
UNIT 13 TESTING OF PACKAGING MATERIALS

Structure

13.0 Objectives

13.1 Introduction

13.2 Sampling Plan

13.3 Conditioning of Test Specimen

13.4 Types of Tests of Packaging Materials

13.5 Testing of Flexible Packaging Materials

1 Paper and Paper Board
Significances and tests of Important Parameters

1 Plastics Films and Laminates
Significances and tests of Important Parameters

1 Aluminum Foil
Significances and Tests of Important Parameters

13.6 Testing of Rigid Packaging Materials

1 Glass Containers
Significances and Tests of Important Parameters

1 Metal Containers
Significances and Tests of Important Parameters

1 Plastic Containers
Significances and Tests of Important Parameters

1 Corrugated Fibre Board Boxes.
Significances and Tests of Important Parameters

13.7 Testing of Semi rigid Packaging materials

1 Folding Carton
Significances and Tests of Important Parameters

1 Lined Carton
Significances and Tests of Important Parameters

1 Aseptic Cartons
Significances and Tests of Important Parameters

1 Thermoformed Containers
Significances and Tests of Important Parameters

13.8 Let us Sum-Up

13.9 Key Words

13.10 Some Useful Books

13.11 Answers to Check Your Progress

13.0 OBJECTIVES

By reading this unit, we will be able to do :

- 1 the sampling plan of packaging materials for testing;
- 1 explain the requirement of conditioning for test specimens;
- 1 explain significances of important parameters for testing;
- 1 describe testing methods for different packaging materials; and
- 1 discuss about the relevant standards used for the testing purpose.

13.1 INTRODUCTION

Over the years, the packaging technology has been grown in multidimensional ways. The overall growth and development has been witnessed by the innovations like waste materials used as resources of packaging raw materials, innovations in conversion technologies and also in the packaging machinery sector. But the recent era of ISO 9000 and ISO 14000 has compelled the society to understand the term ‘quality’ with greater prospects.

In the same line, testing of packaging materials have got greater importance in order to check the existing quality and also to make the judgement about short comings. This helps to take appropriate measures for the improvement of quality.

13.2 SAMPLING PLAN

A sampling plan is required to draw the samples for testing from a large size of lot or batch. A batch is a set of particular type of packaging materials which can be regarded as homogeneous. A set of samples in the total number of individual samples taken from a batch of packaging materials e.g. paper, paperboard, Corrugated Fibre board Box, roll of plastic films or laminates. And a specimen is a piece of particular type of packaging materials from an individual sample.

13.3 CONDITIONING OF TEST SPECIMENS

The packaging materials like paper and allied products are hygroscopic in nature. Due to this fact, these materials absorb moisture and their properties change with humidity. In order to ensure repeatability and reproducibility to avoid misunderstanding amongst all concerned, a standard test atmosphere has been established. The process of exposing the test specimen to a standard condition is known as “conditioning of test specimens”. As per Indian Standards IS : 1060 (Part – I) 1966, a standard atmospheric conditions of $27^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and $65\% \pm 2\%$ relative humidity is maintained to expose the samples for to 24 hours prior to conduct the tests.

13.4 TYPES OF TESTS OF PACKAGING MATERIALS

The different types of packaging materials are tested in the laboratory to assess the different properties which are given below :

(a) Physical Properties, (b) Chemical Properties & (c) Mechanical Properties.

The samples are assessed by conducting two types of tests in the laboratory i.e. qualitative tests and performance tests.

The qualitative tests are conducted to assess the quality of packaging materials in terms of physical, chemical and mechanical properties whereas performance tests are mainly conducted to simulate the field conditions during handling, storage and transportation.

13.5 TESTING OF PACKAGING MATERIALS

13.5.1 Paper and Paper Board

The types of test for paper and paper boards are almost same. But there are certain test like stiffness which is conducted for paper board only.

Significance and Tests of Important Parameters

(a) Grammage

Significance : It specifies the mass of a unit area of a sheet of paper or paper board and it is expressed in gms per square meter.

Test Method : The test method is described in Indian Standard 1060-Part-I (1987). Cut the test specimen of size 10cm x 10cm and then take the weight in weighing balance. At least, ten readings are taken and then take the average value and expressed in gms/square meter .

(b) Moisture Content

Significance : It is necessary to understand the presence of moisture content in paper which affect the other properties of paper such as printing, absorbency etc.

Test Method : This test method is described in Indian Standard IS : 1060-Part-I (1987).

(c) Thickness

Significance : This test is important to measure the thickness of an individual sheet which affect the total thickness of board used in packaging.

Test Method : In the laboratory, the single sheet as test specimen is measured at several points by means of a micro meter and an average value is calculated.

(d) Bursting Strength

Significance : This test is performed to determine the resistance of a paper against to rupture in use.

Test Method : The apparatus generally used “the Jumbo Muller Tester” is either motor driven or hand driven. The testing is done by means of hydraulic pressure communicated through the medium of glycerin or by compressed air to a pure gum rubber diaphragm in contact with the paper. The test values are expressed in kg/cm² or pound/sq inch or kilo pascals.

(e) Water Absorption Test

Significance : This gives an indication of resistance to water absorption (normally referred as cobb value). In this, the quantity of water absorbed by a specified area of paper surface when in direct contact with water over a period of time is measured.

Test Method : The details are given in IS : 4006 – Part – I, 1987.

(f) Breaking Length

Significance : It signifies that when a paper roll is hanged and allowed to fall, then the extent of the length of paper at which the paper breaks on its own weight is measured in meter, and that is expressed as breaking length.

Test Method : The breaking length is measured by the following formula :

$$\text{Breaking Length (meter)} = \frac{\text{Tensile Strength}}{\text{Grammage}} \times 1000$$

(g) Stiffness to Bend

Significance : The test signifies the rigidity of the test sample. Normally, the test is carried out for paper board.

Test Method : One end of the test specimen is clamped on jaws and then allow to bent at 15 degree angle. Measure the force required to bent the sample without cracking, measures the resistance against bending. Stiffness is expressed in either kenley or Taber or mN.

(h) Tear Resistance

Significance : The resistance against tearing of paper is measured.

Test Method : The specimens are clamped on the jaws of Elmendorf Tear Tester. 25% of the specimen is cut by means of a knife inbuilt in the tear testing equipment. Then, the pendulum is released to tear the balance 75% of the test specimen. The force required to tear the paper is measured from the recording scale. The tear resistance is expressed as gms force.

13.5.2 Plastic Films and Laminates

Significances and Tests of Important Parameters

(a) Caliper or Thickness

Significance : To measure the thickness of the film in millimeter or micrometer or micron.

Test Method : The centre portion of the test specimen is placed in between the flat jaws of micrometer to check the uniformity of thickness. (Reference IS: 1060 (Part –I) – 1966.

(b) Density

Significance : To check the specific gravity or density or the ratio of mass upon volume.

Test Method :

The detail test method is described in IS : 2508 - 1987.

(c) Tensile Strength and Elongation at Break

Significance : To measure the force require to break the test specimen while the samples are kept under tension in between the jaws of tensile machine.

Test Method : Two ends of the test specimen are clamped in the machine at the grips separated by 50mm. Start the machine at the pre adjusted speed of 500 mm/min and note the load and elongation at break. Tensile strength is expressed as kg/cm² or Mn/m² and elongation at break are expressed as percentage.

(d) Dart Impact Resistance

Significance : To measure the impact resistance of the plastic film by measuring the load or dart at which 50 percent of the specimen fail when tested by this method.

Test Method : The details are described in IS : 2508 – 1987.

(e) Co-Efficient of Friction or Slip

Significance : It is the ratio of the frictional resistance to the normal pressure acting on two surfaces in contact.

Test Method : A sled of 120 mm square is allowed to move over the plastic film and record the frictional force acting at the contact surface. The value is expressed in Newton. Calculate the dynamic coefficient of friction using the mean load represented by the straight line.

(f) Determination of Gloss

Significance : To measure the percentage of reflectance of light at a particular angle where the angle of incident light and the angle of reflectant light will be the same. This is an optical property of plastic film.

Test Method : The gloss meter is set up to 45⁰. Take reading with plastic film by replacing the standard used for calibrating the instruments. Repeat the test for five times with different specimens. It is expressed as specular gloss at 45⁰.

(g) Determination of Haze

Significance : The haze of the specimen is the percentage of transmitted light which is passing through the specimen deviates from the incident beam by forward scattering. This is also an optical property of the film.

Test Method : Illuminate the specimen by unidirectional beam making an angle with the direction of its axis not exceeding 3°. Determine the reading with haze meter and then expressed in percentage.

(h) Peel Bond Strength for Flexible Laminate

Significance : To measure the tackiness between the two substrate of the laminate in terms of force.

Test Method : The two ends of the test specimen where one end clamped at the jaws of Tensile machine by keeping the gauge length of 50 mm. Run the test at the speed of 300 mm/min and record the force in gm/15 mm width and then calculate the average from the graph. (Ref. ASTM F-88)

13.5.3 Aluminium Foils

Significance and Tests of Important Parameters

(a) Thickness or Caliper

Significance : To measure the thickness of the aluminum foil or web.

Test Method : Properly calibrated dead weight micrometer is used to measure thickness.

(b) Pin Hole Test

Significance : To ascertain the number of pinhole exists in the aluminum foil.

Test Method : The aluminum foil is checked by means of an illumination equipment where a tungsten lamp is positioned in a cylindrical structure and all the surroundings are covered with black paper. The test specimens are placed at the top end of the cylinder and then observed the pinholes against the light.

Check Your Progress - 1

1. What is the significance of conditioning?
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2. Indicate the ideal condition followed in the laboratory for conditioning of samples?
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3. What are important tests relevant to paper and paper board?
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4. What are the important properties involved to plastic film and laminates?

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5) How many types of co-efficient of friction is determined for plastic film?

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6) Indicate the units of bursting strength and stiffness?

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7. How do you express the test values of tensile strength for paper and plastic films?

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13.6 TESTING OF RIGID PACKAGING MATERIALS

13.6.1 Glass Containers

The Important Parameters of Testing are :

(a) Visual Defects

Significance: This is required to check the quality of glass container physically.

Test Method: The critical and major defects to be examined are :

i) **Critical Defects** : Cracked or broken glass, choked bore, internal fins, flanged finish, over press, split finish, channeled and wrapped sealing surface, shifted finish and rocker bottom.

ii) **Major Defects** : Stones, seeds, cords, blisters, oil marks, bad distribution, deformation etc.

(b) Inspection of Colour

Significance: To cross check the colour of the bottle as per requirement.

Test Method: The selected colour glass bottle is examined by comparing with an approved sample in terms of colour shade.

(c) Dimensions

Significance: The dimensions of glass container is highly critical as the dimensions of containers directly affect the automatic filling operation, labelling operation, capping, sealing and thus cause hindrance to marketing.

Test Method: The measurement of dimensions are done by means of 'Go', 'No-Go' gauge. A number of dimensions are examined for glass containers.

(d) Overall Height

For checking any one type of bottle a 'Go' 'No-Go' gauge may also be adequate.

i) Leading Horizontal Dimensions

A 'Go' and 'No-Go' gauge are generally satisfactory for checking body dimensions.

ii) Verticality:

The verticality of bottles can be measured as deviations, with a suitable set up consisting of a vertical shaft, a 'V' block and dial gauge. The details of this test are prescribed in IS: 2091 – 1983

iii) Ovality

The ovality is determined by measuring the maximum and the minimum leading horizontal dimension along the circumferences using a vertical caliper.

iv) Finish Dimensions

The term 'Finish' refer to that part of the glass container which takes on the closure. The dimensions are examined with the help of 'Go' and 'No-Go' gauge.

e) Capacity Measurement

Significance: The capacity of the bottle is defined either as the brimful capacity or capacity upto a filling height agreed upon.

Test Method: The glass bottle is filled with water and then the actual quantity is measure by measuring cylinder and thus, the capacity of bottle is expressed as cubic centimeter or C.C. (Ref : IS: 10497 : Method of test for the determination of brimful capacity of glass container by gravimetric method)

(f) Mechanical Impact Strength

Significance: This test is useful to the extent of defecting gross manufacturing defects in respect to mechanical strength of glass bottle.

Test Method: The normal test is to use a pendulum consisting of a hardened steel ball as a striker. This method is called as pendulum method to determine the mechanical impact strength.

(g) Annealing

Significance: To determine the interface of colour of glass containers which might happen during gradual cooling process.

Test Method: The specimen sample is subjected to a polariscope and then viewed the glass containers through the polarised light to determine any sign of stained glass due to interface of colour.

(h) Thermal Shock Test

Significance: The main objective of this test is to determine the resistance of thermal shock of glass containers.

Test Method: The test specimen of glass containers are subjected to sudden temperature difference by means of filling hot water followed by cold water. And then, the observations are taken for any breakage or crackness on the glass containers.

(i) Hydrostatic Pressure Test

Significance: To determine the resistance of glass containers against withstanding of pressurized liquid.

Test Method: This particular test is performed by means of a hydrostatic pressure test equipment. The details are described in IS :10516 : Methods of test for internal pressure resistance for glass containers).

(j) Impact Testing

Significance: To determine the rigidity or impact strength of glass containers.

Test Method: This test will signify about the impact strength or resistance against breakage due to sudden load on the containers.

(k) Pendulum Test

Significance : To check the vertical impact strength of glass containers.

Test Method : This particular test is conducted in a testing equipment where the glass container is placed in vertical position and then a steel ball is allowed to swing and strike the bottle. Subsequently, the glass containers are checked for any kind of breakage or crackness due to impact.

(l) Chemical Test

Significance : To identify the composition of glass materials.

Test Method : The glass container are broken into pieces and then glass pieces are analysed in the laboratory by means of sedimentation process to identify the composition of glass materials.

13.6.2 Metal Containers

The important parameters for the testing of metal containers are as follows :

Visual Inspection

Significance : To inspect visually about the printing aspect and other manufacturing defects to assess the quality of packaging materials.

Test Method : The test specimens are selected by following the standard sampling method and then samples are inspected visually for different important parameters like manufacturing defects, printing defects, any spots cuts, proper joints etc. of the containers.

(a) Dimensions

Significance : To check the dimensions of the metal containers in order to comply with the standard sample (Ref IS : 1060 – PART 1, 1985)

(i) **Container Height :** The height of containers is very important as affects the automatic filling line. The dimensions are measured either by using seale or digital gauge.

(ii) **Overseam Diameter :** The dimensions are checked by means of particular dial gauge and expressed in millimeter.

(iii) **Capacity**

Significance : To determine the actual capacity of container so that there should be any hindrance in the automatic filling operations.

Test Method : The particular metal container is taken and filled with water upto the brimful capacity. The containers is then emptied where water is measured in the measuring cylinder and thus, the capacity of metal containers is calculated.

(b) Tin Coating Thickness

Significance : To check the thickness of tin coating (internal) as well as (external) of the tin plate.

Test Method :

The tin coating is measured either by using chemical solvant (CLEARK'S solution) or by elcometer.

(c) Hydraulic Pressure Test

Significance : To check the extent of withstanding capacity of the metal container when exposed to hydraulic pressure.

Test Method : The filled metal containers are subjected to hydraulic pressure test equipment and then held for 5 minutes to observe any leakage of the containers.

(d) Air Pressure Test

Significance : To determine the leakage of metal container.

Test Methods : The empty metal containers are filled with air and then dipped in water tank to observe any appearance of air bubble and to identify the leakage.

(e) Product Compatibility

Significance : To check the compatibility of the product with the internal contact surface of metal containers.

Test Method : The metal container is filled with skimmed milk powder and exposed to accelerated conditions i.e. $38^{\circ}\text{C} \pm 1^{\circ}\text{C}$ & $90\% \pm 2\%$ R.H. for minimum period of 90 days. The exposed samples are also withdrawn at an interval of 7 days and the products are analysed for all the parameters.

13.6.3 Plastic Containers

Significances and Test of Important Parameters :

The details of important tests are discussed below :

(a) Identification of Plastics

Significance : To determine the type of polymeric material used for the manufacturing of blow moulded plastic containers.

Test Method : The samples are subjected to burning test to get smell, appearance of smoke etc to identify the polymer. Subsequently, the density of polymeric materials could be identified.

(b) Wall Thickness

Significance : This is important to check the uniformity of thickness of containers.

Test Method : The thickness is measured by slide caliper or any other dial gauge micrometer and it is expressed as millimeter or micron.

(c) Dimensions

Significance : To check the dimensions of plastic containers.

Test Method : All the dimensions like neck diameter, body diameter, height, thread dimensions, etc are determined by means of dial gauge micrometers.

(d) Capacity

Significance : To check the brimful capacity of containers.

Test Method : The plastic container could be filled with water and the capacity of water is measured by gravimetric method.

(e) Environmental Stress Crack Resistance

Significance : To determine the resistance to crack of plastic container against environment.

Test Method : The test is conducted in the laboratory by following the method prescribed in IS : 8747 (Environmental stress crack resistance of blow moulded plastic container).

(f) Extrability Test

Significance : To check whether the polymeric materials are of food grade or not.

Test Method : This test is conducted in the laboratory by following the test methods as prescribed in IS : 9845 (Extractability studies on plastics).

13.6.4 Corrugated Fibre Board Boxes

Significances and Test of Important Parameters :

i) Kraft Liner, Fluting Media

The following tests are performed on liner and fluting medium.

(a) Grammage

Significance : Grammage is a measure of the weight of paper or paper board expressed in gms per square meter. It is also called as substance. Its unit is gms/sq mt and popularly known as gsm.

Test Method : TAPPI T 410 or IS : 1060 (Part – I) 1987 are the reference for test method. Minimum 10 numbers of specimen of size 10 cm X 10 cm are cut, weighed and calculate the gsm by dividing the area.

(b) Caliper of Thickness

Significance : Caliper is the measure of the thickness of a sheet of paper. Its units is mm or microns.

Test Method : The reference of test methods are TAPPI T-441 or IS: 1060-Part-I-1966. Thickness of test specimens are measured by using a calibrated micrometer.

(c) Water Absorptiveness of Nonbibulous Paper and

Paperboard (COBB Test)

Significance : Water absorbency is a characteristic pertaining to the sheets ability to resist water penetration and absorption.

The details about test methods are prescribed in TAPPI T 441 and IS : 1060 Part – I – 1966. The test specimens are clamped, poured 100 ml. of water. Allowed to absorb water for 60 seconds. The water is removed after 45 seconds prior to 30 minutes, the additional water, is wiped and weighed. The difference in weight divided by sample area gives the value in gm/ml.

(d) Bursting Strength

Significance : To measure the force required to rupture the board when pressure is applied from one side.

Test Method : The sample is subjected to mullen bursting testing equipment and the force require to burst the paper is measured The test values are expressed as kg/cm² or pound/sq inch or kilopaseals.

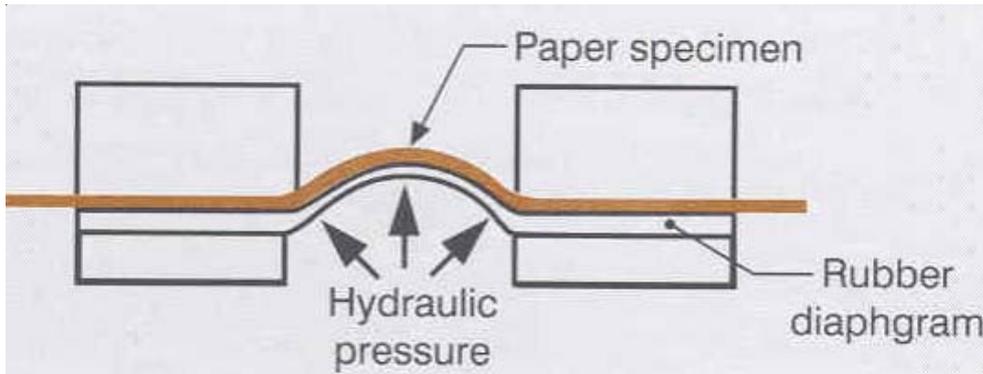


Fig. 13.1

(e) Burst Factor

Significance : The mathematical expression is as follows :

$$\text{Burst Factor (BF)} = \frac{\text{Bursting Strength (BS)}}{\text{Grammage (gsm)}} \times 1000$$

(f) Ring Crush Test (RCT)

Significance : The RCT of papers is defined as the maximum vertically applied compressive force on the rim of a circular ring of the paper without the paper buckling. Expressed in KN.

Test Method : RCT its measured according to TAPPI T822. In RCT. The test specimen is formed in ring, inserted into the holder as shown below. A top down load is applied on the strip of paper till it buckles.

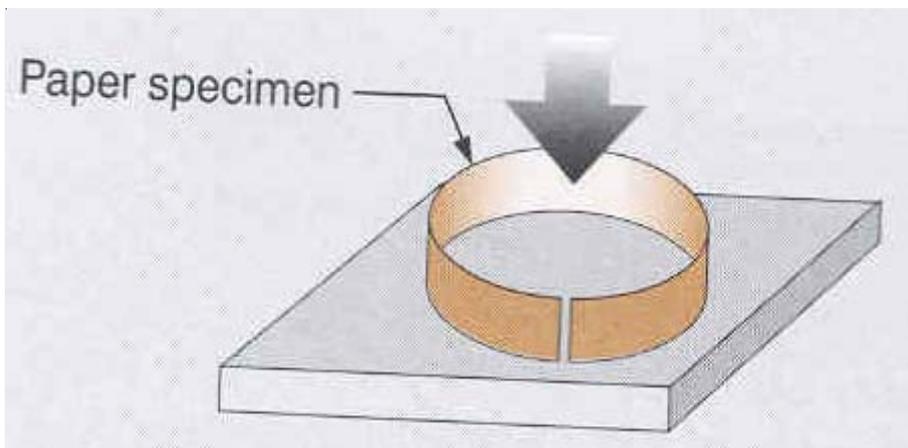


Fig. 13.2

(g) Corrugating Medium Test (CMT)

Significance : CMT is measure of the crushing resistance of a laboratory-fluted strip of corrugating medium. Unit is Newton. 'N' also called 'Concora'.

Test Method : The reference test method is TAPPI T 809. The force at which the flute is crushed, is CMT value and can be read on the indicator. The single facer sample is kept in between the platen as shown in Figure 13.3.

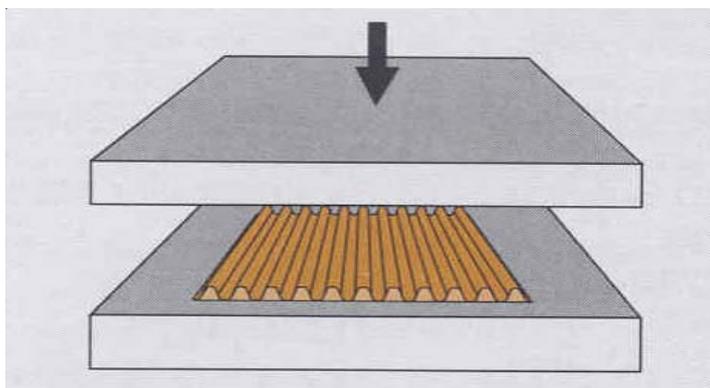


Fig. 13.3

(h) Tensile Breaking strength

Significance : It is the maximum tensile force per unit width developed in a test specimen at rupture or break.

Test Method : Test specimen cut to specified size is clamped between two jaws of tensile tester. Then the two jaws move away from each other at a specific speed. The force at which specimen breaks is recorded. This test is

conducted five times. The average breaking force divided by specimen width gives tensile strength in KN / m.

ii) Corrugated Board

The following parameters are assessed in the laboratory for corrugated fibre board.

(a) Caliper

Significance : The thickness of corrugated board is the distance in millimeters measured between the two parallel contact plates of a micrometers between which the specimen is subjected to a pressure of 20 kpa.

Test Method : The reference of list methods are TAPPI T-441 or IS: 1060-Part-I-1966.

(b) Board Grammage by Ply Separation Method

Significance : To determine the basic weights of the combined board and its components. As per TAPPI, the average readings are considered.

Test Method : The samples are soaked in water to allow the adhesive to dissolve in water. Then the layers of papers are peeled off to separate the layer carefully.

(c) **Bursting Strength**

Significance : To measure the strength properties of the board in terms of kg/cm².

Test Method : The sample is subjected to mullen bursting strength tester and the force required to rupture or burst the board is determined.

(d) **Puncture Resistance**

Significance : The puncture resistance is a measure of the energy needed to punch through a material.

Test Method : The reference test method is TAPPI T 803. A pendulum with pyramidal shaped head, selected so as to simulate a corner of a box, is released from a certain height. The freely falling pendulum acquires kinetic energy and the head puncture the board. The energy consumed is expressed in ounce inch per tear inch or kg-cm.

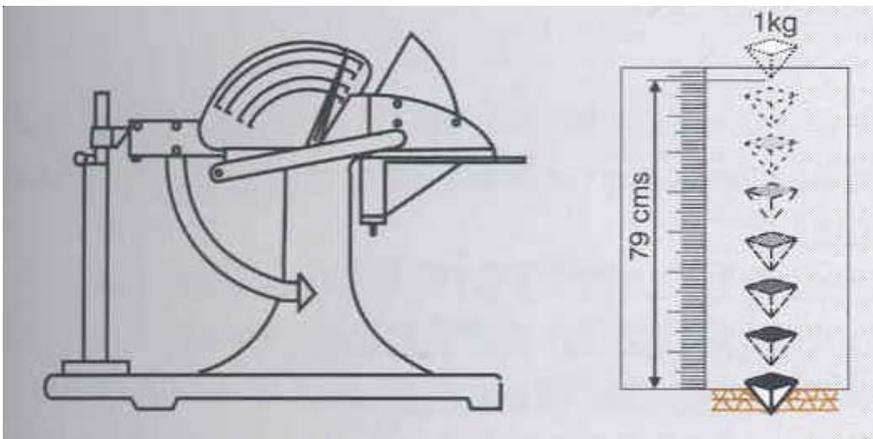


Fig. 13.4

(e) **Flat Crush Test (FCT)**

Significance : To measure of the resistance of the flutes in corrugated board to a crushing force applied perpendicular to the surface of the board.

Test Method : TAPPI T 825 or IS : 4006 – Part-I are the reference standards. Circular shaped CFB is kept in between the platen and compressed till rupture the flutes. Measure the force is measured in Kg.

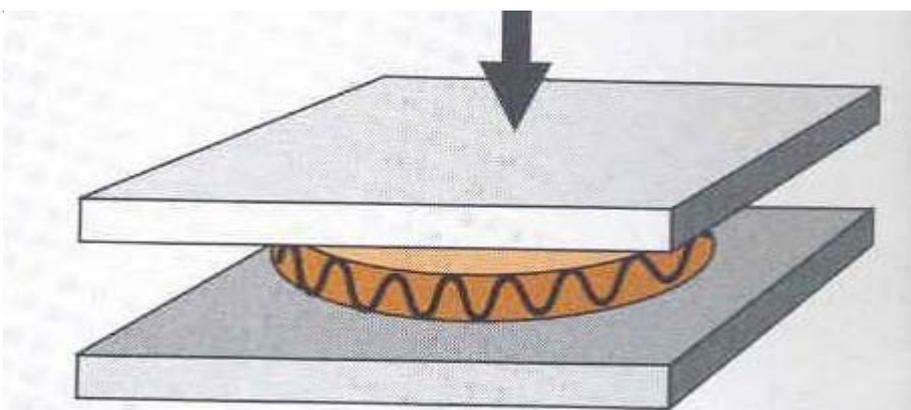


Fig. 13.5

(f) Edgewise Compression Test or Edge Crush Test (ECT)

Significance : ECT of a corrugated board is defined as the maximum vertically applied compressive force along the edge of the board without the board buckling.

Test Method : The reference is TAPPI T 811. The sample is kept under horizontal plates with the flutes vertical. The plates are then passed down with a constant speed of 10 ± 3 mm/minute so that the load on the edge of the board gradually increases. The load at which the board buckles gives the ECT. SI unit of ECT is KN/m.

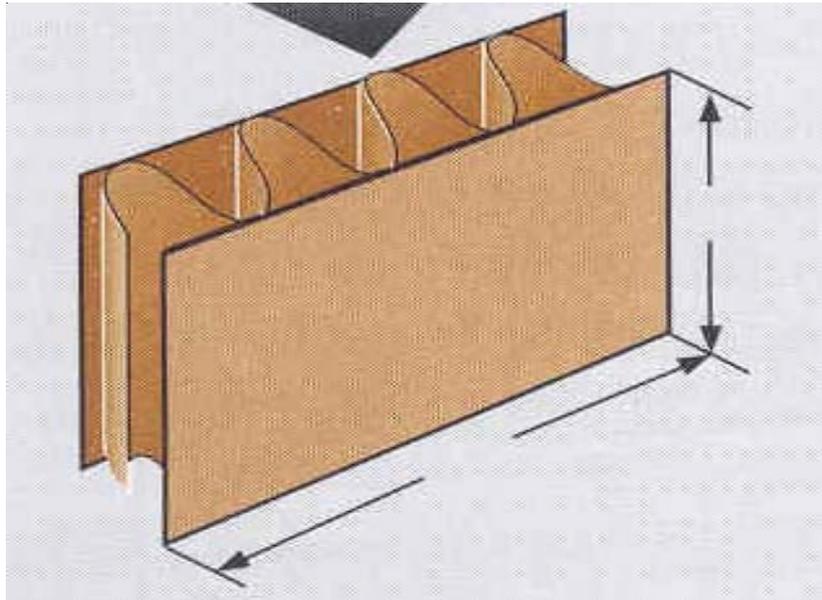


Fig. 13.6

(g) Performance Tests of Corrugated Fibre Board Boxes

(a) Box Compression Test (BCT)

Significance : This is the most important and the most common test for corrugated boxes. BCT is the measure of the ability of a corrugated box to take top down loads. It is the measure of stackability of the box and determines how much load can be stacked upon the box without the walls of the box buckling.

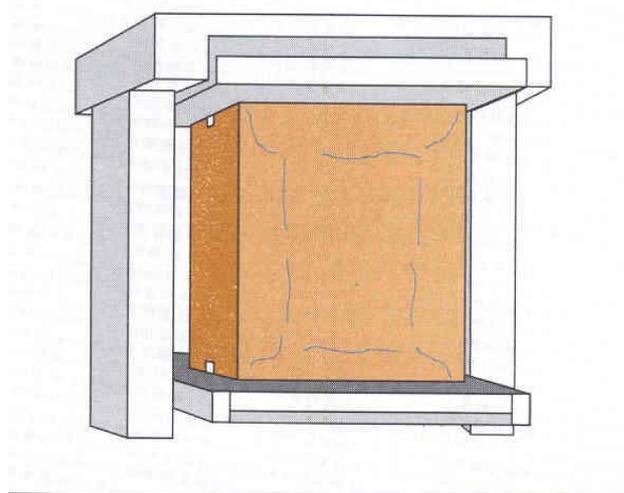


Fig. 12.7

Test Method : TAPPI T 804 or IS : 7028 (Part-VI) are the reference test method for BCT. The box is placed in a press between two parallel plates which apply pressure to the box at right angles to its flaps. The bottom platen is fixed and the top plates moves at the speed at $10\pm 3\text{mm/min}$. Now, run the machine and continue till the box gets crush. Take the reading from the recorder in kgs. This will clearly indicate that how much force is required to compress the box.

(b) Drop Test

Significance : This test is conducted : To determine the ability of the package to stand up to rough handling, the degree of protection offered to the contents by the package and to compare the different types of packaging for the same product.

(c) Vibration Test

Significance : The aim of this test is to simulate the vibrations to which the box and its contents are subjected during transportation and to

- determine the effects on the box, the degree of protection offered to the contents by the package and to compare the different types of packaging for the same product.

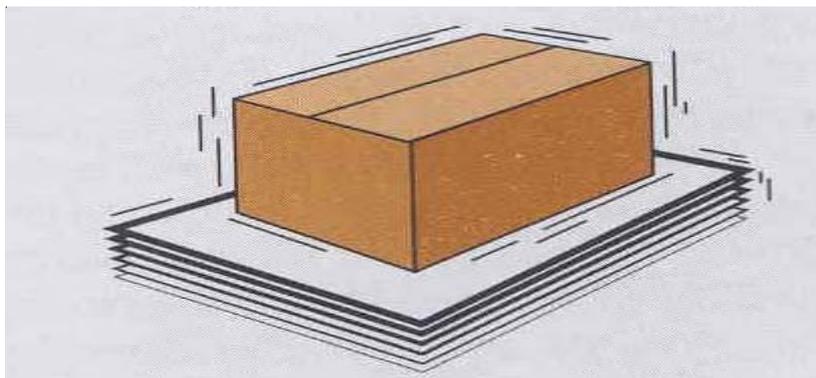


Fig. 13.8

Test Method : The test method has the reference of TAPPI T 817 and IS : 7028. Normally the package is vibrated for one hour duration at an amplitude of one inch for 120 cpm.

(d) Inclined Impact Test

Significance : This test is conducted to determine the ability of the package to stand up to rough handling, determine the degree of protection offered to the contents by the package and to compare different types of packaging for the same product.

Test Method : The reference test method is TAPPI T 801.

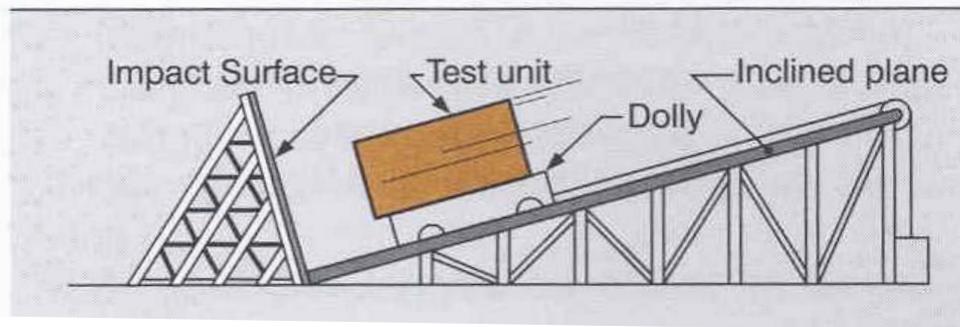


Fig. 13.9

The distance travelled or the speed at the moment of impact is noted. The test is repeated a certain number of times until there is a sign of damage.

(e) Rolling Test

Significance : To check the performance of the box during transit.

Test Method : The reference test method is DIN 55449. The full box is tipped over on its side. The test is performed according to the shape and the centre of gravity of package.

(d) Climatic Test

Significance : To check the performance of boxes at different climatic condition.

Test Method : The same packages area also subjected to $38^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and $90\% \pm 2\%$ RH and to observe the performances.

(e) Rain Test

Significance : The test is carried out to determine at what extent the package protects its components from the rain and to prepare the package for a test or a series of tests to determine the effect of rain on the performance of the package.

Check Your Progress -2

1) What are the important tests for glass containers to be performed in the laboratory?

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2) Indicate the significance of 'ESCR' Test.

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3) Write down the five important tests of metal containers?

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4) How do you explain the different tests of kraft liner, Corrugating media, and CFB board?

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5) What are the important tests of corrugated fibre board Boxes to assess the performance?

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6) Write down the significance of compression strength of CFB boxes?

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13.7 TESTING OF SEMIRIGID PACKAGING MATERIALS

13.7.1 Folding Cartons

The important tests and their significances are given below :

Significances and Tests of Important Parameters

(a) Grammage

Significance : To measure of weight of paper board expressed in gms/square metre. It is also called as substances and popularly known as grammage.

Test Method : The test method is same as for paper or kraft liner and the details have already been explained in 2.6.4.

(b) Thickness or Caliper

Significance : It is to determine the thickness of paper board used for making the folding carton. It is important for the design and development of folding carton.

Test Method : The test method is described in 2.6.4.

(c) Stiffness.

Significance: To determine the rigidity of paper board so as to make the assessment about load bearing capacity of product in folding carton.

Test Method : Test method is explained in IS: 4060 – Part-II- 1987. The values are expressed in Taber or kenley or milliNewton (MN).

(d) Brightness :

Significance : The objective is to measure the brightness in percentage.

Test Method : The test method is explained in IS : 1060 – Part-II, 1987.

(e) Surface Oil Absorption Time (SOAT)

Significance : To determine the characteristics of paper board about the absorption capacity of surface oil, which depends on the quantity of sizing and filler materials exists on the paper board.

Test Method : The test specimen of paper board is placed on the table. Then two drops of printing inks are put on the board and allowed to penetrate inside. The time taken to absorb ink completely by the board is recorded. Off set inks are oil based which acts as a vehicle. High soat indicate penetration of ink will be slow drying of ink as well as set off.

(f) Moisture Content

Significance: The objective is to determine the presence of moisture content in percentage in the paper board.

Test Method: Test method can be referred in IS: 1060 – Part-I 1987.

(g) Water Absorption or Cobb Value

Significance : The objective is to determine the water absorption capacity of board or cobb value.

Test Method : Test method is explained in IS: 4060-Part-II-1987 (Ref. 2.6.4.).

(h) Surface Smoothness

Significance : The objective is to measure the smoothness of board. This is important to get the good quality of printing.

Test Method : The test specimen is exposed to the testing equipment & then surface smoothness is measured in terms of ml/sec.

(i) Physical Observation

Significance : To check the physical properties of the paper board.

Test Method: The samples are checked physically to check properties like appearance on spots, speaks, loose fibre / waviness prior to accept for conversion into folding carton.

(j) Folding Endurance :

Significance: To determine the sustainability of duplex board against double fold.

Test Method: The test specimen of 15 mm x 76 mm are cut and then clamped into the machine. The test is run till the samples get torn due to double fold. This will indicate the sustainability of duplex board and this is expressed in terms of No.of double fold.

(k) Compression strength

Significance: To measure the load bearing capacity of folding carton.

Test Method: Refer 2.6.4. for detail procedure.

13.7.2 LINED CARTON

Significances and tests of important parameters :

Paper Board Carton :

(a) Stiffness :

Significance : To measure the resistance of the carton against bulging, crushing, and bowling of the sides. Low stiffness of the board causes to less compression strength and stackability of cartons.

Test Method : The test specimen is subjected to stiffness equipment and the test values are measured in machine direction (MD) and cross direction (CD).

(b) Moisture Content :

Significance : It is very important to asses the moisture content of paper board.

Test Method: The details of test method is given in 2.7.1. Normally, the paper board is having moisture content between 6 to 9 %.

(c) Caliper

Significance: To check the thickness of paper board.

Test Method : The test specimen are measured by means of digital or mechanical micrometer and the values are expressed as micron or millimeter.

(d) Grammage

Significance: To measure the weight of paper board in gms. High grammage board offers resistance against bursting, puncturing and tearing.

Test Method: You can refer the test method as given in 2.7.1.

(e) Ply Bond Strength :

Significance: This parameter pertains to the strength of the inter layer bond in the board. If the ply board is less, these layers would have a tendency to separate, particularly during creasing.

Test Method: The test specimen are taken and then place in between two metallic plates, subjected to heat and then observe the degree of separation of layer. No separation will indicate good ply bond strength.

(f) Surface Appearance :

Significance: This test is important as attributes relevant pertain to brightness, smoothness, oil absorption capacity and blemishes affecting surface finish.

Test Method: This is a subjective method and the observations are taken visually. However, the laboratory tests on brightness, smoothness, SOAT etc. are also conducted to assess the overall surface appearance of lined carton.

Liners

(a) Barrier Properties

Significance: To measure the barrier properties in terms of water vapour transmission rate and oxygen transmission rate as these properties have got direct effect on the degree of deterioration of dairy product and thus affect the shelf life of products.

Test Method: The details are described in IS : 1060 – Part-III and ASTM D 3985.

(b) Treatability

Significance: To measure the level of treatability or the surface energy of the film or laminate.

Test method: Normally, the energy level should have more than 38 dynes/cm.

(c) Peel Bond Strength :

Significance: To measure the force require to separate the two plies of the laminates.

Test Method: You can refer 2.6.4 for details.

13.7.3 ASEPTIC CARTONS

Significance and Tests of Important Parameters

The significance and test method of important parameters are as below:

(a) Delamination of Laminate & Thickness & Grammage

Significance : The objective is to separate all the important layers and to check the thickness and grammages of layer.

Test Method : The details are given in IS : 1060 – Part-I – 1985.

(b) Leakage Test for Aseptic Carton

Significance : To check the integrity of the seals of the carton and to assess the leakage.

Test method : A filled aseptic carton is immersed into a beaker filled with water. Keep it for 15 minutes and take the observation about the appearance of any air bubbles through the water. This will clearly indicate about the integrity of seal or leakage properties of aseptic carton.

(c) Barrier Properties

Significance : To check the barrier properties of the laminate against moisture, Oxygen gas, light etc.

Test Method : The detail test methods are explained in 2.7.2.

(d) Mechanical Properties :

Significance : The objective is to determine the mechanical properties of the laminate in order to ascertain about various parameters like tensile strength, stiffness, tear properties, bursting strength etc.

Test Method : The test method of paper based laminate is same as paper and paper board. The details about the test methods are already explained in 2.5.1 and 2.7.1.

(e) Dimensional Stability :

Significance : The objective of this test is to determine the dimensional stability of the laminate.

Test Method : The test specimen is measured for all the dimensions like length, width and height. The sample is then exposed to high temperature & high humidity i.e. $38^{\circ}\text{C} \pm 1^{\circ}\text{C}$ & $90\% \pm 2\%$ R.H.

(f) Flex Crack Resistance :

Significance : This test is conducted to determine the performance of laminate in terms of resistance against flex crackness.

Test Method : The test specimen is cut into a size of 30 cm x 20 cm. And then the laminate is clamped into Gelbo flex Tester and then run the machine for 2800 cycles.

13.7.4 THERMOFORMED CONTAINERS

Significances and Tests of Important Parameters.

The important parameters are considered for the qualitative tests. The details are as follows :

(a) Identification of Polymeric Materials.

Significance : The main objective of this test is to determine the kind of plastic materials used for making thermoformed containers.

Test Method : The chemical method is normally employed for the identification purpose. However, differential scanning calorimetry (DSC) is also used for the identification of polymeric materials.

(b) Extractability Test

Significance : To check the level of extractable residues so that to ascertain about their suitability for processed food products.

Test Method : The testing is done in the laboratory by referring IS:9845 – 1987. (Migration test). The details of test procedure have been explained in 2.5.2.

(c) Product – Package Compatibility Test.

Significance : This test will ascertain about their suitability for the packaging of particular product. In other words, the test will confirm about compatibility due to interaction during storage, handling and transportation.

Test method : In the laboratory, the thermoformed containers are filled with particular type of dairy product. Then the filled packages are exposed to accelerated condition i.e. $38^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and $90\% \pm 2\%$ RH for specified period of time.

Check Your Progress - 3

(1) Write down the five important tests of folding carton :

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(2) The liners of lined carton should have excellent barrier properties, why?

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(3) Indicate the most important test of Aseptic Carton and what is its importance?

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(4) Mention the importance of product – package compatability test.

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(5) What is the significance of Soat test?

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(6) Mention five important common tests for all kinds of semirigid packaging materials.

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13.8 LET US SUM UP

In this unit, we have been able to know the importance of sampling plan as well as conditioning of the samples prior to undertake testing in the laboratory. The different types of tests required for packaging materials have also been discussed.

In addition, the significances and test methods of important parameters w.r.to different packaging materials like paper, paper board, plastic film and laminates, aluminium foil, glass container, metal container, plastic container, corrugated fibre board boxes have been elaborately discussed.

Moreover, the different semi rigid packaging materials like folding carton, lined carton, aseptic carton, thermoformed containers, their importance for the packaging of dairy products, their applications, the different tests for evaluating the quality of these materials have also been covered in the unit.

After studying this unit, you will have sufficient knowledge to understand about the requirement of various tests, test methods and their relevant Indian Standards for analyzing in the laboratory.

13.9 KEY WORDS

- TQM** : Total Quality Management
- Accelerated Condition** : The extreme Climatic Condition with high temperature and high humidity. Normally, the environmental conditions like 38 °C ±1°C & 90% + 2% R.H. are considered.

- Performance Test** : The tests pertain to the evaluation of packages during transit.
- Burst factor** : It is the ratio of bursting strength and grammage
Burst factor = $\frac{\text{Bursting St.}}{\text{Grammage}} \times 100$
- Go, No Go Gauge** : The measurement is done without any adjustment of gauge meter, where the arms are fixed and checking is done only by pushing the gauge inside the glass Neck or body etc.
- Polariscope** : This is an instrument to determine the interface of colours of glass containers during gradual cooling process.
- Clearks' Solution** : A chemical solvent developed by Scientist, Cleark, used to dissolve the Tin coating for the determination of the Tin Coating thickness.
- Concora Medium Test** : It is the same as corrugating medium test.
- Finish** : The important part of glass container that fits onto the closures.
- Pendulum** : A steel ball swings like a Pendulum and then hits the glass container while checking the Impact strength.

13.10 SOME USEFUL BOOKS

- IS 2508 : 1984 Specification for low density polyethylene films (*second revision*), Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.
- IS 2828 : 2001 Plastics – Vocabulary (*first revision*), Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.
- IS 3025(Pt 5):1983 Methods of sampling and test (physical and chemicals) for water and wastewater: Part 5 Odour (*first revision*), Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.
- IS 3025(Pt 8):1984 Methods of sampling and test (physical and chemicals) for water and wastewater: Part 8 Taste rating (*first revision*), Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.
- IS 4905:1968 Methods for random sampling, Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.
- IS 7019 : 1998 Glossary of terms in plastics and flexible packaging, excluding paper (*second revision*), Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.
- IS 7028(Pt2): 2002 Performance tests for complete, filled transport packages : Part 2 Vibration test at fixed low frequency (*second revision*), Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.

IS 9845 : 1998 Determination of overall migration of constituents of plastics materials and articles intended to come in contact with foodstuffs – Methods of analysis (*second revision*), Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.

IS 10146 : 1986 Polyethylene for its safe use in contact with foodstuffs, pharmaceuticals and drinking water, Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.

IS 14500:1998 Linear low density polyethylene films, Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.

IS 14535 : 1998 Recycled plastics for the manufacturing of products – Designation, Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.

IS 15495:2004 Printing ink for food packaging – Code of Practice, Bureau of Indian Standards, Manak Bhavan, Bahadur Saha Zafar Marg, New Delhi.

13.11 ANSWERS TO CHECK YOUR PROGRESS

Your answer should include the following points

Check Your Progress – 1

1.
 - 1 The main significance is to allow the sample to attain equilibrium condition of moisture content throughout the surface of the sample.
 - 1 To obtain concurrent test values.
2.
 - 1 $27^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and $65\% \pm 2\%$ RH.
 - 1 Duration is 24 hours.
3.
 - 1 Grammage
 - 1 Moisture Content
 - 1 Water absorption test
 - 1 Thickness
 - 1 Bursting strength
 - 1 Breaking Length
 - 1 Stiffness
 - 1 Tear Resistance
4.

| | |
|-------------------------|----------------------------|
| i) Caliper | vi) Dart Impact Resistance |
| ii) Density | vii) Co-efficient |
| iii) Tensile Strength | viii) Haze |
| iv) Elongation at Break | ix) Glass |
| v) Peel Boud Strength | |

5.
 - 1 Static Friction
 - 1 Dynamic Friction
6.
 - 1 Kg/cm² or pound / sq. inch or kilo pascals.
 - 1 Tabes or Kenley or kilo Neulton.
7.
 - 1 For paper, it is expressed as kg/cm²
 - 1 For plastic film, its is expressed as kg/cm width.

Check Your Progress – 2

1.
 - i) Visual defeats
 - ii) Dimensions
 - iii) Capacity
 - iv) Hydrostatic pressure test.
 - v) Chemical test
 - vi) Mechanical Impact
 - vii) Annealing
 - viii) Thermal Shock test.
2. To check the resistance against crackness of plastic contains due to environment.
3.
 - 1 Drop test
 - 1 Air pressure test
 - 1 Hydraulic pressure test
 - 1 Dimensions
 - 1 Static Load test.
4.
 - i) Grammage
 - ii) Thickness
 - iii) RCT
 - iv) Breaking Length
 - v) Folding Endurance
 - vi) FCT
 - vii) ECT.
 - viii) Burst Factor.
5.
 - 1 Compression Strength
 - 1 Drop test
 - 1 Vibration
 - 1 Stack Load test
 - 1 Rolling test
 - 1 Rain test

6. 1 To determine the load bearing capacity of the box.
- 1 To determine the stackability of box.

Check Your Progress - 3

1. i) Grammage
ii) Stiffness
iii) Brightness
iv) Folding Endurance
v) SOAT
vi) Moisture Content
vii) Smoothness
2. 1 To restrict the deterioration of processed food products due to moisture, light and oxygen gas.
1 To enhance the shelf-life of food products.
3. 1 Leakage test of aseptic carton.
1 Sterilization will be affected due to leakage and thus the shelf-life of product will be reduced.
4. 1 To ensure that there is no deterioration in quality of product due to interaction between the product and package.
1 To determine that the plastic packaging materials used are food grade and there is no affect on product quality during storage at accelerated as well as ambient condition.
5. 1 To determine the characteristics of paper board about the absorption capacity of oil with respect to time.
1 Off set ink are oil based which acts as a vehicle.
1 Indicates about the degree of penetration of ink and thus the degree of drying of ink.
6. i) Grammage
ii) Thickness
iii) Stiffness
iv) Barrier Properties
v) Impact strength
vi) Dimensional stability