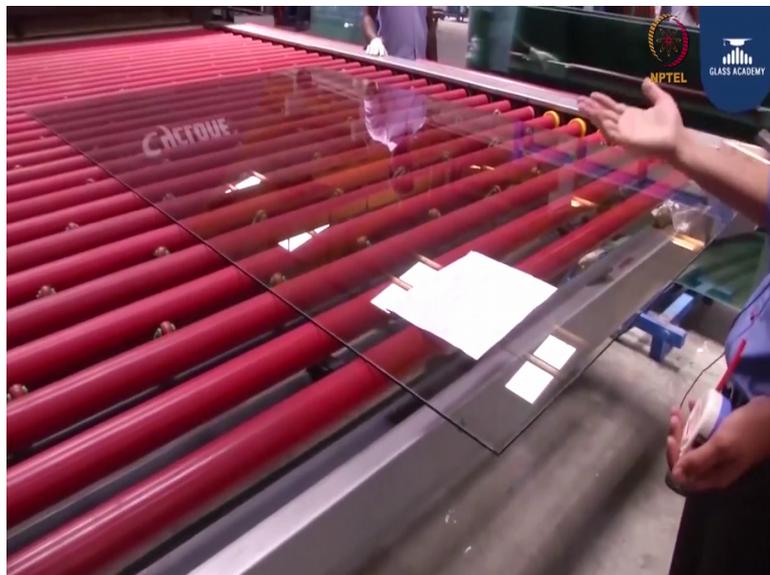


Glass Processing Technology
Mr. Ramu
Department of Civil Engineering
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Lecture- 30
Tempering Part- VII

Now, this is a tempering process, where we are increasing the strength in the glass. Earlier whatever we have seen basically we were dealing with annealed or raw glass, where the strength of the glass is very weak.

(Refer Slide Time: 00:22)



Now, we are going to increase the strength of this glass by heating and cooling. So, basically we are enhancing the mechanical properties of the glass through tempering process and we are not changing the physical properties of the glass. Here we need to see the height and width basically in order to avoid a distortion. So, first we will measure the size of the glass if you see it is 1460, this is the order where I require my glass has to be heat strengthened and heat strengthened. Now, I am processing 6 mm pier glass and the width is 1459.

And my height is 2243 2244 it is coming 1 mm. Now, they are going to we are going to differentiate, through the help of logo we are going to identify whether the glass has been tempered or not.

(Refer Slide Time: 01:34)



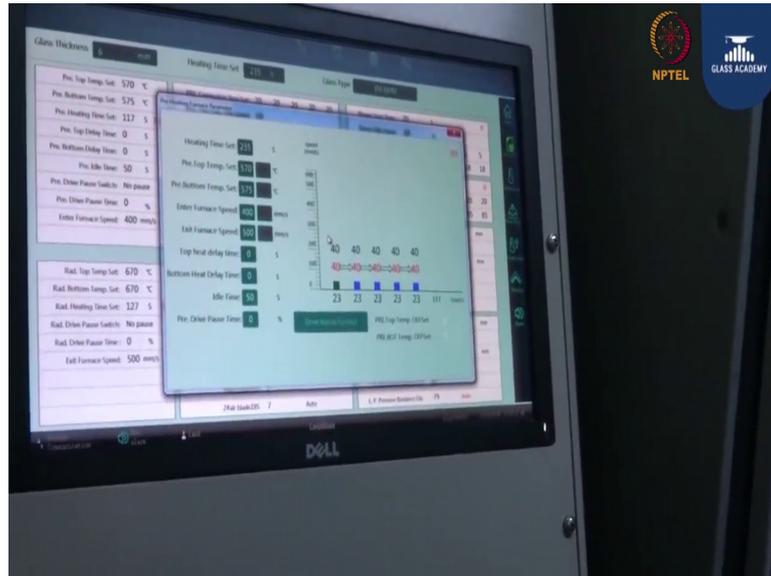
Now, you see this is this logo describes that it is a FUSO make and it is a heat strengthened glass, always be the stand width parallel furnace role furnace.

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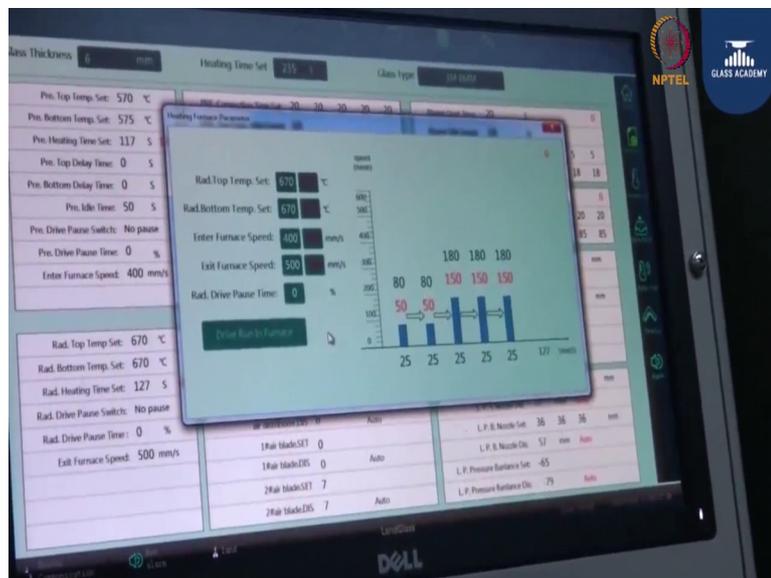
This is the first screen where we are where we are going to take the top and bottom temperatures, top temperatures, timings pressures all this things.

(Refer Slide Time: 01:50)



Next now, they are going to keep preheating furnace parameters ok, next now they are going to give heating furnace parameters.

(Refer Slide Time: 02:00)



Next now they you can see the convection motor parameters for the preheating furnace they are setting is the top convection parameter.

(Refer Slide Time: 02:10)



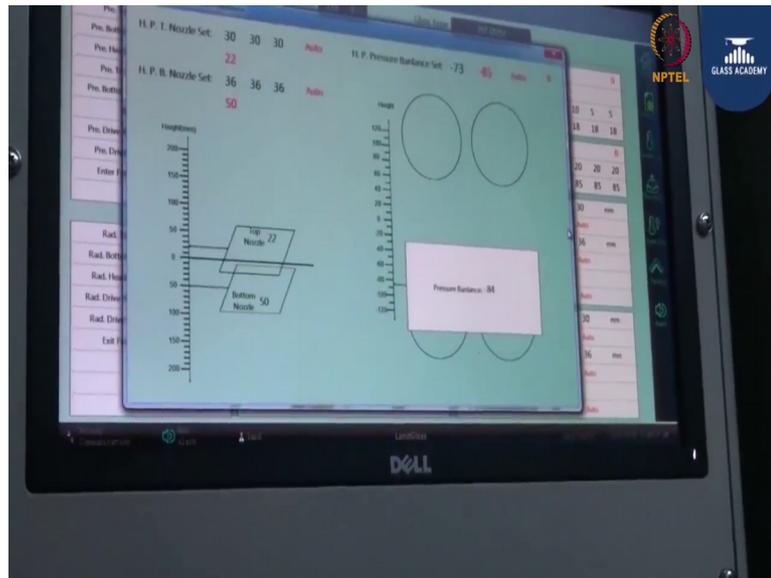
Next you see these are top convection parameters set again this second thing. Next now, you can see this is quenching parameters next, now you see this is cooling parameters what they are going to give.

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Next and if you say this is the balancing parameters what they are going to keep quenching pressure balancing parameters.

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Next, now you see again the cooling pressure balancing parameters, next these overall.

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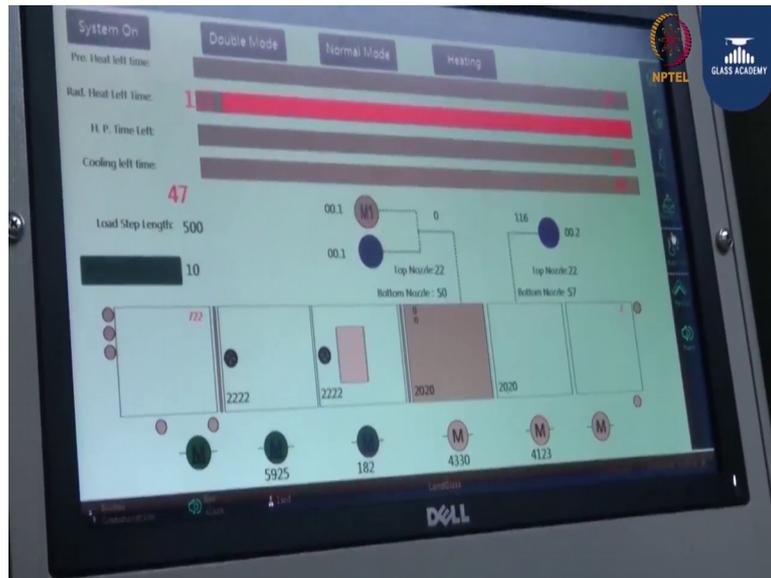


Student: (Refer Time: 03:14) bottom

Ok if you say this is talks about the heaters, top heaters as well as the bottom this slide shows the top heaters and the next slide shows the bottom heaters next.

Student: (Refer Time: 03:32) top heaters.

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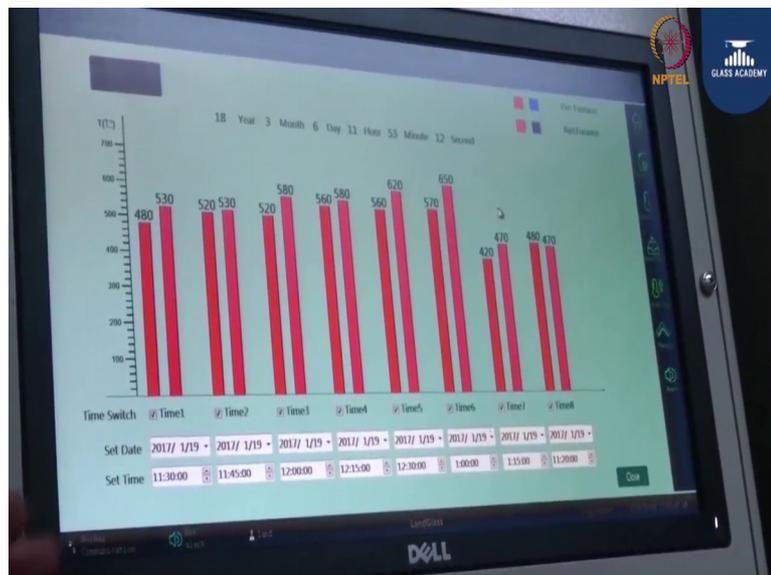


Student: (Refer Time: 04:20).

This is you can see the chart showing the heating, this is time versus heat chart, next.

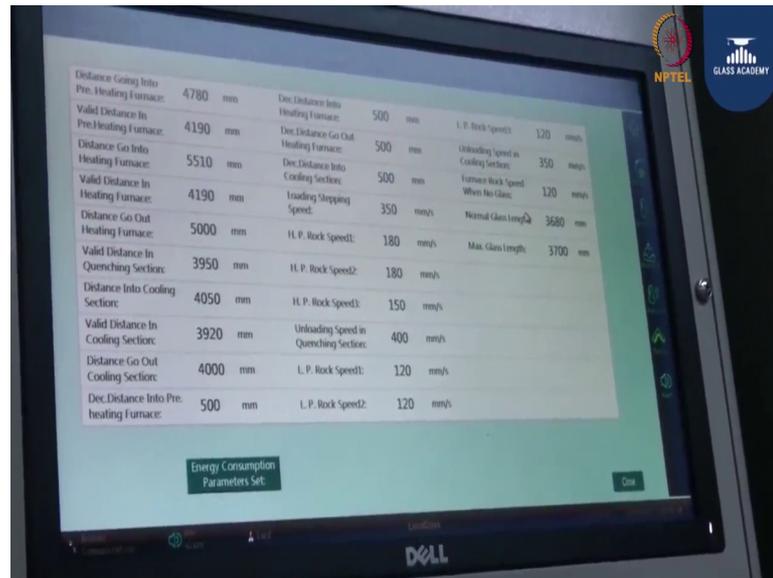
Student: (Refer Time: 04:31).

(Refer Slide Time: 04:31)



You can see the overall settings of this particular glass, all the went inside? No.

(Refer Slide Time: 04:33)



The screenshot shows a control panel with a table of parameters. The table is organized into two columns. The left column lists distances and valid distances for various stages, while the right column lists deceleration distances, unloading speeds, furnace rock speeds, and normal glass lengths. A 'Close' button is visible at the bottom right of the panel.

Distance Go into Pre-Heating Furnace:	4780 mm	Dec. Distance Into Heating Furnace:	500 mm	L. P. Rock Speed1:	120 mm/s
Valid Distance In Pre-Heating Furnace:	4190 mm	Dec. Distance Go Out Heating Furnace:	500 mm	Unloading Speed in Cooling Section:	350 mm/s
Distance Go Into Heating Furnace:	5510 mm	Dec. Distance Into Cooling Section:	500 mm	Furnace Rock Speed When No Glass:	120 mm/s
Valid Distance In Heating Furnace:	4190 mm	Loading/Shipping Speed:	350 mm/s	Normal Glass Length:	3680 mm
Distance Go Out Heating Furnace:	5000 mm	H. P. Rock Speed1:	180 mm/s	Max. Glass Length:	3700 mm
Valid Distance In Quenching Section:	3950 mm	H. P. Rock Speed2:	180 mm/s		
Distance Into Cooling Section:	4050 mm	H. P. Rock Speed3:	150 mm/s		
Valid Distance In Cooling Section:	3920 mm	Unloading Speed in Quenching Section:	400 mm/s		
Distance Go Out Cooling Section:	4000 mm	L. P. Rock Speed1:	120 mm/s		
Dec. Distance Into Pre-heating Furnace:	500 mm	L. P. Rock Speed2:	120 mm/s		

Student: (Refer Time: 04:41).

Weight.

Student: (Refer Time: 04:42).

(Refer Slide Time: 04:48)



Which will be able to this one will help us to trace the glass. Or you see the glass is going inside the furnace, where the glass can be done heating. Sit down and zoom, for now the glass is inside the furnace where the preheating will be done.

(Refer Slide Time: 05:15)



The preheating will ensure the quality of the product. Next it goes to the secondary heating section and after that the glass moves into the quenching section.

(Refer Slide Time: 05:31)



Where the, with the help of nozzles, cool air is rolled onto the glass. In this furnace, we can make two types of products: one is heat-strengthened glass and one more is toughened glass. We will get a toughened glass when rapid cooling or quenching is done on the glass; whereas, a gradual cooling will result in the heat-strengthening of the glass.

Student: (Refer Time: 05:51).

Now, you now you can see there are nozzles on the glass who can find the nozzles in the quenching area through that nozzles the cool air will be coming on to the glass.

Student: (Refer Time: 06:05).

You can see now the glass has it entered in to the quenching section (Refer Time: 06:18) you open and show possible open.

(Refer Slide Time: 06:49)



See down and back you take. Now the glass is in quenching section, where the glass will be oscillated uniformly.

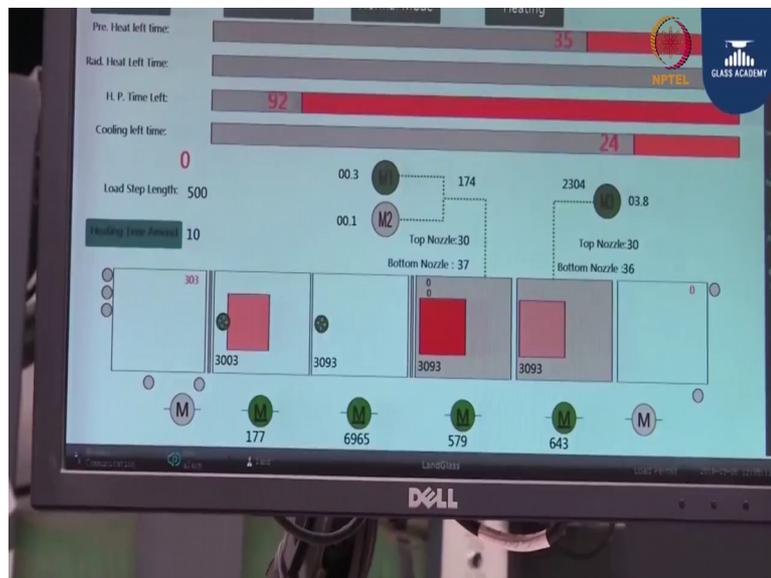
(Refer Slide Time: 07:22)



Student: you can do the fragmentation (Refer Time: 07:21), but ((Refer Time: 07:22).

You take and blow around, now come this side now the glass is moving at this particular place.

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And the next glass is already inside the furnace, you see this is the loading this is the quenching area one more glass is there.

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This is the second glass it is the exit unloading point, now the glass will come right.

(Refer Slide Time: 09:00)



Now, we need to understand the zebra board on to the glass to check the distortion levels. So, that image we will see on the glass all 4 glasses. So, this is one way of visual inspections through zebra board for a preheated glass. Now, now we are going to this is one way of at the time of one loading we will be checking for the class have a bend or bow. You see from this edge to the 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 the edge glass.

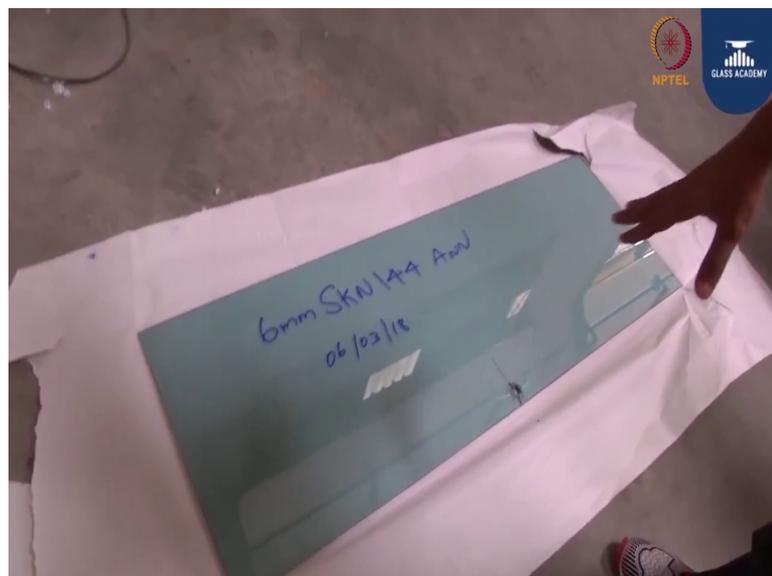
Now you see the straightness of the glass is having any bend or bow that we can check at the time of unloading. And always there should be an inter waving between the glass at the time of stacking ((Refer Time: 10:16). Now, you see if you have 3 glasses one is of annealed or raw glass one is of H S glass one is of toughened glass by looking at the glass we cannot say which one is which type of glass.

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So, one of the one of the traceability to the crossing of the glass is to breakage, that is known as fragmentation test.

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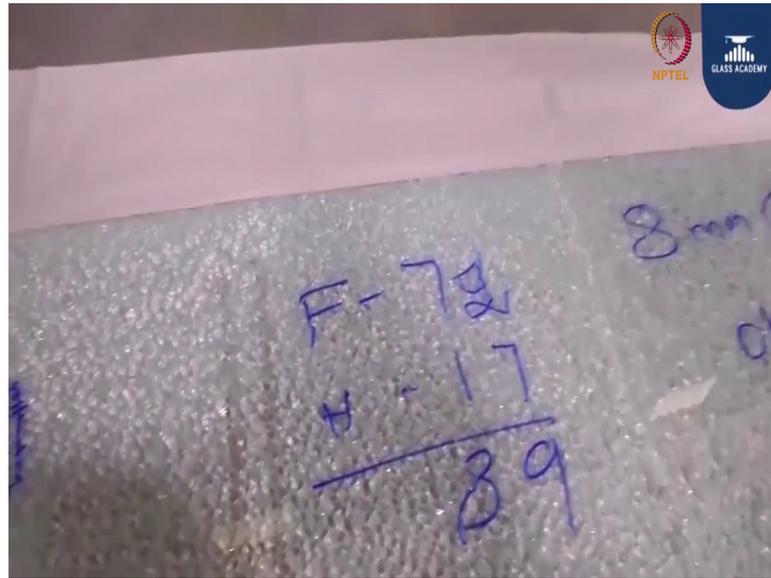
If I break an annealed glass, it has no direction it has no pattern. It can break an irregular pattern and it can harm injuries it can be create injuries also. So, annealed glass will break like this.

(Refer Slide Time: 11:18)



Whereas if you say see a H S glass, if you see a heat strengthened glass from the impact point the impact at the crack will end at the opposite edge, which describes it is a heat strengthened glass. The same thing when you see at toughened glass, when I impact you can find that small granules of the particles known as fragments. See if you see for a 8 hour here glass it will if I found the particles it should be minimum 40 particles. So, in this particular thing we have got 89 particles.

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So, through breakage pattern we can describe which whether it is annealed glass or a H S glass or a toughened glass put at all to 3 from top. Now, we are going to measure the bend in the heat treated glass first the S O P first we need to measure the bend should be always measured on the longest side tape. So, it is 2100, so next we need to apply setting blocks at the quarter positions.

So, what we are doing is we are giving setting blocks at 500 distance. Now, visually we need to see the bend direction. Next step is we need to see visually where the bend is. So, it is toward this side now this is a straight roller with the help of straight roller we are going to measure the bend in the glass. So, this is a taper gauge, which will determine the bend levels in the glass I am going to keep the glass straight.

(Refer Slide Time: 14:25)



And I am going to measure the gap of the bend between the glass and a 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

(Refer Time: 15:14).

Now, this is a diagonal measuring remove, glass straight you can see it is less than 2 mm bend we are getting diagonally also ok.

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So now we are going to conduct roller wave measurement of the glass. If you see this is a 6 mm S K N 7 6 5 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.

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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, we need to have a 1100 by 360 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 that tinted side is touching the roller. So, we will get a roller impression on the tin side.

Now, we are going to measure the roller wave on the glass. 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. First we need to live 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, now we need to keep the roller wave on the glass surface and we need to drag the roller wave on the glass surface, you note down the reading. You can see that value is getting change now it is minus 0.2 minus 0.1 minus 0.2 0.

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So, you can see generally we measure the roller wave gauge now the roller wave is equal to roller wave gauge is equal to the peak and the valley.

Student: (Refer Time: 18:00).

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 it, so sorry it is a summation of peak and the valley. So, the minimum value what we get it 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. The roller wave is a summation of peak and valley it is a

summation of peak and valley. So, with the peak value what we got is 0.02 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. Now, we are going to perform sorry in order to recap I am just re-summarizing.

Student: (Refer Time: 19:02)

I am just summarizing how we are going to measure the roller wave first to we need to take 1100 by 360 sample as per the standard E N 1 8 6 3, 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 live a one 50 mm on the edges, then we need to stack 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 E N 1 8 6 3 is 0.3 mm ok

Now, we are going to perform the next test that is the edge lift or edge (Refer Time: 19:42) the proper the process for this one is first we need to hang 150 mm on the on the flatness surface, next we need to take as straightedge and we need to take a filler gauge. So, we need to keep it a straightedge vertically and we need to insert the filler gauges, we need to make sure the coating is on top.

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Now, we are going to insert the filler gauge readings into the glass surface, whichever scale is not going that will indicate your own 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. So, it is 0.19 mm. So, to conclude for tempered glass we will be doing 4 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 the that is measured from the distortion levels in the glass and 4th one is the edge lift that the roller wave what we get at the edges. Through tempering process, we are enhancing the physical property we are enhancing the mechanical properties of the glass, we are not changing the physical properties of the glass a dimensions width thickness everything will remain same; only we are enhancing the mechanical properties of the glass in which we are acquiring strength in the glass.