3-Piece Tinplate Aerosol Cans

Factors in Container Selection and The Manufacturing Process
SATA Aerosol 101 – March 28, 2007

BWAY packaging
a division of BWAY Corporation

Overview

- Factors and Test Methods - Container Selection
- Regulatory / USDOT Requirements
- Commercial Standards / CSPA
- Materials and the Can Manufacturing Process

Factors to Consider

- Can Size & Style
- Decoration
- Container Linings
- Formula/Container Stability

Can Size and Style

- Several standard can diameters available in a wide variety of heights
- Straight-sided, necked-in, or shaped cans

Can Size and Style

- Aerosol Can Sizes
  - Sales Code Designation
    - Expresses can diameter (at doubleseam) X can height (doubleseam to doubleseam)
    - Three digit number
      - First digit = whole number of inches
      - Second two digits = 16th's of an inch
    - Example: 211 x 604
      - Can Diameter = 2-11/16 inches
      - Can Height = 6-4/16 inches

Can Size and Style

Common Aerosol Can Sizes (straight-sided)

202 x	**211 x**	**300 x**
406	413	709
509	604	
700	612	
	713	
	908	

Can Size and Style

Common Aerosol Can Sizes (necked-in)

200/202x	202/205x	207.5/211x	211/214x
406	604	413	714
509	608	604	804
700	704	612	
	710	713	
	802		

Can Size and Style

Decoration

- Lithographed or Wrap-label
- Lithography
  - Multi-color process printing, can recreate a wide range of solid colors and halftones to reproduce photographic quality images
  - Variety of exterior coating options
    - Gloss Varnish – standard, high gloss appearance
    - Pearlized Coating – pearlescent appearance
    - Matte Varnish – flat appearance
- Labels
  - Reduced and more flexible inventory

Formula/Container Selection

- Solvent or water-based formula
- Typically
  - Solvent-based: plain (unlined) cans
  - Water-based: plain or lined cans

Formula/Container Selection

- pH is a critical factor in corrosivity and when considering whether to employ a can lining
- pH > 7.0 recommended, > 8.0 even better
  - pH 7-9, consider lined cans
  - Linings often unnecessary and incompatible with more alkaline formulas
    - pH > 9 or 10, consider plain cans
- Consider adding corrosion inhibitors to combat liquid and/or vapor phase corrosion

Formula/Container Selection

- Can Linings
  - Designed primarily to protect the formula from the can (metal)
  - Not effective at preventing localized pitting corrosion

Formula/Container Selection

- Can Linings
  - Various coating chemistries available, some offered as single linings while others are used in combination
    - Epoxy
    - Epoxy Phenolic
    - Vinyl
  - Gold Epoxy Phenolic is the industry standard

Formula/Container Interaction

- Types of Interactions
  - Product Degradation
  - Container Degradation
- How to Predict?
- Goal: Formula/Container **Compatibility**

Product Degradation

- Loss of efficacy
- Product discoloration
- Odor changes
- Product contamination
- Clogged Valves

Container Degradation

- De-tinning
- Rusting
- Lining blisters, loss of adhesion
- Pitting corrosion, perforation

Formula/Container Testing

- To avoid product and container degradation, a variety of test methods are available to evaluate formula/container compatibility
  - Electrochemical Testing
  - Testpacks / Can Stability

Electrochemical Testing

- Several “accelerated” corrosion test methods are commonly used, often in combination
  - Crevice cell, driven can cell, cyclic polarization, electrochemical impedance spectroscopy
- Can predict the mode and severity of corrosion that is anticipated with a given formula
- These are screening tools, not a replacement for testpacks
- Quick indication of stability, reduce development time and expense wasted on failed testpacks

Testpacks / Can Stability

- Static storage of filled cans
- Cans stored at various controlled temperatures
- Opened and evaluated at specific intervals
- Best measure of product/container stability, but time consuming

Regulatory

- USDOT is the regulatory body for aerosols
- Primary Purpose - Safe shipment of filled cans
- Code of Federal Regulations (CFR)
  - CFR 49, §100 to 185

Regulatory

- Three key sections pertaining to aerosols
  - §173.306 “Limited Quantities of Compressed Gases”
  - §178.33 “Specification 2P”
  - §178.33a “Specification 2Q”

Regulatory

- Aerosol - USDOT Classification
- Three main groups, based on internal pressure of filled can at 130 F
  - Non-spec (2N)
  - 2P
  - 2Q
- Customer/Filler must determine which can spec is needed based on actual pressure @ 130F

Regulatory

- §173.306 “Limited Quantities of Compressed Gases”
- Max Capacity = 1 Liter (33.8 fluid oz)
- Pressure @ 130º F of filled aerosol?
  - Must be less than 180 psig
  - < 140 psig = Non-spec
  - 140 - 160 psig = DOT 2P
  - 160 - 180 psig = DOT 2Q
  - Regardless, can must withstand 1-1/2 x p @ 130º F

Regulatory

- §173.306 “Limited Quantities of Compressed Gases” -- cont’d
- Liquid contents must not fill can @ 130º F
- Must be packed in “strong outside packagings”
- Water Bath
  - Proof Test
  - EACH filled can must be subjected to water bath
  - Bath temp & dwell time must ensure that contents reach 131º F, No leaks or deformation

Regulatory

- §178.33 “Specification 2P”
- Max Capacity = 1 Liter, Max Dia = 3 inches
- Wall Thickness = 0.007” MIN
- Testing -- Buckle/Burst
  - One can per lot (25M or less) must be tested to destruction
  - Must not burst below 240 psig
- Marking – Manuf. ID & “DOT-2P”

Regulatory

- §178.33a “Specification 2Q”
- Max Capacity = 1 Liter, Max Dia = 3 inches
- Wall Thickness = 0.008” MIN
- Testing -- Buckle/Burst
  - One can per lot (25M or less) must be tested to destruction
  - Must not burst below 270 psig
- Marking – Manuf. ID & “DOT-2Q”

Regulatory

- Aerosol - USDOT Classification
- Three main groups, based on internal pressure of filled can
  - Non-spec (2N)
  - 2P
  - 2Q
- Customer/Filler must determine which spec is needed

Regulatory

- Overview: Non-Spec, 2P, & 2Q

	Non-Spec(2N)	DOT 2P	DOT 2Q
Internal Pressure-MAX	140 psig.	160 psig.	180 psig.
Buckle Strength-MIN	140 psig.	160 psig.	180 psig.
Burst Strength-MIN	210 psig.	240 psig.	270 psig.
Wall Thickness-MIN	N/A	.007”	.008”
Req’d Can Marking	N/A	YES	YES
Pressure Testing (USDOT)	N/A	1/25,000	1/25,000

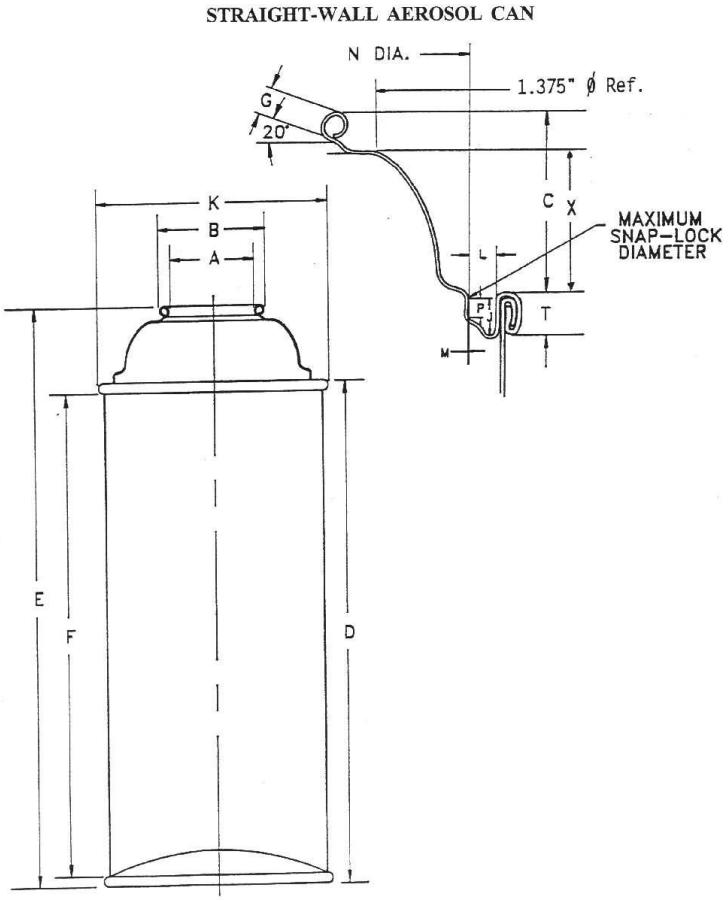
Commercial Standards

- Primary industry group for aerosol cans is the CSPA (formerly CSMA)
- “CSPA Aerosol Guide”
- Details industry accepted dimensions and test methods
- Section F - “Steel and Tin Plate Aerosol Cans”

Commercial Standards

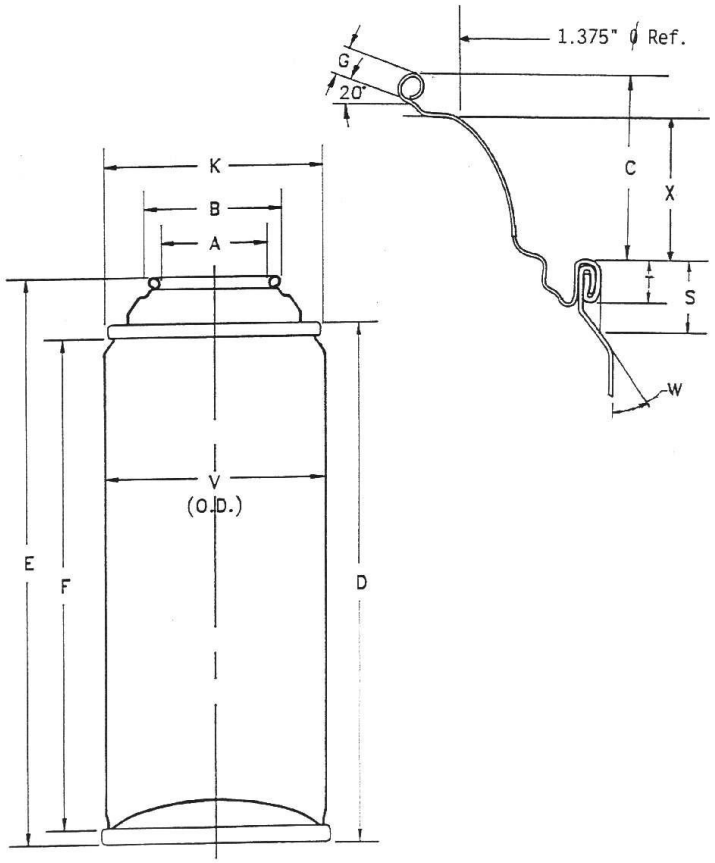
- CSPA Standards
  - Covers the most common can sizes
  - Information for both straight-sided and necked-in cans
  - Dimensions typically given a letter designation, i.e. “K-dimension”

Commercial Standards



Commercial Standards

NECKED-IN AEROSOL CAN



Can Manufacture

- Incoming Material
- Coil Cutting
- Coating
- Lithography
- End Manufacturing
- Can Assembly

Incoming Material

- Electrolytic Tin Plate (ETP)
  - Steel onto which a very thin layer of tin is electrolytically deposited
- Base Box
  - Unit of surface area = 31,360 in^2
- Basis Weight / Baseweight
  - Expression of metal thickness as weight/SA (pounds per Base Box)

Incoming Material

- Basis Weight (BW)
  - Plate Thickness expressed in Pounds/Base Box
  - Calculation: BWx0.00011=Thickness (inches)
  - Basis Weight Range for Aerosol Body Plate
    - 65# to 85#
  - Basis Weight Range for Aerosol End Plate
    - 100# to 130#

Incoming Material

- Temper: Measure of plate hardness
  - Contributes to can strength
  - Higher temper allows for use of lower basis weight, but offers reduced ductility
  - Temper Values:
    - Single Reduced: T1 to T5
    - Double Reduced: DR7 - DR9
  - Common tempers used in aerosol components:
    - Bodyplate: DR8
    - Domes/Tops: T2-T4
    - Bottoms: T5

Incoming Material

- Tin Coating
  - Refers to the amount of tin distributed on both sides of the plate
  - 0.20 lb/BB typical for aerosol cans (20 ETP)
  - Differential Plate: 0.50/0.20 lbs/BB
    - 0.25 lb/BB on one side
    - 0.10 lb/BB on the other

Coil Line

- Coil Cutting
  - Typical Coil is 18,000 to 25,000 lbs
  - Ordered by width, cut to specific sheet length

Coating

- Interior Coatings
  - Common interior coating systems
    - Epoxy
    - Epoxy Phenolic
    - Vinyl

Coating

- Exterior Coatings
  - Size Coat, if necessary
  - White Coat
  - Varnish

Lithography

- Offset Lithography
  - Based on the principle that oil and water do not mix
  - Aluminum photopolymer press plate contains ink-receptive (image area) and water-receptive (non-image area) regions
  - Image area of the press plate accepts ink, which is then transferred to the blanket and then from the blanket to the substrate (tin plate sheet)

Lithography

- Offset Lithography
  - Multiple color presses: allows for the application of two or more colors in one “pass”
  - Half-tones allow the appearance of shading and gradation of different colors for photo-quality decoration
  - Protective varnish applied over the decorated plate
  - Both conventional (temperature/heat cure) and UV-cured inks and varnishes are used in decorating aerosols

End Manufacture

- Aerosol dome (top) manufacture
  - Sheets are sheared into strips and fed into press
  - “Blank and Draw” - Blanks are punched from the strip, this initial draw forms a “cup”

End Manufacture

- Aerosol dome (top) manufacture
  - Cup is transferred through multi-stage conversion press
  - Cup is trimmed and critical dimensions are formed here, including the one-inch curl
  - Cut-edge is curled
  - Compound is applied, this compound serves as a gasket in the doubleseam to ensure hermetic seal

End Manufacture

- Aerosol Bottom Manufacture
  - Also begins with sheared strips
  - Blank is punched and the bottom is formed
  - Cut-edge is curled
  - End compound is applied

Can Assembly

- Slitter/Bodymaker
  - Sheets of body plate are cut into individual body blanks. Size is dependent upon the diameter and height of the can
  - Body blanks are transferred to bodymaker. The blank is flexed into a cylinder with a slight overlap for welding

Can Assembly

- Welder
  - The overlapped portion of the cylinder is passed between two copper electrodes. Electrical current and pressure are applied to weld the two surfaces together.

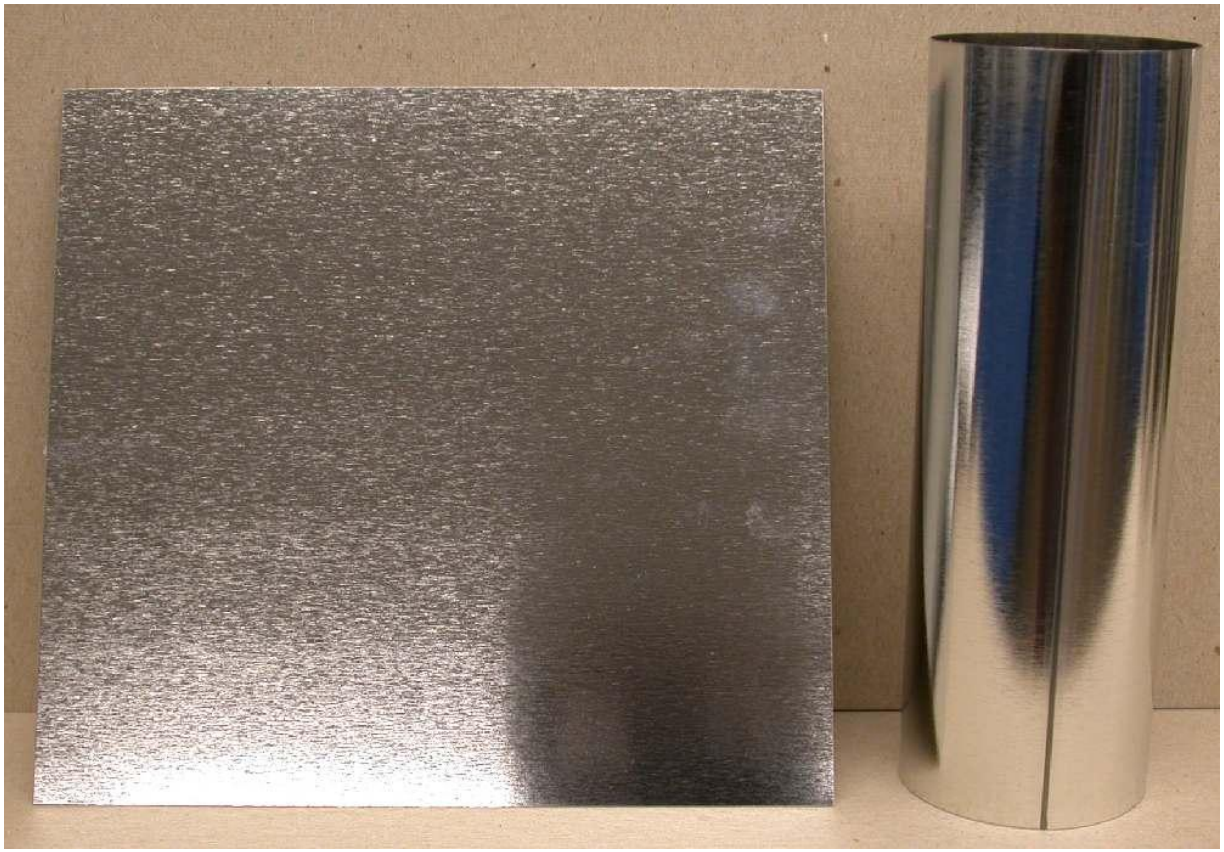
Can Assembly

- Sideseam Stripe Application (optional)
  - A liquid or powder coating is applied to the uncoated metal adjacent to the weld. The cylinder is transported through a series of ovens to cure the stripe material
  - May be applied to interior and/or exterior of cylinder

Can Assembly

- Necking (where applicable)
  - The diameter of the cylinder at the top and bottom are reduced
  - Provides cosmetic appeal/shape
- Flanging
  - Each end of the cylinder is flanged, this will later become the body hook of finished doubleseam

Can Assembly



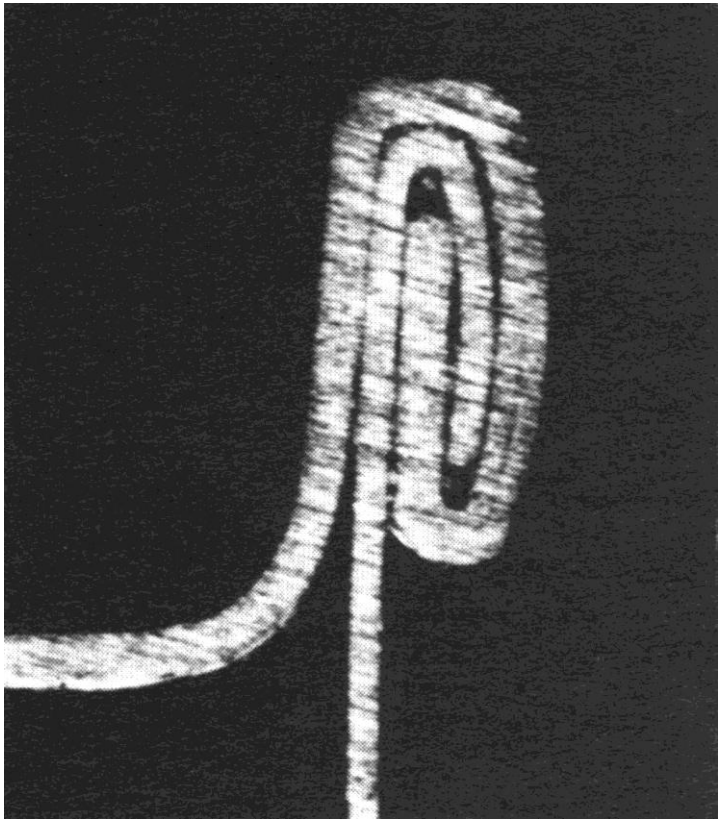
Can Assembly

Can Assembly

- Top and Bottom Doubleseam
  - One end is seamed on first, then the can is inverted and the other end is applied
  - Takes place in two operations
    - The body hook and cover hook are first formed with the end curl and cylinder flange
    - Pressure is applied around the seam to tighten and smooth

Can Assembly

Cross-Section of Doubleseam



Can Assembly

- Tester
  - Cans are fed through an in-line rotary air tester
  - The can is sealed in the pocket and internal pressure is applied (90 - 120 psig)
  - If a minimum volume of air displacement is detected, the can is rejected
- Packaging (palletizer)

Thank you

Questions?

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