	—	—	—	—	—	10.54	6.48	—	—
13	—	—	—	—	13.21	10.92	13.21	7.11	—	—
15	—	—	—	—	14.86	13.59	14.86	7.11	—	—
18	18.03	9.14	18.03	12.70	18.03	15.11	—	—	18.03	15.37
20	20.07	9.14	20.07	13.46	20.07	18.29	—	—	20.07	15.37
22	22.10	9.14	22.10	14.22	22.10	20.70	—	—	22.10	15.37
24	24.00	9.91	24.00	15.75	24.00	23.75	—	—	24.00	16.51
28	27.81	9.91	27.81	17.40	27.81	26.92	—	—	27.81	18.42
30	28.70	9.91	—	—	—	—	—	—	28.70	19.30
33	32.26	9.91	—	—	—	—	—	—	32.26	19.69
35	34.80	9.91	—	—	—	—	—	—	—	—
38	37.59	9.91	—	—	—	—	—	—	37.59	23.88
40	40.39	9.91	—	—	—	—	—	—		
43	42.16	9.91	—	—	—	—	—	—	—	—
45	44.45	9.91	—	—	—	—	—	—	—	
48	47.63	9.91	—	—	—	—	—	—	—	—
51	50.16	9.91	—	—	—	—	—	—	—	—
53	52.71	9.91	—	—	—	—	—	—	—	—
58	56.64	9.91	—	—	—	—	—	—	—	—
60	59.69	9.91	—	—	—	—	—	—	—	—
63	62.74	9.91	—	—	—	—	—	—	—	—
66	65.53	9.91	—	—	—	—	—	—	—	—
70	69.72	9.91	—	—	—	—	—	—	—	—
75	74.17	9.91	—	—	—	—	—	—	—	—
77	77.22	11.94	—	—	—	—	—	—	—	—
83	83.19	11.94	—	—	—	—	—	—	—	—
89	89.41	13.08	—	—	—	—	—	—	—	—
100	100.20	14.73	—	—	—	—	—	—	—	—
110	110.23	14.73	—	—	—	—	—	—	—	—
120	120.27	17.14	—	—	—	—	—	—	—	—

Guide for Selecting a Cap Liner

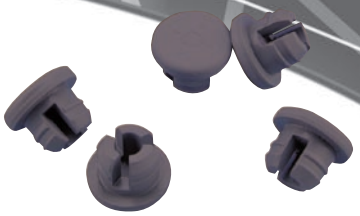
Usually the smallest component part of the package and usually overlooked is the selection of the cap liner. The liner must not alter or be altered by the product. It must withstand repeated applications and removals against the container surface while maintaining the integrity of the sealing surface. Below is some information that may help in choosing the right liner from our product offering.

Material	Description	Applications
Poly-Vinyl	One mil poly vinyl film bonded to one mil HDPE on a #30 white pulp paper backing. Superior to plain pulp paper because it provides excellent moisture barrier.	General purpose: Suitable for wide range of applications. Chemical resistance: Good for mild acids, alkalis, solvents, alcohols, oils and aqueous products; poor for active hydrocarbons and bleaches.
Poly-Seal®	Manufactured from LDPE. The unique cone design provides a wedge type seal that not only seals across the top but also across the inside diameter.	Unique problem solving type of liner. This liner is stress crack resistant and offers superior torque retention and excellent sealing characteristics. It is recommended that this liner be tested prior to use for leak seal.
Foamed Polyethylene	A one piece, three ply coextruded liner consisting of foamed and solid LDPE. The foam core is sandwiched with solid clear PE.	General Purpose: Broad applications base. Chemical resistance-good for acids, alkalis, solvents, alcohols, oils, household cosmetics and aqueous products. Poor for hydrocarbon solvents. Liner provides tight seal.
Pulp/Metal Foil	Aluminum foil bonded to pulp board.	Good barrier properties, good resistance to hydrocarbons, oils, ketones and alcohols. Not good for acids or alkalis.
Styrene-Butadiene Rubber (14B)	The white rubber lining material consists of homogeneous sulfur cured styrene-butadiene rubber (SBR). FDA Status complies with 21CFR 177.26, "Rubber articles intended for repeated use."	Excellent properties of resilience, resistant to moisture vapor. Satisfactory for most moderate chemicals. Not good for oils, strong acids and hydrocarbons. Autoclavable.
Styrene-Butadiene Rubber/0.005 PTFE	The white rubber/0.005" PTFE liner consists of virgin PTFE bonded to the white sulfur cured, styrene-butadiene rubber. Complies with the FDA 21CFR 177.1550.	Designed for the ultimate in product safety. PTFE provides totally inert inner seal and surface facing the sample or product. Autoclavable.
Teflon Faced Silicone Rubber	The liner consists of 0.005" thick Teflon bonded to 0.055" thick silicone rubber.	Ideal for low temperature storage applications. Teflon facing provides excellent chemical barrier. Autoclavable
Teflon Faced Foamed Polyethylene	Teflon®-faced foamed polyethylene liner that offers the excellent chemical resistance of Teflon® with the compressibility and sealing properties of polyethylene foam.	Typical applications: analytical lab samples, high purity chemicals, strong acids, solvents. Excellent for environmental samples, pharmaceuticals and diagnostic reagents.

Note: Closures and liners are designed for a variety of applications. Product performance can vary depending on conditions. It is recommended that proper tests be performed to determine the best liner for the application.

2-Leg Lyophilization Stoppers

Straight Plug Style



3-Leg Lyophilization Stopper

Rubber Stopper Formulation Descriptions

Listed below are the primary stopper formulations with general descriptions that are supplied by Wheaton Science Products.

Gray Bromobutyl/39 with Complete Coat

Pros: low gas and vapor permeability, good for multiple piercing applications, compatible with most cephalosporin's, resistant to animal, vegetable, and mineral oils, good resistance to aliphatic, aromatic and chlorinated solvents. Cons: not recommended for use with ketones. Can be autoclaved and irradiated.

Gray Bromobutyl/46

Pros: low gas and vapor permeability, good for multiple piercing applications, excellent moisture absorption and desorption properties following autoclave and lyophilization drying cycles. Cons: poor resistance to mineral oil, aliphatic, aromatic, and chlorinated solvents. Can be autoclaved and irradiated.

Gray Bromobutyl/47

Pros: low gas and vapor permeability, great for multiple piercing applications after gamma irradiation, ultra low extractable compound, compatible with most cephalosporin's, very good moisture absorption and desorption properties following autoclave and lyophilization drying cycles, compatible with WFI applications. Cons: poor resistance to mineral oil, aliphatic, aromatic, and chlorinated solvents. Can be autoclaved and irradiated.

Gray Bromobutyl/50

Pros: low gas and vapor permeability, very good properties regarding ozone, animal and vegetable oil. Cons: not good for multiple piercing applications, poor resistance to mineral oil, aliphatic, aromatic, and chlorinated solvents. Can be autoclaved.

Gray Chlorobutyl/45

Pros: low gas and vapor permeability, good for multiple piercing applications, resistant to animal and vegetable oils. Cons: poor resistance to mineral oil, aliphatic, aromatic, and chlorinated solvents. Can be autoclaved and irradiated.

Gray Chlorobutyl/46

Pros: low gas and vapor permeability, good for multiple piercing applications, resistant to animal and vegetable oils, good for lyophilization applications. Cons: poor resistance to mineral oil, aliphatic, aromatic, and chlorinated solvents. Can be autoclaved and irradiated.

Gray Chlorobutyl/50

Pros: low gas and vapor permeability, resistant to animal and vegetable oil, good for lyophilization applications. Cons: poor resistance to mineral oil, aliphatic, aromatic, and chlorinated solvents. Can be autoclaved and irradiated.

Gray Chlorobutyl/55

Pros: low gas and vapor permeability, resistant to animal and vegetable oil, good for lyophilization applications. Cons: not good for multiple piercing applications, poor resistance to mineral oil, aliphatic, aromatic, and chlorinated solvents. Can be autoclaved and irradiated

Gray Chlorobutyl/Isoprene Blend/40 with PTFE Facing

Pros: barrier properties of PTFE, good coring characteristics, fair resistance to gas and moisture transmission compared to red isoprene. Cons: contains dry natural rubber. Can be autoclaved.

Gray Chlorbutyl/Isoprene Blend/50

Pros: good coring and reseal characteristics, fair resistance to gas and moisture transmission compared to red isoprene, good for lyophilization applications. Cons: contains dry natural rubber. Can be autoclaved.

Black Halobutyl/60

Pros: good resistance to gas and vapor transmission, good for lyophilization applications. Cons: poor coring and re-seal characteristics, not good for use with acidic products. Can be autoclaved.

Red Isoprene/45

Pros: good coring and re-seal characteristics. Cons: contains dry natural rubber, poor resistance to gas and vapor transmission compared to butyl, not appropriate for products that require an inert gas blanket, not good for use with acidic products or solvents. Can be autoclaved and irradiated.

Red Natural/40

Pros: good coring and re-seal characteristics. Cons: contains dry natural rubber, poor gas and vapor transmission compared to butyl, not appropriate for products that require an inert gas blanket, not good for use with acidic products or solvents. Can be autoclaved and irradiated.

Pink Natural/48

Pros: good coring and re-seal characteristics. Cons: contains dry natural rubber, poor gas and vapor transmission compared to butyl, not appropriate for products that require an inert gas blanket, not good for use with acidic products or solvents. Can be autoclaved and irradiated.

Natural Silicone/55

Pros: Good for high heat applications, can withstand multiple steam autoclaves. Cons: very poor barrier to gas and vapor transmission, not appropriate for products that require an inert gas blanket. Can be autoclaved and irradiated.

Black Viton®/55

Pros: low gas and vapor permeability, resistant to animal, vegetable and mineral oil, aliphatic, aromatic, and chlorinated solvents, good for high heat applications. Cons: not recommended for ketones. Can be autoclaved.

Rubber Stopper Formulation Characteristics

	Gray Bromobutyl/39 w/Safety Coat	Gray Bromobutyl/46	Gray Bromobutyl/47	Gray Bromobutyl/50	Gray Chlorobutyl/45	Gray Chlorobutyl/46	Gray Chlorobutyl/50	Gray Chlorobutyl/55
Typical Properties:								
Base Polymer	Bromobutyl	Bromobutyl	Bromobutyl	Bromobutyl	Chlorobutyl	Chlorobutyl	Chlorobutyl	Chlorobutyl
Durometer (shore A +/- 5)	39	46	47	50	45	46	50	55
Specific Gravity	1.19	1.35	1.26	1.35	1.24	1.32	1.30	1.38
Ash %	31	48	41	44.9	38.4	45.5	42.7	47.9
Typical Extraction Data, USP:								
Distilled Water								
pH Change	- 0.3	- 0.12	0.00	+ 0.22	- 0.20	- 0.37	- 0.23	- 0.30
Reducing Agents, ml, .01N I_2	0.00	0.00	0.01	0.04	0.00	0.00	0.00	0.00
Turbidity, NTU	0.01	0.70	0.03	1.40	1.00	0.40	0.05	1.00
Total Solids, mg/100 mL	0.8	0.7	0.3	1.3	0.0	0.3	0.4	1.0
Zinc, ppm	—	—	—	1.31	1.20	—	0.20	0.30
Lead, ppm	—	—	—	< 0.50	< 0.50	—	< 0.50	< 0.50
Toxicity Data:								
Acute Systemic	Passes	—	—	—	Passes	—	Passes	Passes
Intracutaneous Reactivity	Passes	—	—	—	Passes	—	Passes	Passes
Cytotoxicity	Passes	Passes	Passes	Passes	Passes	Passes	Passes	Passes

	Gray Chlorobutyl Isoprene Blend/40	Gray Chlorobutyl Isoprene Blend/50	Black Halobutyl/60	Red Isoprene/45	Red Natural/40	Pink Natural/48	Natural Silicone	Black Viton/55
Typical Properties:								
Base Polymer	Chloro/Iso Blend	Chloro/Iso Blend	Halobutyl	Isoprene	Natural	Natural	Silicone	Viton
Durometer (shore A +/- 5)	40	50	60	45	40	48	55	55
Specific Gravity	1.15	1.46	1.43	1.33	1.25	1.65	1.14	1.87
Ash %	29.5	55.7	51.2	32.0	38.9	55.6	N/A	N/A
Typical Extraction Data, USP:								
Distilled Water								
pH Change	- 0.6	- 0.8	- 0.3	- 0.2	+ 0.1	+ 1.5	- 0.30	0.38
Reducing Agents, ml, .01N I_2	0.0	0.0	0.0	0.00	0.0	0.0	0.10	0.06
Turbidity, NTU	0.7	2.6	5.0	0.90	29.0	34.0	1.00	0.00
Total Solids, mg/100 mL	0.0	0.0	0.5	1.6	1.4	1.9	0.0	0.4
Zinc, ppm	1.0	1.6	0.5	2.50	0.2	0.3	—	<0.05
Lead, ppm	0.0	—	0.0	< 0.50	0.0	0.1	< 0.50	< 0.50
Toxicity Data:								
Acute Systemic	Passes	Passes	Passes	Passes	Passes	Passes	Passes	—
Intracutaneous Reactivity	Passes	Passes	Passes	Passes	Passes	Passes	Passes	—
Cytotoxicity	Passes	Passes	Passes	—	—	—	Passes	Passes

All stopper formulation data presented above is general information. Specific laboratory results are available upon request. It is recommended that all stoppers be thoroughly tested by the customer for compatibility.