FOOD PACKAGING

TESTS & EQUIPMENT

Educative Series

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Packaging Testing

Purpose and importance

One of the primary purposes of a package is to ensure the safety of its contents during transportation and warehousing. If a product gets damaged during this process, then the package has failed to accomplish a primary objective. The customer will either return the product or be unlikely to purchase the product altogether. Product rejections are always a concern for the company as it hits their operating margins.

Also if such failures happen repeatedly, the brand equity takes a big hit, which sometimes is more precious than making profits.

Packages need to be tested very thoroughly when there is a new packaging design, a revision to a current design or a change in the packaging material. Testing a new packaging design before putting it up for full scale manufacturing can save a lot of time, money and heartburn.

Classification of Tests

Testing of Packaging can be broadly classified in 2 segments.

1. Testing of the Materials used. Eg. Paper, Film, Foil, Laminate, etc.
2. Testing of the formed Package. Eg. Pouch, Bottle, Carton, etc

These tests can be further classified as :

a) Chemical Tests. Eg. pH value of the materials, sulphate and chloride in paper or board, alkalinity of glass, etc. These are done to ensure product compatibility (reactions between the food product and packaging material).
b) Mechanical Tests. Eg. Stiffness of board, Tensile Strength of Plastic Film, etc.

There can be an extremely large variety of materials, packages and test combinations, making this a very exhaustive list.

We shall restrict the scope to a smaller but more commonly used set of Mechanical Tests.

GSM Test

Summary : GSM is one of the most basic tests which stands for Grams per Square Meter. It is also known as the "grammage" and is actually the weight of 1 square meter of sample. Most paper is bought and sold in accordance with its mass per unit area, and therefore the grammage has great significance both to the consumer and the producer in defining price.

Applicable to : Paper

Test Method : A sample of 100cm2 area (usually a square of 10x10cm or a round of 11.284cm diameter) is cut and weight accurate to 0.01gm resolution and multiplied by 100 to give you the result in g/m2 or gsm

Test Standard : TAPPIT-410 / ISO 536 / IS 1060

GSM
Calculation

80 GSM?

Thickness Test

Summary : Thickness is an important property of paper, paperboard, foil, film or Laminates, and variations in thickness can lead to variations in their other mechanical properties such as stiffness, permeability, etc. Thickness is defined as the perpendicular distance between the two principal surfaces of the sample substrate.

Applicable to : Paper, Paperboards, Film, Foils, Laminates

Test Method : A sample is measured in a Dial Type or Digital Thickness Gauge mounted on a vertical stand with a weight (called as dead mass) on top. The weight exerts a constant pressure of 50 kPa (100 kPa as per ISO) at the contact surface (point of measurement). This ensures high repeatability in test results. Ordinary screw type micrometers are not to be used as they are highly operator dependent and any amount of excess pressure can compress the specimen and give lower results.

Test Standard :
TAPPI T-411 / ASTM D 645 / ASTM F 2251 / ISO 534 / IS 1060

Pinhole Test

Summary : Aluminum foils are used in food packaging laminates to enhance the barrier properties of the package and to protect the contents from gas / moisture permeation and also from light. Thinner gauges of aluminum foil contain pinholes through which moisture and oxygen from the environment can enter the package accelerating the degradation of the contents. Presence of excessive pinholes in the foil will significantly hamper the shelf life of such products.

Applicable to : Foils and Foil Laminates

Test Method : A sample of foil or foil laminate is placed on a glass plate with lights under it. This apparatus is also called as a Light Box and usually has a hood on top to cover the sample. Pinholes will be visible as white spots as light from underneath the sample will pass through the holes while the opaque sample blocks the remaining light. Count the number of pinholes per square meter of sample.

Test Standard : ASTM B 926 / IS : 15392-2003

Maximum Allowable Pinhole Count in One Square Meter of Aluminum Foil

Foil Thickness (µm)	Average	Maximum
7	423	1584
9	211	1056
13	85	528
18	21	106
25	0	0

Source : "The Impact of Foil Pinholes and Flex Cracks on the Moisture and Oxygen Barrier of Flexible Packaging" by Lee Murray of Alcan Packaging, Neenah Technical Center

http://www.tappi.org/content/enewsletters/eplace/2006/22-2murray.pdf

Typical Pinhole Count in One Square Foot or One Square Meter of Aluminum Foil.

Foil Thickness (inch)	Foil Thickness (µm)	Typical Pinhole / Sqft.
0.00025	6.35	41
0.00030	7.62	20
0.00035	8.89	12
0.00050	12.7	6
0.00070	17.78	1
> 0.00100	> 25.4	0

The smallest hole visible with the unaided eye is generally about 10 µm in diameter.

Source : "FAQ : Impact on Barrier of Pinholes in Foil Layer of a Lamination" by The Sterilization Packaging Manufacturers Council (USA)

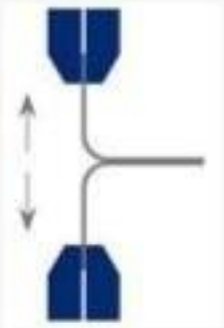
http://faqs.sterilizationpackaging.org/questions/7

Max Pinhole Count in One Square Meter of Aluminum Foil used in Food Packaging.

Foil Thickness (µm)	Typical Pinhole / Sq Mtr.
11	60
14	40
18	30
20	20
➢ 25	0

Source : B.I.S. 15392-2003

Delamination Test (a.k.a. Peel Bond Test)



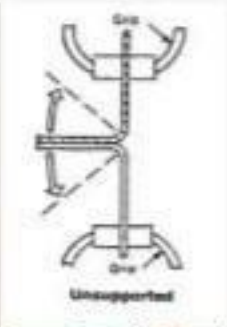
Summary : Laminates are made by bonding together two or more layers of material or materials. Their performance is often dependent on the ability of the laminate to function as a single unit. If the plies have not been properly bonded together, the performance may be adversely affected.

Applicable to : Flexible Laminates

Test Method : Ply separation is initially started mechanically by the application of heat or by using a solvent. The separated plies of the test specimen are placed into the grips of a tensile testing machine. The grips are then separated and the force required to further separate the plies is defined as bond strength. The most difficult part of the test is the sample preparation itself which is very time consuming. Some layers of the laminate are so thin that you will rarely get a proper peel test done.

Test Standard : ASTM F 904

Seal Strength Test (a.k.a Heat Sealability Test)



Summary : Seal strength is a quantitative measure for use in process validation, process control and capability. Seal strength is not only relevant to opening force and package integrity, but to measuring the packaging processes' ability to produce consistent seals. Seal strength at some minimum level is a necessary package requirement, and at times it is desirable to limit the strength of the seal to facilitate easy opening.

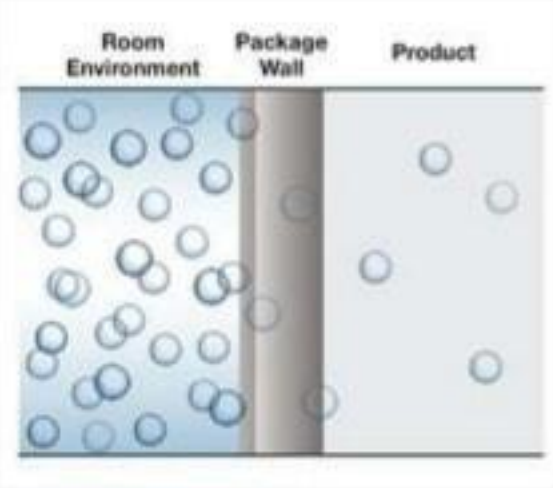
Applicable to : Flexible Laminates and formed Pouches.

Test Method : Samples are cut from a formed pouch. Alternatively laminates can be sealed with controlled temperature, pressure and dwell-time to create sample seals. The test specimen is then gripped in a tensile testing machine. The grips are then separated and the force required to separate the seal is defined as seal strength.

You can use a Lab Heat Sealer and a Tensile Tester to create samples using different materials, temperature, pressure and dwell-time setting and find the combination offering the best seal strength.

Test Standard : ASTM F 88

Permeation Tests



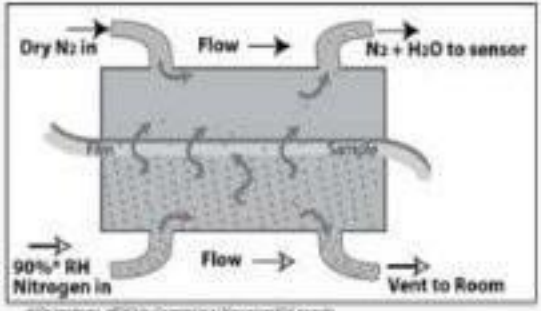
Summary : Packages made with plastic are permeable to small molecules like gases, water vapour, and to other low molecular weight compounds like aromas, flavour, and additives present in food. As a consequence of the barrier properties of the material, the transfer of these molecules ranges from high to low. The knowledge of the permeation behaviours of the polymer film is very important to ascertain optimum shelf-life for Aromatic Foods or Foods that are susceptible to excess moisture or oxygen.

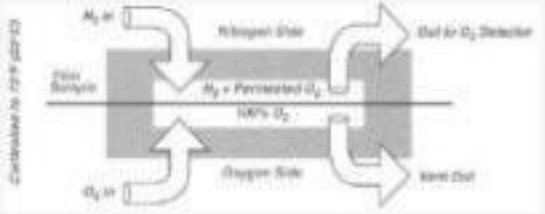
Permeation properties are of 2 major types.
Barrier to Moisture Vapour or Water Vapour called as MVTR or WVTR
Barrier to Gas Transmission (Generally Oxygen, but can also be used for other gases) called as GTR or OTR.

Although it may seem logical to claim that a High OTR barrier film will have High WVTR barrier too, but it is not always so. Different films have different barrier properties, hence laminate structures are chosen according to the properties desired for the particular product / application.

Applicable to : Plastic Films and Laminates.

Permeation Tests





Test Method :

Samples are mount in a WVTR / OTR machine which basically has 2 chambers of different concentrations of Water Vapour or Oxygen.

The amount of Moisture or Gas that permeates through the surface of film is found out and calculated in terms of g/m2/day for WVTR and cc/m2/day for OTR.

Lower values indicate high barrier.

Test Standard :

WVTR : ASTM E96, E398, F1249, D6701, Tappi T557, T523, ISO 15106, JIS K7129

OTR : ASTM D3985, F1307, F2622-8, F1927

OTR Permeation Analyser by PreSens (Germany)

For most food applications a permeation measurement system would have to be able to detect in a measurement range of 0.05 - 2000 $cm^3/(m^2 d\ bar)$.

A new measurement system for testing synthetic materials on oxygen permeability was developed.

Unlike the currently used systems with electrochemical or barometrical sensors it was designed for optical measurement.

The Fibox 4 trace together with chemical optical sensors was applied to detect trace oxygen concentrations and validate the new measurement system. Apart from an already available sensor type different other types of sensor material were tested to develop an oxygen sensor with an improved limit of detection for high barrier permeation measurements.

This sensor type - PSt9 - together with the measurement cells seems to be a promising solution for easy, cost effective permeation measurements in technical applications.

PSt6 Range : 10^{-2} to 10^{-7} cm^3 (STP)/(m^2 d bar)
PSt9 Range : 10^{-3} and 100 cm^3 (STP)/(m^2 d bar)

Coefficient of Friction (C.O.F.) Test

Summary : Flexible packaging is usually done on Vertical or Horizontal Form-Fill-Seal (FFS) machines in which the roll of film or laminate comes in contact with itself or other metallic /non-metallic components of the FFS machine. The contact generates friction which can inhibit the material to run properly on the machines and achieve desired production speeds.

Measurements of frictional properties may be made on a film/laminate when sliding over itself or over another substance (usually stainless steel).

The amount of friction required to be overcome to initiate motion is called as the Static Coefficient of Friction and the amount of friction required to be overcome to continue the motion is called as the Kinetic Coefficient of Friction.

Applicable to : Plastic Film and Laminates.

Test Method : A sled weighing 200 ± 5 g is wrapped around with the test specimen and made to slide over a similar substrate or stainless steel surface with a speed of 150 ± 30mm/min. The initial and average drag force (in grams) is recorded and divided by the sled weight (200g) to calculate the static and kinetic COF respectively.

Test Standard : ASTM D 1894

Ink Rub Test / Scuff Test (Print Quality Test)

Summary : Packaging is known as a "Silent Salesman". The package has to be attractive enough for the consumer to feel compelled to pick it up from the shelf. It also has to display technical information about the product, such are contents, packing dates, expiry info, etc as mandated by law. However the packaging can get scuffed or rubbed during various stages of production, transportation and distribution. This test allows us to create standardized conditions of rubbing to evaluate the performance of different test specimens. Can also be used to evaluate the efficacy of varnishing or any other specialized coatings on the printed surface.

Applicable to : All types of surface printed packaging such as Foils, Labels, Printed Cartons, and even batch coding on pouches.

Limitation : Can be used for testing material in sheet form only. Though the test can also be modified for curved surfaces of rigid packaging.

PATRA Rub Test / Sutherland Rub Test

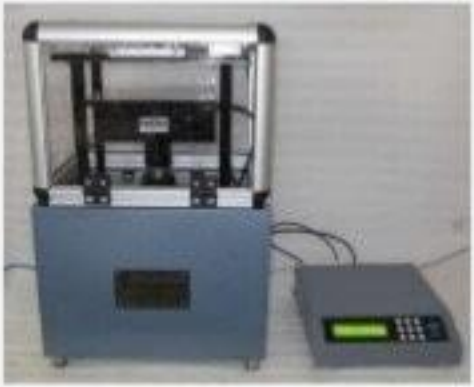
Test Method : There are typically 2 method of testing :
1) Rotary Rubbing using 2 circular discs of size 2 and 4.5 Inches.
2) Linear Rubbing using 2 rectangular samples of specified sizes.

Rotary Rub test is more commonly known as the Patra / Pira Rub Test and is the preferred test method for Rigid substrates like paperboards. This test cannot be done successfully on thinner and more flexible substrates which crumple upon rotary rubbing.

Linear Rub test is more commonly known as the Sutherland Rub Test and is an all-rounder test since it can be used on all thin or thick specimens.

Test Standard :
Rotary Rub : British Standards BS-3110
Linear Rub : British Standards BS-3110 and ASTM D 5264

Pouch Compression Test (aka. Load Burst Test)



Summary : When a shipper carton fails, stacking loads can be transmitted on to the package. Hence a flexible or semi flexible package (such as a pouch or blister pack) should have the ability to withstand small amounts of loads for short periods of time.

Applicable to : Flexible pouches and Blister Packs.

Limitation : Applies only to gas or liquid filled packs, or those that can be filled with water for testing. Cannot be directly used for testing pouches filled with powder or solid products.

Test Method : There are 2 basic methods of test.

1) Static Compression Test, where a package is loaded upto a predetermined level, held there for a predetermined time period and then relaxed. This may or may not lead to a burst.

2) Dynamic Compression Test, where a package is loaded incrementally till it cannot bear the load any longer and eventually bursts open.

Static Compression Test

Weight / Volume of Package	Static Load
< 100g	20 Kg
100 – 400g	40 Kg
400 – 2000g	60 Kg
> 2000g	80 Kg

Place a sealed package, filled with its original contents or water in a compression machine. Load the sample with force as per the table below and hold it for 60 seconds. Remove and check for leakages and seal integrity.

The above test method is prescribed by JETRO (Japan External Trade Organisation) in "Specifications, Standards and Test Methods for Foodstuffs, Implements, Containers and Packaging, Toys, Detergents 2008" published in January 2009.

Canadian Food Inspection Agency (CFIA) recommends a similar test method for Flexible Retort Pouches used in Food Packaging.

CFIA recommends that "Pouches must withstand a force of 7.5 kg for 15 mm of internal seal length applied for 15 seconds". For Eg, if you have a pouch of approx. 8x10 Inches, it would have an internal seal length (perimeter) of approx. 780mm (after deducting about 10mm on all sides for the seal width). Hence this pouch should be subject to a static load of (780/15)*7.5 = 390 Kgs for a period of 15 seconds.

After test, the pouch seals should also be inspected to see if they are still intact or there was a decay in seal quality.

Dynamic Compression Test

Place a sealed package, filled with its original contents or water in a compression machine.

Load the sample with increasing force till the seals rupture and the contents come out.

Pouches should be strong enough to withstand the forces that will be subjected to them in the event of its outer package (shipper) failure.

The higher your Dynamic Compression Strength, the better is the quality of the pouch.

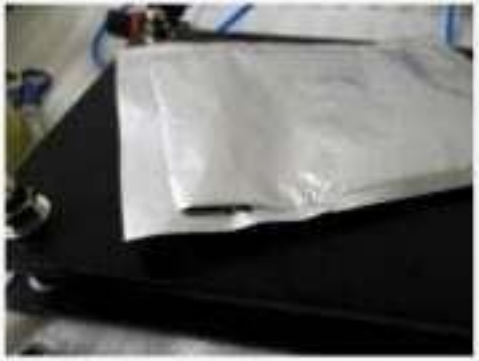
Pouch Burst Test (a.k.a. Internal Burst Test)

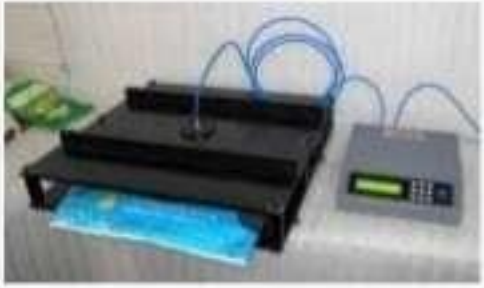
Summary : This test in principle is similar to the Pouch Compression Test, except that the pouches here are subjected to internal air pressure in lieu of external force. The internal burst test is used as a good overall test for a hermetic seal including an indication of correct heat sealing conditions and a measure of the ability of a package to withstand transportation and handling.

Applicable to : Flexible pouches and Blister Packs.
Limitation : This test is performed on empty packs only and cannot be performed on product filled packs.

Test Method : Sample is mounted in a burst test which internally and increasingly pressurizes a package until an area of the package seal around the perimeter "bursts" open in response to pressurization. Visually examine the tested package and note the position and type of failure, as well as the pressure at which the failure occurred. If the seals open, then the weakest seal. If the laminate ruptures, note the result as a Laminate Failure.

Test Standard : JETRO / CFIA / ASTM F 2054





Vacuum Leakage Test

Summary : Package integrity is often an important characteristic of package performance. Breaches of package integrity may permit substances to enter or contents to escape packages. A Leak means an opening in a flexible package that, contrary to intention, either lets contents escape or permits substances to enter.

Applicable to : Any non-porous package such as Pouches, Blister Packs, Cans, Bottles, etc. This test can also help understand the performance of a package when transported through non-pressurized air cargo or when it is used at high altitudes (low atmospheric pressures).

You must have witnessed the puffed up pouches of dairy creamer (milk powder) or single-serve milk blister packs, served with tea in aircrafts. If the pouches were not strong enough, they would have burst open at these low pressure conditions.

Limitation : This test is can only detect leaks due to reasonable large pinholes or gaps which can allow the fluid or gas to pass out and / or water to enter the package. This test is not suitable for detecting micro leakages or for testing packages containing high viscosity fluids. This test also cannot be used to test vacuum sealed packs.

Test Method :
There are 2 variations to this test.

Dry Test, in which the package is filled with the actual liquid product or more preferably colored water (because water viscosity is usually lower than the actual product).

A white tissue paper or similar, is kept in a Vacuum Dessicator Tank and the package is kept on it. Bottles have to be kept inverted. The tank is then closed and gradually increasing vacuum is applied to the tank upto a predetermined level. The vacuum is then held at that level for a predetermined time period and then released.

If there is any leakage in the pouch, the product (or colored water) would have come out and stained the tissue paper under it. Incase of bottle, the bottle in kept vertical and tapped slightly from the cap. The cap is then removed to see if any product is visible on the lip of the bottle or the threads of the cap.

Wet Test, in which the package either contains a product that is essentially solid or powder and has a considerable amount of air in the headspace. Alternatively you can also fill air in the package. Bottles can be tested empty. The Vacuum Dessicator Tank is filled with water (preferably colored water) and the package is dipped in the water. Suitable method to restrain the package and keep it dipped in water throughout the test. The tank is then closed and gradually increasing vacuum is applied to the tank upto a predetermined level. The vacuum is then held at that level for a predetermined time period during which leaks can be identified as visible streams of air bubbles. Random air bubbles are to be ignored. After the preset time period, the vacuum is released.

If you had seen constant stream of air bubbles, it is a confirmed leakage.
But sometime the bubbles can be random and less distinct in semi-rigid or rigid packs.
In such cases, the packages are opened after the completion of the test and the product is tested for wet or stained spots. Water enters the packs from the leak spots when the vacuum is released.

Stream of Air Bubbles = Leak.
Water inside package = Leak.

Test Standard : ASTM D 3708

Note : There are special purpose machines which use Helium or other Tracer gases to detect even micro leakages which cannot be detected by the Vaccum Leak Test.

Torque Test

Summary : Package integrity in rigid packaging such as Bottles has less chances of being hampered due to pinholes and more chances of leaks due to loosely fitting closures. It is important that the bottles closures should be applied with an optimum torque.

Effects of Application Torque :

Low Application Torque = Low Removal Torque.

This may allow closures will further become loose due to vibrations during transport and handling. And this will lead to leakages or product contamination.

High Application Torque = High Removal Torque.

This can lead to discomfort to the user in opening the bottle and dispensing the product.

Extra High Application Torque = Closure Break or Thread Slip.

This can lead to the closure cracking or threads overlapping and then slipping, both of which are bad news.

Torque Test

Test Method :

Test # 1: Bottle is attached to a grip on a Torque Tester. The closure is applied until the cap threads slip over each other. The peak reading is recorded. This is the slip torque. Packaging Machines should not be allowed to tighten the bottle upto this level of torque.

Test # 2: Bottle is attached to a grip on a Torque Tester. The closure is applied until the known torque that is usually being applied by the packaging machines. Then the cap is removed to understand the co-relation between the Application Torque and Removal Torque. You can also close the bottle samples at different application torques and find out which one gives the most optimum opening torque in return.

Test # 3: A machine closed Bottle is attached to a grip on a Torque Tester. The closure is then opened to know if the bottles are achieving optimum opening torque which indicate that their application torques are also optimum.

Test Method : ASTM D 2063

Top Load / Compression Test

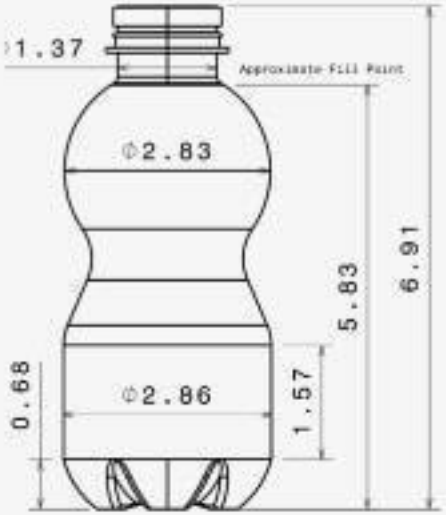
Summary : Rigid Packaging such as Plastic Bottles (or Jars) are named so because they have remain erect and presentable. Poor distribution in material across the walls of the plastic bottles defines the rigidity of the bottle at that particular weight.

The bottles may or may not be expected to take stacking loads if placed in corrugated cartons. But bottles will need to take stacking loads if packed in Shrink-wrapped Trays or Bundles and in this case their Top Load carrying capacity (or compression strength) should be much higher.

Applicable to : Plastic Bottles / Jars. Can also be used on paperboard cartons, cups, trays, cans etc

Test Method : The bottle (generally empty) is placed in a compression tester of suitable capacity and pressed until it cannot bear the load and buckles. The peak load is captured alongwith the deflection at that point. The load should be high and deflection low.

Bottle Wall Thickness Measurement



Summary : Uniform distribution of material across the walls of a plastic bottle is a key to achieving the best Top Load bearing capability.

In order to check for the uniformity, usually people will cut the bottle open and then use standard micrometers. Unfortunate the cutting process is both time consuming and poses a threat to the operator. The risk is much higher for glass bottles or jars.

The better method is to use a Wall Thickness Measurement device which does a non-destructive measurement of the wall thickness. This is a quick and safe method.

Applicable to : Generally Plastic or Glass Bottles and Jars. But can be used for other types of packages also.

There are 2 types of equipment : Magnetic & Ultrasonic

Magnetic Bottle Wall Thickness Gauge

Magnetic Thickness Gauges need a small steel ball to be placed inside the bottle and the probe outside.

The ball gets attracted to the magnetic probe and uses the hall-effect principle to measure the distance between the ball and the probe.

This is the most versatile equipment and doesnot need re-calibration for different substrates.

The only limitation is that it cannot measure thickness of ferrous material. But since ferrous (steel) packaging (drums) is not used commonly, it is not a problem. There are special Ferrous / Steel Drum wall thickness devices for this particular purpose.

Ultrasonic Bottle Wall Thickness Gauge

Ultrasonic Thickness Gauges measure from outside only.

The ultrasonic trans-receiver sends sound waves through the wall of the bottle and measures the time required for it to bounce back. Based on the known sound velocity of material, it can calculate the thickness.

The limitation is that for every different material you wish to test, the unit's calibration setting (a simple menu based setting) needs to be changed.

The good point however is that these devices are considerably cheaper than magnetic thickness gauges.

Headspace Gas Analysis (O2 Measurement)

Summary : Modified Atmosphere Packaging (MAP) is now used commonly to enhance the shelf life of food and pharmaceutical products that are sensitive to the presence of Oxygen or other gases. The process of MAP involves flushing of nitrogen (or other gas / mixes) to displace the air inside the package. Sometimes the flushing happens incorrectly or inadequately thereby allowing an undesirable amount of oxygen to remain inside the package and reduce the shelf life or stability of the product.

Test Method : A septum seal sticker is applied to the package (pouch / blister / tetra-pack / bottle, etc and a needle in pushed through it. The gas inside is allowed to come out through the needle and is analysed by an Oxygen (or other gas) sensor. The instrument shows the O2% directly.

Ambient air has 20.9% oxygen. MAP targets to flush out this air and bring down the O2 level to under 1.5%. Presence of O2 in excess of 2% can have a degrading effect in product stability and shelf life.

Headspace Gas Analysers

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GERMANY

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Moisture Content

Summary : Presence of excess moisture is paper based packaging has a multifold effect. The standard moisture in Paper or paper based packaging should be between 6-8%. Studies suggest that in case of Shipper Cartons, for every 1% increase in this moisture %, the compression strength of the cartons will fall by 6.5%. So when the moisture goes up to 12% (very common in monsoon season), the compression strength will take a dip of 26%. This needs to be accounted for while preparing specifications for packaging to be used in high humidity/moisture conditions.

Another major issue which specifically is of interest to the Food & Pharma industry is the formation of mildew (mold / fungus). Moisture and porosity in paper when combined with dark and cold climate of a warehouse, provide the perfect conditions for bacteria and fungus to develop and grow rapidly, which is a cause of serious concern.

Moisture should be kept under control to avoid rapid growth of such organisms.

Moisture Measurement (Oven)

Samples are first weighed and then kept in an Oven @ 105 ± 2°C for 2 hours.

The loss in weight is found out and moisture % calculated as :

Moisture % = (Loss in Weight / Original Weight) x 100

This test works on the principle called "Loss On Drying" (or LOD in short) and is the most scientific way to testing moisture content or average moisture.

Oven method is the most authentic method but takes a lot of time. Test reports should be based on this method only.

Moisture Measurement (Instant Meters)

MADE IN GERMANY

Made In the U.S.A.

Samples are penetrated with an electronic device which measure the electrical resistance between 2 penetration points. Since electrical resistance is related to the moisture in the substrate, the correlation can be established. These devices are known as the Instant Moisture Meters.

They are the quickest way to detect moisture %, but it is to be noted that presence of any contaminant in the paper (usually in recycled paper) will have an effect on the electrical resistance. Also paper from different wood types will have slightly different properties and hence the moisture meter will not be a very accurate test method.

Further when testing corrugated boards, the moisture meter will tend to give you the peak moisture (because it measures the least electrical resistance) from amongst all the layers / plies of the board.

Eg. If we test a 5 ply corrugated board which as 12-10-10-10-10 moisture % in its layers, the Instant Moisture Meter will show a reading of 12%, whereas the Oven (LOD method) will give you a result of 10.4%

Instant Moisture Meters are not the most correct method but offer quick results which may be good enough for in-process decisions and quick checks.

Bursting Strength Test of Corrugated Board

Summary : One of the most common test methods of the packaging industry in India is the Bursting Strength Test. The bursting strength of combined board is primarily an indication of the character of the materials used in manufacturing a fiberboard box and has value in this respect.

There is a general misconception that a higher BS means a better carton.

Unfortunately this is a "Material Test" only and doesnot in any way guarantee the performance of the shipper carton formed out of such material. You can have a lower BS corrugated carton having a better compression strength than a high BS carton.

International standard specify that Triple-wall corrugated board (7 Ply) cannot be tested suitably by the bursting method. Testing of double-wall board (5 Ply) is of questionable accuracy since it is rarely possible to get sufficiently simultaneous bursts of the multiple facings. The test is simple and rapid to execute, but it must be recognized that it is subject to serious errors if instrument, diaphragm, and gages are not properly maintained or if improper procedures are used.

Bursting Strength Test of Corrugated Board

Test Method :
The test specimen is clamped in a BS Tester and gradually increasing hydrostatic pressure is applied perpendicular to the face of the sample through a rubber diaphragm till the sample cannot bear the pressure and bursts.

The peak burst pressure is recorded as the Bursting Strength.

Test Standard : TAPPIT-810

Compression Test of Corrugated Shippers

Summary : A corrugated shipper / carton's primary purpose is to protect the unit packaging inside and prevent any undue stress to reach the product. The carton has to withstand the stress of stack load in warehousing and transportation. If the carton is stronger than the stack load, the products will survive. If the carton is weak, the carton will collapse and pass on the load to the inner packs.

Carton Compression Specification = Stacking Load x Safety Factor.

Safety factor is usually between 3-7 and depends on a lot of factors including product fragility, product cost, distribution cycle, transit period, transportation methods, etc.

This test is a typical "Performance Test" and a good compression strength directly signifies a good carton.

Test Method :
The test specimen is placed between 2 parallel platens of a compression tester and pressed. The max load it can bear before the carton collapses is recorded as the Compression Strength.

Test Standard : TAPPI T-804 / ASTM D 642 / ISO 12048 / IS 7028

Compression Test of Corrugated Shippers

Pneumatic Model
(Runs on Compressed Air)

Mechanical Model
(Runs with Motor driven Ball-Screw)

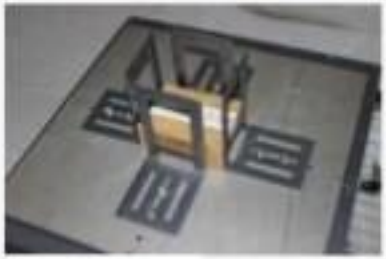
Transport Worthiness Test / Vibration Test

Summary : Generally a product is placed in its primary packaging and then in a secondary packaging before being dispatched in truck or similar transport vehicle. Sometimes the transportation is also through Rail or Air. In order for the product to reach the consumer intact it has to be designed to withstand the hazards of a road / rail / air journey.

The most common failures are seen as breakages, leakages, scratches, etc.

Vibration tests are generally done on filled shipping containers. Such tests may be used to assess the performance of a container, with its interior packing and means of closure, both in terms of its strength and of the protection it provides its contents when it is subjected to vibration such as it experiences in transportation. These procedures are suitable for testing containers of any form, material, kind, design of interior packing, means of closure, and any size and weight. They are not intended for determining the response of products to vibration for product design purposes, nor are they intended for tests of products in their operational configuration as other more suitable procedures are available for these purposes.

Transport Worthiness Test / Vibration Test



Test Method :
As per ASTM D 999, the package is placed on a vibration table which is made to move up / down and cause a displacement of 1 inch. The speed is gradually increased till the package starts bouncing off the platform surface by around 1.6mm. The test is then continued at this speed for the remaining test period as determined by the user (usually 1 or 2 hours).

A study conducted on Indian Road Conditions concluded that for every 1 km of road, there are about 7 pits of 1 inch or more depth.

Which means that in order to simulate a journey of 1000 km, we would need to subject the package to 7000 vibrations of 1 inch displacement. Based on the current test speed, you can calculate the time required for the test.

Vibration Test Machines are usually equipped with Vibration Counter and/or Digital Timer

Test Standard : ASTM D999

Transport Data Loggers are portable, battery operated devices which can sense and record vibration. You can use this data to compare real life vibrations (in a truck) and those that are being generated by a Vibration Test Machine. Some data loggers even have additional recordable parameters such as Temperature, Humidity, and Atmospheric Pressure.
This can help you understand the transit conditions even better.

Drop Test

Summary : Another important requirement for packaging is to be able to bear accidental drops which are the most common effects of incorrect handling practices. Unit packs may get subjected to drops during various stages of production, packing and even while being loaded on store shelves by the store staff or while being picked up from the shelf by the consumer. The package must keep the contents intact. Similarly, the Secondary or Transport Packs may get subjected to accidental drops during transport and warehousing activities.

This test is intended for use in evaluating the capability of a container to withstand the sudden shock resulting from a free fall, or to evaluate the capability of a container and its inner packing to protect its contents during the sudden shock resulting from a free fall. This test method may also be used to compare the performance of different package designs. This test method may also permit observation of the progressive failure of a container and the damage to its contents.

The test help assess :

1) Durability of internal packages.
2) Effectiveness of Partitioning and Cushioning arrangements.
3) Product Fragility
4) Drop Failure Height (which can be used to specify the max storage height of the product).

Drop Test

Test Method :
Individual Unit Packages or Secondary Packages are dropped at different heights and different orientations to assess for durability.

The test height is generally the expected height the product can be dropped from in real life or slightly higher. Heavier packages are generally handled at lower heights and hence dropped from lower heights. Likewise, light weights products are placed higher in shelfs or stacked higher, hence they need to be dropped from higher heights.

Test Standard : ASTM D 5276