Glass Processing Technology
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Lecture - 33
Lamination (Process & Lab Tests)

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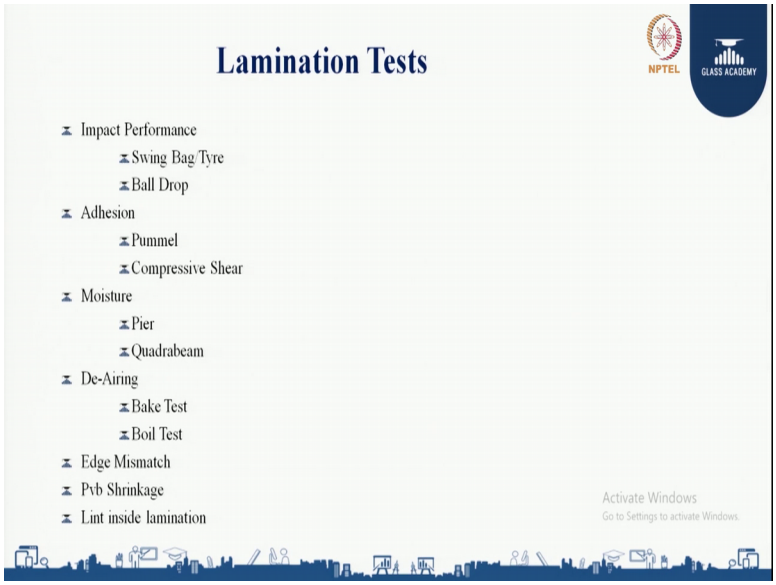

Now, we are going to see the laminate Lamination test, if you see basically we will be focusing on impact a performance that is with respect to swing bag or tyre test and ball drop test or fracture relation test. When it comes to adhesion we will be checking pummel test and compressive shear test; when it comes to moisture we will be checking with the Pier and Quadrabeam tests. When it comes to de airing we will be checking bake test and boil test; along with this we will be checking edge mismatch, PVB shrinkage and the lens lint or dust inside lamination these are all visual inspections. Now, let us take each one by one.

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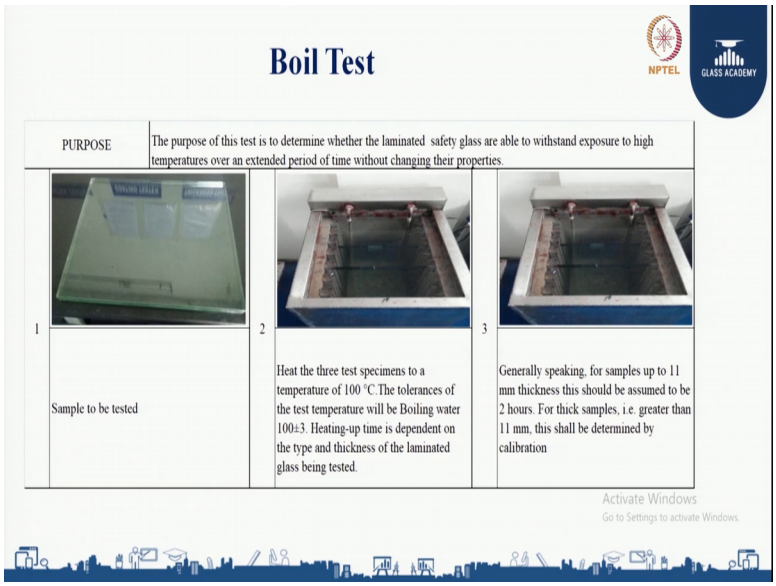

Boil test; the purpose of this test is to determine whether the laminated safety glass are able to withstand exposure to high temperature over an extended period of time without changing its properties. If you say first we need to take a sample which has to be tested after lamination, next we will be placing the sample in a boiling chamber of 100 degree centigrade. You can see in the second figure heat the 3 displacements to a temperature of 100 degree centigrade; the tolerances of the test temperature will be boiling water 100 degrees plus or minus 3 degree centigrade, heating time is dependent on the type and the thickness of the laminated glass being used.

Next, generally speaking for sample up to 11 mm thick this should be assumed to be 2 hours, for the thick samples that is greater than 11 mm this shall be determined by calibration. So, it is basically talking about the overall thickness of the lamination and the duration of the temperature.

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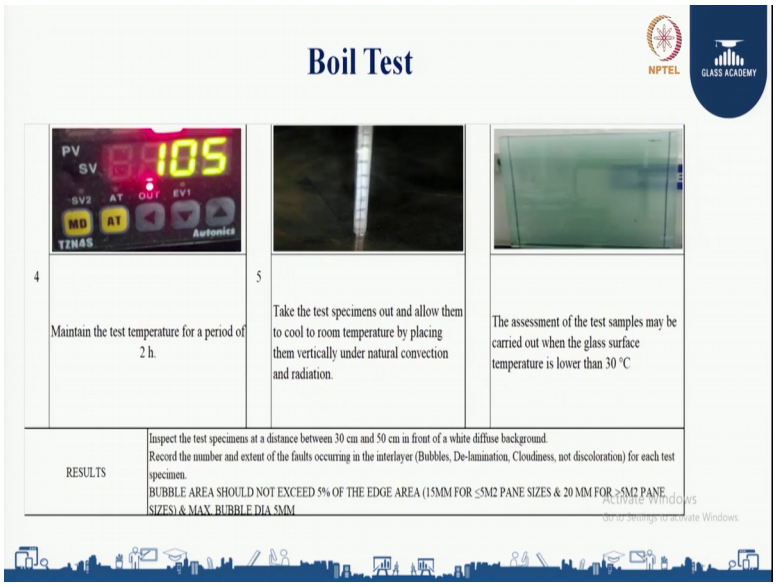

If you say in the fourth slide it is saying maintain a test temperature for a period of 2 hours, in the digital meter you can see now the temperature is set to 100 degrees and we need to maintained for 2 hours. Take the displacement out and allow them to cool, in the safe 5th figure you can see even with the help of thermometer also we can measure the boiling water temperature. And once the boil, glass has been boiled for 2 hours at 100 degree centigrade now we need to take out the sample.

Take the dispersements out and allow them to cool to room temperature, by placing them vertically under natural convection and radiation system, how we need to observe or make a conclusion. The assessment of the test based test samples may be carried out when the glass surface temperature is lower than 30 degree centigrade and how we are going to conclude and give the result. Inspect the test specimen at a distance between 30 centimeter and 50 centimeter in front of a white diffused background, record the number and extent of the faults occurring the interlayer, that is in the form of bubbles, delamination, cloudiness or no nor discoloration per each test specimen.

Bubble area should not exceed 5 percent of the edge area, in general 15 mm for less than 5 square meter panel size and 20 mm for more than 5 square meter panel size and the maximum dia of the bubble shall not exceed 5 mm. So, this is about boil test.

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Now, let us take one more test that is a bake test, the purpose of this test is to determine whether the laminated safety glass is able to withstand exposure to high temperatures over an extended period of time without changing their properties. If you see for this one we need to make a test oven that is the high temperature test may be carried out by using an oven; the tolerance of the test temperature will be 100 degrees plus or minus 2 degree centigrade.

If you see in the second photograph heat the test specimen to a temperature of 100 degrees, we need to place it as a laminated samples into test oven and we need to heat the glasses at 100 degree centigrade for 16 hours. In an oven the heating up time is dependent on the load type and the thickness of the laminated glass being tested, maintain the test temperature for a period of 16 hours.

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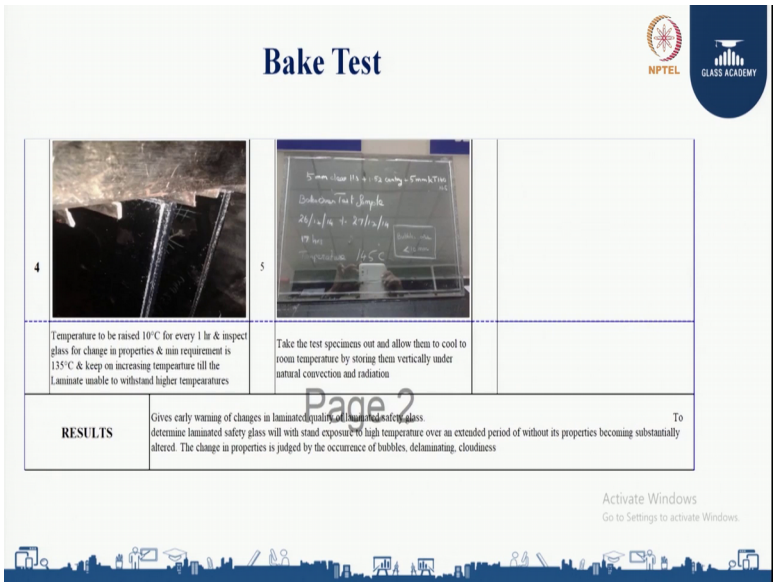

So, we need to basically we need to take samples of laminated glass we need to place it inside an oven and we need to heat it 100 degree centigrade for 16 hours; temperature to be raised 10 degrees for every 1 hour and inspect the glass for change in properties.

So, in the if you see the fourth photo, what the what is the pressure is what the pressure we need to make is, suppose my glass is kept at 100 degree centigrade for 16 hours. Then after 16 hours I need to take out the glass I need to check any changes in the properties of the glass, if there is no change again on the 17th hour I will be increasing the temperature from 100 to 110 degree centigrade. And I need to continue this process till I when I found that my lamination glass is unable to withstand the high temperature. So, the minimum requirement is 135 degree centigrade and we need to continue this process that is every hour 10 degree rise in temperature and inspection and until the until the laminated is able to withstand high temperature.

So, basically this is a durability test for a laminated product, once the test is oven and when we see that the bubbles are started to form, we need to take out the sample and no make a note of the temperature. If you say in the fifth the photograph the test specimen is taken out and allowed to cool to room temperature and it is observed under a white diffused background; you can see this specimen was able to withstand 145 degree centigrade. So, basically the conclusion or the with the conclusion or the result what we can find in bake test is; bake test gives an early warning of changes in laminated quality

of safety glass. Determines laminate safety glass with extend exposure to high temperature over an extended period of time, its properties becomes sustainable, substantially altered the change in properties is judged by occurrence of bubbles delamination and cloudiness.

So, in order to summarize in bake test (Refer Time: 06:38) we are going to take a samples and we are going to heat it 100 degree centigrade for 16 hours then every 1 hour we are going to raise the temperature by 10 degree centigrade. And we need to inspect the glass every hour, we need to make a note when the bubbles are going to be started to form. So, the minimum requirement is 135 degrees centigrade and we need to keep on testing until where my glass is able to, my glass is not able to withstand high temperature and bubbles are getting started to form.

So, this is a durability test and through this test we are ensuring that how our laminated glass is able to withstand over a high temperature and extended period of time. And the change in properties in the form of bubbles is de-lamination and cloudiness we can found.

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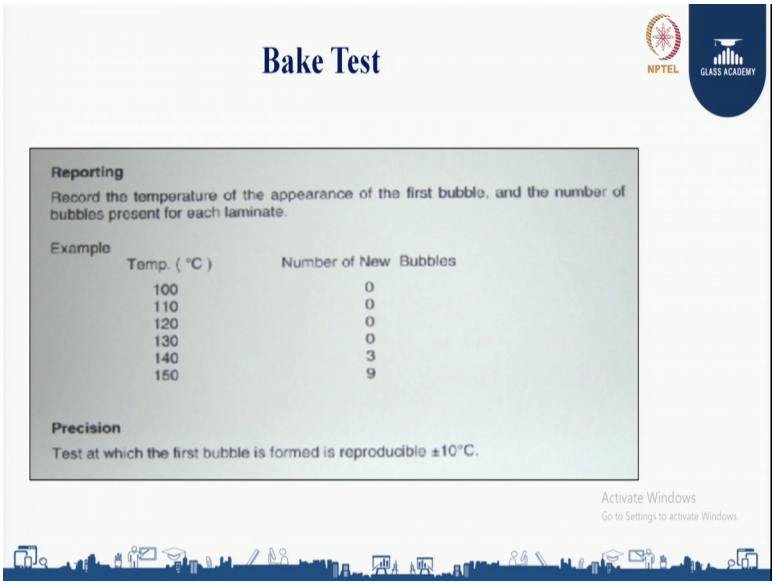

You can say in this report that the recording temperature of the appearance of the first bubble and the number of bubbles present for each laminate for example, my temperature is at 100 degree centigrade and the number of bubbles were found to be 0. When I raise it the temperature to one 10 degree centigrade the bubbles were still 0, at

120 0; 130 0 once 140 started I found there are 3 bubbles, at 150 there are 9 bubbles found. So, we need to understand the precision is test at which the first bubble is formed easily reproducible at plus or minus 10 degree centigrade.

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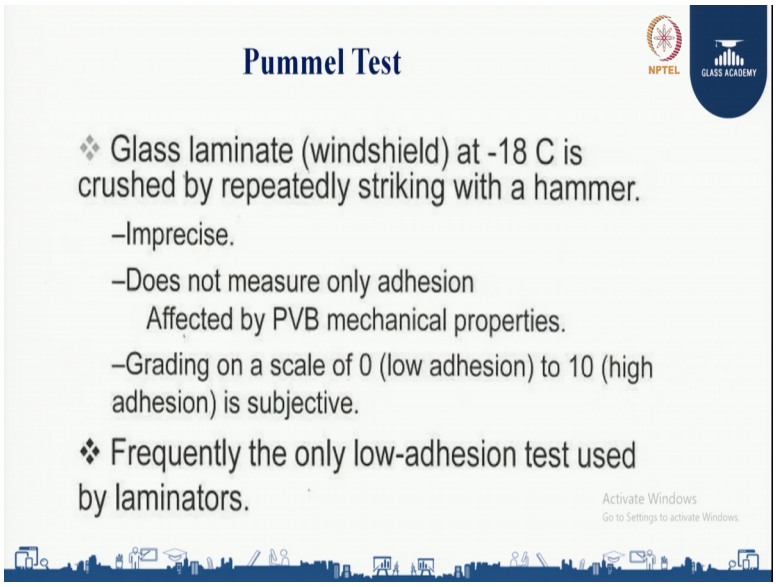

Now, let us take the pummel test which is used for adhesion since, the one more test that is used for laminated glass. So, pummel test the glass laminate at minus 18 degrees centigrade is trust by repeatedly striking with a hammer, the test is imprecise does not measures only adhesion affected by PVB mechanical properties grading on a scale of 0. That is low adhesion to high 10 that is the high adhesion and is subjective frequently the only low adhesion test used by laminators.

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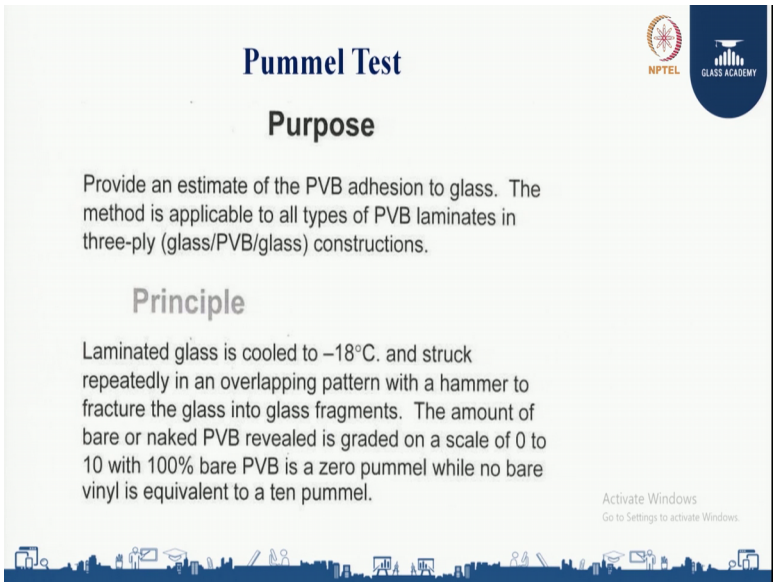

So, the purpose of this test is to provide an estimate of the PVB adhesion to the glass, the method is applicable to all types of PVB laminates in three-ply that is glass PVB and glass construction. The principle how it works is laminated glass is cooled to minus 18 degree centigrade for normal PVB and direct breakage for a sentry glass PVB and struck repeatedly in an overlapping pattern with a hammer to fracture the glass into small fragments. The amount of bare or naked PVB revealed is graded on a scale of 0 to 10, with 100 percent bare PVB is 0 pummel while no bare vinyl is equal to 10 pummel.

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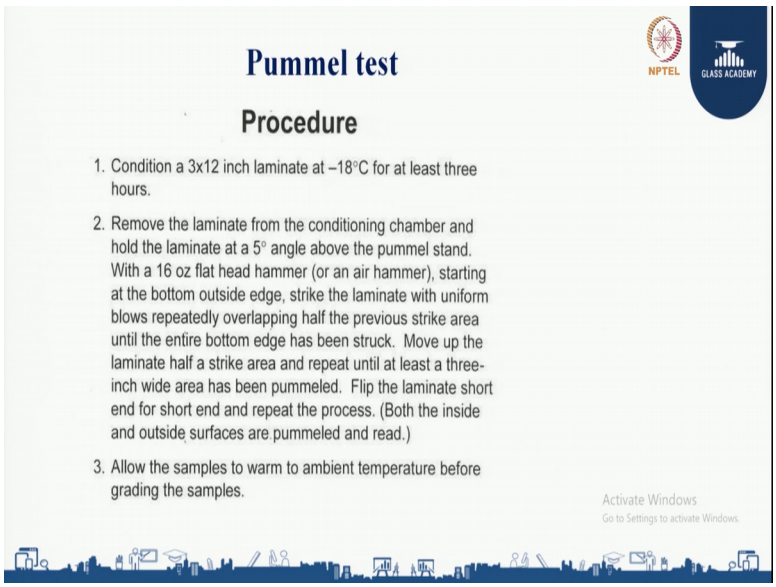

The procedure is a three bit well inch laminate at minus 18 degree centigrade for at least 3 hours is cooled, then remove the laminate from the conditioning chamber and hold the laminate at 5 degree angle above the pummel stand with a 16 oz flat head hammer or an air hammer; starting at the bottom outside edge strike the laminate with uniform blows repeatedly overlapping half the previous strike area until the entire bottom edge has been struck.

Move up the laminate half a strike area and repeat until at least a 3 inch wide area has been pummeled, flip the laminate shortened for shortened and repeat the process both the inside and outside surface are pummeled and read. Allow the samples to warm to ambient temperature before grading the samples.

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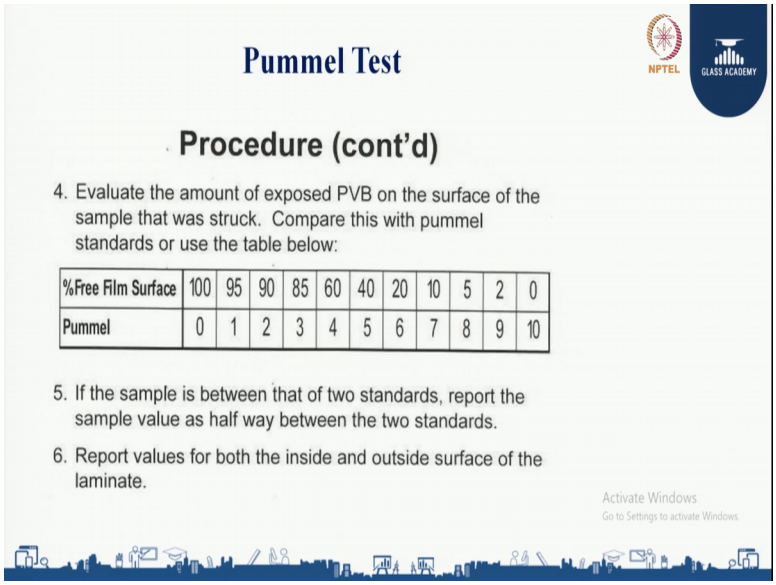

Evaluate the amount of exposed PVB on the surface of the sample that was struck, compare with this pummel standards or use the table below for example, if 100 percent free film surface that is 100 percent is I am able to say the PVB then it is it is graded as 0 pummel. When I am able to see 95 percent of the PVB, then it is graded as first pummel 1, 90 means if the percentage of film surface is 90 it is graded as pummel 2.

If I am able to see I am not able to see the PVB means it is graded as highest pummel, if the sample is between the two of the standards report the sample value as the half between the two standards. For example if my pummel is matching between 5 and 6 it

should be considered as 5 and half, report the values for both the inside and outside surface of the laminate.

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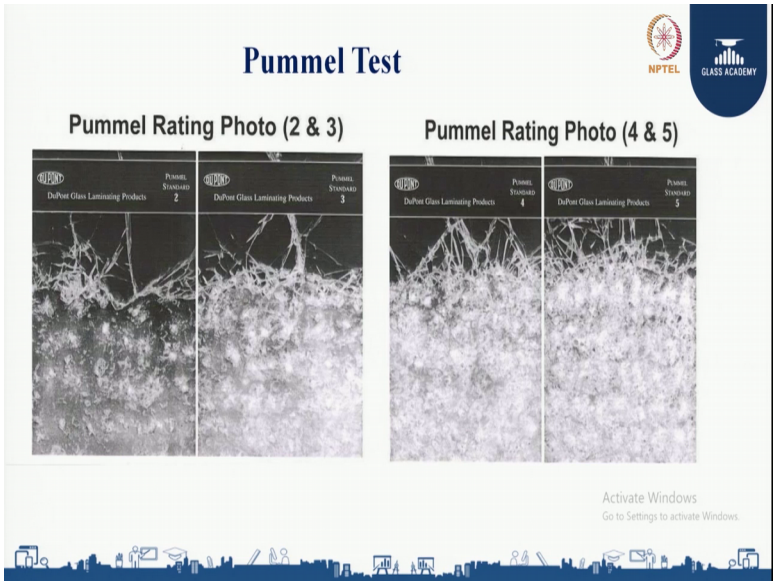

You can say in the photos, this is how you can see this is the pummel rating photographs 2 and 3 where you can see you are able to see the there is no adhesion between the glass and the PVB lesser adhesion between the glass and the PVB, this similarly you can see pummel ratings photos 4 and 5.

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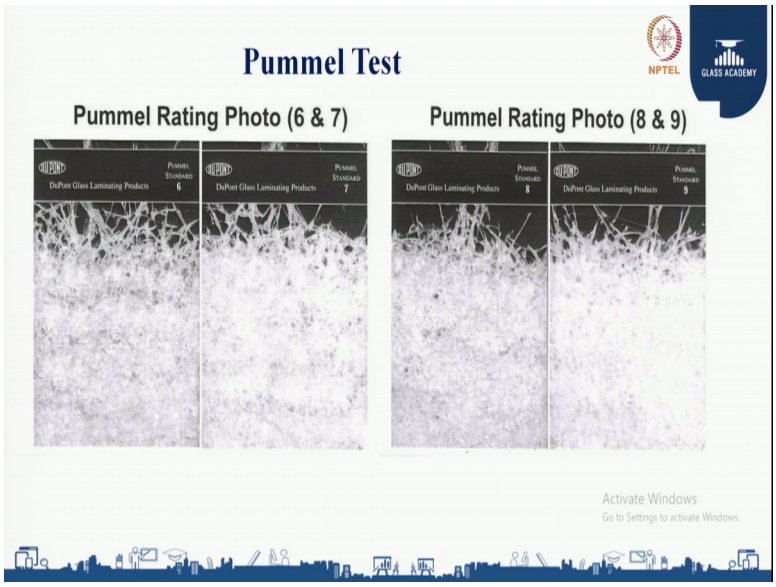

Pummel rating photos 6 and 7, pummel rating for photos 8 and 9 if you see 9 which is the highest pummel rated graph, you can say there is a very good bonding between the glass and the PVB.

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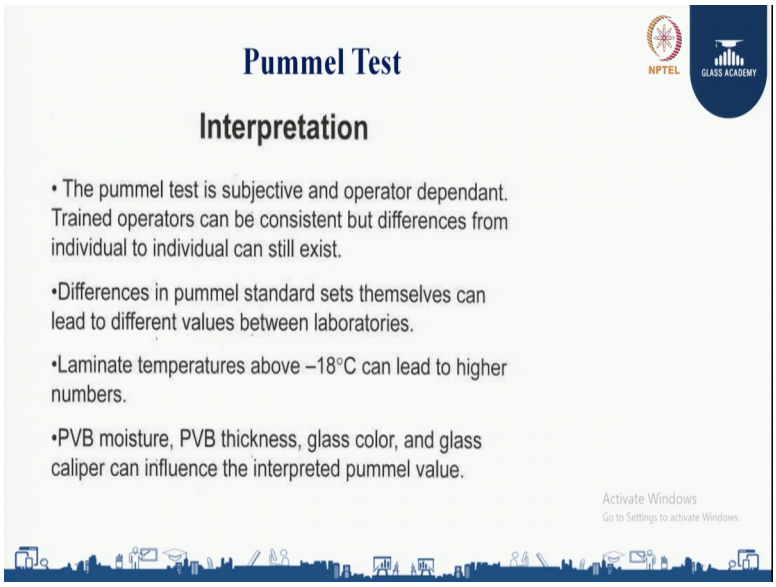

The, but this pummel test is not a standardized one because the pummel test is subjective and operator dependant, only trained operators can be consistent, but differs from individual to individual can still exist.

Differences in pummel standards sets themselves can lead to a different values between laboratories. Laminate temperatures above minus 18 degrees centigrade can lead to a higher number. PVB moisture, PVB thickness, glass color and glass caliper can influence the interpreted pummel value in order to make a pummel glass; in order to make a pummel test for a sentry glass lamination we need to go for; we need to check in the laboratory the different types of glass combinations like air side pin sight, inside air side air side inside, air side air side.

So, all the a t t a, t a a t all these combinations we need to make sure and wait and we need to assure that in a particular combination glass combination or glass construction we are having a good pummel. Generally the suppliers can help you in finding the pummeling of your lamination product.

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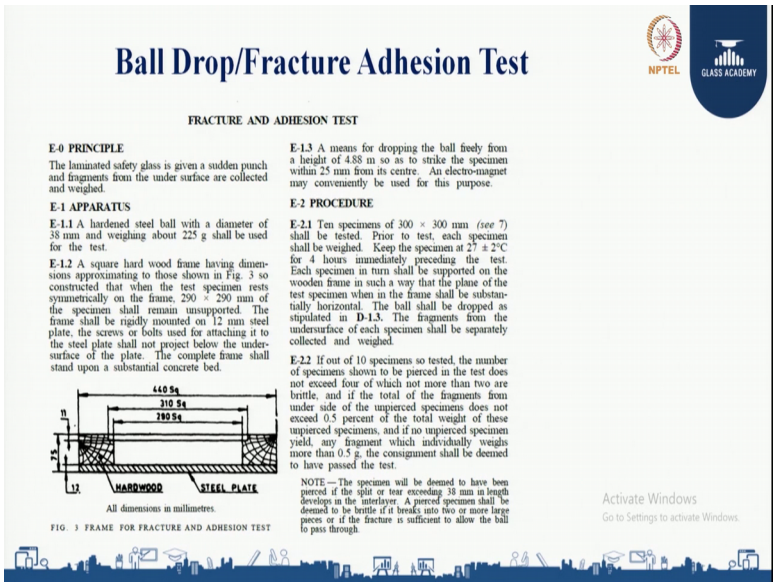

Next comes is next test what we do in our laboratory for lamination is the ball drop or fractured adhesion test. So, the purpose of the ball drop or fracture adhesion test is, the laminated glass is given a sudden punch and frag grip and fragments from the under surface are collected and weighed in order to set up this test we need to have a steel ball with a 38 mm dia weighing about 225 grams. And we need to have a setup of square hardwood frame having dimensions approximately to those as you can see in the figure and the procedure is we need to drop a ball freely from a height of 4.88 meter so, that it strikes the specimen within 25 mm from its center.

We need to in order to perform ball drop test we need to have 10 test specimens of 300 by 300 mm prior to test, each a test specimen shall be weighed keep this specimens at 27 degree centigrade for 2 hours, for 4 hours immediately preceding the test. Each test specimen is turn shall be supported on a wooden frame as you can see in the figure, out of 10 specimens. So, tested the number of specimens is shown to be pierced in test does not exceed 4 of the way 4 of which more than 2 are brittle and if the total of the fragments from the underside of the un-pierced specimen does not exceed 0.5 percent of the total weight of these un-pierced specimens. And if no un-pierced specimen yield any fragment which individually weighs more than 0.5 grams the consignment shall be deemed to have passed the test.

So, we need to basically we need to understand when I drop a ball from a distance of 4.88 how the ball is going to perform on the laminate whether it is going to penetrate or it is going to stick or it is going to tear the PVB. And we need to collect the number of fragments from underneath the laminate sample and we need to weigh and we need to check and the weight should shall not exceed 0.5 percentage of the weight of the glass.

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You can see here this is a set of for ball drop test. So, we will be dropping a 308 gram, 38 mm dia 225 gram ball from a distance of 4.88 meter and you can see in the second photograph how it is going to impact the laminated glass.

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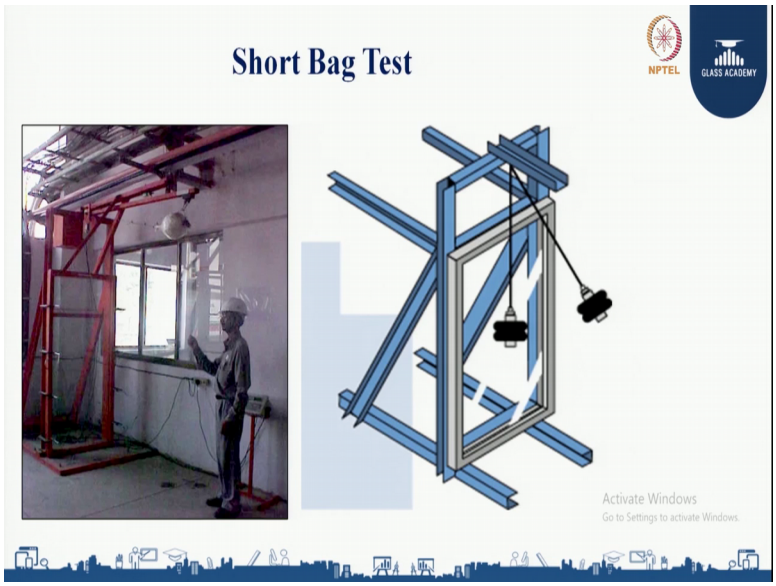

In a similar way the other test what we do for lamination is the short back test, you can see in the photo the setup used for the short back test.

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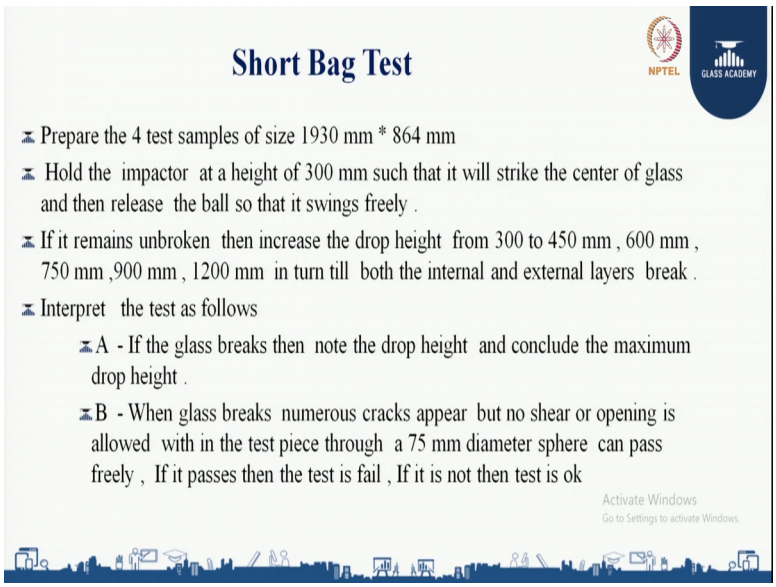

Here also in order to perform this test we need to have 4 test samples of 1930 by 864 mm, we need to hold the impactor at a height of 3 00 mm such that it will strike the center of the center and then release the ball. So, that it swings freely if it remains unbroken, if the glass remains unbroken the increase and then increase the drop height

from three 100 to 450 in a similar way 600, 750, 9100, 1200 in turn till both the internal and external in the external layers break.

The interpretation of the result shall be A if the glass breaks, they note the drop height and conclude the maximum drop height; B when the glass breaks numerous cracks appear, but no share or opening is allowed within the test specimen through a 75 mm diameter sphere can pass freely. If it passes the test is fail, if it does not then the test is ok, this is how we are going to do short back test.

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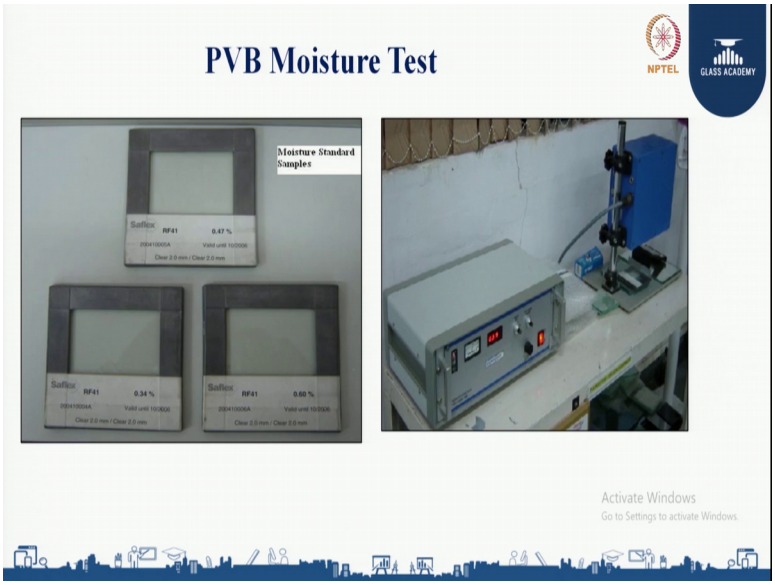

Now, this is the one more test that is used that is a PVB moisture test. PVB moisture test this is a setup this is the equipment what we use for PVB moisture test, you can see here the moisture test moisture standard samples.

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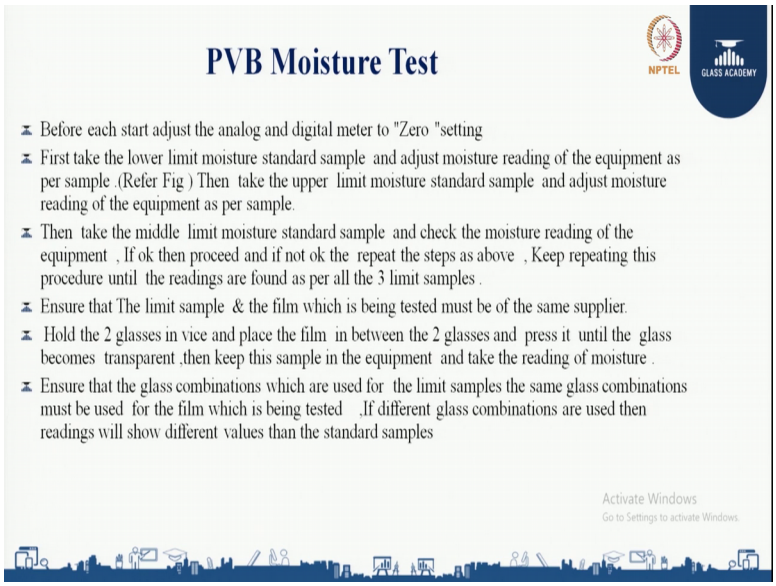

In order to perform this test we need to adjust the analog and digital meter to 0 setting, first to take the lower limit moisture standard sample and adjust moisture reading of the equipment as per sample, then the upper limit moisture standard sample and adjust the moisture reading of the equipment as per the sample. Then take the middle limit moisture standard sample and check the moisture reading of the equipment if then proceed if not then repeat the steps as above.

Keep repeating this procedure until the readings are found as for all the 3 limit samples ensure that the limit sample and the film which is being tested must be of the same supplier. Hold the 2 glasses in wise in vertical place hold the tube 2 glasses and place the film in between the 2 glasses and press it until the glass becomes a transparent. then keep this sample in the equipment and take the reading of the moisture ensure the glass combination which are used for the limit samples of the sample glass combinations must be used for the film which is being tested. If different glass combinations are used the readings will follow different values than the standard samples, this is how we are going to stress the moisture levels in the PVB.

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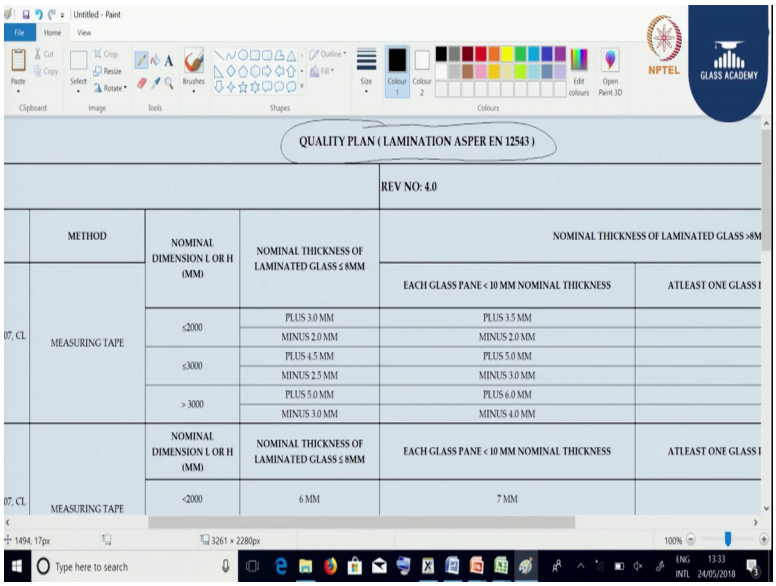

QUALITY PLAN (LAMINATION ASPER EN 12543)

REV NO: 4.0

	METHOD	NOMINAL DIMENSION L OR H (MM)	NOMINAL THICKNESS OF LAMINATED GLASS ≤ 8MM	NOMINAL THICKNESS OF LAMINATED GLASS >8M	
				EACH GLASS PANE < 10 MM NOMINAL THICKNESS	ATLEAST ONE GLASS I
07, CL	MEASURING TAPE	≤2000	PLUS 3.0 MM	PLUS 3.5 MM	
			MINUS 2.0 MM	MINUS 2.0 MM	
		≤3000	PLUS 4.5 MM	PLUS 5.0 MM	
			MINUS 2.5 MM	MINUS 3.0 MM	
		> 3000	PLUS 5.0 MM	PLUS 6.0 MM	
			MINUS 3.0 MM	MINUS 4.0 MM	
	METHOD	NOMINAL DIMENSION L OR H (MM)	NOMINAL THICKNESS OF LAMINATED GLASS ≤ 8MM	EACH GLASS PANE < 10 MM NOMINAL THICKNESS	ATLEAST ONE GLASS I
07, CL	MEASURING TAPE	<2000	6 MM	7 MM	

Now will understand the quality plans for the lamination and the standard what we follow is EN 12543, the test parameters what we use in lamination are length and width. The standard what we are going to follow is EN 12543 part 5, page number 7 and cross number 4.2 point 3 and the method what we use is a measuring tape. Here how we are going to measure the length and width tolerances, if my panel size is less than or equal to 2000 and my nominal thickness of the laminated glass is less than or equal to 8 mm plus 3 mm is allowed or minus 2 mm is allowed.

Or if a nominal thickness of laminated glass is more than 8 mm that is each panel glass pane is less than 10 mm nominal thickness, then plus 3.5 mm is allowed and minus 2 mm is allowed. And for the at least 1 pap 1 pane of glass is more than 10 mm thickness nominal thickness plus 5 mm is allowed and minus 2.5 mm is allowed.

In the similar way if my panel size is less than or equal to 3000 mm and for the glass thickness no and for the nominal thickness of the laminated glass less than or equal to 8 mm plus 4.5 mm is allowed and minus 2.5 mm is allowed. And for each glass pane less than 10 mm nominal thickness plus 5 mm is allowed or minus 3 mm is allowed and for at least 1 glass pane greater than or equal to 10 mm nominal thickness plus 4.5 mm is allowed and minus 3 mm is allowed.

In a similar way, if my panel size is more than 3000 mm and for the nominal thickness of the laminated glass less than or equal to 8 mm plus 5 mm is allowed and minus 3 mm is

allowed as per the standard EN 12543 and for the each pane of glass less than 10 mm nominal thickness plus 6 mm is allowed and minus 4 mm is allowed. In the similar way if at least 1 glass pane is more than or equal to 10 mm nominal thickness plus 5 mm is allowed and minus 3.5 mm is allowed and the frequency of testing shall be 1 number in every 10 numbers.

The next test parameter what we are going to check is a diagonal and the standard what we follow is EN 12523 part 5 and the tool what we use is a measuring tape, here also if my nominal thickness if my dimension of the glass dimension of the glass is less than 2000 and the nominal thickness of the laminated glass is less than or equal to 8 mm 6 mm diagonal is allowable. And each glass pane less than 10 mm nominal thickness 7 mm is allowed and for the each glass spent more than 10 mm nominal thickness 9 mm is allowed.

In the similar way, if my glass panel is less than 3000 mm diagonally and the thickness of the nominal thickness of the laminated glass is less than or equal to 8 mm. 8 mm is allowed and for each glass pane less than 10 mm nominal thickness 9 mm is allowed and for at least 1 glass pane greater than or equal to 10 mm nominal thickness 11 mm is allowed.

If my diagonal measurement is more than 3000 mm for the nominal thickness of the laminated glass less than or equal to 8 mm 10 mm is allowed, for each glass pane less than 10 mm nominal thickness 11 mm is allowed and for at least 1 glass pane more than 10 mm normal thickness 13 mm is allowed. And the frequency of testing shall be one number in every 10 numbers. Now, let us take the next test parameter that is the thickness; the standard what we follow is EN 12543 part 5 and the thickness where how we are going to measure is through the help of micrometer and we need to understand what is the inter layer thickness.

If my inter layer thickness is less than 1 mm the tolerance allowed is 0 plus or minus 0.4 mm, if my inter layer thickness is between 1 to 0032 mm the tolerance is plus or minus 0.5 mm. If my inter layer thickness is between 2 to 3 mm the tolerance is plus or minus 0.6 mm, if my interlayer thickness is more than 3 mm the tolerance is plus or minus 0.7 mm and this is also the frequency of testing shall be one number in every 10 pieces of glass.

Next, let us understand the next test parameter that is that is a displacement or the offset, the standard what we follow is EN 1254345 and generally we do we measure the displacement through visually or with the measuring tape. Here also we need to understand the nominal dimensions the displacement is always dependent on the dimensions of the glass dimensions of the glass. If my panel size is between if my panel size is less than or equal to 1000 and the maximum displacement allowed is 2 mm, if my panel size is between 1 to 2000 mm the displacement allowed is 3 mm. If my panel size is between 2 to 4 mm the displacement allowed is 4 mm and if my panel size is more than 4000 mm the maximum permissible displacement is allowed is 6 mm and this also this displacement will be checked measuring for every glass.

Now, let us understand the spot defects and the standard what we follow is EN 12543, these spot defects also will do through visual or through measuring tape. Here we need to understand size of the defect, what is the size of the defect first we need to understand, size of the pane we need to understand and the number or density of the permissible defect. So, here we need to consider three parameters and if my size of the defect we need to understand whether the defect size of the defect is between 0.5 and 1 or it is between 1 to 3 and size of the panes.

If my, let us understand everything one by one; if the glass is having 2 panes of glasses are laminated and if my area of defect is and if my area is less than or equal to 1 square meter; less than or equal to 1 square meter the defects allowed the spot defects, about the spot defects allowed are 1. And if my if my area is between 1 to 2 square meter 2 hours 2 are allowed and if my area is between 2 to 8 square meter once per 1 square meter is allowed and if my area is more than 8 square meter 1.2 per square meter is allowed.

Similar way if the if the lamination is done with the help of 3 panes and the area of the laminated glass to less than 1 square meter, then two spot defects are allowed if the area is between 1 to 2 square meter three spot defects are allowed and if the area is between 2 to less than or equal to 8 1.8 square meter is allowed and if it is more than 8 square meter 1.8 per square meter is allowed. In the similar way for 4 panes and 5 panes also we can understand these values and the frequency of testing this spot defect shall be measured for every glass.

Now, let us understand the linear defects, the linear defects what we follow in the standard is EN12543, the linear defects also we will understand through visual or measuring tape. Here also we need to see the area of the pane and the number of permissible defects, if you see the area of the pane that is if it is less than or less than or equal to 5 square meter and the number of permissible defects is more than 30 mm length it is not allowed. For the area between 5 to 8 square meter only 1 number of permissible defect with more than 30 mm in length is allowed; if the area of the pane is more than 8 square meter 2 number of permissible defects with more than 30 mm length are allowed and the frequency of testing will shall be for every glass.

Now, let us take the next test parameter that is a short interlayer that is known as PVB shrinkage the standard what we follow is IS 2553 it is also through visual and measuring tape, here we need to understand if it is less than 3 mm from the edge then only it is allowed; otherwise, it is not allowed. And the frequency of testing shall be for every glass, along with all these parameters here we need to focus on other water quality also in order to maintain the good adhesion between the glass and the PVB.

So, the water parameters like PH, TDS and conductivity that has to be taken care; ph should be 6 to 8 TDS should be 0 to 20 milligram per liter and conductivity shall be 0 to 20 micro siemens per centimeter. Along with the water quality we need to maintain the temperature and RH values also in the layup room, the temperature should be less than 25 degree centigrade and the RH should be less than 25 percent. In order to have a good adhesion and the durability on the glass and the frequency of testing shall be the measurement of these water readings as well as the RH and temperature shall be 3 times per shift or based on the load production that we need to decide.

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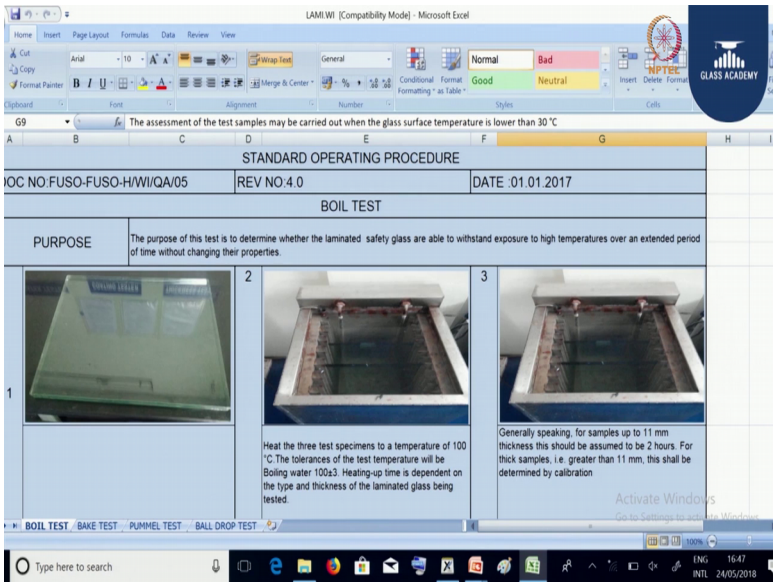

Yeah, now we are going to see the test that we do for laminated glass, let us take boil test the purpose of this test is to determine whether the laminated safety glass are able to withstand exposure to high temperatures over an extended period of time without changing their properties. The steps what we do is first we will be taking a laminated glass; we will be placing the first we will be taking a laminated glass and we need to have a boil test chamber.

Here we heat, here what we do is first we will be placing that we will be taking inside the boil test chamber we will be filling with water and we are going to keep the temperature of the water at 100 degree centigrade. And we will be placing that these glass samples inside the water for 2 hours, then we will be trying we will be opening the glass you can see here the temperatures you can see in the figure the temperatures.

First figure will show you it is a laminated glass the second figure will show you the glasses are kept inside the boil test chamber the third figure you can see the temperature of the glass is maintained at 100 degree centigrade for 2 hours. In the fourth figure also you can see the temperature and fifth you can see with the help of thermometer also you can measure out there is a 100 degrees the temperature of the water and once the 2 hours is completed at 100 degree centigrade we will be removing the glass from the boil test chamber and with the with the background we will be trying to inspect the glass for bubbles haziness and discoloration.

The result what we can see is inspect the inspect the test specimen at a distance between 30 centimeters to 50 centimeters in front of a wide diffused background, record the number and extent of faults occurring in the interlayer in the form of bubbles, delamination, cloudiness, discoloration for each displacement. Bubble area should not exceed 5 percent of the edge area that is 15 mm for less than 5 square meter glass and 20 mm for more than 5 square meter glass. And maximum bubble dia should shall not exceed 5 mm, a sample showing cracks shall be discarded and other test specimen shall be tested again.

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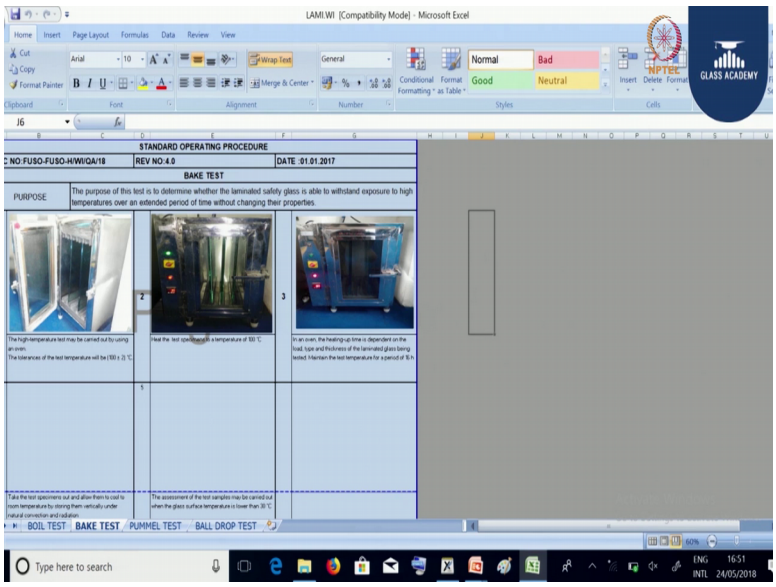

Next we will be understanding the next test that is used for temperature that is the bake test, in bake test what we are going to see is the purpose of this test is to determine whether the laminated safety glass is able to withstand exposure to high temperatures over an extended period of time without changing its properties.

First what will be do is we will be taking a bake test oven and inside the bake test oven we will be placing the glasses at 100 degree centigrade for 16 hours then gradually every 1 hour we are we are going to increase the temperature by 10 degrees. For example, if I am keeping the glass at 100 degree centigrade for 6 16 hours on the 17th hour I will be keeping 110 degree centigrade, on the 18th hour I will be keeping 120 degree centigrade like that every hour I am going to increase 10 degrees temperatures.

And I will be taking out the glass inspecting and again placing back in the oven for bubbles or a discoloration, at a particular temperature the bubbles started to form, I will be noting the temperature the minimum temperature that glass has to withstand is 135 degrees centigrade and beyond 135, I need to see what up to what level my glass is able to withstand. So, basically with the help of bake test I am able to see the durability over the durability of the glass for a high temperature.

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This is the fan which will help to clean all the dust from the form on the head whichever person is going inside the layup room you can feel air, for the cleaning procedure, cleaning entry procedure.

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Now, this is the lamination layup room or we can say assembly room or we can say clean room where we are going to join two glasses with the help of one interlayer known as PVB. This is the PVB material, [FL] milky PVB, clear PVB, coconut PVB [FL] (Refer Time: 33:14) 0.76 or 1.8 [FL]. Yeah if you see first they have taken the bottom glass and on top of it they are placing 1.5 to thickness of PVB layer and like, first they have taken the first glass on top of it they have kept 1.52 that is 0.762 layers of PVB and next they have placed another glass.

And they will be making sure that the holes are matching and the edges are matching, now they are going to do trimming that is PVB trimming by leaving 2 mm excess edge, at excess PVB. We need to make sure that RH and temperature, that is relate to humidity and temperature are maintained in the lab, [FL] you can see here; you can see here [FL] the temperature is 25 degrees and the RH is 17 percentage.

It should be below 25 for a good bonding between the glass and the PVB; now that is going for pressing you show me [FL]. Clear PVB, milky PVB, coconut PVB; no they are going to stick this production sticker on the glass. wait they are going to stick this production sticker for identification and now it is going for pressing. [FL] Milky bar, coconut. You finish this coconut [FL]. Coconut [FL], and next [FL] sentry. Sentry [FL] (Refer Time: 35:29) 0.76, come [FL].

Come; in PVB we have basically two varieties one is known as a normal PVB which will give sound insulation whereas, another layer is known as sentry glass PVB. The sentry glass PVB is, with the sentry glass PVB is known for its stiffer less and it will give additional structural strength to the class. So, you cannot fold it is it is very stiffer compared to the normal PVB; this is a 0.76 sgp sentry glass PVB and if you see a normal PVB we have basically three types of PVB's one is known as clear PVB where the transparency is there next one is the translucent PVB.

Means like this is a milky PVB, if I keep my hand here you will not be able to say full features and one more is known as coconut PVB that will give opaqueness to the glass. [FL] [FL] once the assembly is tense the glass comes to pressing section, now if you see this is the heating. [FL] Yeah this is the heating section next it goes to pressing section, this is known as nip crawling one, next again go it goes to a second heating section.

Again we have one more nip crawl section in the nip crawl section, there it goes for unloading and next it comes out for unloading. You can say the haziness is there on the glass, through this pressing we are dearing the moisture in between the glass and the PVB and we are doing basically primary sealing in pressing [FL].

This is a temperature gun; this is a temperature gun which will measure the output of the temperature, output temperature do you see now it is measuring 58 degree centigrade; generally, it will be on an average of a 60 degree centigrade now this glass is coming from assembly now it is going to heating section. (Refer Time: 38:44) Pardon.

Yes, from assembly it is going to pressing section here it is getting heating; this is known as oven heating oven next it goes to pressing. So, take that next it goes to nip rolling system. The speed depends on the glass thickness and the combination now the glass is entering into a nip rolling system.

The pressing will be done as for the combination of the glass; now it is a second heating section, this is the second heating section or zone and this is an nip roll nip roll to that goes to unloading. During pressing process primary ceiling will be done through de airing process, you can able to find the haziness on the glass that will be removed inside the autoclave. Now, it goes to staking now the glasses are getting stacked and they will be sent inside the autoclave (Refer Time: 41:32).

[FL] (Refer Time: 41:39) This will open [FL] glass [FL]. Here now you are able to see, once the glasses has been assembled and pressing through nick rolling system it goes inside the autoclave for secondary ceiling. Inside the autoclave the secondary ceiling will be done as well as the haziness will be removed, you will be getting a clear transparent vision to the glass. Inside autoclave you will be having 3 phases of cycle that is first the glasses will be heated, when it gets to holding state again it goes to cooling state. You can see the fan is there in the in the back backside and air will be circulating (Refer Time: 44:24).

Yes, air will be circulating and we have pressure with a certain 135 degrees temperature and at 13 bar pressure the glass will be kept. And at a time of cooling the pressure wall will be released, lift to the glass from the conveyer to the stacking; with the vacuum section comes they are lifting the glass and placing on the autoclave trolley.