Glass Processing Technology
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Lecture - 45
Insulating Glass Unit (Process and Lab Tests)

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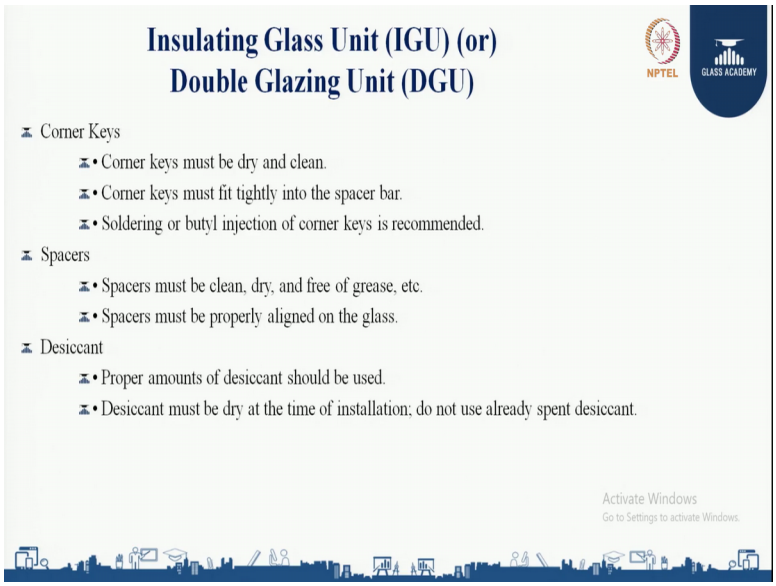

Now we will understand the test what are all we do for Insulating Glass Unit or double glazing unit. Generally, if you see double glazing unit it is a combination of 2 glasses with air gap in between. We are assembling 2 glasses with the air gap. The DGU glass acquires insulation property, insulation 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. Soldering or butyl injection of corner key is recommended.

So, now what are all we are going to discuss? These checklist will help us in making a durable long performance DGU glass. Spacer; the spacers 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 installation; do not use already spent desiccant.

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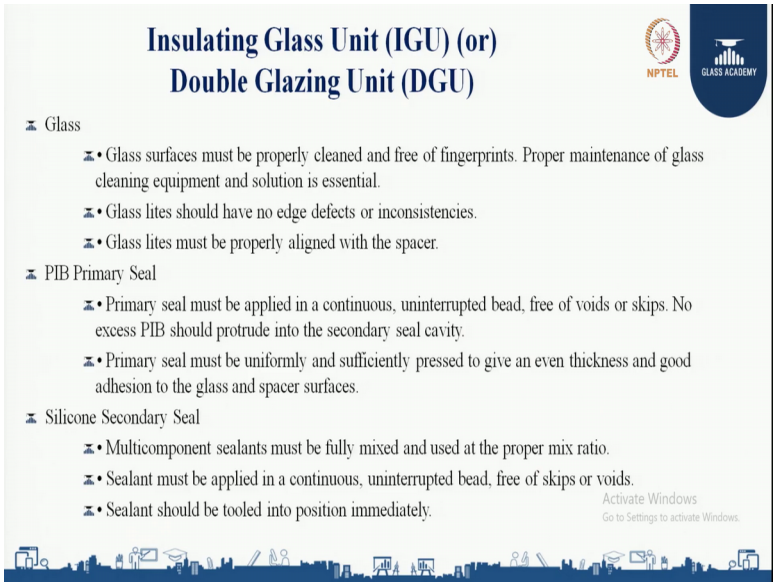

Next glass; glass surface must be properly cleaned free from fingerprints. Proper maintenance of glass cleaning equipment and solution is essential. Glass lites should have no edge defects or inconsistencies. Glass lites must be properly aligned with the spacer. Now, let us understand PIB: polyisobutylene 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. Silicone the secondary seal, multicomponent 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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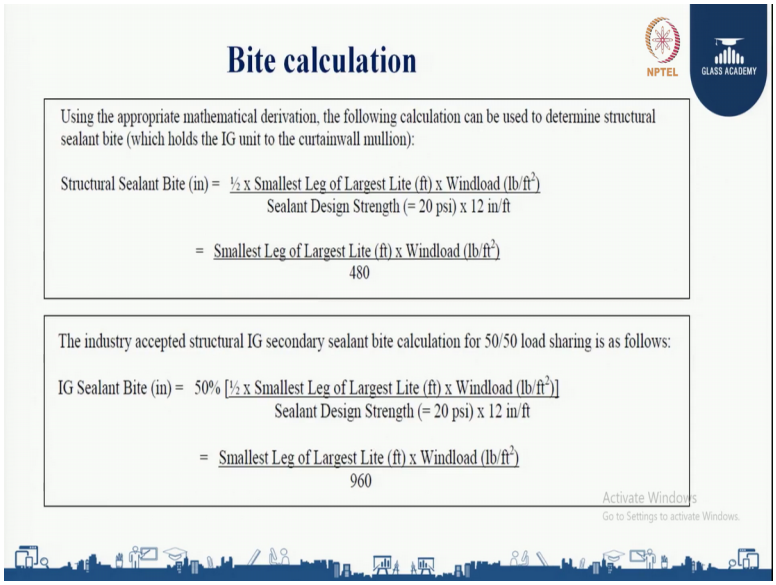

Now we will see; what do you mean by bite? Bite is nothing, but the area that has to be edge removed or the depth of the silicone. The bite will give you structural strength, strength with respect to wind pressure, strength with respect to thermal deflection, strength with respect to dead load or self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

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

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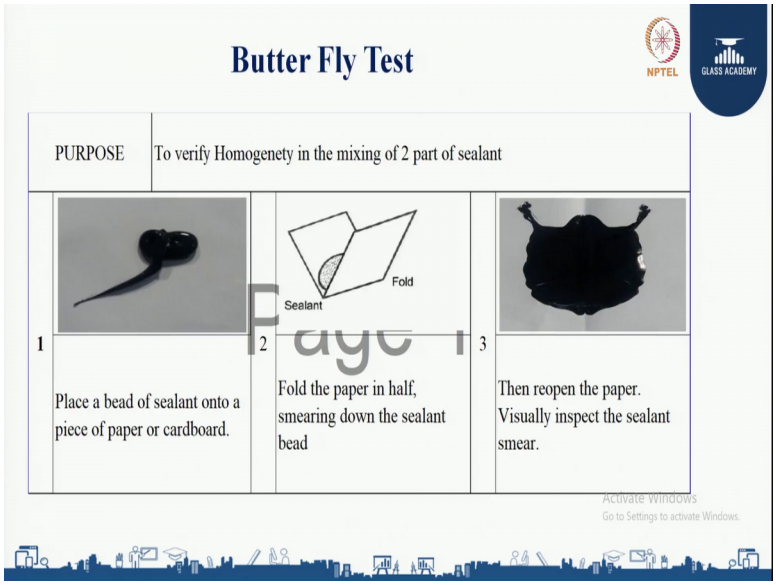

Now, we will understand each test one by one what we do in DGU glass. Butterfly test, when you talk of a secondary sealant it is the sealant what we use to make the insulating glass unit it is a 2 part component that it is a mixture of base and hardener. So, we need to have a proper mixing of the base and hardener that you are ensuring through butterfly test.

The purpose of butterfly test is to verify the homogeneity in the mixing of the 2 part of sealant. If you see place a bead of sealant in to a piece of paper or cardboard then fold the paper in half, smearing down the sealant bead reopen the paper and visually inspect the sealant smear.

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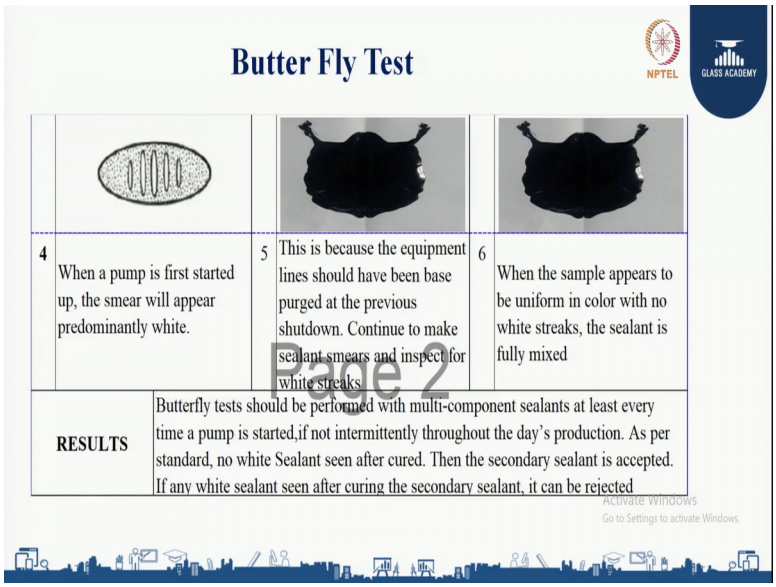

When a pump is first started up the smear will appear predominantly white. This is because the equipment lines should have been base purged at the previous shutdown. Continue to make sealant smears and inspect for white streaks. When the sample appears to be uniform in colour with no white streaks, the sealant is fully mixed. The result is butterfly test should be performed with multicomponent sealants at least every time a pump is started, if not intermittently throughout the day's production. As per the standard, no white Sealant seen after cured. Then the secondary sealant is accepted. If any white sealant is seen after curing the secondary sealing, it is rejected.

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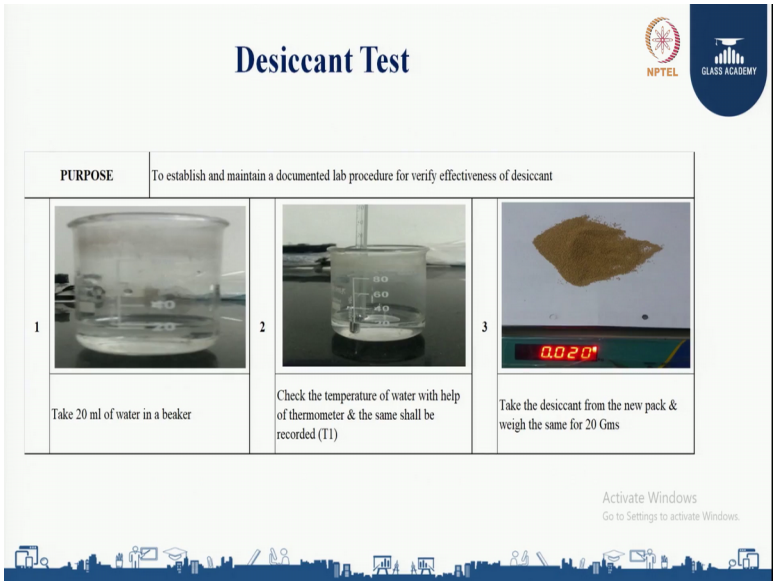

Next is desiccant test or molecular sieve test. The purpose of this test is to establish and maintain a documented lab procedure, for verify the effectiveness of desiccants. The purpose of desiccant is to absorb the moisture inside the DGU, in order to check whether the desiccants are in a position to 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 thermometer is checked, it is a recorded as T1. Then we need to take a desiccants weighing 20 grams immediately add this desiccants into the water.

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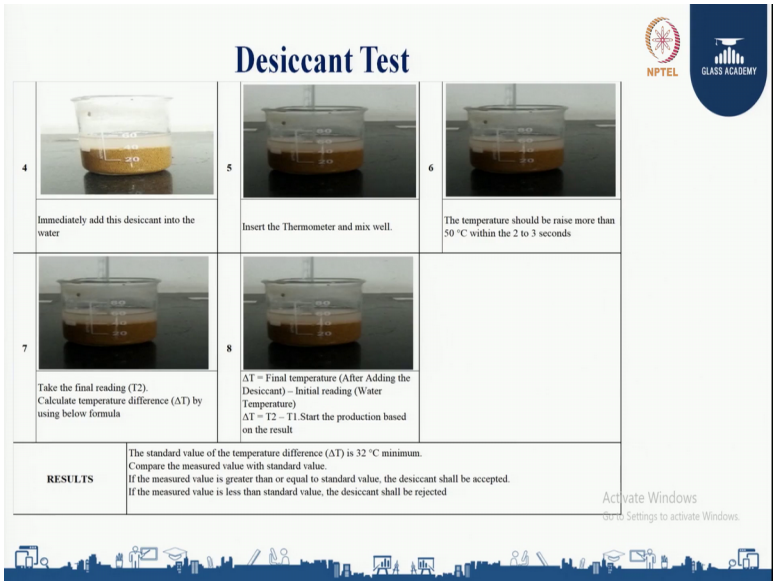

Insert the thermometer and mix well. The temperature should raise more than 50 degree centigrade within a 2 to 3 seconds. Take the final reading that is T2. Calculate the temperature difference by using below formula. The delta T is equal to final temperature after adding the desiccants minus initial reading that is water temperature. That is delta T is equal to T2 minus T1. Start the production based on the result.

The result is the standard value for the temperature difference is 32 degree centigrade minimum. Compare the measured value with the standard value. For example, if my room temperature is 25 degree 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 desiccants shall be accepted and in a position to absorb the moisture. When the measured value is less than the standard value the desiccant shall be rejected.

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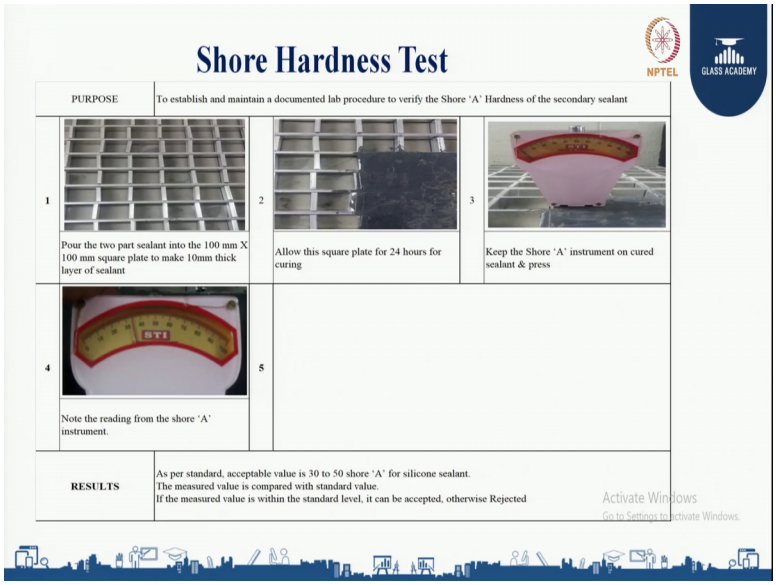

Next coming is shore hardness test. Through shore hardness test we are ensuring the hardness of the secondary sealant. The purpose of this test is to check the hardness of the secondary sealant. What we do is we will be taking pour the two part sealant into a 100 mm by 100 mm square plate to make 10 mm thick layer of sealant. Allow this square plate for 24 hours of curing.

Keep the 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 silicone 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.

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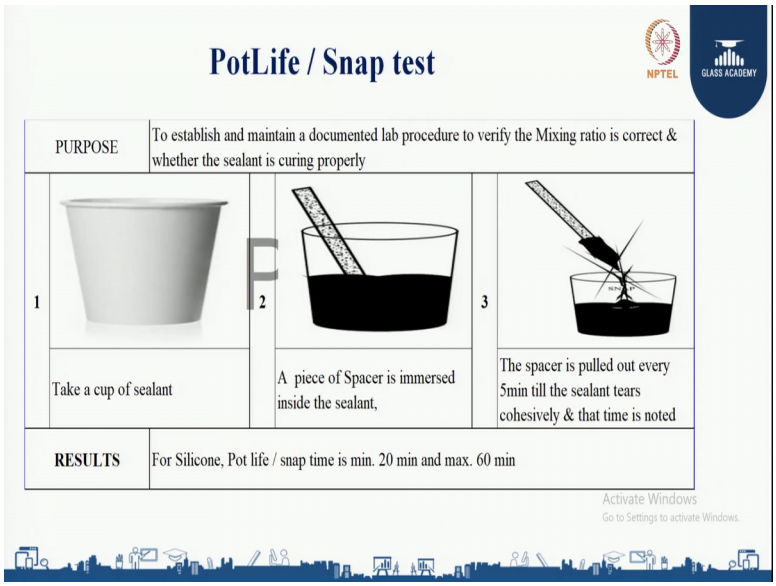

Next test is spot life or snap test is performed to verify the mixing ratio is correct and whether the sealant is curing properly. The procedure for this one is first we need to take a cup of we need to take a cup of sealant. Then a piece of spacer is immersed inside the sealant. The spacer is pulled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

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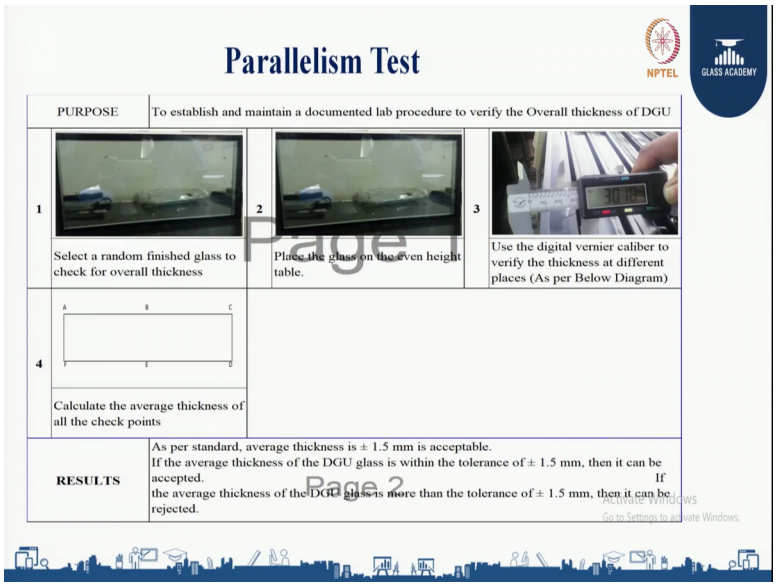

Next one is the parallelism test. The parallelism test is to check the overall thickness of

the DGU. As a DGU is a combination of 2 glasses with aluminium spacer, we need to ensure the overall thickness of the DGU. And, that we are going to ensure through parallelism test. 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 centre 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 that is accepted, if it is more than the tolerance then it is rejected.

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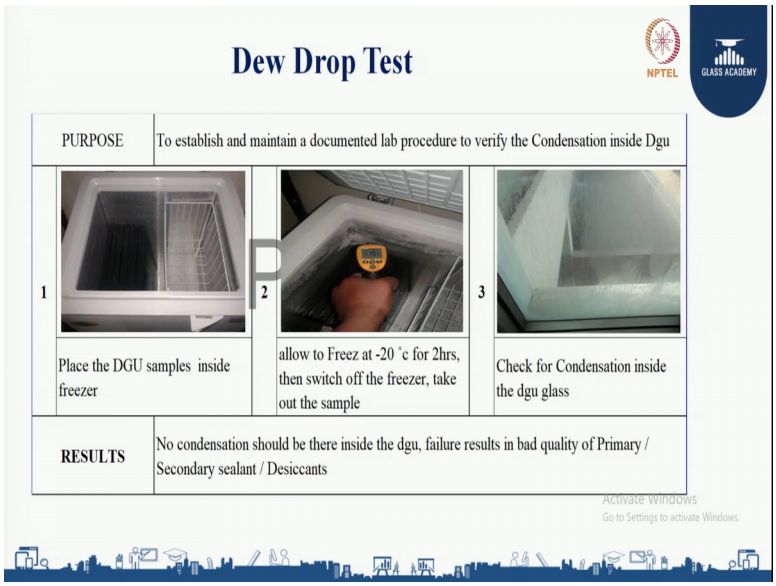

Next one is a dew drop test, what we do to check the condensation inside the DGU. So, we will be taking a DGU sample and keeping in inside the freezer at minus 18 degree centigrade for 3 hours. Allow the freezer to freeze at minus 20 degree centigrade and after 2 hours take out the DGU sample from this freezer 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 ok.

In that case we need to check the primary sealant continuity, secondary sealant curing and hardness and desiccant are in a position to absorb the moisture or not. So, the failure of condensation results in 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.

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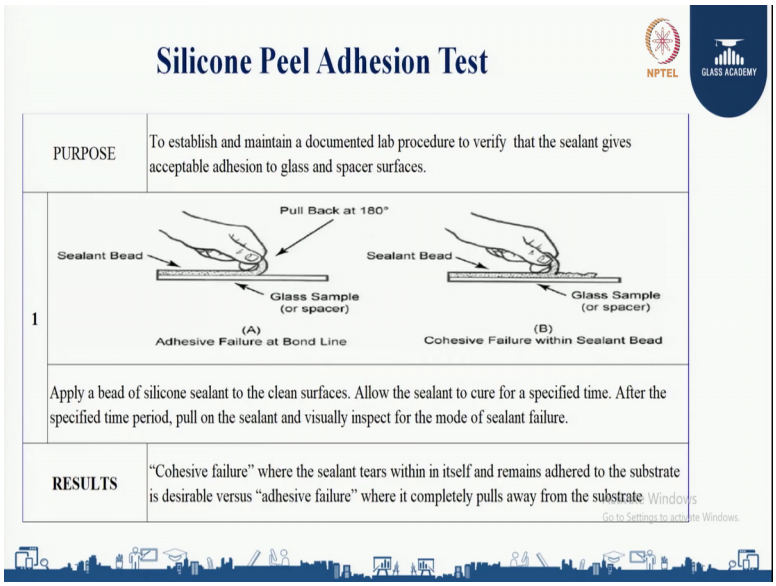

Next one is silicone peel adhesion test. The purpose of the silicone peel adhesion test is to ensure the bonding or the adhesion between the glass, silicone and the spacer. To sealant gives acceptable adhesion to the glass and the spacer surfaces. The procedure for this one is apply a bead of silicone 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 the mode of sealant failure.

You can see in the figure when I am trying to pull back at minus 180 degree sorry, when I am trying to pull back at 180 degree centigrade, it is the glass sample from spacer, it is the adhesive failure. The same thing when I am trying to pull out in the figure B there is a cohesive failure where, the PVB is tearing within itself. So, an adhesive failure is a bad signs 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 is completely pulls away from the substrate.

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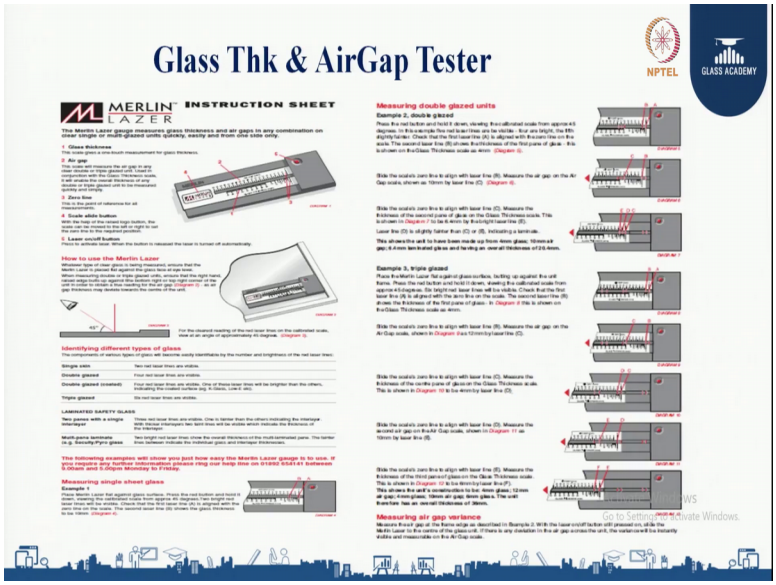

Next test is the glass thickness test and air gap test. So, you can see as it is a DGU glass, it is a combination of minimum 2 glasses with the air gap. With the help of air gap tester, we can say; what is the thicknesses of individual pins as well as the air gap in between the DGU. So, with the help 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 1, surface 2, surface 3, surface 4. So, when I 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 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 PVB layer is present that also can be traced to through this equipment.

So, you can see if it is a single glazing unit, you will be getting 2 surfaces thereby, 2 lines. If it is a double glazing means, you will be getting 4 surfaces thereby, 4 lines. If it is a laminated DGU means, you will be getting 6 surfaces thereby, 6 lines. If it is a double laminated 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 we do for a DGU glass make.