Glass in Buildings: Design and Application
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Lecture - 63
Silicone for Structural Glazing

Apart from structural silicone Dow Corning provides, apart from structural silicone Dow Corning provides an entire range of sealants for many applications.

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In the construction building industry, sealants for structural glazing or metal panels are the most modern trend enabling safe and aesthetically pleasing architectural solutions.

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Dow Corning has therefore, created a systematic approach based on domestic and international standards for structural glazing systems.

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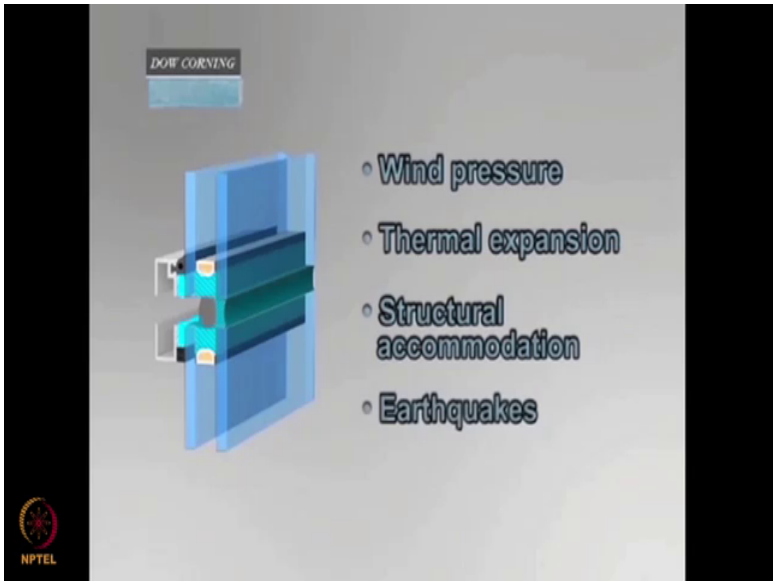

Structural silicone sealants must be able to withstand all possible panel movements.

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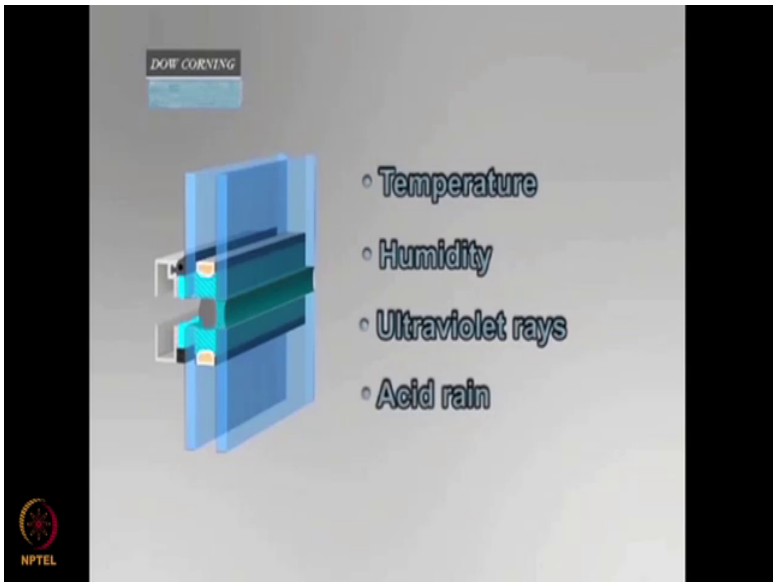

They must also be weather proof.

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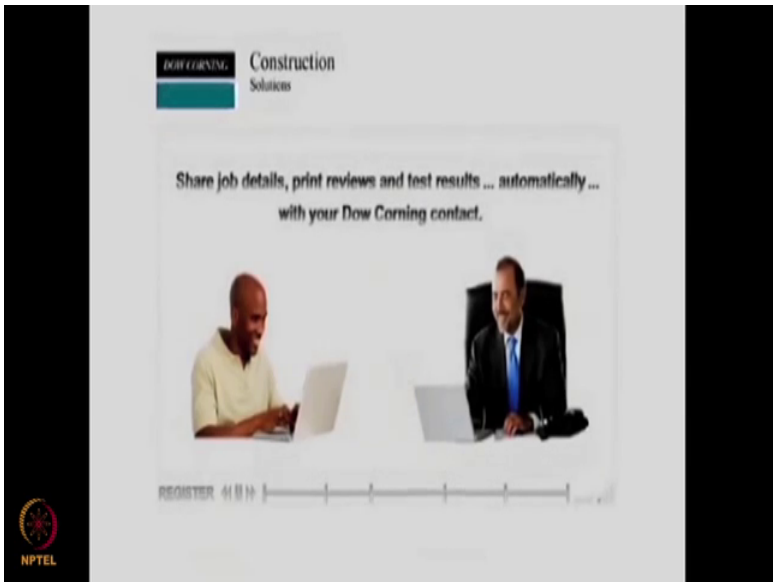

Dow corning as we continue to innovate has created COOL, a tool that brings together our global support services.

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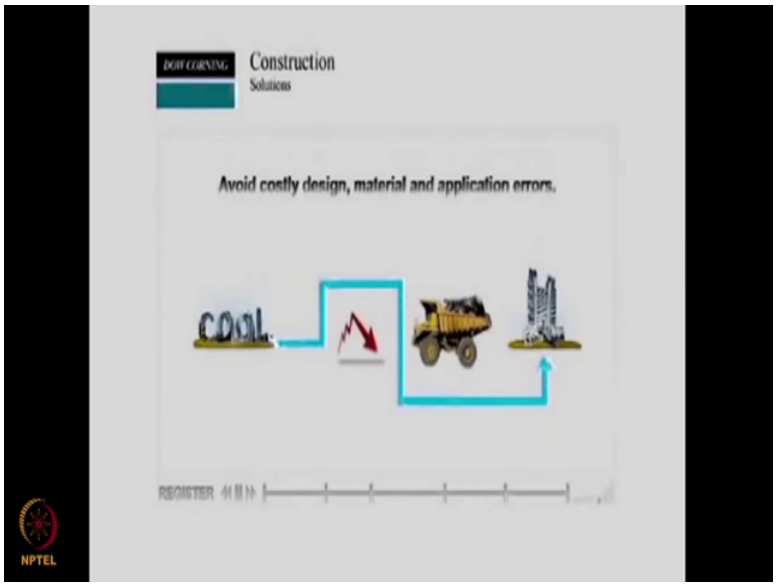

And make sure that each customer interaction with Dow Corning is unique.

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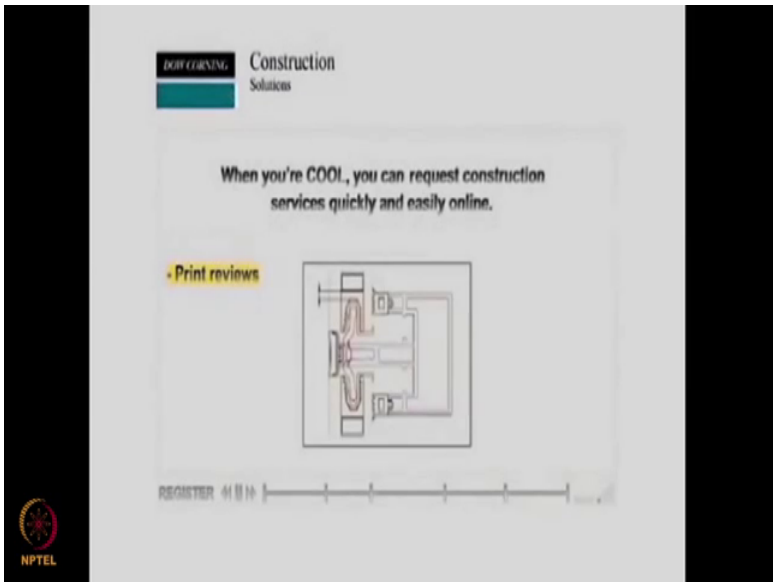

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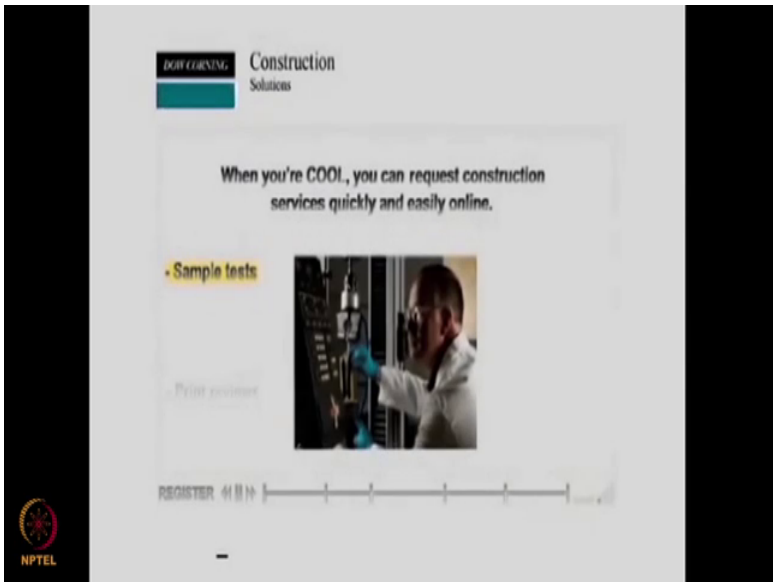

This innovative internet tool simplifies project management.

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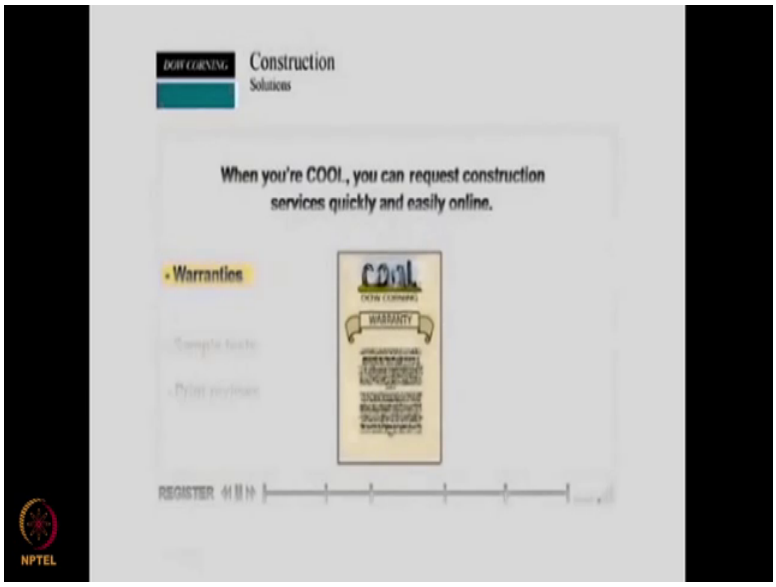

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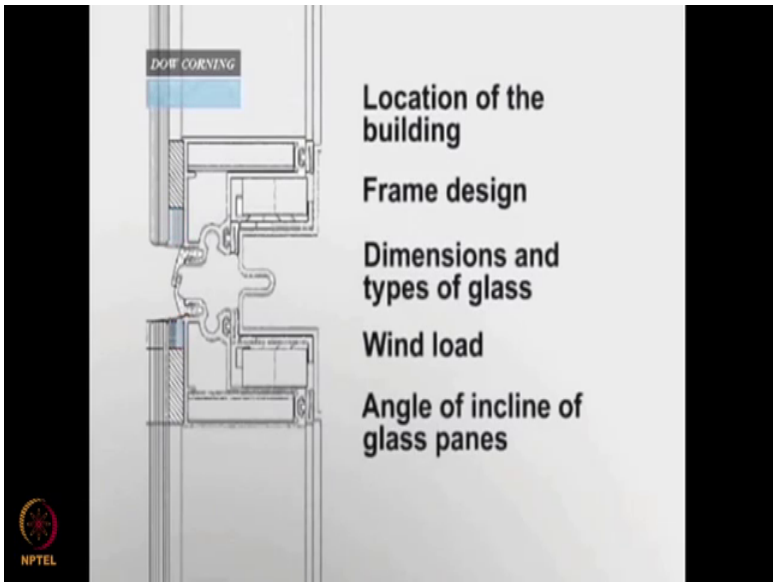

When possible making it quick and easy to perform revisions, request sample tests and warranties. The first step in the process is to calculate the dimensions of the structural silicone sealant joint by keying information into COOL.

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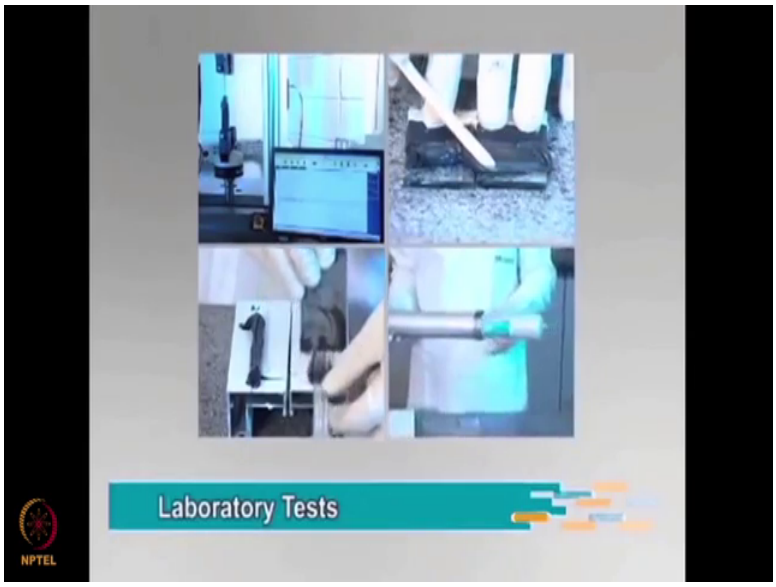

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The next step is to perform laboratory tests; three samples of each type of material to be used on the building must be supplied.

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The samples must be sent directly to the laboratory after being registered in COOL. Dow Corning evaluates the adhesion of the sealants using a peel adhesion test.

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This test will identify the best solvent for cleaning each substrate, and whether a primer needs to be used.

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The test takes three weeks to complete, once the samples have been received for industry standards.

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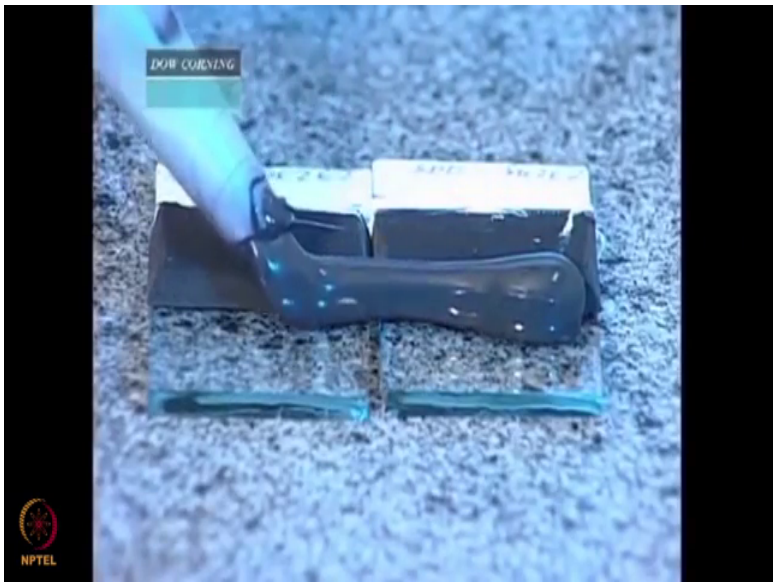

Another test performed is for compatibility.

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Chemically incompatible glazing accessories may cause discoloration of the sealant and or loss of adhesion to the substrate.

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This test takes 4 weeks to complete; once the samples have been received for industry standards. If natural stone is used in the project, Dow Corning may test and evaluate the performance of its sealants to determine whether the sealant fluent can migrate into these substrates.

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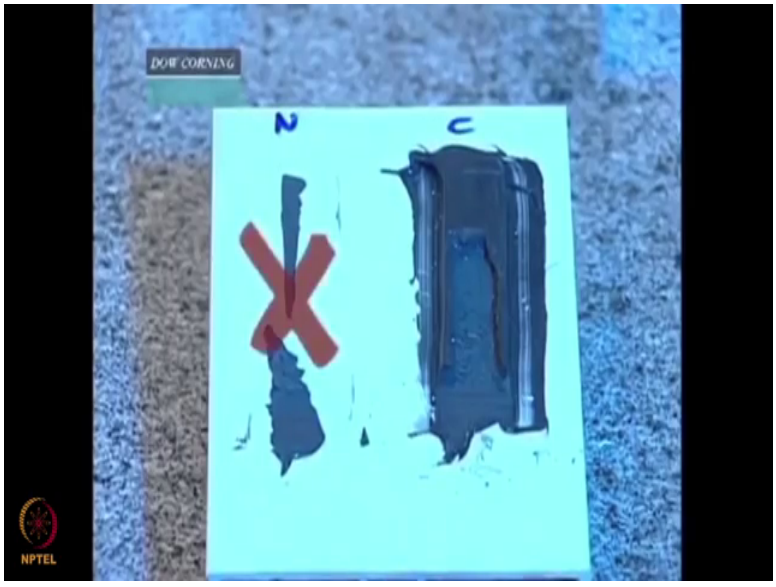

This test takes 6 weeks to complete; once the samples have been received for industry standards. Once the tests have been completed and the results delivered the customer may begin the phase of applying the structural sealant.

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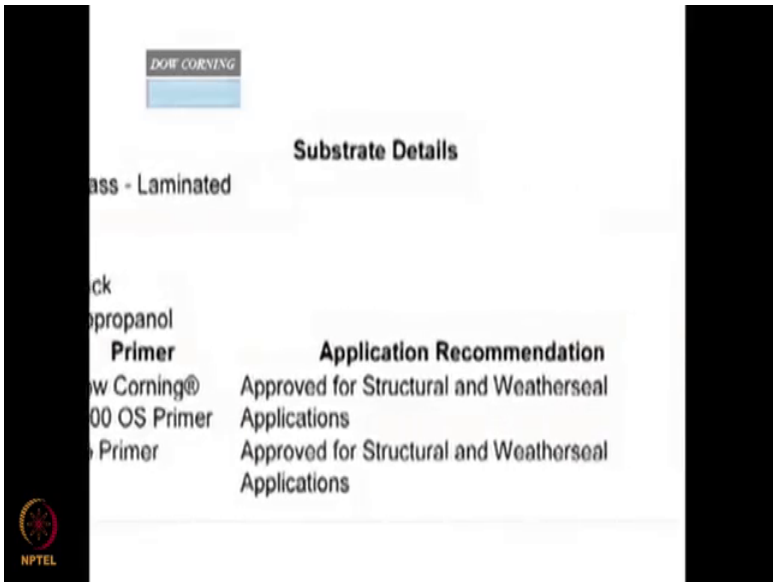

Important point glazing may only begin after delivery of the Dow Corning report containing all the completed test results. Read the product safety sheet, before beginning application of the structural sealant. It contains all the necessary procedures personal protective equipment, and storage conditions for the products to ensure safe work

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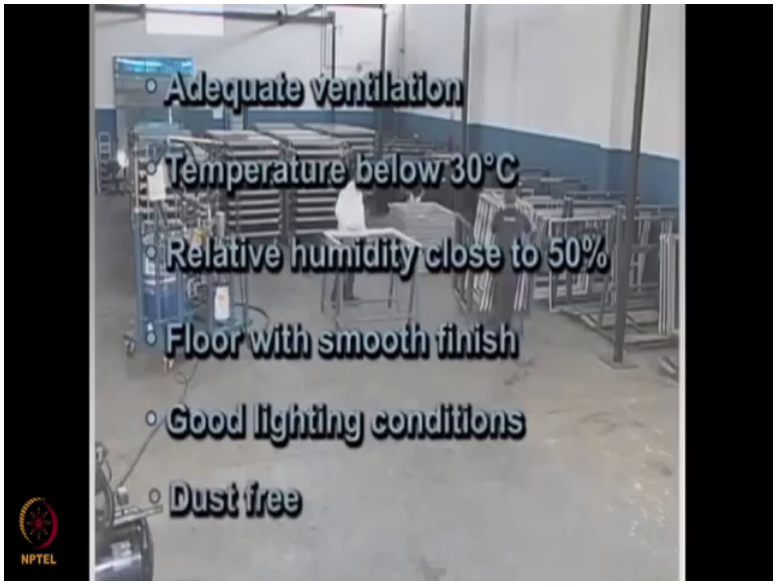

The location where structural glazing is to be performed must be reserved for the application of silicone.

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To begin the process of applying structural sealant, the first step is to clean the aluminum frame with the solvent indicated in the laboratory test result report. Using a two cloth cleaning method, if a primer is needed apply after cleaning, but primer must be applied evenly and sparingly covering the entire perimeter of the substrate and you must wait 30 minutes for the surface to be ready for sealant application.

Next place polyethylene spacers or gaskets on the entire surface of the frame, in order to support the glass and define area of the structural silicone joint. This spacer may be mono or by adhesive provided it is made of a material whereas, previously been tested and approved by Dow Corning. Once the spacer has been applied, but glass must be cleaned using the solvent indicated in the laboratory test result report. Applying it with a lint free cloth, cleaning must be very thorough to remove all residues.

Following this step and before the solvent evaporates, wipe with a clean dry cloth to make sure excess solvent is removed. Use masking tape to protect the area lying next to the location to be filled with structural silicone; any excess silicone will be spread on top of the masking tape rather than on the aluminium, after the substrates have been prepared, but glass can be rested upon the aluminum frame.

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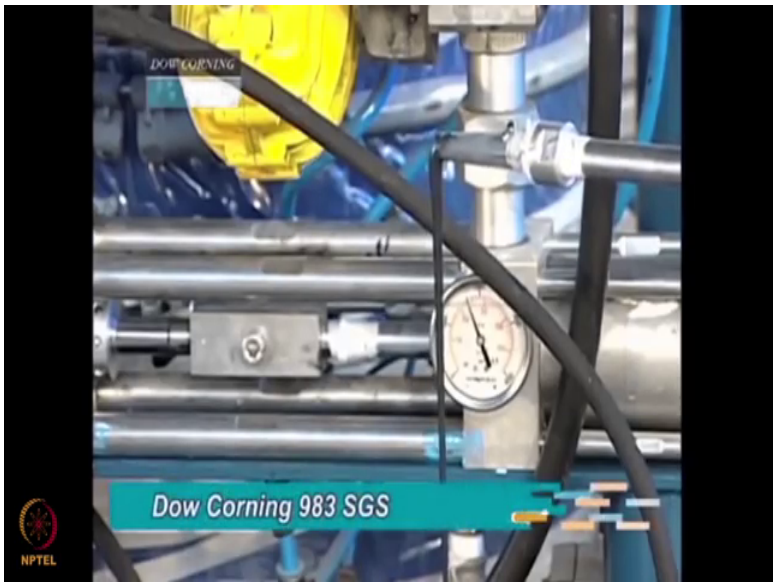

Precision is fundamental in this step, because the glass and aluminum must be perfectly aligned in the frame.

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Three types of tests are carried out before bonding if a two part silicone is to be used the first is a mixing test known as a butterfly test.

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A bead of sealant of at least 15 centimeters is applied to a sheet of white paper; which is folded in half and squeezed until the sealant spreads when the sheet is pulled open again the stain must be even in colour

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If it is uneven, more sealant must be purged and the operation repeated until the expected result is achieved.

The second is a cure time test also known as the cup test. Sealant is poured into a plastic cup and a wooden stick is placed into the sealant. Pull out the stick every 5 minutes and

make a record of the time. If the sealant does not break cohesively when the stick is pulled out this means it has not cured yet. The time it takes for the sealant to tear cohesively when the stick is pulled out is the cure time of the mixture.

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If the time observed is greater than 45 minutes, the application must be suspended. Then there is the adhesion test, clean the surface of a sample of the aluminum to be used in the project with the solvent indicated in the report and apply the primer if specified.

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Lay down a strip of masking tape transversally, and then put down a bead of sealant approximately 20 centimetres long, making sure it passes over the tape. After the sealant has cured pull the tape perpendicular to the substrate to see whether there is any adhesive failure. If the bead of sealant does not show adhesion to the substrate the batch must be rejected; this test is to be performed at the end of each production batch.

The structural silicone can now be applied all around the perimeter of the frame. The application and finishing processes are the same for both one part and two part sealants. After application the silicone must be spread inwards using a spatula forcing the silicone into the joint. For finishing all the spatula at 45 degrees to the edge of the frame. After spreading by spatula remove the masking tape to remove excess silicone.

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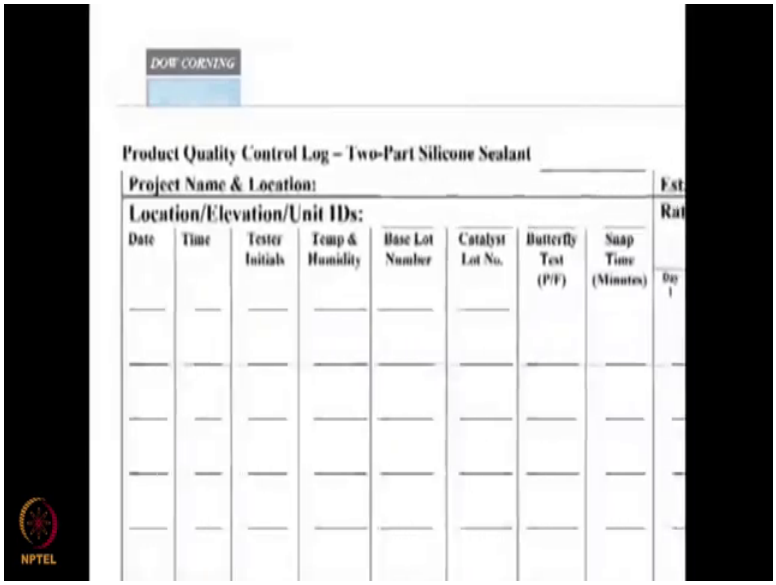

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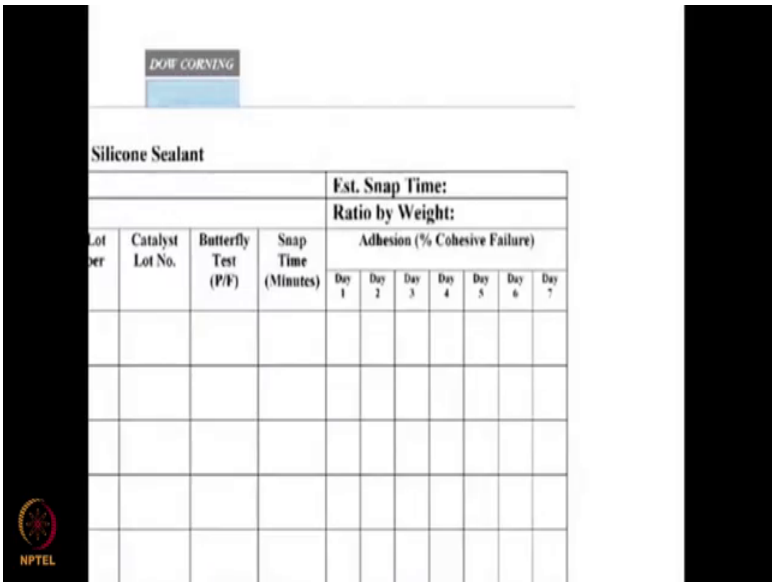

Each glass tile produced must be identified with its number date and position on the building, and recorded on a report. Until the complete adhesion of the sealant has obtained, the frames must be stabilized in horizontal position using a drawer type rack to keep the frame separate from each other.

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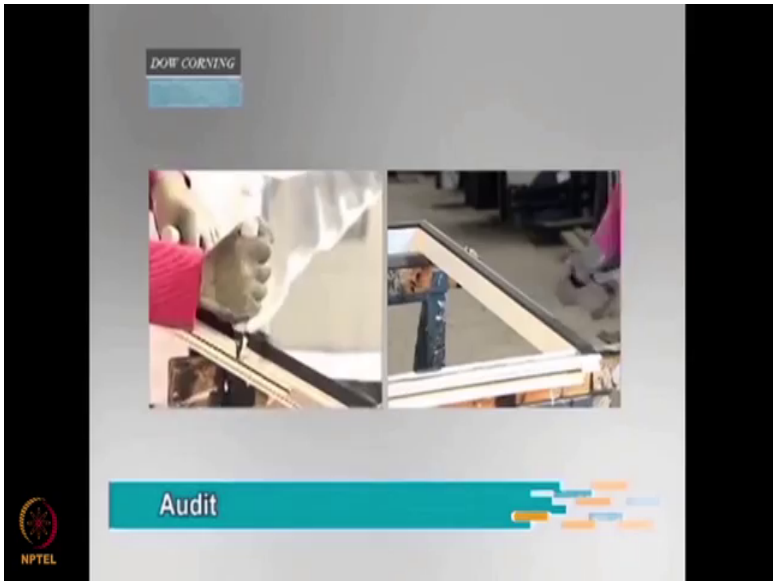

Quality control is the responsibility of the frame manufacturer a technical expert or person trained by Dow Corning will conduct periodical audits of this control evaluating the tests performed and the bonded frames.

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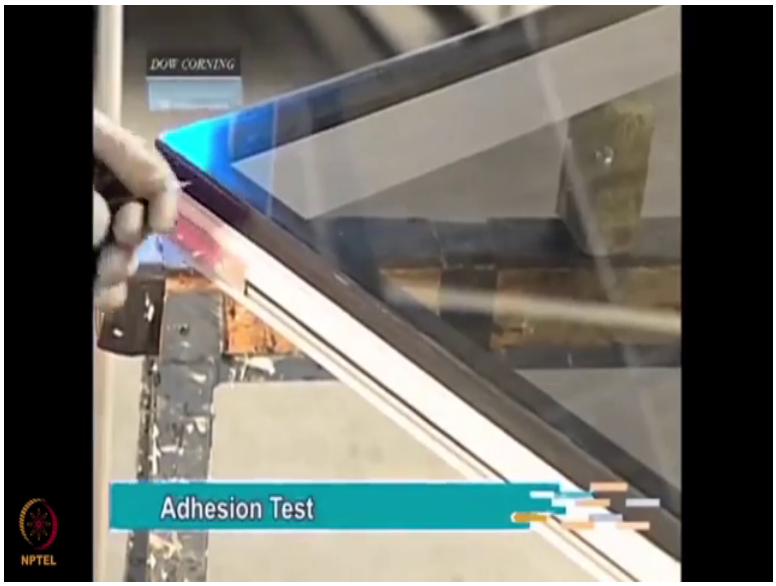

An adhesion test the post cure test is performed on 10 percent of glazing units, the test consists of cutting approximately 10 centimeters of the join lengthwise and then the sealant is pulled at a 90 degree angle to the frame. This test examines the adhesion of the silicone, its elasticity, the presence of bubbles the dimensions of the join and the cure of the sealant. If the joint is not completely cured the frame cannot be installed.

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Another essential test for assuring system quality is deglazing. A knife or steel strip is used in order to cut all the sealant close to the glass. The glass is removed and the

dimensions and filling of the joint adhesion and cleanliness are assessed. This test checks the conditions of the structural bonding after the sealant has completely cured and the compliance of all the following steps can be seen. A daily report containing the exact number of glazed units and their positions must be provided to the technical expert test samples are identified by building and by date of bonding.

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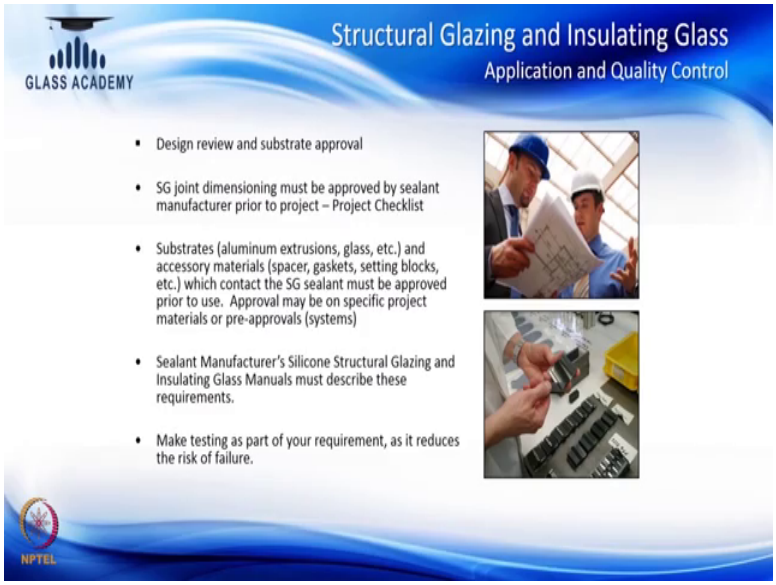

So, you have got an opportunity to go through the video, which essentially you know talks about the various quality control checks of the other applications related to facade like insulating glass and weather seal. So, what is the first thing which has to be done is the design review. So, the design has to be reviewed and the recommendation has to be made, on how much silicone as we use for a structural insulating and weather seal application.

So, the sealant manufacturer should be approached for giving this review, and all the other you know substrates the substrates which are coming in contact with silicone, also has to be approved prior to use. So, there is you would have seen in the video how the peel adhesion testing is done.

So, the testing is essentially done in a dry condition on a on a jobsite whereas, when we it is done in the manufacturers laboratory, it is done to ASTM standard which talks about doing tests in dry condition as well as in wet conditions. So, it is essential that the project

samples are tested for you know getting a good bonding and the recommendations are made prior to the start of the project.

So, what is the first thing which has to be done is the design review. So, the design has to be reviewed and the recommendation has to be made on how much silicone as we use for the structural insulating and weather seal application. So, the sealant manufacturer should be approached for giving this review, and all the other you know substrates the substrates which are coming in contact with silicone also has to be approved prior to use. So, there is you would have seen in the video how the peel adhesion testing is done. So, the testing is essentially done in a dry condition on a on a job site whereas, when we it is done in the manufacturers laboratory it is done to ASTM standard which talks about doing tests in dry condition as well as in wet conditions.

So, it is essential that the project samples are tested for you know getting a good bonding and the recommendations are made prior to the start of the project. So, you saw this particular testing which is an adhesion test. So, I have been always saying that the single most important property for the silicone in façade application is bonding.

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So, to get to that good bonding you know depending upon the substrate sometimes you need a primer or you need not have a primer to be used.

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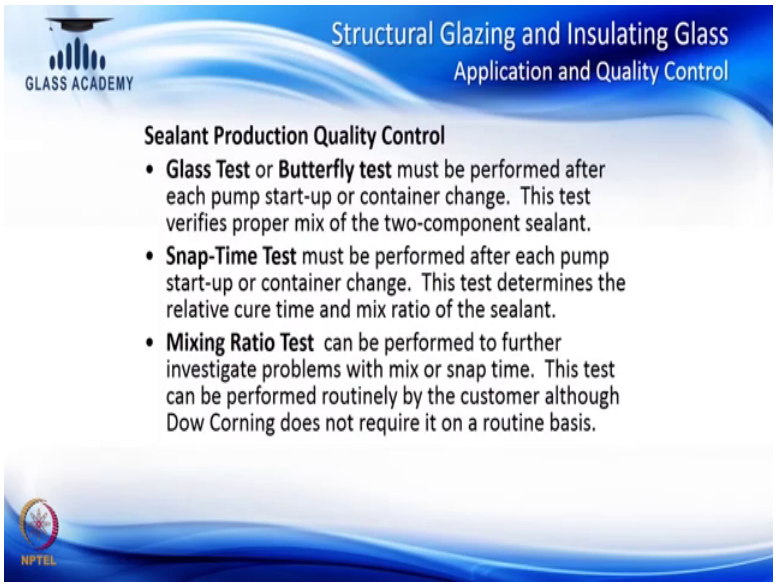

So, this can be checked by doing the adhesion testing and also the nature of failure for sealant bonding is always cohesive. So, a layer of silicone should be always stuck to the substrate, it should not come out clean like a tape or a gasket or a dry fixed system, but which does not leave any trace whereas, silicone mechanically or chemically bonds to the substrate, and then you know when you pull it tears within itself and does not leave the subject which is called as a good bonding.

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And also essentially what is important to understand is any accessory coming in contact with silicone should not really affect the performance of the silicone.

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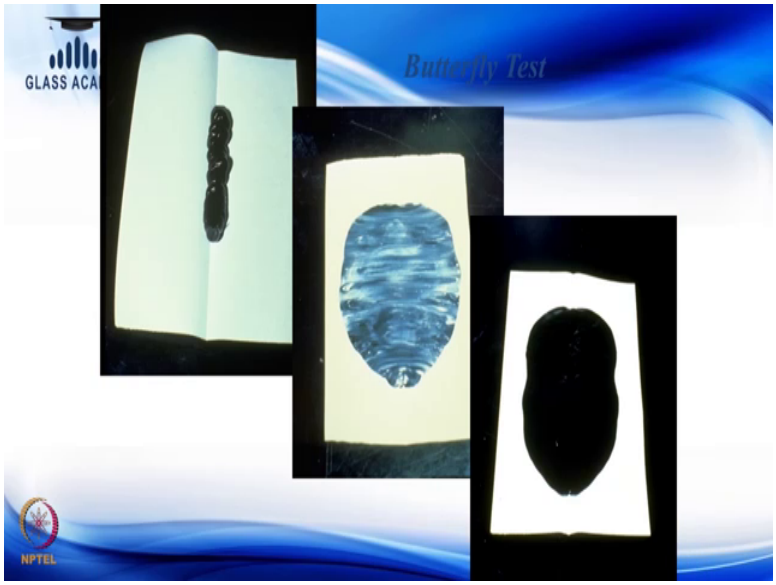

And this can be checked through a weathering study test again as per ASTM C1087.

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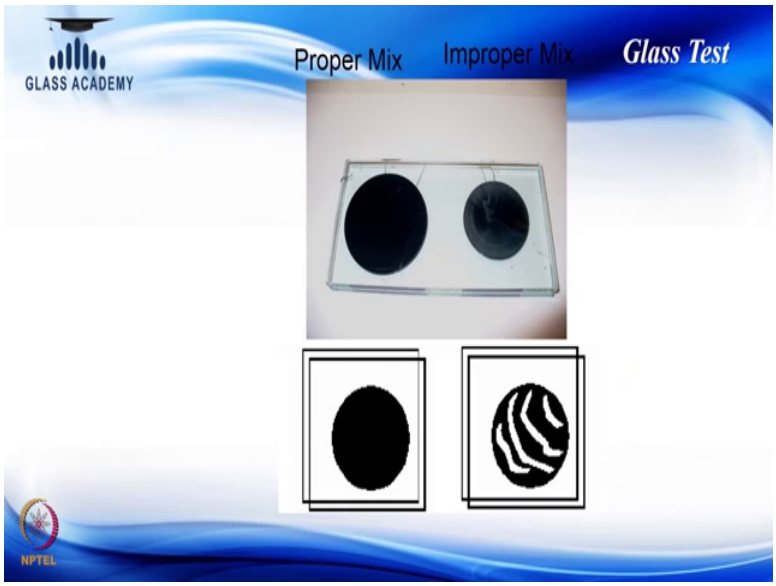

So, wherein any discoloration no test that is a particular accessory is not suitable to be used in contact with silicone.

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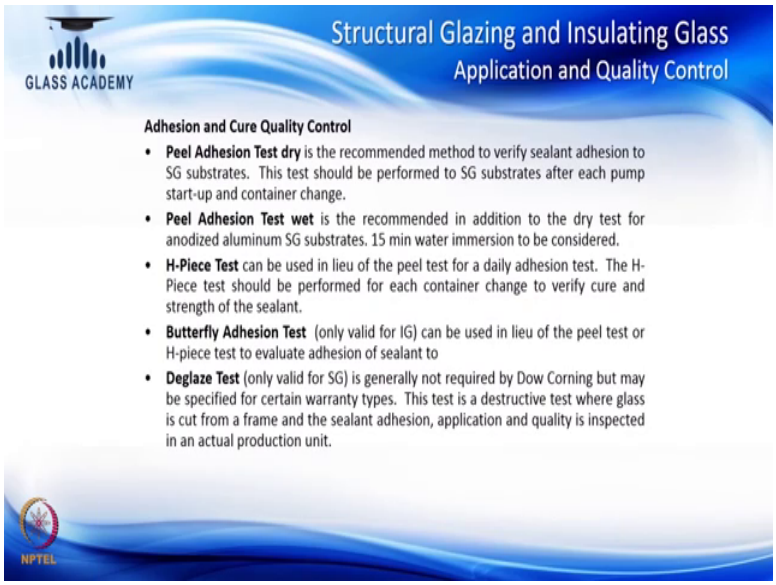

Also the other tests in terms of checking the staining' because if you remember on the in radiant part, I talked to you about a particular chemical like plasticizer which is added which migrates into the porous substrates or on the substrate or non porous like a building or staining in porous.

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So, this can be checked by doing straining test as per ASTM C148 wherein joint as 50 percent compress and put in an oven and then after 14 days of testing, then you can see whether there is any migration of fluid into the stone. So, this can be this is important test for stones because once the stone gets in it can never be cleaned. And also you can see on the right side some of the pictures wherein you can see the streaks which are running down on the facades its can be avoided by using a non-leading silicone sealant. So, this can give you better aesthetic looking performance for the longer time.

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Also what is critical to understand is, silicone I said you know sealants are chemicals this has to be stored under particular temperature and also every sealant would have a batch number mentioned on the product so, and also the storage temperature and it has to be always stored within that. So, it is good to have a system like FIFO First In First Out, in your factory and also it is important that the product is always stored below its stated recommendations like temperature as well as a good you know humidity controlled atmosphere. Otherwise the shelf life mentioned in the product is of no use if you are storing it at a high temperature or exposing it to higher humidity's.

The where the two component sealants are tested for mix quality snap time which you have seen in the video, the same thing with the one component one component sealants you have to do a quality check by taking a small amount of silicone, putting it on a polyethylene sheet and then make a small drawdown. And when you make a drawdown and initially when you touch it you will find its coming on to your fingers.

So, after some time you know when you touch it nothing will come onto your fingers; that means there is a skin formation which happens on top of the top layer of the sealant, which shows that the product is curing properly. So, this is one test which is has to be done for single component sealant. So, prior to use you know that the product whether it has been stored properly otherwise this will affect the curing rate of the sealant.

So, we saw that in the two part system, what is the temperature to be maintained, what is the humidity level and what are the you know how the glazing room was maintained you saw this test like glass butterfly test or the snap time, and also what is essential is to get a uniform mix and do not have any streaks on to the two parts which are when you know they when they are mixed together. So, there should be will give you an uniform colour.

So, it can be checked through a paper or through a glass, but when you are doing it through a glass also maintain a thickness you know gauge or a small sticker. So, that you do not compress it too much to get a split the silicone itself. So, this is a snap time test by putting a small stick into the mixed sealant just coming out of the machine.

So, initially you will find a string which is attached to the sealant and after some time you can see it snaps. So, that is a cohesive failure you will see, and this is really called a snap time. And there are again ratios depending upon the ratio the snap time will vary and depending upon the manufacturer's recommendation you need to follow the ratios.

So, the peel adhesion test is something done on the substrates like glass and aluminium essentially on the aluminium, and the powder coating anodized and then put a small bead of silicone allow you take care if it is 2 part after 24 hours you can pull it if it is one part after 7 days. So, the same sample you can put it in water when it is anodized and check for the dry and wet testing to get 100 percent cohesive failure.

There are another advance test like HP's you make a silicone joint between two glass like a H. So, you use fixtures to make that and then cure it for 21 days, remove the fixture then pull it to the tensile testing machine. And then see the amount of strength required to tell the silicone apart and also the nature of the you know failure.

And the butterfly adhesion test is one important test which has to be followed for IG.

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So, wherein you take a small 1 feet glass with spacers and primary seal put in, apply secondary seal only on one side of the you know 4 sides. And after one day you just open it like a book and what I did idea and see that the silicone is not leaving the spacer on the glass you can see the silicone gets completely stretched. So, that is a good adhesion and deglazing test you would have seen the glass getting cut and removed from the frame for this structural glazing, and wherein you can check the height, how much width, the nature of cure, bubbles any mixing issues or also the adhesion ok. So, this is the peel testing just showing you this would have been you would have seen it in the video, this is

the butterfly adhesion test, you can see either of the side you can keep one side and then open it like a book and check the seal interpretation.

So, you saw the way the sealant is applied, what is important is cleaning; cleaning is very critical, clean does not replace you know priming does not replace a cleaning, prime if required and then place the put the spacer tape and then apply the keep the glass and then apply the sealant or before that you put the masking tape. In case of DGU the glass gets cleaned automatically by the line. So, no need to do any additional cleaning, but the spacer has to be cleaned with a solvent to get good silicone bonding to the spacer. So, this is just show you cleaning check silicone application, inspection and then quality check by cutting the silicone and what you need is a good cohesive failure. So, this is the one what you would have seen in the video.

And after that the units are handled who have to be handled properly it has been put in a proper a rack system or you know proper crate system, wherein you can then you know pack them nicely and then send them to the site. So, I also want you to quickly take you through the silicone design for the insulating and weather glass specifically, because if you really see nowadays lot of projects due to the thermal performance and other special performance like some aquatics, some safety people are going for insulating glass with different combinations.

So, if you really look at insulating glass there are two panes and the outer pane the outer side is called as the exterior side is called as one and the inner side of the outer glass is called as 2, and the inner glass the inner side you know which is bonded to the secondary seal is called as side 3 and the one which is inside what you see is the side 4.

So, essentially if you look at the component here, of this is the spacer which creates an air gap and also gives the rigidity to this you know a space and there is a primary seal which is applied here on the edge of the spacer to the glass, and the secondary seal is a silicone which is supplied here. And there is a molecular seal which is filled inside the spacer. So, there are only few components two panes of glass has spacer molecular seal primary seal and a secondary seal.

So, what are the important things of the seals here? The spacer provides the air gap and also some rigidity to this particular dimensional you know joints, and also it the primary

seal actually bonds between keeps the spacer to the glass in place and it acts like a complete moisture seal and also that is not allow the inert gas tape get through.

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So, but this does not have a structural integrity; the structural integrity for the whole unit is comes from the secondary silicone sealant which is applied here and the amount of silicone which has to be applied is always calculated from the middle of the spacer to the edge of a glass.

This is called as secondary seal depth and it is calculated using a similar formula to what we have seen for the structural bite ok.

So, it is critical to understand what is the function of spacer word and the desiccant needs to observe the moisture in the air here to keep the air dry and if there is some migration then also it keeps a moisture in the air completely observed. So, that is good visibility achieved inside the unit. So, the butyl is essentially an imperial to moisture and inert and secondary seal is the structural capable product which is holding the units together.

So, you would have seen in the previous slides the advantage of using insulating glass where you get very good you know thermal insulation properties. So, what is critical here is, if you do not have a proper you know insulating secondary seal applied here with a proper design. So, any load coming onto this if this is not designed to take then this will pass on to the primary seal and the primary seal cannot take loads it will say

resulting into the fogging of the units or sometimes the failure of the outer unit or even the whole unit.

So, what is important is, every is you know product has got its own function, but the structural integrity part is from secondary seal silicone, and it is been proven by a study saying that such a dual system using a primary seal of butyl and secondary seal of silicone gives you a very good life for DGU in any climate, and a climate like ours it is much more you know prone to many other parameters like humidity or UV or sunlight or weathering compared to many cold climates outside India.

So, weather seal. So, this is you know this can really make the facade look very neat and nice. So, which architects like, and or also it can be done in a very savvy way that it looks it makes the building look very ugly. So, it can be nicely done in our clock way and if you do not do the weather seal properly thinking that this is a very simple way to you know apply silicone, you may get into a trouble wherein the water can come through the joint and you will never know from where the leakage is happening. So, the weather seal accommodates movement. So, it has to be applied and designed properly and a proper product needs to be selected.

So, this acts like a stopper air and water intrusion, it also accommodate you know joint difference in thermal movement, and also the you know deviations in terms of structure. So, if you look at the structure, it is not that when you make a window measurement and go to the side and fix it you will have a uniform gap all around. So, if you are going with a pre-form things, it does not going to fit there where a silicone being a paste form it can be applied to any gap because of any variation. So, sealant is not going to be a problem in order to apply into that joint. It provides good sound insulation; it also gives a good aesthetics if it is done nicely well. And once these are done in the factory sometimes you can do the weather seal at the factory also, then it is packed like this in the units are sent to the site and installed and you get a nice building coming up like this.

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So, what is important is also during the production of these units, you would have seen in the video there they would have shown you the documentations. So, the documentation in terms of quality checks are essential to be mentioned in the log books or through separate records; both for structural glazing as well as for the insulating glass, and then this needs to be used for getting a warranty from the manufacturer ok.

And one more thing which I want to again touch upon here which is essentially to understand between site and factory which I mentioned earlier also, that if you are doing any application at site kindly ensure that you know there is a proper safety in place and also there are essential climatic conditions like dust dirt and temperature are taken care of wall sealant applications. If you apply silicone on a hard surface it is going to have the byproduct released immediately touching on the surface. So, it will lead to a premature failure; and also when you are sitting on a side joint you should have a proper safety mechanism. So, that you are able to nicely move around and apply silicone.

And then there are some kits available wherein you can use two part; in cartridges for some of the fast curing site applications. So, these are the essential standards which are used for the structural glazing, and for the products which are used for the glazing and weather seal and the insulating glass. So, scene 19 talks about movement capability of a product the way to test it, 794 talks about the adhesion in peel, and 902 talks about overall structural you know sealant specification for various applications, 1184 is

essentially for the structural glazing sealant, and 91193 talks about how to use silicone or sealant for various applications, 1248 about the stain test, 1299 it talks about the guide and selection of silicone and 1401 is a bible for structural glazing and also it other standards are talking about efs and kite for calculating joint moment.

Whereas if you take insulating glass en 127 in its the predominantly followed standard for the insulating glass units, in that part 4 talks about the physical attributes of the you know edge c's which are essentially used for making this insulating glass units. So, I am going to quickly also take you through some of the you know most probable failures what you will see in a field for silicone is the one of the failures what you normally notice is called adhesion failure ok.

This adhesion failure can happen in any applications, it could be in structural it could be in insulating or it could be weather seal. It could be were just simple you know kitchen edge granite or you know wash basin or the sink, where they apply the silicone and still the water comes through. So, when you pull it comes out like a gasket without bonding; that means, that is an adhesive failure. So, this can happen if the surface is not clean, surface is not dry that require a primer it is not applied properly. So, these are the main reasons for this failure to happen.

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And also whenever there is a change over in two part, if the air is not released because of there is a ramp which is going in and there is an air which is entrapped between the

material to the ramp and if the air is not escaped or went properly then the air can go into the material leading to a complete bubble into the seal and so, you will find something like this which is not good.

So, it do not have good strength to be applied. So, this is when you keep the substrate hot like the site applications where the substrate is very hot only apply silicone, you can see the by-product gets released immediately on the bonding area leading to a velcro effect and it do not have a good adhesive strength.

And this is when you seal you know keep the silicone at high temperatures before application, then you will see the bubbles coming inside the silicone after application. So, this is because of the Hoover storage conditions during you know on the silicone is stored in a particular location, this is again not a good application because it is going to very poor strength.

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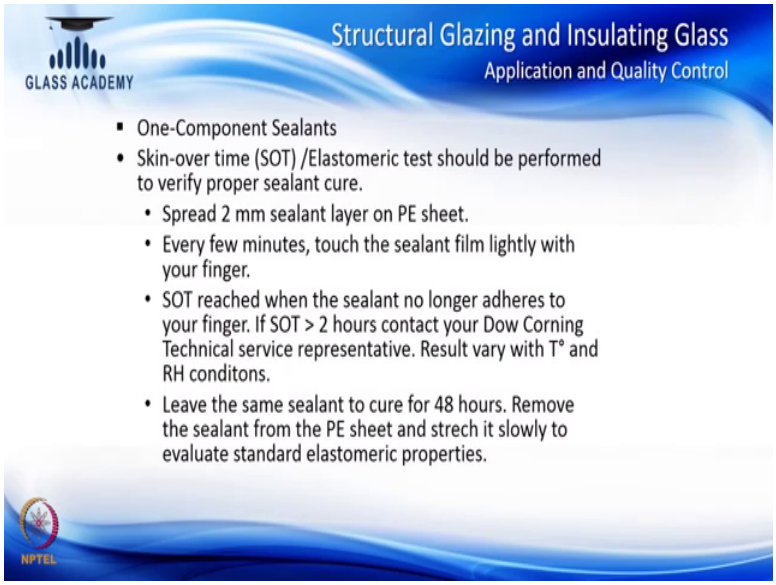

This is one common problem we notice in the weather seal is the poor joint bulge which happens on the weather seal because the baker rod, which is put to control the depth of the weather seal is an open cell. So, when you puncture them using sharp object to insert, then it releases a gas and when you apply silicone on top of that the gases push the sealant making it look like a wavy thing or with this bubbles.

So, whenever you do the baker rod, you wait for 2 to 4 hours before you do the sealant application. This is a poor to finish nobody has finished till just kept this the apply the sealant, and went off this is a ripple effect and this is a poor joining of two when you are applying sealant and it is coming and meeting another joint this has to meet well.

So, and this is a very poor smaller joint, a wrinkle effect you can see this because sometimes architect say that I do not want to see that joint and you do a 2 millimeter join you cannot apply the sealant you cannot have a watertight sealant this is what it leads to.

So, this is a wrong sealant being used on a facade giving a staining. So, this is because the stone is facade here and then the sealant applied on the joint has got a lot of plasticizers, which got migrated into the stone making now it is stain completely. So, now, it is uniformly stained. So, it looks nice probably, but this is a problem and this can happen when you use a wrong product for such for stone application.

This is one of the thing which you notice in essentially on the insulating glass is sometimes the primary seal runs down, this can be due to a poor selection of the secondary seal also a sealant, which is coming in contact with the secondary seal and also should be compatible with the secondary seal and if that has got plasticizers of organic solvents, then it can swell the secondary seal and migrate into the primary seal or it could be also related to the quality of the primary seal which does not have a good you know effect in terms of holding the glass in place and it melts, with the temperature. Also if you are fixing it in the wooden frames the chemicals used to treat the wooden frames can also sometimes affect the sealant.

So, I am quickly going to take you through the durability part, to give you a confidence that there are some manufacturers who have done the testing, showing that the silicone which has been used in the facade is got life expectancy or performance of 50 years already you know which is proving that the product is very durable.

So, one of the facade which was 25 years old, they removed the silicone and as for the European approval a technical approval guideline. Once you test the silicone it if it meets certain quality parameters then the expectation is that the product is going to perform 25 years.

So, the 25 year old facade the sealant is removed and tested and the parameters are the product performance water delivered showed that this can still give you another 25 years of life showing that the product, which is already subjected to the natural movements is again going to give you another 25 years. So, there was another study done with an independent laboratory in Germany bam.

So, wherein they developed an equipment simulating the movement of one you know cycle equivalent to one years of life. So, that here joint was made and it was subjected to movement shear tensile you know and then compression and also weathering. So, all in one leading saying that it is this withstands one cycle of this is equal to one year. So, some products which have been tested from the proven companies who are supplying this like Dow. So, they have done this testing and found that after 52 cycles, the product still had remaining good life showing that the product has already met the 50 years of life expectancy.

So, it is not only that the product can be also now extended to be used for different applications other than glass is one of the picking you know segment which is growing is, a bonding a fiber cement board or a thin stone tile or a high pressure laminate to the facade area to give a rear ventilated façade systems or on those areas where there is no its an opaque area like a dry wall systems, to give a performance or also give you a good significant look and aesthetics with performance.

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So, silicone can be used essentially which will give you like the feel of a glass like no mechanical fixing is required from outside, you can go to any heights by doing a semi unitized or a patch system. So, which can essentially give you a confidence of doing this applications of any height and also the sealant is a proven technology which we have been using it for 45 years. So, this is a material which is already being working. So, and also for the interiors like mirrors or the lacquered glass; so, these are the products which have been again used and there are many cases which available with some of the very proven products which has got high grade strength, and that gives essentially advantage of doing some of the side bonding applications where the quality is also taken care of properly.

Silicone is inherently coming from an inorganic side; it gives you excellent fire resistant properties. So, this can be also used as a fire and smoke seal wherever there is slab and the facade is meeting the slab area that is going to be opening. So, that particular joint can be coated with on the Rockwell using a silicone seal and coatable materials so, that the smoke or fire will not pass through you achieve certain ratings of one or two hours so, that the occupants can escape and they will not die because of smoke coming through them.

So, these are all life saving measures. So, there are regulations which are controlling this today, but silicone as you know it is not going to propagate fire like organic materials, like if you burn a tire, it is going to burn and then realise sort of toxic gases. There are so, many other materials like a gasket which is going to burn or which is which are essentially you know the materials which are going to propagate fire whereas, silicone inherently you know is going to not propagate the fire and they are even if fuels it forms a white ash. So, it goes back to the silica. So, that is that is one of the important thing and advantage of using silicone particularly products, which are tested as a system for fire joint seal applications.

So, I essentially covered on the points like how silicone can be used for structural glazing, what are the essential properties of silicone as a sealant the compositions the ingredients the chemistry, the UV stability and also we talked about what is one part what is two part, and what are the different you know mechanisms of designing a structural joint, the insulating glass joint.

And a weather seal joint and also we also looked at silicone being how it is being used for other applications other than the facade we also looked at panel bonding fire stuff we also looked at you know some of the applications, which it can where it can be used as a movement joint for the pavements.

So, it Is a versatile product it goes to multiple industries and this is an industry which is growing in India. So, the quality control and the right product selection and a partnership with the manufacturer who can support you with services in terms of providing a training to your team. Also they should be able to come and talk to the specifiers and make them understand the criticality of this application, and captures those things into the you know specification. And more also essentially for the peace of mind of for developers architects and facade manufacturers they should give a warranty which also covers the application, a performance warranty after application for 10 or even extended warranties for those approved approve applicators can also be should be provided.

So, this will give essentially you know enable the technology to be used more and more and this is a technology which is getting more popular and you can see more and more facades are building with silicone as an enabler as a for the facade material being used. Not only façade insulating glass, weather seal for various applications like window perimeters, it could be the internal sanitary or partition wall or it could be a stone joints. So, you talk about any of the weather seal applications. So, silicone is playing a very critical role and it gives you the excellent stability and durability. So, with this I complete my presentation, I hope this session was informative and then and we look forward to have you have more interactions and thank you for giving this opportunity.

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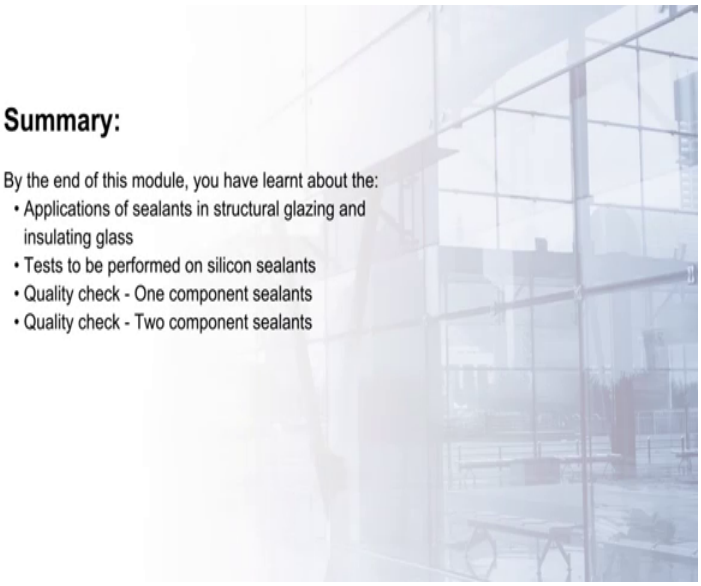

Thank you.