

Packaging Technology

‘M’ Scheme Syllabus



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PACKAGING TECHNOLOGY

AGPC

PREFACE

This book of Packaging Technology covers all the topics in a clear and organized format for the Third year Diploma in Printing Technology students as prescribed by the Directorate of Technical Education, Chennai, Tamilnadu. It is confidently believed that this book furnishes the students the necessary study material. The topics covered were neatly illustrated for better understanding of the students.

The book is prepared step-by-step lessons in large, eye pleasing calligraphy make it suitable for both direct one-to-one tutoring and regular classroom use. The highlight of this book is its simple English with clear and easy explanation of each topic.

All the topics are explained with supporting diagram for diploma level students to understand effectively.

This book majorly deals with Basics of Packaging Process, Packaging Materials, Packaging Machinery & Finishing, Ancillary Packaging and Specialty Packages etc.

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PACKAGING TECHNOLOGY

DETAILED SYLLABUS

Unit	Name of the Topic	Hours
I	<i>Basics of Packaging Process</i> 1.1 - Introduction, Classification of Packaging – Flexible, Semi Rigid and Rigid Packaging, Functions of a Package, Factors influencing the design of a package. 1.2 - Functions/Objectives of a Packaging – physical, barrier, Agglomeration, information, marketing, security and convenience. 1.3 - Folding Carton, Common Styles and their uses - Glue end carton, Tuck in flap carton, Lock end carton, Lock bottom carton and Autolock bottom carton. 1.4 - Tube and Tray Style Cartons - One piece tray carton, Two piece tray carton and Window carton. 1.5 - Die Making process – Diagram preparation and manual/laser cutting, cutting and creasing rule bending and fixing.	13 Hrs
II	Packaging Materials 2.1 - Types of boards used in packaging – Solid bleached/unbleached board, Duplex, Pulp and Art boards. 2.2 - Types of Corrugated boards - Single face corrugated board, Double face corrugated board and Triple face (or) Double walled corrugated board. 2.3 - Plastic packaging materials - BOPP, HDPE, LDPE, LLDPE, PVC, PP, PET, Polyolefins, Polyamides and Non-woven. 2.4 - Metal packaging materials - Tin and Aluminium Foil – Properties and Applications.	13 Hrs
III	<i>Packaging Machinery & Finishing</i> 3.1 - Factors influencing the design of a package – product, distribution, marketing Statutory & regulation, packaging operation and cost. 3.2 - Structural Fundamentals of folding carton – Types of panels, types of flap, grain direction, creasing and cutting. 3.3 - Introduction to Food packaging and shelf life improving techniques, Introduction to Aseptic packaging (Tetra pack), Structural layers used in Aseptic packaging, Importance of Ultra Heat treatment Technology. 3.4 - Flexible pouch forming – Thermoform/fill/seal machines.	13 Hrs.

Unit	Name of the Topic	Hours
<i>IV</i>	<p>Ancillary Packaging</p> <p>4.1 - Closures - Screw cap, Lug cap, Roll on, Crown Cap, Child resistant closure and Tamper evident closure.</p> <p>4.2 - Dispensing devices - Snip-top, Dial disc, Dip tube, Brush applicator, Shaker sifter and push-pull type.</p> <p>4.3 - Cushioning Materials, Types - Resilient, Non-resilient and Space fillers.</p> <p>4.4 - Types of Strapping and Sealing tapes.</p>	13 Hrs
<i>V</i>	<p>Specialty Packages</p> <p>5.1 - Shrink-Wrapping, Types of Shrink wrapping – Sleeve wrap and Envelope wrap, Skin Packaging, Blister Packaging.</p> <p>5.2 - Strip Packaging, Blister Packaging and Stretch Wrapping.</p> <p>5.3 - Introduction to RFID, QR Code and Barcode, applications in packaging, Symbols used in Packaging.</p> <p>5.4 - Introduction - Aerosol Packaging and Modified Atmospheric Packaging, Application.</p>	13 Hrs

UNIT-I

BASICS OF PACKAGING PROCESS

Introduction

Packaging is the science, art and technology of enclosing or protecting products for distribution, storage, sale, and use.

1.1 CLASSIFICATION OF PACKAGING:

Flexible packaging



These packaging are more popular for food packaging because they provide superior flavor retention and longer shelf life. Also it is resistant to light, air, water and most other gases and liquids; it protects packages from harmful oxygen, sunlight and bacteria. One of the most important flexible packaging applications is pouch making

Rigid packaging



They are rigid in nature to assist transportation, safety etc. The seal creates consumer confidence and product quality. These packages are easy to open, close and reuse without destroying the package. Mostly these are made from recycled fibers and in addition they provide lasting reuse, features. Product identity is rugged strength.

Semi rigid packaging



Semi rigid packaging are formed by folding cartons and collapsible tubes, as opposed to flexible packaging that conform to the shape of the product, semi rigid packaging have a shape of their own. In most cases Aluminum foil, containers, sheets

are used in semi rigid packaging as they provide protection, barrier to permeation, cooling, handling and temperature variation.

Factors Influencing the Design / Selection of Package

- ❖ Product
- ❖ Distribution
- ❖ Marketing
- ❖ Statutory and regulation
- ❖ Packaging operation
- ❖ Cost

Product

a, Product for consumer/ industrial *etc.*,

b, Physical properties/ characteristics

Physical state (Solid/ Liquid/ Powder *etc.*) Weight, Volume, Shape, Rigidity, Stability, Fragility, Surface finish *etc.*,

c, Content (Vulnerabilities of Contact) compatibility of product with package.

Vulnerability to environmental atmospheric conditions (Color, Flavor, Dirt, Odor, Correction, Mold, Pilferage & Rodents).

Distribution

Destination, type of handling, type of transport, type of storage, atmospheric conditions making of goods it dangerous, degree of production need from after environmental hazards drop, vibration, compression *etc.*, unit node system palletizations / containerization.

Marketing Factors

Type of consumer, sex, age, income, social level customer, buying habit, location of market, consumer convenient in handling product. Product appearance, color, size, shape, language, disposability.

Statutory and Regulation

- ❖ Standards of weights and measures
- ❖ Marking of MRP
- ❖ Safety points and consumer protection
- ❖ Legislation of importing countries

Packaging Operations

Time factor, convenience factors, versatility, growth factor, consideration on seasons.

Cost Factors

Design cost, Quality control cost, Transportation and Storage, Operation Cost, Labor and Overhead, Maintenance and Depreciation of Machinery, Loss and Damage cost, Replacement/ repairing defective items. Insurance recharge and Developments, Package development cost like modification, Trails, Evaluation, Feedback, New regulation *etc.*,

1.2 FUNCTIONS (OR) OBJECTIVES OF PACKAGING

Physical Protection:

The food enclosed in the packaging may require protection from, among other things Shock, Vibration, Compression, Temperature, etc.

Barrier Protection:

A barrier from Oxygen, Water vapor, Dust etc., is often required modified atmospheres or controlled atmospheres are also maintained in some food packages keeping the contents clean, fresh and safe for the intended shelf life is a primary function.

Containment or Agglomeration:

Small items are typically grouped together in one package for reasons of efficiency. Powders, and Granular materials need containment.

Information Transmission:

Packaging and labels communicate how to use, Transport, Recycle or dispose of the package or product. Some types of information are required by governments.

Marketing:

The packaging and labels can be used by markets to encourage potential buyers to purchase the product.

Security:

Packaging can play an important role in reducing the security risks of shipment. Packages can be made with improved tamper resistance to deter tampering and also can have tamper-evident features to help reduce the risks of packaging Pilferage.

Convenience:

Packages can have features which add convenience in distribution handling, stacking, display, Sale, Opening reclosing use and reuse.

1.3 FOLDING CARTON:

The term folding cartons is applied to a package made from paper board of thickness between 0.012" and 0.044" and delivered in a flat collapsed state.

Types of Folding Cartons:

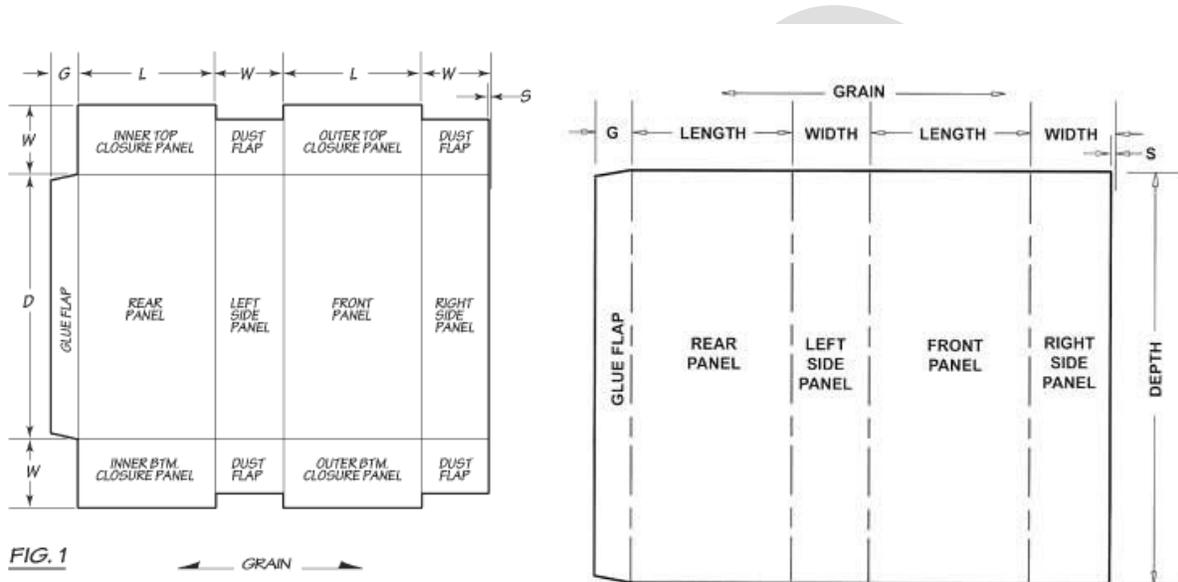
1. Tube Styles Cartons
2. Tray Styles Cartons.

Types of Tube Styles Cartons:

1. Glue - end cartons
2. Tuck- in- flap cartons
3. Lock-end cartons

- 4. Auto lock - bottom cartons
- 5. Lock bottom cartons
- 6. Shell and slide cartons

1. Glue - end cartons:

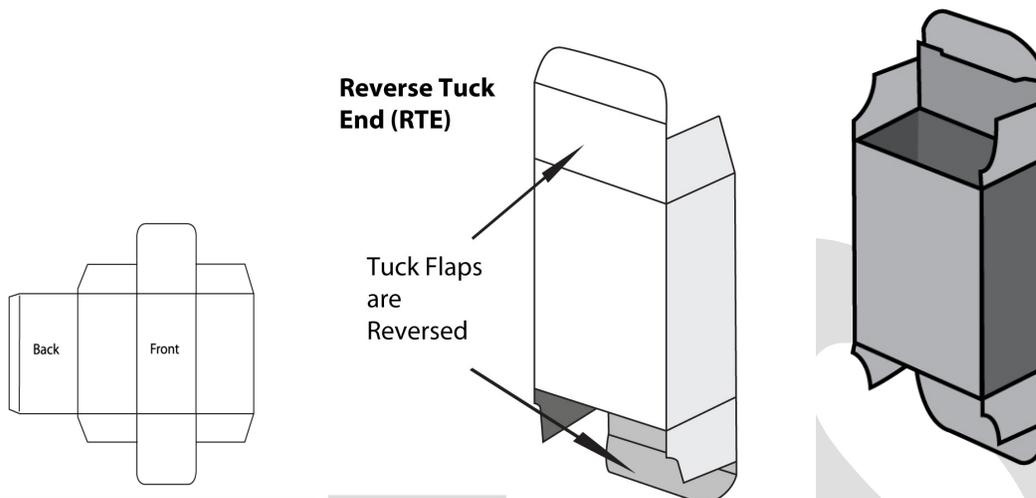


This carton has four square cut flaps at each end of the tube. Gluing or stitching the end forms the tube. After filling up the product the flaps are glued together.

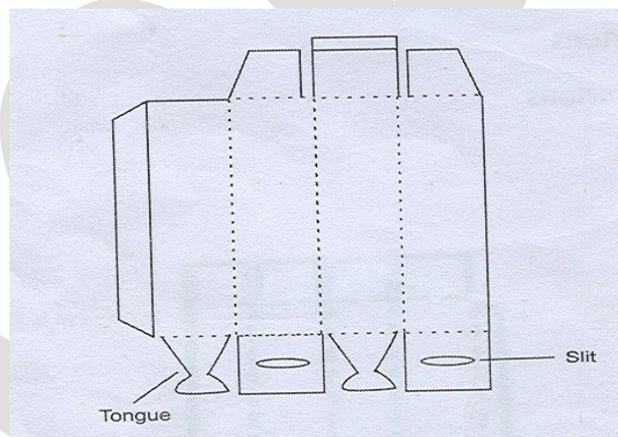
Example: Toothpaste, Soap, etc.,

2. Tuck- in -flap cartons:

This carton is used where an enclosure is required. This carton has three flaps at each end of its tubes. The two side flaps are of same length. The third flap is longer than side flaps. The third flaps have an extra flap which is tucked into the tube. ex: Toothpaste, Medicine.



3. Lock-end cartons:

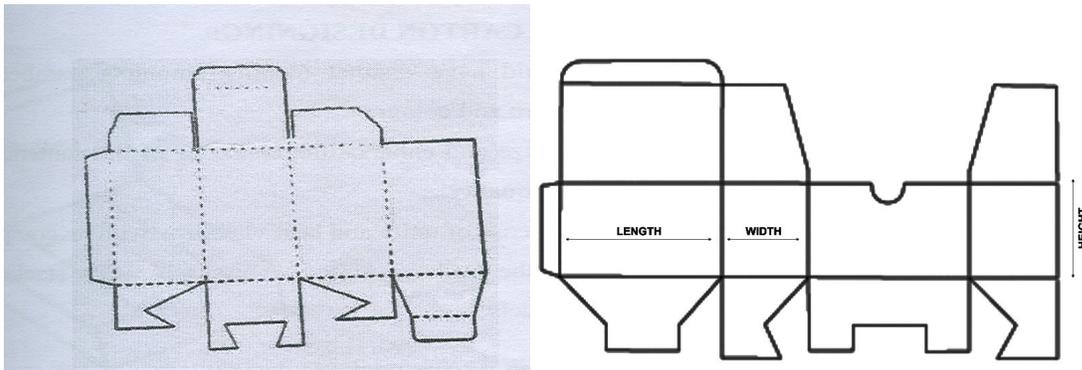


This is used for heavier articles, which require a safer enclosure. It is designed with a tongue or tongues on one of the main flaps. This is engaged with corresponding slits in the opposite flaps.

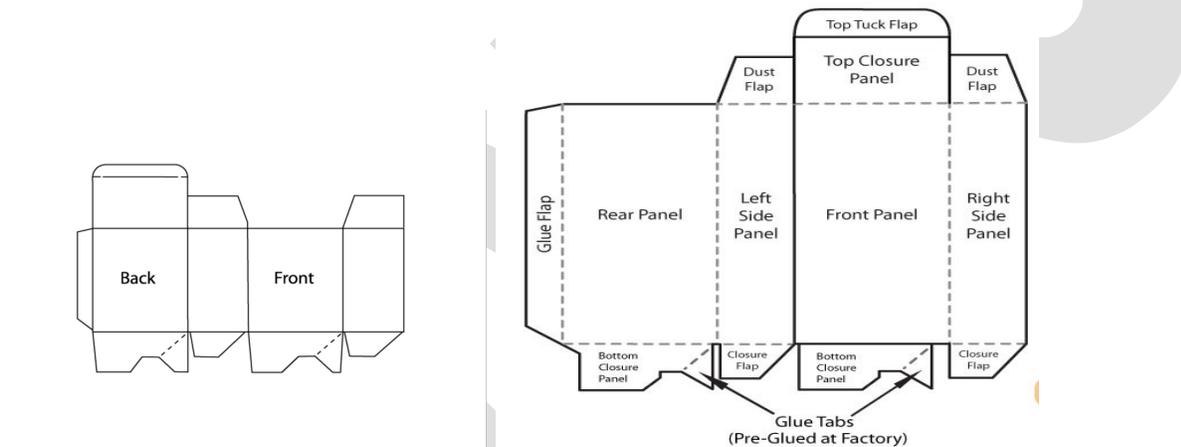
Example: Ink bottle.

4. Lock bottom cartons:

This carton has tuck in flap on the top. The bottom of the tube has four flaps on all the panels. These flaps are cut at an angle of fifteen and thirtier degrees. These flaps are locked with each other when it is erected.



5. Auto lock - bottom carton:



The bottom flaps are designed with diagonal creasing and scoring. First the flaps are pre folded inside the carton. The diagonal flaps are spot glued on the side crease. The main panels are folded and the seam is glued. When the carton is erected the base locks itself automatically. **Example: Liquor bottles.**

6. Shell and slide cartons:

This consists of an outer tube called as shell. A tray is formed with tuck - in ends. This tray is called as slide. This is inserted into the tube after filling with the product. This is also called as "flip top" Carton reducing the carton to a one piece blank.

Example: Cigarette Pockets.

1.4. TUBE AND TRAY STYLE CARTON

Tray cartons:

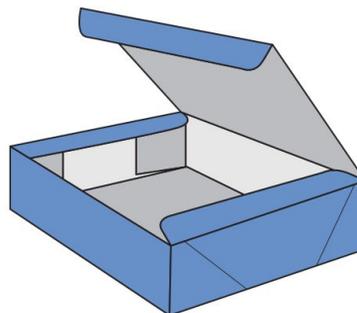
In tray carton all the four sides' one folded at right angles to ~ main sheet. Then they are joined together at the four corners. There are two types they are

A) One piece tray

b) Two piece Tray

A) One piece tray:

In one piece tray one side of the panel is extended with tuck in end style to form a lid.



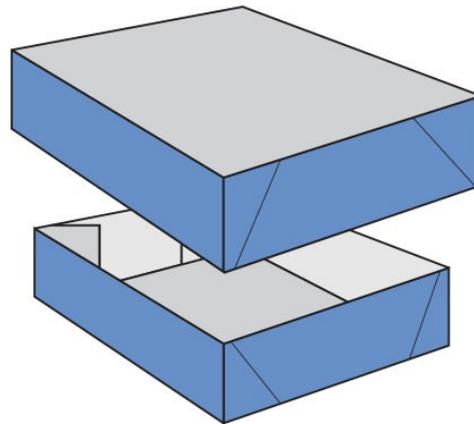
Hand Erected

Example: Cake box

B) Two piece tray:

In two piece trays are formed one tray is larger than another tray. This larger will act as Lid for the smaller will act as tray.

Example: Shirting's and cloth boxes.



2 Piece Lid & Base

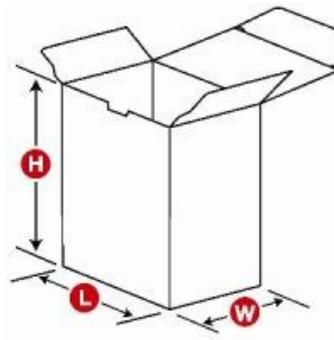
Window Carton



The window on the box allows consumers to see the product through the window so that they will have a general impression on the products. The following are two types of glass paper materials: economical PVC and environmentally friendly PET.

How to Measure a Folding Carton

When requesting a quote for your folding carton, it is important to be able to provide accurate measurements. There are three dimensions to the basic folding carton: Length (L), Width (W), and Height (H). In written form, the dimensions should appear in that order (L x W x H).



LENGTH (L) refers to the front panel dimension from left to right.

WIDTH (W) is the second panel dimension from the front of the box to the back of the box.

HEIGHT (H) is the distance between the two open ends of a carton, or from the top of the box to the bottom of the box.

1.5 THE SEQUENCE OF PREPARING A CUTTING AND CREASING RULE DIE

1. Layout diagram to be prepared:

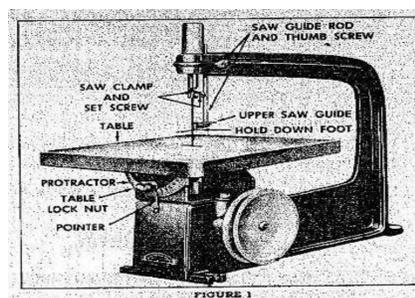
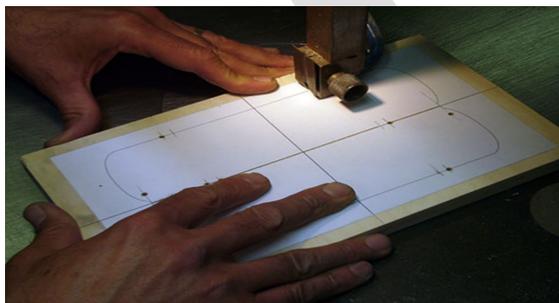
On a tracing paper the layout is drawn accurately

2. Fixing of Diagram:

On a multiply plywood the diagram is pasted

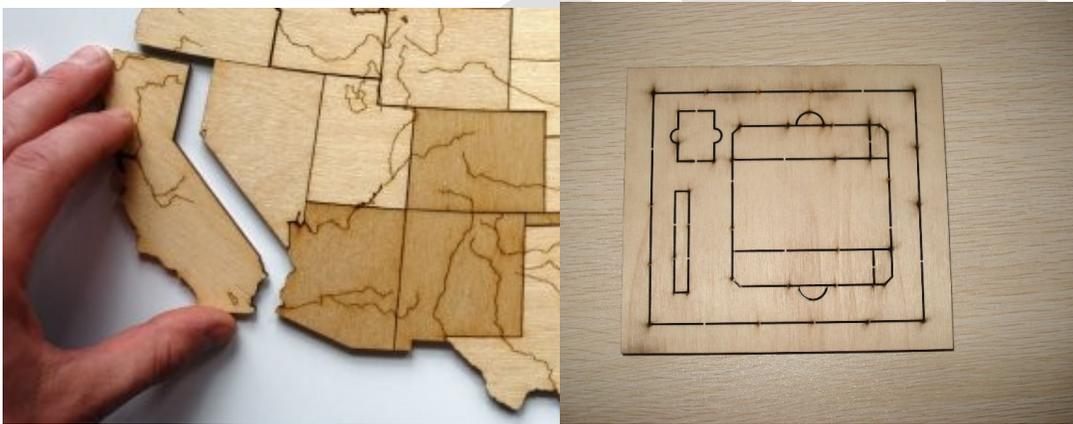
3. Saw cutting done on the die board:

The die board is fixed on a jigsaw machine. According to the diagram pasted on it, the die (*i.e.*, Multiply Plywood) is cut with the help of the saw blade.



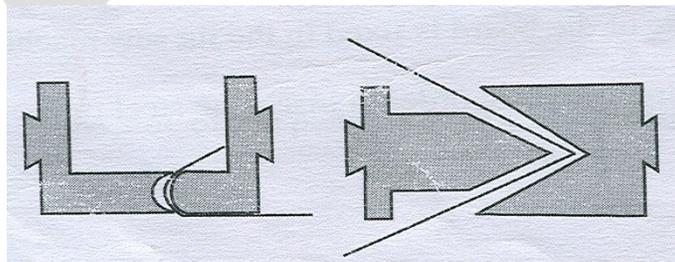
Laser Die cutting

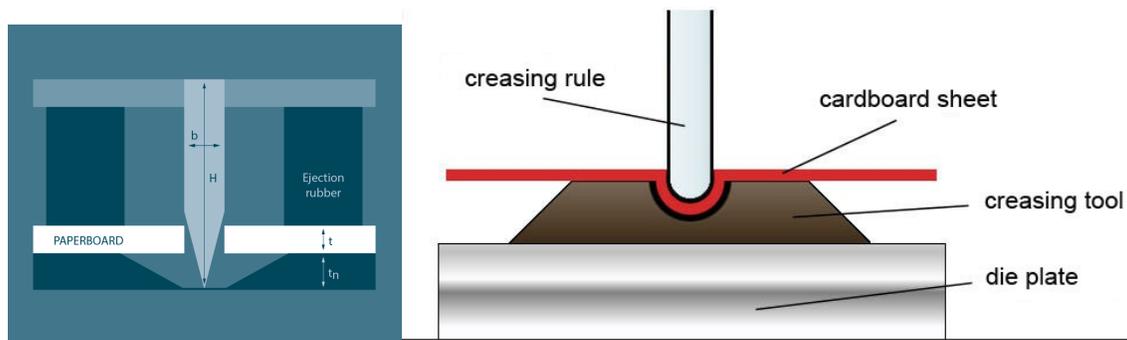
It allows cutting with an accuracy measured in thousandths of an inch makes very accurate parts and perfect fits. They can cut out the same shape with incredible repeatability. Besides accuracy, their ability to cut complex shapes is very easy. Here the focused laser beam is directed at the material, which then either melts, burns, vaporizes away, or is blown away by a jet of gas, leaving an edge with a high-quality surface finish.



The laser Die cutting equipment can be used to Cut Die Board for Carton Box, Label, Cartoon, Cards, etc. Applicable materials include Plywood, Plastic, Organic Materials and other non-metal materials with the precision of less than 0.05mm. It Adopts Superfine CO2 Laser and supports CorelDraw / AutoCad / Photoshop software.

4. Knives to be shaped by bending:





5. Notching machine:

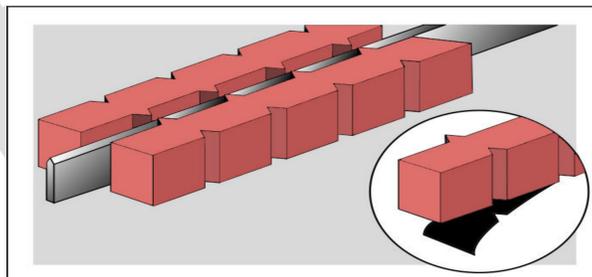
In this machine the cutting and creasing rules are notched at the corresponding places.

6. Die knives should be corked:



By welding and grinding the corners, the die cutting and creasing rules are brought.

6. Die board to be corked:



Rubber ejections are fixed to sides of the cutting rules the die board.

7. Nicks to be cut:

A small chisel or a sharp file is used to cut tiny nicks in the cutting rules.

8. To affix a list:

Indicating manufacture date, No of impressions to be obtained, height of rules, job number etc...

2 Marks**1. What are the types of folding carton? or common styles of folding carton?**

- Tube Style- Glue end, Lock Bottom, Tuck in, Auto Lock
- Tray Style- Single and Two piece

2. What are the classifications of packaging?

- Flexible Packaging
- Semi Rigid packaging
- Rigid Packaging

3. What are the functions/objectives of packaging?

- Physical Protection
- Barrier Protection
- Containment
- Information Transmission
- Marketing
- Security
- Convenience

4. What are the factors influencing the design of a package?

- Product
- Distribution
- Marketing
- Statutory and Regulation
- Packaging operation

- Cost

5. What is auto lock bottom carton?

The bottom flaps are designed with diagonal creasing and scoring. The diagonal flaps are spot glued on the side crease. The main panels are folded and the seam is glued. When the carton is erected the base locks itself automatically. **Example: Liquor bottles.**

6. What are the tray style cartons?

In tray carton all the four sides' one folded at right angles to ~ main sheet. Then they are joined together at the four corners. There are two types they are

A) One piece tray b) Two piece Tray

7. What is window carton?

The window on the box allows consumers to see the product through the window so that they will have a general impression on the products. The following are two types of glass paper materials: economical PVC and environmentally friendly PET.

8. Name the tools and devices used in Die making process.

- Jigsaw machine
- Plywood
- Notching machine
- Rule Bending machine
- Rubber Ejectors

9. What is laser die cutting?

It allows cutting with an accuracy measured in thousandths of an inch makes very accurate parts and perfect fits. They can cut out the same shape with incredible repeatability

10. Define packaging.

Packaging is the science, art and technology of enclosing or protecting products for distribution, storage, sale, and use.

3 Marks

1. What is rigid packaging?
2. What is flexible Packaging?
3. What are the factors to be considered package distribution?
4. What are the marketing factors influences the design of package?
5. Write short notes on window carton.

10 Marks

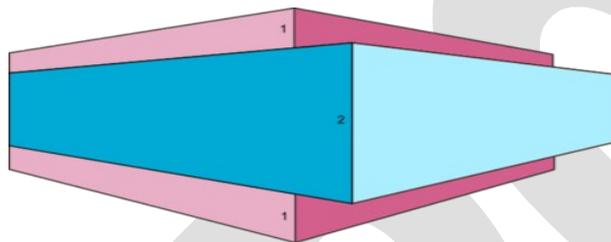
1. How do you classify the packaging and explain in detail.
2. What are the factors to be considered in designing of a package?
3. Write all about the functions of a package.
4. Explain the types of tube style folding carton with neat diagram.
5. Explain the process of Die Making with necessary sketch.
6. What is tray style carton? and explain its types with neat sketch.

UNIT II

PACKAGING MATERIALS

2.1 Types of Paper Boards used for packaging

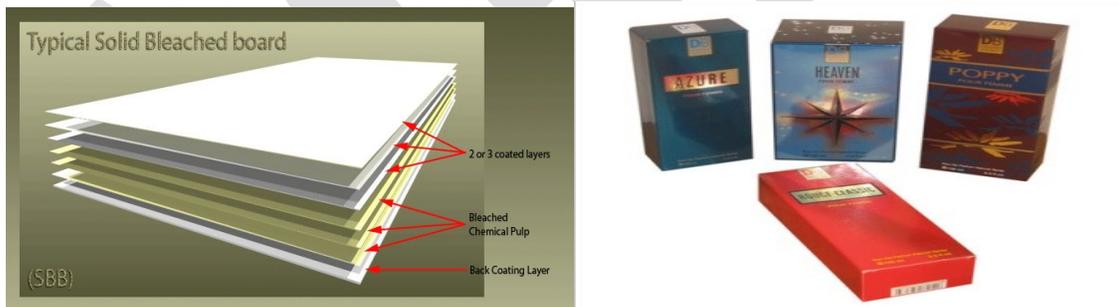
Solid Bleached Board (SBB)



1 - Coating

2 - Bleached chemical pulp

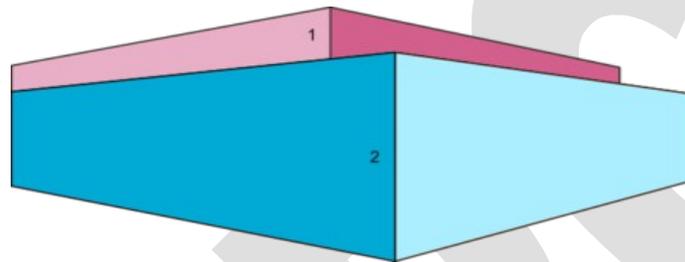
1. Solid Bleached Board (SBB)



Solid Bleached Board (SBB) or Solid Bleached Sulphate (SBS) is a virgin fibre grade of [paperboard](#). SBB has excellent printing, structural design and embossing characteristics making it ideal for luxury products and for products where preservation of product aroma, flavor and hygiene are critical. It is made exclusively from bleached chemical pulp. It usually has a white pigment coated top surface in 2 or 3 layers and some grades are also coated on the reverse.

It is a medium [density](#) board with good printing properties for [graphical](#) and [packaging](#) end uses and is perfectly white both inside and out. It can easily be cut, creased, hot foil stamped and embossed. Its other properties, such as being hygienic and pure with no smell and taste, make it usable for packaging aroma and flavor sensitive products such as [chocolate](#), [cigarettes](#) and [cosmetics](#).

Solid Unbleached Board (SUB)



SUB construction:

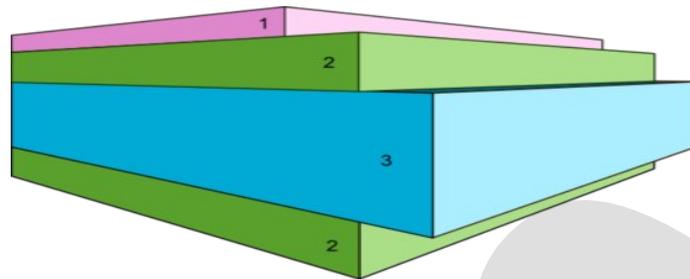
- 1 - Coating
- 2 - Solid Unbleached Board



SUB is used where either a very high strength (puncture, tear, etc.) or good wet strength properties are required. This is a grade of [paperboard](#) which is typically made of unbleached chemical pulp. Most often it comes with two to three layers of mineral or synthetic pigment [coating](#) on the top and one layer on the reverse side. Recycled fibres are sometimes used to replace the unbleached chemical pulp.

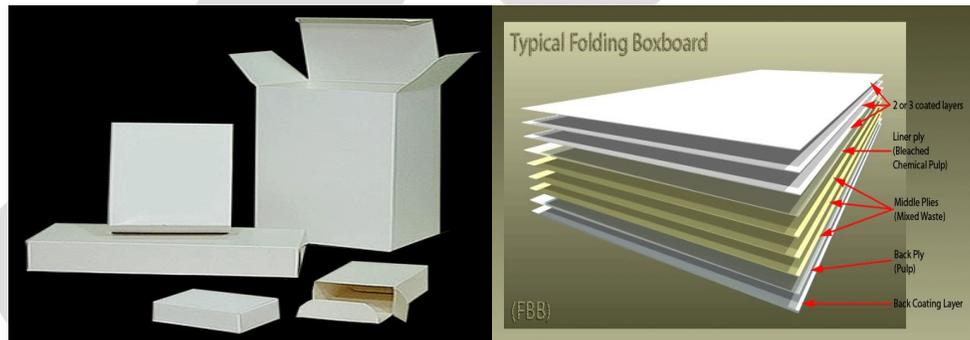
The main end use for this type of board is for packaging of frozen or chilled food, beverage carriers, detergent, cereals, shoes, toys, etc.

Folding Box Board (FBB)



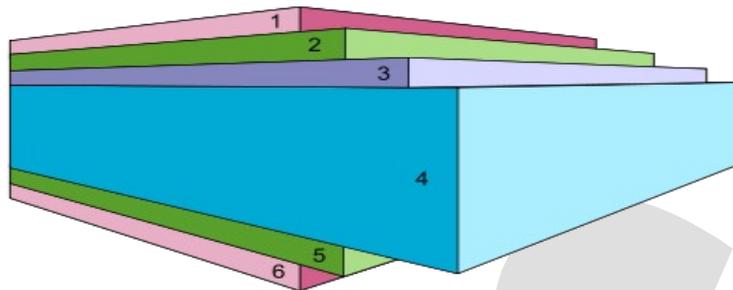
FBB construction:

- 1 - Coating
- 2 - Bleached chemical pulp
- 3 - Mechanical pulp
- 4 - Unbleached/ Bleached chemical pulp



FBB is a [paperboard](#) grade which is made up of multiple layers of chemical and mechanical pulp. This grade is made up of [mechanical pulp](#) in between two layers of chemical pulp. The top layer is of bleached [chemical pulp](#) with an optional [pigment coating](#). This is a low density material with high [stiffness](#) and has a slightly yellow color, mainly on the inside. FBB has a wide range of applications which include cosmetics, chocolate and confectionery, medical and healthcare, toiletries, dry foods, frozen and chilled foods, tea and coffee, biscuits, baked goods, clothing, toys, games and photographic products.

White Lined Chipboard (WLC)



WLC construction:

- 1) Two or three coating layers
- 2) Pulp or white recovered fiber
- 3) Recovered fibre under liner
- 4) One or more layers of mixed and/or recovered fiber
- 5) Pulp or white recovered fiber
- 6) Back coating



This grade of [paperboard](#) is typically made from layers of [waste paper](#) or [recycled fibers](#). Most often it comes with two to three layers of [coating](#) on the top and one layer on the reverse side. Because of its [recycled](#) content it will be grey from the inside. The main end uses for this type of [board](#) is for [packaging](#) of [frozen](#) or [chilled food](#), [cereals](#), [shoes](#), [toys](#) and others.

Kraft:

It is a strong paper mainly used for wrapping, packaging, sack bag etc. GSM range is 70 to 100. It plays an important role in the whole distribution system. An important class of Kraft paper is sack Kraft. This paper is used for making bags for various materials like cement, sugar, chemicals etc.

Duplex Board:

It has two different stocks laminated together. The top layer is made up of superior chemical wood pulp and the bottom layer is of waste paper and mechanical pulp. This board offers a better printing finish on top and protection on the inner side as well as being economical. These boards are used to make folding cartons of sweet boxes, medicines etc. (230 - 420 gsm)

Pulp Board:

They are manufactured from one type of pulp and used for making boxes where cleanliness and strength are important. These boards are used for manufacturing solid fiber box liner and folding cartons.

Linear Boards:

These are strong homogeneous boards used for corrugated and solid fiber board inner and outer facing. It acts as a good binder as well as gives resistance towards hard usage.

Straw Board:

These are made from grasses, bagasse and straws. These are extensively used for book binding, textile industry and boxes.

Corrugated Packaging:

Corrugated packaging is a versatile, economic, light, robust, recyclable, practical and yet dynamic form of packaging. Corrugated is a rigid shipping and packaging medium that can be cut and folded into an infinite variety of shapes and sizes. This is

very effective form of transit packaging that provides protection, identification, economy and performance. Corrugated can be printed by Flexographic, litho and silk screen.

Flutes

Architects have known for thousands of years that an arch with the proper curve is the strongest way to span a given space. The inventors of corrugated fiberboard applied this same principle to paper when they put arches in the corrugated medium. These arches are known as flutes and, when anchored to the linerboard with an adhesive, they resist bending and pressure from all directions.

The air circulating in the flutes also serves as an insulator which provides excellent protection against temperature variations. There are many types of corrugated, each with different flute sizes and profiles which offer many combinations designed to create packaging with different characteristics, strength and performances.

Flutes come in several standard shapes or flute profiles (A, B, C, E, F, etc.). Generally the larger flute profiles give greater vertical strength and cushioning. The smaller flutes help enhance graphic capabilities while providing greater structural integrity. Different flute profiles can be combined in one piece of combined board.

A-Flute

It has 33 flutes per linear foot and is used for very fragile goods as it has great shock absorbency. It ranges between 4.5 - 4.7mm in thickness.

B –Flute

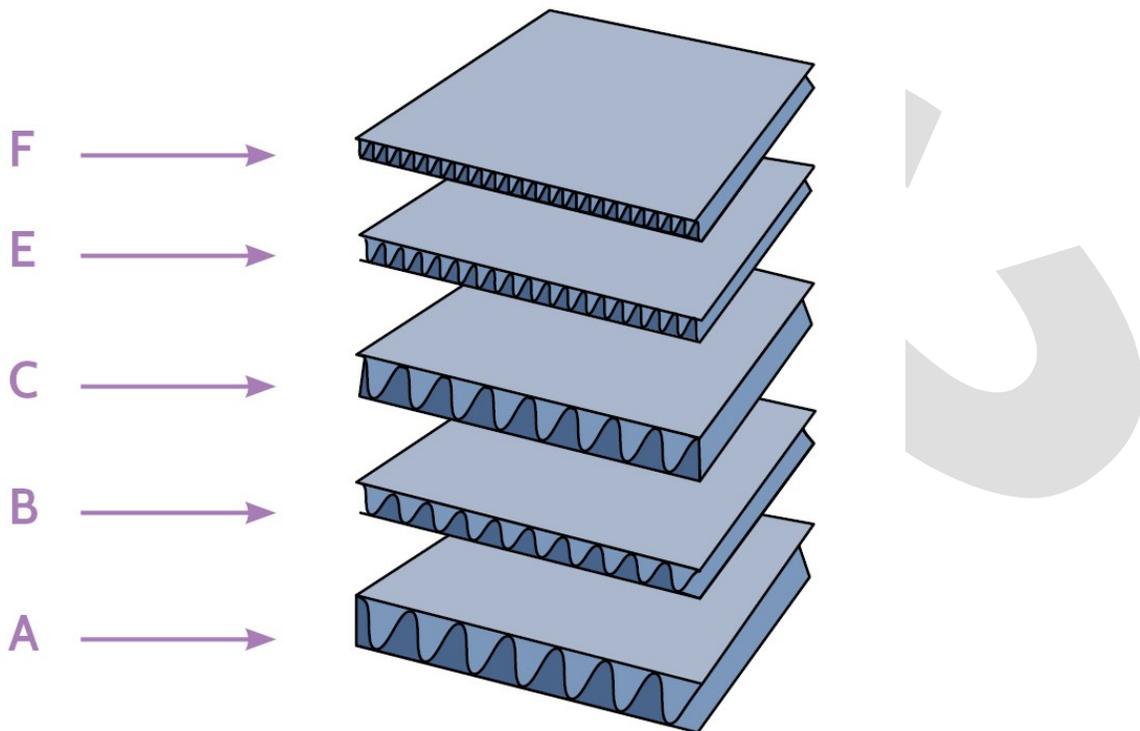
It has 47 flutes per linear foot and is high shock absorbency packaging with optimal levels of crush resistance. It ranges between 2.1 - 2.9mm in thickness.

C -Flute

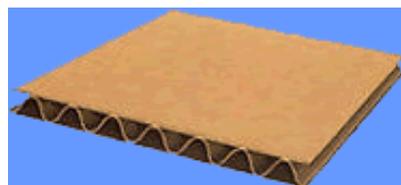
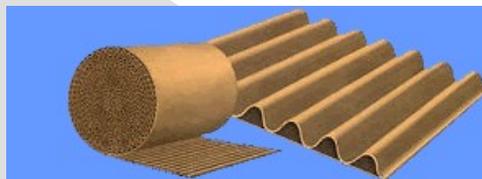
C-flute followed the development of A & B and is between A and B in size. It has 39 flutes per linear foot and it ranges between 3.5 - 3.7mm in thickness.

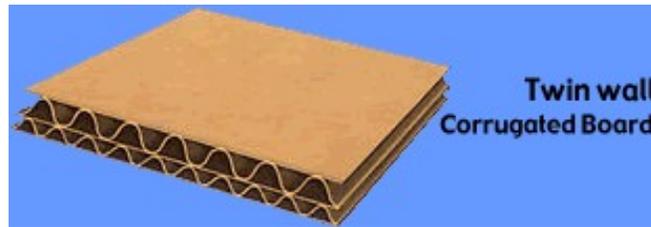
E&F-Flute

E-flute is smaller than B flute and has 90 flutes per linear foot and it ranges between 1.1 - 1.2mm in thickness. F flute is smaller again.

**Combined Board**

The below illustration demonstrates four basic types of combined board that are most commonly created from linerboard and medium using the variety of flute structures:





- **Single Face:** One corrugated medium is glued to one flat sheet of linerboard.
- **Single Wall:** The corrugated medium is glued between two sheets of linerboard. Also known as Double Face.
- **Double Wall:** Three sheets of linerboard with two mediums in between.
- **Triple Wall:** Four sheets of linerboard with three mediums in between.

2.2 Plastic Packaging materials

Nylon (Polyamide)

Nylon is a [thermoplastic](#), silky material, first used commercially in a [nylon-bristled toothbrush](#). Commercially Nylon is commonly used in the production of cords, rope, belts, filter cloths, sports equipment and bristles. It is particularly useful when

machined into bearings, gears, rollers and thread guides. Nylon was intended to be a synthetic replacement for [silk](#)



- Excellent resistance to Oils
- Good resistance to Solvents, Formaldehyde and Alcohols
- Limited resistance to Dilute Acids
- Poor resistance to Phenols, Alkalis, Iodine and Acids
- Excellent material for machining
- Tough, strong, and impact resistant material
- Very low coefficient of friction
- Abrasion resistant
- Melts instead of burning
- High elongation
- High resistance to insects, fungi, animals, as well as molds, mildew, rot and many chemicals

Polyolefin:-

A **polyolefin** is a [polymer](#) produced from a simple [olefin](#) (also called an [alkene](#) with the general formula C_nH_{2n}) as a [monomer](#). For example, [polyethylene](#) is the polyolefin produced by polymerizing the olefin [ethylene](#). An equivalent term is **polyvalence**; this is a more modern term, although *polyolefin* is still used in the [petrochemical](#) industry. [Polypropylene](#) is another common polyolefin which is made from the olefin [propylene](#).

Linear low-density polyethylene (LLDPE)

Linear low-density polyethylene differs structurally from conventional [low-density polyethylene](#) (LDPE) because of the absence of long chain branching.

Features

- High strength
- Durable
- Weather resistant
- Resistant to high temperature
- Non oxidizing
- Non toxic

It is used for [plastic bags](#) and sheets (where it allows using lower thickness than comparable LDPE), [plastic wrap](#), [stretch wrap](#), pouches, toys, covers, lids, pipes, buckets and containers, covering of cables, [geomembranes](#), and mainly flexible tubing.

LLDPE has higher [tensile strength](#) and higher impact and [puncture resistance](#) than does [LDPE](#). LLDPE films can be down gauged easily while maintaining high strength and toughness.

Material properties of some thermoplastics

Properties of some thermoplastic materials							
Name	Symbol	Density [g/cm ³]	Tensile strength [MPa]	Elastic modulus [GPa]	Elongation at rupture [%]	Thermal stability [°C]	Expansion at 20°C [10 ⁻⁶ /°C]
High Density Polyethylene	HDP E	0.95	31	1.86	100	120	126
Low Density Polyethylene	LDP E	0.92	17	0.29	500	90	160

Polyvinyl Chloride	PVC	1.44	47	3.32	60	80	75
Polypropylene	PP	0.91	37	1.36	350	150	90
Polyethylene terephthalate	PET	1.35	61	1.35	170	120	70
Polycarbonate	PC	1.2	68	2.3	130	120	66
Polyamide	Nylon 6	1.13	60	2.95	60	110	66
Polyimide	PI	1.38	96	3.1	7	380	43
Polyamide-imide, electrical grade	PAI	1.41	138	4.1	12	260	30
Polyamide-imide, bearing grade	PAI	1.46	103	5.5	6	260	25
Polytetrafluoroethylene	PTFE	2.17	24	0.49	300	260	95
Polyetherimide	PEI	1.27	105	2.9	60	210	31

BOPP

When polypropylene film is extruded and stretched in both the machine direction and across machine direction it is called *biaxially oriented polypropylene*. Biaxial orientation increases strength and clarity. BOPP is widely used as a packaging material for packaging products such as snack foods, fresh produce and confectionery. It is easy to coat, print and laminate to give the required appearance and properties for use as a packaging material.

Features of BOPP film:

- Excellent clarity
- Good dimensional stability and flatness
- Low electrostatic charge
- Good barrier to water vapor
- High gloss
- Good performance on high speed printing
- Resistant to oils and greases

- Good puncture and flex-crack resistance over a wide range of temperatures
- Not affected by moisture and does not wrinkle or shrink with environmental changes
- Recyclable

The main features of BOPP films are improved stiffness, high tensile strength, excellent optics and good water vapor barrier properties.

2.3 Metal Packaging Materials

TIN

Tin can be applied as a thin layer on steel used for metal packaging. It is applied electrolytically during the manufacture of ETP (electrolytic tinplate). The tin layer provides corrosion resistance and in some cases is not coated, as tin can act as an efficient oxygen scavenger. However, using uncoated tin is limited by the various possible interactions between the metal surface and the foodstuff.

PROPERTIES

- Tin is a white metal at room temperature.
- Tin is soft.
- Tin is highly corrosion-resistant and fatigue-resistant.
- Tin is non-toxic.
- Tin is highly malleable (able to be shaped).
- Tin alloys easily with other metals.
- Tin has a low melting point (232°C).
- Tin is easy to recycle.

USES

Tinplate About 50% of tin is used as tinplate for canned foods and drinks, where steel cans are coated with tin to make them rust-resistant, more attractive, and more

easily shaped and soldered. (Steel alone would rust, and tin alone would be too soft and too expensive). Solder About 30% of tin is used as a tin-lead solder in electronic parts, plumbing, machinery, and cars.

Bronze an alloy of copper and tin – used for statues, bearings in car engines and heavy machinery, and musical instruments such as bells, cymbals and gongs.

Aluminium foil

Foil is made on rolling mills in a process that involves pulling a sheet of aluminium between two rotating rollers under pressure.



Aluminium foil is sheet that is between 0.004 and 0.24 mm thick. Aluminium foil is 8 times thinner than a banknote and yet it provides barrier to light, oxygen, moisture and bacteria. For this reason, foil is used extensively in food and pharmaceutical packaging. Aluminum foil is also used to make aseptic packaging. This type of packaging enables storage of perishable goods without refrigeration.

Many groceries are easily affected by sunlight, which damages their appearance and worsens their taste. Foil solves this problem in the best way possible which is why it is generally regarded as the ideal core packaging material for dairy products, pastries, and beverages. For example, dry milk in hermetically sealed packages made from laminated

foil has a shelf life of 2 years. Aluminium foil is non-toxic, so it does not damage the foods wrapped in it, but instead protects them. Aluminium foil is used in food containers, bins, bottle caps, soft packages for liquids or bulk food stuffs and many other types of containers.

Foil does not melt from high temperature, nor does it lose its shape or impart any bad smell to the food wrapped in it. This means foil can be used for grilling food or even for cooking on an open fire. Laminated foil with paper stuck on the inside is used for packaging tea and sweets. This kind of foil is three times as waterproof as standard foil even in hot climates. Foil with water and grease proof paper on one side is used in the packaging of butter, cheese, ice cream and other dairy products.

Fruit juices and wines can be kept for extended periods of time at room temperature in containers made from paper, aluminium foil and polyethylene film. At home, people also prefer to store and bake food in aluminium foil as they have enough strength to withstand heat. Aluminium foil is used in the packaging of all types of medications such as pills, capsules, creams, lotions, liquid and powder medications. Aluminium foil offers 100% protection against light, moisture, oxygen and other gases as well as against microorganisms and bacteria.

Properties of Aluminium

After iron, aluminum is now the second most widely used metal in the world. This is because aluminum has a unique combination of attractive properties like.

Light Weight

Aluminium is a very light metal with a specific weight of 2.7 g/cm³, about a third that of steel.

Corrosion Resistance

Aluminium naturally generates a protective oxide coating and is highly corrosion resistant.

Electrical and Thermal Conductivity

Aluminium is an excellent heat and electricity conductor and in relation to its weight is almost twice as good a conductor as copper.

Reflectivity

Aluminium is a good reflector of visible light as well as heat, and that together with its low weight.

Ductility

Its ductility allows products of aluminium to be basically formed close to the end of the product's design.

Impermeable and Odorless

Aluminium foil, even if rolled only 0.007 mm thickness, is still completely impermeable. Moreover, the metal itself is non-toxic and releases no aroma or taste substance.

Recyclability

Aluminium is 100 percent recyclable with no downgrading of its qualities.

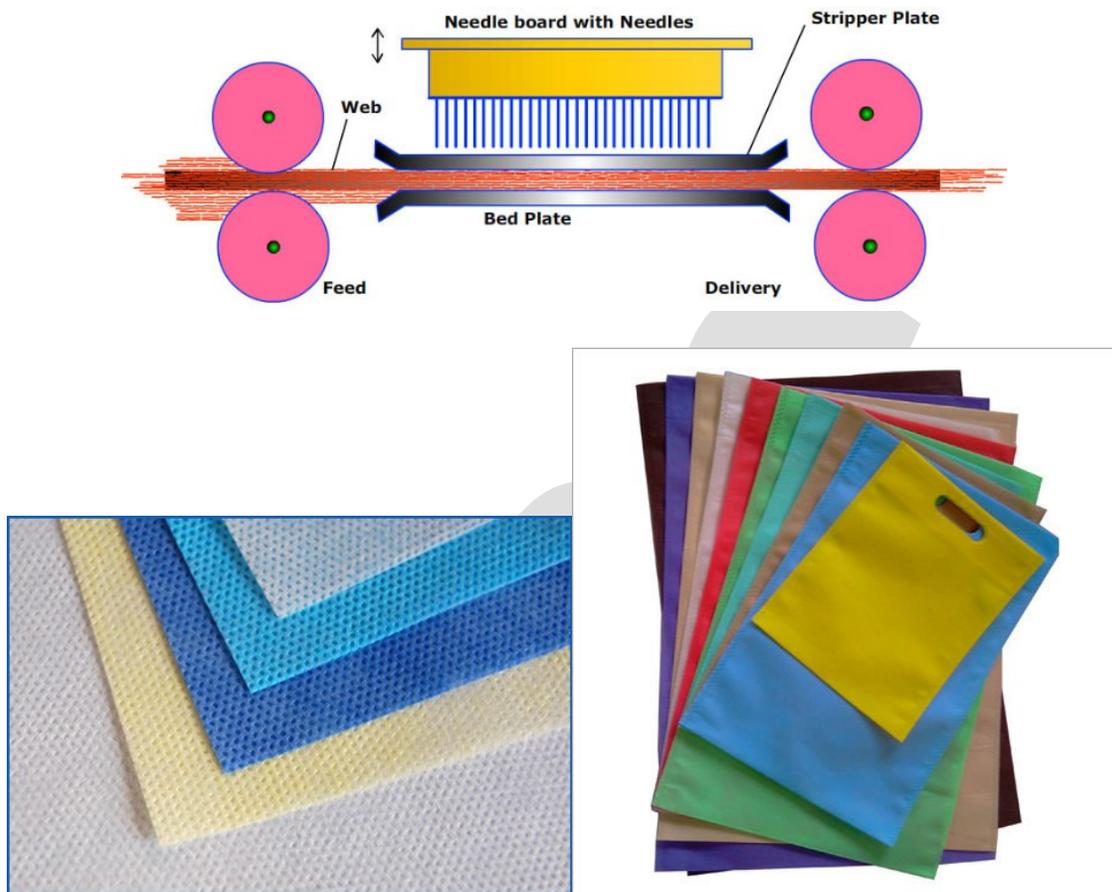
Non Magnetic

Aluminium has non-magnetic properties which make it useful for electrical shielding such as busbar or magnetic compass housings.

Non Toxic

The fact that aluminium is non-toxic (not poisonous and is therefore highly suitable for the preparation and storage of foods) which enables the metal to be used in cooking utensils without any harmful effect on the body.

Non-Woven materials



Nonwoven fabrics are broadly defined as sheet or web structures bonded together by entangling fiber or filaments (and by perforating films) mechanically, thermally or chemically. They are flat or tufted porous sheets that are made directly from separate fibers, molten plastic or plastic film.

They are not made by weaving or knitting and do not require converting the fibers to yarn. Typically, a certain percentage of recycled fabrics and oil-based materials are used in nonwoven fabrics. Rayon used to be a common fiber in nonwovens, now greatly replaced by polyethylene terephthalate (PET) and polypropylene.

Nonwoven fabrics provide specific functions such as absorbency, liquid repellence, resilience, stretch, softness, strength, flame retardancy, washability, cushioning, thermal

insulation, acoustic insulation, filtration, use as a bacterial barrier and sterility. They are used for apparel, home furnishings, health care, engineering, industrial and consumer goods.

DIFFERENT TYPES OF PLASTICS AND THEIR CLASSIFICATION



Polyethylene Terephthalate sometimes absorbs odours and flavours from foods and drinks that are stored in them. Items made from this plastic are **commonly recycled**. PET(E) plastic is used to make many common household items like beverage bottles, medicine jars, rope, clothing and carpet fibre.



High-Density Polyethylene products are very safe and are not known to transmit any chemicals into foods or drinks. HDPE products are **commonly recycled**. Items made from this plastic include containers for milk, motor oil, shampoos and conditioners, soap bottles, detergents, and bleaches. It is NEVER safe to reuse an HDPE bottle as a food or drink container if it didn't originally contain food or drink.



Polyvinyl Chloride is **sometimes recycled**. PVC is used for all kinds of pipes and tiles, but is most commonly found in plumbing pipes. This kind of plastic should not come in contact with food items as it can be harmful if ingested.



Low-Density Polyethylene is **sometimes recycled**. It is a very healthy plastic that tends to be both durable and flexible. Items such as cling-film, sandwich bags, squeezable bottles, and plastic grocery bags are made from LDPE.



Polypropylene is **occasionally recycled**. PP is strong and can usually withstand higher temperatures. It is used to make lunch boxes, margarine containers, yogurt pots, syrup bottles, prescription bottles. Plastic bottle caps are often made from PP.



Polystyrene is **commonly recycled**, but is difficult to do. Items such as disposable coffee cups, plastic food boxes, plastic cutlery and packing foam are made from PS.



Code 7 is used to designate miscellaneous types of plastic not defined by the other six codes. **Polycarbonate** and **Poly lactide** are included in this category. These types of plastics are **difficult to recycle**. Polycarbonate (PC) is used in baby bottles, compact discs, and medical storage containers.

Plastic Type	General Properties	Common Household Uses
PET	Good gas & moisture barrier properties High heat resistance Clear Hard Tough Microwave transparency Solvent resistant	Mineral Water, fizzy drink and beer bottles Pre-prepared food trays and roasting bags Boil in the bag food pouches Soft drink and water bottles Fibre for clothing and carpets Strapping Some shampoo and mouthwash bottles

<p>HDPE</p>	<p>Excellent moisture barrier properties</p> <p>Excellent chemical resistance</p> <p>Hard to semi-flexible and strong</p> <p>Soft waxy surface</p> <p>Permeable to gas</p> <p>HDPE films crinkle to the touch</p> <p>Pigmented bottles stress resistant</p>	<p>Detergent, bleach and fabric conditioner bottles</p> <p>Snack food boxes and cereal box liners</p> <p>Milk and non-carbonated drinks bottles</p> <p>Toys, buckets, rigid pipes, crates, plant pots</p> <p>Plastic wood, garden furniture</p> <p>Wheeled refuse bins, compost containers</p>
<p>PVC</p>	<p>Excellent transparency</p> <p>Hard, rigid (flexible when plasticised)</p> <p>Good chemical resistance</p> <p>Long term stability</p> <p>Good weathering ability</p> <p>Stable electrical properties</p> <p>Low gas permeability</p>	<p>Credit cards</p> <p>Carpet backing and other floor covering</p> <p>Window and door frames, guttering</p> <p>Pipes and fittings, wire and cable sheathing</p> <p>Synthetic leather products</p>

LDPE	<p>Tough and flexible</p> <p>Waxy surface</p> <p>Soft – scratches easily</p> <p>Good transparency</p> <p>Low melting point</p> <p>Stable electrical properties</p> <p>Good moisture barrier properties</p>	<p>Films, fertiliser bags, refuse sacks</p> <p>Packaging films, bubble wrap</p> <p>Flexible bottles</p> <p>Irrigation pipes</p> <p>Thick shopping bags (clothes and produce)</p> <p>Wire and cable applications</p> <p>Some bottle tops</p>
PP	<p>Excellent chemical resistance</p> <p>High melting point</p> <p>Hard, but flexible</p> <p>Waxy surface</p> <p>Translucent</p> <p>Strong</p>	<p>Most bottle tops</p> <p>Ketchup and syrup bottles</p> <p>Yoghurt and some margarine containers</p> <p>Potato crisp bags, biscuit wrappers</p> <p>Crates, plant pots, drinking straws</p> <p>Hinged lunch boxes, refrigerated containers</p> <p>Fabric/ carpet fibres, heavy duty bags/tarpaulins</p>
PS	<p>Clear to opaque</p> <p>Glassy surface</p> <p>Rigid or foamed</p> <p>Hard</p> <p>Brittle</p> <p>High clarity</p> <p>Affected by fats and solvents</p>	<p>Yoghurt containers, egg boxes</p> <p>Fast food trays</p> <p>Video cases</p> <p>Vending cups and disposable cutlery</p> <p>Seed trays</p> <p>Coat hangers</p> <p>Low cost brittle toys</p>

2 Marks**1. What are the types boards used in packaging?**

- Solid Bleached board
- Solid Unbleached Board
- Folding Box Board
- White Lined Chip Board

2. What are the types of corrugated board?

- Single Face corrugated board
- Double wall corrugated board
- Triple wall corrugated board

3. What is BOPP?

Biaxially Oriented Polypropylene

Biaxial orientation increases strength and clarity. BOPP is widely used as a packaging material for packaging products such as snack foods, fresh produce and confectionery

4. What is HDPE?

High-Density Polyethylene products are very safe and are not known to transmit any chemicals into foods or drinks. HDPE products are **commonly recycled**.

5. What is LLDPE?

Low-Density Polyethylene is sometimes recycled. It is a very healthy plastic that tends to be both durable and flexible. Items such as cling-film, sandwich bags, squeezable bottles, and plastic grocery bags are made from LDPE.

6. What is PET?

Polyethylene Terephthalate sometimes absorbs odours and flavours from foods and drinks that are stored in them. Items made from this plastic are commonly recycled

7. What are the metal packaging materials?

- Steel
- Tin
- Aluminium
- Alloy (Bronze)

8. What is Foil?

Foil is made on rolling mills in a process that involves pulling a sheet of between two rotating rollers under pressure. Foil is sheet that is between 0.004 and 0.24 mm thick, it provides barrier to light, oxygen, moisture and bacteria. For this reason, foil is used extensively in food and pharmaceutical packaging.

9. What is Double wall corrugated board?

It has two flute layers and three liners for additional protection

10. What is Non Woven material?

Nonwoven fabrics are broadly defined as sheet or web structures bonded together by entangling fiber or filaments (and by perforating films) mechanically, thermally or chemically. They are flat or tufted porous

11. What is flute?

Flutes come in several standard shapes or flute profiles (A, B, C, E, F, etc.). Generally the larger flute profiles give greater vertical strength and cushioning.

3 Marks

1. Brief about SBB board.
2. What is the application of BOPP material?
3. Brief about Non Woven material advantage and application.

4. Write down the application of Aluminium foils.
5. Write down the application of Tin materials.
6. Write down the advantage of corrugated board.

10 Marks

1. Explain the types boards used in packaging in detail.
2. Explain the types of plastic materials used in packaging in detail.
3. What is the role of metals in packaging? and write down its properties.
4. Explain all about corrugated packaging in detail.

UNIT-III

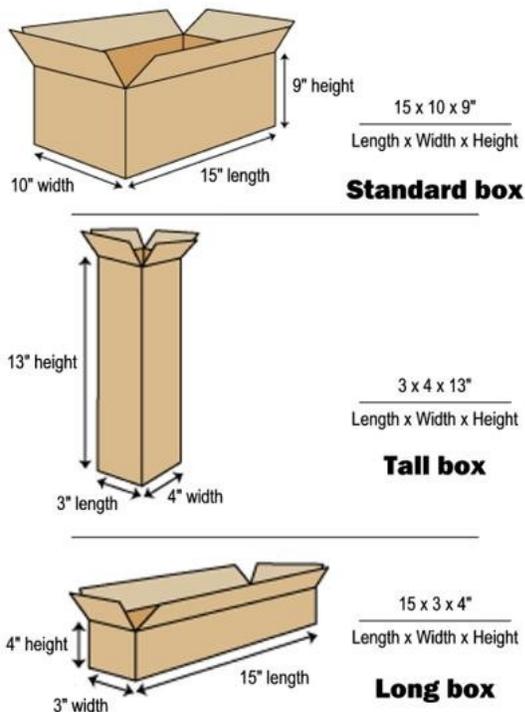
PACKAGING MACHINERY USED FOR VARIOUS PURPOSES

Food packaging is packaging for food. A package provides protection, tampering resistance, and special physical, chemical, or biological needs. It may bear a nutrition facts label and other information about **food** being offered for sale.

3.1 Factors influencing the design of package (refer unit I)

3.2: Structural Fundamentals of folding carton

Folding Carton Structural Design can be defined as the 'the engineering of a carton or a box out of paperboard to create a package to hold a specific product.' Structural design is very complicated and involved on many levels. Structural designers focus first on understanding the unique qualities of your product. Then they produce innovative structural concepts that help communicate *value* to the customers you are trying to reach.



Shape

Let's start with the carton's shape. The order of the box dimensions is essential to creating your structure design.

Measuring

To determine the proper length, width and depth of an existing structure, place the carton facing you with the opening up. Dimensions should be measured from the center of score to centre of score, and given to the nearest sixteenth of an inch. Always refer to the outside dimensions of the carton.

Style

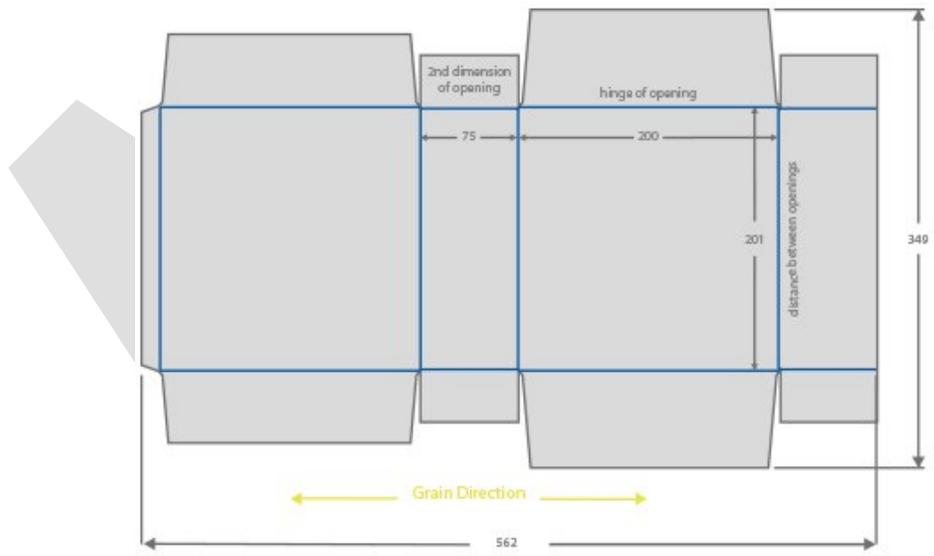
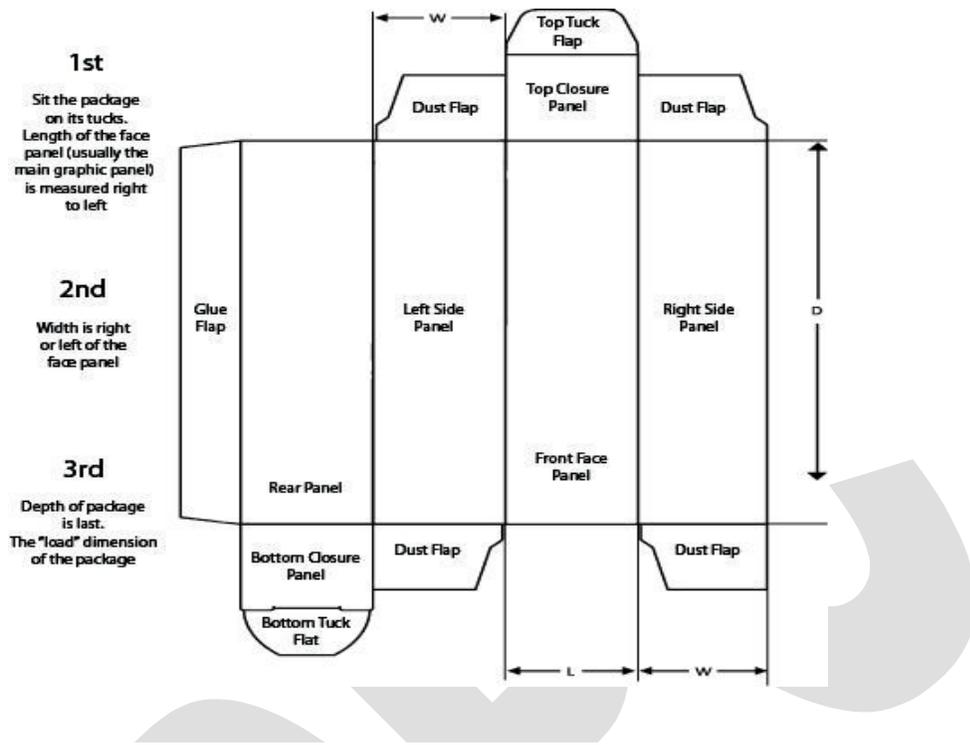
All cartons are custom-made structures that often include various elements of common folding carton styles and closures.

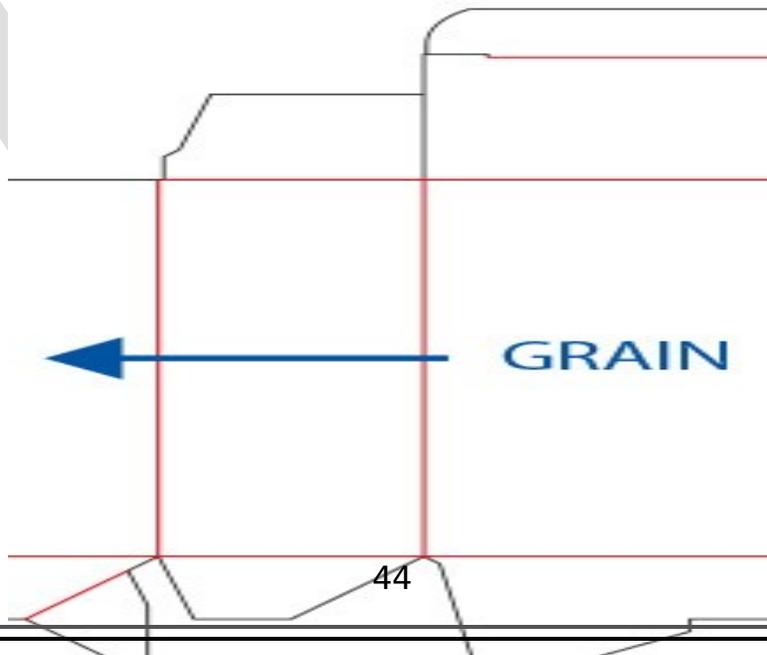
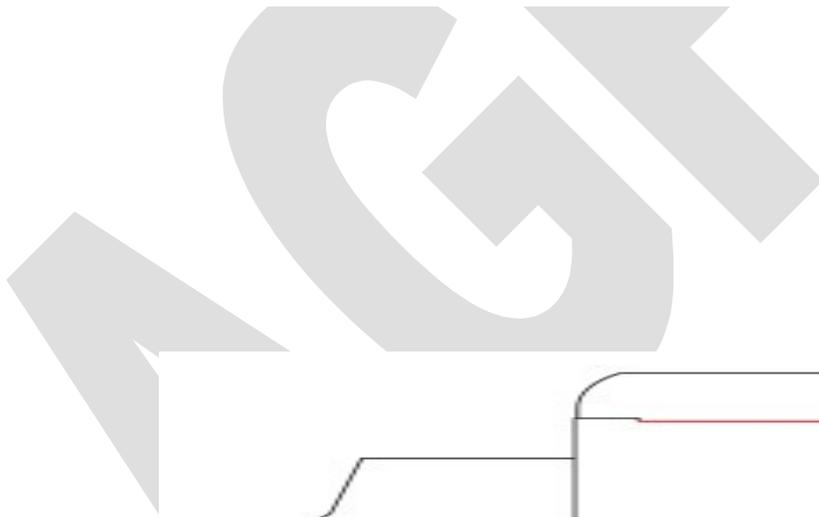
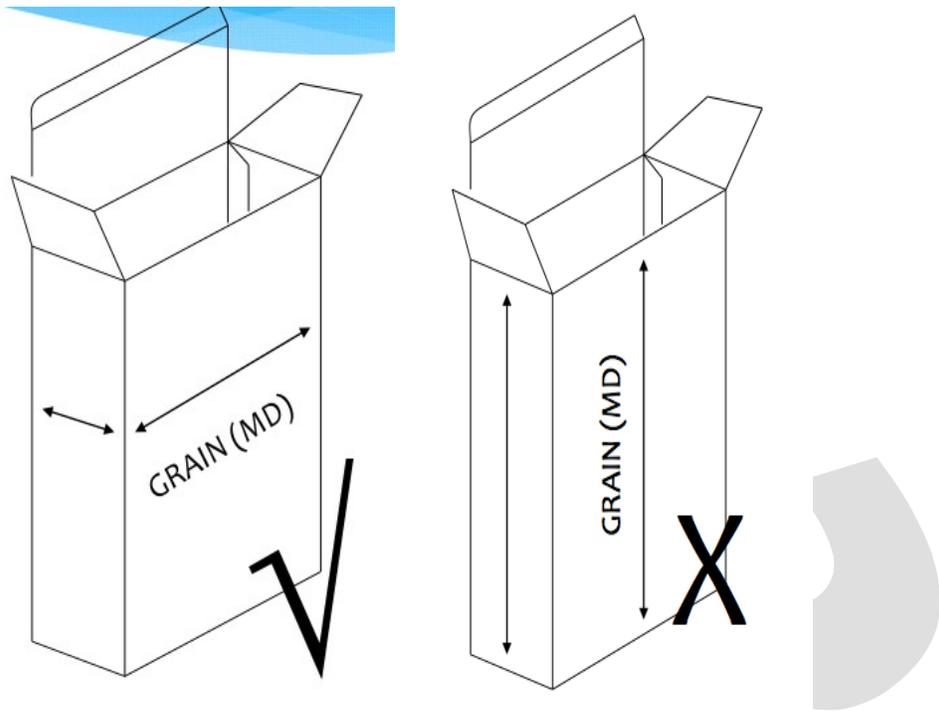
Follow the Rules

There are a lot of regulations and requirements for packaging, especially in the food and medical/pharmaceutical industry. Make sure you are carefully following all FDA labelling requirements, so be sure and check with your buyers for guidance before you begin the design process.

A carton should be dimensioned in the order- **L X W X D** (Length of hinge of opening panel" x "length of 2nd dimension of opening" x "distance between openings). Therefore the example above should be 200 x 75 x 201mm

The **blank size** should always be dimensioned with the grain direction as the second number. Therefore the example above should be 349 x 562mm.





Grain direction

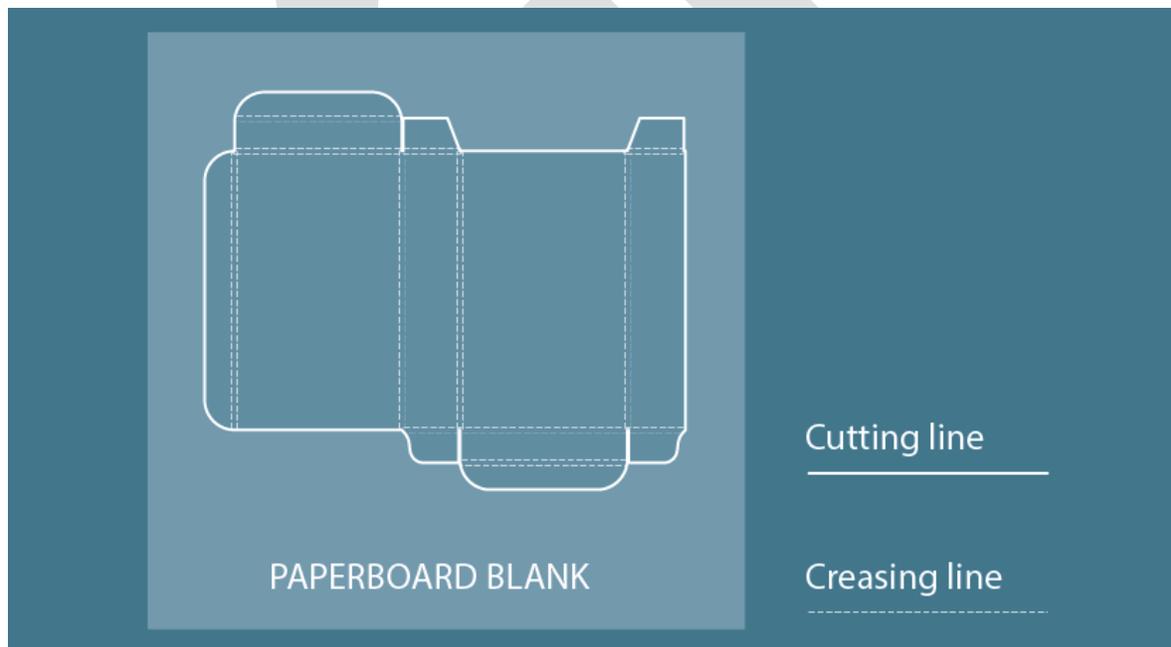
As a rule, the direction of the grain runs opposite to the major creases on the carton for ease of erection on automatic forming/filling machines.

The grain direction of board can be determined by checking the resistance of the board by bending slightly from end to end. The direction that gives the least resistance is the way the board direction is running. It can sometimes be seen by eye, by looking at the reverse of the sheet and observing which way the fibres run. The last dimension on the board measurement also determines the grain of the board.

Cutting and Creasing

Cutting

Cutting is defined as bringing the paper to the desired dimensions by cutting the pile of sheets in a cutting machine. Normally cutting operation is performed in a single knife guillotine machine.

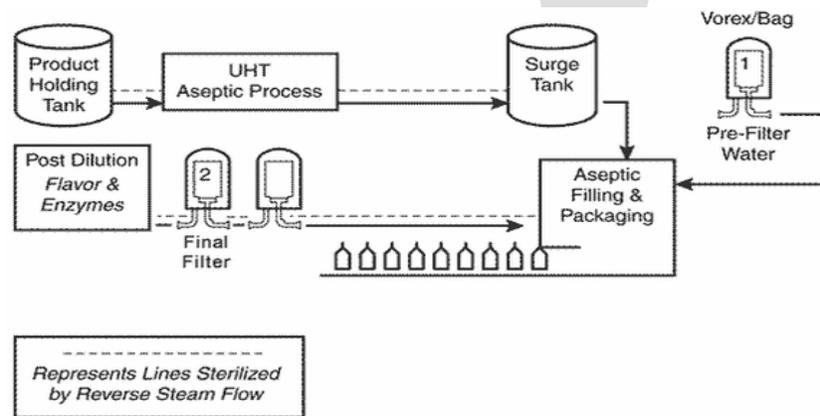


Creasing

When thick material such as board is folded, its surface become damaged and ragged at the line of folding. In order to avoid such damage, creasing is done before folding operation.

The creasing is done with the help of creasing rule, by giving a blind impression into the board so that the board can be folded without any damage.

3.3 Introduction to food Packaging



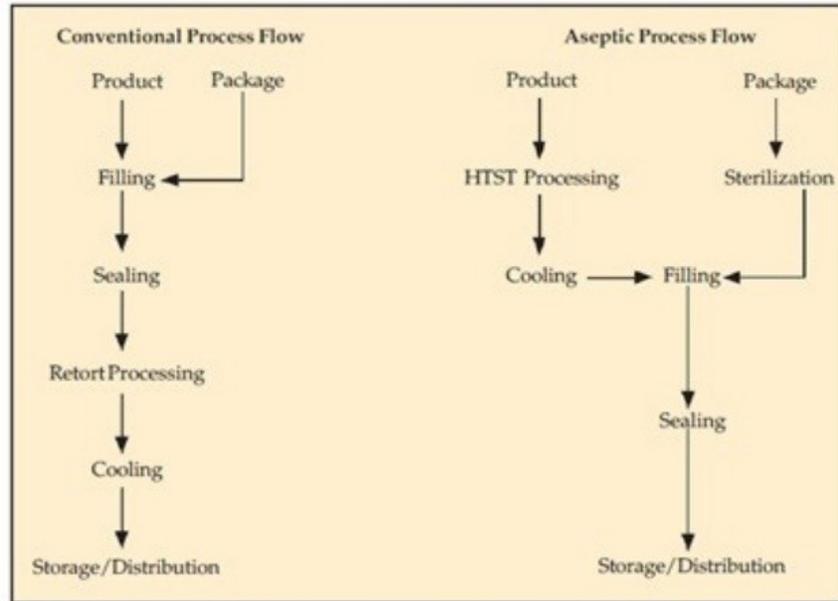
Aseptic packaging is defined as the filling of a commercially sterile product into a sterile container under aseptic conditions and hermetically sealing the containers so that reinfection is prevented.

Aseptic packaging technology is fundamentally different from that of conventional food Processing. It begins with treating of the food prior to filling. Initial operations inactivate enzymes so that these will not degrade the product during processing. The package is cleaned, and the product is introduced into the package, usually hot. Generally, air that can cause oxidative damage is removed from the interior. The package is hermetically sealed and then subjected to heating.

Although conventional canning renders food products commercially sterile, the nutritional contents and the organoleptic properties of the food generally suffer in the processing. Moreover, tins are heavy in weight, prone to rusting and are of high cost.

A simple illustration comparing the basic difference between conventional canning and aseptic packaging processes for the production of shelf-stable food products.

Figure 1: Conventional Canning v/s Aseptic Packaging



Advantages of Aseptic Packaging Technology

Packaging materials, which are unsuitable for in-package sterilisation can be used. Therefore, light weight materials consuming less space offering convenient features and with low cost such as paper and flexible and semi-rigid plastic materials can be Used gainfully.

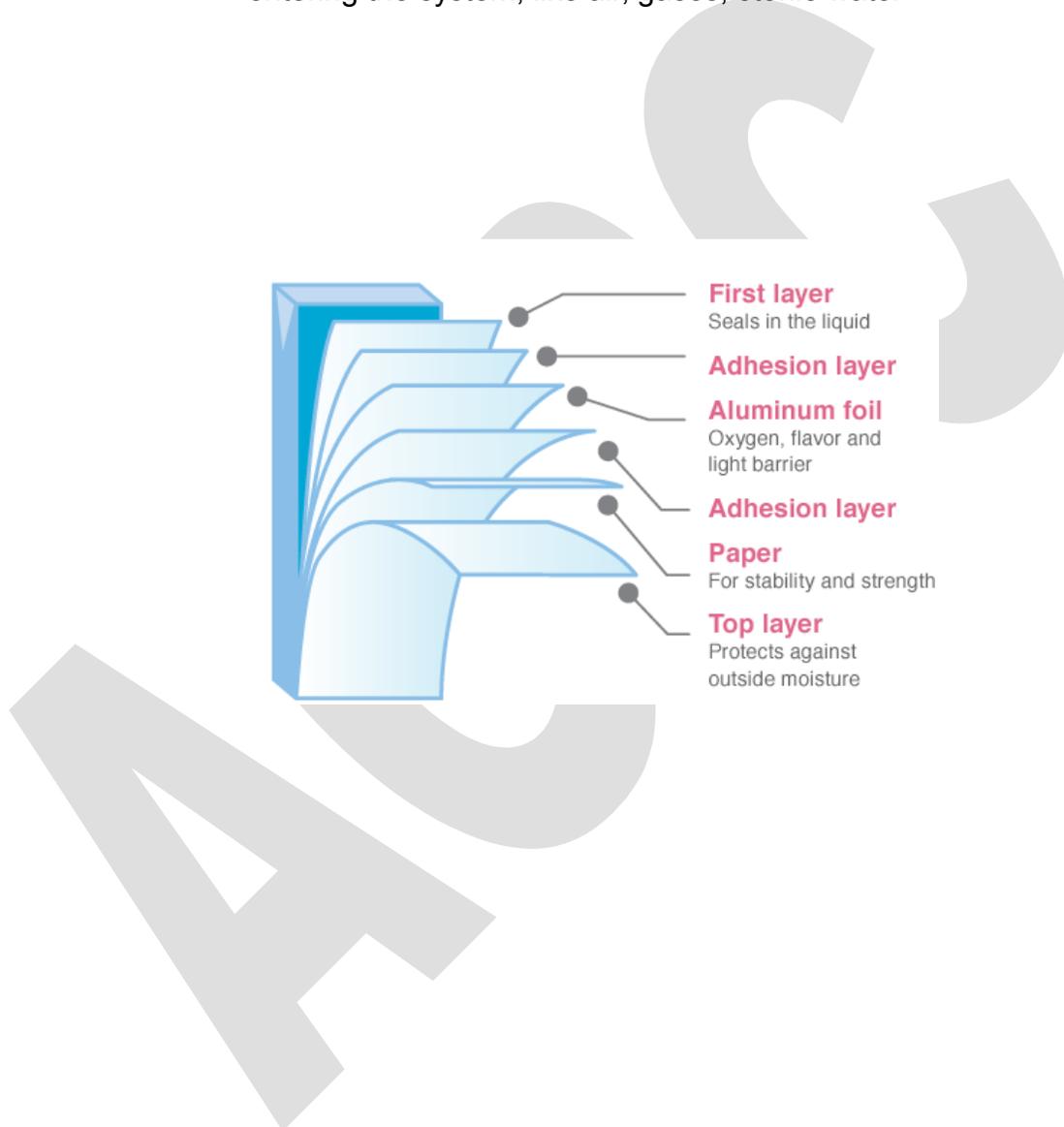
Sterilisation process of high-temperature-short time (HTST) for aseptic packaging is thermally efficient and generally gives rise to products of high quality and nutritive value compared to those processed at lower temperatures for longer time. Additional advantages are that the HTST process utilises less energy, as part of the process-heat is recovered through the heat exchangers.

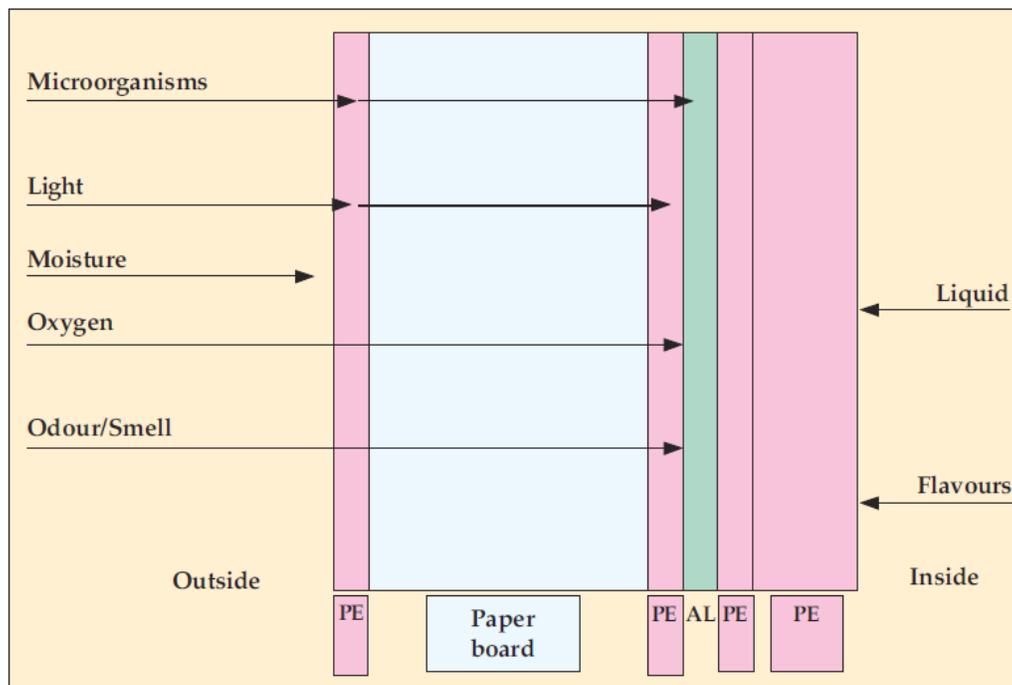
Aseptic Processing – Methodology

Aseptic processing comprises the following:

- Sterilisation of the products before filling

- Sterilisation of packaging materials or containers and closures before filling
- Sterilisation of aseptic installations before operation (UHT unit, lines for products, sterile air and gases, filler and relevant machine zones)
- Maintaining sterility in this total system during operation; sterilization of all media entering the system, like air, gases, sterile water





Sterilization of Products

Pre-sterilization of a product usually consists of heating the product to the desired UHT, maintaining this temperature for a given period in order to achieve the desired degree of sterility, with subsequent cooling, usually to ambient temperature and sometimes to an elevated temperature to achieve right viscosity for filling. Heating and cooling should be performed as rapidly as possible to achieve the best quality, depending upon the nature of the product. A fast heat exchange rate is desired for cost reasons.

Various heat transfer methods are used, but essentially the systems can be divided into direct and indirect heat exchange methods. Some of the latest methods of sterilisation of products include:

- Microwaves
- Electrical resistance heating
- High voltage discharge
- Ultra high pressure
- Sterilisation of Aseptic Packaging Materials and Equipment

Preservation Methods

Preservation Method	Description
High Temperature/ Short Time (HTST) Pasteurisation	The product is heated 72C for 15 seconds.
Sterilisation	A severe form of heat processing that destroys most micro-organisms. The flavour and appearance of a food product may change.
Ultra Heat Treatment (UHT)	Food is heated to 130-150C for 1-3 seconds. The food is kept moving so fewer changes occur.

Preservation Method	Description
Irradiation	Micro-organisms are killed as food is bombarded with ionising radiation. All irradiated food must be labelled.
Modified Atmosphere Packaging (MAP)	Foods are packed in a combination of CO ₂ , N and O ₂ gas instead of air – this delays decay.
Additives	Synthetic or natural substances added to food in small quantities to lengthen shelf life.
Chilling	A short term method of preserving food between 1 and 5C that slows rate of decay.
Smoking	Traditionally meat and fish were hung over wood fires. This changes colour and flavour of foods.

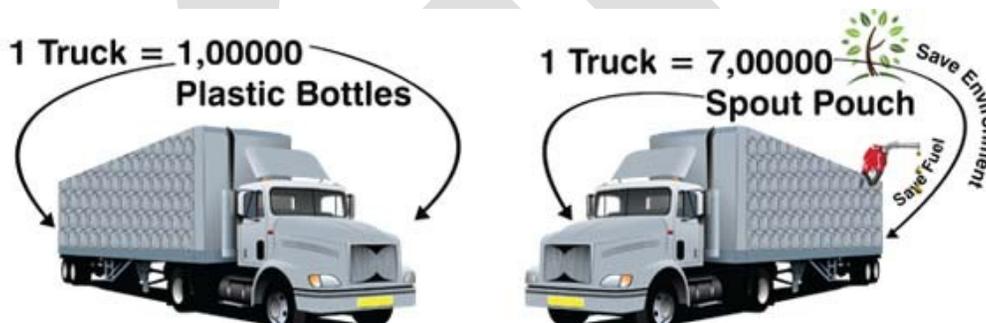
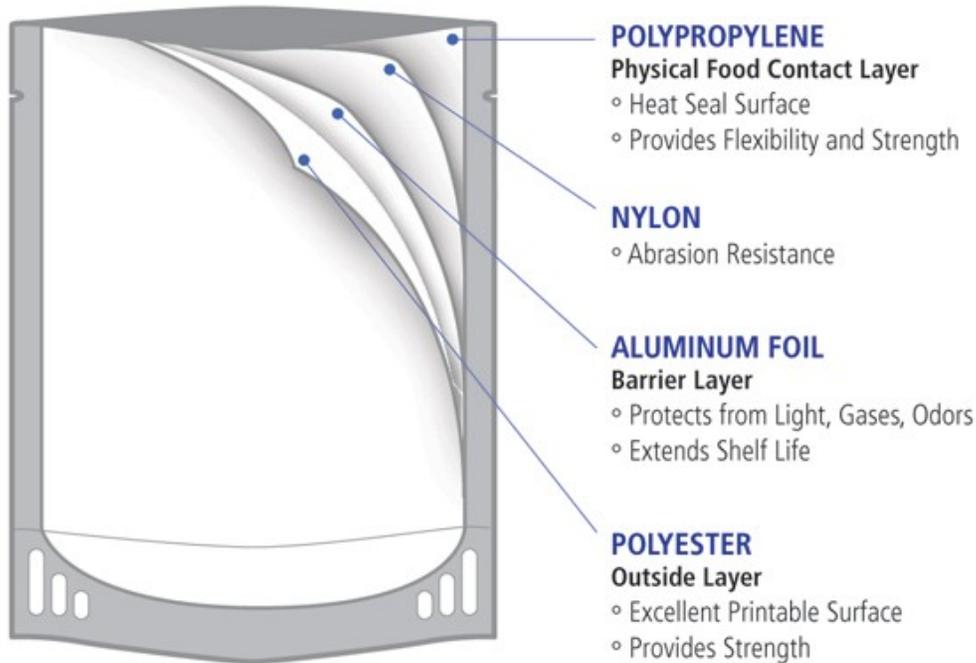
Preservation Method	Description
Sugar Preservatives	When fruit is boiled with sugar the sugar stops the micro-organisms multiplying.
Fermentation	Alcohol or acids are used as preservatives – beer, wine and soy sauce.
Salting	Coating food in salt or placing it in a salt solution reduces the water content and micro-organism growth is retarded.
Bottling/Pickling	Food is packed into glass jars and covered in acidic, alcoholic, salt or sugar solutions.
Spray Drying	A fine spray of liquid is injected into hot chambers. The water evaporates leaving the solid part of the product.
Fluidised Bed Drying	Warm air is blown upwards, directly underneath the food causing it to flow and remain separate.

Preservation Method	Description
Canning	Food is sterilised and placed in air tight containers. The process is: <ul style="list-style-type: none"> -Washing and preparation -Blanching -Filling the cans -Sealing the cans -Heating a retort (large pressure cooker) -Cooling -Labelling
Roller Drying	A liquid or paste form of the food is uniformly spread over rollers or drums which rotate slowly. The water evaporates and the dried product is scraped off.
Sun Drying	Slow and only practical in hot, dry climates.
Immersion Freezing	Refrigerants are directly sprayed onto food.

Preservation Method	Description
Plate Freezing	Food is prepared and packed between flat hollow metal plates that press tightly on the food.
Blast Freezing	Blasting a stream of cold air (-40C) over food.
Fluidised Bed Freezing	The food floats on jets of cold air.
Scraped Heat Exchange	Food is scraped off a cold surface. This method reduces ice-crystal formation producing a smooth end product.
Cryogenic Freezing	Liquid Nitrogen (-196C) or CO2 (-78C) is sprayed onto small food items.
Batch Pasteurisation	The product is held at 62-63C for 30-35 minutes.

3.4 Flexible pouch forming





Production of pouches

Pouches can either be formed from reels of laminated material either on in-line form/fill/seal machines in the packer's plant or they may be obtained as preformed individual pouches sealed on three sides, cut and notched. Forming consists of folding the laminate material in the middle, polyester (or PA) side out, heat sealing the bottom and side seals and cutting to present a completed pouch. Alternatively two webs can be joined, heat seal surfaces face to face, sealed, cut and separated. Hot bar sealing is the most common practice. Notches are made in the side seal at the top or bottom to

facilitate opening by the consumer. Modern pouches have cut rounded corners which reduce the possibility of perforation caused by pouch to pouch contact.

Filling

In-line and premade pouches are filled vertically. Vertical form/fill/seal machines can be used for liquid products. Another method employs a web of pouch material which is formed on a horizontal bed into several adjacent cavities. The cavities are filled whilst the seal areas are shielded. This method is especially useful for filling placeable products. Thereafter the filled cavities are simultaneously sealed from the top using a second web fed from the reel.

The essential requirements for filling are: The pouch should be cleanly presented, positively opened, to the filling station; solids are filled first, followed by the liquid portion, usually at a second station.

Sealing

Sealers incorporate either one of two common satisfactory sealing methods, namely, hot bar and impulse sealing. Both methods create a fused seal whilst the pouch material is clamped between opposing jaws, thereby welding the opposing seal surfaces by applying heat and pressure.

Pouch closure is normally accompanied by some means of air removal, either by steam flushing or by drawing a vacuum in a sealed chamber or simply, in the case of liquid food products, flattening the pouch by squeezing between two vertical plates. Efficient air removal prevents ballooning and rupturing during retorting. Excess air can also adversely affect heat penetration.

A seal area clear of contamination is essential. Irrespective of the method of pouch presentation to the sealing, station grippers engage on each side, stretching the pouch opening and preventing wrinkles. The closure sealing is then carried out. Cooling after the sealing is essential to prevent wrinkling of the seal area.

A retort pouch is a type of food packaging made from a laminate of flexible plastic and metal foils. It allows the sterile packaging of a wide variety of food and drink handled by aseptic processing, and is used as an alternative to traditional industrial canning

methods. which can be eaten cold, warmed by submersing in hot water, or through the use of a flameless ration heater.

A retort pouch is constructed from a flexible metal- plastic laminate that is able to withstand the thermal processing used for sterilization. The food is first prepared, either raw or cooked, and then sealed into the retort pouch. The pouch is then heated to 116-121°C for several minutes under high pressure inside a retort or autoclave machine. The food inside is cooked in a similar way to pressure cooking. This process reliably kills all commonly occurring microorganisms (particularly Clostridium botulinum), preventing it from spoiling.

Material of Package

- ◆ Polyester (PET) – provides a gloss and rigid layer, may be printed inside
- ◆ Nylon (bi-oriented polyamide) – provides puncture resistance
- ◆ Aluminum (Al) – provides a very thin but effective gas barrier
- ◆ Food-grade cast polypropylene (CPP) – used as the sealing layer
- ◆ Polyethylene (PE) – can be used instead of PP as a sealing and bonding layer

Properties and Advantages

- ◆ Low oxygen & moisture permeability.
- ◆ Low hydrophilic properties
- ◆ Heat sealable and sterilisable
- ◆ Resistant to penetration by fats, oils and other food components

- ◆ Physical strength to resist physical abuse during processing
- ◆ Absence of solvent residues.
- ◆ It requires less disposal & storage space.
- ◆ Shelf stable for longer time & requires no refrigeration.
- ◆ Sun light barrier, light weight, easy to open.

AGPC

2 Marks**1. What are the parts of folding carton?**

- Front panel. Side panel, dust flap, glue end, Tuck flap

2. What is grain direction?

It is the direction of the fibre formed during manufacturing process. As a rule, the direction of the grain runs opposite to the major creases on the carton for ease of erection on automatic forming/filling machines

3. What is cutting and creasing?

Cutting is defined as brining the paper to the desired dimensions by cutting the pile of sheets in a cutting machine. Normally.

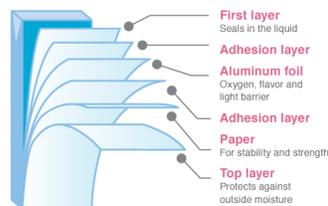
When thick material such as board is folded, its surface become damaged and ragged at the line of folding. In order to avoid such damage, creasing is done before folding operation

4. What is Aseptic packaging?

Aseptic packaging is defined as the filling of a commercially sterile product into a sterile container under aseptic conditions and hermetically sealing the containers so that reinfection is prevented.

5. What do you mean by UHT?

Ultra-high temperature processing (**UHT**), ultra-heat treatment, or ultra-pasteurization is a food processing technology that sterilizes liquid food, chiefly **milk**, by heating it above 135 °C (275 °F) – the temperature required to kill spores in **milk** – for 1 to 2 seconds.

6. What are the layers of Aseptic pack?**7. What are the types of sealing in flexible pouch making?**

- Retort Pouch
- Vacuum Pouch
- Spout
- Stand up
- Valve pouch

8. Why UHT treatment is given?

UHT is a thermal process used to remove dangerous organisms from milk before putting it in the box. The result is milk that's 99.9% free from bacteria. It has a typical unrefrigerated shelf life of six to nine months.

9. What is food packaging?

Food packaging is packaging for food. A package provides protection, tampering resistance, and special physical, chemical, or biological needs. It may bear a nutrition facts label and other information about food being offered for sale.

3 Marks

1. What are the common available distribution channels?
2. Write down the importance of grain direction in folding carton?
3. Differentiate cutting from creasing.
4. What are the available shelf life improving techniques of a package?
5. What are flexible pouches and its types?
6. Differentiate UHT from sterilization process.

10 Marks

1. Explain the factors influence the design of a package.
2. Explain the Structural fundamentals of folding carton?
3. Describe the shelf life improving technique of food packaging.
4. What is Aseptic packaging? and explain its structural layers with neat diagram.
5. How flexible pouches are formed explain its stages with sketch.

UNIT IV

ANCILLARY PACKAGING

4.1 CLOSURES AND DISPENSING DEVICES

Closures:

Closure is stated as, a device that seals the content inside a container, protecting from dust, spilling, or evaporation and from the atmosphere. Principles of closure types are,

1. Screw on
2. Lug caps [or] lug closure
3. Crimp - on (crown)
4. Press - on
5. Miscellaneous closures

Types of material used:

Metal, wood, glass, cloth, rubbers, paper, plastic

Screw on:



Mainly made of steel or plastic, the screw- on closure contains thread which engages with the corresponding thread on the neck of the container. It has a simple mean of operating and closing of the container.

Application:

- Dry, liquid and viscous product, creams or paste are packed in bottles.
- Food and households packed in sale.
- Vacuum packed product.

Lug caps:



The lug caps are closely related to screw caps. They maintain a tight seal. Lug are positioned at the corresponding position on the container neck and forced to a quarter turn to close the container.

It is easy to open and easy to close.

Application:

Suitable for glass container and for high- speed application

Roll- on closures:



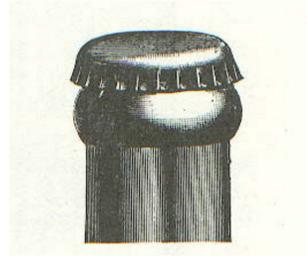
This gives a high integrative seal. It can hold high vacuum or pressure. Unlike screw and lug style, roll -on is supplied as blank shell with out thread made of aluminums]. This is roll against the thread of the container neck under pressure during the closure operation. The container thread tailors the closure thread to a close feed.

Application:

It is used in carbonated beverages and pharmaceutical, inhere high integrative stealing is requires.

Crimp - on closures: [crowns cap]

The closure consists of a simple metal cap with a corrugated skirt or flange and a compressible liner [original cork, now plastics] inside the cap.



The cap is forced against the projection ring in the bottle with considerable pressure.

The corrugated skirt gets locked with the projection ring. The liner inside the cap gives the actual sealing to contents of the bottle. While removing the cap with opener it opens immediately and easily. Application: Mainly used in carbonated beverages -

Press - on -caps:

These are metal lids, which hook to the glass finish by continuous indentations and snap under the projection. These are non-threaded type of closures.

Application:

- Used in jelly and nut containers.
- Pressure on vacuum cap used on food packaging.

Miscellaneous closures:

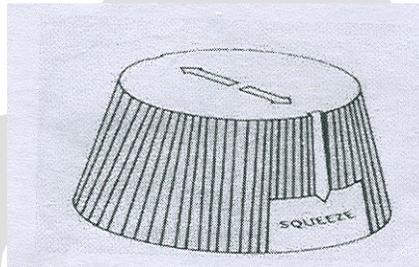
These are made with some variation formed in the principle type closures. They are:

1. Child resistant,
2. Tamper evident closures

1. Child resistance



- **Press - turn caps** are removed when downward force is applied with an unscrewing action.
- **Squeeze Turn caps** have a soft plastic over cap which locks to the inner thread cap or opens, when sidewall pressure is applied



- **Combination lock caps** - These caps are opened by orientating the cap and the container finish in a particular position.
- **Hidden tab caps** - when pressure is applied on the center panel, the tab is exposed. This is the dispensing nozzle is located, through which, we can dispense the

2. Tamper evident closures:

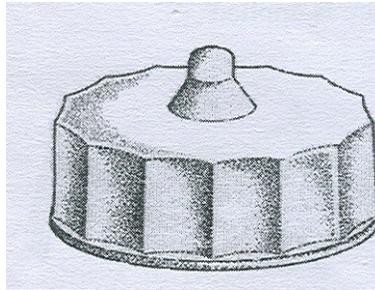


These are security type closures which offer evidence of breached packages. These are refinements of existing closures.

4.2 Dispensing Devices

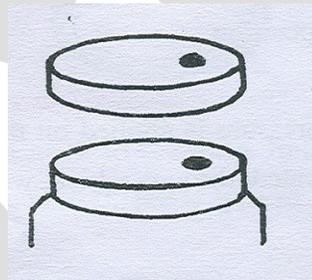
Dispenser is a device, which is attached to the container in order to dispense or take out the required quantity of the content. Common type of dispenser,

Snip-top application:



These are used on prompt, where control over direction of flow is essential. ex: Adhesive, hair die.

Dial disc:



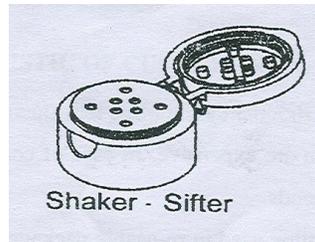
This is hinged dispensing closure. This has a tube to provide a spray of the content, when the bottle is squeezed

Dip tube



This is hinged dispersing closure. This is a tube to provide a spray of the content when the bottle is squeezed.

Ex: Anti septic powder

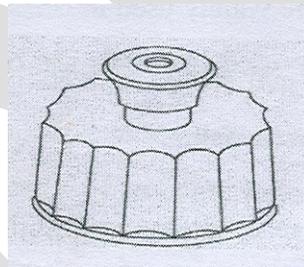
Shaker- sifter:

It has a lid with the hole for dispensing the content and hinged out lay with corresponding studs to close all the holes.

Ex: Talcum powder.

Push -pull type:

This has a lid, which can be pulled out to dispensed the content inside and push into close.



Ex: water bottle for kids

Brush applicator:

Different style and size of brush are attached to the lid of the container to apply the content over the required surface.

Ex: Nail polish, Rubber cement, Gum bottle, etc.

4.2 CUSHIONING MATERIAL:



Goods are frequently transported from one place to another. These goods are sensitive to mechanical stresses. Hence, the goods must be protected from damage due to impact, jolting or vibrations in transit. They are additionally protected by cushioning materials inside the shipping packaging. These cushioning materials absorb a proportion of the kinetic energy arising when the package suffers an impact.

There are four main requirements that cushioning materials must possess.

They are,

- Recovery
- Insensitive to climatic condition
- Corrosion resistance
- Effectiveness

They are three main categories,

- Resilient system
- Non resilient or crushing system
- Space fillers,

Resilient system:

There are two distinct types of resilient systems they are:

- a) Bulk cushioning material. Ex: Rubberized hair**
- b) Cushioning devices. Ex: Rubber & Steel spring**

In general resilient systems are expensive. In case of consumer packaging, they are only used for high value fragile goods.

As it is costly, it is some time used in reusable package. They are mainly used in the package of service stores and equipment.

Non - resilient or crushing system:

Non- resilient or crushing systems are widely used in consumer packaging. It is very cheap. This is not reuse. The most commonly used materials are corrugated fibers board in various form and extended polystyrene.

Space fillers:



The space fillers are used to fill the space around an irregularly shaped article placed in a shaped container. They permit a controlled movement off the product, it is essential to reduce a shock transmitted. Space fillers are used in bulk packaging of glassware and pottery. The space fillers prevent the contact between each other and the wall of the container. space fillers are normally used only Or robust or low value article.

4.3 SEALING TAPE

Sealing Tape:

These are gum adhesive coated, Material in the rolled form. These are used as sealing material. Since it is self- adhesive it needs nothing to stick. Since it is gummed or glued tape, it needs water to moisten it. They are three type of sealing tape,

- Plastic sealing tape

- Fabric sealing tape
- Paper sealing tape

Plastic sealing tape:

- There are three variety of plastic sealing tape they are,
- Regenerated cellulose film
- Cellulose acetate film
- Poly vinyl chloride film (PVC)

Regenerated cellulose film:

Cellulose film is in transparent or in colour form. This type is used for the purpose of - sealing, parceling bundling. This tape is not waterproof but has resistance to oil, grease and many solvents.

Cellulose acetate film:

Cellulose acetate film is suitable for making self adhesive tape. These tape are used for sealing in corrosive or damp conditions.

Polyvinyl chloride film (PVC):

The general grade PVC is unplasticised and has low water vapour permeability. It has excellent mouldability, and it can be pasted or surface. It has hide sue, cab and can withstand deep freeze condition.

Fabric sealing tape:

Bleached carton fabrics are used for making high- strength fabric sealing tape. These tapes are mainly used for sealing metal container, and fiber drum- closures. The low strength adhesive tapes are used as protective and masking tapes.

Paper sealing tape:

Strong Kraft paper is used in making moisture resistance paper tapes. The Kraft paper used is coated on one side with the silicone resin. The silicone provides both moisture resistance and easy unwinding from the role. It has high strength and can be used in deep freeze condition.

4.4 Strapping



Strapping is used to close cartons bundle or bale items unitize pallet loads (or~ brace shipments of goods during transmit. There are four primary types of strapping materials. They are,

- Steels strapping
- Nylon strapping
- Polypropylene strapping
- Polyester strapping

Steel strapping:

Steel strapping is commonly used for unitizing very-heavy loads. Steel strapping is not used for shrinking loads but it has strength to hold highly compressed loads. It is mainly used in unitizing rigid loads.

In general, steel strapping is used where high strength and high retained tension are hired.

It has the highest tensile strength of all the strapping materials.

Nylon strapping:

Nylon strapping has high retained tension capabilities. It is commonly used to unitize shrinking loads of heavy items. It also elongates and recovers more tension than polyester or polypropylene strapping.

Polypropylene strapping:

Polypropylene is generally used for lighter duty unitizing bundling and carton closure. Polypropylene strapping has high elongation and elongation but does not retain tension as well other plastic strapping materials.

Polyester strapping:

Polyester offers the greatest strength and highest retained tension of the plastic strapping materials. It remains tight on rigid loads that require strapping tension throughout handling, strapping and storage. Polyester strapping is commonly used in many applications, where high tensile strength, high retained tension and elongation are required.

2 Marks**1. What are the types of closures?**

- Screw on
- Lug caps [or] lug closure
- Crimp - on (crown)
- Press - on
- Miscellaneous closures

2. What is child resistant closure?

Child-resistant packaging or CR packaging is special [packaging](#) used to reduce the risk of children ingesting dangerous items. This is often accomplished by the use of a special safety cap

3. What is tamper evident closure?

Tampering involves the deliberate altering or adulteration of information, a product, a package, or system. Solutions may involve all phases of product production, distribution, logistics, sale, and use. No single solution can be considered as "tamper proof"

4. What are the dispensing devices?

Dispenser is a device, which is attached to the container in order to dispense or take out the required quantity of the content. Common type of dispenser.

5. What are the types of cushioning material?

- Resilient system
- Non resilient or crushing system
- Space fillers,

6. What are the types of strapping?

- Steels strapping
- Nylon strapping
- Polypropylene strapping

- Polyester strapping

7. What are the types of sealing tapes?

- Plastic sealing tape
- Fabric sealing tape
- Paper sealing tape

8. What is space fillers?

The space fillers are used to fill the space around an irregularly shaped article placed in a shaped container. They permit a controlled movement of the product, it is essential to reduce a shock transmitted

9. What is Non resilient cushioning material?

Non- resilient or crushing systems are widely used in consumer packaging. It is very cheap. This is not reuse. The most commonly used materials are corrugated fibers board in various form and extended polystyrene

10. Write down the advantage of Lug cap closures.

It is easy to open and easy to close, It is easy to open and easy to close

3 Marks

1. Differentiate child resistant from Tamper evident closure.
2. Differentiate closures from dispensing devices.
3. Write down the purpose of cushioning material?
4. What is Nylon strapping?
5. Write short notes on PVC tape.

10 Marks

1. What are the types of closures and explain with neat sketch?
2. What are the types of Dispensing devices and explain with neat sketch?
3. Explain about cushioning material and its types.
4. Write about types strapping and sealing tapes.

UNIT-V**SPECIALTY PACKAGING****5.1 Shrink wrapping:**

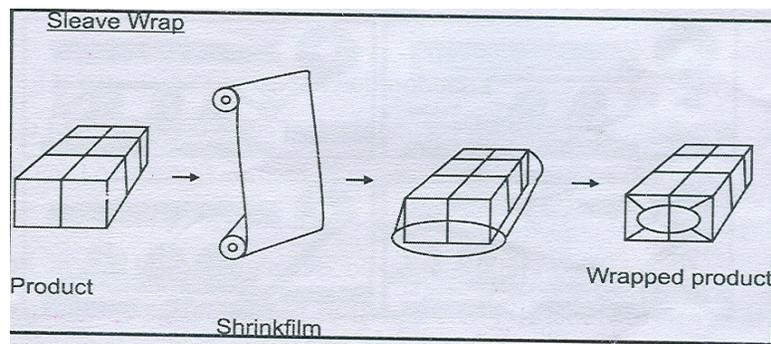
Shrink wrap, also **shrink film**, is a material made up of polymer plastic film. When heat is applied, it shrinks tightly over whatever it is covering. Heat can be applied with a handheld heat gun (electric or gas), or the product and film can pass through a heat tunnel on a conveyor.

The most commonly used shrink wrap is polyolefin. It is available in a variety of thicknesses, clarities, strengths and shrink ratios. Other shrink films include PVC, Polyethylene, Polypropylene, and several other compositions.

Shrink wrap is applied over or around the intended item, often by automated equipment. It is then heated by a heat gun or sent through a shrink tunnel or oven for shrinking.

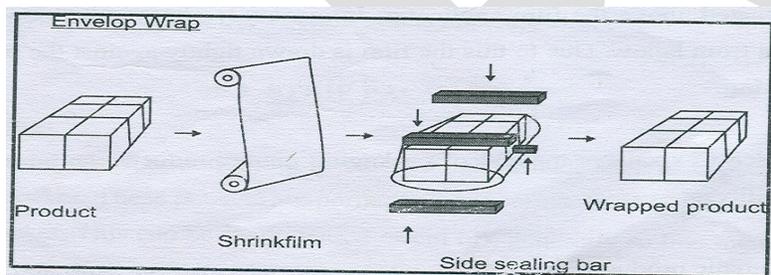


1. Sleeve wrap
2. Envelop wrap



To form a sleeve wrap the pack is pushed against a curtain of film. While passing through the pack draws the film over it. After completely passing the product the heat is applied to shrink the film. Finally the end of the film is sealed by a sealer bar. This is called sleeve wrap. Here both side of the pack are opened and not completely covered.

2. Envelop wrap: envelop Wrap



For additional protection against dust and moisture, this method wraps the entire product by sealing all the sides.

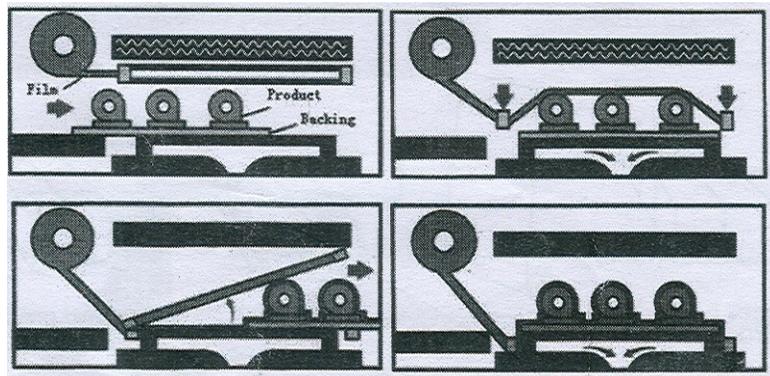
Advantages:

- Increases the perceived value through high gloss finish
- Protective finish
- Cleanliness
- Tamper evidence and tamper resistance

Application:

Software, CD's, Twin Packs, Cosmetic boxes

5.2 Skin packaging



This is a method of packaging by which thin, clear, plastic film is shrunk on the object backed by printed card. In this, item to be packed acts as the mold for its non-plastic cover.

Material Used:

Poly Ethylene & PVC (Poly vinyl chloride)]

This packaging unit contains a heating unit, a roll of polyethylene or poly vinyl chloride and a suction table. The film is preheated before applying on the product. For this a heating UD it situated above the film applicator. Immediately after application of film the inside is sucked Tom below. Due to this the film is drawn tightly against the product forming a skin like packing.

Advantages:

This is least expensive method of packaging many produce be packed together with clear visibility.

Application:

Cosmetic products, Toys

5.3 Blister packaging

This is a method of packaging in which the product will be placed in a performed clear plastic blister and backed by a printed card or sheet.



Material Used

All type of plastic will be used but mosdy PVC is used Explanation: Blister packaging is made up of two vital components

A thermo formed "BLISTER" which houses the product and

A blister card or sheet is printed with adhesive coating on the front.

In a PVC sheet, blister is produced according to the structure of the product. When the product is filled in the blister, then the blister card is attached to the blister by a blister machine. This machine produces heat to flange area of the blister flange area of the blister. Due to the heat the glue in the card adheres to the blister. Hence the blister and the card get secured. The backing or blister card and the product printed on it. But the blisters are clear and the products are visible. The product is tightly secured without eunuch movement of the exact shape of the blister.

5.4 Strip packaging:

This is a method of packaging in which small articles such as capsules or tablets axe packed in on pocket. These pocket we normally in a continuous strip that can be divided into segment or pocket. This can be easily teared or cut of f generally so that the user can take out.

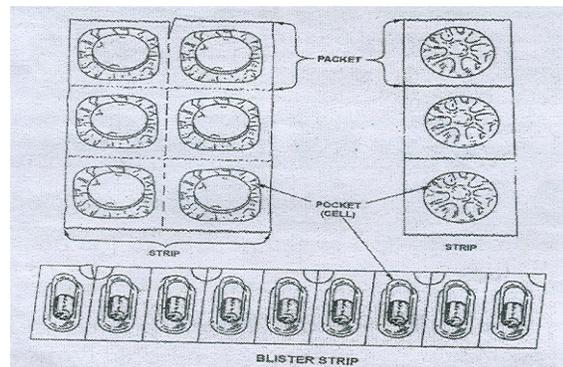
Ex: Hardware, Pads, Cosmetic, Tools, Tablets and capsules.

Material Used:

Metallic foil, Paper.

Explanation:

Strip packaging is normally used in drug packaging, pills or tablets are packed in a film, foil, or heat sealable paper. These are formed as a continuous strip. These strips are finally packed in a folding carton.



The tablet can be easily dispensed by tearing one pocket at a time. This type of packaging enables the dosage easily and achieves control of medicine.

In strip packaging foil is mainly used because this protects the medicine against moisture light, air.

Ex: Drug, Supari.

5.5 Stretch wrapping:

In stretch wrapping a film is wound around the load while the film is stretched. It is the method of unitizing and protecting pallet loads or grouping individual containers by applying stretched layer of plastic film.

The film is mechanically stretched without heating to create a rubber band effect to keep the load unitized. There are two method of stretch wrapping, they are, a) Pass through b) Rotary

a) Pass through:

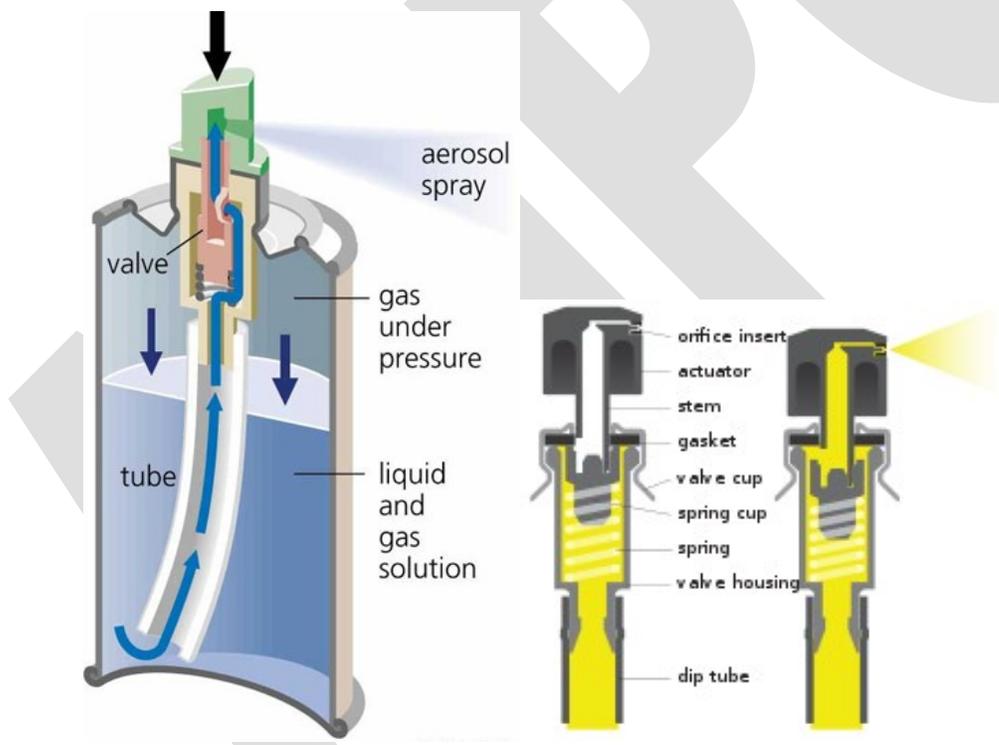
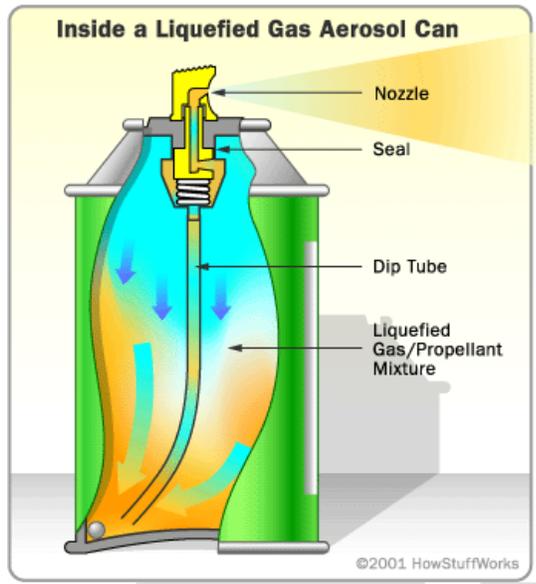
A roll of film is used across a conveyer system. The pallet is kept on a conveyer. The load is passed through a film. The film is wrapped around the load. The sealing bar seals the end of the edge. The height of film used is equal height of load. In this method a single- layer of film is wrapped around of the product.

b) Rotary:

The Load is placed on a plat form.' This is rotatable and mechanically driven. In this method, multi layers of film are wrapped around the product. The thickness of the film used is 0.5 mm to 1.5 mm. The packaging is done by applying the film in the spiral way.

5.4 Aerosol Packaging

An aerosol is a dispenser that holds a substance under pressure and that can release it as a fine spray (usually by means of a propellant gas). This is obtained with a can that contains a liquid under pressure. When the spray valve is opened, the liquid is forced out of a small hole and emerges as an aerosol or mist. It uses compressed gas as a propellant. In the more popular system, the propellant is a **liquefied gas**.



Since the product is liquid at room temperature, it is simply poured in before the can is sealed. The propellant, on the other hand, must be pumped in under high pressure after the can is sealed. When the propellant is kept under high enough pressure, it doesn't

have any room to expand into a gas. It stays in liquid form as long as the pressure is maintained.

Environmental aspects

Chlorofluorocarbons (CFCs) were once often used as propellants, due to the negative effects CFCs have on Earth's ozone layer, volatile hydrocarbon propellants, such as carbon dioxide, propane and butane are used. In general aerosol cans are considered hazardous waste because they contain ignitable or chlorinated solvents or other toxins such as pesticides. Aerosol containers are mostly made of the aforementioned lacquered tinplate steel and are easy to recycle.

Airless technology

There are two main types of airless systems, but the most used is the piston airless system. A piston airless system uses a moulded piston in the bottle, to help push the product out of its package. Airless systems by design create a vacuum. The piston helps maintain that vacuum.



Recently the pouch airless system is getting popular, capturing a significant percentage of the airless market. A pouch system is made of a rigid bottle containing a soft pouch with an airless pump. When the product is expelled, the pouch shrinks so that there is no air intake inside the pouch.

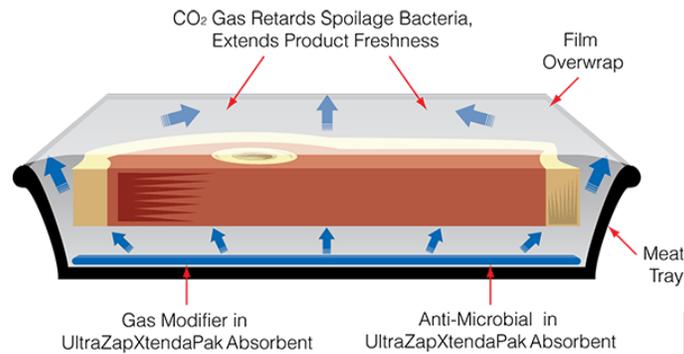
Benefits of Aerosol Packaging Containers:

The benefits of aerosol packaging are fairly obvious:

- Precise amounts of product to an exact area, eliminating waste
- Spill-proof
- Hermetically sealed, meaning no air gets in and no air gets out, like a vacuum
- One step - no mixing
- Push-button – continuous spray with just the touch of a button, no repeat pumping required
- Enabling technology - some products would not be possible without aerosol technology such as shaving cream, insecticides and asthma inhalers
- Extra hand - delivery to hard-to-reach areas, nooks and crannies

MODIFIED ATMOSPHERE PACKAGING

The shelf life of perishable foods as meat, poultry, fish, fruits and vegetables and bakery products is limited in the presence of normal air by two principal factors the chemical effect of atmospheric oxygen and the growth of aerobic spoilage micro organisms. These factors either individually or in association with one another bring about changes in odour, flavour, colour and texture leading to an overall deterioration in quality. Chilled storage will slow down these undesirable changes but will not necessarily extend the shelf life sufficiently for retail distribution and display purposes.



The modified atmosphere concept for packaged goods consists of modifying the atmosphere surrounding a food product by vacuum, gas flushing or controlled permeability of the pack thus controlling the biochemical, enzymatic and microbial actions so as to avoid or decrease the main degradations that might occur. This allows the preservation of the fresh state of the food product without the temperature or chemical treatments used by competitive preservation techniques, such as canning, freezing, dehydration and other processes.

MAP is the replacement of air in a pack with a single gas or mixture of gases; the proportion of each component is fixed when the mixture is introduced. The normal composition of air is 21% oxygen, 78% nitrogen and less than 0.1% carbon dioxide. Modification of the atmosphere within the package by reducing the oxygen content while increasing the levels of carbon dioxide and/or nitrogen has been shown to significantly extend the shelflife of perishable foods at chill temperatures

Technology

MAPAX gas mixtures usually consist of the normal atmospheric gases such as carbon dioxide (CO₂), nitrogen (N₂) and oxygen (O₂). Microbial growth can also be inhibited to a certain extent with the help of other gases such as nitrous oxide (N₂O), argon (Ar) and hydrogen (H₂). These gases can be applied individually or mixed according to specific ratios.

Although the oxygen level should be as low as possible in most food packages, meat is an exception. Here oxygen helps to preserve the oxygenated form of

myoglobin, which gives meat its red color. It is also valuable for fruit and vegetables as it lets them breathe.

Advantages of MAP:

- a) Increased shelf life allowing less frequent loading of retail display shelves;
- b) Reduction in retail waste
- c) Improved presentation - clear view of product and all round visibility;
- d) Hygienic stackable pack, sealed and free from product drip and odour;
- e) Easy separation of sliced products;
- f) Little or no need for chemical preservatives;
- g) Increased distribution area and reduced transport costs due to less frequent deliveries
- h) Centralised packaging and portion control
- i) Reduction in production and storage costs due to better utilisation of labour, space and equipment

Symbols used in packaging

The symbols that are used on cardboard boxes are called "Shipping Mark Guide". These symbols are used to provide the directions about handling the package. Each symbol have it's own meaning.



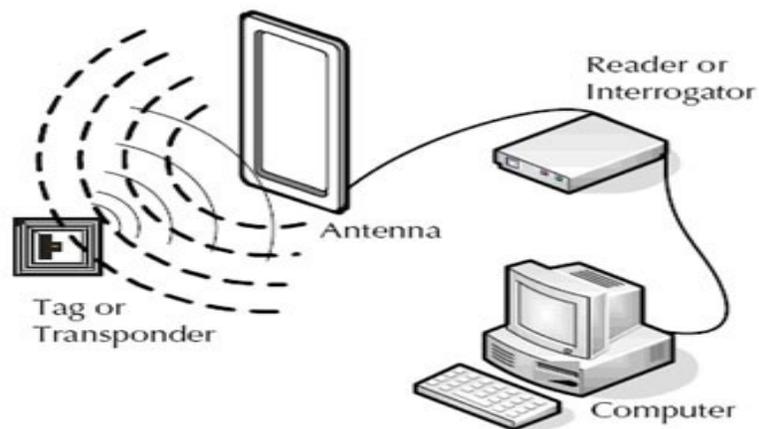


INTERNATIONAL PACKING SYMBOLS		
FRAGILE HANDLE WITH CARE	THIS WAY UP	USE NO HOOKS
PROTECT FROM HEAT	DO NOT STACK	HEAVY DO NOT LIFT
STACK LIMITATION IN UNITS 3	KEEP DRY	SLING HERE
CENTRE OF GRAVITY	DO NOT ROLL	STACKING LIMITATION (WEIGHT)
TEMPERATURE LIMITATIONS °C min / °C max	CLAMP HERE	NO HAND TRUCKS
OTHER COMMONLY SEEN SIGNS		
DANGER	HIGHLY FLAMMABLE	RADIATION RISK
		STATIC SENSITIVE DEVICE
IF PACKING IS RE-USED DELETE ALL OLD MARKINGS		

1	PET POLYETHYLENE TEREPHTHALATE Usually clear or green, sinks in water, rigid. Barrier to gas and moisture.	
2	HDPE HIGH DENSITY POLYETHYLENE Semi rigid, sinks in water. Resistance to moisture, permeability to gas	
3	PVC POLYVINYL CHLORIDE Semi rigid, glossy, sinks in water.	
4	LDPE LOW DENSITY POLYETHYLENE Flexible, not crinkly. Ease of processing. Ease of sealing, barrier to moisture.	
5	PP POLYPROPYLENE Semi rigid, low gloss, resistance to heat, chemicals, greese and oil, versatile barrier to moisture	
6	PS POLYSTYRENE Often brittle, glossy, easily formed,	
7	0 OTHER often Polycarbonate, acrylic, ABS, mixed / multi layer plastic	

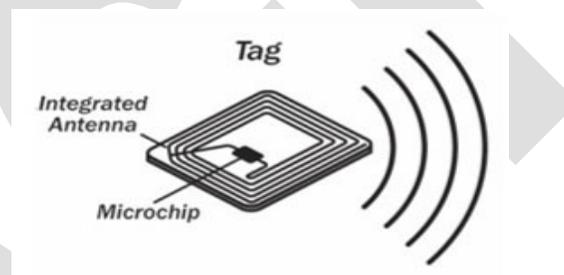
RFID

RFID stands for Radio-Frequency Identification. It consists of a small chip and an antenna. It uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information.



Passive tags - collect energy from a nearby RFID reader's interrogating radio waves.

Active tags - have a local power source such as a battery and may operate at hundreds of meters from the RFID reader. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object



How It Works

With a passive system the reader is scanning each antenna attached to it so that once a tag enters the field of one of the antenna it is first powered up. Once fully powered, the tag "backscatters" its information which the antenna can then pick up.

In the cases where the tag is powered and read properly, the data on the tag is processed by the reader and sent onto your host PC. On your host you would be running some type of software to then put the read tag information to use.

Advantage

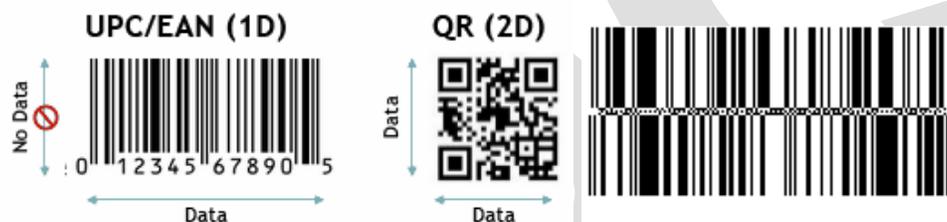
A significant advantage of RFID devices over the others mentioned above is that the RFID device does not need to be positioned precisely relative to the scanner. For

example, you could just put all of your groceries or purchases in a bag, and set the bag on the scanner. It would be able to query all of the RFID devices and total your purchase immediately.

Bar Code

Types of bar codes:

1. Linear bar codes
2. Stacked bar codes
3. 2-D bar codes



Linear bar/1D codes:

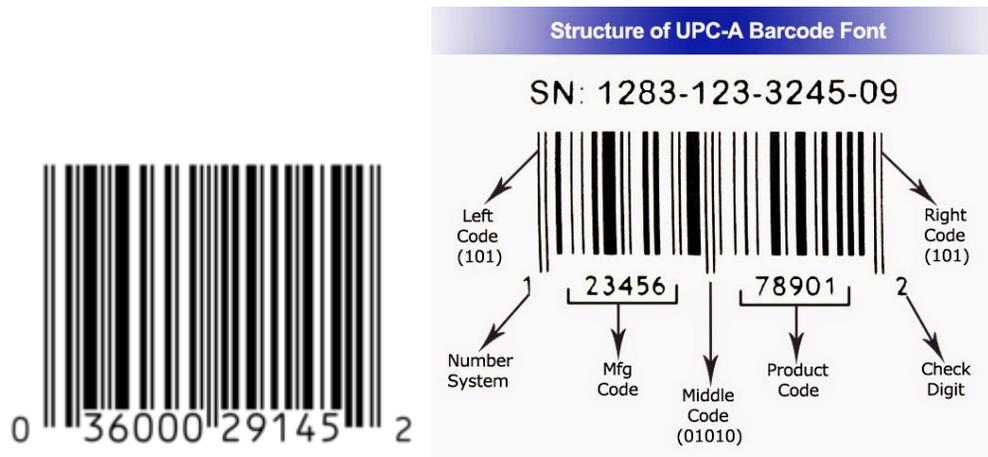
The linear bar code represents a limited group of characters. Linear bar codes identify items and provide document control information for individual item and shipments.

1. Stack bar codes:

Stack bar codes are nothing but linear bar codes stacked on each other. They give options for codes that store a lot more data in two dimensions.

2. 2- D bar codes:

A two dimension bar code stores information along the height as well as the length of the symbol. A 2- D bar code has a greater capacity than a linear bar code.



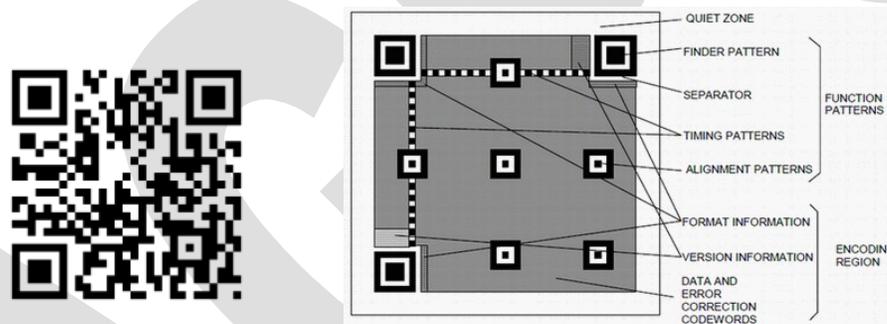
AGPC

A barcode is an optical, ***machine-readable***, representation of data; the data usually describes something about the object that carries the barcode. Originally barcodes systematically represented data by varying the widths and spacings of parallel lines, and may be referred to as linear or one-dimensional (1D).

Types of barcodes

- Numeric-only barcodes – Codabar, Ean, MSI,UPC
- Alpha-numeric barcode- Code 39,93,128, LOGMARS
- 2-Dimensional barcodes – QR Code, Data Matrix, PDF417

QR Code



A QR code (**Quick Response Code**) consists of black squares arranged in a square grid on a white background, which can be read by an imaging device such as a camera, and processed until the image can be appropriately interpreted. The required data is then extracted from patterns that are present in both horizontal and vertical components of the image.

The QR code system became popular due to its fast readability and greater storage capacity compared to standard UPC barcodes. Applications include product tracking, item identification, time tracking, document management, and general marketing.

Typically, a smartphone is used as a QR code scanner, since it provides a way to access a brand's website more quickly than by manually entering a URL.

Application of RFID/Barcode

1. Logistics & Supply Chain Visibility
2. *Item level inventory tracking*
3. *Race timing*
4. *Attendee Tracking*
5. *Materials Management*
6. *Access Control*
7. *Library Systems*
8. *Real Time Location System*

2 Marks**1. What is Shrink wrapping?**

Shrink wrap, also shrink film, is a material made up of polymer plastic film. When heat is applied, it shrinks tightly over whatever it is covering.

2. What is Skin packaging?

This is a method of packaging by which thin, clear, plastic film is shrunk on the object backed by printed card. In this, item to be packed acts as the mold for its non-plastic cover.

3. What is Strip packaging?

This is a method of packaging in which small articles such as capsules or tablets are packed in one pocket. These pockets are normally in a continuous strip that can be divided into segments or pockets.

4. What is Blister packaging?

This is a method of packaging in which the product will be placed in a preformed clear plastic blister and backed by a printed card or sheet.

5. What is RFID?

RFID stands for Radio-Frequency Identification. It consists of a small chip and an antenna. It uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information.

6. What is QR code?

A QR code (**Quick Response Code**) consists of black squares arranged in a square grid on a white background, which can be read by an imaging device such as a camera, and processed until the image can be appropriately interpreted.

7. What is stretch wrapping?

In stretch wrapping a film is wound around the load while the film is stretched. It is the method of unitizing and protecting pallet loads or grouping individual containers by applying a stretched layer of plastic film.

8. What is Aerosol packaging?

An aerosol is a dispenser that holds a substance under pressure and that can release it as a fine spray (usually by means of a propellant gas). This is obtained with a can that contains a liquid under pressure.

9. What is Modified Atmospheric Packaging?

The modified atmosphere concept for packaged goods consists of modifying the atmosphere surrounding a food product by vacuum, gas flushing or controlled permeability of the pack thus controlling the biochemical, enzymatic and microbial actions so as to avoid or decrease the main degradations that might occur

10. What is Barcode?

A barcode is an optical, machine-readable, representation of data; the data usually describes something about the object that carries the barcode. Originally barcodes systematically represented data by varying the widths and spacings of parallel lines

11. Why symbols are used in folding carton?

The symbols that are used on cardboard boxes are called "Shipping Mark Guide". These symbols are used to provide the directions about handling the package. Each symbol have it's own meaning.

3 Marks

1. Differentiate sleeve wrap from envelop shrink wrapping?
2. What are the applications of barcode in Packaging?
3. Write down the advantage of QR code over conventional barcode.
4. Write down the application of RFID in packaging?
5. Write down the application of Modified Atmospheric packaging.
6. What are the applications of Aerosol packaging?

10 Marks

1. Explain the shrink wrapping and its method with neat sketch.
2. Explain all about skin packaging with neat sketch.
3. Explain about strip and blister packaging with its application.
4. Explain about the role of Modified Atmospheric packaging
5. Write all about the aerosol packaging and its application in packaging.

AGPC

