AEROSOL PRODUCTS IN PLASTIC CONTAINERS GUIDE

THIRD EDITION - 2020

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AEROSOL PRODUCTS IN PLASTIC CONTAINERS

INTRODUCTION

The methods have been developed by the Plastic Aerosol Research Group, LLC. (PARG), as a result of many years of work and validation amongst cross-industry members.

The information contained in this section should be useful in conducting evaluations to address regulatory requirements and identifying appropriate measurements during the development of and manufacturing of an Aerosol Products in Plastic Containers, hereafter referred to as "Plastic Aerosol."

This section features a glossary of terms and voluntary standard test methods for the determination of key attributes associated with a plastic container and plastic aerosol. This work continues and methods will be developed as needed.

The terminology and voluntary standard methods that follow are intended to raise awareness of key attributes that are unique to plastic, versus "metal," aerosol products, to promote a safe and validated means of assessing such attributes. Where plastic aerosol products behave like existing aerosol products, established methods are referenced. These methods are not all-encompassing, but are designed to provide direction and data useful in determining root cause, which may potentially impact the finished goods filling process of capping, labeling, conveying, packing and shipping.

As always, new regulations, new techniques, improved equipment, improved resins, further studies and revised dimensions may be developed in the future. These may be expected to elaborate, augment, refine or otherwise change the material that is presented in this section. It is advisable to seek advice from container, suppliers, valve suppliers, contract fillers, recent literature and/or consultants before adopting the guidelines or other criteria that may be different than those recommended here.

The methodology developed and presented by PARG should be useful in conducting evaluations to address regulatory requirements and identifying appropriate measurements during the development of and manufacturing of an Aerosol Products in Plastic Containers, hereafter referred to as "Plastic Aerosol."

LIMITATION OF LIABILITY: PARG DOES NOT WARRANT OR GUARANTEE THAT ADHERENCE TO THE METHODOLOGY PRESENTED HEREIN WILL ENSURE THAT ANY PRODUCT DEVELOPED USING THESE GUIDELINES IS MERCHANTIBLE OR FIT FOR A PARTICULAR PURPOSE. IT IS THE SOLE RESPONSIBILITY OF THE MANUFACTURER OF THE PLASTIC AEROSOL TO ENSURE THAT ITS PLASTIC AEROSOL PRODUCT WILL NOT CAUSE INJURY OR DAMAGE TO THE USER.

GLOSSARY OF TERMS USED IN THE AEROSOL INDUSTRY FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS

The following terms are used in the aerosol can manufacturing and aerosol filling sectors of the aerosol industry, and are defined as they relate to plastic (non-metallic) aerosol containers.

A

aerosol size limit In the U.S.A., normally 4 fluid ounces (118.3 mL) of overflow capacity, with valve in place, for non-metallic aerosols. At least one exemption, however, has been issued by the Department of Transportation (DOT).

aesthetic fill Filling to a specific level in a clear or transparent package where the fill level is visible.

ambient temperature Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332

annealing A slow cooling process designed to largely relieve stress concentrations in the manufacture of plastic containers.

annealing Lehr See Lehr oven.

ascot An upward tapering shape characterizing certain aerosol bottles.

B

ballistic energy A form of potential energy, concentrated in the vapor space, causing the spread of glass or plastic fragments upon bursting. Fragment speed.

black panel temperature (a.k.a. Black-Standard temperature) A temperature measuring device consisting of a metal panel, having a black coating witch absorbs all wavelengths uniformly, with a thermal sensitive element firmly attached to the center of the exposed surface. The black panel is used to control an artificial weathering device and to provide an estimate of the maximum temperature of samples exposed to a radiant energy source.

blow molding A process in which a warm plastic parison or preform (hollow tube) is placed between the two halves of a mold (cavity) and blown into the desired shape. This improves the gas barrier, stiffness, clarity and impact strength of the container compared to extrusion molding processes; and as a result, containers can be reduced in weight.

blown necks Overheating of the finish area which allows blow pressure air to stretch the material.

blow pressure The pressure required to form the parison or preform into the shape of the mold cavity, in a blow molding operation.

body The principal part of a container, usually the largest and widest part of the bottle. In bottles, the body is the main portion of the bottle without the neck.

bottom plate (plastic) That part of the mold which contains the heel (base radius) radius and the "push-up" of the container to be formed.

bottle A container, most commonly thought of as made from plastic.

Boston Round A term for a round bottle with rounded shoulder.

burst failure or bursting pressure means the minimum pressure which causes the plastic aerosol container to burst or rupture.

bursting energy The kinetic energy generally released by terminal impaction.

C

capacity The amount of space inside a container for a given amount of product. The normal volume (usually measured in ccs, mls, ounces, or grams) of a bottle, published in standard sizes used by industry. When a bottle is filled to standard capacity, the contents usually fill it up to its shoulder area.

clinch Generally considered to be the mode of attachment for a ferrule-type valve to aluminum cans, steel cans or non-metallic containers by an inward compressive action that tucks the lower portion of the ferrule skirt underneath the container bead or finish. Also, the compressive operation used to the valve body to the pedestal of a one-inch (25.4 mm) valve cup. Sometimes defined as the sealing action of a collet in creating the hermetic joint between a valve cup and can. Clinch is also used to describe the method of securing valve parts into the mounting cup.

collet A hardened steel fitment, hollow within, and longitudinally divided into six or eight tines for most of its length. The collet is caused to descend a fixed distance into the valve cup, and then to spread to a fixed diameter, thus effecting a crimped seal. (Other collets may be used for clinching purposes.)

compressed gas One or more gases in a container having an absolute pressure that exceeds 40 pounds per square inch (PSI) at 37.8°C (100°F) as determined by ASTM D-323-72. Typically nitrogen, argon, helium, oxygen, hydrogen. See also liquefied compressed gas.

container See also bottle and plastic aerosol (aerosol product in a plastic container).

control A material which is of similar composition and construction to the test material used for comparison, exposed at the same time.

convexed wall A bottle with the greatest girth about half-way up and having an arc-like central profile. Opposite to concave wall or "Gibson Girl" profile.

crack A fissure that may or may not penetrate the external surface of the material or its entire thickness, the polymeric material being separated completely between the crack walls.

creep Is a time-dependent strain resulting from stress. Material deformation that occurs as a result of long term exposure to levels of stress that are below the yield or ultimate strength, often in combination with the elevated temperatures. The rate of this damage is a function of the material properties and the exposure time, exposure temperature and the applied load (stress). Depending

on the magnitude of the applied stress and its duration, the deformation may become so large that a component can no longer perform its function.

crystallinity Is a process associated with partial alignment of their molecular chains. These chains fold together and form ordered regions called lamellae, which compose larger spheroidal structures named spherulites. Polymers can crystallize upon cooling from the melt, mechanical stretching or solvent evaporation. Crystallization affects optical, mechanical, thermal and chemical properties of the polymer. The degree of crystallinity is estimated by different analytical methods

crimp The seal or method of seal, between valve cup and one-inch (25.4 mm) can plug. Usually affected by various crimping collets. Refer to definition of *clinch* for applicability of plastic aerosols.

cycle The complete, repeating sequence of operations in a process. In molding, the cycle time is the period of elapsed time between a certain point in one cycle and the same point in the next.

cylinder round A bottle having a circular profile when viewed from above, often with a simple, tapered top section.

D

day light As used in weathering, the term equivalent to “sunlight”. It refers to the full spectrum of solar irradiance, that is, ultraviolet through infared, and includes both diffuse sky and direct solar irradiance.

density Weight per unit of volume of a substance, expressed in grams per cubic centimeter, pounds per cubic foot, etc.

dimensional stability The ability of a material to maintain its shape under given processing or use conditions.

deionized water (DI water, DIW or de-ionized water), is water that has had almost all of its mineral ions removed, such as cations like sodium, calcium, iron, and copper, and anions such as chloride and sulfate.

design evaluation is defined as means to compare design alternatives in development process which the container will be expected to meet design qualification requirements.

design qualification is defined as a verification process on the design, typically done during the scale-up to commercial production, to meet particular requirements relating to the integrity, regulatory and manufacturing practices.

dip machine A device containing a dip-tank, containing melted adhesive or polyvinylchloride. The pristine bottle, held through the opening, is dipped as a part of the coating or sheathing process.

drop testing/drop impact failure A quality control test to determine resistance to breakage.

E

end treatment Various surface treatments of the hot or cold bottle. See hot-and-cold treatments.

explosion The bursting or rupture of an aerosol upon terminal impaction or application of excessive pressure.

F

fill point The level to which a container must be filled to supply a designated quantity of the contents.

finish The uppermost part of a bottle, above the neck, and to which the valve ferrule is normally attached.

Nomenclature of finish for aerosol product in a plastic container:

- B – Height of Seal Beads
- E – Lip Root Diameter
- H_i – Minimum clearance from TOF on inner diameter for proper valve application
- H_o – Minimum clearance, at "E" diameter, from TOF for proper valve application
- I – Minimum diameter through the finish to a depth of H_i
- L – Height of the Lip
- T – Lip Clinch Diameter
- W – Support Ledge height
- X – Height from TOF to bottom of Support Ledge
- Z – Diameter of the Support Ledge

flash The extra plastic attached to a molding along the parting line, that is removed before the part is considered finished.

fragment A piece of broken plastic, sometimes ejected from a burst site with considerable energy.

fragmentation The bursting of a plastic container into a multiplicity of small segments.

G

gate The preform is injection molded and must have a gate, or an opening that allows the molten plastic to be injected into the cavity of the mold.

glass transition temperature (T_g) As the temperature of a polymer drops below Tg, it behaves in an increasingly brittle manner. As the temperature rises above the Tg, the polymer becomes more rubber-like. The glass transition is not a sharp transition at a certain temperature as it occurs over a certain temperature range.

H

head space The space between the level of the contents in the neck of a bottle and the closure. It is intended to furnish space for expansion of product due to heat or other action after packing.

hot tank A hot water trough used to warm and leak-test an aerosol products in a plastic container.

Small dispensers are often laid in perforated trays and submerged in lots of a hundred or more. Large units may be drawn through on conveyors while in pucks. (Not a DOT requirement.)

hydro burst tester Also known as, hydrostatic test, is a way in which pressure vessels such as, plastic aerosol containers, can be tested for strength and leaks. The test involves filling the vessel with water and pressurization of the vessel to the specified test pressure. The test unit shall be capable of a programmable ramping profile and a maximum pressure that will take the plastic container to burst.

I

indented label panel When the diameter of the label panel area on a bottle is smaller than the diameter of the bottle immediately above and below the label panel area. Indented label panels are often used to prevent scuffing of pressure-sensitive paper labels.

injection molding A molding process in which, under pressure, melted or liquefied plastic is forced from a cylinder into a cooled mold cavity to form a desired shape

injection blow molding A blow molding process in which the parison or preform to be blown is formed by injection molding and then blown out into the shape of the cavity that surrounds it.

intrinsic viscosity (IV) The Intrinsic Viscosity, usually expressed in dl/g, is a measure of the polymers molecular weight and therefore reflects the material's melting point, crystallinity and tensile strength.

irradiance The radiant power per unit area incident on a receiver, typically reported in watts per square meter (W/m^2).

J

Jetting Is both an appearance and a structural defect in an injection molded part. It is also called a "worm track" which is a descriptive term for what jetting actually looks like in the molded part. It is caused when the first flow of plastic entering the cavity jets through like a stream of water without forming a proper flow front.

L

Lehr oven An annealing oven, in which plastic container is allowed to slowly cool, thus eliminating significant strains.

lip The micro-grooving of surfaces, external or internal, serving to significantly red

liquefied compressed gas See compressed gas. Typically carbon dioxide or nitrous oxide

load The axial compression that may be applied to plastic container or finish during the valve ferrule clinching operation.

M

melt index Is a viscosity measurement used to characterize the molecular weight.

misshapen ware plastic ware that has out-of-specification dimensions, due to incomplete blowing, or other problems.

molecular weight distribution The ratio of the weight-average molecular weight to the number-average molecular weight gives an indication of the distribution.

N

neck The part of the of the container that is below the finish, typically the narrowest portion of bottle (uppermost part of the bottle).

neck insert Part of the mold assembly that forms the neck and finish. Sometimes called the “neck ring.”

neck ring The part of the mold equipment that forms the finish of a bottle.

nominal capacity The sales definition of container size; often about 80 to 90% of the internal capacity. Also, the volume of product that may be safely filled into a container using standard production methods, allowing for over-fills, thermal expansion and other factors.

O

opalescence A coloration tending to be off-white with variegations of hue, as in the semi-precious opal gemstone.

opaque A plastic bottle that is not transparent.

outside clinch valve Generally considered to be the mode of attachment for a ferrule-type valve to small aluminum cans, stainless steel cans or non-metallic bottles by an inward compressive action that tucks the lower portion of the skirt underneath the container Lip or finish.

Nomenclature of outside clinch valve for aerosol product in a plastic container:

F – Thickness of Cup Plate
G – Thickness of virgin sealing gasket
S – Skirt Inside Diameter
D – Cup Outside Diameter
A – Cup Body Outside Diameter
H – Overall Cup Height
C – Skirt Height
M – Clinch Height
J – Clinch Diameter

ovality Denotes how far a nominally cylindrical neck or bottle departs from a perfectly circular cross-section.

overflow capacity The maximum capacity of the container to the top of the finish if it was filled to the very top. This figure allows manufacturers to determine if their product will fit in a certain bottle style.

P

parison see also preform.

permeability A property of a material of transmitting gases and liquids by passage through one surface and out at another surface by diffusion and sorption processes.

plastic aerosol (aerosol product in a plastic container) A plastic container, or inner container, usually with a capacity up to, but not greater than, 1000 mL, and made typically of polyester, PEN, etc., generally capable of withstanding up to 300 psig (21 bars) pressures when pristine.

Polyethylene naphthalate (PEN) (Poly(ethylene 2,6-naphthalate) is a polyester with good barrier properties (even better than Polyethylene terephthalate), because it provides a very good oxygen barrier.

Polyethylene terephthalate (sometimes written poly(ethylene terephthalate)), commonly abbreviated PET, PETE, is a semicrystalline thermoplastic polymer resin of the polyester family. PET is a hard, stiff, strong, and dimensionally stable material that absorbs very little water. It has good alcohol, solvent and gas barrier properties and good chemical resistance. It also has very good oil barrier properties and is rigid and naturally crystal clear.

preform Used in Blow Molding processes. Heat-softened polymer (such as PET) is formed into a shape similar to a thick test tube with neck threads. In 2-stage stretch blow molding, the preform is cooled for storage; when it is needed, the tube is re-heated and inflated while inside a Blow Mold to create the shape of the desired bottle or jar. In single-stage injection stretch blow molding, the preform is formed immediately prior to being placed in the blow molding station without cooling down.

pristine A bottle, either freshly made or perfectly preserved, without any abrasions, bruises, spallates or other signs of surface abuse.

pushup The contour of the bottom of the plastic container designed in such a manner as to allow as even bearing surface on outside edge and prevent the bottle from rocking.

pyranometers Are used to capture the radiant solar energy. This information is converted to Mega Joules per square meter. As the exposure continues the MJ/m^2 displayed are a running total of the radiation captured during the exposure timeframe.

R

regrind A thermoplastic from a processor's own production that, having been processed by molding, extrusion, etc., is then reground or pelletized for reuse or recycling.

runner In injection molding, one of the passages that take plastic melt from the injection point

(sprue) and distribute it to the various cavities in a multicavity mold.

S

scratching The micro-grooving of surfaces, external or internal, serving to significantly reduce strength.

seal bead Raised grooves on the top of the finish that provide a means of improving the seal that protrude into the valve ferrule gasket.

shall Indicates a mandatory requirement.[1]

shoulder The upper area of an aerosol can, especially the rounded sections of the container.

should Indicates a recommendation or that which is advised but not required.[1]

silk-screening A decoration process limited to about two colors of enamel; especially useful for short production runs. Sometimes done by fillers.

side-wall The long, more-or-less vertical surface of a plastic bottle.

solar radiation Is measured with a pyranometer, reported in terms of total radiation or TUVR.

stress A condition where the plastic is under significant tension at any point, thus considerably weakening it. (opposite of the tension point is compression.)

stress crack An external or internal crack in a plastic caused by stresses less than its short-time mechanical strength. Frequently the development of such a crack is accelerated by the environment to which the plastic is exposed (e.g. contact with its contents or exposure to UV-radiations). The stresses which cause cracking may be present internally or externally, or may be combinations of these stresses.

strain point A site where tensile stresses are highest.

sunlight Includes ultraviolet (UV), visible and infrared (IR) radiation and has a wavelength range of 295-3000 nanometers (nm) on the surface of the earth.

support ledge The feature in the bottle neck, below the Lip, that may or may not be present, serving as means to support the bottle when transferring, filling or conveying. (a.k.a. support ring or transfer ring).

T

target fill means the volume or weight to be filled in production.

test pressure (FEA) means the pressure to which and unfilled plastic aerosol container may be subjected for 25 seconds without any leakage being caused nor showing asymmetrical or major distortions or other similar faults shall be rejected. A slight symmetrical fault shall be allowed

[1] NFPA 30B, Code for the Manufacture and Storage of Aerosol Products, Chapter 3, (2015).

provided that the container passes the bursting pressure test.

T_g see glass transition

thermoplastic Most thermoplastics have a high molecular weight. The polymer chains associate through intermolecular forces, which weaken rapidly with increased temperature, yielding a viscous liquid. Thus, thermoplastics may be reshaped by heating and are typically used to produce parts by various polymer processing techniques such as injection molding.

transparent (of a material or article) allowing light to pass through so that objects behind can be distinctly seen.

TOF Top of Finish, to tip of seal beads, if applicable.

total radiation Measured between 395-3000nm.

TUVR Is Total UV, measured between 295-385nm.

V

valve See also Outside Clinch Valve.

variegated colors A system of two or more colors where each blends into the other to various degrees. Flame designs are a common example.

Revisions:

Revision Number	Date	What is changing	Why it is changing
0	09 May 2016	• Initial release	
1	11 June 2020	• Added definitions for crimp, convexed wall, neck, shoulder, target fill. • Added definitions related to UV and sunlight. • Added Revisions table.	• To align with the industry terminology. • New terminology that was not present prior to assist with methods 20.0 and 21.0. • To keep track of revisions made after initial release.
2	18 June 2020	• Added definitions for Design Evaluation and Qualification	• To provide context to methods using this terminology.
3			
4			
5			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-1.0	**DIMENSIONAL MEASUREMENT FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**9 MAY 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith** **PARG CHAIRPERSON**

1. PURPOSE
   1.1. These procedures are intended to serve as a guide for measuring plastic container dimensions. The measuring instruments illustrated are commonly used, however instruments of equivalent accuracy may be substituted for those shown. These readings may differ from those taken by hand, depending on the experience of the inspector. Consistent measurement and nomenclature is essential to develop meaningful specifications for both the container manufacturer and end user.

2. APPARATUS
   2.1. Height gauge
   2.2. Caliper
   2.3. Depth gauge
   2.4. Plug gauge
   2.5. Optical Comparator, CMM, Laser or equivalent, for non-destructive, electronic measuring
   2.6. Knife or cutting tool-used for cutting samples

3. TEST SPECIMENS
   3.1. Recommended Quantity: 6 containers for routine measurements, or 30 containers for mold qualification, per mold cavity.

4. PROCEDURE
   4.1. Verify calibration of equipment
   4.2. At time of testing, containers to be tested should be at a consistent age and condition
   4.3. Recommendations for conditions are:
      4.3.1. As produced: Test containers as soon as desired, but no less than one hour after manufacture.
      4.3.2. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[1] condition for 40 hours[2].
   4.4. Finish Dimension terminology
      4.4.1. Reference PARG-2.0
   4.5. Overall Height
      4.5.1. Is a measure from the base of the bottle to the top of the finish.
      4.5.2. Height to the bottom of the support ledge (if applicable) may also be desired for height comparisons between filled and empty containers.
   4.6. Body width or Diameter (if applicable)
      4.6.1. Is a measure from one outside surface to the other outside surface at the major and minor axis.
      4.6.2. Width is defined as the longer dimension.
      4.6.3. For round bottles, bottle ovality may be measured. In this case record the measurements of the major and minor axis.

[1] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH, per ASTM D4332).
[2] Per Procedure A of ASTM D618.

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-1.0	**DIMENSIONAL MEASUREMENT FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**9 MAY 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

4.7. Body depth (if applicable)
- 4.7.1. Is a measure from one outside surface to the other outside surface at the major and minor axis.
- 4.7.2. Depth is defined as the smaller dimension.

4.8. Base Clearance (if applicable)
- 4.8.1. Place bottle flat on depth gauge measuring base.
- 4.8.2. Extend the spindle until it touches the base push up contour.
- 4.8.3. Move the depth gauge over bottom, adjusting spindle for continuous contact with container push-up in specified area, not on the parting line area.
- 4.8.4. Record minimum and maximum readings.

4.9. Capacity at Fill Point and Overflow
- 4.9.1. Reference PARG-3.0

4.10. Wall Thickness
- 4.10.1. Reference PARG-4.0

4.11. Record results.

5. ACCEPTANCE CRITERIA
   5.1. Report results using predetermined criteria established by the Interested Parties.

6. SAFETY
   6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES
   7.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers
   7.2. PARG-2.0: Finish dimensions-outside clinch of container (preform)-for aerosol products in plastic containers
   7.3. PARG-3.0: Capacity measurements for aerosol products in plastic containers
   7.4. PARG-4.0: Wall thickness measurement for aerosol products in plastic containers

8. OTHER RESOURCES
   8.1. Not Applicable at this time.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	09 May 2016	• Initial release	
1			
2			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-2.0	**FINISH DIMENSIONS OUTSIDE CLINCH OF CONTAINER (PREFORM) FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE

1.1. Various factors of package quality, including seal integrity, are dependent on the quality of the container's finish. The purpose of this method is to verify those finish dimensions.

2. APPARATUS

2.1. Optical Projection Comparator, CMM or Laser
2.2. Vernier or Digital Calipers
2.3. Plug Gauge
2.4. Height Gauge with Flat Surface

3. TEST SPECIMENS

3.1. The number of test replications depends on the desired objectives of the testing and the availability of duplicate plastic aerosol containers/preforms. Replicate testing should be conducted to improve the reliability of the test results.

4. PROCEDURE

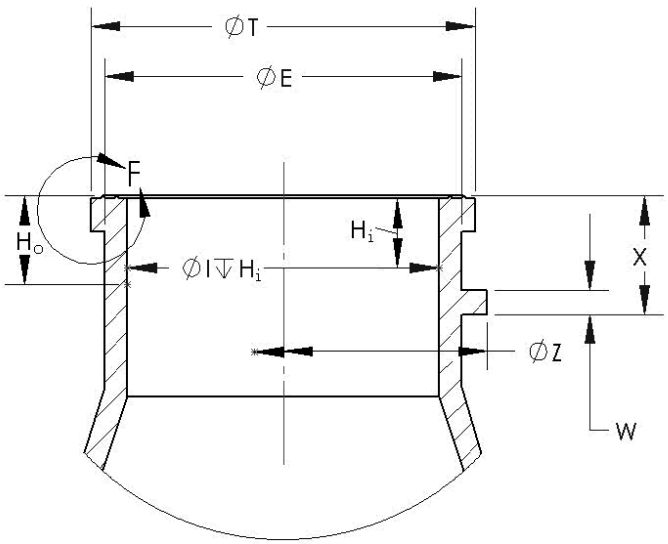
4.1. Verify calibration of apparatus equipment.
4.2. Observe and record incident of gross defects such as "blown necks" and other deformations.
4.3. Observe quality of sealing surfaces. Mark and note instances of short shots, nicks, dents, molding flash, etc.
4.4. At time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are as follows:
    4.4.1. As produced: Test containers once the container has sufficiently cooled, per operator's blow molding quality procedures.
    4.4.2. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[1] temperature for 40 hours[2].
4.5. Measure required finish dimensions.
    4.5.1. Reference MEASUREMENTS, below, for recommended measurements and nomenclature.
        4.5.1.1. Dimensions to be measured are dependent on design.
    4.5.2. Each diameter dimension should be measured at approximately 10°and 90° to the parting line.
    4.5.3. Height and vertical dimensions should not be measured on the parting line.
4.6. Record all data.

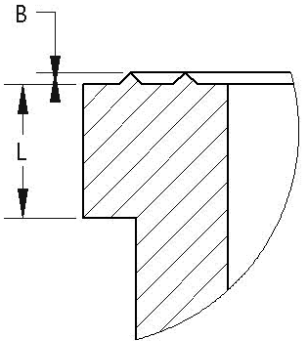
[1] Ambient is Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332
[2] Per procedure A of ASTM D618

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-2.0	**FINISH DIMENSIONS OUTSIDE CLINCH OF CONTAINER (PREFORM) FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

5. MEASUREMENTS
   - 5.1. **B** – Height of Seal Beads
   - 5.2. **T** – Lip Clinch Diameter
   - 5.3. **E** – Lip Root Diameter
   - 5.4. **H_i** – Minimum clearance from TOF[3] on inner diameter for proper valve application
   - 5.5. **H_o** – Minimum clearance, at "E" diameter, from TOF for proper valve application
   - 5.6. **I** – Minimum diameter through the finish to a depth of H_i
   - 5.7. **L** – Lip Clinch height
   - 5.8. **W** – Support Ledge height
   - 5.9. **X** – Height from TOF to bottom of Support Ledge (W)
   - 5.10. **Z** – Diameter of the Support Ledge

6. DRAWING





DETAIL F
SCALE 8 : 1

7. SAFETY
   - 7.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

8. REFERENCES
   - 8.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers

9. OTHER RESOURCES
   - 9.1. Not Applicable at this time.

[3] TOF is defined as Top Of Finish (tip of seal beads, if applicable)

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-2.0	**FINISH DIMENSIONS OUTSIDE CLINCH OF CONTAINER (PREFORM) FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	09 May 2016	• Initial release	
1	11 June 2016	• References of word crimp changed to clinch	• Align with industry terminology
2			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-3.0	**CAPACITY MEASUREMENTS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**22 Nov 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

1. PURPOSE
   1.1 This is a method for determining the capacity of plastic containers at the fill point and at overflow. Accurate assessment of capacity is required to ensure that plastic containers, when filled with product, will meet advertised and legal capacities. The data can also be used to verify sufficient headspace.

2. APPARATUS
   2.1 Balance with accuracy of at least ±0.01 gram
   2.2 Micrometer depth gauge
   2.3 Vented bulb syringe
   2.4 Thermometer with accuracy of at least 0.5°C (1°F)
   2.5 Distilled water
   2.6 Vented top plate (reduces surface tension variability for overflow)
   2.7 Table for density of water per CRC Handbook of Chemistry and Physics
   2.8 A timing device (e.g. stop watch) is used to ensure all bottles are measured within a given amount of time. This allows for a consistent amount of panel expansion during and after fill between the samples.
   2.9 Wetting agent, such as 10% Igepal CO-630 or equivalent nonionic surfactant

3. TEST SPECIMENS
   3.1 Recommended Quantity: 6 mold rounds or minimum of 12 samples for single cavity mold.

4. PROCEDURE
   4.1 Verify calibration of equipment.
   4.2 At time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are as follows:
      4.2.1 As produced: Test containers once the container has sufficiently cooled, per operator's blow molding quality procedures.
      4.2.2 As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[1] temperature for 40 hours[2].
   4.3 Record the actual temperature of the water (target 22°C/72°F).
   4.4 Identify container samples
   4.5 Determine the weight to ± 0.1g of the (first) empty container, record the weight and tare the weight.
   4.6 Prepare a sufficient quantity of test solution, consisting of clean ambient[1] water containing a wetting agent sufficient to flatten the meniscus and eliminate air bubbles. Sufficient wetting agents typically consist of one or two drops of ten percent Igepal CO-630 or equivalent nonionic surfactant.
   4.7 Add the wetting agent, one drop at a time followed by agitation, until the test solution can be transferred without air bubbles. The presence of foaming indicates excessive wetting agent.
   4.8 The solution can be used from bottle-to-bottle, as long as it is not contaminated with solid particles.

[1] Ambient is Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332

[2] Per procedure A of ASTM D618

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-3.0	**CAPACITY MEASUREMENTS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**22 Nov 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

5. Capacity at Overflow
   - 5.1 Weigh the empty bottle and record its weight to the nearest 0.1 gram.
   - 5.2 Place the bottle on a level, vibration-free surface.
   - 5.3 Start timing and transfer test solution to the bottle to just below point of overflow. Eliminate air bubbles, if present, as they interfere with accuracy of the test measurements.
   - 5.4 Add additional test solution in small amounts with the pipette until the meniscus is tangent with the top of the finish.
   - 5.5 The total elapsed time permitted for steps 4.12 through 4.13 must be consistent for a given bottle size and design.
   - 5.6 Weigh the filled bottle and record its weight to the nearest 0.1 gram.
   - 5.7 Repeat the procedure for each bottle on which the capacity at overflow is to be determined.

6. Capacity at Fill Point using Depth Micrometer
   - 6.1 Set the micrometer depth gauge to the specified fill point, as agreed on by parties involved. The fill point is the specified distance below the top of the bottle finish.
   - 6.2 Place the bottle on a level, vibration-free surface.
   - 6.3 Start timing and transfer test solution to the bottle to just below the fill point as rapidly as possible. Eliminate any air bubbles, if present, as they interfere with the accuracy of the measurement. Slight tapping of the bottle will facilitate bubble removal.
   - 6.4 Place the micrometer depth gauge on top of the bottle finish with its stem tip centered inside the bottle and set at the specified fill point.
   - 6.5 Add additional testing solution in small amounts with the pipette until the level of the solution just touches the tip of the depth gauge, and note the elapsed time.
   - 6.6 The total elapsed time permitted for steps 4.20 through 4.22, must be consistent for a given bottle size and design.
   - 6.7 Remove depth gauge and weigh the filled bottle. Record its weight to the nearest 0.1 gram.
   - 6.8 Repeat procedure steps 4.18 through 4.24 for each container.

7. Calculations
   - 7.1 Capacity at fill point and at overflow is determined by subtracting the empty bottle weight from the filled bottle weight.
   - 7.2 The result is the weight of the test solution used to fill the bottle to fill point or to overflow.
   - 7.3 Divide the result by the appropriate volumetric conversion factor to determine capacity in fluid ounces, cubic centimeters, or milliliters.
   - 7.4 The conversion factor for fluid ounce determination of water at 23°C +/- 2°C (73.4 +/- 3.6°F) is approximately 29.50 grams per fluid ounce.
   - 7.5 The averaged conversion factor for determination of volume in cubic centimeters for water at 23°C +/- 2°C (73.4°F +/- 3.6°F) is 0.99756 grams per cubic centimeter.
   - 7.6 The conversion factor for determination of volume in milliliters is 0.99756 grams per milliliter.
   - 7.7 NOTE 1: These conversion factors were developed using the relative density of water at 23°C +/-2°C (73.4°F +/- 3.6°F). They are normally used in volumetric calculations. Any two labs involved in volumetric determinations of representative samples should establish a common factor at the outset.

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-3.0	**CAPACITY MEASUREMENTS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**22 Nov 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

7.8 Determine the density of water at the respective temperature as derived from the water density table in the CRC Handbook of Chemistry and Physics.
7.9 Covert the overflow and fill level weights to volumetric data using the following calculation:
Volume (mL) = Net Weight (g) / Water Density (g/mL)

8. ACCEPTANCE CRITERIA
8.1 Report results using predetermined criteria established by Interested Parties.

6. SAFETY
6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES
7.1. Chemical Technician's Ready Reference Handbook, Fourth Edition, McGraw-Hill, Inc. Copyright-1996 CSPA, Aerosol Guide, Ninth Edition (2009)
7.2. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers

8. OTHER RESOURCES
8.1. Not Applicable at this time.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	22 November 2016	• Initial release	
1			
2			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-4.0	**WALL THICKNESS MEASUREMENT FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**22 NOV 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

1. PURPOSE
   1.1. Successful performance of a plastic container is related to many critical properties that are dependent on the container wall thickness profile consistency (e.g., propellant permeation rate, O2 ingress, water vapor transmission rate, volume change, top-load strength). The purpose of this test is to measure wall thickness in distinct regions of plastic containers in order to monitor and compare with physical performance.

2. APPARATUS
   2.1. Ultrasonic, Magna Mike, IR-Based, Confocal, or other non-destructive thickness testers
   2.2. Micrometer with ball ends or equivalent with minimum resolution of 0.025mm (0.001 inch).
   2.3. Height gauge with ink marking or scribe tip.

3. TEST SPECIMENS
   3.1. Recommended Quantity: 12 containers

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. At the time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are:
      4.2.1. As produced: Test containers as soon as desired, but no less than one hour after manufacture.
      4.2.2. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[1] condition for 40 hours[2].
   4.3. Non-Destructive (direct contact measurements):
      4.3.1. The container should be marked at the desired test locations based on container design and interested parties' specifications.
      4.3.2. Measure the thickness to 0.025mm (0.001 inch) at all intersecting points marked above.
   4.4. Destructive (Optional): Divide the container into 3 broad regions (shoulder, panel and base).
      4.4.1. Cut out a section of the container in the area to be measured for gauge access.
      4.4.2. Measure the wall thickness across the container surface for each of these regions and record minimum values.
      4.4.3. Measure the thickness in several places with the gauge.
   4.5. Record results.

5. ACCEPTANCE CRITERIA
   5.1. Report results using predetermined criteria established by the Interested Parties.

[1] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH, per ASTM D4332).
[2] Per Procedure A of ASTM D618.

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-4.0	**WALL THICKNESS MEASUREMENT FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**22 NOV 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

6. SAFETY
   6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES
   7.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.

8. OTHER RESOURCES
   8.1. Not Applicable at this time.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	22 November 2016	• Initial release	
1			
2			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-5.0	**SECTION WEIGHT MEASUREMENT FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**9 MAY 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

1. PURPOSE
   1.1. A container has a unique material distribution profile depending on the container gram weight and processing technique. Consistency of weight distribution is an important factor in container performance. The purpose of container sectioning is to allow measurement of the weight of a specific segment (such as shoulder, panel and base) of a container.

2. APPARATUS
   2.1. Laboratory scale with capacity of 100 grams minimum and an accuracy of ± 0.01 gram.
   2.2. Container sectioning location guidelines, based on applicable marketer's specification drawing.
   2.3. Equipment for cutting or sectioning container such as a Hot Wire Bottle Cutter.

3. TEST SPECIMENS
   3.1. Recommended Quantity: 12 containers

4. PROCEDURE
   4.1. Verify calibration of scale.
   4.2. Inspect for and remove any foreign matter from containers.
   4.3. Cut each container into sections based on container drawing.
   4.4. Determine each section weight to nearest 0.1 gram.

5. ACCEPTANCE CRITERIA
   5.1. Report results using predetermined criteria established by the Interested Parties.

6. SAFETY
   6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES
   7.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers

8. OTHER RESOURCES
   8.1. Not Applicable at this time.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	09 May 2016	• Initial release	
1			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-6.0	**SEAL INTEGRITY FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. The container finish and external clinch dimensions on a plastic aerosol are critical to obtain a tightly sealed container and maintain the desired pressure over the life of the product to ensure product performance. This test evaluates the integrity of the seal to make sure the finish adequately contains the product and propellant at the target pressures.

2. APPARATUS
   2.1. Calibrated Secure Seal Tester (SST) or equivalent with appropriate fixture
   2.2. Valves with a mounting cup designed for an outside clinch
   2.3. Clinching device capable of applying valves to the containers

3. TEST SPECIMENS
   3.1. Recommended Quantity: 12 containers

4. PROCEDURE
   4.1. Measure key dimensions on the finish of the container.
      4.1.1. Reference PARG-2.0
   4.2. Inspect for consistency of container surface finish and seal bead(s), if present.
   4.3. Apply valves to all container samples plus an additional 3 samples in case samples are damaged during preparation.
   4.4. Inspect the valves to make sure they are properly clinched.
   4.5. Cut the finish/valve assembly off at the neck of the container, without causing damage to the finish.
   4.6. Secure a sample in the fixture of the device.
   4.7. Pressurize the specimen at a rate of 0.34 bar/sec (5 psi/sec) under water.
   4.8. Pressurize the specimen to test pressure[1]
      4.8.1. Optional: The pressure in the container may be increased until a failure occurs, for clinch evaluation purposes only.
   4.9. Stop the test as soon as a continuous stream of bubbles becomes visible.
   4.10. Record the pressure and repeat steps 4.1 to 4.9 for the remaining samples.

5. ACCEPTANCE CRITERIA
   5.1. Report results using predetermined criteria established by the Interested Parties.
      5.1.1. Pressure shall be greater than the test pressure of the intended container.

6. SAFETY
   6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

[1] "Test Pressure" is 50% more than the pressure a nominally filled package reaches at 55°C (130°F).

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-6.0	**SEAL INTEGRITY FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

7. REFERENCES
   7.1. PARG-2.0 Finish Dimensions Outside Clinch Container (Preform) for Aerosol Products in Plastic Containers.
   7.2. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.

8. OTHER RESOURCES
   8.1. Not Applicable at this time.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	09 May 2016	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
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METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-7.0	**FILLING SAMPLES USED IN TEST METHOD DEVELOPMENT FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. This procedure is intended to serve as a guide for filling aerosol products in plastic containers. Primarily for use during the development phase when conducting applicable PARG test methods, not necessarily for production.

2. APPARATUS
   2.1. Constant temperature water bath capable of maintaining 21.1°C.
   2.2. Constant temperature water bath capable of maintaining 38°C.
   2.3. A calibrated digital pressure gauge, capable of recording pressure through the valve stem
   2.4. Digital or analog thermometer
   2.5. Proper Personal Protective Equipment

3. TEST SPECIMENS
   3.1. Minimum of 8 containers.

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. Inspect a set of 8 containers to ensure all samples meet bottle specifications.
   4.3. Fill with Deionized[1] water[2] to appropriate level.
   4.4. Clinch valve.
   4.5. Pressurize to nominal pressure[3].
   4.6. Use appropriate pressure gauge to validate proper pressure.
   4.7. Immediately after filling, shake the cans (10 times with a stroke length of approximately 35cm (12 inches).
   4.8. Record the initial pressure prior to placing in the water bath.
   4.9. Condition 4 containers for a minimum of 1 hour in the 21.1°C (70.0°F) condition bath.
   4.10. Condition 4 containers for a minimum of 1 hour in the 38°C (100°F) condition bath (Use to establish baseline for elevated temperature performance (as an early warning)).
   4.11. Remove containers from bath and immediately shake (10 times with a stroke length of approximately 35cm (12 inches).
   4.12. Record the final shaken condition pressure.
   4.13. Adjust charging pressure to the value that would be the difference between the immediate filling room pressure and the resulting 21.1°C (70.0°F) conditioning pressure, which will yield the desired nominal pressure.

[1] Deionized water could be used as a proxy for preliminary testing with air, nitrogen or other non-volatile propellant.
[2] The quality of tap water varies by location and could affect the integrity of PET.
[3] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions

METHOD NO: **PARG-7.0**	TITLE: **FILLING SAMPLES USED IN TEST METHOD DEVELOPMENT FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

5. PRESSURE SAMPLING
   5.1. Continue to take random pressure checks throughout the filling production to ensure the desired pressure range is being maintained.

6. ACCEPTANCE CRITERIA
   6.1. Product and container meets predetermined criteria established by interested parties and label claim[4].

7. SAFETY
   7.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

8. REFERENCES
   8.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.
   8.2. National Institute of Standards and Technology (NIST), Weights and Measures Program Requirements, NIST Handbook 155.
   8.3. PARG Voluntary Standards and Test Methods
      8.3.1. PARG-1.0: Dimensional measurement for aerosol products in plastic containers
      8.3.2. PARG-2.0: Finish dimensions outside clinch container (preform) for aerosol products in plastic containers
      8.3.3. PARG-3.0: Capacity measurements for aerosol products in plastic containers
      8.3.4. PARG-6.0: Seal integrity for aerosol products in plastic containers

9. OTHER RESOURCES
   9.1. Not Applicable at this time.

10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	09 May 2016	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
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[4] For U.S.A. Label claim: National Institute of Standards and Technology (NIST), Weights and Measures Program Requirements, NIST Handbook 155.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-8.0	**ENVIRONMENTAL STRESS CRACK (PET) FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. The hydroxide ion is the main catalyst of stress cracking in PET containers. A container that has more resistance to Sodium Hydroxide attack should be more resistant to stress crack initiators that a container may be exposed to during its lifetime. This test is used to evaluate the resistance PET containers have to cracking when exposed to a catalyst. This test evaluates stress cracking from external attacks; marketers should also evaluate product compatibility with the container to avoid stress cracking from internal agents.

2. APPARATUS
   2.1. Individual testing stations with safety chambers
   2.2. Stop watch or timer
   2.3. Compressed air regulated to "nominal pressure"[1] at ambient[2] conditions
   2.4. Distilled Water
   2.5. Container valves
   2.6. Clinch device and means of pressurization
   2.7. Titration apparatus (to determine alkalinity of NaOH solution)
   2.8. pH paper
   2.9. Dye additive (to be used when container is not transparent)
   2.10. 0.200% NaOH (sodium hydroxide), solution shall be prepared with distilled water and solid NaOH
3. PRECAUTIONS
   3.1. The following list outlines known hazardous conditions. Conduct your own job safety analysis prior to initiating this test.
      3.1.1. NaOH is a strong alkali, which is corrosive to skin and eyes. Solid NaOH is also hygroscopic. Dilution of solid NaOH with water is an exothermic reaction. Always add NaOH slowly to water. Do not add water to NaOH. The pH of the 0.200% solution is about 12.7.
      3.1.2. Total body protection is recommended when handling the solution and the pressurized containers.
      3.1.3. It is highly likely the containers will burst during the test procedure. It is imperative to take proper precautions to prevent injury.
      3.1.4. NaOH solution must be disposed of according to SDS requirements.

4. TEST SPECIMENS
   4.1. Recommended Quantity: 30 containers per orientation

[1] "Nominal Pressure" is the pressure at which the package is nominally filled at ambient conditions.
[2] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH, per ASTM D4332

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-8.0	**ENVIRONMENTAL STRESS CRACK (PET) FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

5. PROCEDURE
   5.1. Containers should be less than 2 weeks old, then aged at 50°C ± 2°C (122°F ± 3.6°F) and 50 ± 5% RH for 24 hours. After aging, the containers should be stored at ambient conditions for a minimum of 16 hours.
   5.2. Prepare the NaOH solution according to the procedure in the precautions section.
   5.3. Verify the NaOH solution is equilibrated to ambient[2] conditions. The solution shall be stored in a closed container to minimize absorption of CO_2. The container should be maintained at ambient[2] conditions and used within 8 hours of preparation.
   5.4. Measure the alkalinity level of the 0.200% NaOH solution. The acceptable range of alkalinity is 2402-2602 mg/l $CaCO_3$.
   5.5. Label each container in the order the testing will occur.
   5.6. Inspect a set of 60 containers to ensure all samples meet bottle specifications.
   5.7. Initial filling setup, follow procedure PARG-7.0.
   5.8. Fill 60 containers with water, as described in 5.7.
   5.9. Clinch valve.
   5.10. Pressurize to nominal pressure[3], as described in 5.7.
   5.11. Use appropriate pressure gauge to validate proper pressure.
   5.12. Immediately after filling, shake each container (10 times with a stroke length of approximately 35cm (12 inches)).
      5.12.1. For final testing and for packages intended to be used with liquefied petroleum gas (LPG's):
         5.12.1.1. Fill[3] the product in the container as it would be filled for commercial distribution, clinch and then fill with the selected propellant, both at nominal fill levels.
   5.13. Five (5) minutes after pressurizing the containers, mark[4] the fill level on each container according to orientation and gently place each container into an individual pocket of 0.200% NaOH solution at ambient conditions.
      5.13.1. For normal orientation
         5.13.1.1. Mark[4] the liquid level on each container, if applicable.
         5.13.1.2. The solution shall cover the base (to the top of the strap if applicable).
      5.13.2. For inverted orientation
         5.13.2.1. Mark[4] the liquid level on each container, if applicable.
         5.13.2.2. The solution shall cover the amorphous region of the neck/shoulder of the bottle.
   5.14. Record the start time as the time that the container was placed in the 0.200% NaOH solution.
   5.15. The containers should be checked on the following frequency:
      5.15.1. 0-30 minutes: Continual monitoring
      5.15.2. 30-60 minutes: Check every 2 minutes

[3] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions
[4] Marking only a transparent container is needed, if opaque containers, then reference footnote 3.

METHOD NO: **PARG-8.0**	TITLE: **ENVIRONMENTAL STRESS CRACK (PET) FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

5.15.3. 60-90 minutes: Check every 5 minutes
5.15.4. >90 minutes: Check every 10 minutes, up to 3 hours maximum.
5.15.5. If the technician leaves the room, it should be noted on the data collection sheet.
5.16. Record the time to failure in minutes for each container.
5.17. After each use, carefully rinse and dry each test station.

6. ACCEPTANCE CRITERIA
6.1. Failure is defined as a burst or a slow leak. A slow leak is evidenced by a visual fill point drop from the marked line or presence of dye additive leaking into the test solution.

7. SAFETY
7.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

8. REFERENCES
8.1. PARG-7.0: Filling samples used in test method development for aerosol products in plastic containers.
8.2. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.
8.3. International Society of Beverage Technologists, Test Method for Evaluating the Relative Stress Crack Resistance of Poly(ethylene terephthalate) Carbonated Soft Drink Bottles, 03/12/2007.

9. OTHER RESOURCES
9.1. Not Applicable at this time.

10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	22 November 2016	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-9.0	**THERMAL STABILITY FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. The propellant in an aerosol package exerts a pressure on the container walls. As temperature increases, pressure increases, causing the container to expand and creep[1]. Expansion will cause the product fill level to drop, which may negatively affect package appearance and will affect how the container fits into a carrier shell, sits on a shelf, etc. Expansion will affect the internal volume of the container and may reduce internal pressure, thereby affecting long-term dispensing performance of the product. The purpose of this test is to measure a container's expansion.

2. APPARATUS
   2.1. Equipment or chemicals to fill and pressurize the container.
   2.2. An oven or environmentally controlled room set to 38°C ± 2°C (100°F ± 3.6°F)[2].
   2.3. Equipment to measure max pressure.
   2.4. Measurement tools: Pi tape, height gauge, calipers, volume displacement gauge, optical comparator, etc.
   2.5. Appropriate safety equipment as defined by the marketer's safety protocol.

3. TEST SPECIMENS
   3.1. The number of test replications depends on the desired objectives of the testing and the availability of duplicate plastic aerosol products. Replicate testing is recommended to improve the reliability of the test results.

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. At the time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are:
      4.2.1. As produced: Test containers as soon as desired, but no less than one hour after manufacture.
      4.2.2. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[3] condition for 40 hours[4].
   4.3. Determine the amount of test specimens, per 3.1.
   4.4. Inspect containers to ensure all samples meet bottle specifications.
   4.5. The container should be marked at the desired test locations based on container design and Interested Party's specifications.
   4.6. Measure the test locations (and/or immersion volume) on empty containers.
   4.7. Initial filling setup, follow procedure PARG-7.0, if non-compressed gas, reference section 4.7.

[1] Creep: To permanently deform under the influence of an applied stress.
[2] Relative Humidity condition to be determined based on marketer's expected conditions, ± 5%.
[3] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH, per ASTM D4332).
[4] Per Procedure A of ASTM D618.

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-9.0	**THERMAL STABILITY FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

4.8. For packages intended to be used with liquefied petroleum gas (LPG's), fill the container as it would be filled for commercial distribution, with product and selected propellant to nominal fill levels.
4.9. Clinch valve.
4.10. Pressurize to nominal pressure[5], as described in 4.6 or 4.7.
4.11. Use appropriate pressure gauge to validate proper pressure.
4.12. Immediately after filling, shake each container (10 times with a stroke length of approximately 35cm (12 inches)).
4.13. Mark the target fill level height on each container, if applicable (transparent container).
4.14. For preliminary testing the containers can be evaluated not fully dressed. For final testing it is recommended the containers be evaluated fully dressed to determine how creep affects total package performance and aesthetics.
4.15. Immediately check pressures of containers after filling and mark for appropriately for further pressure testing.
4.16. Store all containers at ambient[3] conditions for minimum of 24 hours.
4.17. Record pressures on the containers.
4.18. Divide the user desired amount of filled containers, per 4.3, into to two halves (Set A and Set B).

4.18.1. Test Set A:
4.18.1.1. Place containers in 38°C ± 2°C (100°F ± 3.6°F)2 for 24 hours.
4.18.1.2. After 24 hours remove the containers from the 38°C ± 2°C (100°F ± 3.6°F)2 condition, place them in ambient[3] conditions for minimum of 2 hours then:
4.18.1.2.1. Measure the dimensions of the containers.
4.18.1.2.2. Measure the fill point change from the original mark, if applicable (transparent container).
4.18.1.2.3. Record pressures after completion of measuring.
4.18.1.2.4. Note any visual abnormalities (bulge, tilt, etc.)

4.18.2. Test Set B:
4.18.2.1. Place containers in ambient[3] conditions for 24 hours.
4.18.2.2. After 24 hours then:
4.18.2.2.1. Measure the dimensions of the containers.
4.18.2.2.2. Measure the fill point change from the original mark, if applicable (transparent container).
4.18.2.2.3. Record pressures after completion of measuring.
4.18.2.2.4. Note any visual abnormalities (bulge, tilt, etc.)

[5] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions

METHOD NO: **PARG-9.0**	TITLE: **THERMAL STABILITY FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **11 JUNE 2020**
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4.19. Additionally, the Interested Party should consider other cyclic temperature profiles based on the party's known distribution and product use environments, whereby repeating the procedure from 4.1 to 4.17, and then subjecting the samples to such environment(s).

4.20. Record all data.

5. ACCEPTANCE CRITERIA

5.1. Report results using predetermined criteria established by Interested Parties, pertaining to labeling, production process and distribution requirements.

6. SAFETY

6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES

7.1. PARG-7.0: Filling samples used in test method development for aerosol products in plastic containers.

7.2. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.

8. OTHER RESOURCES

8.1. Not Applicable at this time.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	04 December 2016	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-10.0	**BURST PERFORMANCE FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. Plastic aerosol containers are subjected to pressure during filling, distribution, and use. The purpose of this test is to determine the resistance to burst of the plastic container when pressurized under specific conditions to meet regulatory requirements.

2. APPARATUS
   2.1. Calibrated Hydro Burst Pressure Tester with fill programmable ramping capabilities.
   2.2. Special equipment may be necessary to deliver and control pressure at rates that simulate aerosol filling conditions

3. TEST SPECIMENS
   3.1. Recommended Quantity: Minimum of 50 containers per condition. For production at least one (1) out of each lot of 5,000 must be tested[1].

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. At the time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are:
      4.2.1. As produced: Test containers once the container has sufficiently cooled, per operator's blow molding quality procedures.
      4.2.2. As received: Test containers that have been aged at least 72 hours and conditioned at ambient[2] conditions for 40 hours[3].
   4.3. Place one container at a time in the burst tester. Ensure that the container is properly fitted into the container support and close the safety chamber door.
   4.4. Initiate/Start the burst tester using one of the appropriate test profiles:

      4.4.1. *Regulatory Requirement*[4]:
         4.4.1.1. Pressurize to "test pressure"[5] at 1.0 bar/sec (14.5psig/sec); hold for 25 seconds; ramp at 1.0 bar/sec (14.5psig/sec) to burst or exceeds requirement pressure, reference 'acceptable criteria' section, below.

      4.4.2. *Development Evaluation (Filling Simulation) – Optional for Evaluation Only*:

[1] Per Title 49: Transportation, Part 178, Subpart B, 178.33b-b, Production Tests.
[2] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH, per ASTM D4332).
[3] Per Procedure A of ASTM D618.
[4] The ramp profile is derived from FEA Directive 75/324/EEC, Section 6.1.1.1, annexed in FEA 621E method, per "Verification of the test pressure".
[5] "Test Pressure" is 50% more than the pressure a nominally filled package reaches at 55°C (130°F).

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4.4.2.1. Pressurize to "nominal pressure"[6], at "Fill Rate"[7]; hold for 25 seconds; ramp at 1.0 bar/sec (14.5psig/sec) to burst or maximum pressure achieved (machine capability), whichever comes first.

4.5. After the machine has finished, remove the container.
4.6. Record the following test results for each container.
4.6.1. Burst pressure or maximum pressure achieved (mandatory).
4.6.2. Record percent container expansion after 25 second hold and final expansion (optional).
4.6.3. Time duration for each container tested (optional).
4.6.4. Note location of failure (side wall, base, neck, etc.) and if it is a base failure, describe the location of the failure: through the gate, around the gate, foot to foot, etc. (mandatory).
4.6.5. Note whether or not splintering occurred during failure.
4.6.5.1. Splintering is not preferred even if the container bursts above 16.55 bar (240 psig).
4.6.6. Record the water temperature for each series of tests, should be 20°C ± 5°C.

5. ACCEPTANCE CRITERIA

5.1. *Regulatory Requirement*
5.1.1. Per U.S. DOT[8]: Pressure in the container must not exceed 160 psig at 130°F. If the pressure in the container is less than 140 psig at 130°F, a non-DOT specification container may be used. If the pressure in the container exceeds 140 psig at 130°F (54.4°C) but does not exceed 160 psig at 130 °F (54.4°C), the container must conform to specification DOT 2S.
5.1.1.1. All non-DOT specification and specification DOT 2S containers must be capable of withstanding, without bursting, a pressure of one and one-half times the equilibrium pressure of the contents at 130°F (54.4°C).
5.1.1.2. Production Tests (Title 49CFR: Transportation, Part 178, Subpart B, Section 178.33b-8) for DOT-2S containers:
5.1.1.2.1. One out of each lot of 5,000 containers or less, successively produced per day must be pressure tested to destruction and must not burst below 240 psig. The container tested must be complete as intended for transportation.
5.1.1.3. Each such 5,000 containers or less, successively produced per day, shall constitute a lot and if the test container shall fail, the lot shall be rejected or ten additional containers may be selected at random and subjected to the test under which failure occurred. These containers shall be complete as intended for transportation. Should any of the ten containers thus tested fail, the entire lot must be rejected. All containers constituting a lot shall be of like material, size, design construction, finish, and quality.

[6] "Nominal Pressure" is the pressure at which the package is nominally filled at ambient conditions.
[7] "Fill Rate" is the rate at which the package is nominally pressure filled.
[8] Title 49CFR: Transportation, Part 173, Subpart G, Section 173.306 (5)(ii)

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PARG-10.0	**BURST PERFORMANCE FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
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5.1.2. Per FEA[9].:

5.1.2.1. For containers filled at a pressure of less than 6.7 bars at 50°C, the test pressure must be equal to at least 10 bars.

5.1.2.2. For containers filled at a pressure equal to or greater than 6.7 bars at 50°C, the test pressure must be 50% higher than the internal pressure at 50°C.

5.1.2.3. The burst pressure of plastic containers shall be at least 20% higher than test pressure.

5.1.2.4. "Plastic containers showing asymmetrical or major distortions or other similar faults shall be rejected. A slight symmetrical distortion shall be allowed provided that the container passes the bursting pressure test"[10].

5.1.3. Per Canadian TC-2S[11]:

5.1.3.1. For containers filled at a pressure greater than 0 kPa (0psig) but less than or equal to 1105 kPa (160psig) at 50°C, the test pressure of each finished container shall withstand, without leaking or bursting, the minimum burst pressure of 1655 kPa (240psig).

5.1.3.2. One completed container from each lot of 5000 or fewer containers shall be randomly selected and pressurized to destruction. The rate of pressurization shall not exceed a rate that allows for accurate detection of the burst pressure. The pressure at which the container bursts shall be recorded.

5.1.3.3. 4.4.4.2 Should the container leak or burst below the minimum burst pressure specified in 4.3.3, the lot shall either be condemned or ten additional containers shall be randomly selected from the same lot and subjected to the burst test. Should any of the ten containers tested fail, the entire lot shall be condemned.

5.2. *Development Evaluation (Filling Simulation)*: Evaluation purposes only, acceptance criteria to be determined by Interested Parties.

6. SAFETY

6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES

7.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.

8. OTHER RESOURCES

8.1. Not Applicable at this time.

[9] Plastic aerosol dispensers technical requirements, FEA 647E (03/2020)

[10] FEA Plastic Aerosol Dispensers Technical Requirements, FEA 647E (03/2020), Part 1, *Development of the aerosol containers*, Section 3, *Hydraulic Test*.

[11] Canadian General Standards Board, CGSB-43.123-210, Aerosol Containers and Gas Cartridges for Transport of Dangerous Goods, Sections 4.3 and 4.4 (TC-2S).

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-10.0	**BURST PERFORMANCE FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	08 November 2016	• Initial release	
1	11 June 2020	• References to FEA Plastic Aerosol Dispensers Technical Requirements	• Referencing the latest version dated 03/2020 • Verified the criteria is represented
2			
3			

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-11.0	**DROP IMPACT FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**18 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. An important feature of plastic containers is their resistance to failure on drop impact. The purpose of this test is to determine the ability of the container to withstand free-fall impact forces.

2. APPARATUS
   2.1. Drop Tester; reference ASTM D5276-Section 5 and ISO 2248-Section 4, for apparatus set up.
      2.1.1. Impact surface shall be smooth and free from imperfection.
   2.2. Appropriate safety precautions should be taken to prevent harm to operators and equipment when containers fall.
      2.2.1. Recommend a complete enclosure around drop test apparatus with impact resistant walls.

3. TEST SPECIMENS
   3.1. Recommended Quantity:
      3.1.1. Development Evaluation: 90 containers per conditioning group (reference 4.8.1).
      3.1.2. Design Qualification: 25 containers per conditioning group (reference 4.8.2)

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. At time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are as follows:
      4.2.1. As produced: Test containers once the container has sufficiently cooled, per operator's blow molding quality procedures.
      4.2.2. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[1] temperature for 40 hours[2].
   4.3. Inspect the required set of containers, determined in 3.1, to ensure they meet required specifications.
   4.4. Sample containers must be filled as outlined below for appropriate application:
      4.4.1. For preliminary testing and for packages intended to be used with an air, nitrogen or other non-volatile propellants:
         4.4.1.1. Initial filling setup, follow procedure PARG-7.0.
         4.4.1.2. Fill required set of containers, as described in 4.4.1.1.
         4.4.1.3. Clinch valve.
         4.4.1.4. Pressurize to nominal pressure[3], as described in 4.4.1.1.
         4.4.1.5. Use appropriate pressure gauge to validate proper pressure.
         4.4.1.6. Immediately after filling, shake each container (10 times with a stroke length of approximately 35cm (12 inches)).
      4.4.2. For final testing and for packages intended to be used with liquefied petroleum gas (LPG's):

[1] Ambient is Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332
[2] Per procedure A of ASTM D618
[3] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions

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4.4.2.1. Fill the container as it would be filled for commercial distribution, with product and selected propellant at nominal fill levels.

4.5. It is recommended that the drop impact test be conducted with the containers in their "normal"[4] state.

4.5.1. For example: If the container is normally distributed with a base cup, it is recommended that the drop impact test be conducted with the base cup applied.

4.5.2. Containers need not be fully dressed for drop impact test and shall not have an overcap or fitment protecting the valve.

4.5.3. Interested Parties can choose to include other test configurations at their discretion.

4.6. Test samples must be conditioned according to the following:

4.6.1. DOT-2S[5] Requirements:

4.6.1.1. Group 1: 38°C (100°F) for 26 weeks

4.6.1.2. Group 2: 50°C (122°F) for 100 hours

4.6.1.3. Group 3: 55°C (131°F) for 18 hours

4.6.2. FEA Requirements[6]:

4.6.2.1. Group 1: -18°C (-0.4°F) for minimum of 24 hours

4.6.2.1.1. Substitute test medium that has a relative density to water and remains liquid.

4.6.2.2. Group 2: 40°C (104°F) for minimum of 3 months

4.6.2.3. Group 3: 55°C (131°F) for minimum of 6 hours

4.6.3. Canadian Transport of Dangerous Goods TC-2S[7] requirements:

4.6.3.1. Same requirements as 4.6.1

4.6.3.2. Additionally, Group 4: -18°C (-0.4°F) for minimum of 24 hours

4.6.3.2.1. Substitute test medium that has a relative density to water and remains liquid.

4.6.4. Conditioning apparatus should maintain a relative humidity (RH) of 50% ± 5% RH, per ASTM D4332, for all groups, except 4.5.2.1.

4.7. Drop samples individually onto drop surface from 1.8m (71 inches):

4.7.1. Measured from the touch point of container on the drop lever to drop plate surface.

4.7.2. Closure, or sealing component of the container, must not be protected during the test.

4.7.2.1. Overcaps, actuators, etc. must be removed.

4.7.3. Avoid dropping on the valve.

4.7.4. Conduct tests within 20 minutes of removal from the specified conditioning environments.

4.8. The containers should be dropped for development and final design qualification.

4.8.1. Development Evaluation:

[4] Normal state is which the product would be commonly used throughout the distribution and use of the product.

[5] DOT-2S is specified in the U.S. Code of Federal Regulations, Title 49: Transportation, Part 178, Subpart B, Section 178.33b, Specification 2S.

[6] FEA Plastic Aerosol Dispensers Technical Requirements, FEA 647E (03/2020), Part 2, *Development of the filled aerosol packs*, Section 3, *Material resistance to temperature – Drop Test*.

[7] Canadian General Standards Board, CGSB-43.123-210, Aerosol Containers and Gas Cartridges for Transport of Dangerous Goods, Sections 4.3 and 4.4 (TC-2S).

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PARG-11.0	**DROP IMPACT FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**18 JUNE 2020**
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4.8.1.1. NOTE: During development and/or design comparisons for typical container geometries, based on 90 containers per temperature condition, as reference in section 4.6, the following orientations are suggested within ± 5° for each drop orientation:
4.8.1.2. 30 samples dropped vertically on to the container base: 0° from vertical (flat base).
4.8.1.3. 30 samples dropped vertically on to the container base: 45° from vertical (corner).
4.8.1.4. 30 samples dropped horizontally on to the container side: 90° from vertical (side).
4.8.2. Design Qualification:
4.8.2.1. Repeat 4.8.1, per the discretion of the Interested Party.
4.8.2.2. The containers shall be dropped in statistically random[8] orientations around their vertical axis, based on 25 containers per temperature condition, as referenced in section 4.6.
4.9. Each sample is tested once, then discarded.
4.10. Observe effect of initial impact only, as opposed to the effects of secondary impacts and exclude effects of subsequent or direct impacts to the valve.
4.11. Record leaks or ruptures.
4.11.1. Submerge suspect containers in water to inspect for small leaks.

5. ACCEPTANCE CRITERIA
5.1. DOT-2S[5], FEA[6] and TC-2S[7] Requirements: There is no acceptable failure rate for this test, packages FAIL when product or propellant is able to leak from crack or rupture, following procedure 4.9 and 4.10.
5.2. Non-Spec DOT Plastic Aerosol: There are no mandated drop tests, nor acceptance criteria.
5.2.1. Recommendation is to test per procedure 4.5.1 and use acceptance criteria section 5.1, regardless of non-spec DOT pressure.

6. SAFETY
6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES
7.1. PARG-7.0: Filling samples used in test method development for aerosol products in plastic containers.
7.2. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers
7.3. US Code of Federal Regulations, Title 49: Transportation, Part 178, Subpart B, Section 178.33b, Specification 2S; inner non-refillable plastic receptacles.
7.4. US Code of Federal Regulations, Title 49: Transportation, Part 173, Subpart G, Section 173.306 (5)(ii), Limited quantities of compressed gases.
7.5. FEA, Plastic aerosol dispensers technical requirements, FEA 647E (03/2020).
7.6. FEA Directive 75/324/EEC.

[8] A numeric sequence is said to be **statistically random** when it contains no recognizable patterns or regularities.

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7.7. Canadian General Standards Board, CGSB-43.123-210, Aerosol Containers and Gas Cartridges for Transport of Dangerous Goods, Sections 4.3 and 4.4 (TC-2S).

8. OTHER RESOURCES

8.1. Not Applicable at this time.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	09 May 2020	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch • Reference to FEA technical requirements • Added sections 3.1.2 and 4.8.2	• Align with industry terminology • FEA 647E, dated 03/2020
2	18 June 2020	Changed Design “Qualification” to “Evaluation”, section 3.1.2 and 4.8.1	Aligns with verbiage used in other PARG methods
3			
4			

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-12.0	**VERTICAL COMPRESSION UNFILLED CONTAINER FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. Empty containers must be able to withstand a top load force during palletizing, filling and clinching. This test method measures the mechanical properties of a plastic container when subjected to a compressive force at a constant rate of deflection.

2. APPARATUS
   2.1. Compression Testing Machine, as described in ASTM D2659, or equivalent, which will apply a force at a constant displacement rate and will record the load-deflection curve for the test container.
   2.2. Balance capable of measuring the container weight to the nearest 0.1 gram.
   2.3. Bottle venting device, reference example Figure 1.

3. TEST SPECIMENS
   3.1. Recommended Quantity: Minimum of 30 containers.

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. At time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are as follows:
      4.2.1. As produced: Test containers once the container has sufficiently cooled, per operator's blow molding quality procedures.
   4.3. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[1] temperature for 40 hours[2].
   4.4. Mark all test containers with a unique number for traceability back to mold cavity, sample number, and test results.
   4.5. Weigh containers and record the weight.
   4.6. Set-Up Test Machine according to operating guidelines of equipment being used.
   4.7. Attach appropriate load cell[3] to use with the samples, based on required manufacturing load conditions.
   4.8. Calibrate the load cell.
   4.9. Set the crosshead speed per user defined application.
   4.10. Place container on testing platform.
   4.11. Place venting device on top of the container, reference section for Apparatus 2.3, centering the hole in the venting device with the center of the container opening.

[1] Ambient is Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332
[2] Per procedure A of ASTM D618
[3] load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured.

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PARG-12.0	**VERTICAL COMPRESSION UNFILLED CONTAINER FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

4.11.1. NOTE: Containers are tested with venting. Venting is provided to allow equalization of air pressure during testing when determining strength for palletizing, filling and clinching operations.

4.12. Lower the crosshead so there is minimal distance between the upper platen and the top of the venting device without actual contact.

4.13. Tare or zero out crosshead movement, if necessary.

4.14. Initiate the test and compress the container until its compressive yield load has been exceeded or when a maximum deflection has been reached (user defined).

4.15. Record the compressive yield load, deflection, and any critical deformations at the point of failure.

4.16. Continue with remaining containers repeating steps 4.10 through 4.15.

5. ACCEPTANCE CRITERIA

5.1. A container is considered a failure if the maximum yield load is below the minimum top load requirements for the bottle. Minimum top load requirements are determined by the filling capping/operation and distribution requirements which are predetermined by Interested Parties.

6. SAFETY

6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES

7.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers

8. OTHER RESOURCES

8.1. Not Applicable at this time.

9. Figure 1:

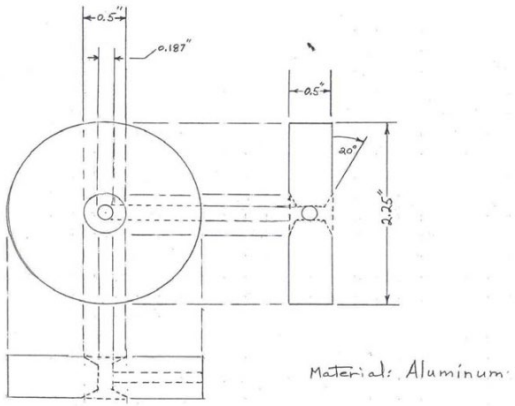

Figure 1. Bottle Venting Device

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10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	09 May 2016	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-13.0	**VERTICAL COMPRESSION FILLED AND PRESSURIZED CONTAINER FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. Filled and pressurized containers must be able to withstand a top load force during capping operation and distribution. This test method measures the mechanical properties of a plastic container when subjected to a compressive force at a constant rate of deflection.

2. APPARATUS
   2.1. Compression Testing Machine, as described in ASTM D2659, or equivalent, which will apply a force at a constant displacement rate and will record the load-deflection curve for the test container.
   2.2. Balance capable of measuring the container weight to the nearest 0.1 gram.
   2.3. Valve Stem protection device, similar to Figure 1, custom to valve used.

3. TEST SPECIMENS
   3.1. Recommended Quantity: Minimum of 30 containers.

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. At time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are as follows:
      4.2.1. As produced: Test containers once the container has sufficiently cooled, per operator's blow molding quality procedures.
   4.3. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[1] temperature for 40 hours[2].
   4.4. Mark all test containers with a unique number for traceability back to mold cavity, sample number, and test results.
   4.5. Weigh containers and record the weight.
   4.6. Initial filling setup, follow procedure PARG-7.0, if non-compressed gas, reference section 4.7.
   4.7. For packages intended to be used with liquefied petroleum gas (LPG's), fill the container as it would be filled for commercial distribution, with product and selected propellant to nominal fill levels.
   4.8. Clinch valve.
   4.9. Pressurize to nominal pressure[3], as described in 4.6 or 4.7.
   4.10. Use appropriate pressure gauge to validate proper pressure.
   4.11. Immediately after filling, shake each container (10 times with a stroke length of approximately 35cm (12 inches)).
   4.12. Set-Up Test Machine according to operating guidelines of equipment being used.

[1] Ambient is Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332
[2] Per procedure A of ASTM D618
[3] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-13.0	**VERTICAL COMPRESSION FILLED AND PRESSURIZED CONTAINER FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

4.13. Attach appropriate load cell[4] to use with the samples, based on required manufacturing load conditions.
4.14. Calibrate the load cell.
4.15. Set the crosshead speed per user defined application.
4.16. Place container on testing platform.
4.17. Place valve stem protection device on top of the container, reference section for Apparatus 2.3, centering the hole in the device over the valve stem.
4.17.1. NOTE: Containers are tested filled and pressurized. Pressurization is used to determine strength for capping and distribution operations.
4.18. Lower the crosshead so there is minimal distance between the upper platen and the top of the valve protection device without actual contact.
4.19. Tare or zero out crosshead movement, if necessary.
4.20. Initiate the test and compress the container until its compressive yield load has been exceeded or when a maximum deflection has been reached (user defined).
4.21. Record the compressive yield load, deflection, and any critical deformations at the point of failure.
4.22. Continue with remaining containers repeating steps 4.10 through 4.15.

5. ACCEPTANCE CRITERIA
5.1. A container is considered a failure if the maximum yield load is below the minimum top load requirements for the bottle. Minimum top load requirements are determined by the filling capping/operation and distribution requirements which are predetermined by Interested Parties.

6. SAFETY
6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES
7.1. PARG-7.0: Filling samples used in test method development for aerosol products in plastic containers.
7.2. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers

8. OTHER RESOURCES
8.1. Not Applicable at this time.

[4] load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured.

METHOD NO: **PARG-13.0**	TITLE: **VERTICAL COMPRESSION FILLED AND PRESSURIZED CONTAINER FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

9. Figure 1:

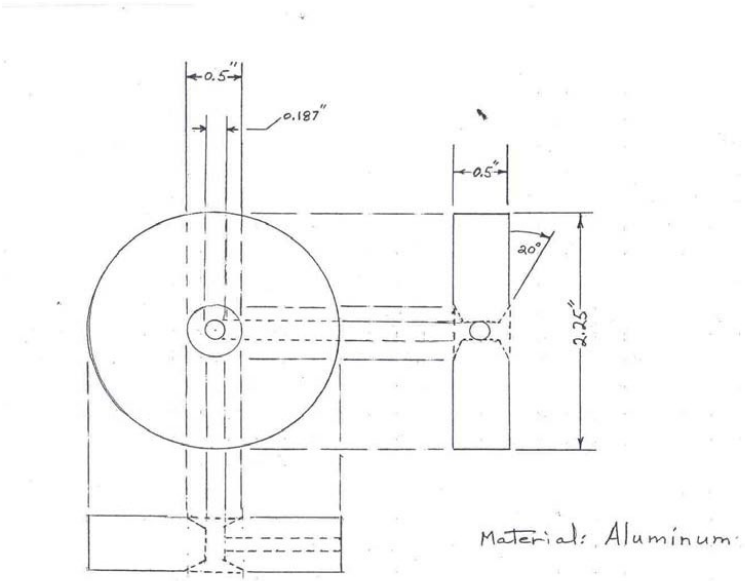


Figure 1. Bottle Venting Device

10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	09 May 2016	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-14.0	**MATERIAL RESISTANCE TO CONSTANT TEMPERATURE EVALUATION FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. The propellant in an aerosol package exerts a pressure on the container walls. As temperature increases, pressure increases, causing the container to expand and creep. As temperatures approach the material's glass transition (T_g) the material will begin to soften, increasing the likelihood of deformation and/or failure. The purpose of this test is for evaluation purpose only, when comparing designs, as an indication of how the plastic container will react when subjected to a constant elevated temperature. The final container design shall be verified by using PARG-15.0.

2. APPARATUS
   2.1. Equipment and chemicals to fill and pressurized the container
   2.2. Appropriate Environmental Chamber, appropriate for product type, capable of maintaining a temperature 64°C (±2°C) at 50% RH.
   2.3. Equipment to measure pressure through the valve stem.
   2.4. Equipment capable to be submersible in water to measure and record pressure gain/loss (optional).
   2.5. Thermometer.
   2.6. Timer (optional depending on equipment).
   2.7. Appropriate containment of samples to capture leak or rupture when being tested without restricting temperature exposure to container.
   2.8. Video recording camera (optional).
   2.9. Appropriate safety equipment as defined by the testing party's safety protocols.

3. TEST SPECIMENS
   3.1. Recommended Quantity: 12 containers

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. Inspect a set of 12 containers to ensure all samples meet bottle specifications.
   4.3. Initial filling setup, follow procedure PARG-7.0, if non-compressed gas, reference 4.4.
   4.4. For packages intended to be used with liquefied petroleum gas (LPG's), fill the container as it would be filled for commercial distribution, with product and selected propellant to nominal fill levels.
   4.5. Fill 12 containers, as described in 4.3.
   4.6. Optional, insert submersible recorders.
   4.7. Clinch valve.
   4.8. Pressurize to nominal pressure[1], as described in 4.3 or 4.4.
   4.9. Immediately after filling, shake each container (10 times with a stroke length of approximately 35cm (12 inches)).

[1] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions.

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-14.0	**MATERIAL RESISTANCE TO CONSTANT TEMPERATURE EVALUATION FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

4.10. Inspect all test containers for abnormal features to ensure they meet manufacturing specifications prior to using them for the test. Optionally, photograph representative test containers before placing them into test, and at the conclusion of the cycle.
4.11. At the time of testing, containers to be tested should be at a consistent age and condition.
4.12. Recommendations for conditions are:
4.12.1. As produced: Test bottles as soon as delivered, but no less than one hour after manufacture.
4.12.2. As received: Test bottles that have been aged a minimum of 72 hours and conditioned at ambient[2] temperature for 40 hours[3].
4.13. Place the filled containers into an ambient temperature storage and condition for 24 hours.
4.14. Measure the initial pressure of each container, using a pressure gauge through the valve stem.
4.15. Pre-condition the chamber to 64°C at 50% RH.
4.16. Once at proper condition temperature:
4.16.1. Place containers into the test chamber using containment per Apparatus section 2.7.
4.16.2. Place the containment apparatus or samples in the middle of the chamber.
4.16.3. Containers should be oriented vertically in an orientation where the valve is in contact with headspace, not product.
4.17. Start timer for 5 hours.
4.18. Optional, use video recording if chamber has a glass viewing window to understand the failure or deformation mode.
4.19. After 5 hours, allow to cool to ambient temperature.
4.20. Measure and record pressure (if applicable).
4.21. Remove the data recorders and download the data (if applicable).
4.22. Record the time, temperature and pressure corresponding to rupture/leak event (if applicable).
4.23. Record how and where the container ruptured or leaked (if applicable).

5. ACCEPTANCE CRITERIA
5.1.1. Report results, for evaluation purposes only.
5.1.2. Once design evaluation is complete, the Interested Party shall test the container using PARG-15.0, to validate the design.

6. SAFETY
6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

7. REFERENCES
7.1. PARG Voluntary Standards and Test Methods

[2] Ambient is Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332
[3] Per procedure A of ASTM D618

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-14.0	**MATERIAL RESISTANCE TO CONSTANT TEMPERATURE EVALUATION FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

7.1.1. PARG-7.0: Filling samples used in test method development for aerosol products in plastic containers.
7.1.2. PARG-15.0: Material resistance to temperature for aerosol products in plastic containers.
7.2. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers
7.3. Study of Internal Automobile Temperature Profiling, Plastic Aerosol Research Group, LLC, July 2015.

8. OTHER RESOURCES
8.1. Not Applicable at this time.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	22 November 2016	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-15.0	**MATERIAL RESISTANCE TO INDUCED HEAT CONDITIONS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. The propellant in an aerosol package exerts a pressure on the container walls. As temperature increases, pressure increases, causing the container to expand and creep. As temperatures approach the material's glass transition (T_g) the material will begin to soften, increasing the likelihood of deformation and/or failure. The purpose of this test is to assess a container's integrity within confined spaces, such as a motor vehicle, as temperatures are induced and fluctuate with external environmental conditions over the course of a day.

2. APPARATUS
   2.1. Equipment and chemicals to fill and pressurized the container.
   2.2. Environmental Chamber, appropriate for product type, capable of automatically changing the temperature OR an appropriate chamber that can be manually changed, either shall be based on the profile schedule (reference Figure 1) over time with a capable temperature range of 23°C to 70°C (±2°C) at 50% (±5°C) RH.
   2.3. Equipment to measure pressure through the valve stem.
   2.4. Equipment capable to be submersible in water to measure and record pressure gain/loss (optional).
   2.5. Thermometer.
   2.6. Timer (optional depending on equipment).
   2.7. Appropriate containment of samples to capture leak or rupture when being tested without restricting temperature exposure to container.
   2.8. Video recording camera (optional).
   2.9. Appropriate safety equipment as defined by the Interested Party's safety protocols.

3. TEST SPECIMENS
   3.1. Recommended Quantity: 12 containers

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. Inspect a set of 12 containers to ensure all samples meet bottle specifications.
   4.3. Initial filling setup, follow procedure PARG-7.0, if non-compressed gas, reference 4.4.
   4.4. For packages intended to be used with liquefied petroleum gas (LPG's), fill the container as it would be filled for commercial distribution, with product and selected propellant to nominal fill levels.
   4.5. Fill 12 containers, as described in 4.3.
   4.6. Optional, insert submersible recorders.
   4.7. Clinch valve.
   4.8. Pressurize to nominal pressure[1], as described in 4.3 or 4.4.

[1] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions.

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-15.0	**MATERIAL RESISTANCE TO INDUCED HEAT CONDITIONS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

4.9. Immediately after filling, shake each container (10 times with a stroke length of approximately 35cm (12 inches)).

4.10. Inspect all test containers for abnormal features to ensure they meet manufacturing specifications prior to using them for the test. Optionally, photograph representative test containers before placing them into test, and at the conclusion of the cycle.

4.11. At the time of testing, containers to be tested should be at a consistent age and condition.

4.12. Recommendations for conditions are:

4.12.1. As produced: Test bottles as soon as delivered, but no less than one hour after manufacture.

4.12.2. As received: Test bottles that have been aged a minimum of 72 hours and conditioned at ambient[2] temperature for 40 hours[3].

4.13. Place the filled containers into an ambient temperature storage and condition for 24 hours.

4.14. Measure the initial pressure of each container, using a pressure gauge through the valve stem.

4.15. Program or manually change the chamber to the described profile referenced in Figure 1 and start the chamber.

4.16. Once at proper condition temperature:

4.16.1. Place containers into the test chamber using containment per Apparatus section 2.7.

4.16.2. Place the containment apparatus or samples in the middle of the chamber.

4.16.3. Containers should be oriented vertically in an orientation where the valve is in contact with headspace, not product.

4.17. Optional, use video recording if chamber has a glass viewing window to understand the failure or deformation mode.

4.18. Once test is complete, allow to cool to ambient temperature.

4.19. Measure and record pressure (if applicable).

4.20. Remove the data recorders and download the data (if applicable).

4.21. Record the time, temperature and pressure corresponding to rupture/leak event (if applicable).

4.22. Record how and where the container ruptured or leaked (if applicable).

5. ACCEPTANCE CRITERIA

5.1. Of the said container, shall be the responsibility of the Interested Party, based on performance and integrity.

5.1.1. Preliminary testing of the containers can be evaluated not fully dressed.

5.1.2. Final validation testing of the containers shall be evaluated fully dressed.

6. SAFETY

6.1 Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

[2] Ambient is Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332

[3] Per procedure A of ASTM D618

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-15.0	**MATERIAL RESISTANCE TO INDUCED HEAT CONDITIONS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

7. REFERENCES
   7.1. PARG Voluntary Standards and Test Methods
      7.1.1. PARG-7.0: Filling samples used in test method development for aerosol products in plastic containers.
   7.2. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers
   7.3. Study of Internal Automobile Temperature Profiling, Plastic Aerosol Research Group, LLC, July 2015.

8. OTHER RESOURCES
   8.1. Not Applicable at this time.

9. FIGURE 1:

Average Profile Data (5hr 20min)			
Time (Minutes)	Elapsed Clock (Hour:Minutes)	Change in Temperature (°C)	Temperature (°C)
15	N/A	0.0 → 50.8	50.8
Insert Samples			
40	0:40	50.8 → 54.6	54.6
40	1:20	54.6 → 57.9	57.9
40	2:00	57.9 → 60.5	60.5
40	2:40	60.5 → 62.4	62.4
40	3:20	62.4 → 63.6	63.6
40	4:00	63.6 → 64.0	64.0
40	4:40	64.0 → 63.6	63.6
40	5:20	63.6 → 62.7	62.7

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-15.0	**MATERIAL RESISTANCE TO INDUCED HEAT CONDITIONS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	22 November 2016	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-16.0	**COMPRESSED GAS PRESSURE LOSS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. This method covers the measurement of potential pressure loss, for compressed gases, caused by permeation, creep, expansion and leakage. Pressure loss may affect the spray performance, delivery rate, total delivery and product retention. Each sample is used sequentially throughout the test and a "valve correction factor" is applied to accommodate gauge measurement loss. Data may be used to inform manufacturing on target filling conditions.

2. APPARATUS
   2.1. A calibrated digital pressure gauge, capable of recording pressure through the valve stem
   2.2. Proper Personal Protective Equipment
   2.3. Permanent black ink marking pen
   2.4. Environmentally controlled chambers capable of maintaining a constant ambient[1] and elevated[2] temperature conditions.

3. TEST SPECIMENS
   3.1. Minimum of 64 containers.

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. At the time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are:
      4.2.1. As produced: Test containers as soon as desired, but no less than one hour after manufacture.
   4.3. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient condition for 40 hours[3].
   4.4. Inspect a set of 64 containers to ensure all samples meet bottle specifications.
   4.5. Initial filling setup, follow procedure PARG-7.0.
   4.6. Fill 64 containers with product, as described in 4.3.
   4.7. Clinch valve.
   4.8. Pressurize to nominal pressure[4], as described in 4.3.
   4.9. Use appropriate pressure gauge to validate proper pressure.
   4.10. Immediately after filling, shake each container (10 times with a stroke length of approximately 35cm (12 inches)), measure and record room temperature equilibrium pressures within 60 seconds, keeping sequential recording.
   4.11. Using the marking pen, number samples 1-60, on dust cap, avoiding direct contact on the plastic container.

[1] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332.
[2] 38°C ± 2°C (100°F ± 3.6°F) @ Minimum 10% RH.
[3] Per Procedure A of ASTM D618.
[4] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-16.0	**COMPRESSED GAS PRESSURE LOSS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

4.12. Take 4 samples. Measure and record a minimum of 15 consecutive room temperature shaken pressures for each sample.
4.13. Calculate the Valve Correction Factor[5,6].
4.14. Apply valve correction factor to account for any pressure loss due to the gauge, during sample testing measurements[7].
4.15. Store 30 containers in an environmental chamber at ambient[1], for the duration of the test.
4.16. Store 30 containers in an environmental chamber at elevated[2], for the duration of the test.

5. SAMPLING
5.1. Recommended Test Conditions and Durations:
5.1.1. Ambient[1] temperature Intervals: 2, 4 weeks, 3, 6, 9 (optional), and 12, 18 and 24 months
5.1.2. Elevated[2] temperature Intervals: 2, 4 weeks and 3, 6 months (place the test interval containers in ambient[1] condition to ensure product has equilibrated to ambient[1] temperature prior to measuring the pressure).
5.1.3. Use the pressure gauge to record the equilibrium pressure of each sample per interval and apply the "valve correction factor" for each sequential measurement.
5.2. Report Pressure and Temperature for each container including Mean, Standard Deviation, and Range (both minimum and maximum) for the pressure at each time interval.

6. ACCEPTANCE CRITERIA
6.1. Product and container shall meet the predetermined criteria established by Interested Parties and label claim[8].

7. SAFETY
7.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

8. REFERENCES
8.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.

[5] Valve Correction Factor = (Final pressure – Initial pressure)/# of pressure readings; where the time between the initial pressure and final pressure readings is short.
[6] Variables that may affect the valve correction factor include the target propellant pressure, type of valve, type of pressure gauge and operator technique.
[7] Apply valve correction factor to each sequential pressure readings as follows: Pressure Reading = Equilibrium Pressure + (N * Valve Correction Factor); N is the number of pressure readings following initial being 1. Example, 2 week interval would be: Equilibrium Pressure + (2 * Valve Correction Factor); next reading at 4 week interval would be: Equilibrium Pressure + (3 * Valve Correction Factor), etc.
[8] For U.S.A. Label claim: National Institute of Standards and Technology (NIST), Weights and Measures Program Requirements, NIST Handbook 155.

METHOD NO: **PARG-16.0**	TITLE: **COMPRESSED GAS PRESSURE LOSS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

8.2. National Institute of Standards and Technology (NIST), Weights and Measures Program Requirements, NIST Handbook 155.

8.3. PARG Voluntary Standards and Test Methods

8.3.1. PARG-1.0: Dimensional measurement for aerosol products in plastic containers

8.3.2. PARG-2.0: Finish dimensions outside clinch for aerosol products in plastic containers

8.3.3. PARG-3.0: Capacity measurements for aerosol products in plastic containers

8.3.4. PARG-6.0: Seal integrity for aerosol products in plastic containers

8.3.5. PARG-7.0: Filling samples used in test method development for aerosol products in plastic containers.

9. OTHER RESOURCES

9.1. CSPA, AEROSOL GUIDE, Ninth Edition (2009)

9.1.1. Standard Method for Determining the Spray Patterns of Aerosol One-Inch (25.4mm) Valves (I24-I26)

9.1.2. Guidelines for Storage Testing of Aerosols (K24-K29)

9.1.3. Standard Test Method for Delivery Rate of Aerosols (K20-K23)

9.1.4. Standard Test Method for Pressure Drop Rate of Aerosol Products Propelled by (High Pressure) Compressed Gases (K8-K11)

9.1.5. Standard Method for Rapid Pressure Determination of Pressurized Products (K1-K4)

9.1.6. Alternate Method for Rapid Pressure Determination of Pressurized Products (K5-K7)

9.1.7. Tentative Procedure for Cross-Sectioning the Crimped Area of a One-Inch (25.4mm) Aerosol Dispenser (J12-J14)

10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	22 November 2016	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-17.0	**COMPRESSED GAS PRESSURE LOSS (ALTERNATE METHOD) FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB- COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. This method covers the measurement of potential pressure loss, for compressed gases, caused by permeation, creep, expansion and leakage. Pressure loss may affect the spray performance, delivery rate, total delivery and product retention. Each sample is measured only once throughout test conditions and durations. Data can also be used to inform manufacturing on target filling conditions.

2. APPARATUS
   2.1. A calibrated digital pressure gauge, capable of recording pressure through the valve stem
   2.2. Proper Personal Protective Equipment
   2.3. Permanent black ink marking pen
   2.4. Environmentally controlled chambers capable of maintaining a constant ambient[1] and elevated[2] temperature conditions.

3. TEST SPECIMENS
   3.1. Minimum of 360 containers (30 containers per interval).

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. At the time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are:
      4.2.1. As produced: Test containers as soon as desired, but no less than one hour after manufacture.
   4.3. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient condition for 40 hours[3].
   4.4. Inspect a set of 360 containers to ensure all samples meet bottle specifications.
   4.5. Initial filling setup, follow procedure PARG-7.0.
   4.6. Fill 360 containers with product, as described in 4.3.
   4.7. Clinch valve.
   4.8. Pressurize to nominal pressure[4], as described in 4.3.
   4.9. Use appropriate pressure gauge to validate proper pressure.
   4.10. Immediately after filling, shake each container (10 times with a stroke length of approximately 35cm (12 inches)), measure 30 containers and record room temperature equilibrium pressures within 60 seconds, discard the 30 tested samples.
   4.11. Using the marking pen, number samples 1-330, on dust cap, avoiding direct contact on the plastic container.
   4.12. Store 190 containers in an environmental chamber at ambient[1] for the duration of the test.

[1] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332.
[2] 38°C ± 2°C (100°F ± 3.6°F) @ Minimum 10% RH.
[3] Per Procedure A of ASTM D618.
[4] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions

METHOD NO: **PARG-17.0**	TITLE: **COMPRESSED GAS PRESSURE LOSS (ALTERNATE METHOD) FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB- COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

4.13. Store 120 containers in an environmental chamber at elevated[2] temperature for the duration of the test.

5. SAMPLING
   5.1. Recommended Test Conditions and Durations:
      5.1.1. Ambient[1] temperature Intervals: 2, 4 weeks, 3, 6, 9 (optional), and 12, 18 and 24 months
      5.1.2. Elevated[2] temperature Intervals: 2, 4 weeks and 3, 6 months (place the test interval containers in ambient[1] condition to ensure product has equilibrated to ambient[1] temperature prior to measuring the pressure).
      5.1.3. Use the pressure gauge to record the equilibrium pressure of each sample per interval, then discard the tested samples.
   5.2. Report Pressure and Temperature for each container including Mean, Standard Deviation, and Range (both minimum and maximum) for the pressure at each time interval.

6. ACCEPTANCE CRITERIA
   6.1. Product and container shall meet the predetermined criteria established by Interested Parties and label claim[5].

7. SAFETY
   7.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

8. REFERENCES
   8.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.
   8.2. National Institute of Standards and Technology (NIST), Weights and Measures Program Requirements, NIST Handbook 155.
   8.3. PARG Voluntary Standards and Test Methods
      8.3.1. PARG-3.0: Capacity measurements for aerosol products in plastic containers
      8.3.2. PARG-6.0: Seal integrity for aerosol products in plastic containers
      8.3.3. PARG-7.0: Filling samples used in test method development for aerosol products in plastic containers.

9. OTHER RESOURCES
   9.1. CSPA, AEROSOL GUIDE, Ninth Edition (2009)
      9.1.1. Standard Method for Determining the Spray Patterns of Aerosol Valves (I24-I26)
      9.1.2. Guidelines for Storage Testing of Aerosols (K24-K29)
      9.1.3. Standard Test Method for Delivery Rate of Aerosols (K20-K23)

[5] For U.S.A. Label claim: National Institute of Standards and Technology (NIST), Weights and Measures Program Requirements, NIST Handbook 155. Other countries to verify with their respective local regulatory standards.

METHOD NO: **PARG-17.0**	TITLE: **COMPRESSED GAS PRESSURE LOSS (ALTERNATE METHOD) FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **11 JUNE 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB- COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

9.1.4. Standard Test Method for Pressure Drop Rate of Aerosol Products (K8-K11)
9.1.5. Standard Method for Rapid Pressure Determination of Pressurized Products (K1-K4)
9.1.6. Alternate Method for Rapid Pressure Determination of Pressurized Products (K5-K7)

10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	22 November 2016	• Initial release	
1	11 June 2020	• Reference of word crimp changed to clinch	• Align with industry terminology
2			
3			

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-18.0	**WEIGHT LOSS USING LIQUEFIED GAS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**21 APRIL 2020** REVISION DATE: **9 MAY 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser** **PARG CHAIRPERSON**

1. PURPOSE
   1.1. This method covers the measurement of the product and/or propellant loss (live and dead storage) due to permeation and leakage resulting in weight (mass) reduction of product inside a plastic aerosol container using LPG. Pressure loss may affect the spray performance, delivery rate, total delivery and product retention.

2. APPARATUS
   2.1. Constant temperature water bath capable of reaching 38°C.
   2.2. A calibrated digital pressure gauge, capable of recording pressure through the valve stem.
   2.3. Digital or analog thermometer
   2.4. Proper Personal Protective Equipment
   2.5. Permanent black ink marking pen
   2.6. Environmentally controlled chambers capable of maintaining a constant ambient[1] and elevated[2] temperature conditions

3. TEST SPECIMENS
   3.1. Refer to CSPA Aerosol Guide method, “Guidelines for Storage Testing of Aerosols”.

4. PROCEDURE
   4.1. Refer to CSPA Aerosol Guide method, “Guidelines for Storage Testing of Aerosols”.
   4.2. At the time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are:
      4.2.1. As produced: Test containers as soon as desired, but no less than one hour after manufacture.
   4.3. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[2] condition for 40 hours[3].

5. SAMPLING
   5.1. Recommended Test Conditions and Durations:
      5.1.1. Ambient[1] temperature Intervals: 2, 4 weeks, 3, 6, 9 (optional), and 12, 18 and 24 months
      5.1.2. Elevated[4] temperature Intervals: 2, 4 weeks and 3, 6 months (place the test interval containers in ambient[1] condition to ensure product has equilibrated to ambient[1] temperature prior to measuring the pressure).
      5.1.3. Use the pressure gauge to record the equilibrium pressure of each sample per interval.

[1] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332.
[2] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH, per ASTM D4332).
[3] Per Procedure A of ASTM D618.
[4] 38°C ± 2°C (100°F ± 3.6°F) @ Minimum 10% RH.

METHOD NO: **PARG-18.0**	TITLE: **WEIGHT LOSS USING LIQUEFIED GAS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **21 APRIL 2020** REVISION DATE: **9 MAY 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

5.2. Report Pressure and Temperature for each container including Mean, Standard Deviation, and Range (both minimum and maximum) for the pressure at each time interval.

6. ACCEPTANCE CRITERIA
   6.1. Product and container shall meet the predetermined criteria established by Interested Parties and label claim[5].

7. SAFETY
   7.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

8. REFERENCES
   8.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.
   8.2. National Institute of Standards and Technology (NIST), Weights and Measures Program Requirements, NIST Handbook 155.
   8.3. PARG Voluntary Standards and Test Methods
      8.3.1. PARG-1.0: Dimensional measurement for aerosol products in plastic containers
      8.3.2. PARG-2.0: Finish dimensions outside clinch for aerosol products in plastic containers
      8.3.3. PARG-3.0: Capacity of bottle at fill point and overflow for aerosol products in plastic containers
      8.3.4. PARG-6.0: Seal Integrity for aerosol products in plastic containers.

9. OTHER RESOURCES
   9.1. CSPA, AEROSOL GUIDE, Ninth Edition (2009)
      9.1.1. Standard Method for Determining the Spray Patterns of Aerosol One-Inch (25.4mm) Valves (I24-I26)
      9.1.2. Guidelines for Storage Testing of Aerosols (K24-K29)
      9.1.3. Standard Test Method for Delivery Rate of Aerosols (K20-K23)
      9.1.4. Standard Test Method for Pressure Drop Rate of Aerosol Products Propelled by (High Pressure) Compressed Gases (K8-K11)
      9.1.5. Standard Method for Rapid Pressure Determination of Pressurized Products (K1-K4)
      9.1.6. Alternated Method for Rapid Pressure Determination of Pressurized Products (K5-K7)
      9.1.7. Tentative Procedure for Cross-Sectioning the Crimped Area of a One-Inch (25.4mm) Aerosol Dispenser (J12-J14)

[5] For U.S.A. Label claim: National Institute of Standards and Technology (NIST), Weights and Measures Program Requirements, NIST Handbook 155.

METHOD NO: **PARG-18.0**	TITLE: **WEIGHT LOSS USING LIQUEFIED GAS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **21 APRIL 2020** REVISION DATE: **9 MAY 2016**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	21 April 2020	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-19.0	**OUTSIDE CLINCH 1-INCH VALVE DIMENSIONS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**15 MAY 2017**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG Chairperson**

1. PURPOSE

1.1. Various factors of package quality, including seal integrity, are dependent on the quality of the clinch and valve to container fit. The purpose of this method is to verify those dimensions.

2. APPARATUS

2.1. Optical Projection Comparator, CMM or Laser, Vernier or Digital Calipers

3. TEST SPECIMENS

3.1. The number of test replications depends on the desired objectives of the testing. Replicate testing should be conducted to improve the reliability of the test results.

4. PROCEDURE

4.1. Verify calibration of apparatus equipment.

4.2. Observe and record incidents of gross defects such as “blown necks” and other deformations.

4.3. Observe quality of sealing surfaces and valve cup forming. Mark and note instances of nicks, dents, pedestal crimp abnormalities, sealing gasket present, rust/corrosion (if applicable), and etc.

4.4. At time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are as follows:

4.4.1. As produced: Test containers once the container has sufficiently cooled, per operator’s blow molding quality procedures.

4.4.2. As received: Test containers that have been aged a minimum of 72 hours and conditioned at ambient[1] temperature for 40 hours[2].

4.5. Record all data.

5. MEASUREMENTS

5.1. **F** – Thickness of Cup Plate

5.2. **G** – Thickness of virgin sealing gasket

5.3. **S** – Skirt Inside Diameter

5.4. **D** – Cup Outside Diameter

5.5. **A** – Cup Body Outside Diameter

5.6. **H** – Overall Cup Height

5.7. **C** – Skirt Height

5.8. **M** – Clinch Height

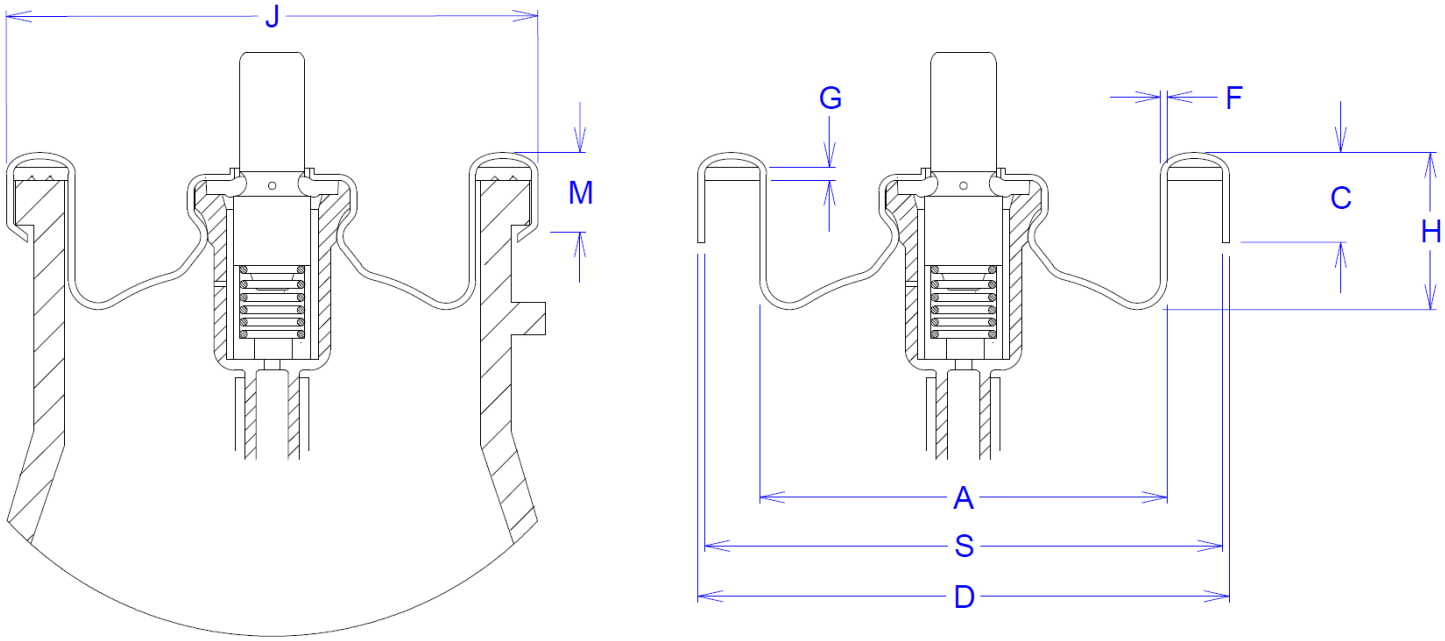
5.9. **J** – Clinch Diameter

[1] Ambient is Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH), per ASTM D4332

[2] Per procedure A of ASTM D618

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-19.0	**OUTSIDE CLINCH 1-INCH VALVE DIMENSIONS FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**15 MAY 2017**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG Chairperson**

6. DRAWING



7. SAFETY

7.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc.

8. REFERENCES

8.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.

9. OTHER RESOURCES

9.1. Not Applicable at this time.

10. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	15 May 2017	• Initial release	
1			
2			
3			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-20.0	**UV EXPOSURE USING XENON ARC LIGHT APPARATUS AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**30 April 2019**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

1. PURPOSE
   1.1. The purpose of this test is to determine the impact or degradation from UV radiation that may occur to the material (resin) or pigment (container colorant), if applicable. The unfilled and unpressurized specimens are exposed to filtered xenon-arc light under controlled conditions (temperature and humidity) to represent such exposure on a consumer's windowsill. The comparison should be made versus a control by means of visual inspection, and physical performance testing (pressure loss, burst and drop testing).

2. APPARATUS
   2.1. Light source consisting of calibrated quartz jacketed xenon-arc lamps, fitted with suitable window filters, to simulate the spectral power distribution of daylight in the ultraviolet (UV) and visible regions of the spectrum with a chiller system to control the black plate-standard.

3. TEST SPECIMENS
   3.1. Recommended Quantity: 110 containers

4. PROCEDURE
   4.1. Verify calibration of equipment.
   4.2. At the time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are:
      4.2.1. As produced: Test containers once the container has sufficiently cooled, per operator's blow molding quality procedures.
      4.2.2. As received: Test containers that have been aged at least 72 hours and conditioned at ambient[1] conditions for 40 hours[2].
   4.3. Testing
      4.3.1. Place 55 of the specimens in a closed box in standard conditioning atmosphere, for control purposes.
      4.3.2. Place 55 of the specimens in the Xenon Arc chamber, set chamber to the conditions stated in Table 1, cycling with light and dark periods.
         4.3.2.1. Cycle Light for 3 hours and 30 minutes
         4.3.2.2. Cycle Dark (no light exposure) for 30 minutes
         4.3.2.3. Cycle between 4.3.2.1 and 4.3.2.2 continuously for the determined amount of exposure in relation to placed on windowsill timeframe, reference Table 2.

[1] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH, per ASTM D4332).
[2] Per Procedure A of ASTM D618.

METHOD NO: **PARG-20.0**	TITLE: **UV EXPOSURE USING XENON ARC LIGHT APPARATUS AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	EFFECTIVE DATE: **30 April 2019**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

4.3.3. Upon completion of testing period, remove samples, visually inspect for abnormalities and do a performance test, comparing to samples that were un-exposed to UV (i.e. control).

4.3.3.1. Burst Test:

4.3.3.1.1. Using twenty-five (25) of the UV exposed and twenty-five (25) of the un-exposed specimens, place in burst tester and follow PARG-10.0 method.

4.3.3.1.2. Records burst results.

4.3.3.2. Drop Test:

4.3.3.2.1. Drop thirty (30) of the UV exposed and thirty (30) of the un-exposed specimens, whereby utilizing ten samples, from each set, to be dropped in three orientations. Reference drop height and orientation guidelines as described in PARG-11.0.

4.3.3.2.2. Record results.

5. ACCEPTANCE CRITERIA

5.1. The resultant values should show no gross/significant difference between the UV exposed and un-exposed specimens.

5.2. Method was validated for PET resin. Any other resin material should be validated by the Interested Party.

Table 1.

Exposure Period	Time	Narrowband (420 n/m) W/(m2*nm)	Black-Panel Temperature (BPT) °C	Chamber Air Temperature (AT) °C	Relative Humidity %
Light ON	30hr 30min	0.45 ± 0.02	35	25-29	50 ± 10
Light OFF	30min	N/A	N/A	23	50 ± 10

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-20.0	**UV EXPOSURE USING XENON ARC LIGHT APPARATUS AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**30 April 2019**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

Table 2.

Expected Number of Months Exposure Behind Single Pane of Glass	Equivalent PARG Chamber Dosage Duration (Hours)*
1	405
2	810
3	1214
4	1618
5	2021
6	2450
7	2830
8	3235
9	3640
10	4045
11	4449
12	4852
18	7280
24	9705

*Based on TUVR comparison to 12 month outdoor Florida exposure, under glass, per ISO 877-2 Method B (2009)

6. SAFETY
   6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc. Operate the closed chamber under corporate guidelines to handling flammable products, when applicable.

7. REFERENCES
   7.1. Study of UV Degradation on Plastic Aerosols, Plastic Aerosol Research Group, LLC, 2019
   7.2. PARG-10.0: Burst Performance for Aerosol Products in Plastic Containers
   7.3. PARG-11.0: Drop Impact for Aerosol Products in Plastic Containers
   7.4. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-20.0	**UV EXPOSURE USING XENON ARC LIGHT APPARATUS AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**30 April 2019**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Scott E. Smith PARG CHAIRPERSON**

8. OTHER RESOURCES
   8.1. ASTM G155-05a, Standard Practice for Operating Xenon Arc Light Apparatus for exposure of Non-Metallic Materials.
   8.2. ASTM G151, Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that use Laboratory Light Sources.
   8.3. ASTM G113, Terminology Relating to Natural and Artificial Weathering Tests for Nonmetallic Materials.
   8.4. ASTM D5870, Practice for Calculating Property Retention Index of Plastics.
   8.5. ISO 4892-1, Plastics-Methods of Exposure to Laboratory Light Sources - Part 1: General guidance
   8.6. ISO 4892-2, Plastics-Methods for Exposure to Laboratory Light Sources - Part 2: Xenon Arc Lamps.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	30 April 2019	• Initial release	
1			
2			
3			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-21.0	**UV EXPOSURE OF PRODUCT FORMULA USING XENON ARC LIGHT APPARATUS AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 June 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. The purpose of this test is to determine the impact or degradation from UV radiation that may occur to the product formula. The specimens are exposed to filtered xenon-arc light under controlled conditions (temperature and humidity) to represent such exposure on a consumer's windowsill. The comparison should be made versus a control by means of visual inspection and product performance testing. PARG makes no evaluation requirement nor recommendation for product performance.

2. APPARATUS
   2.1. Light source consisting of calibrated quartz jacketed xenon-arc lamps fitted with suitable window filters, to simulate the spectral power distribution of daylight in the ultraviolet (UV) and visible regions of the spectrum with a chiller system to control the black-standard.
   2.2. Filling and Pressurizing process.

3. TEST SPECIMENS
   3.1. Recommended Quantity: 24 containers

4. PROCEDURE
   4.1. Before beginning any UV testing, the interested party should test their container as referenced in PARG-14.0, to ensure it can withstand the temperature conditions that are potential inside the UV Xenon-Arc equipment.
   4.2. Verify calibration of equipment.
   4.3. At the time of testing, containers to be tested should be at a consistent age and condition. Recommendations for conditions are:
      4.3.1. As produced: Test containers once the container has sufficiently cooled, per operator's blow molding quality procedures.
      4.3.2. As received: Test containers that have been aged at least 72 hours and conditioned at ambient[1] conditions for 40 hours[2].
      4.3.3. Fill the test specimens, with interested party's product formula.
      4.3.4. Clinch valve.
      4.3.5. Pressurize to nominal pressure[3].
      4.3.6. Immediately after filling, shake each container (10 times with a stroke length of approximately 35cm (12 inches)).
      4.3.7. Use appropriate pressure gauge to validate proper pressure, mark and record for all specimens.

[1] Standard Conditioning Atmosphere (23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5% RH, per ASTM D4332).
[2] Per Procedure A of ASTM D618.
[3] Nominal pressure is the pressure at which the package is nominally filled at ambient conditions

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-21.0	**UV EXPOSURE OF PRODUCT FORMULA USING XENON ARC LIGHT APPARATUS AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 June 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

4.4. Testing

4.4.1. Place 12 of the specimens in a closed box in standard conditioning atmosphere, for control purposes.

4.4.2. Place 12 of the specimens in the Xenon Arc chamber, set chamber to the conditions stated in Table 1, cycling with light and dark periods.

4.4.2.1. Cycle Light for 3 hours and 30 minutes

4.4.2.2. Cycle Dark (no light exposure) for 30 minutes

4.4.2.3. Cycle between 4.4.2.1 and 4.4.2.2 continuously for the determined amount of exposure in relation to placed on windowsill timeframe, reference Table 2.

4.4.3. Upon completion of testing period, remove samples, visually inspect for abnormalities and do a performance test, comparing to samples un-exposed to UV.

4.4.3.1. Pressure Test:

4.4.3.1.1. Measure and record post pressures for each specimen.

4.4.3.1.2. Record results.

4.4.3.2. Product Performance Test:

4.4.3.2.1. To be determined by the interested party.

5. ACCEPTANCE CRITERIA

5.1. The resultant values should show no gross/significant difference between the UV exposed and un-exposed specimens and product performance shall be determined by the interested party.

Table 1.

Exposure Period	Time	Narrowband (420 n/m) W/(m2*nm)	Black-Panel Temperature (BPT) °C	Chamber Air Temperature (AT) °C	Relative Humidity %
Light ON	30hr 30min	0.45 ± 0.02	35	25-29	50 ± 10
Light OFF	30min	N/A	N/A	23	50 ± 10

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-21.0	**UV EXPOSURE OF PRODUCT FORMULA USING XENON ARC LIGHT APPARATUS AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 June 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

Table 2.

Expected Number of Months Exposure Behind Single Pane of Glass	Equivalent PARG Chamber Dosage Duration (Hours)*
1	405
2	810
3	1214
4	1618
5	2021
6	2450
7	2830
8	3235
9	3640
10	4045
11	4449
12	4852
18	7280
24	9705

*Based on TUVR comparison to 12 month outdoor Florida exposure, under glass, per ISO 877-2 Method B (2009)

6. SAFETY
   6.1. Use appropriate personal protective equipment, such as safety glasses, gloves, etc. Operate the closed chamber under corporate guidelines to handling flammable products, when applicable.

7. REFERENCES
   7.1. Study of UV Degradation on Plastic Aerosols, Plastic Aerosol Research Group, LLC, 2019
   7.2. PARG-7.0: Filling samples used in test method development for aerosol products in plastic containers.
   7.3. PARG-14.0: Material Resistance to Constant Temperature Evaluation for Aerosol Products in Plastic Containers
   7.4. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-21.0	**UV EXPOSURE OF PRODUCT FORMULA USING XENON ARC LIGHT APPARATUS AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**11 June 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

8. OTHER RESOURCES
   8.1. ASTM G155-05a, Standard Practice for Operating Xenon Arc Light Apparatus for exposure of Non-Metallic Materials.
   8.2. ASTM G151, Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that use Laboratory Light Sources.
   8.3. ASTM G113, Terminology Relating to Natural and Artificial Weathering Tests for Nonmetallic Materials.
   8.4. ASTM D5870, Practice for Calculating Property Retention Index of Plastics.
   8.5. ISO 4892-1, Plastics-Methods of Exposure to Laboratory Light Sources - Part 1: General guidance
   8.6. ISO 4892-2, Plastics-Methods for Exposure to Laboratory Light Sources - Part 2: Xenon Arc Lamps.

9. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	30 April 2019	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			

PLASTIC AEROSOL RESEARCH GROUP, LLC.

TEST METHOD

METHOD NO:	TITLE:	EFFECTIVE DATE:
PARG-22.0	**GASKET COMPRESSION NON-DESTRUCTIVE EVALUATION FOR AEROSOL PRODUCTS IN PLASTIC CONTAINERS**	**21 APRIL 2020**
METHOD CLASSIFICATION: **Plastic Aerosol**	AUTHOR(S): **PACKAGING SUB-COMMITTEE**	APPROVED BY: **Andrew W. Franckhauser PARG CHAIRPERSON**

1. PURPOSE
   1.1. The external clinch on a plastic aerosol is critical to obtain a tightly sealed container, by maintaining the desired pressure over the life of the product to ensure product performance. This method details the steps to calculate the minimum % gasket compression for a non-pressurized clinched container. This involves taking two height measurements, without removing a clinched valve. The difference in the measurements can then be used to calculate the minimum % Gasket Compression for the container.

   1.2. Methods appear in the following order:
      1.2.1. Method 1: Gasket Compression with a Support Ledge feature
      1.2.2. Method 2: Gasket Compression without a Support Ledge feature

2. APPARATUS
   2.1. Valves with a mounting cup designed for an external clinch.
   2.2. Clinching device capable of securely applying valves to the containers.
   2.3. Apparatus (Method 1) capable of securely holding under the support ledge and a gauge capable of measuring top of container (with and without valve attached) utilizing a measurement probe, offset calipers, optical comparator, Kroeplin/Socage gauge, or other calibrated gauge apparatus.
   2.4. Apparatus (Method 2) capable of measuring clinched valve from top of mounting cup to under the clinch.
   2.5. Filling and Pressurizing process (optional).

3. TEST SPECIMENS
   3.1. Recommended Quantity: 30 containers (either method)

4. **Method 1: Gasket Compression with a Support Ledge feature**
      4.1.1. Mark a minimum of four (4) equidistant points on the Support Ledge feature[1], on all 30 containers.
      4.1.2. Reference Figure 1, for subsequent measuring points.
      4.1.3. Measure and record the N-dimension, at the points marked in 4.1.1.
         4.1.3.1. N = Height from Top of Finish (which is X+B, reference PARG-2.0, or just X if no seal bead is present) to underside of Support Ledge, use the Mean of the measurements.
      4.1.4. Optional: Fill the 30 containers as it would be filled for commercial distribution, with product to nominal fill levels.

[1] If the container does not have a Support Ledge, this method will not apply, interested party shall find another robust datum point or refer to Method 2.

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4.1.5. Clinch valves on each container, record clinch settings.
4.1.6. Measure and record P-Dimension at the points marked in 4.1.1.
4.1.6.1. P = Height from top of Mounting Cup to underside of Support Ledge, use the Mean of the measurements recorded in 4.1.6.
4.1.7. G = Nominal thickness of the virgin Sealing Gasket per supplier drawing (or measured by taking an average of a minimum of twelve (12) valve samples by removing the gaskets without causing stretch or damage).
4.1.8. F = Nominal thickness of the Cup Plate, at the top of the Mounting Cup, per supplier drawing (or measured by taking an average of a minimum of twelve (12) valve "metal" thicknesses at the top of the mounting cup location).
4.1.9. Calculate the minimum % Gasket Compression using Equation 1, then proceed to Acceptance Criteria section:

Equation 1:

$$\% C = \left[1 - \left[\frac{(P-N-F)}{G}\right]\right] x\ 100$$

5. **Method 2: Gasket Compression without a Support Ledge feature**
5.1.1. Mark a minimum of four (4) equidistant points on the container neck under the Lip Clinch, on all 30 containers.
5.1.2. Reference Figure 1, for subsequent measuring points.
5.1.3. Measure and record the R-dimension, at the points marked in 5.1.1.
5.1.3.1. R = Height from Top of Finish (which is L+B, reference PARG-2.0, or just L if no seal bead is present) to underside of Lip Clinch area, use the Mean of the measurements.
5.1.4. Optional: Fill the 30 containers as it would be filled for commercial distribution, with product to nominal fill levels.
5.1.5. Clinch valves on each container, record clinch settings.
5.1.6. Measure and record the M-dimension, at the points marked in 5.1.1.
5.1.6.1. M = Height from Top of Mounting Cup to underside of valve skirt, use the Mean of the measurements.
5.1.7. G = Nominal thickness of the virgin Sealing Gasket per supplier drawing (or measured by taking an average of a minimum of twelve (12) valve samples by removing the gaskets without causing stretch or damage).
5.1.8. F = Nominal thickness of the Cup Plate, at the top of the Mounting Cup, per supplier drawing (or measured by taking an average of a minimum of twelve (12) valve "metal" thicknesses at the top of the mounting cup location).

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5.1.9. Calculate the minimum % Gasket Compression using Equation 2, then proceed to Acceptance Criteria section:

Equation 2:

$$\%C = \left[\frac{(G + 2F + R) - M}{G}\right] x100$$

6. ACCEPTANCE CRITERIA
   6.1. The resultant value can be used to calculate the minimum % Gasket Compression.
   6.2. In order to obtain good clinch integrity on the neck of a container, the sealing gasket material (rubber) must have some amount of compression. The amount of compression is dependent on multiple variables such as gasket material, durometer, clincher settings, and other factors. Therefore, acceptable compression is to be determined by the interested party, which can be correlated to attributes, such as, but not limited to, pressure or weight loss (reference methods PARG-16.0 to 18.0), Seal Integrity (reference PARG-6.0) or other attributes.
   6.3. Although this method references unpressurized containers, interested parties may also use this method on pressurized containers to get a correlation between pre- and post-pressurized conditions. Interested parties should determine acceptable compression for post-pressurized containers specific to their respective process and/or product performance expectations.

7. NOTES
   7.1. Method 1 provides more accuracy than Method 2. However, Method 2 may be used when a Support Ledge feature is not present or when desired by an interested party for any reason.

8. REFERENCES
   8.1. Glossary of terms used in the aerosol industry for Aerosol Products in Plastic Containers.
   8.2. PARG-19.0: Outside Clinch 1-inch Valve Dimensions for Aerosol Products in Plastic Containers.

9. OTHER RESOURCES
   9.1. Not Applicable at this time.

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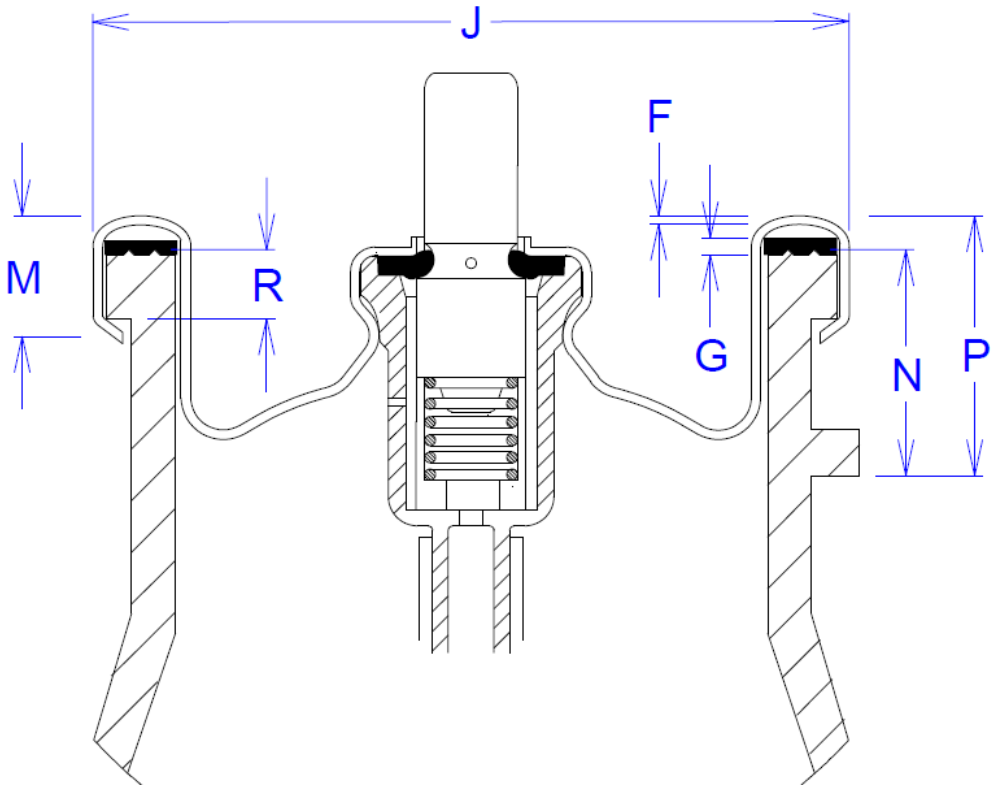
10. FIGURE 1



11. REVISIONS

Revision Number	Date	What is changing	Why is it changing
0	08 December 2019	• Initial release	
1	11 June 2020	• References of word crimp changed to clinch	• Align with industry terminology
2			
3			