

**Food Packaging Technology**  
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**Week – 05**  
**Lecture – 24**  
**Transport worthiness test P2**

Hello everyone. Welcome to the third module of the food packaging technology course. We have been discussing a few topics this week. First, we talked about the principles in developing a safe and protective packaging and we have been discussing the transport worthiness test. We are now going to start with the third part. I hope you remember the transport worthiness test can be divided one into the mechanical tests and in these you will have the drop test, we have discussed this, the vibration test, all this happens on the road or the rail, compression test, we went in for the incline impact test.

Now in today's class we will continue with the mechanical tests that we will be doing for the transport worthiness test which will be the rolling test, drum test, a dart impact test and a few climatic tests. We have also discussed in the previous classes that climate or the environment through which the package goes through has an effect on the contents of the package. So, in this we will be doing tests like rain test, the sand and dust test, salt spray test and the fungus resistance test. Continuing with the rolling test.

Now as the name indicates just like the other cases when you do a drop test you drop it from a particular height. In a roll test you will roll it on all six faces. You have six faces; you have the edges and the corners. So basically, the transit packages or your cardboard corrugated fiber boats they are rolled on the ground on the surface where it is likely to encounter and you will test if there is any impact on the contents in the package. So as the experiment goes you will take the package on its base, you will rotate it so it is on the edge almost three fourth of it and then you let it fall flat on one side.

And with that impact the package is then lifted, balanced again on its other edge and allowed to fall on the other face. So, this falling on each face is allowing it to fall on every face and the whole sequence from base-to-base traveling in a particular direction is going to be repeated. And this test is a very simple test but it will actually help you to evaluate the overall strength of your container. The cushioning that is provided that also helps you can judge if that is good enough and if there is any failure to the contents after your rolling test. And once you get the results it will help you to design a suitable packaging material, helps you to access adequacy in the cushioning material if you need

to add more or if sometimes the cushioning may be too much and it might only be adding to your extra cost.

So that also can be adjusted and you can arrive at a suitable economic placement to the contents in the bulk containers. We will now look at the video which is performed in the laboratory and I think you will get a better idea from that. Next, we will do the rolling test. A package has 6 phases 1, 2, 3, 4th phase, 5 and 6. It has 12 edges and 8 corners.

Here the package is rolled to test its strength and the protection it offers to its contents. Roll the package on its phases, edges and corners. A good package will confront the hazards of rolling. Then we take out the consumer packs in the box and check for any damage or leak. If there is none it has passed the test.

Our next transferred worthiness test is the drum test. So, drum test is just the name given to the tests that are done for packages or shipping containers other than your corrugated fiber boards like your metal crates, boxes, your wooden fiber boards. Now whatever tests you do for your corrugated fiber boards, it can be done for these kind of shipping containers also. Whether it is stacking to see what is the effect on the lower ones, those kinds of tests the same things will be done and those are known as the drum test. The dart impact test is another very important test.

Now what happens you will have seen these darts which have got a slightly blunt surface but at the same time depending on the height from which a dart falls. It can have an impact especially on your plastic films. So, the dart test is actually done to determine the resistance of your plastic films. So, what they do in the test you can see in the video that follows here. They will keep the film stretched and airtight and a dart is allowed to fall on it at a particular height.

So the height can be adjusted and also the weight of the darts. So, each dart that you have has got a particular weight. For example, the red ones that you see in the video will be the 5 grams one. The blue ones will be the 100 gram each. So, you can add on to the weight of the darts by adding on each of these extra ones.

Catching the weights you can adjust the actual weight that is going to fall on your plastic film. So, two things that can be adjusted. One is the height from which the dart falls and one is the weight that is going to fall on the plastic film. So, there are some LDP can have lesser weight while some of the stronger ones you need to add on to the weights. And the height also LDP usually is that is dropped at a height of 660 meters while a high impact strength film you can go up to 1524 millimeter which is again shown very clearly in the video.

So, the dart is released at the center of the film using an electromagnetized holder and the puncture that it causes is going to be observed and you are going to note the weight and the height from which it punctures. So basically, when you do the experiment, it is first a trial-and-error method. You will have to put in the dart, you will have to add on to the weights and see at what point. Suppose it comes at 100 grams you find no puncture. But at 150 grams you do find a puncture.

Basically, you need to test out all the weights between 100 and 150 to see which is the minimum weight at which the plastic film punctures. I hope it is clear. I think it will be clearer once you watch the video. Next is the dart impact tester where we determine the resistance of the plastic film to rupture. Here we use a dart which is dropped at different heights.

In low impact strength films as LDP we use 616 mm and for high impact strength films we use 1524 mm. Different weights may be added to the dart. The red is 5 grams each, white 2 grams, yellow 50 grams and blue 100 gram each. In this test we have used LDP or the low-density polyethylene film. The film is held air tight.

In fact we use clamps to tighten it. The test is designed to measure the ability of the film to resist rupture by shock. It is a measure of the toughness of the material and it is a combination of deformation and breaking properties. As mentioned in case of LDP the height from which it is dropped is important, 660 mm. In high impact strength films, we can go up to 1524 mm.

After suitable weights are added the dart is dropped vertically to the center of the film using electromagnetized holder. The weight of the dart can be increased by using attached weights. Here the film has punctured due to the impact of the dart on the film. The weight required for the rupture is noted. Now that we have completed all the mechanical tests let's move on to the climatic transport worthiness test.

And of this rain test is one of the most important climatic tests. Just like you encounter rain in the real system what you do in the laboratory you will produce a simulated rain. So, this simulated rainfall of 6 into 1 inch per hour they will be produced by a water spray nozzle which is designed to emit the water in small droplets rather than in a fine mist. Okay. And this should be uniformly distributed throughout your packaging material and it is usually done for 2 hours.

So, they will allow the simulated rain to fall on your container for 2 hours and you will see what is the effect. Is it being absorbed? Is it reaching the contents? Is it spoiling the

contents? What happens? So, this is exactly what is happening in a rain test. The second climatic test will be your sand and dust test. Now this seems to be a very simple one but the transit packages would encounter the sand and dust on its journey. So, it is to evaluate the resistance of the package to penetration of the sand and dust one.

Another one to determine the erosive effect of the blowing sands. Suppose in certain regions you have these blowing sands and dust. So, you will see what is the effect of these blowing sands, of these strong blowing sands on the exposed surface of the packages. And also, to determine the effect of any malfunction of the mowing parts in the presence of dust and storm. So, what that experiment is, you will take a standardized mixture of sand and dust.

You should have a density of 0.1 to 0.5 g per cubic feet and this is used to create an atmosphere for the sand and dust test. The temperature is maintained around 77-degree Fahrenheit and this is done for a period of 6 hours. Slowly you will increase the temperature to 160 degrees Fahrenheit for another 6 hours. This is the extreme cases which the packages can encounter.

And the standard dust and sand velocity is usually 200 feet per minute and this is maintained throughout the test. Now if there are items that should always be shielded, it should be tested under a standard velocity of 200 feet per minute and items that will be exposed by blowing sand which is most likely to be exposed. Now there are certain items that will be protected or shielded. You can go for lower velocity for that. But there are some items that are sure will be exposed to these sands so you need to give a higher velocity of around 2300 feet per minute.

These tests are fairly simple but to get the same effect you need to simulate that in the laboratory. And the third one is your salt spray test. Where would the package encounter salt spray? Naturally, during shipment. So, the salt spray test, the purpose is to evaluate the resistance of the package to corrosion by salt spray that you might encounter in your shipment and to serve as a general standard for corrosion resistance. So now coming to the experiment, what they do is the package is exposed for 50 hours to a wet dense fog that is generated by automation.

You know you generate or simulate water which is having a 20% of sodium chloride and this is sprayed onto your packages for 50 hours. And the solution is usually maintained at a pH of 6.5 to 7.2 and the temperature is maintained at 95 degrees Fahrenheit. Now with this you will be able to know if there is any corrosion.

Naturally, salt has a corrosive effect on any surface that it comes in contact. So, what

you would like to see is at certain points, wherever it touches the packages, is there any corrosion taking place, is there any color change, these kinds of things have to be noted. And the last test of climatic test is the fungus resistance test. Now fungus is, you can have mold growth because it's a natural substance, corrugated fiber boards are natural substances, exposed to the humidity, exposed at a particular temperature and naturally there might be growth of fungus. So, what you would test here is, is your package susceptible to fungus growth? So, all materials they should be tested for your fungus growth.

And usually they prepare a spore suspension, it has a fungus growth, more than 4% of the exposed surface has this fungus, then your material is supposed to be a fungus nutrient or it is most likely that fungus will grow on your material. But if 2% or less of the exposed surface is covered with this fungus, then your material is supposed to be fungus resistant or it is inert to the growth of fungus. So that's where you will know if your packaging material is susceptible to the growth of fungus or not. You can correlate your laboratory test with the things that it might encounter in the field. So, you usually get a fairly good picture about the correlation between the performance of the package in service and the laboratory transport test, which reproduces in some degrees to the events.

You can actually correlate and say, okay, this has happened in the test in the laboratory, so it's likely to happen in the field or this has not happened in the laboratory, so likely your product is supposed to be safe during the transit. Second there is a correlation between the laboratory transport test on the package and tests on the empty containers. So, you will also be able to design and increase the cushioning if required, you'll be able to change the design of the package if required, depending on the test or results that you get in the laboratory. And thirdly, a correlation is made between the materials of construction and the containers. So, you get a fairly good idea without going through the whole test in the field.

So, a quick recap, transport worthiness test is mechanical, which are the drop test, the vibration test, the compression test, incline impact test, rolling test, drum test, dart impact test, which we all study today. And moving on to the climatic test, we went through the rain test, sand and dust test, salt spray test, and finally the fungus resistant test. And the particular type of test that you do will depend on the circumstance through which the package might go through. And whatever information you want, you want to change the design, you want to add the cushioning, you want to see what happens to the package.

Depending on that you choose the test. So, in general, it might be said that all these tests would help to include the overall durability of the container. Any possible reduction in the cost of the packaging that you can do after these tests. Number three, any

improvement in the design that you can apply. And number four, any adequacy of the cushioning material that may need to be adjusted. So, in short, a series of tests would enable us to determine the transport worthiness of the package.

I hope you got a fairly good idea from these videos of the tests that are done in the laboratory to check the worthiness of your package during transport. I will see you in the next class, till then take care. Thank you.