PACKAGING EVALUATIONS / TESTS

Abrasion — Scuff/Scratch
Barrier Properties
Blister Adhesion to Board
Cap Liner — Thickness/Adhesion
Carbon
Chemical Resistance
Compression
Corrugated — Stack Strength/Burst/ETC
Decoration Adhesion
Density (SPG)
Dimensions
ESCR (Environmental Stress Cracking Resistance)
Fading — Light Sensitivity
Function
Glue Seam/Flap Sealing Strength
Grain Direction
Headspace
Label Adhesion
Leakage
Legibility of Printing
Line/Machinery Trial
Melt Flow
Neck — Finish Dimensions & Mating
OverFlow
Oxygen
Permeability
Plastic Properties
Porosity
Product Compatibility
Product Dispensing/Delivery
Product Resistance
Sealing
Ship Test (NSTA/UPS) — Vibration and Drop
Sterility
Strength of Material
Thickness (Caliper)
Torque
Tube Seal Strength
UPC Scanning
Vacuum
WVTR (Water Vapor Transmission Rate)
Weight

CHILD PANEL TEST PROTOCOL

CHILD TEST PANEL	CUMULATIVE NUMBER OF CHILDREN	CHILD PANEL PASS/FAIL LEVELS					
		FIRST 5 MINUTES			FULL 10 MINUTES		
		PASS	CONTINUE	FAIL	PASS	CONTINUE	FAIL
1	50	100% - 94%	92% - 80%	≤ 78%	100% - 90%	88% - 72%	≤ 70%
2	100	96% - 90%	89% - 82%	≤ 81%	84% - 85%	84% - 76%	≤ 75%
3	150	92.7% - 88%	87.3% - 83.3%	≤ 82.7%	89.3% - 83.3%	82.7% - 77.3%	≤ 76.7%
4	200	90.5% - 85%	—	≤ 84.5%	87% - 80%	—	≤ 79.5%

CHILD PANEL COMPOSITION

Gender: 50% female/male
Age: 30% 42–44 months, 40% 45–48 months, 30% 49–53 months.
Sites: Minimum of 5 sites, no more than 20% per site.
Testers: Minimum 4 testers, no more than 30% per tester.

TESTING PROCEDURE

Children are tested in pairs. Children are initially given 5 minutes to open the package or access the product. After 5 minutes, the tester gives a visual demonstration on how to open the package. Children are told they may use their teeth, then are given five more minutes to open the package.

SENIOR PANEL TEST PROTOCOL

SENIOR ADULTS	SENIOR ADULT USE EFFECTIVENESS*
	PASS
100	90% OR HIGHER

The SAUE is the senior adult effectiveness minus the percent of children over 20% who fail (i.e., open the package). For example, if 92 of the 100 seniors pass and 22 of the children fail, the SAUE is 92 - [(22-18.4*)] = 88.4% effective. This would not be considered a "pass" since it is less than 90%. *The 18.4 represent 20% of the child panel. Child failures in excess of 20% are subtracted from the senior passes.

SENIOR PANEL COMPOSITION

Gender: 70% female, 30% male
Age: 25% aged 50–54 years, 25% aged 55–59 years, 50% aged 60–70 years
Sites: Minimum of 5 sites, no more than 24% per site.
Testers: Minimum 3 testers, no more than 35% per tester.

TESTING PROCEDURE

Seniors are given five minutes to open (or close) the first package. Seniors are then given an identical package and given 60 seconds to open, and if appropriate, close the second package. If a resecuring check is needed, the second package is given to a child panel. The SAUE calculation would then include the results of the child panel.

If the senior fails to open the first package, he is given two non-child-resistant packages, each of which must be opened and closed in 60 seconds. Only seniors who can open and close two non-CR packages are included in the panel.

CUSTOMARY U.S. WEIGHTS AND MEASURES

LINEAR MEASURE

12 inches (in)	=	1 foot (ft)
3 feet	=	1 yard (yd)
5.5 yards	=	1 rod (rd), pole, or perch (16.5 ft)
40 rods	=	1 furlong (fur) = 220 yards = 660 ft
8 furlongs	=	1 statute mile (mi) = 1,760 yds = 5,280 ft
3 land miles	=	1 league
5,280 feet	=	1 statute or land mile
6,076.11549 feet	=	1 international nautical mile

AREA MEASURE

144 square inches	=	1 sq ft
9 square feet	=	1 sq yd = 1,296 sq in
30.25 square yards	=	1 sq rd = 272.25 sq ft
160 square rods	=	1 acre = 4,840 sq yds = 43,560 sq ft
640 acres	=	1 sq mi
1 mile square	=	1 section (of land)
6 miles square	=	1 township = 36 sections = 36 sq mi

CUBIC MEASURE

1,728 cubic inches	=	1 cu ft
27 cubic feet	=	1 cu yd

LIQUID MEASURE

When necessary to distinguish the liquid pint or quart from the dry pint or quart, the word "liquid" or the abbreviation "liq" should be used in combination with the name or abbreviation of the liquid unit.

4 gills (gi)	=	1 pint (pt) (= 28.875 cu in)
2 pints	=	1 quart (qt) (= 57.75 cu in)
4 quarts	=	1 gallon (gal) (= 231 cu in) = 8 pts = 32 gills

APOTHECARIES' FLUID MEASURE

60 minims (min)	=	1 fluid dram (fl dr) (= 0.2256 cu in)
8 fluid drams	=	1 fluid ounce (fl oz) (= 1.8047 cu in)
16 fluid ounces	=	1 pt (= 28.875 cu in) = 128 fl drs
2 pints	=	1 qt (= 57.75 cu in) = 32 fl oz = 256 fl drs
4 quarts	=	1 gal (= 231 cu in) = 128 fl oz = 1,024 fl drs

DRY MEASURE

When necessary to distinguish the dry pint or quart from the liquid pint or quart, the word "dry" should be used in combination with the name or abbreviation of the dry unit.

2 pints	=	1 qt (= 67.2006 cu in)
8 quarts	=	1 peck (pk) (=537.605 cu in) = 16 pts
4 pecks	=	1 bushel (bu) (= 2,150.42 cu in) = 32 qts

GUNTER'S OR SURVEYOR'S CHAIN MEASURE

7.92 inches	=	1 link (li)
100 links	=	1 chain (ch) = 4 rods = 66ft
80 chains	=	1 statute mile = 320 rods = 5,280 ft

AVOIRDUPOIS WEIGHT

When necessary to distinguish the avoirdupois dram from the apothecaries' dram, or to distinguish the avoirdupois dram or ounce from the fluid dram or ounce, or to distinguish the avoirdupois ounce or pound from the troy or apothecaries' ounce or pound, the word "avoirdupois" or the abbreviation "avdp" should be used in combination with the name or abbreviation of the avoirdupois unit. (The "grain" is the same in avoirdupois, troy and apothecaries' weights.)

27.3438 grains	=	1 dram (dr)
16 drams	=	1 oz = 437.5 grains
16 ounces	=	1 lb = 256 drams = 7,000 grains
100 pounds	=	1 hundredweight (cwt)*
20 hundredweights	=	1 ton (tn) = 2,000 lbs*

In "gross" or "long" measure, the following values are recognized:

112 pounds	=	1 gross or long cwt*
20 gross or long hundredweights	=	1 gross or long ton = 2,240 lbs*

*When the terms "hundredweight" and "ton" are used unmodified, they are commonly understood to mean the 100-pound hundredweight and the 2,000-pound ton, respectively; these units may be designated "net" or "short" when necessary to distinguish them from the corresponding units in gross or long measure.

CIRCULAR MEASURE

Second (")	=	1/60 minute
Minute (')	=	60 seconds
Degree (°)	=	60 minutes
Right angle	=	90 degrees
Straight angle	=	180 degrees
Circle	=	360 degrees

TROY WEIGHT

24 grains	=	1 pennyweight (dwt)
20 pennyweights	=	1 ounce troy (oz t) = 480 grains
12 ounces troy	=	1 pound troy (lb t)
	=	240 penny weights
	=	5,760 grains

APOTHECARIES' WEIGHT

20 grains	=	1 scruple (s ap)
3 scruples	=	1 dram apothecaries' (dr ap)
	=	60 grains
8 drams apothecaries'	=	1 ounce apothecaries' (oz ap)
	=	24 scruples
	=	480 grains
12 ounces apothecaries'	=	1 pound apothecaries' (lb ap)
	=	96 drams apothecaries'
	=	288 scruples = 5,760 grains

METRIC WEIGHTS AND MEASURES

LINEAR MEASURE

10 millimeters (mm)	=	1 centimeter (cm)
10 centimeters	=	1 decimeter (dm) = 100 millimeters
10 decimeters	=	1 meter (m) = 1,000 millimeters
10 meters	=	1 dekameter (dam)
10 dekameters	=	1 hectometer (hm) = 100 meters
10 hectometers	=	1 kilometer (km) = 1,000 meters

AREA MEASURE

100 square millimeters (mm^2)	=	1 sq centimeter (cm^2)
10,000 square centimeters	=	1 sq meter (m^2) = 1,000,000 sq millimeters
100 square meters	=	1 are (a)
100 ares	=	1 hectare (ha) = 10,000 sq meters
100 hectares	=	1 sq kilometer (km^2) = 1,000,000 sq meters

WEIGHT

10 milligrams (mg)	=	1 centigram (cg)
10 centigrams	=	1 decigram (dg) = 100 milligrams
10 decigrams	=	1 gram (g) = 1,000 milligrams
10 grams	=	1 dekagram (dag)
10 dekagrams	=	1 hectogram (hg) = 100 grams
10 hectograms	=	1 kilogram (kg) = 1,000 grams
1,000 kilograms	=	metric ton (t)

VOLUME MEASURE

10 milliliters (ml)	=	1 centiliter (cl)
10 centiliters	=	1 deciliter (dl) = 100 milliliters
10 deciliters	=	1 liter (l) = 1,000 milliliters
10 liters	=	1 dekaliter (dal)
10 dekaliters	=	1 hectoliter (hl) = 100 liters
10 hectoliters	=	1 kiloliter (kl) = 1,000 liters

CUBIC MEASURE

1,000 cubic millimeters (mm^3)	=	1 cu centimeter (cm^3)
1,000 cubic centimeters	=	1 cu decimeter (dm^3)
	=	1,000,000 cu millimeters
1,000 cubic decimeters	=	1 cu meter (m^3) = 1 stere
	=	1,000,000 cu centimeters
	=	1,000,000,000 cu millimeters

GEOMETRIC FORMULAS

CIRCLE		
area	=	.5 diameter X .5 circumference
area of sector	=	length of arc X .5 radius
area of segment which is greater than semicircle	=	area of sector of equal radius + area of triangle
area of segment which is less than semicircle	=	area of sector of equal radius - area of triangle
circumference	=	diameter X 3.1416 radius X 6.283185
diameter	=	circumference X .3183
radius	=	circumference X .0159155
CYLINDER OR PRISM		
surface	=	(area of both ends) + (length X circumference)
ELLIPSE		
area	=	product of the two diameters X .7854
PARABOLA		
area	=	2/3 altitude X base
PARALLELOGRAM		
area	=	altitude X base
POLYGON (REGULAR)		
area	=	sum of sides X perpendicular from center to one of sides ÷ 2
PYRAMID OR CONE		
surface	=	circumference of base X .5 slant height + area of base
contents	=	1/3 altitude X area of base
RECTANGLE		
area	=	length X width
SPHERE		
circumference	=	cube root of solidity X 3.8978
	=	square root of surface X 1.772454
contents	=	diameter X .5236
contents of segment	=	(height squared + three times the square of radius of base) X (height X .5236)
diameter	=	square root of surface X .56419
	=	cube root of solidity X 1.2407
surface	=	circumference X diameter
volume	=	surface X 1/6 diameter
	=	diameter cubed X .5236
	=	radius cubed X 4.1888
	=	circumference cubed X .016887
SQUARE		
area	=	length X width
Trapezium		
area	=	divide trapezium into two triangles; add their areas
Trapezoid		
area	=	altitude X .5 sum of parallel sides
Triangle		
area	=	.5 altitude X base
WEDGE		
contents	=	.5 altitude X area of base

CUSTOMARY/METRIC CONVERSIONS (APPROXIMATE)

CUSTOMARY				METRIC	METRIC			CUSTOMARY
Inch (in)	x	25.4	=	millimeter	Millimeter (mm)	x	.04	= inch
Foot (ft)	x	.3	=	meter	Meter (m)	x	3.3	= foot
Yard (yd)	x	.9	=	meter	Meter (m)	x	1.1	= yard
Mile (mi)	x	1.6	=	kilometer	Kilometer (km)	x	.6	= mile
Square inch (in^2)	x	6.5	=	sq centimeter	Sq centimeter (cm^2)	x	.2	= sq inch
Square foot (ft^2)	x	.1	=	sq meter	Sq meter (m^2)	x	10.8	= sq feet
Square yard (yd^2)	x	.8	=	sq meter	Sq meter (m^2)	x	1.2	= sq yard
Acre	x	.4	=	hectare	Hectare (ha)	x	2.5	= acre
Cubic foot (ft^3)	x	.03	=	cu meter	Cu meter (m^3)	x	35.3	= cu foot
Cord (cd)	x	3.6	=	cu meter	Liter (l)	x	1.1	= quart (liq)
Quart (lq) (qt)	x	.9	=	liter	Cu meter (m^3)	x	284.2	= gallon
Gallon (gal)	x	.004	=	cu meter	Gram (g)	x	.04	= ounce (avdp)
Ounce (avdp) (oz)	x	28.4	=	gram	Kilogram (kg)	x	2.2	= pound (avdp)
Pound (avdp) (lb)	x	.5	=	kilogram	Kilowatt (kW)	x	1.3	= horsepower
Horsepower (hp)	x	.7	=	kilowatt	Degrees Celsius	x	9/5 + 32	= degrees Fahrenheit
Degrees Fahrenheit (-32)	x	5/9	=	degrees Celsius				

UNITS OF LENGTH AND AREA

CUSTOMARY				METRIC	METRIC			CUSTOMARY
Inch (in)	=		=	25.4 millimeters	Millimeter (mm)	=	.001 meter	= .039 inch
Foot (ft)	=	12 in	=	.305 meter	Centimeter (cm)	=	.01 meter	= .394 inch
Yard (yd)	=	36 in or 3 ft	=	.914 meter	Decimeter (dm)	=	.1 meter	= 3.937 inches
Mile (mi)	=	5,280 ft	=	1.609 kilometers	Meter (m)	=		= 3.281 feet
Square inch (in^2)	=		=	6.452 cm^2	Kilometer (km)	=	1,000 meters	= .621 mile
Square foot (ft^2)	=	144 sq in	=	.093 m^2	Sq millimeter (mm^2)	=	.000 001 m^2	= .002 sq in
Square yard (yd^2)	=	1,296 sq in or 9 sq ft	=	.836 m^2	Sq centimeter (cm^2)	=	.0001 m^2	= .155 sq in
					Sq decimeter (dm^2)	=	.01 m^2	= 15.5 sq in
Acre	=	43,560 sq ft	=	.405 ha	Sq meter (m^2)	=		= 10.764 sq ft
Square mile (mi^2)	=	640 acres	=	2.59 km^2	Hectare (ha)	=	10,000 m^2	= 2.471 acres
					Sq kilometer (km^2)	=	1,000,000 m^2	= .386 sq mi

UNITS OF WEIGHT (OR MASS)

CUSTOMARY	AVOIRDUPOIS[1]		METRIC	METRIC		CUSTOMARY
Grain	=		= .065 gram	Gram (g)	=	= .035 oz avdp or .032 oz troy
Ounce (oz avdp)	=	437.5 grains or 16 drams	= 28.350 grams	Dekagram (dag)	=	10 g = .353 oz avdp or .322 oz troy
Pound (lb avdp)	=	7,000 grains or 16 ounces	= .454 kilogram	Hectogram (hg)	=	10 g = 3.527 oz avdp or 3.215 oz troy
Hundredweight (cwt)	=	100 pounds	= 45.359 kg			
Ton, short (tn)	=	2,000 pounds	= .907 metric ton	Kilogram (kg)	=	1,000 g = 2.205 lb avdp or 2.679 lb troy
Ton, long	=	2,240 pounds	= 1.016 metric tons	Metric ton	=	1,000 kg = 1.102 short tons or .984 long ton
	TROY[2]					
Ounce (oz troy)[3]	=	480 grains	= 31.104 grams			
Pound (lb troy)	=	5,760 grains or 12 ounces	= .373 kilogram			

[1]For weighing ordinary commodities. *[2]For weighing precious metals, jewels, etc.* *[3]Also known as fine ounces.*

UNITS OF CAPACITY

CUSTOMARY	LIQUID		METRIC	METRIC	DRY		CUSTOMARY
Fluid ounce (fl oz)	=		= 29.573 ml	Pint (pt)	=		= .551 dm^3
Pint (pt)	=	16 fl oz	= .473 liter	Quart (qt)	=	2 pints	= 1.101 dm^3
Quart (qt)	=	32 fl oz or 2 pt	= .946 liter	Peck (pk)	=	8 quarts	= 8.810 dm^3
Gallon (gal)	=	8 pt or 4 qt	= 3.785 liters	Bushel (bu)	=	32 quarts	= 35.238 dm^3

	METRIC	CUSTOMARY	
Milliliter (ml)	= .001 liter	= .034 fl oz (liquid)	= .002 pt (dry)
Liter (l)	=	= 1.057 qt (liquid)	= .908 qt (dry)
Hectoliter (hl)	= 100 liters	= 26.418 gal (liquid)	= 2.838 qt (dry)

CUSTOMARY/METRIC EQUIVALENTS

LENGTH

1 angstrom[1] (light wave measurement)	0.1 millimicron
	0.0001 1 micron
	0.000 000 1 millimeter
	0.000 000 004 inch
1 cable's length	120 fathoms
	720 feet
	219.456 meters
1 centimeter	0.3937 inch
1 chain (Gunter's or surveyor's)	66 feet
	20.1168 meters
1 decimeter	3.937 inches
1 dekameter	32.808 feet
1 fathom	6 feet
	1.8288 meters
1 foot	0.3048 meter
1 furlong	10 chains (surveyor's)
	660 feet
	220 yards
	1/8 statute mile
	201.168 meters
1 inch	2.54 centimeters
1 kilometer	0.621 mile
1 league (land)	3 statute miles
	4.828 kilometers
1 link (Gunter's or surveyor's)	7.92 inches
	0.201168 meter
1 meter	39.37 inches
	1.094 yards
1 micron	0.001 millimeter
	0.000 039 37 inch
1 mil	0.001 inch
	0.0254 millimeter
1 mile (statute or land)	5,280 feet
	1.609 kilometers
1 mile (nautical international)	1.852 kilometers
	1.151 statute miles
	0.999 US nautical miles
1 millimeter	0.03937 inch
1 millimicron (mμ)	0.001 micron
	0.000 000 039 37 inch
1 nanometer	0.001 micrometer or
	0.000 000 039 37 inch
1 point (typography)	0.013 837 inch
	1/72 inch (approximately)
	0.351 millimeter
1 rod, pole, or perch	16.5 feet
	5.0292 meters
1 yard	0.9144 meter

CAPACITIES OR VOLUMES

1 barrel, liquid	31 to 42 gallons[2]
1 barrel, standard for fruits, vegetables, and other dry commodities except cranberries	7,056 cubic inches
	105 dry quarts
	3.281 bushels, struck measure
1 barrel, standard, cranberries	5.286 cubic inches
	86 45/64 dry quarts
	2.709 bushels, struck measure
1 bushel (US), struck measure	2,150.42 cubic inches
	35.238 liters
1 bushel, heaped (US)	2,747.715 cubic inches
	1.278 bushels, struck measure[3]
1 cord (firewood)	128 cubic feet
1 cubic centimeter	0.061 cubic inches
1 cubic decimeter	61.024 cubic inches
1 cubic foot	7.481 gallons
	28.316 cubic decimeters
1 cubic inch	0.554 fluid ounce
	4.433 fluid drams
	16.387 cubic centimeters
1 cubic meter	1.308 cubic yards
1 cubic yard	0.765 cubic meter
1 cup, measuring	8 fluid ounces
	1/2 liquid pint
1 dram, fluid or liquid (US)	1/8 fluid ounce
	0.226 cubic inch
	3.697 milliliters
	1.041 British fluid drachms
1 dekaliter	2.642 gallons
	1.135 pecks
1 gallon (US)	231 cubic inches
	3.785 liters
	0.833 British gallon
	128 US fluid ounces
1 gallon (British Imperial)	277.42 cubic inches
	1.201 US gallons
	4.546 liters
	160 British fluid ounces
1 gill	7.219 cubic ounces
	4 fluid ounces
	0.118 liter
1 hectoliter	26.418 gallons
	2.838 bushels
1 liter	1.057 liquid quarts
	0.908 dry quart
	61.024 cubic inches
1 milliliter	0.271 fluid dram
	16.231 minims
	0.061 cubic inch
1 ounce, fluid, or liquid (US)	1.805 cubic inch
	29.574 milliliters
	1.041 British fluid ounces
1 peck	8.810 liters
1 pint, dry	33.600 cubic inches
	0.551 liter
1 pint, liquid	28.875 cubic inches
	0.473 liter
1 quart, dry (US)	67.201 cubic inches
	1.101 liters
	0.969 British quart
1 quart, liquid (US)	57.75 cubic inches
	0.946 liter
	0.833 British quart
1 quart (British)	69.354 cubic inches
	1.032 US dry quarts
	1.201 US liquid quarts
1 tablespoon, measuring	3 teaspoons
	4 fluid drams
	1/2 fluid ounce
1 teaspoon, measuring	1/3 tablespoon
	1 1/3 fluid drams
1 assay ton[4]	29.167 grams
1 carat	200 milligrams
	3.086 grains
1 dram, apothecaries'	60 grains
	3.888 grams
1 dram, avoirdupois	27 11/32 (=27.344) grains
	1.772 grams
1 grain	64.79891 milligrams
1 gram	15.432 grains
	0.035 ounce, avoirdupois
1 hundredweight, gross or long[5]	112 pounds
	50.802 kilograms
1 hundredweight, net or short	100 pounds
	45.359 kilograms
1 kilogram	2.205 pounds
1 microgram [μg (the Greek letter mu in combination with the letter g)]	0.000 001 gram
1 milligram	0.015 grain
1 ounce, avoirdupois	437.5 grains
	0.911 troy, or apothecaries' ounce
	28.350 grams
1 ounce, troy, or apothecaries'	480 grains
	1.097 avoirdupois ounces
	31.103 grams
1 pennyweight	1.555 grams
1 point	0.01 carat
	2 milligrams
1 pound, avoirdupois	7,000 grains
	1.215 troy, or apothecaries' pounds
	453.59237 grams
1 pound, troy, or apothecaries'	5,760 grains
	0.823 avoirdupois pound
	373.242 grams
1 ton, gross, or long[5]	2,240 pounds
	1.12 net tons
	1.016 metric tons
1 ton, metric	2,204.623 pounds
	0.984 gross ton
	1.102 net tons
1 ton, net, or short	2,000 pounds
	0.893 gross ton
	0.907 metric ton

AREAS OR SURFACES

1 acre	43,560 square feet
	4,840 square yards
	0.405 hectare
1 are	119.599 square yards
	0.025 acre
1 hectare	2.471 acres
1 square centimeter	0.155 square inch
1 square decimeter	15.5 square inches
1 square foot	929.030 sq centimeters
1 square inch	6.4516 sq centimeters
1 square kilometer	0.386 square mile
	247.105 acres
1 square meter	1.196 square yards
	10.764 square feet
1 square mile	258.999 hectares
1 square millimeter	0.002 square inch
1 square rod, square pole, or square perch	25.293 square meters
1 square yard	0.836 square meters

[1]The angstrom is basically defined as 10^{-10} meter. [2]There is a variety of "barrels" established by law or usage. For example, federal taxes on fermented liquors are based on a barrel of 31 gallons; many state laws fix the "barrel for liquids" at 31.5 gallons; one state fixes a 36-gallon barrel for cistern measurement; federal law recognizes a 40-gallon barrel for "proof spirits"; by custom, 42 gallons comprise a barrel of crude oil or petroleum products for statistical purposes, and this equivalent is recognized "for liquids" by four states. [3]Frequently recognized as 1 1/4 bushels, struck measure. [4]Used in assaying. The assay ton bears the same relation to the milligram that a ton of 2,000 pounds avoirdupois bears to the ounce troy; hence the weight in milligrams of precious metal obtained from one assay ton of ore gives directly the number of troy ounces to the net ton. [5]The gross or long ton and hundredweight are used commercially in the United States to only a limited extent, usually in restricted industrial fields. These units are the same as the British "ton" and "hundredweight."

CLOSURE APPLICATION TORQUE

The application torque of closures must be controlled in order for the closures to perform properly in the field. Closures must be applied tight enough to maintain a seal and to resist closure back off, but must not be applied so tightly that the end user cannot remove the closure.

A general guide is that the application torque should equal approximately 1/2 the inch pounds of the closure millimeter size.

As application torque cannot be measured directly on an automatic capper, removal torque measurements are used as an indication of application torque. Since each package will have its own relationship of application to removal torque, the packager should determine this relationship for each of his packages. By applying caps by hand with a torque meter and immediately measuring the removal torque, a correlation between application and removal torque can be determined. This correlation can then be used as an indicator of the actual application torque generated by the capper. By checking removal torque regularly after capping, one can determine if there is a need for adjustment.

CLOSURE APPLICATION TORQUE

CAP SIZE	*TORQUE (INCH/POUNDS)*	
	Glass	**Plastic**
15	6 - 9	7 - 9
20	8 - 12	10 - 12
24	10 - 15	12 - 15
28	11 - 17	13 - 17
33	13 - 20	16 - 20
38	15 - 23	19 - 23
43	17 - 26	21 - 26
45	18 - 28	23 - 29
48	19 - 29	24 - 29
53	21 - 32	27 - 32
58	23 - 35	29 - 35
63	25 - 38	31 - 38
70	28 - 42	35 - 42
83	34 - 49	41 - 49
89	36 - 53	44 - 53
100	40 - 60	48 - 60
110	45 - 65	55 - 65
120	48 - 72	60 - 72

Courtesy of
THE LERMAN CONTAINER CORPORATION, NEW HAVEN, CT

DECIMAL EQUIVALENTS OF COMMON FRACTIONS

		1/64	=	0.015	625
	1/32	2/64	=	.031	25
		3/64	=	.046	875
1/16	2/32	4/64	=	.062	5
		5/64	=	.078	125
	3/32	6/64	=	.093	75
		7/64	=	.109	375
1/8	**4/32**	**8/64**	**=**	**.125**	
		9/64	=	.140	625
	5/32	10/64	=	.156	25
		11/64	=	.171	875
3/16	6/32	12/64	=	.187	5
		13/64	=	.203	125
	7/32	14/64	=	.218	75
		15/64	=	.234	375
1/4	**8/32**	**16/64**	**=**	**.25**	
		17/64	=	.265	625
	9/32	18/64	=	.281	25
		19/64	=	.296	875
5/16	10/32	20/64	=	.312	5
		21/64	=	.328	125
	11/32	22/64	=	.343	75
		23/64	=	.359	375
3/8	**12/32**	**24/64**	**=**	**.375**	
		25/64	=	.390	625
	13/32	26/64	=	.406	25
		27/64	=	.421	875
7/16	14/32	28/64	=	.437	5
		29/64	=	.453	125
	15/32	30/64	=	.468	75
		31/64	=	.484	375
1/2	**16/32**	**32/64**	**=**	**.50**	

		33/64	=	0.515	625
	17/32	34/64	=	.531	25
		35/64	=	.546	875
9/16	18/32	36/64	=	.562	5
		37/64	=	.578	125
	19/32	38/64	=	.593	75
		39/64	=	.609	375
5/8	**20/32**	**40/64**	**=**	**.625**	
		41/64	=	.640	625
	21/32	42/64	=	.656	25
		43/64	=	.671	875
11/16	22/32	44/64	=	.687	5
		45/64	=	.703	125
	23/32	46/64	=	.718	75
		47/64	=	.734	375
3/4	**24/32**	**48/64**	**=**	**.75**	
		49/64	=	.765	625
	25/32	50/64	=	.781	25
		51/64	=	.796	875
13/16	26/32	52/64	=	.812	5
		53/64	=	.828	125
	27/32	54/64	=	.843	75
		55/64	=	.859	375
7/8	**28/32**	**56/64**	**=**	**.875**	
		57/64	=	.890	625
	29/32	58/64	=	.906	25
		59/64	=	.921	875
15/16	30/32	60/64	=	.937	5
		61/64	=	.953	125
	31/32	62/64	=	.968	75
		63/64	=	.984	375

FADEOMETER TEST & EQUIVALENT SHELF-LIFE (DAYS)

FADEOMETER EXPOSURE HOURS	*JUNE JULY AUGUST*	*SEPTEMBER APRIL MAY*	*OCTOBER NOVEMBER MARCH*	*DECEMBER JANUARY FEBRUARY*
1	0.42	1.26	2.5	7.5
2.33	1.0	3.0	6.0	18.0
6	2.5	7.5	15.0	45.0
12	5.0	15.0	30.0	90.0
24	10.0	30.0	60.0	180.0
48	20.0	60.0	120.0	360.0
96	40.0	120.0	240.0	720.0
134	60.0	180.0	360.0	1080.0

NOTES:

1) BASED ON DATA DETERMINED BY THE UNITED STATES BUREAU OF STANDARDS AT WASHINGTON. FOR AVERAGE DAYS IN WASHINGTON, D.C. AT SEA LEVEL AND A LATITUDE OF 39°.

2) SUNLIGHT HOURS (9 a.m. TO 3 p.m.) IS CONSIDERED ONE DAY.

Courtesy of
JENKEN ASSOCIATES

PLASTIC BURNING TEST

Plastics are complex organic compounds which in the course of manufacture are generally compounded with dyes or pigments, extenders, anti-oxidants, stabilizers, plasticizers, impact modifiers, ultra-violet inhibitors, slip agents and/or a score of agents that contribute to the function and stability of the molded part. Accordingly, there are no rapid simple tests that will completely identify a plastic material owing to the contaminating effects of the additives. Completely accurate identification can only be carried out by sophisticated spectrographic and chromatographic means; however, it is possible to utilize experience and some basic measures to estimate the chemical nature of a specimen. It is recommended whenever possible to compare the behavior and appearance of an unknown specimen with an authentic sample of a known polymer.

Care should be exercised when subjecting materials to combustion tests that only small specimens of the sample be burned. Certain polymers are flammable with almost explosive violence; others may decompose and emit noxious or poisonous vapors.

ABS (ACRYLONITRILE/BUTADIENE/STYRENE)

Burns readily and is not self-extinguishing. The flame is similar to that of polystyrene, much black and soot being evolved. When the flame is extinguished, the characteristic odor of styrene (monomer) tends to predominate, but the bitter acrylonitrile and rubbery butadiene distinguish the material from polystyrene.

ACETYL POLYMERS AND COPOLYMERS, POLYFORMALDEHYDES

Burns readily with a very pale blue flame. When the flame is extinguished, the extremely pungent odor of formaldehyde is unmistakable.

ACRYLIC

Burns readily with a yellow flame, blue around the bottom edges, sometimes a white tip and some black smoke; spurts and is not self-extinguishing. Very little char is left after the flame is blown out. The odor is characteristic of acrylic monomers: a not unpleasant floral scent.

BUTYL RUBBER

Burns readily and is not self-extinguishing. The flame is yellow, and black smoke is given off. Softens and cracks on ignition. Characteristic burnt rubber odor.

CASEIN

Burns with moderate ease producing a yellow flame that is self-extinguishing. Emits gray smoke, swells and chars, having the characteristic odor of burning milk.

CELLULOSE

There is a yellow-white luminous flame, not self-extinguishing, releasing the odor of burnt paper.

CELLULOSE ACETATE

Burns slowly but is not self-extinguishing. The flame is vivid yellow, and some smoke and sparks are given off. The ignited material melts and drips. The drippings continue to burn emitting the vinegar smell of acetic acid. A woody odor may also be detected once the flame is extinguished.

CELLULOSE ACETATE BUTYRATE

Burns readily and is not self-extinguishing. The flame is vivid yellow with a light blue edge. Some black smoke is given off. The ignited plastic melts and drips burning droplets. The odor is characteristic of butyric acid (rancid butter). Molded parts from CAB emit the same odor when being held in a hot moist environment.

CELLULOSE ACETATE PROPIONATE

Burns readily and is not self-extinguishing. The flame is intense yellow. Some black smoke is given off. The ignited plastic melts and drips burning droplets. The odor is characteristic of propionic acid.

CELLULOSE NITRATE

Extremely flammable and may burn violently. Burns at a very rapid rate and is not self-extinguishing. The flame is an intense white or yellow and very hot. The material burns completely, too quickly often to permit the odor of camphor to be discerned. This odor may be recognized when vigorously rubbing unburned samples on one's clothing.

CELLULOSE PROPIONATE

Burns readily and is not self-extinguishing. The flame is dark yellow and some black smoke is given off. It softens upon heating and the odor is characteristic of propionic acid.

ETHYL CELLULOSE

Burns readily and is not self-extinguishing. The flame is yellow with a light blue edge. Some black smoke is given off. The ignited plastic melts and drips burning droplets. The odor is characteristic of cellulose acetate with a slightly woody scent.

MELAMINE FORMALDEHYDE AND UREA FORMALDEHYDE

Burns with difficulty and is self-extinguishing. The flame is pale yellow with a light blue-greenish edge. On ignition, the plastic swells, cracks and turns white at the boundaries of the burnt sec-

tions. The odor is characteristic of pungent formaldehyde and may have fish-like overtones.

METHYLPENTENE POLYMERS
Burns readily and is not self-extinguishing. The base of the flame has a smaller clear blue area than has polyethylene, the remainder being yellow. When the flame is extinguished, the odor is quite distinct from that of either polyolefins and is suggestive of camphor.

NATURAL RUBBER
Burns readily. The flame is bright yellow and black smoke is emitted. On ignition, the material softens and has a characteristic familiar odor.

NATURAL RUBBER, HARD (EBONITE)
Burns readily and is not self-extinguishing. The flame is orange-yellow and emits black smoke with spurts or shots of light yellow flame. The material swells on ignition, does not soften, but liquid comes to the surface. The odor is characteristic of burning natural rubber.

NEOPRENE (POLYCHLOROPRENE OR CHLOROPRENE RUBBER)
Ignites easily but is slowly self-extinguishing. The flame is orange-yellow with a slight green area at the base. Black smoke is emitted on ignition, the material softens but char remains. The characteristic odor slightly resembles natural rubber, but is not unpleasant; however a pungent overtone is present.

NYLON
Somewhat difficult to ignite and is self-extinguishing in that the material melts to a free-flowing liquid which drips, carrying the flame with the droplets. The flame is blue with a yellow top and the material froths while burning. The odor is characteristic of burning vegetation. If the resin is glass filled, the glass fibers act as a wick and the specimen continues to burn.

PHENOLIC, CAST
Burns with difficulty and is self-extinguishing. The flame is yellow and sparks are given off. Many deep fissures appear and a strong odor of formaldehyde is emitted.

PHENOLIC MOLDED WITH FILLER
Burns with moderate difficulty and is self-extinguishing. The flame is yellow and the material swells and cracks upon ignition. Although the odor is a formaldehyde scent, it may be masked by decomposing organic fillers such as woodflour.

POLYCARBONATE
Rather difficult to ignite, it burns with a yellow flame and is self-extinguishing. There is a phenol odor.

POLYETHYLENE AND POLYPROPYLENE
Burns readily and is not self-extinguishing. The burning material becomes clear when molten and tends to drip. The base of the flame is clear blue and the remainder yellow. When the flame is extinguished, the smell resembles molten paraffin wax if the polyolefin is polyethylene. The odor is somewhat like burnt motor oil if the material is polyproplene.

POLYETHYLENE TEREPHTHALATE
Burns slowly with a yellow smoky flame. There is a floral (ester) odor. Molten material forms droplets.

POLYSTYRENE
Burns readily and is not self-extinguishing. The flame is orange-yellow and black dense smoke is given off containing smuts of soot. On ignition, the material softens and the odor is that of characteristic styrene monomer. When sniffed in small concentrations, it resembles the scent of marigolds.

POLYTETRAFLUOROETHYLENE
Will not ignite.

POLYURETHANE
Burns with a fairly clear yellow flame emitting a very characteristic acrid odor and very little smoke. Molten plastic drips readily. Most formulations are not self-extinguishing.

POLYVINYL ACETATE
Burns readily and is not self-extinguishing. The flame is vivid yellow and spurts with black smoke. The material softenS upon ignition and has a characteristic sweet fruity odor.

POLYVINYL CHLORIDE (PVC), VINYL CHLORIDE/ACETATE COPOLYMER AND CHLORINATED POLYVINYL CHLORIDE (CPVC)
UNPLASTICIZED: Burns with difficulty and is self-extinguishing. The flame is yellow with green at the bottom edges, spurting green and yellow and giving off white smoke. The material softens upon ignition and has a characteristic unpleasant odor of hydrogen chloride. PLASTICIZED: The flammability behavior is dependent upon the proportion as well as type of plasticizer in the polymer. Most plasticizers burn readily with a yellow smoky flame. The odors are characteristically ester-like, but the pungent hydrogen chloride scent is readily recognizable.

POLYVINYLIDENE CHLORIDE
Ignites only with difficulty and is self-extinguishing. The flame is yellow, green at the edges and spurts green sparks. The material softens upon ignition and on burning, emits a characteristic hydrogen chloride gas odor.

SHELLAC
Burns easily and is not self-extinguishing. The flame is orange-yellow with bottom edges of blue. Black smoke is emitted as well as sparks of blue and light yellow. The material softens upon ignition and has a characteristic odor of molten sealing-wax.

Courtesy of
ROBERT J. SHEFFER

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