Glass Processing Technology
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Lecture - 53
Quality Testing

Now we need to understand the zebra board on to the glass.

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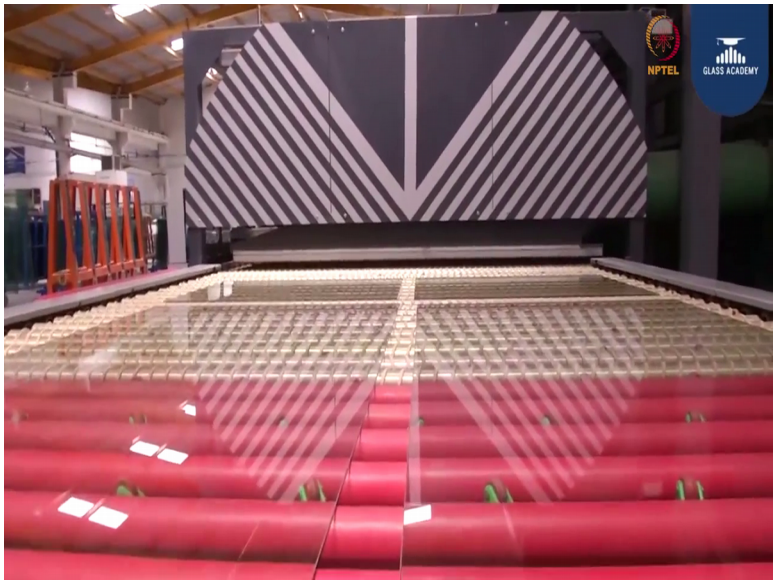

We need to see the zebra board on to the glass to check the distortion levels. So, that image you see on the glass, that image you see on the glass, all four glasses. So, this is one way of visual inspection through zebra board for a heat treated glass come.

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Now, we are going to this is one way of at the time of unloading we will be checking for the glass having bend or bow. You see from this edge to that edge that edge from this edge to that edge you can find what is the bend level inside the glass. So, in between there is (Refer Time: 01:29) glass. Now you see the straightness of the glass, glasses having any bend or bow that you can check at the time of unloading. And always there should be an interleaving between the glass at the time of stacking.

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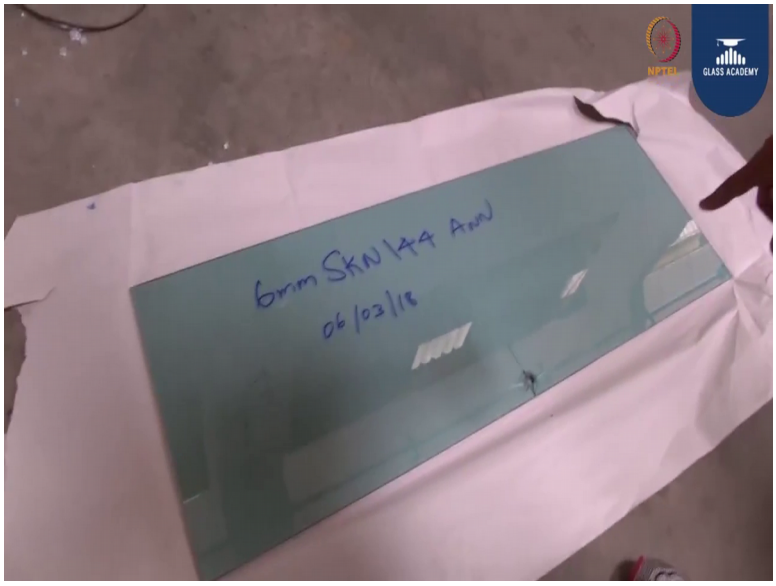

Now, you see if you have three glasses one is of annealed or raw glass.

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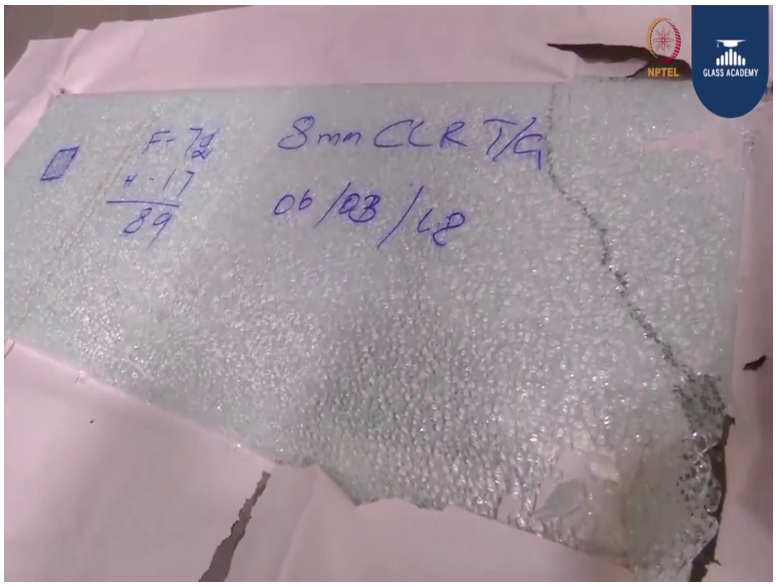

One is of HS glass; one is of toughened glass by looking at the glass we cannot say which one is which type of glass. So, one of the one of the traceability to the processing of the glass is through breakage. That is known as fragmentation test if I break an annealed glass it has no direction it has no pattern. It can break an irregular pattern and it can harm injuries it can create injuries also. So, annealed glass will break like this whereas; if you say see a HS glass if you see a heat strengthened glass.

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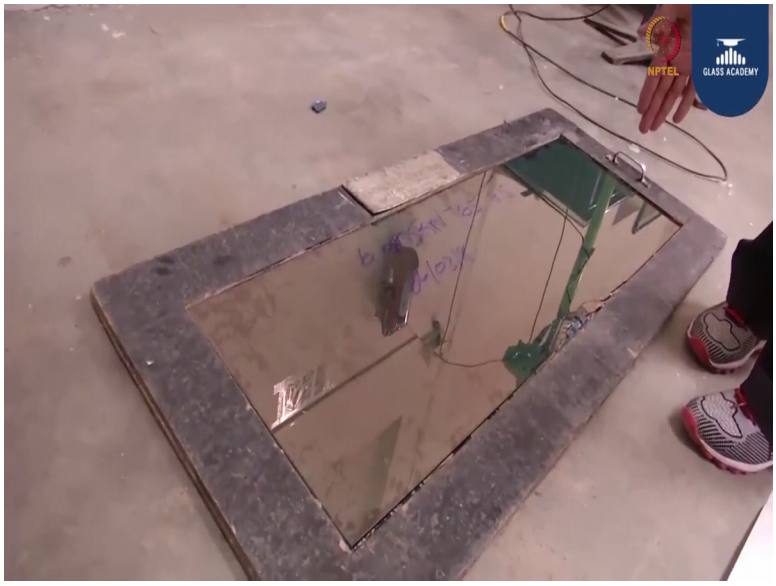

If you see a heat strengthened glass from the impact point the impact at the crack will

end at the opposite edge from the impact point the crack will end at the opposite edge which describe it is a heat strengthened glass. The same thing the same thing when you see a toughed glass when I impact you can find the small granules on the particles known as fragments. If you if you see for a 8 mm clear glass. If I found the particles it should be minimum 40 particles so in this particular thing we have got 89 particles. So, through breakage pattern, we can describe which whether it is a annealed glass or a HS glass or a toughened glass.

Sir: You take all the three from top.

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Now, we are going to measure the bend in the heat treated glass. First the sop; first we need to measure the bend should be always measured on the longest side (Refer Time: 03:55).

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So, it is 2,100.

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So, next we need to apply setting blocks at the quarter positions. [FL].

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So, what we are doing is we are giving setting blocks at 500 distances.

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Now, visually we need to see bend direction. Next step is we need to see visually where the bend is. So, it is towards this side.

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Now this is a now, this is a straight ruler with the help of straight ruler we are going to measure the bend in the glass.

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So, this is the taper gauge this is the taper gauge which we determine bend levels on the glass. I am going to keep the glass straight keep the glass straight.

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And I am going to measure the gap or the bend between the glass and the taper gauge if you see it is coming less than it is coming 1 mm. So, this is how you are going to measure the bend. So, it is coming 1 mm less than 2 mm 1 mm 1.5 mm. It is coming here you can see there is no bend only this particular point you can find there is a bend of 1 mm. We can check even diagonally also, cross cross.

[FL] glass [FL]

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Now, this is a diagonal measuring glass straight you can see it is less than 2 mm bend we

are getting diagonally also. So, now, we are going to conduct roller wave measurement on the glass.

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If you see this is a 6 mm SKN 765 glass as the glass is passing through heating and cooling. The glass will be acquiring certain mechanical properties like roller wave, edge lift, bend and stress. Now, we are going to measure what is the roller wave in this particular glass. In order to perform the roller wave we need to have a roller wave gauge.

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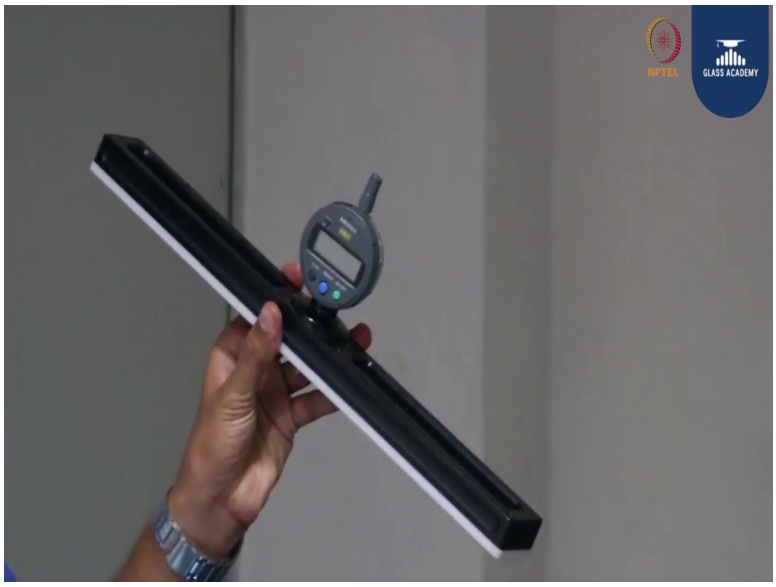

We need to have a have a 1,100 by 36 glass sample and we need to make sure the glass is

kept on the tinted side on top. As the glass is during tempering process the tinted side is touching the roller. So, we will get a roller impression on the tint side now, we are going to measure the roller wave on the glass.

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First we need to place the roller wave gauge on the glass we need to ensure the flatness of the table and we need to Make sure that glass is resting flatly on the surface ok.

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First we need to leave 150 mm for edge lift; next we will be starting the gauge the movement of the roller wave to be perpendicular to the glass direction, so perpendicular

to the glass direction.

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Now, we need to keep the roller wave on the glass surface and we need to drag the roller wave on the glass surface to note down the reading. You can see that value is getting changed. Now it is minus 0.2 minus 0.1 minus 0.2 0. So, you can see generally we measure the roller wave gauge.

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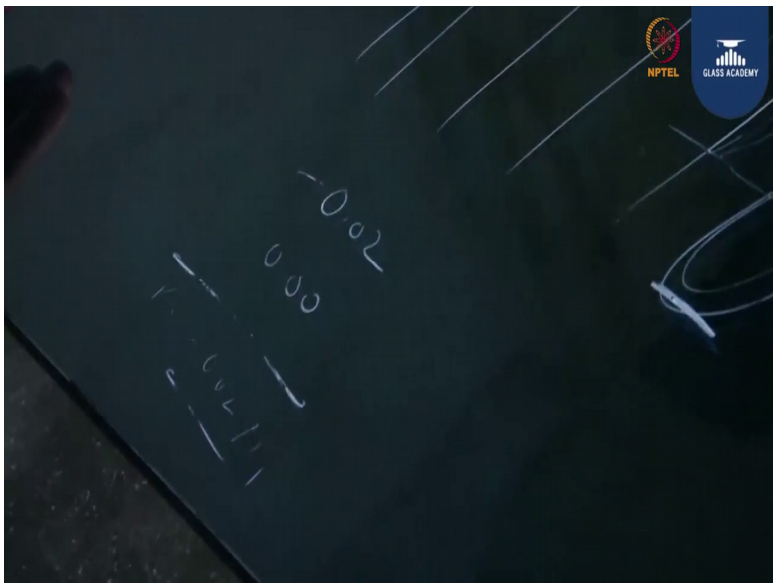

Now, the roller wave is equal to roller wave gauge is equal to the peak and the valley is permanent one no white pencil is there white pencil.

White pencil.

As the glass is moving through rollers as the glass is moving through rollers, it will be acquiring a sinusoidal wave. And one complete cycle will give me the roller wave. So, it is a mixture of base and hardener sorry it is a summation of peak and the valley. So, the minimum value what we get is what is minus 0.2 and the maximum value what we got is 0.00. So, the overall roller wave is equal to 0.02 mm shall I repeat or.

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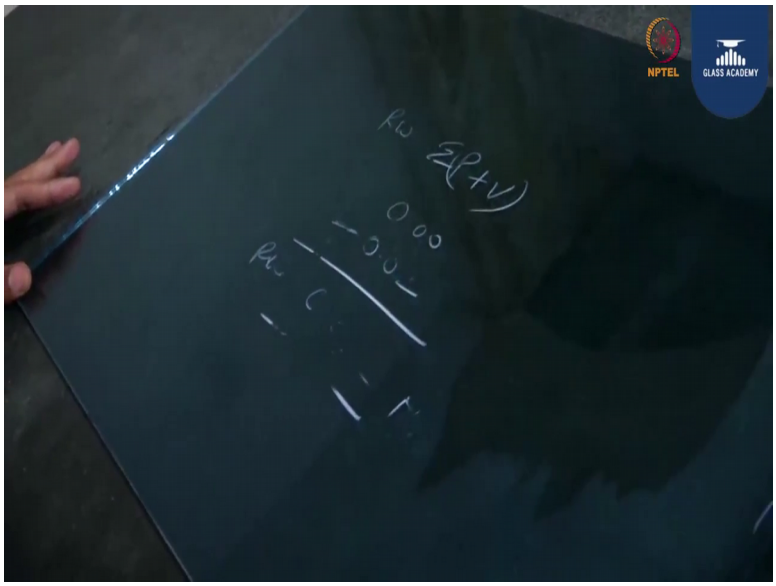

The roller wave is a summation of peak and valley is a summation of peak and valley. So, with the peak value what we got is 00 and the valley what we got is 0.02 minus so it is a summation. So, our roller wave is equal to 0.02 mm in this particular glass roller wave is equal to 0.02 mm.

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Now, we are going to perform so in order to recap I am just summarising how we are going to measure the roller wave. First tool we need to take a 1,100 by 360 sample as per the standard en 1863, Next we need to play we need to take a roller wave gauge the placement of the roller wave gauge to be perpendicular to the glass direction. Next we need we need to leave 150 mm on the edges.

Then we need to start dragging the roller wave glass on the roller wave gauge on the glass surface. We need to note down the maximum and minimum value the summation of the maximum and minimum value will give the roller wave on the glass the allowable roller wave as per the standard en 1863 is 0.3 mm ok. Now we are going to see the second test that is known as edge lift.

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Now, we are going to perform the next test that is the edge lift or edge (Refer Time: 11:24). The proper the process for this one is first we need to hang one 50 mm on the on the flatness surface.

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Next we need to take a straight edge, and we need to take a feeler gauge. So, we need to keep it the straight edge vertically and we need to insert the feeler gauges. We need to make sure the coating is on top.

Now, I am trying to insert the feeler gauges.

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From starting?

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Ok now we are going to insert the feeler gauge readings into the glass surface. Whichever scale is not going that will indicate your roller wave. Sorry, edge lift in the glass you see this reading is not going. So, this is how you are going to measure the edge lift in the glass.

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So, it is 0.19 mm so it is 0.19 mm (Refer Time: 13:13) came out only. So, for tempering basically we will. So, to conclude for tempered glass we will be doing four test. First one is the fragmentation, which will determine whether the glass has been heat strengthened or toughened or annealed. Second test is the bend or bow that will determine the bend levels in the glass. Third one is the roller wave that is that is measured for the distortion levels on the glass.

And fourth one is the edge lift that the roller wave what we get at the edges. Through tempering process we are enhancing the physical we are enhancing the mechanical properties of the glass, we are not changing the physical properties of the glass. The dimensions width thickness everything will remain same only we are enhancing the mechanical properties of the glass; through which we are acquiring strength in the glass.

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Now, this is one more now this is one more machine known as Heats of Chamber.

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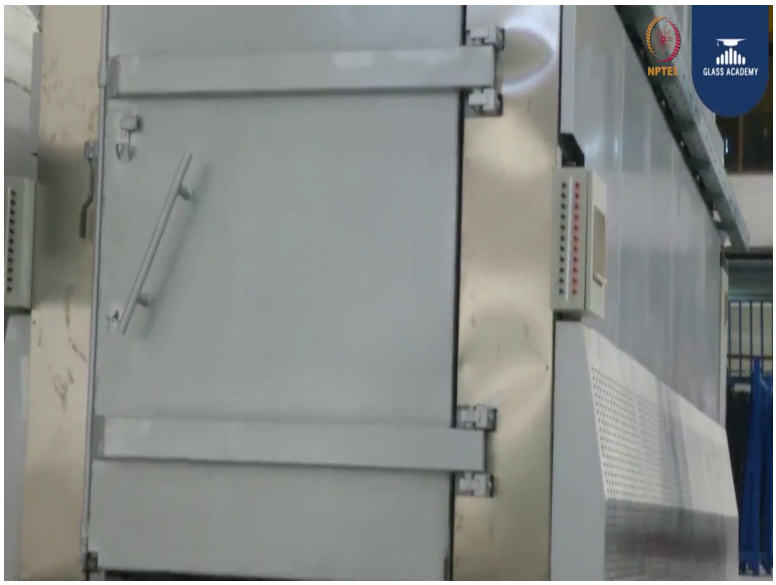

Generally the glass tends to break spontaneously. This is exclusively for a toughened glass because inside the raw material composition there is one impurities known as Nickel Sulphide. The nickel sulphide content get activated during the toughening process because it has two states alpha and beta. And during toughening process it is unable to complete, it alpha and beta state because of the glass tend to break spontaneously. In order to minimise this spontaneous breakage the toughened glasses we are going to send inside the heats of chamber.

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This works similar to a autoclave where the glass will be heated and hold at 290 degree centigrade and again it will be cooled. This is a complete 6 and half hour cycle.

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So, this is how we are going to send the glasses inside the inside this chamber this is a additional process. Whichever glass is having impurity that will be getting broken inside the furnace this chamber. The glass having impurity will get break inside the chamber itself.

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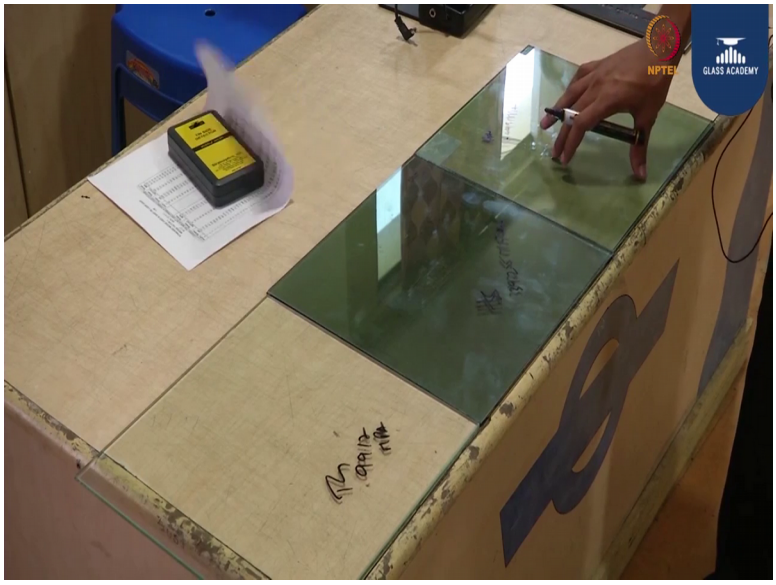

Now, if you see there are three glasses one is toughened glass one is heat strengthened glass one is annealed glass. By looking at the glass we cannot say which one is annealed, which one is HS, which one is toughened. So, in order to distinguish which is annealed which is toughened and which is HS; we have certain testing's.

One of the testing is what we have in the shaft floor that is the fragmentation test; with the fragmentation test we can say, with the breakage pattern we can say; whether it is a annealed glass, HS glass or a toughened glass. When I break a toughened glass it will break into small fragments, when I break a HS glass from the impact point the crack will end at the opposite edge, when I break annealed glass it has irregular shape and a pattern can be anywhere. That is but that is a destructive method of testing. If at all a glass breaks at the site level, we cannot go on a breaking all the glasses.

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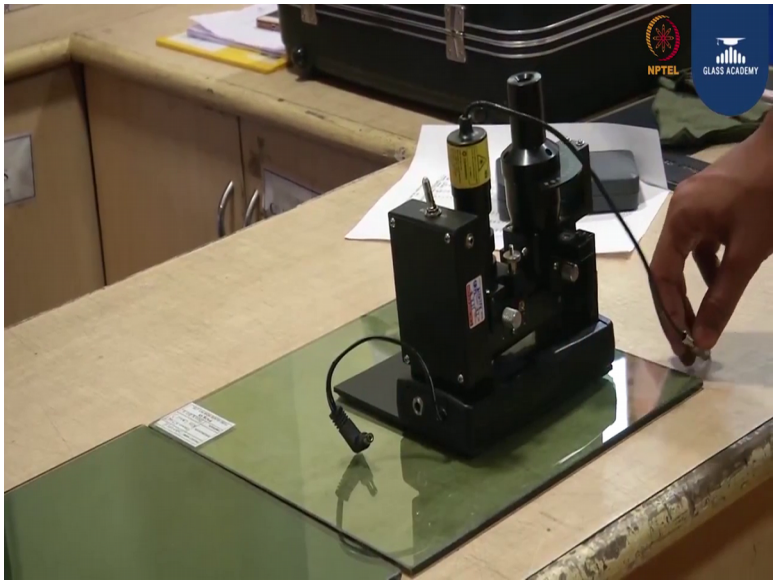

So in order to avoid breakage we have one more test known as GASP. This is known as Glazing Angle Surface Polari meter; with the help of this GASP equipment we can measure what is the stress level induced during the tempering process. Annealed glass will have less than 2,400mpa; annealed glass will have less than 2,400 pounds per square inch psi. Whereas, a HS glass will have 3,500 to 7,500 psi and a toughened glass will have more than 10,000 psi. So, with the help of stress levels we are going to measure, what is the stress induced in the glass with the help of this GASP.

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This is self calibrated plate so this is this is showing this reading or this value is showing it is 12,500 psi so indirectly indicates it is a toughened glass. Now, we can do self

calibration with this equipment. First we will do self calibration, then we will do the testing on the actual glass this is known as Liquid Index.

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So, this is known as liquid index.

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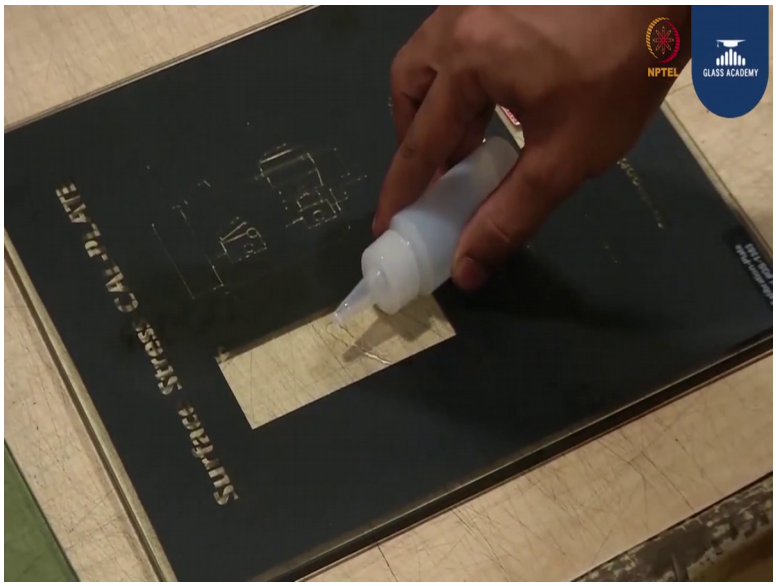

We need to place it on the area, where we need to measure the reading.

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And inside if you see there is a prism here, inside at the bottom surface. So, when the light passes through this thing it works this GASP works with the concept of light refraction, when the light is passing on this thing. How it is getting reflected and what with what angle through the angle we have one chart.

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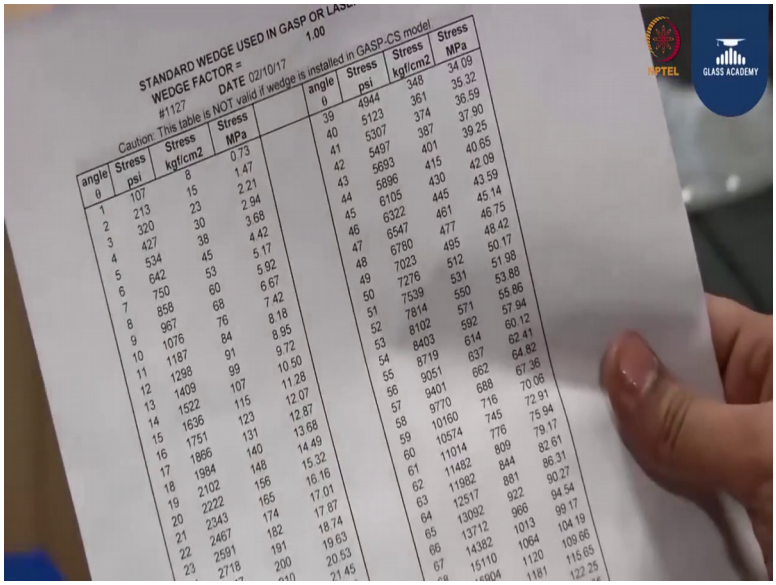

This is known as a angle and test reading chart. So, based on the angle we are going to measure what is the stress induced inside the tempered inside the glass.

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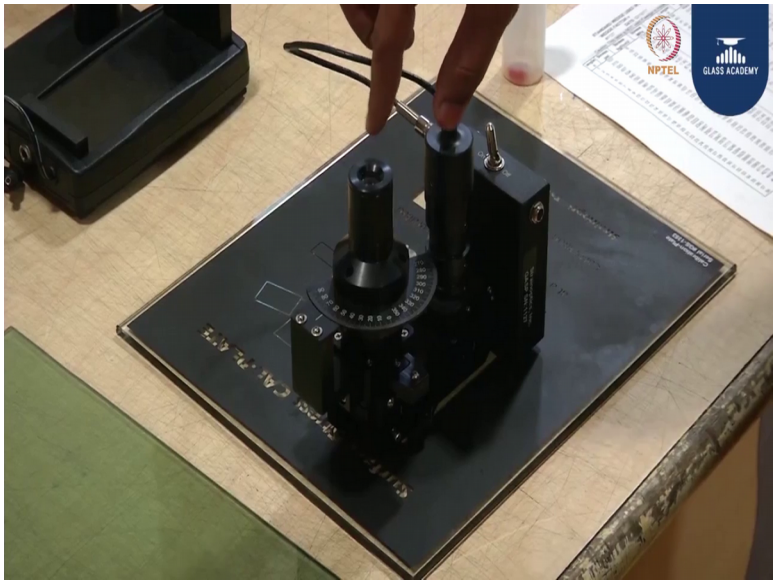

So, first we do self calibration first we need to switch on the GASP equipment. First we need to switch on the GASP equipment, then through the lens we need to see if you see inside there will be a stress lines. We need to match the stress lines with the widget. And we can adjust through this adjuster.

switch off fan.

Now, if you come; if you see first we first this is now we are doing self calibration. So, when I see any toughened glass or any heat treated glass I will be able to see the stress lines. So, through this angle and widget, I am able to match the stress lines of both the equipment and the glass. You can zoom it in this particular area.

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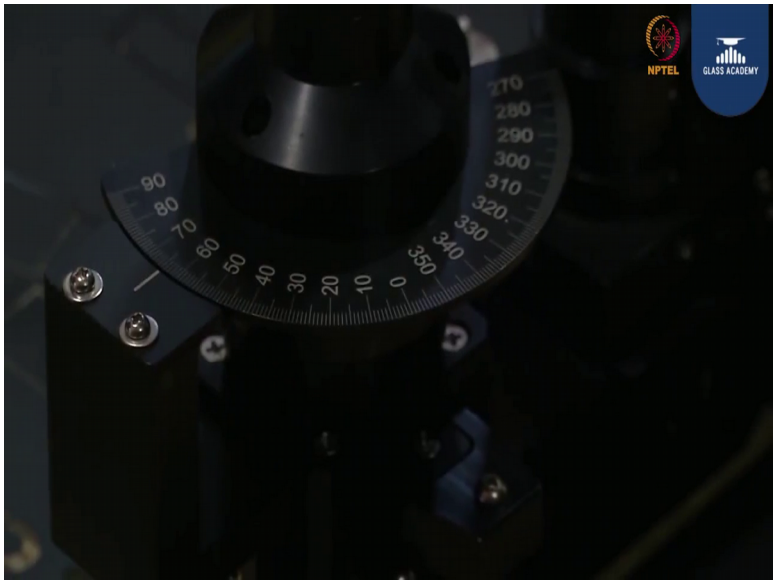

This particular angle and the stress lines are colliding at the angle of 65 degrees 65 degrees.

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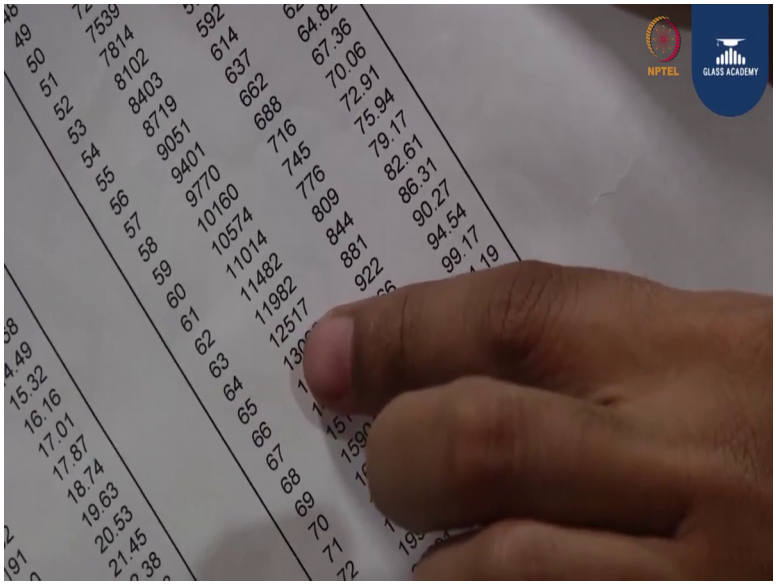

Now, we need to cross verify here 65 degrees; what is the stress level that is getting induced. So, it is 12517 and the as per this thing it is coming 12520.

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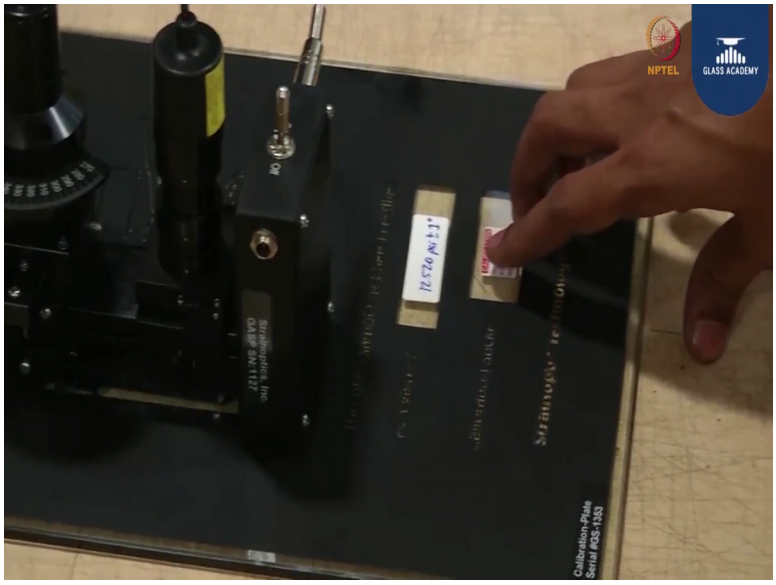

The stress lines colliding at 64 degree angle, as per the 64 degree angle here you can see the reading is 12517 whereas, we are getting 12520. So, this plate and this equipment means based on the self calibration we can say that the equipment is calibrated. Now we see that this thing on actual our glass.

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First we are going to measure on annealed glass. In order to make this reading we need make we need to make sure that the reading is taken on the tinted side. Generally if you see any glass the glass will have two surfaces; that is known as surface1 and surface 2. If you put your finger and if you are able to fill the single impression that indicates it is a coating surface, if you are able to fill multiple impressions that is a non coating surface

so for this particular glass this is a tin side.

The same thing we can even check with the tin side tester also just will place this on this thing when you are able to see the haziness that indicates it is a tin side you see here the haziness is visible. So, bottom one is the tin side, you are able to see the haziness you are able to see the haziness here.

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Sir: Switch on fan or else.

You are able to see the haziness here or shall I take that side.

Sir: Side.

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If I am able to find the haziness at the point of contact that indicates my tin side. In this particular case I am not able to find any haziness or fogginess. The same thing if I keep on this surface, I am able to find the fogginess or haziness.

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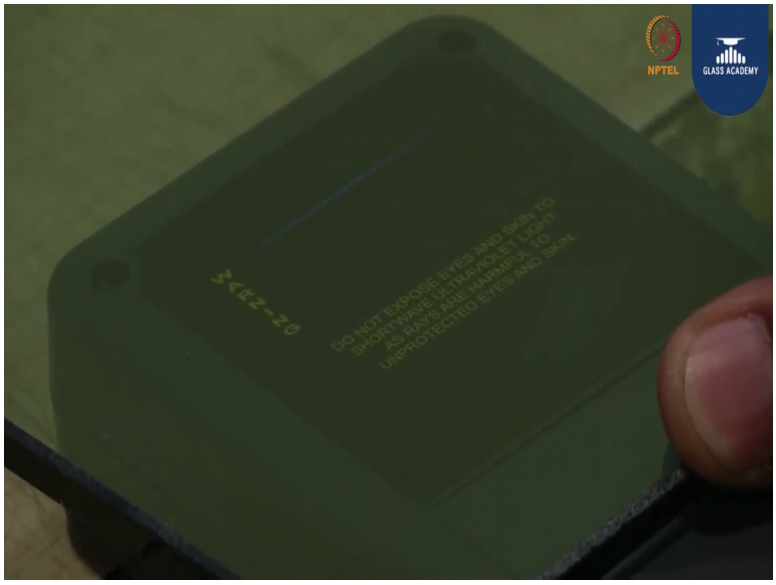

With the help of tin side tester, we are making sure what is the tin side in the glass. You are not able to find any haziness in the glass surface. The same thing when I keep the glass in the opposite side, I am able to see the haziness. So, the bottom one is my tin side. So, now I will be placing be my GASP equipment on the tester.

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I will be using a liquid index for better vision brighter vision.

Charging not there, no charging, never used.

Just only one day I

Never used.

I was using sir

What using sir, no charge. If no charge means the vision will be very less.

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Ok.

That thing you show it. (Refer Time: 26:12).

What we do is actually I am manipulating here. Come now you see this angle.

You keep here.

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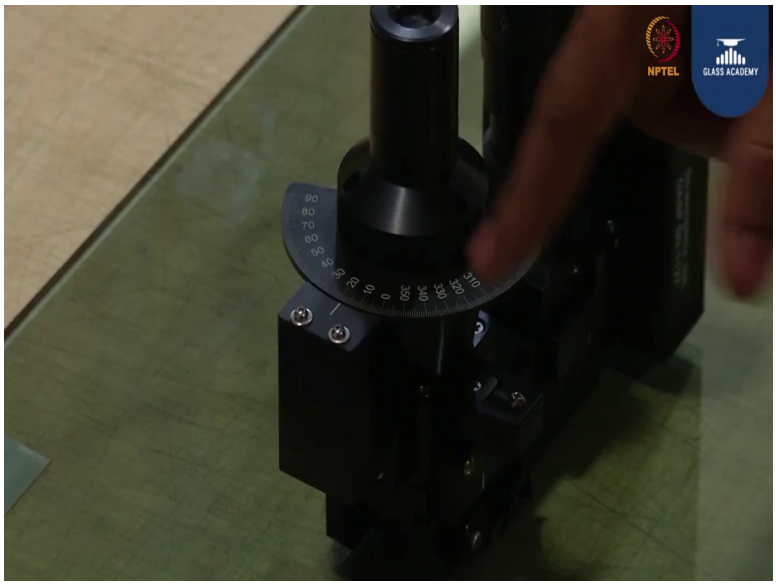

If you see when I keep my GASP on the annealed glass the reading, it is showing is 19 degree angle it is showing 19 degree angle.

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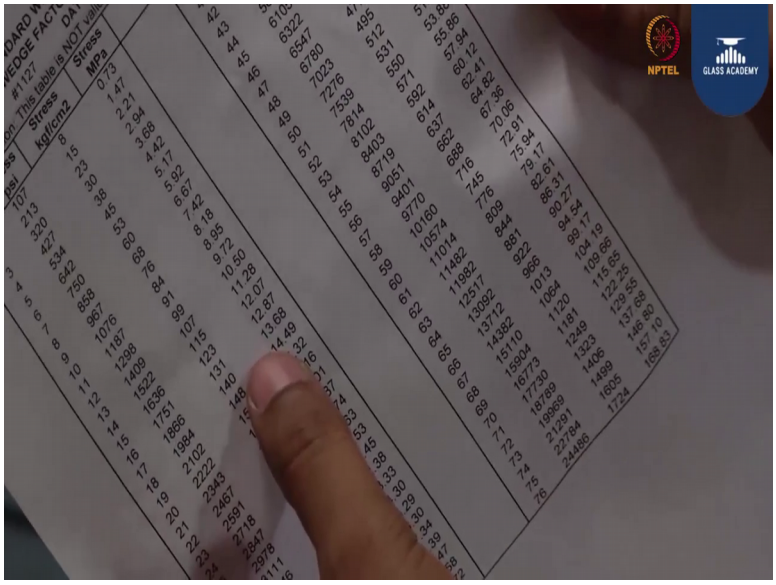

Through this chart I can able to find the stress level in the glass GASP is 2102 psi or it is equivalent to 14.49 MPa which indicates the annealed glass has less strength. The same thing we will compare on the heat strengthened glass.

We can able to see that (Refer Time: 27:03).

Now, same procedure first we need to identify what is the air side what is the tin side for this particular glass this is the tin side. So, with the help of tin side tester we are cross verifying.

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Now, if you see when I keeping this I am able to find haziness on the glass.

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The same thing when I rotate in this surface there is no haziness.

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There is haziness so this is my tin side. Now again I will be applying liquid index. You see here now the reading it is showing is 43 now the reading it is showing is 43. And the 43 the respect to MPa is 39.25. So, earlier we have seen for the annealed glass it was 14.49 MPa. The same thing when I checking on the heat strengthened glass it is coming to be it is coming to be 39.25 MPa.

Now, the same reading we are going to write for measure for toughened glass. For a annealed glass it was 14.49 MPa. For a HS glass it is 39.25, 39.25mpa. Now we are going to measure for toughened glass; in order to measure for toughened glass again we need to check which one is the tin side and which one is the aid side.

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So, this is by looking at the haziness we can make out we can make out this is the tin side. The same thing when I when we check on the other side there is no haziness.

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So, this is my tin side surface.

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Now, I will be applying a liquid index.

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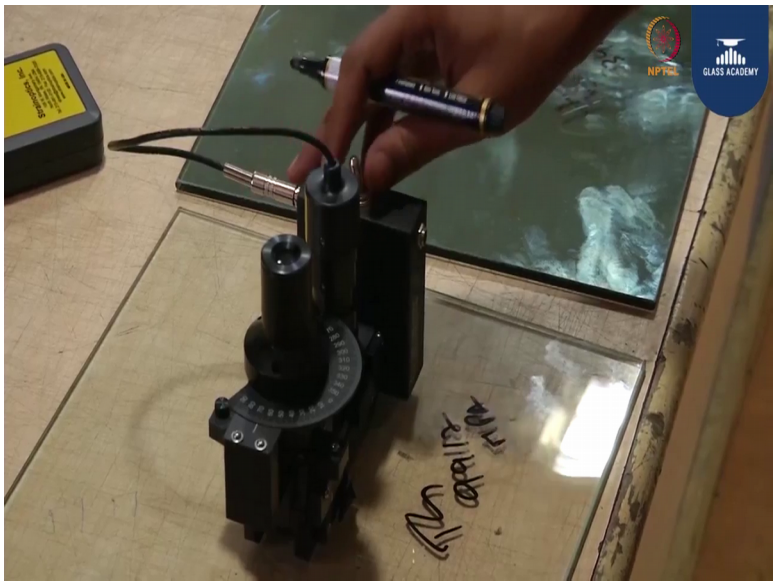

Next I will be placing this GASP and shells measure the reading.

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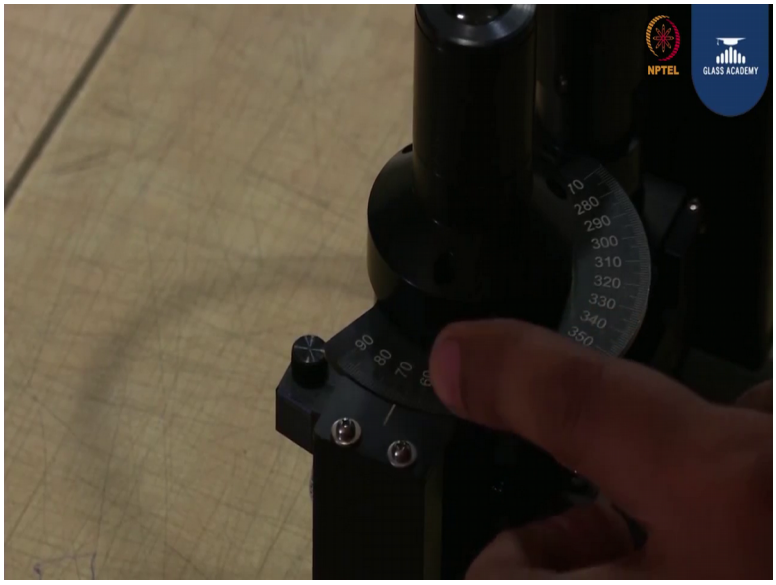

So, you can see it is so you can see it is 67 degree angle it is matching now. Now we need to compare with the chart 67 is equivalent to 99.17. So, this particular toughened glass is having 99.17 MPa.

1 minute.

So, now we need to summarise to summarise so when you see a annealed glass HS glass and a toughened glass. By looking at the glass we cannot say which one is HS, which one is annealed, which one is toughened. We have two methods to differentiate; one is destructive method that is through fragmentation test. We are going to say with the help of breakage pattern and the fragments we will say whether it is a annealed or a HS or a toughened glass. But fragmentation test or destructive method destructive method of testing is not always possible.

So, we are going to have a non destructive method of testing known as GASP with the help of GASP during the heat treatment process glass will be acquiring stress. So, with the help of stress levels we can make out whether it is a annealed glass, or a HS glass or a toughened glass. So, we have checked all the three glasses we have found that for a annealed glass the stress levels are 14.49 MPa whereas, the HS glass it is 39.25 MPa and for a toughened glass it is 99.17 MPa. So, this is one method of doing stress levels in the glass without breakage.

So, through stress levels also we can find make one more point what is; that means, annealed glass if you see this is the weakest glass, HS glass is twice the annealed glass.

And the toughened glass is 4 to 5 times is stronger than the annealed glass. And also HS glass is in between annealed and toughened ok.