Glass Processing Technology
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Lecture - 28
Tempering_Part V

So, let us move on our final topic about a Tempering a Standard. So, tempering a standard is as per EN 12150.

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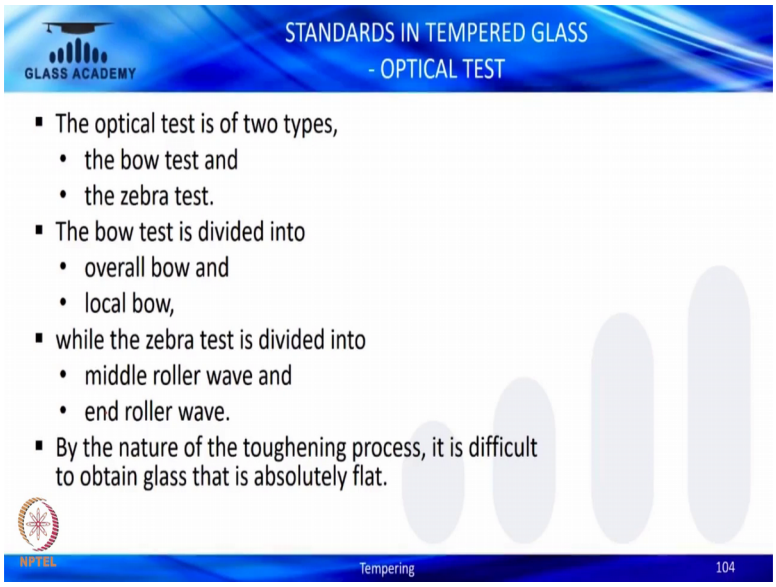

So, it is I am sure you are going to have a practical sessions which we will have. So, I will, I would like to touch upon few things about what is exact standard it says and in terms of European standard EN 12150 for a tempering process.

Optical test of two types: one is bow test and zebra test. The bow test again it is divided into the overall bow and local bow, while the zebra test divided into middle roller wave and end roller wave. By the nature of toughening process it is difficult to obtain glass is absolutely flat. So, such why so, that the standard says it is safeguard as so, it gives some certain regulations, certain process how to conduct the test, if in case if a processes and the how to determine this quality. What is basis it is like bible, it is like set of standards has been listed over there, how to test and what are the values to be used in terms of glass tempering process.

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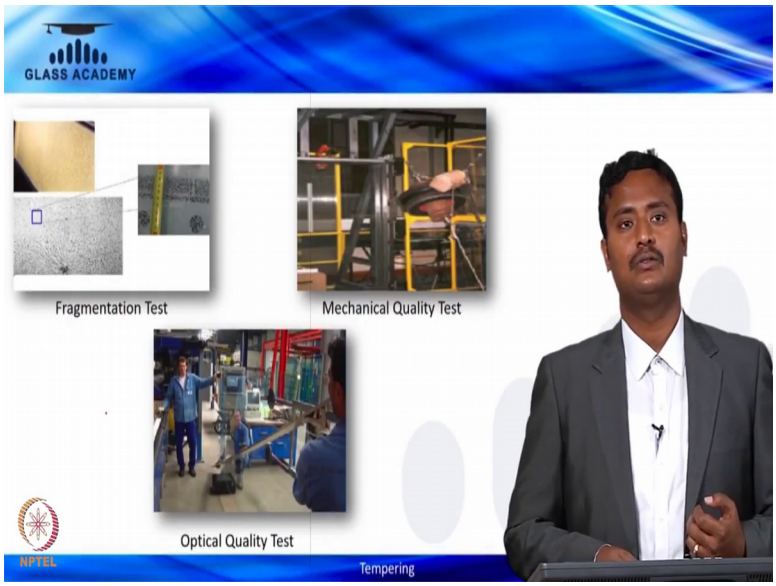

So, fragmentation test which as you all know about it. So, as per the EN 12150 so, we have to take it like a 360 by 1100 at the centre market where 50 by 50 mm once you market and you break it; so those area you have to calculate. If it is more than 40 particles you are your tempering process is passed for architecture applications. And, mechanical test like soft part test like 5 kg of short bag can be lifted like it is like a pendulum test which in fall from the distance of 250 centimetre, then you can be drop.

If it is not break will be passed on this and quality test, optical quality test like overall bow, local bow, overall bow which you can see there is the flatness case which will be kept in the center or will be diagonal portions where you can measure this overall bow; what is basically bend is that depend on them.

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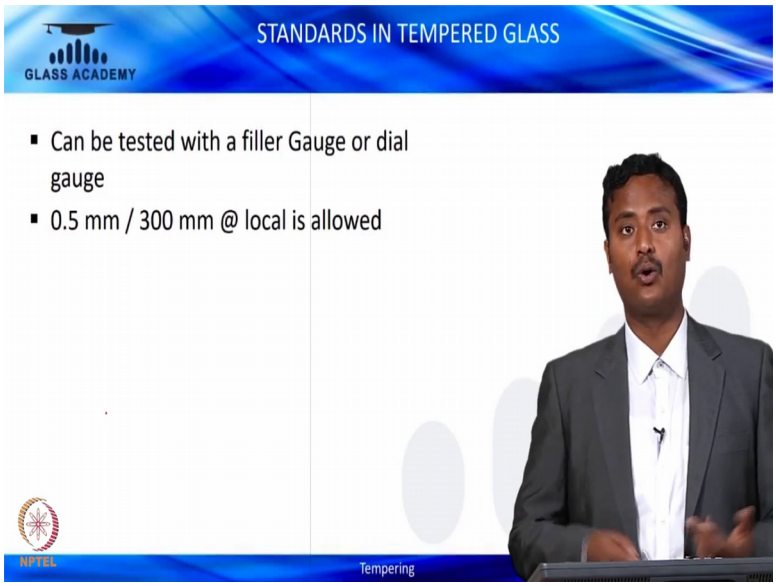

So, local bow can be I mean can be tested with the filler gauge or dial gauge like 0.5 mm per 100 mm is the local bow is allowed as per EN 12150.

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And this is the bow test this is the overall bow test as per the EN standard is 3 mm for 1 meter is allowed as per the EN 12150.

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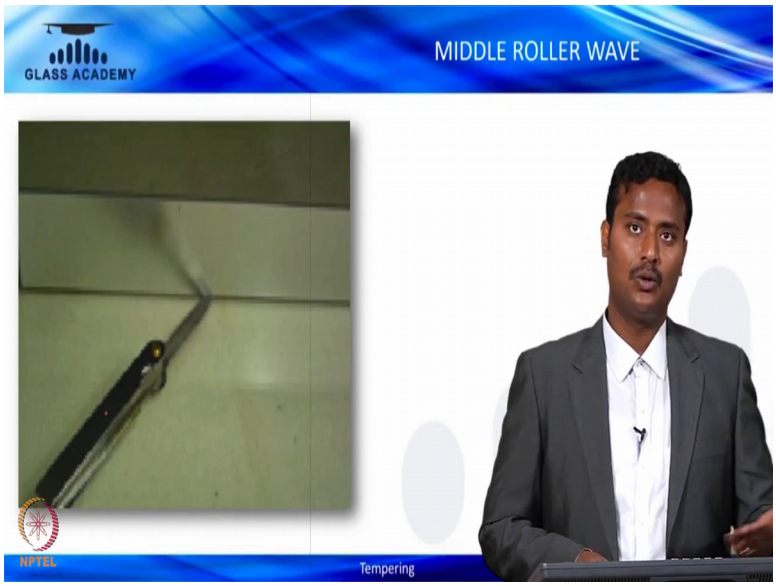

And this is the roller filler gauge which you can fill through, if you are not able to keep it straight you know I mean the flatness gauge you can fill a gauge or these tool can help us identify the how much overall bow local bow is there.

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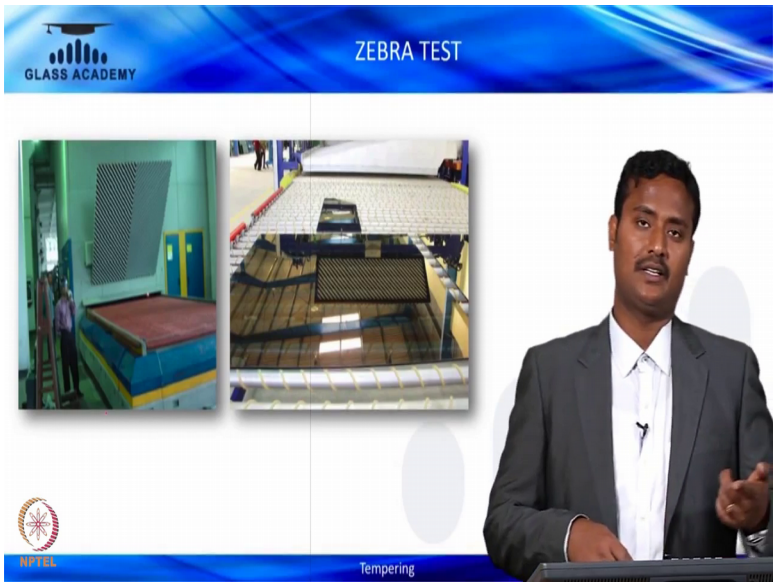

And zebra test so, this is the optical test which we will conduct from the distance of 3 meter distance at the 30 degree angle which you can see when the glass exit. So, already there is the zebra bow has been placed over on the of tempering furnace. When the glass exit you can see through this how much the reflections against the zebra lines, if it is

completely distorted you have to reject it.

So, you can see that the left hand side and the right hand side pictures is eliminated which shows that the glass perfectly alright now, as good as there is no zebra line has been completed distorted. It is as good as similar line of similar line of zebra bow. So, this is a test for optical distortion which you can test at the time of tempering.

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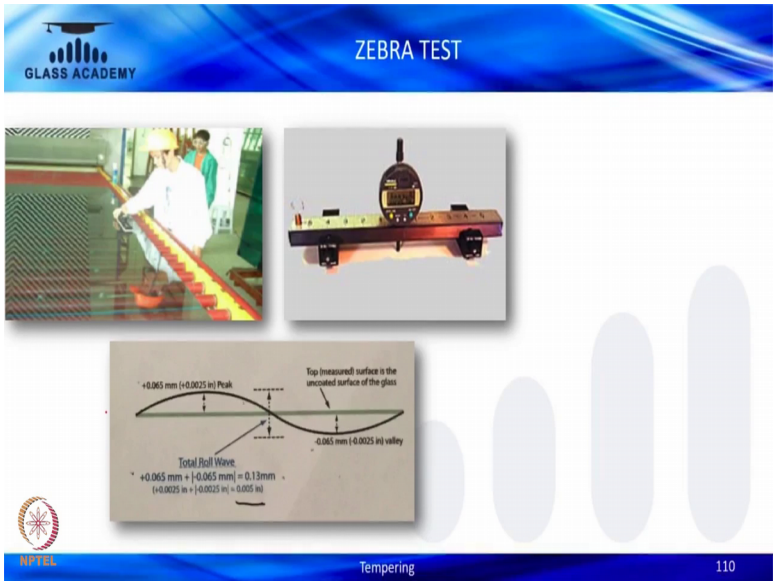

Next is during zebra either you can test or you can do it at the large scale as well, this is roller wave. Basically, this will help us to understand what is the peak and valley distance of the tempered glass. So, what you have to do at the, if you take a such big glass for example, as per the standard 360 b 1100 mm if you take it, we have to leave it 150 mm at the bottom and keep the apparatus and just drag it from this till 600 mm or 700 mm. Then, thereby you will have readings of peak and valley distances. Then you calculate how much what is the peak and what is the valley.

So, you take average and you can calculate this. So, that is your overall roller wave. Basically, roller wave will be tested either you can do it on the lab scale or at the time of tempering you can do that.

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And this is the most widely used in processing industry which is called the gaze gazing angle surface polari meter which will help us how much stress strain has been induced on the glass. So, this is the stress pattern in case, the left hand side will be a manual which you have to dilute till that line is comes you as a horizontal line. So, based on the dialling gauge you will have a there will be a chart.

So, we have to look at it and what is coming like that in the left hand side. Whereas, the right hand side you will have a more it is a digital kind of this, where you can see that exactly without altering everything you can see that there is a rim lines which will be seen through on this digital meter which you can see that also.

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And this is we have already having said that we already discussed about this fragmentation test. This test been conducted on 360 by 1100 as a sample from the center that in mm distance you have to keep it, the either sharp knife you can take or a kind of our tool which you can be used for testing the detector part.

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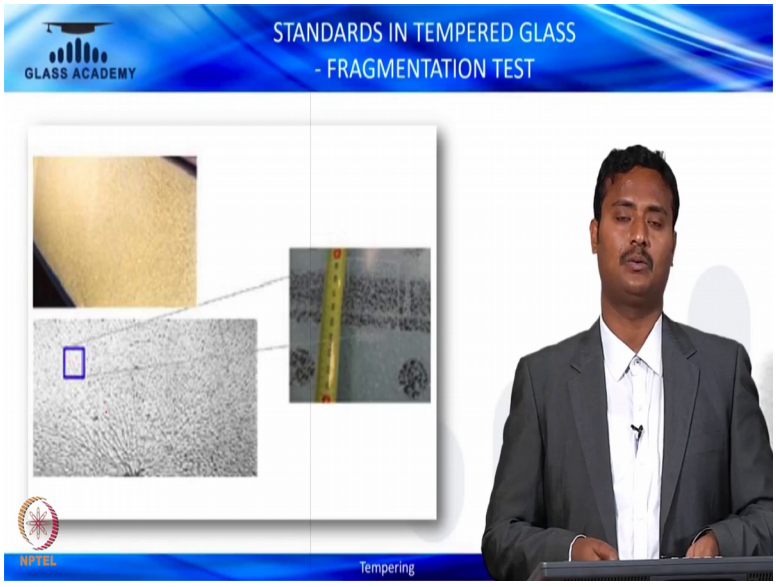

So, once you done it so, you have to mark it how much it is coming you have to measure that one that the stipulated marked bow point towards them.

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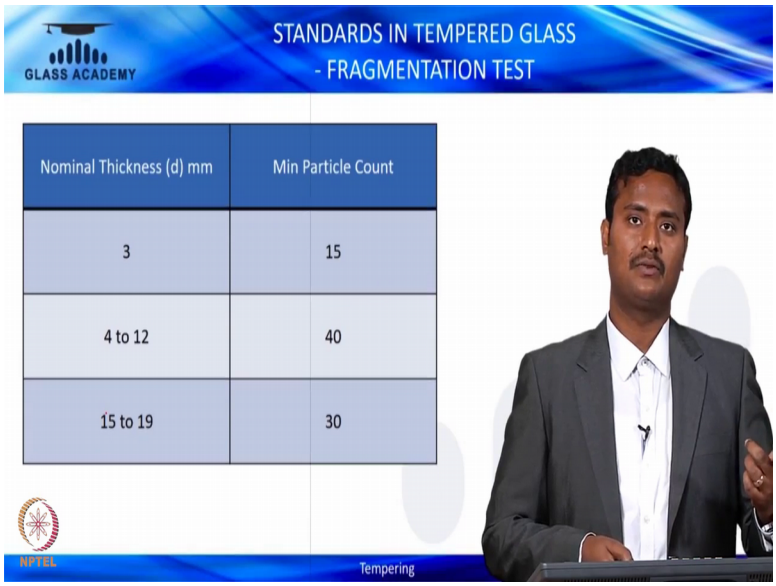

And nominal thickness for example, 4 to 12 mm the 40 count is as per the EN 12150 which is acceptable. If it is 15 to 19 mm will be 30 count will have to stabilize a architectural point of view.

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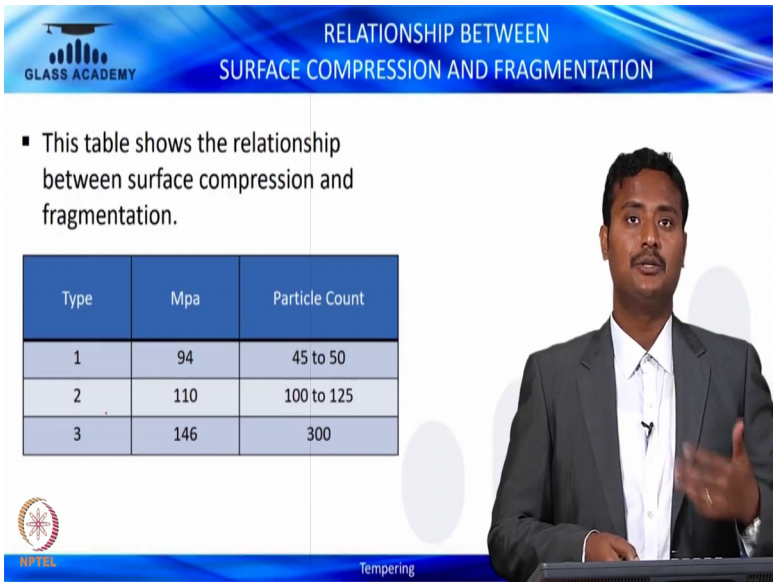

The relationship between surface compression and fragmentation. This table shows relationship between surface compression fragmentations. Like type 1 like 94 mega Pascal when you measure it through the same glaze glazing surface polari meter, if you measure the 94 the obviously, there will be relation between the particle count also close

to 45 to 50. If it is more than 100, 110 then you are particle count also will be more than 100 to 125. So, it is correlated with mega Pascal to particle count. So, that is all about relation between surface compression and fragmentations.

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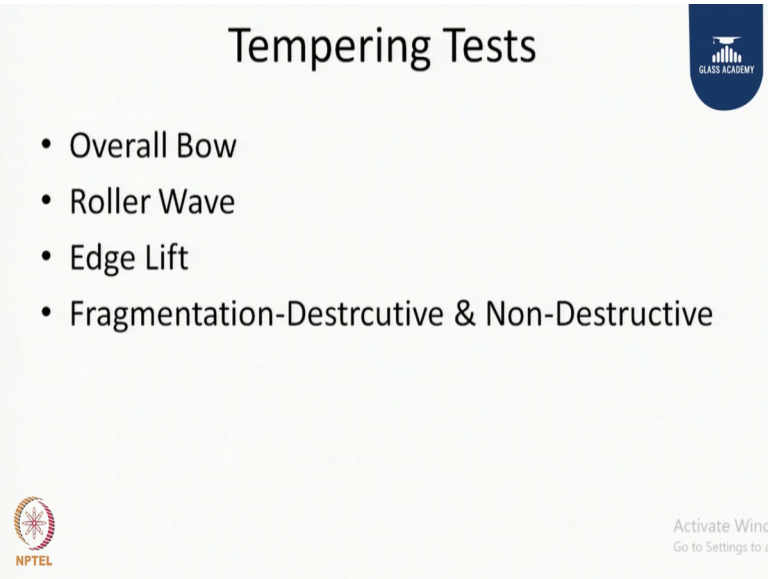

Tempering tests we basically focus on 4 parameters that is the overall bow, the roller wave, the edge lift, the fragmentation. The fragmentation is with respect to destructive or non-destructive. Now, let us elaborate every parameter in detail.

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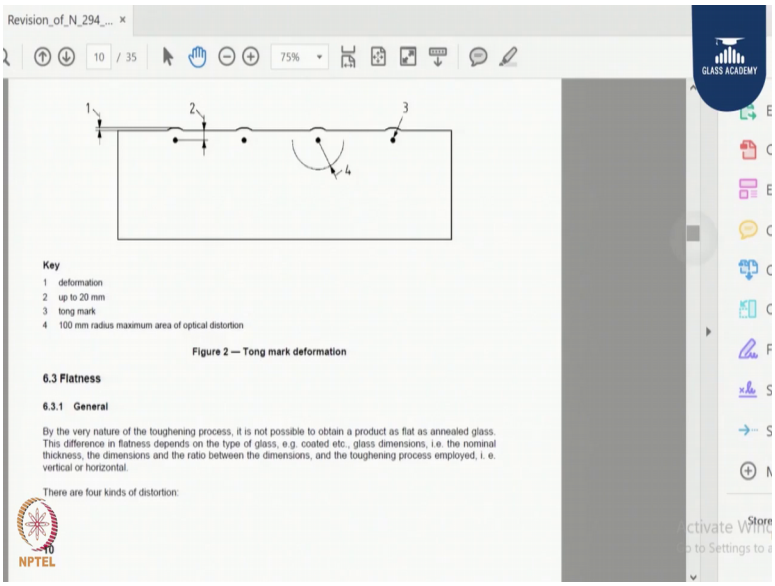

If you see in the tempering department our main intention, our main intention is to keep

the glass as flat as possible. So, how we are going to and the flatness is dependent as the glass is passing through heating process it acquires undulations and we need to overcome.

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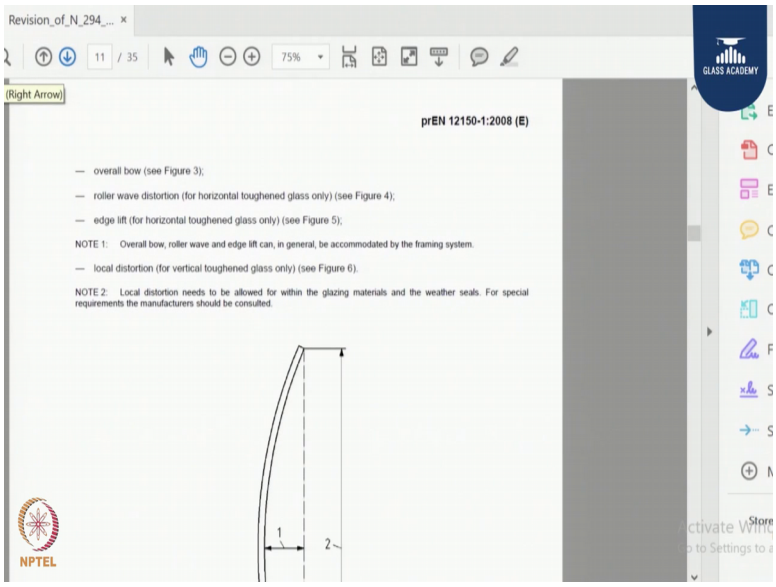

So, in order to overcome the glass will be having we need to overcome 4 deformations like overall bow, roller wave, edge lift and the local distortion. If you see in the figure this is the overall bow, over bow measurement. The test how I am going to execute is, I am going to take the glass on the longest side of the glass I am going to; on the longest side of the glass I am going to keep on the wooden blocks sitting wooden blocks at quarter position resting on the glass.

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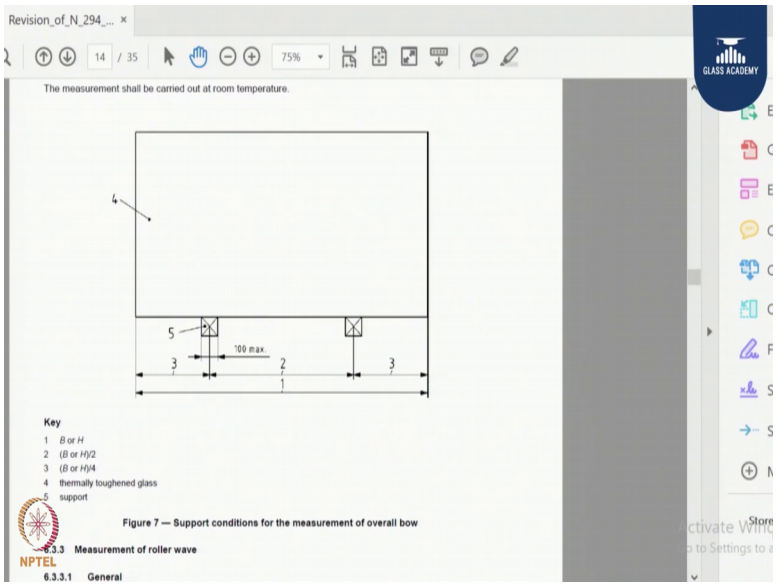

And, I will be taking a straight edge ruler and keeping along the glass surface and with the help of a taper gaze I will be measuring the gap between the glass and the straight roller.

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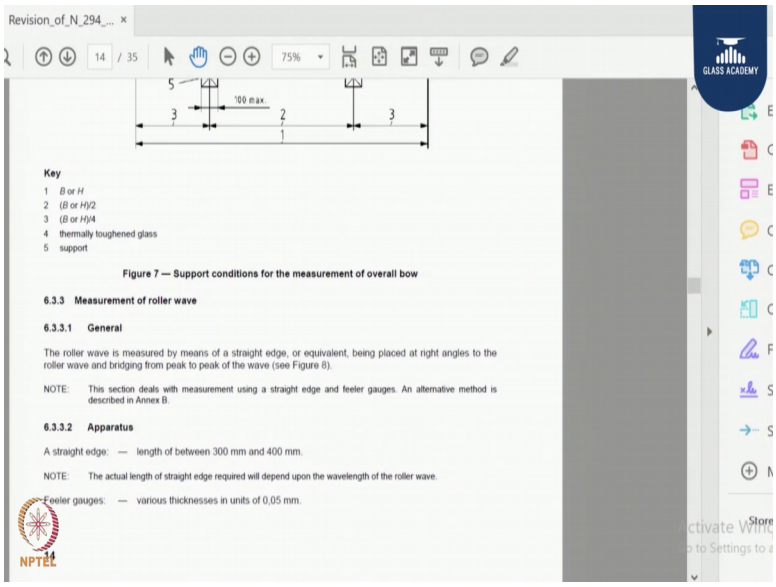

Generally, the as per the standard in a 3 in a litre in a 1 meter glass 3 mm bend is allowed. So, this is how I am going to check the deformation.

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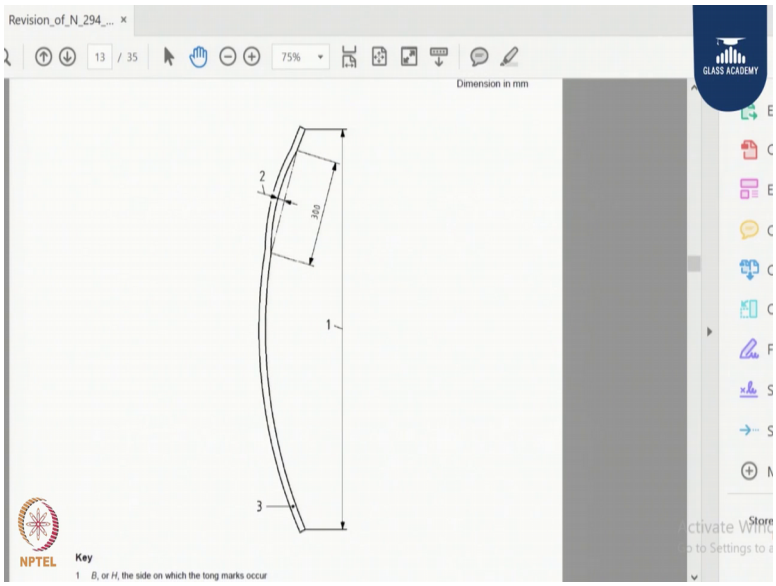

If you see here I am able to check the deformation that is the point local distortion, the point where from one edge or one end of the edge to other end of the edge, I am measuring with the straight ruler and I am get I am measuring the gap between the glass and the straight ruler.

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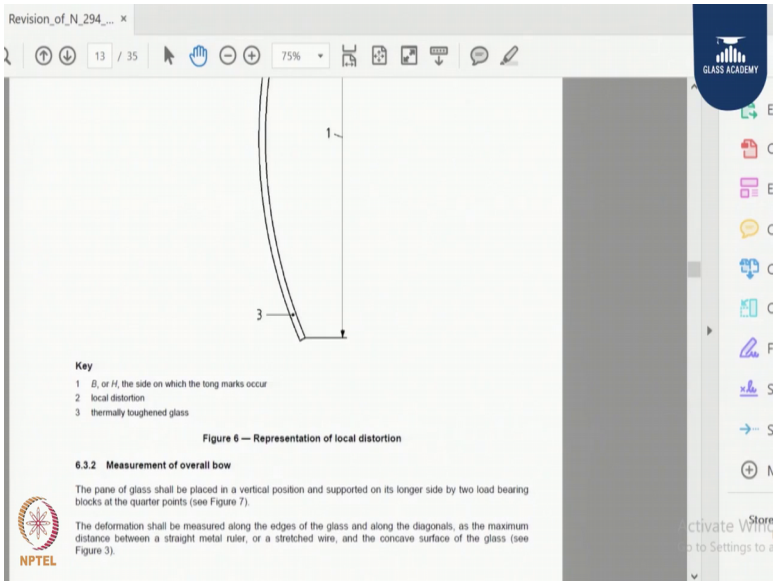

And, 1 mm in as per the standard in a meter of meter glass 3 mm bend is allowed. So, this is how I am going to keep the glass on a vertical supporting system. Now, we will be understanding the roller wave. If you see the roller wave what do you mean by roller

wave? As the glass is passing through the passing on the rollers it will be acquiring undulations. So, we need to see how we are measuring the roller wave.

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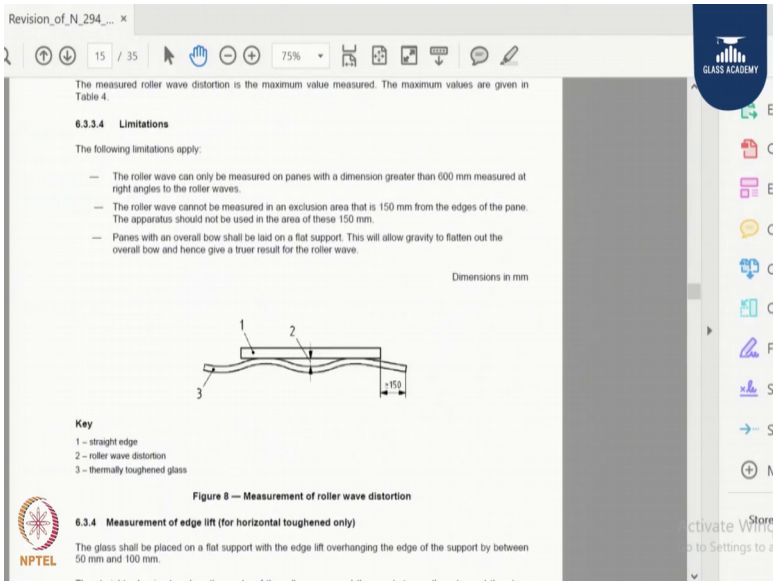

What we do is, if you see in the figure the glass is moving on the rollers and it will acquire roller waves. Generally, the roller waves will be in the form of a sinusoidal wave. So, it will be having a peak and a valley.

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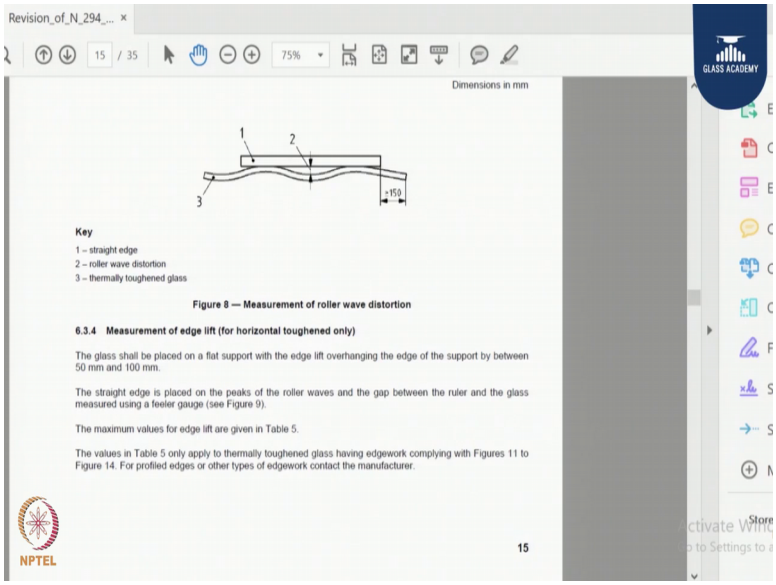

So, we need to measure the peak and the valleys of the glass and if you see the next is the edge lift. This is how the edge lift is going to get, edge lift is nothing but the distortion

what we get on the edges. You can see in the figure there is the, there is a curl or dip on the edges which will be measuring by leaving 100 to 50 mm on the edges.

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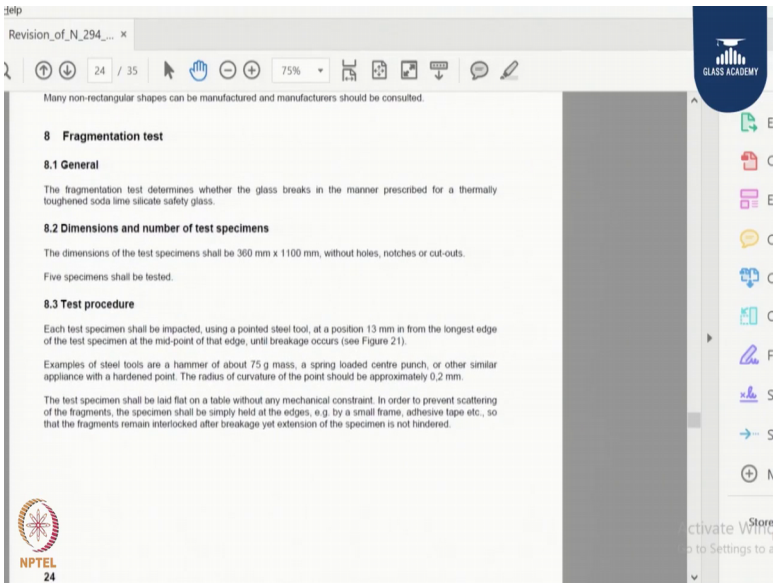

Next you see the fragmentation procedure, fragmentation test. If you see the fragmentation test what we do is we will be taking a 360 by 1100 sample.

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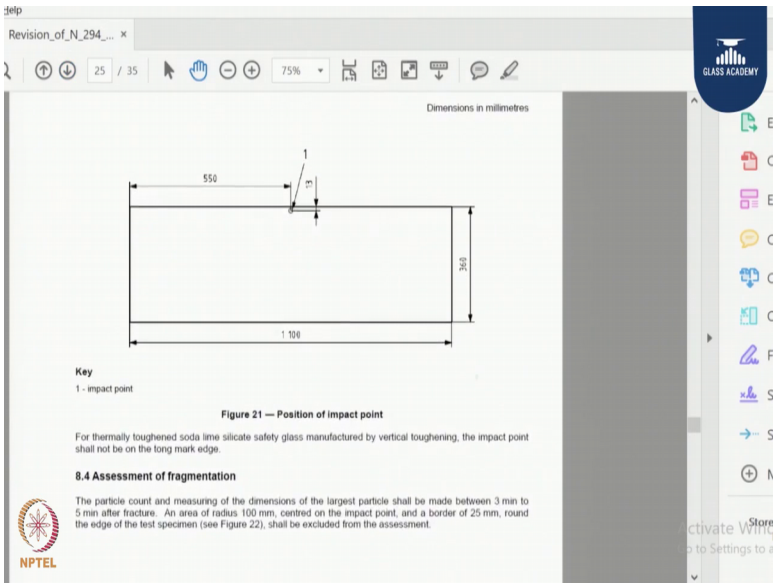

And at the by leaving the half inch we will be we will be taking a centre point that is 500 mm at 500 m 550 mm will be taking a centre point and by leaving half inch from the edge we will be marking the glass, punching tool will be punching the glass.

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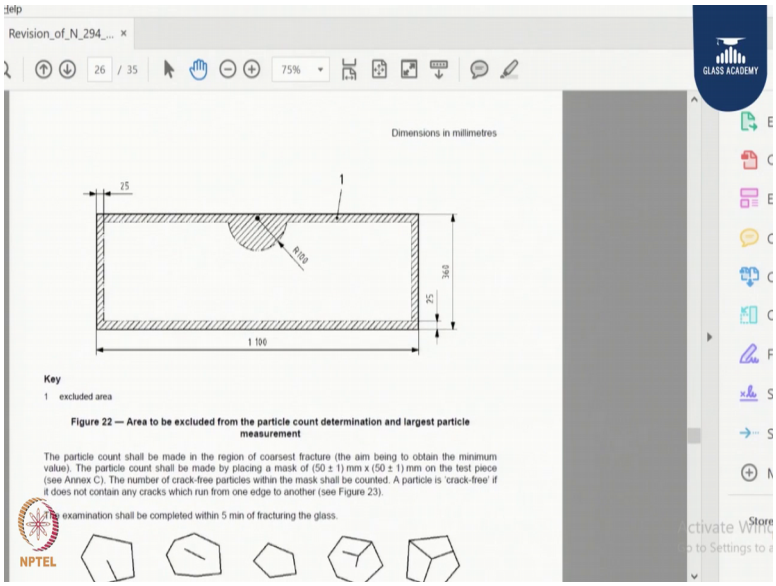

If you see the glass will be and we will be applying a productive film so, that the glasses shall not scattered and we when we punch the glass we will be leaving a 100 mm arc length. And, we will be measuring we will be even leaving 25 inch on all the 4 sides of the glass and we will be seeing the particle counts.

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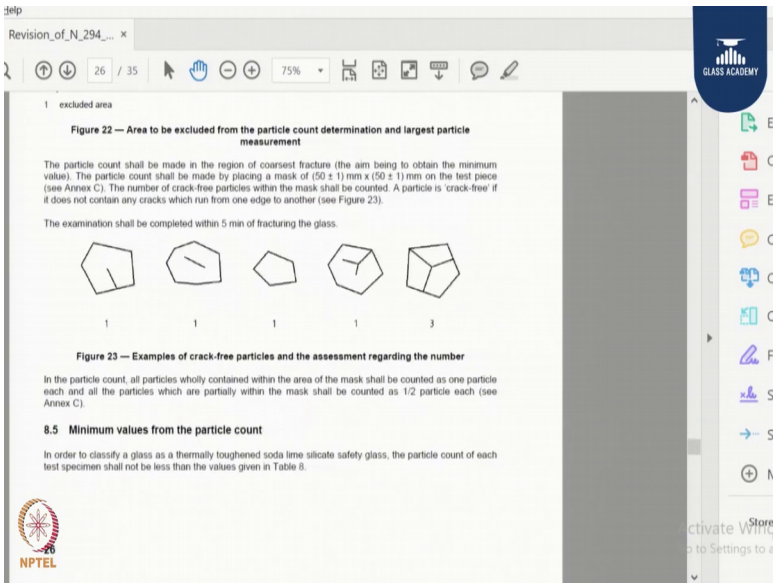

You can see the particles will get in this pattern.

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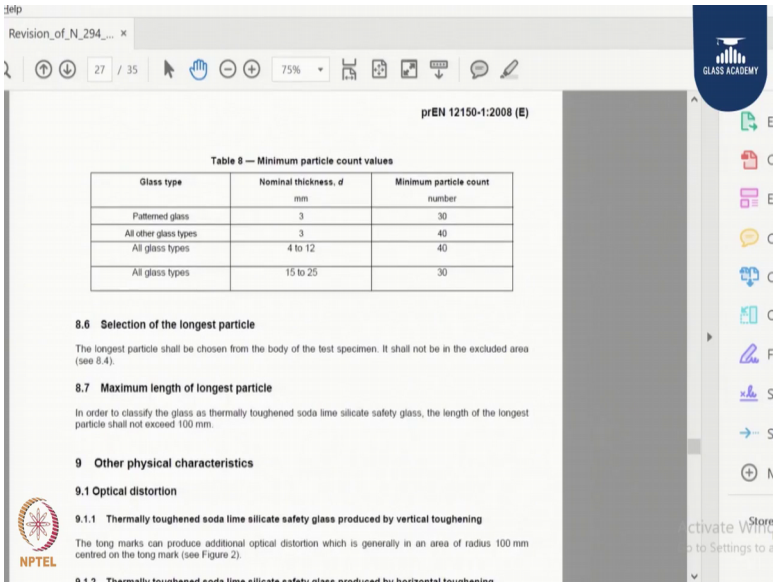

As per the standard if I am breaking a 6 mm glass, I should get a minimum of 40 particles when I measuring in a 50 by 50 square plate along with that.

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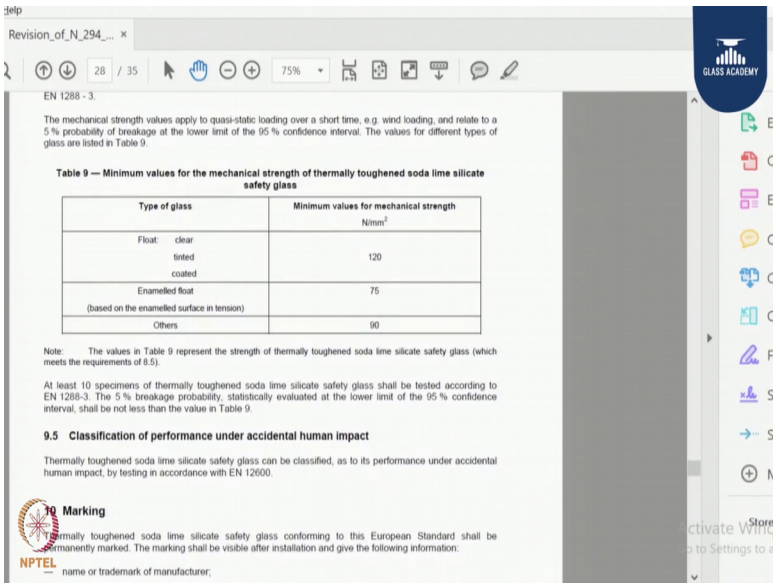

Now, we need to understand the other method also, which is a non-destructive method.

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