


FOOD PACKAGING MATERIALS

Materials used to enclose, protect, transport, and market food products are termed as food packaging materials.

Common Food Packaging Materials

| Packaging Material | Characteristics | Types | Advantages | Limitations |
|---|--|---|--|---|
| PAPER & PAPER BOARD | 1. Lightweight 2. Biodegradable 3. Printable A. But it is moderate barrier to air & moisture. B. For improving its strength and barrier properties it is usually coated/waxed. | 1. Kraft paper sacks 2. Paperboard cartons 3. Waxed / laminated papers 4. Corrugated board | 1. Economical 2. Easy availability 3. Recyclable 4. Good printability | 1. Poor moisture resistance 2. Not heat-sealable |
| GLASS | Inert (does not react with food) Gas and moisture impermeable Transparent for product visibility | Beverages, pickles, sauces, jams, baby foods | Excellent shelf-life Chemically safe and non-toxic Sterilizable and reusable | Heavy and breakable Higher transport cost |
|  Tinplate | Steel coated with | Fruits, | Resistant to | |

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| | | | | | |
|-------------------------------------|-----------------------|---|--|--|--|
| | | tin | vegetables, meat cans | corrosion (with enamel coatings) | |
| | Tin-free Steel | Chromium coating | | Cheaper and harder | |
| | Aluminum | instead of tin | 1. Foils 2. Beverage cans 3. Trays | 1. Lightweight 2. Suitable for retorting 3. Tamper-proof 4. Excellent gas/light barrier | 1. Possibility of corrosion 2. High energy cost for manufacturing |
| P LASTICS POLYMERS | | Polyethylene (PE) (LDPE/HDPE) Flexible, moisture barrier | Milk pouches, bags | 1. Lightweight 2. Flexible 3. Heat sealable 4. Customizable | Environmental pollution |
| | | Polypropylene (PP) Heat-resistant, rigid | Microwave containers, caps | | |
| | | Polyethylene Terephthalate (PET) Strong, transparent | Soft drink bottles | | |
| | | Polyvinyl Chloride | Blister packs | | |

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|--|---|--|---|---|
| | <p>(PVC)</p> <p>Good clarity & sealing</p> <p>Polystyrene (PS)</p> <p>Rigid/foamed</p> <p>EVOH / Nylon / PVDC</p> | Yogurt cups, trays | | |
| <p>FLEXIBLE PACKAGING</p> | Multilayer structures combining paper, plastic, foil. | <p>Retort pouches</p> <p>Stand-up zipper pouches</p> <p>Snack wrappers</p> | <p>High strength</p> <p>Excellent barrier</p> <p>Used for ready-to-eat meals, chips, juices</p> | |
| <p>BIODEGRADABLE & EDIBLE PACKAGING</p> | Sustainable | <p>Bioplastics</p> <p>Starch-based</p> <p>Edible coatings</p> | <p>Reduced pollution burden</p> <p>Consumer-friendly "green" image</p> | <p>Higher production cost</p> <p>Lower barrier & heat stability (in most cases)</p> |

CRITERIA FOR SELECTING PACKAGING MATERIAL

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- A. Barrier properties (moisture, oxygen, light)
- B. Mechanical strength
- C. Chemical compatibility with food
- D. Cost & availability
- E. Recyclability & environmental impact
- F. Regulatory approval (FSSAI, FDA)

Exercise

- 1. What is the most significant limitation of glass as a packaging material?**
 - A. Its ability to be coloured
 - B. Its permeability to water vapor
 - C. Its chemical reactivity with food
 - D. Its susceptibility to breakage**
- 2. What raw material, also known as common sand, is the primary component used to form glass?**
 - A. Sodium carbonate
 - B. Calcium carbonate
 - C. Silicon dioxide**
 - D. Borosilicate
- 3. What is the primary distinction between paper and paperboard?**
 - A. The source of the pulp (wood vs. recycled)
 - B. Thickness**
 - C. The color of the final product
 - D. Their resistance to water
- 4. What defining characteristic allows thermoplastic polymers to be reshaped?**
 - A. They are composed of multiple layers of different materials.
 - B. They have strong ionic bonds between chains.
 - C. They are made of only one type of monomer.
 - D. They can be melted repeatedly.**
- 5. What is the primary function of the coatings, such as waxes and silicones, applied to the outside of glass containers?**
 - A. To reduce breakage by protecting the surface from scratches**
 - B. To increase the chemical inertness of the glass
 - C. To provide a hermetic seal for the lid

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D. To filter UV light from damaging the contents

Answer

1-D, 2-C, 3-B, 4-D, and 5-A

Metal Cans

Metal cans are rigid, hermetically sealed containers widely used for packing a variety of foods such as fruits, vegetables, fish, meat, beverages, soups, and ready-to-eat meals. They protect food from physical, chemical, and microbiological hazards and allow long-term storage without refrigeration.

Importance of Metal Cans in Food Packaging




1. It maintains food quality and preserves nutrients
2. Metal cans enable long-term storage of food without refrigeration
3. It is essential for food security and emergency supplies
4. It supports global trade in seasonal and perishable products

Common Metals Used for the Manufacturing of Food Cans

| Metals | Properties | Use |
|-----------------------------|--|--|
| Tinplate | Steel sheet coated with thin layer of tin Good corrosion resistance | Suitable for acidic foods after interior lacquering |
| Tin-Free Steel (TFS) | Chromium-coated steel Strong, economical | Requires protective lacquer layer to prevent corrosion |
| Aluminum | Lightweight, does not rust Naturally corrosion resistant | Used for beverages, tuna, beer, soft drinks, energy drinks |

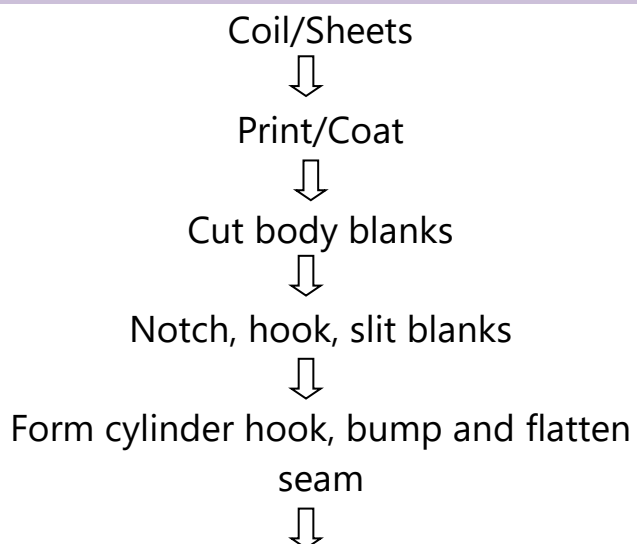
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Components of a Metal Can

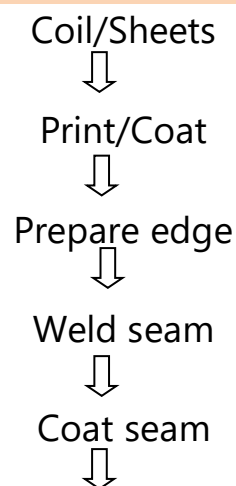
| Component | | |
|--------------------------|---|---|
| Body | Cylindrical container forming the main volume |  |
| Double seams | Mechanical joints sealing lid and bottom, providing airtight seal | |
| Plain end (non-opening) | |  |
| Easy-open end (pull-tab) | |  |
| Internal coating | Lacquer or enamel coating preventing interaction between food and metal | Epoxy, acrylic, BPA-free coatings |

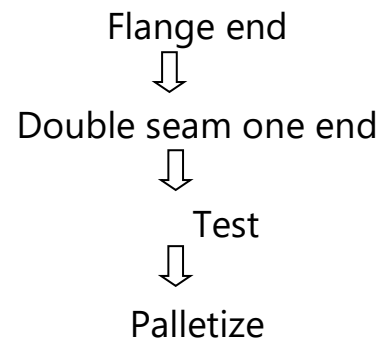
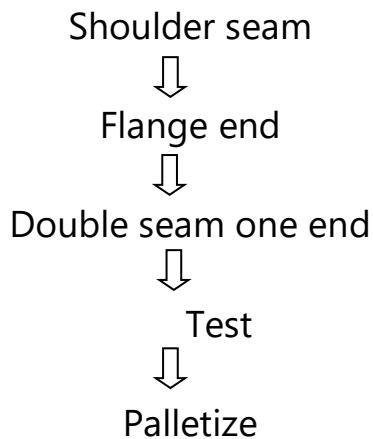
Manufacturing Methods for Three-Piece Can

Three-Piece shouldered (Tinned Steel)



Three-Piece welded (Tin Free Steel)

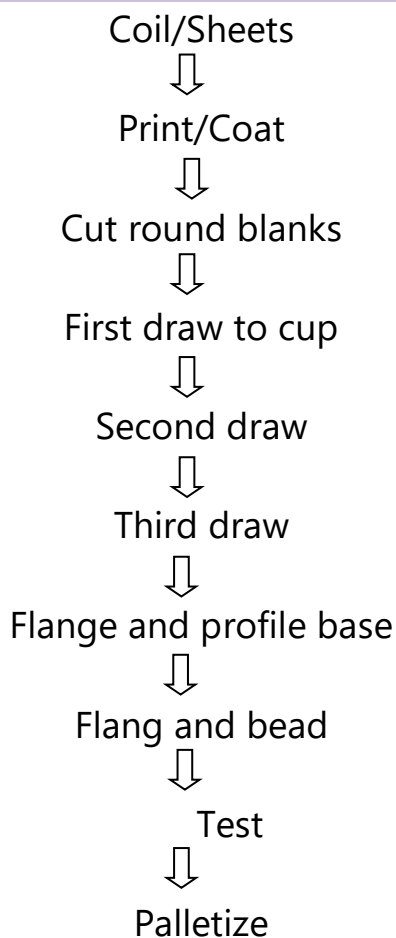




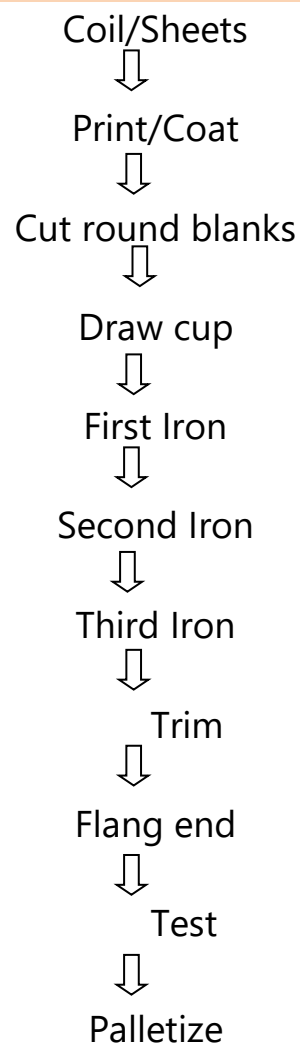
Manufacturing Methods for Two-Piece Can

Made by drawing and ironing a single metal sheet

Two-Piece draw & re-draw (Tin Free Steel)



Two-Piece draw ironrd (Aluminum)



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Benefits of Metal Cans Over Other Packaging Materials

| Compared to | Property of metal | Advantage |
|---------------|------------------------------------|--|
| Glass | Lightweight | Easier handling & transport |
| | Unbreakable | Safe during shipping and storage |
| | Better heat transfer | Faster sterilization, saving energy |
| Plastic | Complete light & oxygen barrier | Prevents oxidation and spoilage |
| | High temperature tolerance | Suitable for retorting/thermal processing |
| | No permeation issues | Long shelf life without leaching risks |
| Paper/Cartons | Superior mechanical strength | Resists puncture, crushing |
| | Long-term preservation (2–5 years) | Suitable for emergency and bulk food storage |
| | Excellent tamper evidence | Cannot be resealed once opened |

Advantages and Limitations of Metal Cans

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| Advantages of Metal Cans | Limitations of Metal Cans |
|--|--|
| Hermetic seal prevents entry of microorganisms, moisture, gases | Higher cost compared to flexible packaging |
| Thermal processing compatibility → sterilization inside container | Potential corrosion without proper coating |
| Recyclability Steel and Aluminum highly recyclable Can be remelted endlessly without quality loss | Metal taste risk if coating fails |
| Sustainability High recycling rate reduces environmental burden | Weight higher than plastic and laminated pouches |

Applications in food industry

1. Vegetables and fruits (peas, tomatoes, pineapple)
2. Meat and fish
3. Dairy (evaporated/condensed milk)
4. Ready-to-eat meals
5. Soups, sauces, baby foods
6. Carbonated and non-carbonated beverages

Classification of Metal Cans

Metal cans are classified as under.

| | | |
|--------------------------------|--|--|
| Basis of Classification | | |
|--------------------------------|--|--|

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| Construction Type | Three-Piece Can | Made from three parts: Body (cylindrical sheet) Top end Bottom end Body seam welded or soldered Very common for food (vegetables, meat) |
| | Two-Piece Can | Made from single metal sheet Formed by drawing and ironing No side seam Mostly used for beverages |
| Number of Ends | Open-Top Can (OTC) | One open end, ends added after filling (food) |
| | Open-Bottom Can (OBC) | Used in beverage processing |
| | Open-Top Sanitary (OTS) Can | For thermally processed foods with hermetic seal |
| Can End Type | Plain End | No opening device Removed by can opener |
| | Easy-Open End (EOE) | Pull-tab or ring opening Used for beverages, tuna, ready meals |
| | Peel-Off End | Aluminum foil seal bonded to steel ring Used in baby foods and milk powders |
| Material | Tinplate Can | Steel coated with tin |
| | Tin-Free Steel (TFS) | Chromium-coated steel |
| | Aluminum Can | Lightweight, corrosion-resistant |
| Shape | Cylindrical | Most common |
| | Rectangular/Oval | fish/meat packs |
| | Conical | Powders, syrups |
| | D-shaped/specialty | Institutional packs |
| Dimensions | Small cans (202 × 214) | (Can Size Coding) First three digits → diameter in inches and 1/16 in. |
| | Vegetables (303 × 406) | Next three digits → height in inches and 1/16 in 307 × 409 can |

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| | large fruit/meat cans (307 × 512) | 3 07 = 3 inches + 7/16 inch body diameter 4 09 = 4 inches + 9/16 inch height |
| Body Seam | Soldered seam | Older |
| | Welded seam | Modern, lead-free |
| | Overlap seam | Tinplate |
| Internal Coating | Plain (unlacquered) | For dry/low-acid foods |
| | Lacquered/enamelled | For acid foods (tomatoes, citrus) |

Exercise

- In a tin-coated can acting as a galvanic cell for food preservation, what material typically serves as the anode?**
 - Oxygen (O₂)
 - Tin (Sn)**
 - The food product
 - Iron (Fe)
- How are the dimensions of a standard can, such as '303 x 406', interpreted?**
 - The first number is the diameter in millimeters, and the second is the height in millimeters.
 - The numbers represent the fill volume in cubic inches and the can's weight in grams.
 - The first digit is whole inches, and the next two are sixteenths of an inch for both diameter and height.**
 - The dimensions represent the diameter and height in centimeters, respectively.
- A can with the dimension code '203 x 308' would have what diameter?**
 - 2 and 3/16 inches**
 - 2 and 3/8 inches
 - 2.3 inches
 - 3 and 2/16 inches

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4. Food cans require internal lacquer coating to prevent

- A. A. Sweetness loss
- B. B. **Metal corrosion**
- C. C. Weight gain
- D. D. Paper tearing

Answer: 1-B, 2-C, 3-A and 4-B