

PROPERTIES OF PLASTICS

PROPERTY	HDPE	LDPE	POLY-PROPYLENE	PVC	POLY-STYRENE	BAREX	PET	PETG
RIGIDITY	<i>M</i>	<i>Low</i>	<i>M to H</i>	<i>M to H</i>	<i>H</i>	<i>H</i>	<i>M to H</i>	<i>M to H</i>
IMPACT	<i>G</i>	<i>G</i>	<i>F</i>	<i>F</i>	<i>P</i>	<i>F</i>	<i>F</i>	<i>F to G</i>
GAS BARRIER	<i>P</i>	<i>P</i>	<i>F</i>	<i>G</i>	<i>P</i>	<i>E</i>	<i>G</i>	<i>G</i>
STRESS CRACK RESISTANCE	<i>F</i>	<i>G</i>	<i>E</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>E</i>	<i>E</i>
CLARITY	<i>Hazy Translucent</i>	<i>Hazy Transparent</i>	<i>VG</i>	<i>C</i>	<i>E</i>	<i>C</i>	<i>C</i>	<i>C</i>
COLD RESISTANCE	<i>VG</i>	<i>VG</i>	<i>P to F</i>	<i>F</i>	<i>P</i>	<i>F</i>	<i>G</i>	<i>G</i>
HEAT DISTORTION TEMP. °F	<i>171°</i>	<i>111°</i>	<i>205°</i>	<i>170°</i>	<i>207°</i>	<i>165°</i>	<i>176°</i>	<i>158°</i>

CHEMICAL RESISTANCE	HDPE	LDPE	POLY-PROPYLENE	PVC	POLY-STYRENE	BAREX	PET	PETG
SOLVENTS	<i>U</i>	<i>U</i>	<i>F to U</i>	<i>U</i>	<i>U</i>	<i>F to G</i>	<i>P to U</i>	<i>P to U</i>
OIL	<i>F</i>	<i>P</i>	<i>F to G</i>	<i>G</i>	<i>P to F</i>	<i>G</i>	<i>G</i>	<i>G</i>
ALCOHOL	<i>E</i>	<i>E</i>	<i>E</i>	<i>G</i>	<i>P to F</i>	<i>G</i>	<i>G</i>	<i>F</i>
ESSENTIAL OIL FLAVOR	<i>P</i>	<i>P</i>	<i>P to F</i>	<i>G</i>	<i>P</i>	<i>VG</i>	<i>G</i>	<i>G</i>
ACID	<i>E</i>	<i>E</i>	<i>G to E</i>	<i>G</i>	<i>P to U</i>	<i>F to G</i>	<i>P to F</i>	<i>P to F</i>
ALKALI	<i>E</i>	<i>E</i>	<i>E</i>	<i>G</i>	<i>P to U</i>	<i>P to F</i>	<i>F to U</i>	<i>F to U</i>

E.....EXCELLENT

VG.....VERY GOOD

G.....GOOD

F.....FAIR

P.....POOR

U.....UNSATISFACTORY

M.....MODERATE

H.....HIGH

C.....CLEAR

RESIN COMPARISON GUIDE



PROPERTY	POLYETHYLENE TEREPHTHALATE	HIGH DENSITY POLYETHYLENE	AIROPAK® BARRIER CONTAINER	POLYVINYL CHLORIDE (PVC)	LOW DENSITY POLYETHYLENE	POLYPROPYLENE	POLYSTYRENE	OTHER PLASTICS
CLARITY	CLEAR	TRANSLUCENT	TRANSLUCENT	CLEAR	TRANSLUCENT	TRANSLUCENT	CLEAR	PLASTIC ID CODE "7" IS FOR OTHER PLASTICS
MOISTURE BARRIER	FAIR TO GOOD	GOOD TO EXCELLENT	GOOD TO EXCELLENT	FAIR	GOOD	GOOD TO EXCELLENT	POOR TO FAIR	
OXYGEN BARRIER	GOOD	POOR	POOR	GOOD	POOR	POOR	FAIR	
DISTORTION TEMPERATURE	145°F	160°F	160°F	150°F	160°F	212°F	150°F	
RIGIDITY	HIGH	MODERATE	MODERATE	HIGH	LOW	MODERATE	HIGH	
RESISTANCE TO IMPACT	EXCELLENT	EXCELLENT	EXCELLENT	GOOD	EXCELLENT	FAIR	POOR	
RESISTANCE TO COLD	GOOD	EXCELLENT	EXCELLENT	FAIR	EXCELLENT	POOR TO FAIR	POOR	
RESISTANCE TO SUNLIGHT	GOOD	FAIR	FAIR	POOR TO GOOD	FAIR	FAIR	POOR TO FAIR	
RESISTANCE TO ACIDS	FAIR	GOOD	GOOD	GOOD	MEDIUM	GOOD	MEDIUM	
RESISTANCE TO ALCOHOL	GOOD	GOOD	GOOD	VERY GOOD	GOOD	GOOD	FAIR	
RESISTANCE TO ALKALIS	POOR	VERY GOOD	VERY GOOD	GOOD	VERY GOOD	VERY GOOD	GOOD	
RESISTANCE TO SOLVENTS	GOOD	POOR	EXCELLENT	GOOD	POOR	POOR	POOR	

THIS CHART IS MEANT ONLY AS A GUIDE. ACTUAL PERFORMANCE IS THE RESPONSIBILITY OF THE PACKAGER. PLEASE TEST YOUR PRODUCTS.



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PLASTIC PROPERTIES

General oxygen- and moisture-barrier properties of various plastics

<i>Material</i>	<i>Moisture Barrier</i>	<i>Oxygen Barrier</i>
LDPE	FAIR	POOR
HDPE	EXCELLENT	POOR
EVAL	POOR	EXCELLENT
PVDC	EXCELLENT	EXCELLENT
PA (NYLON)	POOR	GOOD
PS	POOR	POOR
PET	FAIR	GOOD
OPP	GOOD	POOR

General comparison of tensile and elongation properties of common packaging plastics

<i>Best-Tensile-Property Materials</i>	<i>Tensile (PSI)</i>	<i>Elongation (%)</i>
Poly(Ethylene Terephthalate) (PET)	32,000	50
Oriented Polypropylene (OPP)	30,000	80
Acrylonitrile Copolymer (Barex)	9,500	3

Good-Tensile-Property Materials

Polyamide (nylon)	7,000	400
Unoriented Polypropylene	6,000	600
High-density Polyethylene (HDPE)	5,000	400

Low-Tensile-Property Materials

Low-density Polyethylene (LDPE)	3,500	600
Linear Low-density Polyethylene (LLDPE)	3,500	700
Plasticized Poly (Vinyl Chloride) (PVC)	2,000	500

Best-Oxygen-Barrier Materials

	<i>Permeability</i>	<i>Comments</i>
Ethylene-vinyl Alcohol (EVAL)	0.02	Water Sensitive
Poly(Vinylidene Chloride) (PVDC or saran)	0.05	Best Universal Barrier
Acrylonitrile Copolymer (Barex)	1.0	Poor Water Vapor Barrier

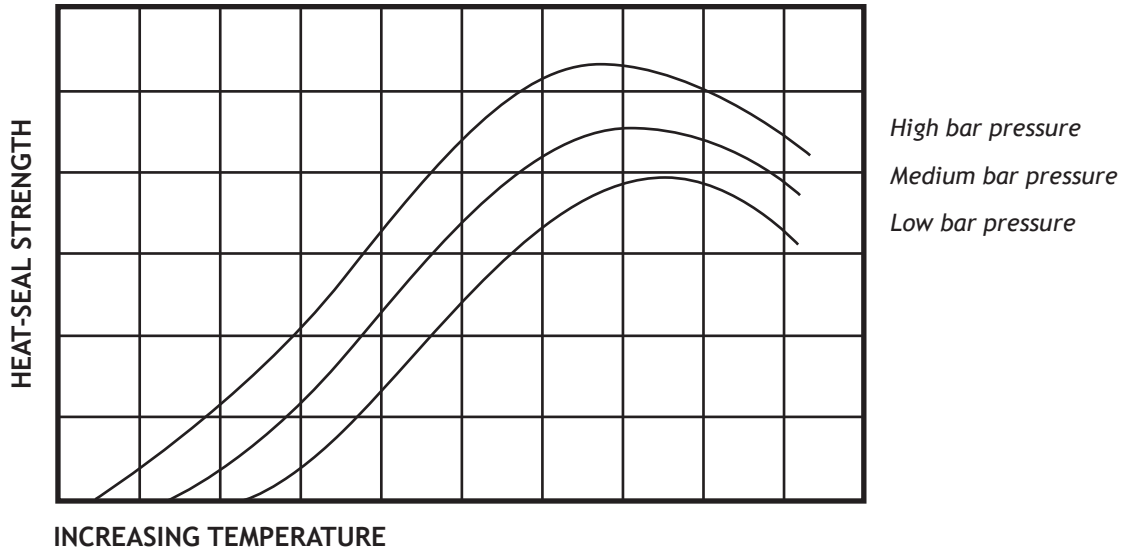
Good-Oxygen-Barrier Materials

Polyamide (PA or nylon)	3	Poor Water Vapor Barrier
Poly(Chlorotrifluoroethylene) (PCTFE OR Aclar)	4	Cost Limits Use
Poly(Ethylene Terephthalate) (PET)	5	Good Universal Barrier

Low-Oxygen-Barrier Materials

High-density Polyethylene (HDPE)	110	
Polypropylene (PP)	150	Frequently Metallized
Low-density Polyethylene (LDPE)	450	

PLASTIC PROPERTIES



THE OPTIMUM CONDITION FOR CREATING A STRONG HEAT SEAL SHOULD BE DETERMINED.

Material	Maximum use temperature (°C/°F)
Poly(Ethylene Terephthalate) (PET)	204 / 400
Polyamide (PA or nylon)	177 / 350
Unoriented Polypropylene (PP)	116 / 240
High-density Polyethylene (HDPE)	100 / 212
Poly(Vinyl Chloride) (PVC)	93 / 200
Linear Low-density Polyethylene (LLDPE)	77 / 170
Low-density Polyethylene (LDPE)	66 / 150

PLASTIC PROPERTIES

Polymer compatibility with household chemicals

<i>Household Product</i>	<i>LDPE</i>	<i>HDPE</i>	<i>PP</i>	<i>PVC</i>	<i>PET</i>	<i>PS</i>
AMMONIA	2	1	1	1	?	2
ANTIFREEZE, ETHYLENE GLYCOL	1	1	1	1	2	1
CAMPHOR OIL	X	X	X	2	?	2
CHARCOAL STARTER FLUID	X	2	2	2	2	X
CHLORINE BLEACH	1	1	1	1	?	2
DETERGENTS	2	1	1	2	2	2
DRAIN CLEANER, DRY	2	1	1	1	?	2
DRAIN CLEANER, LIQUID	2	2	1	2	?	X
FABRIC SOFTENER	1	1	1	1	2	2
FLOOR POLISH, NAPHTHA BASE	X	2	2	1	?	X
FLOOR WAX REMOVER	2	2	2	1	?	X
FURNITURE POLISH	2	2	1	1	1	2
GASOLINE	X	2	2	2	2	X
GLUE, SOLVENT BASE	2	2	?	2	?	X
GLUE, VINYL ACETATE BASE	?	1	1	X	?	X
HYDRAULIC BRAKE FLUID	2	1	1	2	X	2
INSECTICIDE, SOLVENT BASE	2	2	1	2	?	X
INSECTICIDE, POWDER	1	1	1	2	?	X
INSECT REPELLENT	2	2	1	?	?	X
KETTLE CLEANER	2	1	1	2	2	2
LEMON OIL	X	X	2	1	2	X
LIGHTER FLUID	X	X	2	1	2	X
LINSEED OIL	1	1	1	1	2	2
LUBRICATING OIL	1	1	1	1	2	2
MOTH-PROOFING, NAPHTHALENE	X	X	?	X	?	2
MOTH-PROOFING, P-DICHLOROBENZINE	X	2	2	X	?	X
OVEN CLEANER	?	1	1	1	?	X
ROOM DEODORANTS	2	2	1	1	?	2
SHELLAC	X	2	1	1	?	X
SHOE POLISH	2	2	1	1	?	2
SILVER POLISH	2	2	1	1	?	2
WEED KILLER	2	2	2	2	?	X

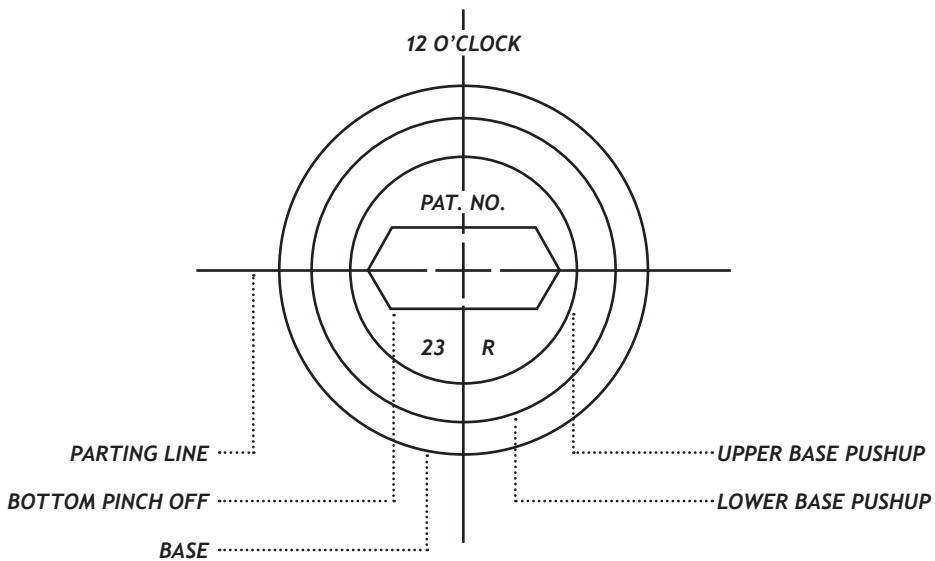
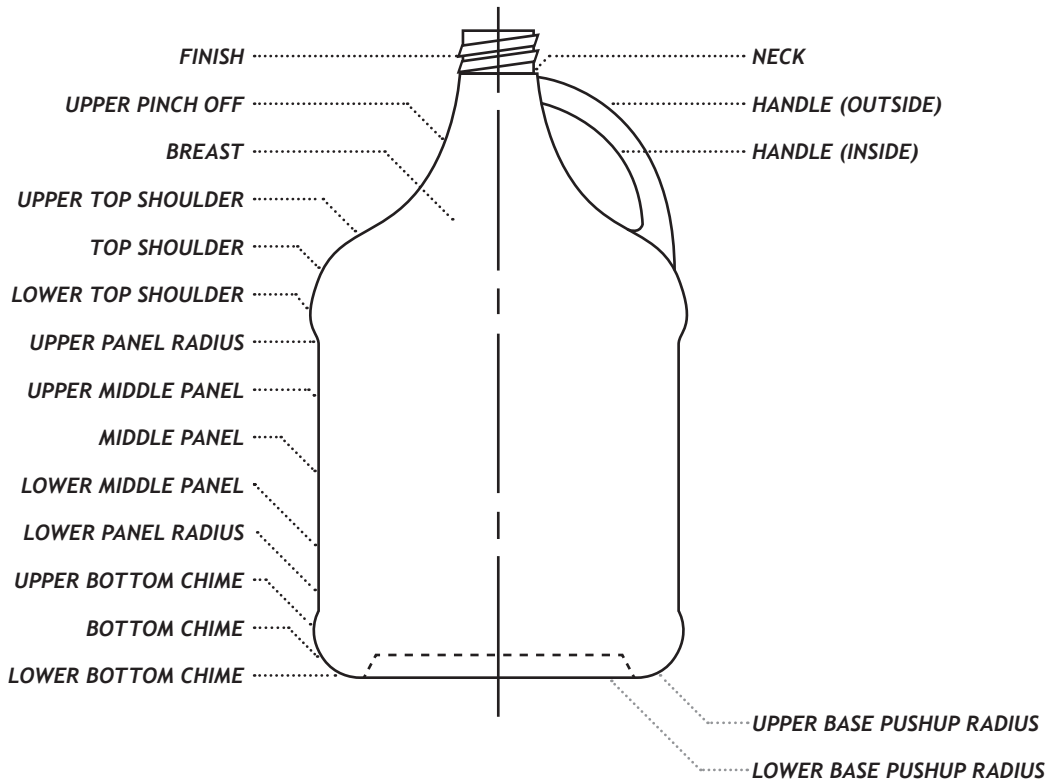
1.....SATISFACTORY PERFORMANCE

2.....PROBABLY SATISFACTORY BUT SHOULD BE VERIFIED FOR SPECIFIC APPLICATIONS

X.....NOT COMPATIBLE

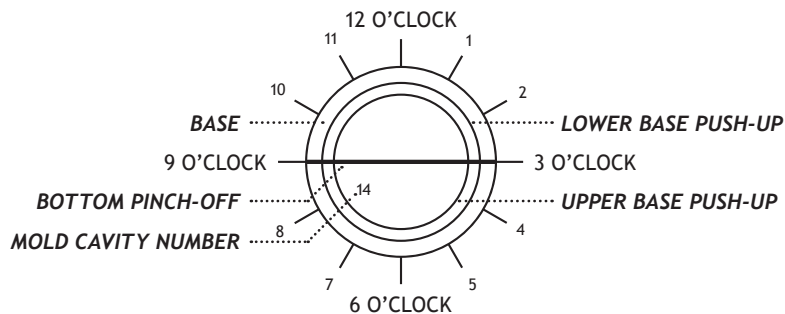
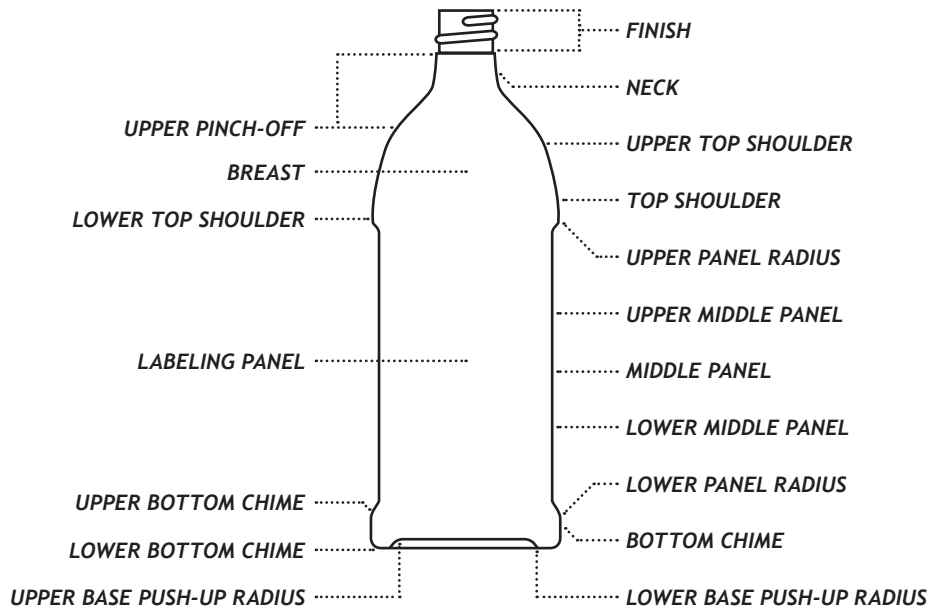
?.....INFORMATION NOT AVAILABLE

NOMENCLATURE OF PLASTIC BOTTLE



NOTE: 12 o'clock position is at top as specified above 90° from parting line and in position to any Patent No., Mold No., Manufacturer's No. can be easily read.

PLASTIC BOTTLES



NOTE: Standard bottle terminology. The 12 o'clock position is at right angles to the parting line when the container is turned so that the mold number and other text are right side up.

Extrusion Blow Molding And Injection Blow Molding Compared

Advantages

Extrusion Blow Molding

- Requires Single Mold
- Handware Readily Produced
- Co-extruded Bottles Readily Produced
- Large Containers (e.g., 200-l Drums) Possible
- Large-mouthed Jars Awkward

Injection Blow Molding

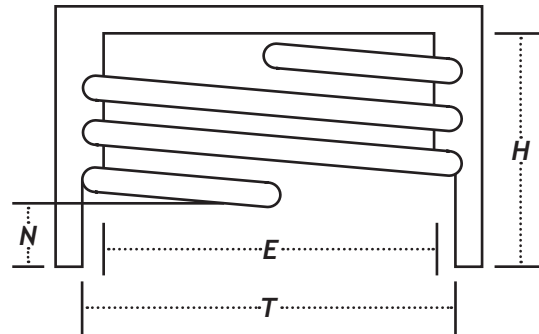
- No Secondary Operations (Ream, Trim, Regrind)
- No Regrind Generated
- High-precision Neck and Finish
- More Cavities Possible for Small Bottles
- Better Material Distribution
- Large-mouthed Jars Easy to Make

Disadvantages

- Produces Trim Regrind
- Limited Precision
- Limited Number of Cavities
- Cold Weld is a Weak Area
- Requires Two Mold Sets
- Limited Container Size
- Handware Difficult
- Multilayer Constructions Difficult

CAP & BOTTLE FINISHES

CAP



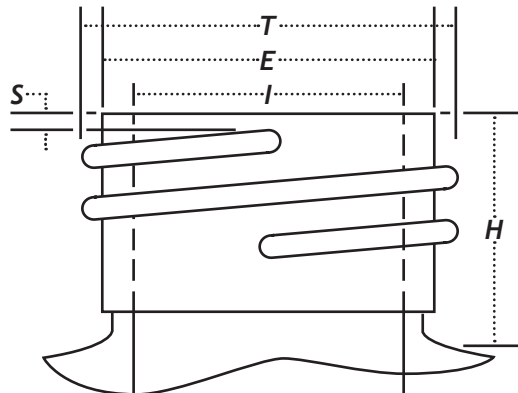
T: "T" DIAMETER - The thread diameter of a continuous thread finish of a container or the cooperating thread in a closure.

N: The distance from the cap skirt to the thread start of a closure.

E: "E" DIAMETER - The root thread diameter of a continuous thread finish of a container or the cooperating root thread diameter of a closure.

H: The distance from the cap skirt to the plane of the land seal in a continuous thread closure.

BOTTLE



S: Dimension "S" is measured from the top of the finish to the top edge of the first threads.

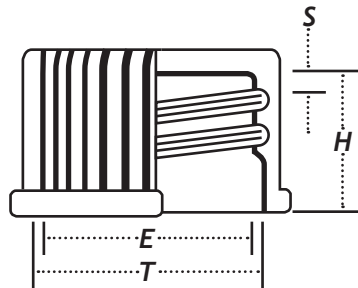
I: Dimension "I" is a specified minimum diameter inside the bottle neck. While most industry specifications denote only a minimum "I" Dimension for the filler tube, some closures with a valve or plug seal may require a controlled dimension.

T: Dimension "T" is the outside diameter of the thread on a bottle finish.

E: On a threaded bottle neck, Dimension "E" is the outside diameter of the bottle neck.

H: Dimension "H" is the height of the bottle finish, measured from the sealing surface, in a line down to a point where the line intersects the shoulder of the container.

PLASTIC CLOSURES



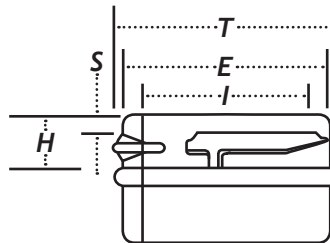
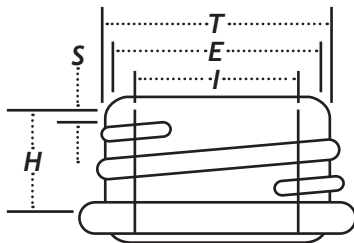
E: Thread root diameter.

I: Diameter at smallest opening inside finish.

H: Top of finish to top of bead or to intersection with bottle shoulder on beadless designs.

T: Thread diameter measured across the threads.

S: The vertical distance from the top of the finish to the start of the thread.



NOTE: Standard finish dimension nomenclature for a continuous-thread closure (left) and a lug-type closure (right). Closure dimension nomenclature mirrors container finish nomenclature.

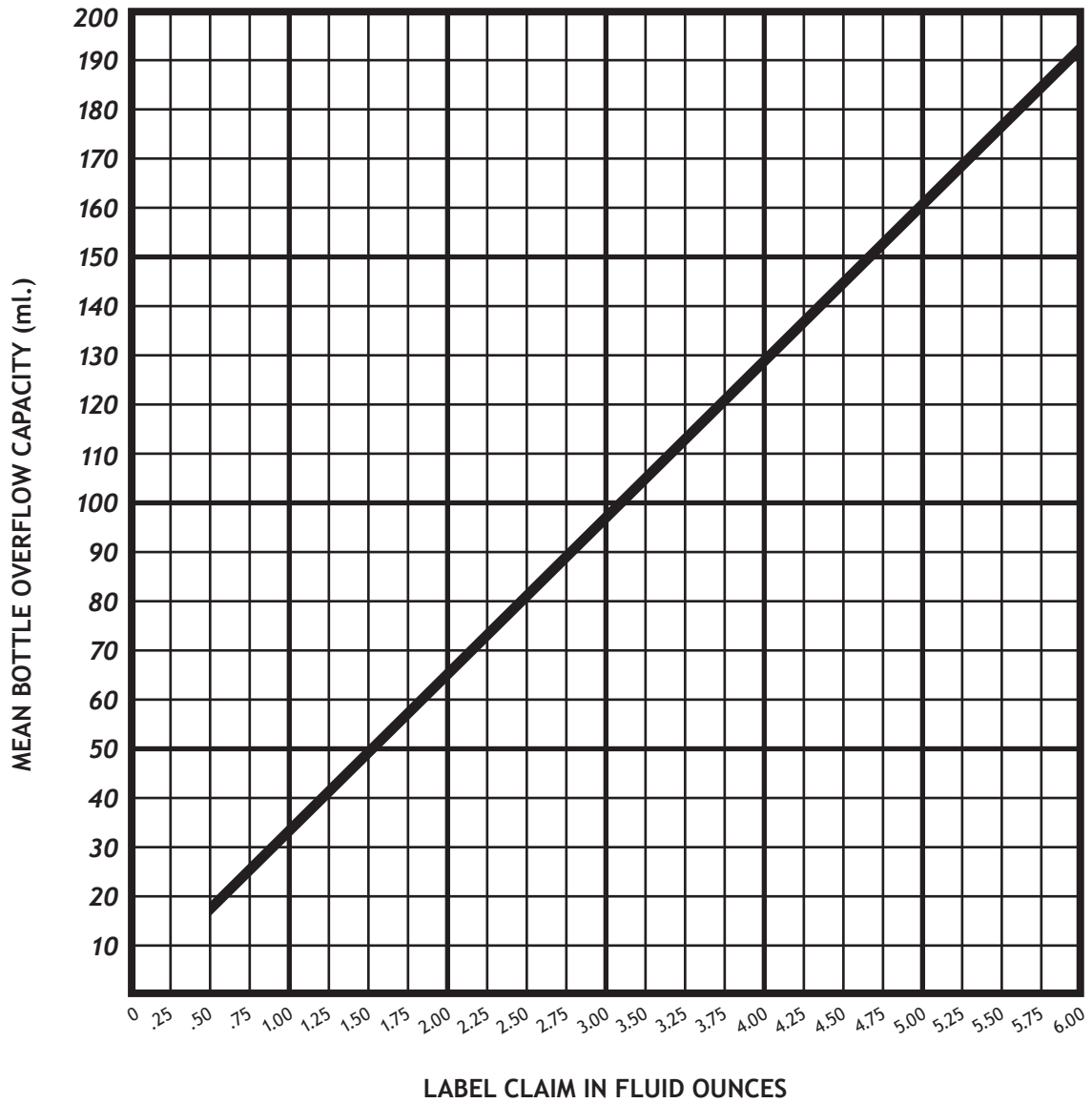
Selected common closure code groups.

<i>Designation</i>	<i>Description*</i>
120, 140, and 160	2-lug, 4-lug, and 6-lug Amerseal quarter-turn finish
400 series	shallow CT finish
	401 - with wide sealing surface
	410 - medium CT concealed-bead finish
	415 - tall CT concealed-bead finish
	425 - 8 to 15mm shallow CT
	430 - pour-out CT
	445 - deep S CT
	460 - home canning-jar finish
600	Beverage crown finish
1240	Vacuum lug-style finish
1600	Roll-on finish
1620	Roll-on pilferproof finish
1751	Twist-off vacuum seal
SP 100	CT for plastic SP 100 finish
SP 103	CT for plastic SP 103 finish
SP 200	CT for plastic SP 200 finish
SP 444	CT for plastic SP 444 finish

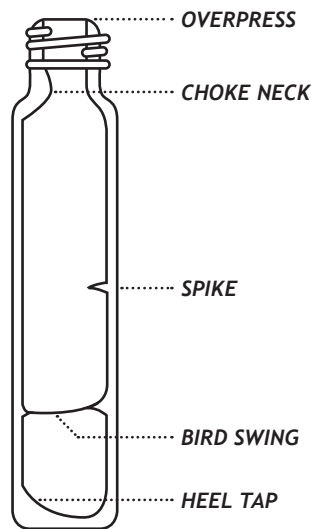
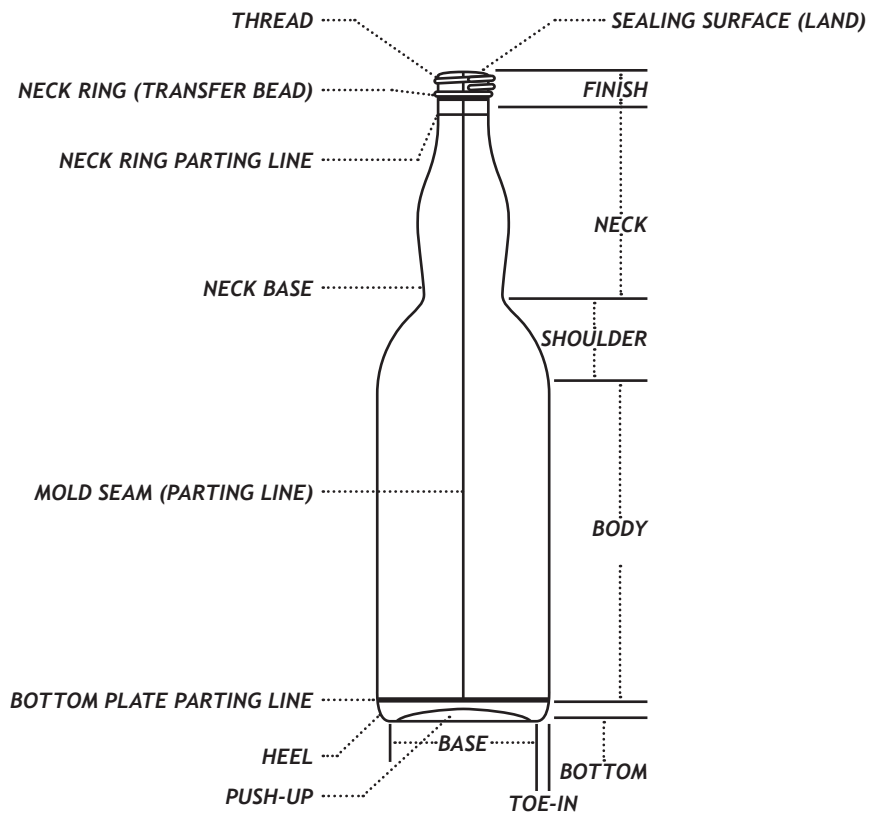
* The abbreviation "CT" indicates a continuous-thread closure.

**OVERFLOW CAPACITY OF GLASS
CONTAINERS FOR FRAGRANCES**

INCLUDING ALLOWANCE FOR PUMP AND DIP TUBE DISPLACEMENT



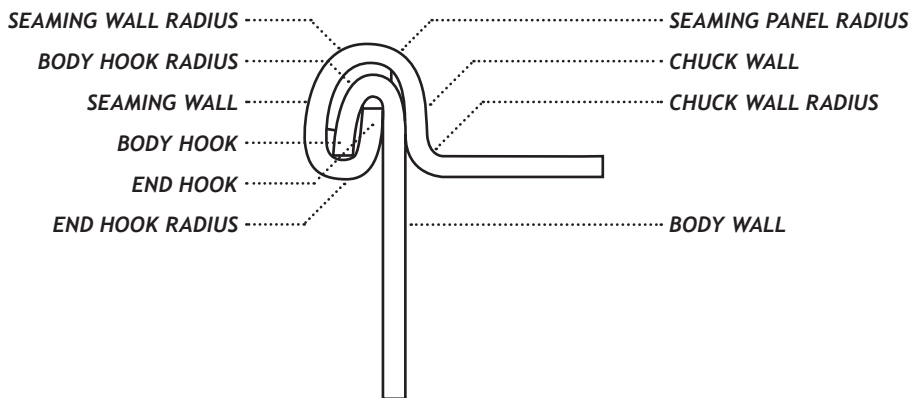
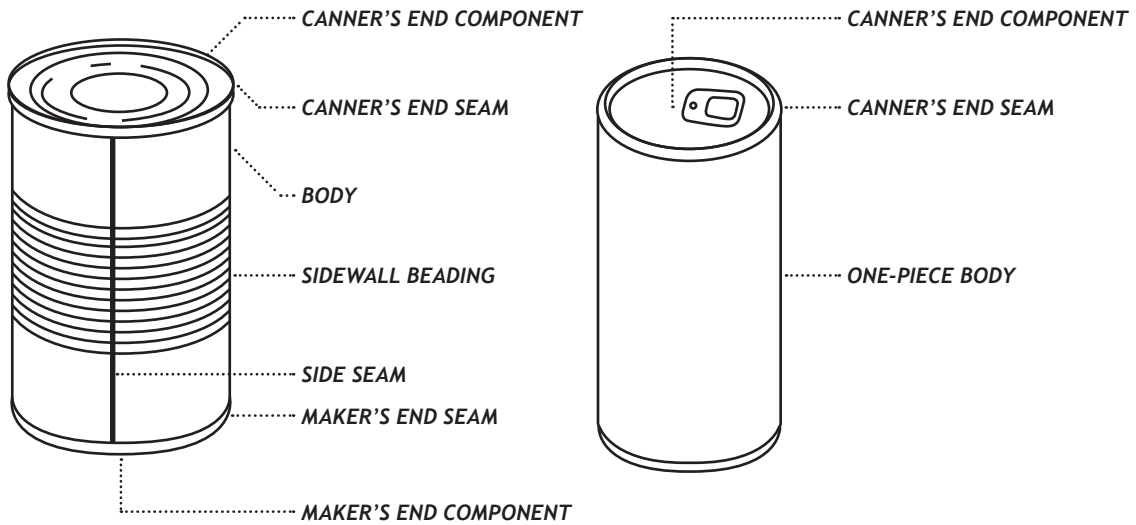
GLASS DESIGN



NOTE: Flat bottles sometimes develop "bird swing" and "spike" defects. Spikes are glass projections inside the bottle, and a bird swing is a glass thread joining the two walls.

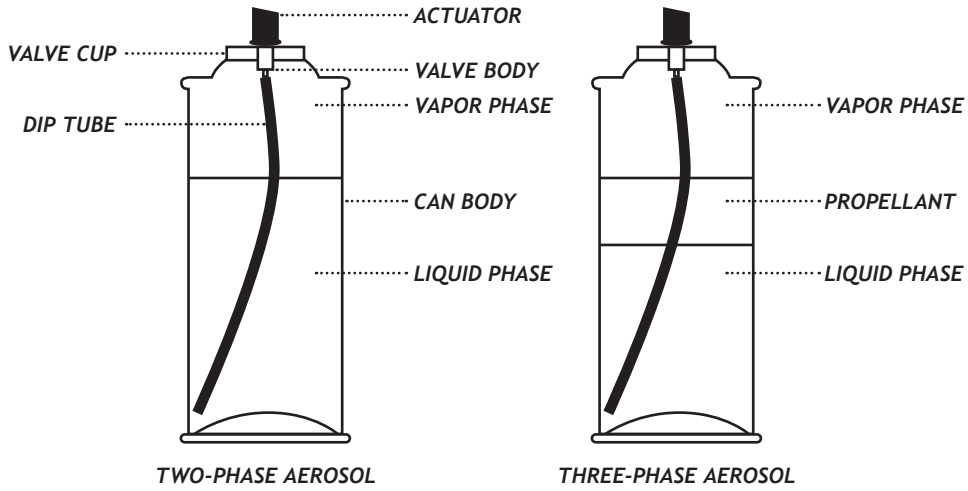
METAL

<i>Temper</i>	<i>Rockwell Hardness</i>	<i>Application</i>
T1	46 - 52	Soft and ductile steel for deep draws
T2	50 - 56	Moderate-draw steel: shallow cans, closures
T3	54 - 63	Shallow-draw steel: general purpose, ends, crowns, closures
T4	58 - 64	General purpose, bodies and ends
T5	62 - 68	Can ends and bodies
DR-8	70 - 73	Maximum-stiffness ends and bodies
DR-9	76 - 77	Maximum-stiffness ends and bodies

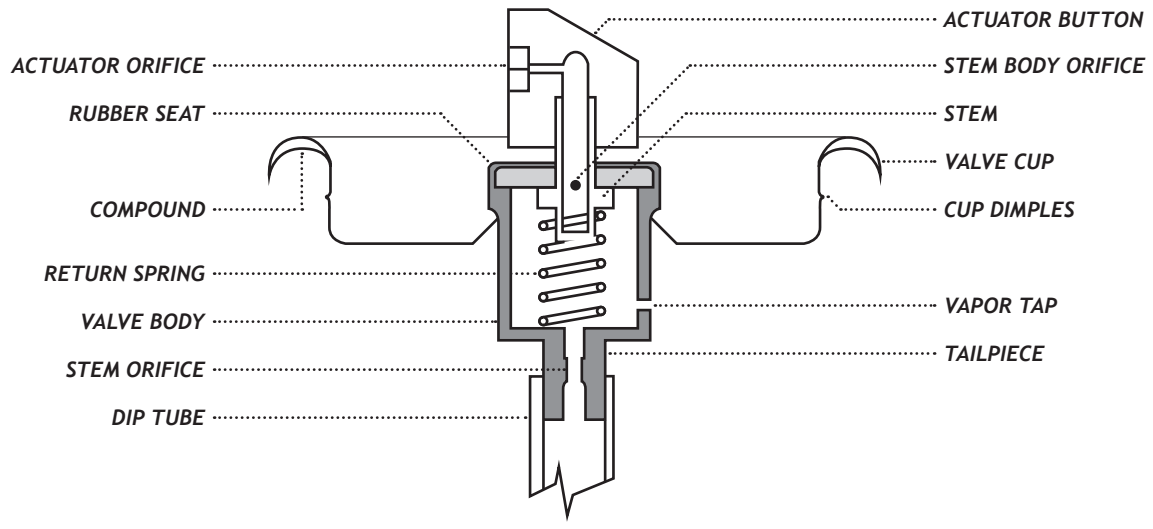


NOTE: *The double seam is a critical can component. Every angle, radius, and dimension must be correct to ensure a hermetic seal.*

AEROSOLS



NOTE: In a two-phase aerosol, the propellant is dissolved in the product.
 In a three-phase system, the propellant forms a separate layer.



TYPICAL AEROSOL VALVE AND MOUNTING CUP

TUBES

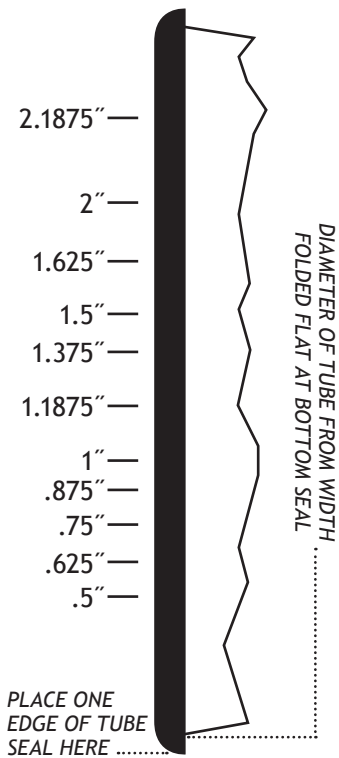
HOW TO MEASURE YOUR PRESENT TUBE

FOR TUBE LENGTH, PLACE SHOULDER OF TUBE HERE.....

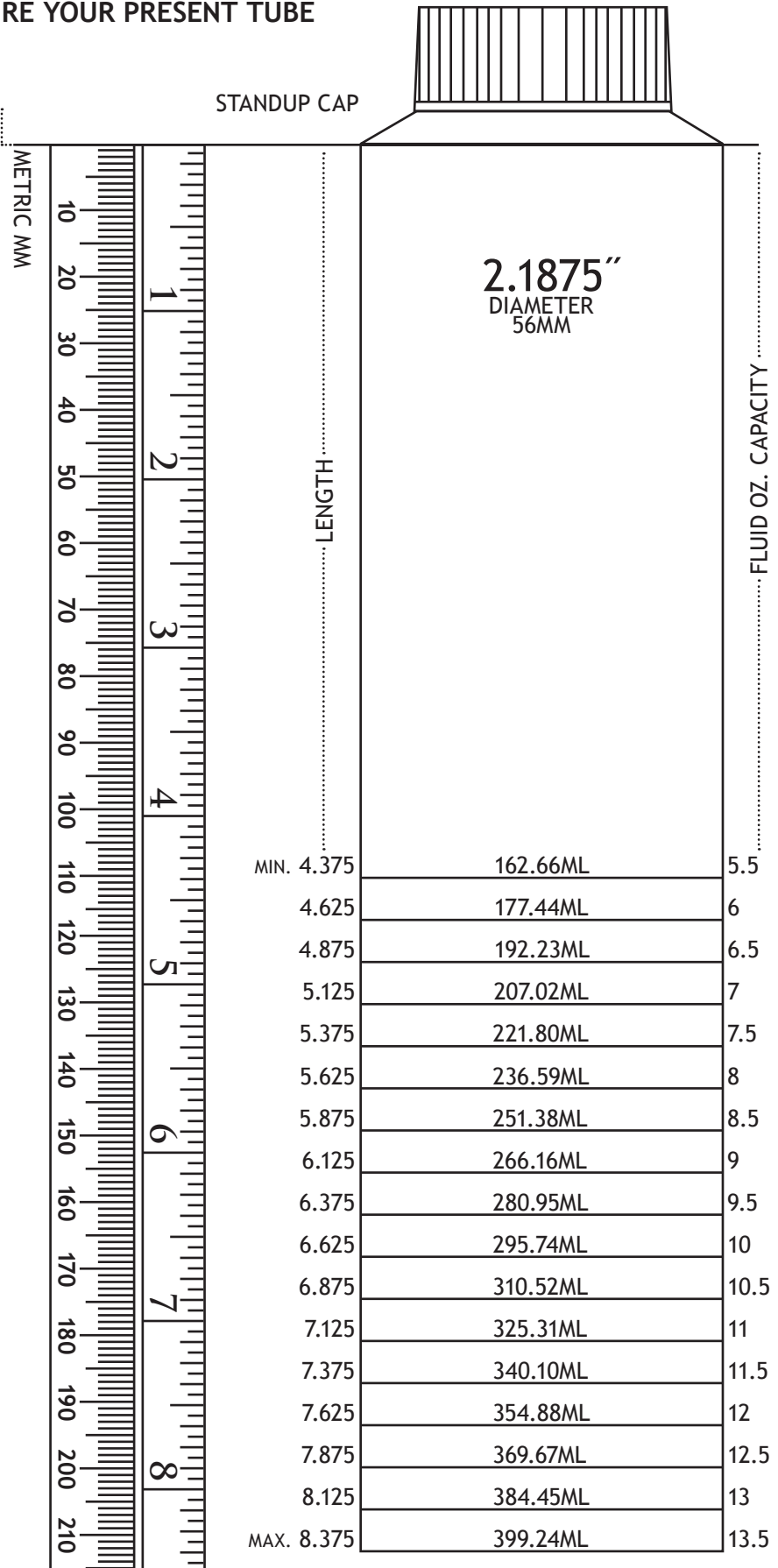
Measure length as directed on printed ruler at right and compare with calibrated lengths and fluid ounce capacities on diagrammed tube at the right. (Tube length is measured from shoulder to open end.)

TO DETERMINE TUBE DIAMETER

Measure diameter on chart below. Note the dimension and compare with range of diameter size diagrammed at the right.



STANDUP CAP

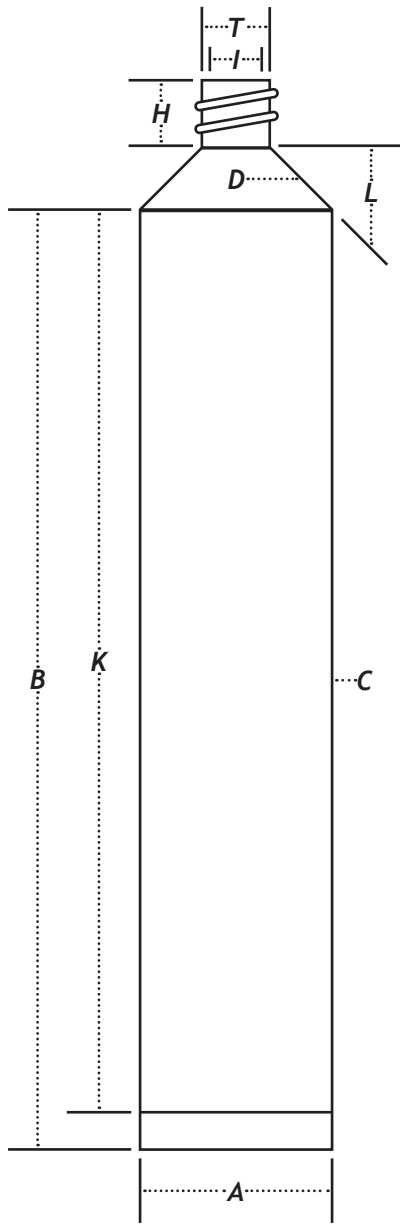


2.1875"
DIAMETER
56MM

FLUID OZ. CAPACITY

PLACE ONE
EDGE OF TUBE
SEAL HERE

TUBES



<i>DIMENSION</i>	<i>DESCRIPTION</i>	<i>DIMENSION</i>	<i>DESCRIPTION</i>
A	OUTSIDE DIAMETER	I	ORIFICE DIAMETER
B	BODY LENGTH	K	DECORATED LENGTH
C	WALL THICKNESS	L	SHOULDER ANGLE
D	SHOULDER THICKNESS	T	FINISH NECK DIAMETER
H	NECK LENGTH		

TUBE DIMENSIONS