Glass Processing Technology
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Lecture – 55
Quality Testing Part VI

Now, we will be understanding the quality plan for double glazing unit and the standard is EN 1279.

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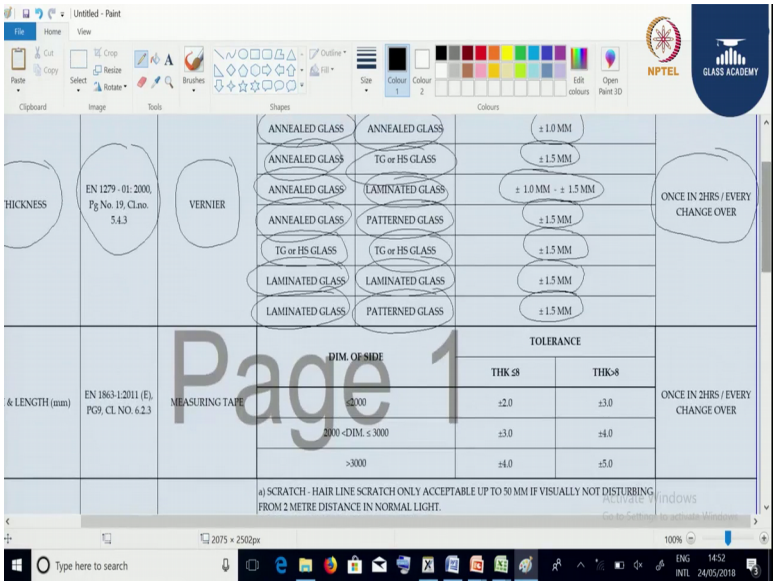

So, here the test parameter starts with thickness overall thickness of the DGU, the standard what we follow is EN 1279. The tool what we use to measure the overall thickness of the DGU is vernier caliper. Here as it is a double glazing unit it consists of minimum two panes of glasses; the first pane and the second pane. The pane of glasses can be either annealed or toughened or HS. Annealed or laminated glass, annealed or patterned glass, tougher or HS or toughened or HS glass, lamination with laminated glass, laminated and pattern glass; so the combination of the panes can be any.

So, here we need to understand thickness tolerance. When the glass is of annealed-annealed combination the overall thickness allowed is plus or minus 1 mm. When the glass combination is an annealed and toughened or a HS glass; the overall thickness tolerance is plus or minus 1.5 mm, when the glass combination is annealed and laminated glass that the thickness tolerance shall be plus or minus 1 mm to plus or minus 1.5 mm. When the glass combination is annealed and a patterned glass the thickness

tolerance is plus or minus 1.5 mm. When the glass combination is a toughened or HS glass and toughened or HS glass the thickness tolerance is plus or minus 1.5 mm.

When the glass combination is a laminated glass plus laminated glass the thickness tolerance is plus or minus 1.5 mm. When the glass combination is a laminated glass and a patterned glass the thickness tolerance is plus or minus 1.5 mm. So, and the frequency of testing shall be 1 cent towards our every changeover whenever there is a change of thickness, then we need to recheck the thickness of the overall DGU. Next coming to this thing the second parameter is length and width it is similar to the pre process or tempering the standard that is EN 1863 or EN 12150.

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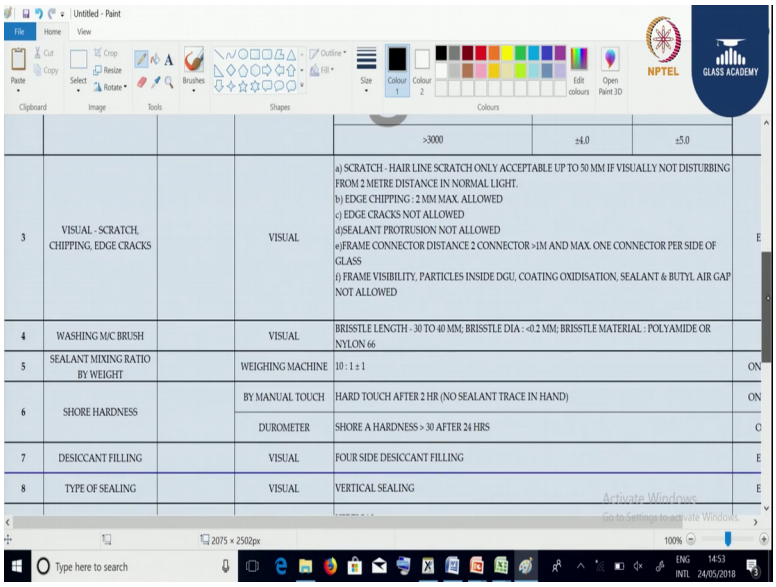

Next visual inspections and scratches, chipping, edge works; all these are applicable as per the pre process and tempering standards. Here, we need to understand the few parameters it is a washing machine brush quantity we need to check sealant mixing ratio. That we need to check the sealant mixing ratio will be generally we measure with respect to volume and by weight 10 is to 1 plus or minus 1. Here we need to check few test parameters that is make sure hardness test. The tool how we follow is that with the help of our hardest meter or a dynamometer we call. And with that if it is through a single part component we use manual touch method.

Next we need to check the desiccant filling and in a particular linear meter space spacer; how much desiccant we need to fill, and in all edges we need to fill, type of ceiling what

we are using; whether it is a vertical or a horizontal ceiling. Curing how what is the curing and stacking that we need to address. What is a delta t that is a temp what temperature difference that we need to understand and everything will be undergoing through the lab tests that we are that are coming in the later sessions.

We need to check butterfly test, next we need to see the secondary sealant depth; we have we need to see how we are stacking, what is the labeling position, what here logo, how where we are using the logo, what is the labeling position, primary sealant, butyl, how you are keep front and rear code, coating surfaces, shining effect, because of anti deletion, air gap, water. All these parameters we need to understand keep in mind when we are processing a double glazing unit. Now we are going to see the defects that are going to arise in DGU process: that is a Double Glazing Unit.

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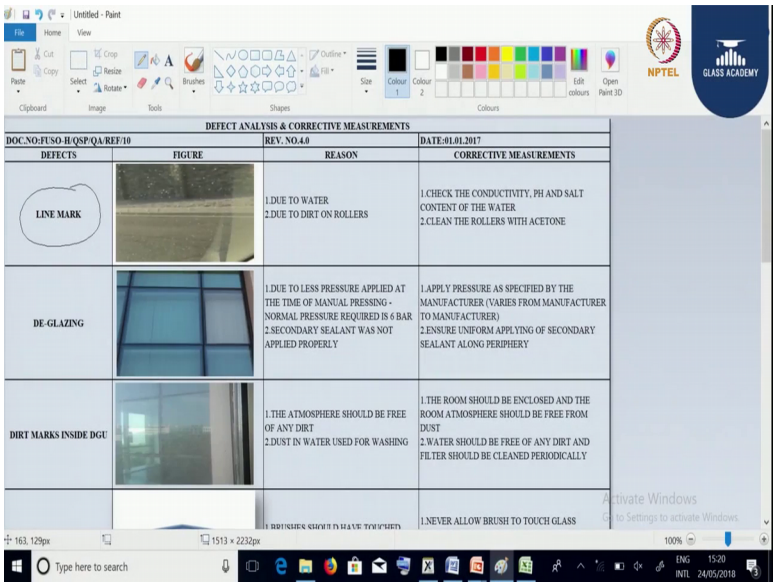

We see we can see the defect a is line marks; means aligning on the glass surface you can see the lining on the glass surface the reason being because of poor water or because of the dirt on the rollers. We can overcome this issue by checking the water parameters like conductivity pH and salt contains in the water and clean the rollers with acetone on a regular basis. Next to defect what we are going to get is De-glazing means the 2 glasses got separated. You can see in the figure the glass the one of the glass got fallen down the reason being. Due to less pressure applied at the time of manual pressing normal pressure required is a 6 bar.

Secondary sealant was not applied properly we can overcome these issues by applying the pressure as prescribed by the manufacturer and ensured uniform applying of secondary sealant along the periphery of the glass. You can see the dirt marks inside the DGU; you can see there is a dirt marks inside the DGU in the figure. The reason being the atmosphere should be free from any dirt nursed in water used for washing. We can overcome these issues the room should be clean and enclosed and room atmosphere should be free from dust. Water it should be free of any dirt and filter should between the periodically.

Next you can see the scratches mark scratches on the glass surface, this is because of the brush should have touched the glass without water. We can overcome this issue by we should never allow brush to touch the glass without water. First to water should touch the glass and then brush should touch the water. Next one is poor edge deletion you can see here in the figure the glass because the edge deletion. That is the edge deletion what we have done on the glass is not complete if there is a poor edge deletion you can see the traces of the coating. Our intention is the coating surface should be completely removed and the surface should be as good as a clear glass. This is because the reason being because of poor edge deletion edge deletion and then we can overcome this issue by properly doing the edge deletion and with the proper bill to be used in with the proper pressure.

Next one is the non uniform butyl application; you can see in the figure the butyl is like a zigzag line. Always the butyl should be straight and it should be continuous the butyl acts as a moisture barrier. The reason being the zigzag line reason being the non-uniform butyl application and we can overcome this issue by applying butyl uniformly and continuously. Next to defect what we are going to get in DGU is the poor sealant application. You can see there is a depth insufficient or there is a continuity missing in the sealant; the reason being because of poor sealant application. We can overcome this issue by maintaining a proper edge seal and the uniformity and tooling to be done once the pasting is done.

Next we depict what we are going to get is the condensation inside the DGU that is the moisture is trapped inside that DGU there issues the reasons being desiccant is absent in the spacer or the secondary sealant is absent in patches or time delay between the

desiccant filling and the secondary sealant applying at the end of the process or proper sealing not done after argon gas is filled.

We can overcome these issues by desiccant should be provided in the aluminum spacer, apply secondary sealing properly along the edges, time delay should be maximum 30 minutes, longer than the time delay greater the chances of desiccant absorb the moisture from atmosphere, and ceiling should be proper after argon gas is filled. The next depict what you are going to get is a desiccants inside the DGU. You can see here the desiccants are falling inside the DGU. The reason being avoid direct a punching to the DGU generally we whenever we go to any glass which is having desiccant inside the major causes you can see that DGU got drilled. So, we need to avoid the drilling directly drilling of the spacer we can overcome this issue by air or gas filling make sure that the punches in the dia is less than the desiccant dia.

Next to defect you can see is the edge offset you can see with the right angle there is offset of the edge in the figure. The reason being individual glass size variations or improper pressing or wrong stacking method of adopted. You can overcome this issue by both the glasses to have uniform dimensions, pressing to be uniform on all sides, glass stacking to be uniform, resting on the trolley uniformly resting on the trolley. So now we will be starting the various tests that are applicable for insulating glass unit. Let us start with butterfly test.

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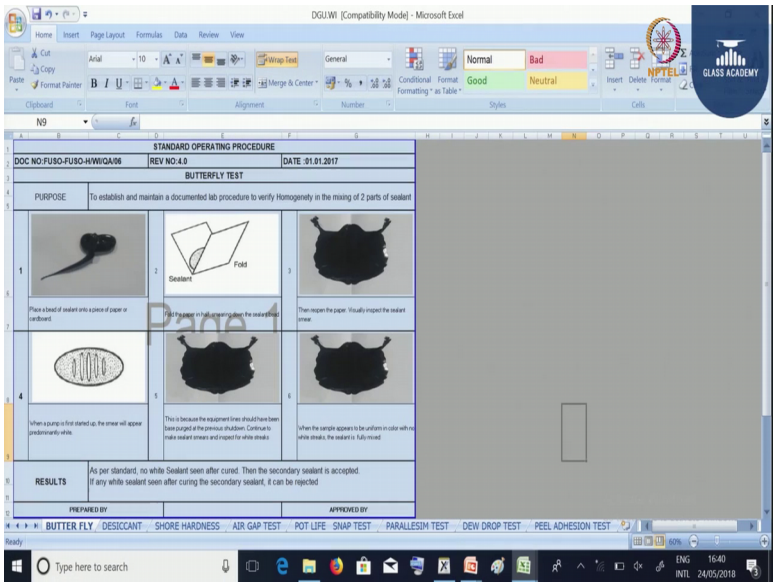

The butterfly test we perform on secondary sealant the second sealant is available in three forms in the market. That is insulating glass unit, structural glazing unit, and for weather weathering sealant. Now, let us take with the insulating glass sealant; the purpose of doing butterfly test is as the sealant secondary sealant is a two part component we need to maintain the homogeneity of the two parts of the sealant. And one of the tests which is used to see the homogeneity in the mixing is the butterfly test.

The procedure what we do is first we will be taking a piece of we will be taking a bit of sealant onto the piece of paper and we will be folding it and we will be trying to open; when we open the shape of the sealant shall come like a butterfly so that is why it is called a butterfly test. And if you see if at all after once you are open the paper and we are able to see any white patches in the sealant then you say that there is a mixing issue is there in the sealant. If there is no mixing issue in the sealant the sealant will come out to be black. So, through this butterfly test we are ensuring that there is a homogeneity of the mixing of the two part sealant is maintained.

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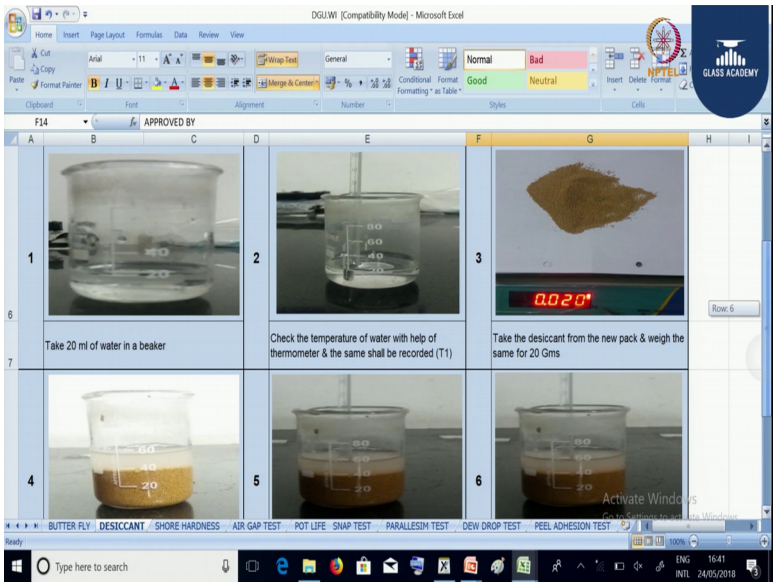

Next to test what we do is a desiccant test that we use inside the space it will absorb the moisture. If you see here the first what we do is we will be taking a 20 ml of water in a beaker. Next we will be measuring the temperature of the water then we will be taking a 20 grams of desiccants and we will be pouring the desiccants inside the water. And we will be checking the temperature after the desiccants is kept inside the water.

Within a fraction of seconds the temperature will raise, then we will be calculating the temperature difference; that is after adding the desiccant what is the temperature minus initial water temperature will give me the desiccant temperature. And it should be minimum 32 degree centigrade. You can see here the standard value for temperature difference is 32 degree centigrade minimum

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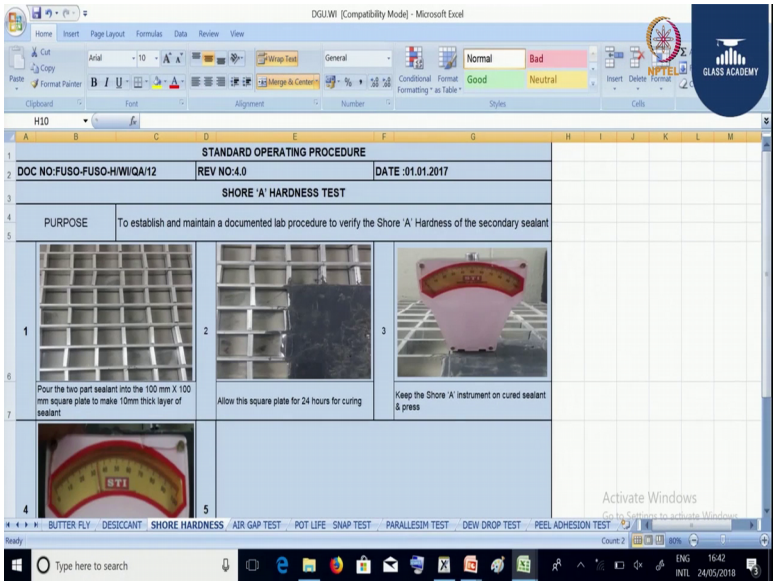

Next we will see the shore hardness test; the shore hardness test is used to check the hardness of the secondary sealant. The procedure what we do is we will be taking a seat we will be taking a two part sealant into a 100 mm 100 by 100 mm square plate of 10 mm thickness layer. Then we will be applying a secondary sealant on the area of 100 by 100 mm square area. And after 24 hours of production we will be trying to see the hardness with the help of a shore hardness tester.

You can see in the figure three we are keeping the shore hardness equipment shore hardness tester on the sealant and we are trying to measure the reading. If you are getting more than 30 then it is a good sealant. You can see here as per the standard acceptable value is 30 to 50 shore here for secondary sealant. If you are getting below means still it requires curing and if you are getting higher value means always there is a chance of getting the sealant as a sticky material second sealant will act as a rubber material

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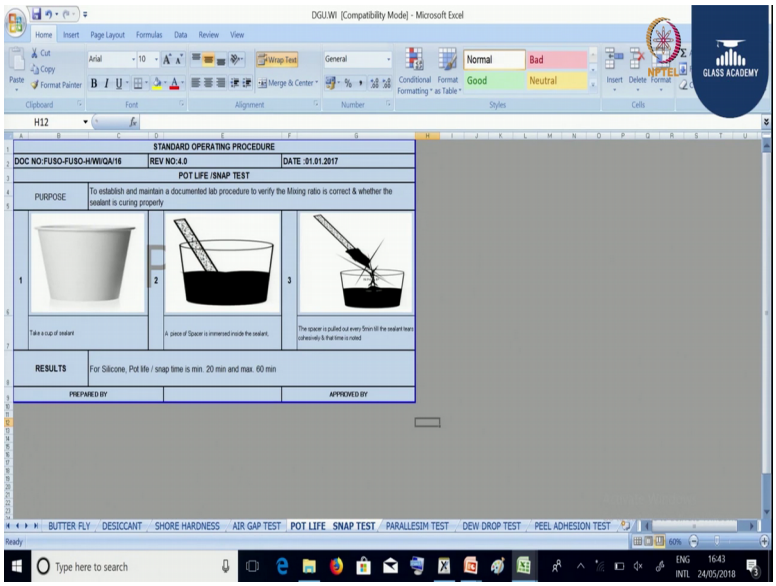

Next if you see we have one more test known as spot life test or snap test. The test why we do is to have the curing, snap time will determine the curing time and the curing rate. This test is to a step you can see here the procedure what we follow his first will be taking a cup of sealant inside the sealant will be we will be taking cup of first we will be taking a cup inside that will be applying the sealant and we will be taking a spacer and we will be inserting inside the cup and we will try to remove the spacer every 5 minutes, at a particular time it will not come out. We need to see here the whether it is a cohesive failure or adhesive failure and at what time. If it is tearing within itself and a particular time is we need to note down note down that time. And the result is for silicon the snap time should be minimum 20 minutes and the maximum is 60 minutes basically the snap time will divide determine the curing time between the glass and the spacer.

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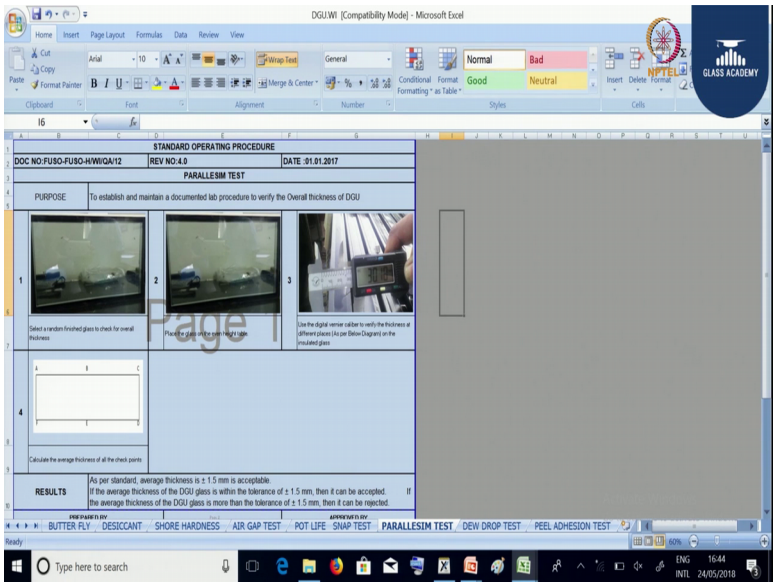

Next to test what we do is the parallelism test that is known as to measure the overall thickness of the DGU. What we do is first we will be placing the DGU vertically on at the edges are at the center of the 4 edges we will be measuring the thickness of the glass. Generally the thickness of the glass includes the individual glass thicknesses and the air gap what the DGU is covering with. So, if you see in the 4 figure 4, we should be measuring the overall thickness at these particular areas ABCDEF and as for the standard as we have seen in the standard the thickness difference shall be plus or minus 1.5 mm is acceptable.

Next test what we do for DGU is a dew drop test; the procedure what we follow is we will be taking a DGU glass, a final DGU product and we will be placing the DGU glass inside the freezer. And we are going to freeze the glass minus 20 to 22 degree centigrade for 2 hours. And with the help of a pyrometer we will be measuring the temperature of the glass. If at all the glass is properly sealed with the butyl continuity and desiccants we will not find any condensation or dew drop inside the DGU. If you are getting a condensation inside the DGU like figure 3; you can say that this is because of there is a failure of the butyl. That is the butyl is not continuous or there is a gap between there is a no discontinuity of butyl the desiccants what we place inside the spacer are not in a position to absorb the moisture.

So, here we need to per dew drop test we need to find out three things you can see in the result no condensation should be there inside the DGU. Failure shall result in the bad quality of the primary sealant, secondary sealant and the desiccants. Next we will see silicone peel adhesion test this is also one of the tests performed on the secondary sealant. If you see we try will be applying the sealant on a space and will try to remove will try to remove the sealant. When the sealant is completely coming out you can say there is a adhesion failure between the secondary sealant and the spacer. Whereas, in the figure b you can see there is a cohesive failure where some of the sealant is still sticking to the spacer. So, with the help of our sealant this peel adhesion test we can measure the addition between the spacer and the sealant.

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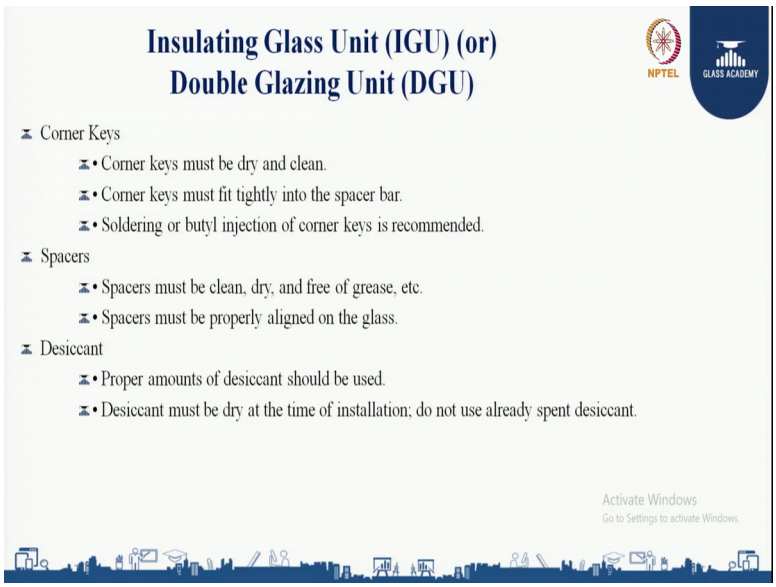

Now, we will understand the test what all we do for insulating glass unit or double glazing unit. Generally if you see double glazing unit it is a combination of two glasses with air gap in between. As we are we are assembling two glasses with the air gap the DGU glass acquires insulation property; insulation with respect to heat, insulation with respect to sound, thereby giving energy conservation parameters. If you see in insulating glass apart from glass there are many components which make up the DGU glass. Now we will understand one by one and what is their importance and how all these parameters that are going to the contribute to the combination of DGU will help in durability of the DGU and performance.

Now let us understand each one by one corner keys corner keys must be dry and clean. Corner keys must fit tightly into the spacer bar, shouldering or butyl injection of corner key is recommended. So, now water all we are going to discuss these checklist will help us in making a durable strong performance DGU glass. Spacer the spaces must be clean, dry, and free from grease, spacer must be properly aligned on the glass. Desiccant proper amounts of desiccant should be used inside the spacer desiccant must be dry at the time of insulation do not use already spent a desiccant.

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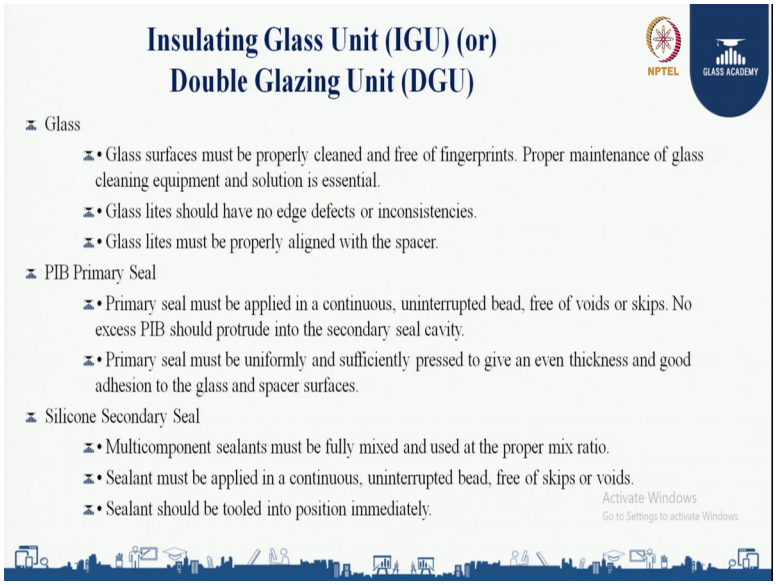

Next glass, glass surface must be properly cleaned and free from fingerprints. Proper maintenance of glass cleaning equipment and solution is essential. Glass lights should have no edge defects or inconsistencies glass plates must be properly aligned with the spacer. Now, let us understand PIB poly isobutylene primary seal, primary seal must be applied in a continuous uninterrupted bead free of void or skips. No excess PIB should protrude into the secondary seal cavity, primary seal must be uniformly and sufficiently pressed to give an even thickness and good adhesion to the glass and the spacer surfaces. Silicon the secondary seal multi component sealants must be fully mixed and used at the proper mixing ratio. Sealant must be applied in a continuous uninterrupted bead free of skips or voids sealant must be tooled into position immediately.

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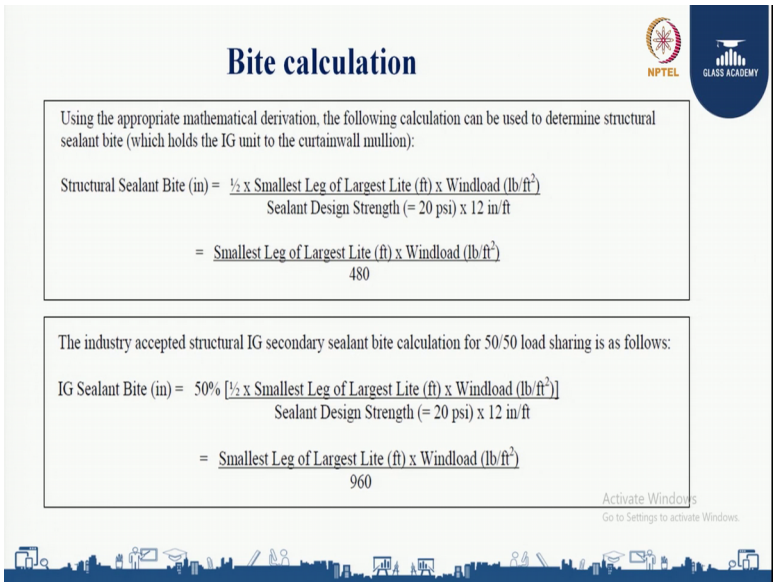

Now we will see what do you mean by bite whitey is nothing but the area that has to be edge removed or the depth of the silicone. The bite will give you structural strength, strength with respect to wind pressure, strength with respect to thermal deflection, strength with respect to dead load or self weight of the glass. So, basically the silicone bill will give you structure strength to that DGU product. Now this is how we are going to calculate the bite using the appropriate mathematical deviation derivation the following calculations can be used to determine the structural sealant bite; which holds the ig unit to the curtain wall mullion.

Structural sealant bite is equal to in inches is equal to half of the smallest leg of largest light into wind load divided by sealant design strength. When it comes to when it comes to IGS sealant bite which is equal to 50 percent of half of the smallest leg of largest light into wind load divided by sealant design strength. You can see here when the sealant for the IGU bite calculation and for the 50-50 load sharing this is the formula what we are going to use to calculate the bite.

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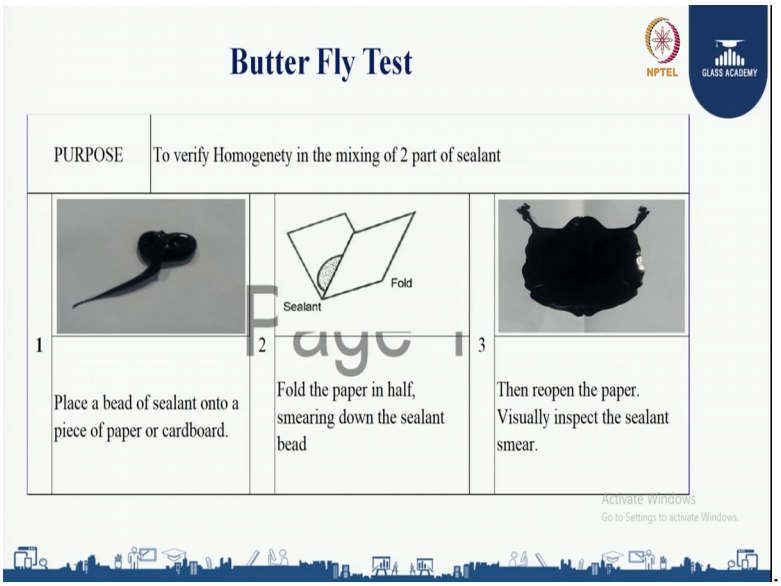

Now, we will understand each test one by one what we do in DGU glass. Butterfly test, when you talk of a secondary sealant it is the sealant what we use to make the insulating glass unit it is a two part component. That is; it is a mixture of base and hardener so we need to have a proper mixing of the base and hardener that you are ensuring through butterfly test. The purpose of butterfly test is to verify the homogeneity in the mixing of the two part of sealant. If you see place a bit of sealant into a piece of paper or cardboard, then fold the paper in half smearing down the scene and wait reopen the paper and visually inspect the sealant smear.

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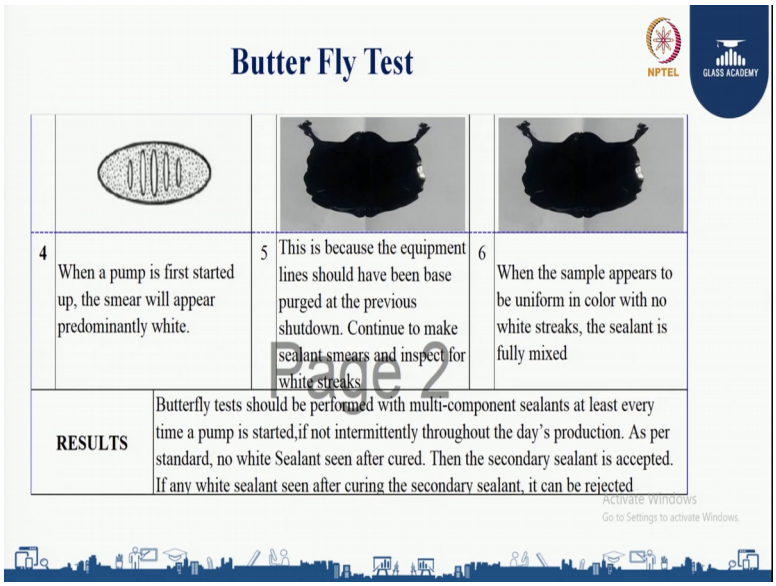

When a pump is first started up this smear will appear predominantly white this is because the equipment lines should have been base purged at the previous shutdown. Continue to make sealant smears and inspects for white streaks when the sample appears to be uniform in color with no white streaks the sealant is fully mixed. The result is butterfly test should be performed with multi component sealants at least every time a pump is started. If not intermittently throughout the days production as per the standard no white sealant scene after cured. Then the second resident is accepted if any white sealant is seen after curing the secondary sealing it is rejected.

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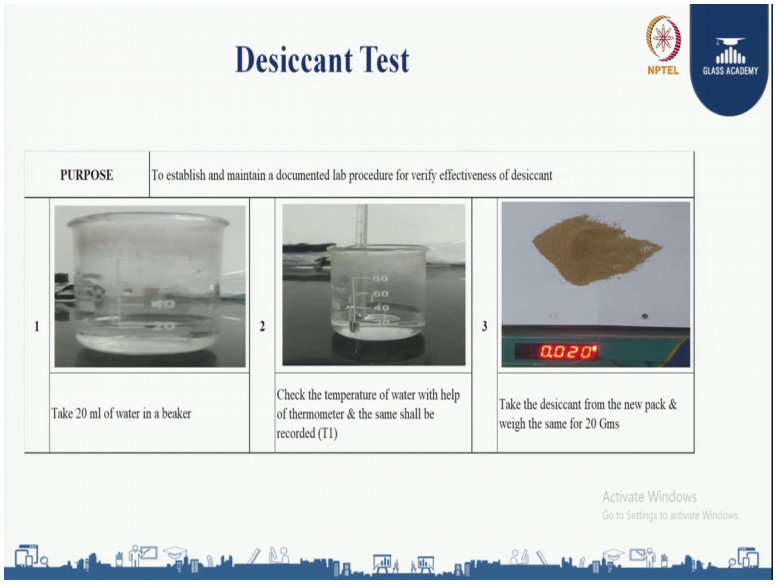

Next is desiccant test or molecular sieve test the purpose of this test is to establish and maintain a document lab procedure for verifying the effectiveness of the desiccants. The purpose of desiccant is to absorb the moisture inside the DGU in order to check whether the desiccants are in a position to absorb the moisture or not. First we will be taking a 20 ml water in a beaker then the temperature of the water with the help of a thermometer is checked it is recorded as t 1 then we need to take a desiccant weighing 20 grams.

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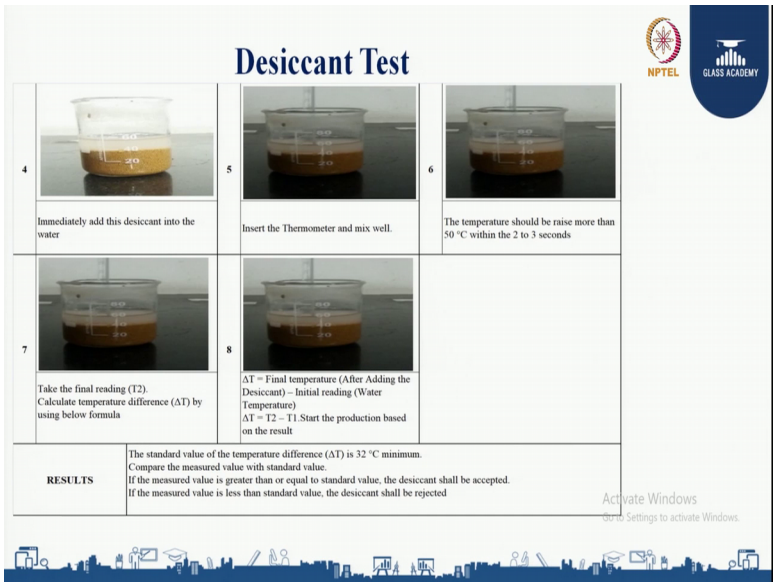

Immediately add these desiccants into the water inside the thermometer and mix well the temperature should raise more than 50 degree centigrade within a 2 to 3 seconds. Take the final reading that is t 2 calculate the temperature difference by using below formula. The delta t is equal to the final temperature after adding the desiccants minus initial reading that is water temperature that is delta t is equal to t 2 minus t1. Start the production based on the result the result is the standard value for the temperature different is 32 degree centigrade minimum.

Compare the measured value with the standard value for example, if my room temperature is 25 degrees centigrade and my desiccant temperature is coming to be 75. So, 75 minus 25 will give me 50 degree centigrade. That is delta t and the minimum required is 32 degree centigrade. If the measured value is greater than or equal to the standard value the desiccant shall be accepted and in a position to absorb the moisture. When the measured value is less than the standard value that is shall be rejected.

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Next coming is shore hardness test through shore hardness test; we are ensuring the hardness of the secondary sealant. The purpose of this test is to check the hardness of the secondary sealant. What we do is we will be taking pour the two part sealant into a 100 mm by 100 mm square plate to make 10 mm thick layer of sealant. Allow the square plate for 24 hours of curing keep the we shore a instrument on the cured sealant and press note the reading from the shore a instrument standard as per the standard acceptable value is 30 to 50 shore a for silicon sealant. The measured value is compared with the standard value, if the measured value is within the standard level it can be accepted otherwise the sealant requires more curing.

Next test is pot life or snap test the pot life or snap test is performed to verify the mixing ratio is correct and whether the sealant is curing properly. The procedure for this one is first we need to take a cup of sealant then a piece of spacer is immersed inside, the sealant the spacer is pulled out every 5 minutes till the sealant tears cohesively and that time is noted. For silicon pot life force nap time is minimum 20 minutes and maximum 60 minutes so through pot life or snap test we are ensuring the curing time.

Next one is the parallelism test; the parallelism test is to check the overall thickness of the DGU as the DGU is a combination of two glasses with the aluminum spacer. We need to ensure the overall thickness of the DGU and that we are going to ensure through parallelism tests. First what we will do is we will take a DGU finished product and place

it on a vertically then using the digital vernier caliper we need to measure the thickness at the center of the 4 edges. As we can see in the figure, ABCC, ABCDEF we need to take the average thickness. As per the standard average thickness is allowed is plus or minus 1.5 mm. If the average thickness of the DGU is glass is within the tolerance of plus or minus 1.5 mm then it is accepted, if it is more than the tolerance then it is rejected.

Next one is a dewdrop test what we do to check the condensation inside the DGU. So, we will be taking a DGU sample and keeping in inside the freezer at minus 18 degrees centigrade for 3 hours. Allow the freezer to freeze at minus 20 degree centigrade. And after 2 hours take out the take out the DGU sample from the suppressor and check for condensation. Condensation can happen either on surface outside surface or inside surface or in between DGU outside or inside can be wiped out. Whereas, the in between DGU is a not in that case we need to check the primary sealant continuity, secondary sealant curing, and hardness and butyl in and desiccant are in a position to absorb the moisture or not. So, the failure of condensation results in the condensation should be no condensation should be there inside the DGU. Failure results in bad quality of primary sealant, secondary sealant, and desiccant. You can see in the figure 1 the DGU glass is placed inside the freezer then it is freezed at minus 18 degree centigrade for 2 hours. Then it is taken out to inspect for whether it is having any condensation inside DGU.

Next one is silicon peel adhesion test; the purpose of this silicon peel adhesion test is to ensure the bonding or the adhesion between the glass, silicon, and the spacer. To sealant gives a acceptable adhesion to the glass and the spacer surfaces. The procedure for this one is apply a bit of silicon sealant to the clean surface spacer, allow the sealant to cure for a specified time. After the specified time period pull out the sealant and visually inspect for a mode of sealant failure. You can see in the figure when I am trying to pull back at 180 degree centigrade it is the glass sample from spacer it is an adhesive failure. The same thing when I am trying to pull out in the figure b there is a cohesive failure where the PVB staring within itself. So and adhesive failure is a bad science whereas, a cohesive failure is recommended. So, we can see in the result also cohesive failure where the sealant tears within itself and remains adhered to the substrate is described versus desirable versus adhesive failure where it commits is completely pulls away from the substrate.

Next a test is a glass thickness list and air gap test so, you can see as it is a DGU glass it is a combination of 4 minimum 2 glasses with the air gap. With the help of air gap tester we can say what is the thicknesses of individual panes as well as the air gap in between the DGU. So, with the help of Merlin laser air gap tester just we need to place the equipment on the glass surface and we need to identify. How we are going to identify means; I will be placing that this equipment on the DGU glass once I press on the button I will be getting minimum of 4 lights which indicates surface one surface two surface three surface 4. So, when I am measuring from first line from right to left first line to the second line it indicates the glass thickness, second line to third line indicates the air gap between the DGU, and third line to fourth line indicates the second glass thickness. So, through this air gap tester you are able to check a glass thickness as well as the air gap inside the DGU. Also this equipment can be used to measure the coating surface as well as if at all any PIB layer is present that also can be traced through this equipment.

So, you can see if it is a single glazing unit you will be getting 2 surfaces there by 2 lines. If it is a double glazing means you will be getting 4 surfaces there by 4 lines. If it is a laminated DGU means you will be getting 6 surfaces there by 6 lines. If it is double laminating DGU means you will be getting 8 surfaces with 8 lines. This is how you are going to trace out the glass thickness as well as the air gap inside the DGU. This concludes all the tests that are that we do for a DGU glass make. Now as we are using actually if you say silicon we have three types of silicones. One is known as structural silicon, second one is insulating silicon, and third one is whether it is weathering silicon. The silicon what we use in architecture system is the insulating glass silicon. Now this is a two part component is a mixture of waves and hardener.

So, this is known as the butterfly test which will determine the mixing ratio between the base and the hardener. That is the homogeneity between the base and hardener. We will take a paper and we will take a sphere small quantity of silicon, but then we will fold will properly squeeze it. If we open this is how a butterfly test will look by the shape itself we can say it is a butterfly, it is looking like a wings of the butterfly. And you we need to see any white patches inside the mixing; if at all any white patches the mixing is not ok. If there is no white patches the mixing is ok. We have one more test known as ANOVA test by placing your finger on the silicon if you are able to feel the wetness after 2 hours also we need to inspect.

So, if it is after 2 hours also it is touching this there is mixing ratio issue is there. If it is not touching means the test is pass. These one more tests one has pot life or snap test where what we are going to do is; we are going to take a cup of we are going to take a cup and inside this we are going to keep a space keep a spare silicon and immerse the spacer. And every 5 minutes we try to pull out this spacer and it is at any time it will break cohesively that time we need to note down. If you see the start time for the spacer is 1055 and any time is 1045. So, the snap time is known as 50 minutes.

So, at a particular 50 minutes the silicon got cured that is known as savage nap time. Now we are going to do one more test known as silicon peel adhesion test this will determine the bonding or the adhesion between the silicon glass and to the spacer. We will cut a piece of silicon and we will try to pull out the silicon and the silicon is coming completely that indicates that is a weak bonding. If it is coming coercively means and is breaking within itself means that is a good bonding.

Now, if you see if you see here it is not completely removed the part of the silicon is still sticking to the glass as well as spacer. So, this is known as silicon peel adhesion test. Always the silicon should have a elongation property and when we cut also it is not coming directly. So, some part of the silicon is still adhering to the glass and the spacer. So, this shows that the bonding between the glass spacer and silicon is good this is known as silicon peel adhesion test.

Now you say it is breaking like this so there is there is no spacer visibility. As long as there is no space ability and the silicon is sticking to the glass and the spacer the silicon is of good quality. Now we are going to it perform one test known as desiccant test for delta t test. What we are going to do is we are going to take a 40 ml of water I am going to take a 40 ml of water. And next we are going to take 40 grams of desiccants. Now we are going to take 40 grams of desiccants with the help of thermometer we are going to measure the temperature of the water with the help of thermometer we are going to measure the temperature of the water. You see the water temperature it is 23 degree centigrade so you note down 23degree centigrade is the initial temperature.

Now we are going to place these desiccants inside the water you see here focus here. We will see within a fraction of seconds there is a increase in the temperature. Now you see there is a temperature is getting increased now the temperature is 65 degrees centigrade.

So, our delta t will indicate now delta t will indicate that is 65 minus 23 which is equal to 42 degree centigrade is the delta t. Minimum required is 32 degree centigrade. So, once the desiccants so this shows the desiccants are in a position to absorb the moisture. Now this is one more test to determine the hardness of the secondary sealant this is known as shore a hardness tester. What we will do is we will be taking it shore a hardness tester and we will be taking a silicon and we will be placing on a glass with the spacer supporting.

Now we will be placing this equipment on the silicon and we will see the hardness of the secondary sealant. You see it is coming 40 42 so the unit is 42 shore A. The desirable reading needs more than 30 more than 20 it should be in between 20 and 60 where we are getting 42 shore A, so this test will determine the hardness of the secondary sealant. Next what we have is so with respect to DGU we have seen butterfly pot life. Now this is one of the in house testing that is used to check the condensation or dew drop inside the DGU. What we do is the purpose of this test is to check the condensation inside the DGU will be taking a DGU sample and placing inside the freezer it minus 18 degree centigrade for 2 hours. So, through this test we are making sure that under extreme negative temperatures how the DGU is going to perform. If at all any condensation is there inside the DGU whether the desiccants. Desiccants what we have seen in the shop floor are able to absorb the moisture and any discontinuity in butyl that we need to see and silicon is properly sealed or not that we need to see.

So, if you see there is no condensation formed inside the DGU. So, this test will determine the properties of the performance of the desiccant how the butyl is acting as a barrier to the moisture and how the secondary sealing is protecting the surface and giving structural strength to the glass. Now we are going to see the one more test related to the final product of DGU known as parallelism test. As the DGU is a composition of two glasses and it is in between the airspace is there we need to measure the overall thickness of the glass. Because the glass can be heat strengthened or toughened on annealed and in between there is a air gap is also there.

So, this parallelism test it will determine the overall thickness of the DGU, through the help of vernier caliper I am measuring the overall thickness at different positions or the places of the DGU. You can see here the value is coming to be 24.71 at this particular area. The same thing when I measure on this thickness it is coming 24.87. Now the same

thing when I measure on the other side it is coming 24.82. Now the same thing if I measure on the other side we are getting 24.7981. So, if you see the average overall thickness it is almost remaining same if you see the glass combination is 6 mm 12 mm 6mm.

So, it should be 24 mm whereas, we are getting 24.7 on an average as per the standard plus or minus 1.5 mm is allowable. So, through this test we are assuring that the overall thickness of the DGU is maintained throughout the product. Now, this is one more equipment similar to gas this is one more equipment similar to gas known as toughened glass indicator. Now we are going to see whether the glass has been heat treated or not with the help of this toughened glass indicator. I am placing a toughened glass indicator on the glass surface and moving across the glass surface we need to see there any change in the color of the lighting.

When I am moving across the glass I am able to find there is a change in the color of the second line, which indicates the glass has been pretreated. Now this is one more test to determine the properties of the base glass what we get from a supplier. So, this is known as visual light transmission phase. If you see any gas like Saint Gobain they will be keeping a remark as the nomenclature for a particular qualities ST467 they will give they will give either ST467. Here the ST indicates it is a reflective glass and 4 indicates, the color of the glass which is green color and 67 indicates the light transmission that is a visual light transmission in the glass. So, through this test we are ensuring the light transmission in the glass is 67 percentages.