Introduction to Aerosol Valve Technology

Presented by:
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Objective

- Provide a basic overview of aerosol valves:
  - Valve Types
  - Components
  - Product Design
  - Valve Technology
Determine Valve Requirements

- Determine the Type of Product:
  - Space Spray
    - Air Freshener
    - Air Sanitizer
  - Surface Spray
    - Pan Spray
    - Cleaner
    - Pre-Wash
    - Disinfectant
    - Polish
    - Starch
    - Paint
    - Insect Repellant
    - Insecticide
    - Lubricant
    - Industrial
  - Personal Care
    - Body Spray/Deodorant
    - Antiperspirant
    - Hair Spray
    - Shave Foam or Gel
  - Specialty Product
    - Whipped Cream
    - Fogger
    - Tire Inflator
    - Gas Lighter Refill

- Consider Spray Characteristics:
  - Spray Rate
  - Spray Projection
  - Spray Pattern
  - Particle Size
  - Flammability
  - Cloggage Potential

- Type & Amount of Propellant
  - Hydrocarbon
    - Propane (A-108)
    - Butane
      - n-Butane (A-17)
      - i-Butane (A-31)
    - Propane/Butane Blend (A-17 – A-108)
  - HFC
    - 134a (70 PSIG)
    - 152a (62 PSIG)
  - DME (63 PSIG)
  - Compressed Gas
    - CO₂
    - N₂O
    - N₂
    - Air

- Select the Type of Valve
Aerosol Valve Types

- Female Valve
- Tilt / Toggle Action Valve
- Vertical Action Valve
- Metered Valve
- Plastic Aerosol Valve
Valve Component Nomenclature

- Actuator
- Insert
- Stem
- Gasket
- Spring
- Body
- Mounting Cup
- Dip Tube
Bag-On-Valve
Materials of Construction

3-Ply
PE / AI / BON

4-Ply
PP / BON / AI / PET
PE / BON / AI / PET

Bottoms
Welded, Folded & Gusseted
Barrier Pack

What do you give up?
- Internal Valve Orifice Size and Number Selection
- Dip Tube Options
- Vapor Taps

What does ALL the work?
- Actuators
  - Spray Rate
  - Spray Pattern
  - Atomization
- Product
  - Viscosity
  - Surface Tension
  - Etc.
**Sizing**

Bag Width minimum = \(\frac{1}{2}\) Container Circumference

Bag Length maximum = from Top of Cup to Top of Bottom Can Dome

Bag is NOT a Balloon
Propellant Considerations

Liquefied versus Compressed Propellant
Pressure Curves
Volume of Propellant
Bottom Line Pressure

UTC Pressurized
TTV Product Filled

Boyle’s Law
PV = nRT → PV = C → $P_1V_1 = P_2V_2$
Boyle’s Law

\[ PV = C \]
Actuator

- Dispenses Product
- Provides a Controlled Spray
  - Consistent Spray Rate
    - Actuator or Insert Orifice Diameter
  - Maintains Desired Spray Pattern
    - Actuator or Insert Orifice
    - Mechanical Break-Up (MBU) Configuration
      - Doughnut
      - Full Round
      - Fan Spray
      - Stream / Jet
      - Foam or Mousse
  - Controls Particle Size
    - Actuator Orifice
    - Mechanical Break-Up (MBU) Configuration
Female Valve Actuators

- ‘Valve Stem’ is Tailpiece of Actuator
  - Provides for consumer cleaning
  - Slot Size in Tail Piece Helps Control Spray Rate
Tilt Action Valve Actuators

- Note either angled finger pad or vertical spray

- Available in:
  - One Piece Non-Mechanical Break-Up
  - Two Piece Non-Mechanical Break-Up
  - Two Piece Mechanical Break-Up
  - Extension Tube Actuators
Vertical Action Valve Actuators

- Note flat/horizontal finger pad
- Available in:
  - One Piece Non-Mechanical Break-Up
  - Two Piece Non-Mechanical Break-Up
  - Two Piece Mechanical Break-Up
  - Extension Tube Actuators
Other Actuators...
One-Piece Non-Mechanical Break-Up

- Orifices from 0.020” to 0.050”
- Tapers:
  - Standard
  - Straight
  - Reverse
  - Fan Spray
- Available in most style actuators

**Standard**  
**Straight**  
**Reverse**
**Inserts**

- Provides Terminal Orifice for Two Piece Non-MB and MB Actuator Assemblies.
- Controls Spray Pattern:
  - Full Round
  - Doughnut
  - Jet / Stream
  - Fan Spray
- Wide Array of:
  - Orifices: from 0.011” to 0.035”
  - Land Lengths: from 0.010” to 0.057”
  - Counter Bores: Flat Back (no counter bore), small, medium, & large
  - Fan Spray Configuration (Non-MB)
- Some Inserts will Accept an Extension Tube
Two-Piece Non-Mechanical Break-Up
Two Piece Mechanical Break-Up

- MB Styles:
  - 2-Arm
  - 4-Arm Styles (shown)
- Channel Depths (CD) Available in:
  - 0.008”
  - 0.010”
  - 0.018”
  - 0.025”
  - 0.035”
  - 0.045”
Mounting Cup

- **Dimples:**
  - From 0.002” to 0.018” Diameter

- **Profiles:**
  - Conical or High Profile
  - Flat

- **Pedestal Crimp**
  - Holds the valve together
    - Produced by Valve Manufacturer

- **Can Crimp**
  - Provides a permanent gas tight seal to the aerosol container
    - Produced by Filler

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Stem Gasket

- **Materials:**
  - Buna
  - Neoprene
  - Butyl
  - Viton

- **Function:**
  - Provide a gas tight seal
  - Remain effective over time
    - Exposure to product concentrate and propellant
    - Exposure to temperature changes
Stem Gasket Testing

- **Swell Testing**
  - Seven and Thirty day test results
  - Shrinkage or Excessive Swell will result in valve malfunction or dead valves

- **Gasket Hardness Testing**
  - Durometer measurements
  - Concurrent with Swell tests
  - Slight Softening is Preferred
  - Hardening or Excessive Softening will result in valve malfunction or dead valves

- **Color Leaching**
  - Concurrent with Swell Testing

- **Product Stability Testing**
  - Long-term weight loss evaluation
  - Long-term spray performance
  - Even Small changes in formulation can have dramatic effects on gasket performance
    - If you change the formula, re-test the gasket!
Tilt Action Stems

- Orifices:
  - Single, Double, and Triple Orifices Available
  - Range from 0.013” to 0.030” Diameter

Straight Walled

Retention Ring
Available on Ribbed and Non-Ribbed Styles

Ribbed

Projection

Undercut

Ringed
Vertical Action Stems

- Orifices:
  - Single & Double Orifices Available
  - Range from 0.011” to 0.040” Diameter
  - High Flow: 2 x 0.035” x 0.090”

Straight Walled

High Flow Design

Fast Fill Design

Under Cut
Spring

- Holds the Valve Stem in the Closed Position
- High and Low Force Springs Available in all Valve Models
- Materials:
  - 302 Stainless Steel
  - Hard Drawn Steel (Female Valve Only)
Body / Spring Cup

- Restricted Entrance (RE) from 0.013” to 0.080”
- Vapor Tap (VT) from 0.008” to 0.044”
- Ball Valve (Spray-Anyway)
- Slotted Spring Cups for Inverted Use Only
  - Available in a wide array of RE and VT combinations
Upright / Inverted Spring Cup

Upright Use

Inverted Use
Standard vs. Capillary Tip Tube
Vapor Tap Diameter vs Spray Rate

\[ y = -22.241x + 0.9475 \]
\[ R^2 = 0.9951 \]

Vapor Tap Diameter vs Spray Rate

\[ y = 1.0718e^{-2.138x} \]
\[ R^2 = 0.9213 \]
Vapor Tap vs Particle Size

Vapor Tap Diameter (inches)

Particle Size (mm)

D[4, 3]
D[3, 2]
D(v, 0.1)
D(v, 0.5)
Dip Tubing

- **Materials:**
  - **LDPE**
    - For standard (outside fit) bodies and Upright/Inverted bodies
  - **MDPE**
    - For standard (outside fit) bodies
    - For Greater Dip Tube Retention in Aggressive Formulations
      - Standard ID: 0.125”
      - Upright/Inverted body ID: 0.184”
  - **Polypropylene**
    - for Capillary (inside fit) bodies
      - Capillary dip tube can also control Spray Rate
      - ID’s:
        - 0.042”
        - 0.050”
        - 0.062”
Thank You

Any Questions ?