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. Economic 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	

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

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

CRITERIA FOR SELECTING PACKAGING MATERIAL

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

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)
Coil/Sheets	Coil/Sheets
⇩	⇩
Print/Coat	Print/Coat
⇩	⇩
Cut body blanks	Prepare edge
⇩	⇩
Notch, hook, slit blanks	Weld seam
⇩	⇩
Form cylinder hook, bump and flatten seam	Coat seam
⇩	⇩

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Shoulder seam
⇩
Flange end
⇩
Double seam one end
⇩
Test
⇩
Palletize

Flange end
⇩
Double seam one end
⇩
Test
⇩
Palletize

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)
Coil/Sheets	Coil/Sheets
⇩	⇩
Print/Coat	Print/Coat
⇩	⇩
Cut round blanks	Cut round blanks
⇩	⇩
First draw to cup	Draw cup
⇩	⇩
Second draw	First Iron
⇩	⇩
Third draw	Second Iron
⇩	⇩
Flange and profile base	Third Iron
⇩	⇩
Flang and bead	Trim
⇩	⇩
Test	Flang end
⇩	⇩
Palletize	Test
	⇩
	Palletize

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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		

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. Next three digits → height in inches and 1/16 in 307 × 409 can
	Vegetables (303 × 406)	

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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

1. **In a tin-coated can acting as a galvanic cell for food preservation, what material typically serves as the anode?**
    A. Oxygen (O_2)
    B. Tin (Sn)
    C. The food product
    D. Iron (Fe)
2. **How are the dimensions of a standard can, such as '303 x 406', interpreted?**
    A. The first number is the diameter in millimeters, and the second is the height in millimeters.
    B. The numbers represent the fill volume in cubic inches and the can's weight in grams.
    C. The first digit is whole inches, and the next two are sixteenths of an inch for both diameter and height.
    D. The dimensions represent the diameter and height in centimeters, respectively.

3. **A can with the dimension code '203 x 308' would have what diameter?**
    A. 2 and 3/16 inches
    B. 2 and 3/8 inches
    C. 2.3 inches
    D. 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