

## **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
<b>PAPER &amp; PAPER BOARD</b>	<ul style="list-style-type: none"> <li>1. Lightweight</li> <li>2. Biodegradable</li> <li>3. Printable</li> </ul> <p>A. But it is moderate barrier to air &amp; moisture.</p> <p>B. For improving its strength and barrier properties it is usually coated/waxed.</p>	<ul style="list-style-type: none"> <li>1. Kraft paper sacks</li> <li>2. Paperboard cartons</li> <li>3. Waxed / laminated papers</li> <li>4. Corrugated board</li> </ul>	<ul style="list-style-type: none"> <li>1. Economic</li> <li>2. Easy availability</li> <li>3. Recyclable</li> <li>4. Good printability</li> </ul>	<ul style="list-style-type: none"> <li>1. Poor moisture resistance</li> <li>2. Not heat-sealable</li> </ul>
<b>GLASS</b>	<p>Inert (does not react with food)</p> <p>Gas and moisture impermeable</p> <p>Transparent for product visibility</p>	<p>Beverages, pickles, sauces, jams, baby foods</p>	<p>Excellent shelf-life</p> <p>Chemically safe and non-toxic</p> <p>Sterilizable and reusable</p>	<p>Heavy and breakable</p> <p>Higher transport cost</p>
 <b>Tinplate</b>	Steel coated with	Fruits,	Resistant to	

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		tin	vegetables, meat cans	corrosion (with enamel coatings)	
	<b>Tin-free Steel</b>	Chromium coating		Cheaper and harder	
	<b>Aluminum</b>	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
<b>P</b> LASTICS <b>POLYMERS</b>		<b>Polyethylene(PE)</b> (LDPE/HDPE) Flexible, moisture barrier  <b>Polypropylene (PP)</b> Heat-resistant, rigid  <b>Polyethylene Terephthalate (PET)</b> Strong, transparent  <b>Polyvinyl Chloride</b>	Milk pouches, bags  Microwave containers, caps  Soft drink bottles  Blister packs	1. Lightweight 2. Flexible 3. Heat sealable 4. Customizable	Environmental pollution

## Food Packaging Technology

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	<p>(PVC)</p> <p>Good clarity &amp; sealing</p> <p>Polystyrene (PS)</p> <p>Rigid/foamed EVOH / Nylon / PVDC</p>	<p>Yogurt cups, trays</p>		
<b>F</b> LEXIBLE PACKAGING	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>	
<b>B</b> IODEGRADABLE & EDIBLE PACKAGING	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 &amp; 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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**B. Tech. (Agricultural Engineering) 4<sup>th</sup> Year**

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

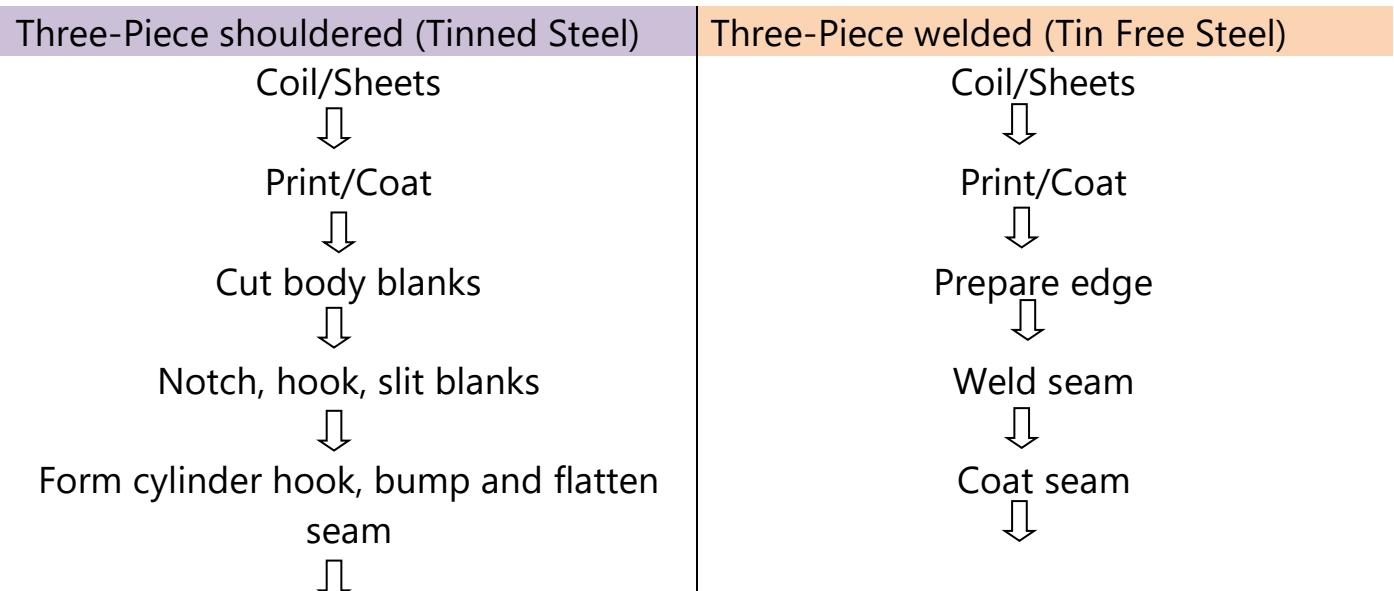
### **Common Metals Used for the Manufacturing of Food Cans**

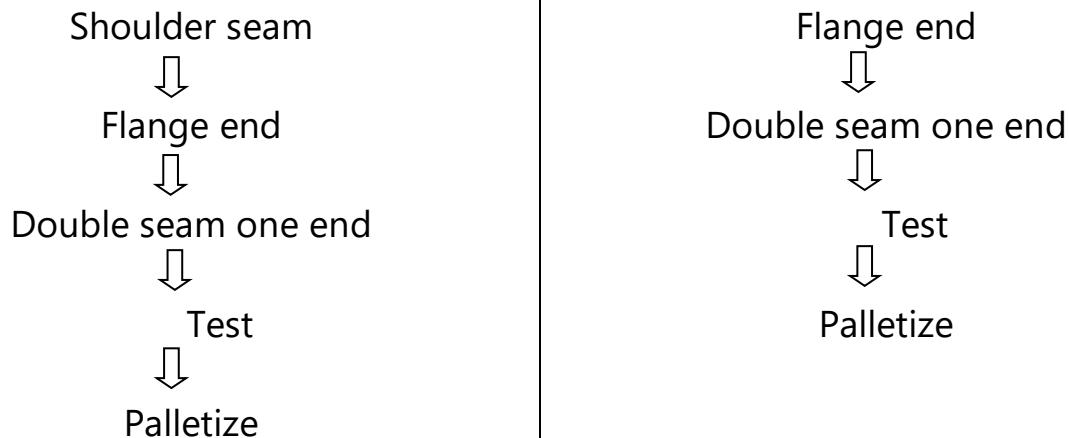
<b>Metals</b>	<b>Properties</b>	<b>Use</b>
<b>Tinplate</b>	Steel sheet coated with thin layer of tin Good corrosion resistance	Suitable for acidic foods after interior lacquering
<b>Tin-Free Steel (TFS)</b>	Chromium-coated steel Strong, economical	Requires protective lacquer layer to prevent corrosion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

## **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**

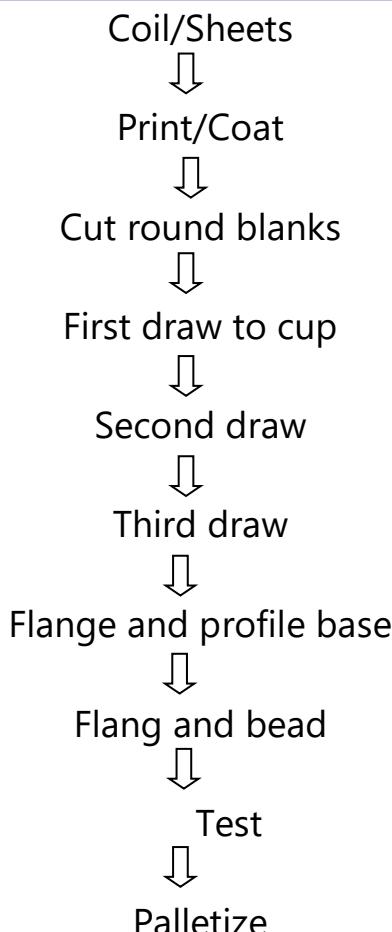




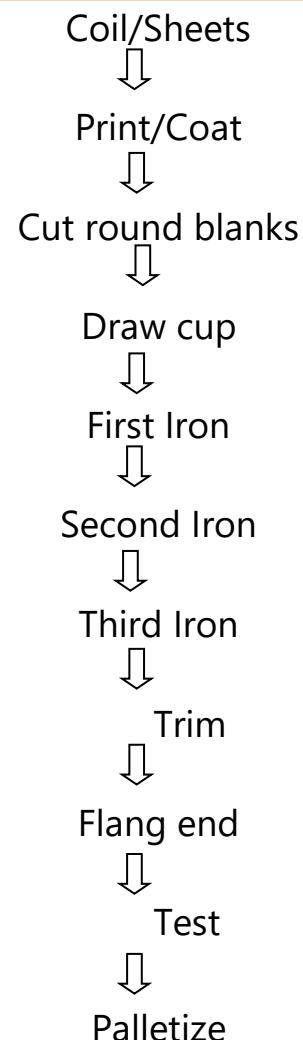
### **Manufacturing Methods for Two-Piece Can**

Made by drawing and ironing a single metal sheet

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



#### **Two-Piece draw ironrd (Aluminum)**



## **Benefits of Metal Cans Over Other Packaging Materials**

Compared to	<b>Property of metal</b>	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**

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

<b>Basis of Classification</b>		

## Food Packaging Technology

### B. Tech. (Agricultural Engineering) 4<sup>th</sup> Year

<b>Construction Type</b>	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
<b>Number of Ends</b>	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
<b>Can End Type</b>	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
<b>Material</b>	Tinplate Can	Steel coated with tin
	Tin-Free Steel (TFS)	Chromium-coated steel
	Aluminum Can	Lightweight, corrosion-resistant
<b>Shape</b>	Cylindrical	Most common
	Rectangular/Oval	fish/meat packs
	Conical	Powders, syrups
	D-shaped/specialty	Institutional packs
<b>Dimensions</b>	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

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

### Exercise

- 1. In a tin-coated can acting as a galvanic cell for food preservation, what material typically serves as the anode?**
  - Oxygen (O<sub>2</sub>)
  - Tin (Sn)**
  - The food product
  - Iron (Fe)
- 2. 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.
- 3. 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

**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