Module 18. Flexible/Semi-Rigid Containers

Thermal Processing for Meat and Poultry Products Training

USDA
Semi-Rigid Container

- Not significantly affected by enclosed product at atmospheric temperature/pressure
- Can be deformed by external pressure less than 10 psig
Examples of Semi-Rigid Plastic Containers
Semi-Rigid Plastic

- Co-extruded, multi-layer body
- Multi-layer laminated lid fusion sealed to body flange
- Metal lid double seamed to a co-extruded, multi-layer body
- Retortable or aseptic filled
Plastic Containers with Double Seamed Metal Ends
Introduction

- Container sealed with double seam
- Seam consists of interlocking layers of metal and plastic
- Plastic container made of multiple layers of material
BODY
HOOK

METAL END

THICKNESS

OVER LAP COVER HOOK

WIDTH

PLASTIC CONTAINER
Package Terminology

- **Retortable/microwaveable bowl**: Semi-rigid container made of plastic and adhesive blends
- **Height**: Distance from base of bowl to body flange
- **Width**: Diameter of opening
Package Terminology

- **EZO end**: Scored metal end with pull-tab
- **Stacking ring**: Curved area below body flange
- **Double seam**: Interlocking and compression of end curl and body flange
Defects or damage to container and double seam must be prevented to ensure container integrity.

- Cuts
- Damaged flanges
- Short height
- Swollen package
Major and Minor Defects – Plastic Containers with Double Seamed Metal Ends

**Major**
- Abrasion
- Foreign matter inclusion
- Load damage
- Malformed

**Minor**
- Abrasion
- Delamination
- Foreign matter inclusion
- Gels
- Malformed
Two important measurements:

1 - Overlap
   - Interlock of cover hook and body hook
   - Measured optically

2 - Tightness
   - Body wall compression of plastic components in double seam
   - Different methods for evaluation
   - Package supplier will recommend method
Tightness

Operational Range: 30% - 50%

Body Wall Compression

20% Compression: Too Loose

70% Compression: Too Tight
Inspections **must** be conducted at frequencies sufficient to ensure proper closure.

- Recommend every 30 minutes for visual inspections.
- Recommend every 4 hours for tear down examinations.
Paperboard Cartons

- Pre-formed/fill/seal
- Form/fill/seal
Flexible Container

Shape is significantly affected by enclosed product
Retortable Plastic Tray
Aseptic Cups, Bowls, and Bottles
Container Construction

- Container body comprised of oxygen barrier sandwiched between polypropylene layers
- Flexible container lids comprised of oxygen layer sandwiched between polypropylene and/or other layers of polymer materials
<table>
<thead>
<tr>
<th>Packaging Component</th>
<th>Properties</th>
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<tbody>
<tr>
<td>ETHYLENE VINYL ALCOHOL (EVOH)</td>
<td>Good Oxygen Barrier</td>
</tr>
<tr>
<td>POLYVINYLADINE CHLORINE (PVDC/SARAN)</td>
<td>Good Oxygen Barrier</td>
</tr>
<tr>
<td>POLYPROPYLENE</td>
<td>Structure; Good Heat Sealing; Fair Moisture Barrier; Retortable</td>
</tr>
<tr>
<td>ALUMINUM FOIL</td>
<td>Good Oxygen and Moisture Barrier</td>
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</table>
Container Structure (Plastic Container with Heat Sealed [Peelable]) Lid

High Barrier Retortable Container

Lid

Body

PET
Adhesive
Foil
Adhesive
PP

PP
Adhesive
Eval/Saran
Adhesive
PP
Containers are received pre-formed or formed by the food processor in conjunction with product filling (form fill and seal)
Container Forming Methods

- Thermoforming - Pressing plastic rollstock into die molds
- Blow Molding - Molten plastic air blown into mold to shape of container
Thermoform / Fill / Seal

Thermoform Fill-seal

1 - Coextruded web roll (container body material)
2 - Hydrogen peroxide sterilization bath
3 - Radiant heat dissipates the peroxide and softens the web for thermoforming
4-5 - Forming (male plug and air into female cavity)
6 - Filling
7 - Lid stock roll
8 - Hydrogen peroxide bath for lid stock
9 - Hot bar sealing
10, 11, 13 - Cutting/trimming
Co-Extruding Plastic Sheets
Plug Assist Thermoforming
It is important that the food processor measures thickness of side walls, corners, and flange upon receipt.
Sealing Principles

- Avoid seal area contamination
- Avoid wrinkles in seal area
- Maintain adequate sealing bar temperature, pressure and dwell time
- Assure that sealing materials are compatible
Sealing Methods

- Induction
- Impulse
- Hot bar
- Ultrasonic
Bar Sealing
Adhesive Failure of the Seals

- Sealant layer (PP) of lid breaks away from foil component and remains fused to container flange
Detachment of the Seal

- After peeling lid from container body, the presence of PP residues on flange indicates a well fused seal
  - Good seal
  - Poor seal
Cohesive Failure of the Lid Stock

- Sealant layer (PP) of lid breaks within itself and splits
- Half of sealant layer remains adhered to lid
- The other half remains adhered to flange
Defect Definitions and Classification
Critical Defects - Semi-Rigid Containers with Heat Sealed Lid

- Channel leaker
- Cut
- Fracture
- Incomplete seal
- Swollen package
- Puncture
A pathway of non-bonding across the width of the seal creating a leaker.
INCOMPLETE SEAL

A portion of the seal that has a lack of adhesion between lid and body.
Major Defects – Semi-Rigid Containers with Heat Sealed Lids

- Contaminated seal
- Abrasion
- Crushed
- Seal width variation
- Uneven seal impression
CONTAMINATED SEAL

Foreign matter in the seal area, such as, but not limited to, water, grease, or food.
ABRASION

A scratch partially through the surface layer(s) of the package caused by mechanically rubbing or scuffing.

2. If pronounced and may affect hermeticity.

3. If slight and does not affect hermeticity.
Minor Defects - Semi-Rigid Containers with Heat Sealed Lids

- Abrasion
- Burnt seal
- Crushed
- Delamination
- Flex cracks

- Foreign matter inclusion
- Gels
- Label foldover
- Malformed
- Wrinkle
GELS
MALFORMED

Plastic which does not conform to contours as specified.

Panel body defect affecting appearance, but not integrity.
Critical Defects – Flexible Containers with Heat Sealed Lids

- Channel leaker
- Cut
- Fracture
- Incomplete seal
- Swollen package
- Puncture
Channel leaker
Critical Defect - Contaminated Seal
Examples of Cuts

Major—Cut

Critical—Cuts
Critical Defect – Incomplete Seal
Critical Defect - Unbonded Seal
Critical Defect - Wrinkle
Major Defect - Abrasion
Short Seal Width
Major Defect - Blister
Minor Defect – Double Seal
Minor Defect - Cosmetic
Destructive Test Requirements for Fusion Sealed Containers

- Appropriate and detailed inspections and tests must be conducted at intervals of sufficient frequency by qualified personnel.

- Test records must be maintained.

- Select test containers from each seaming head or lane.
Destructive Tests

- Burst test
- Peel test
- Dye test
- Electro-conductivity test
- Residual gas
Preparing Semi-Rigid Trays for Burst Testing
Burst Test Under Water
The continual and even presence of a frosty like residue (pp residue from lid) on the flange indicates a well fused seal.
Dye test the seal area by adding drops of dye to the inside seal area through a hole cut in the bottom of the cup.
Electrolytic Testing

1. Power source
2. Ammeter
3. Electrode
4. NaCl solution
5. Package cut in half
Residual Gas Test

- Pipette bulb
- 50 cm³ burette
- Retort stand & clamp
- Rubber connector
- Funnel
- Water
- Puncture to let air escape
- Container
Non-destructive Examination

- Visual test
- Squeeze test
- Pressure differential test
- Vacuum (bubble) test
Figure 9—Lid deflection will occur in a properly sealed plastic cup with a heat sealed lid when the container is subjected to pressure by squeezing the sidewalls.
Pressure Differential Test

Differential Pressure Sensor

Package

Food

Inert Gas Supply

Recorder

$V_1, P_1$

$V_0, P_0$

$\Delta P$
Pressure Differential Test
Vacuum Bubble Test
Visual Examinations:

- Seals must be examined from each sealing machine.
- Necessary corrective actions must be taken and recorded.
- The entire container must be examined.
- Must be performed before and after the thermal process operations.
- Must be done at sufficient frequency.
- Should be based on a statistical sampling plan.
Physical Tests:

- Must be conducted with sufficient frequency
- Must be performed after the thermal process and should be made at least every 2 hours of continuous production
- Guidelines for test procedures must be on file and made available to the CSI
- Results and corrective actions must be recorded.
Questions?