

Glass Processing Technology
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Lecture - 48
Processing Standards (EN NORMS) & Checks

Hello everyone my name is Chiranjit Roy. I am the national manager for projects and processing in Sengobben India private limited. Today I am going to take you through the processing standards and the checks. We will be discussing on what are the EN norms of different processing standards and what are the checks carried out for doing different processing.

(Refer Slide Time: 00:49)

AGENDA

- Processed Glass Standards & Checks
 - Fully Tempered Glass (EN12150)
 - Heat Strengthened Glass(EN1863)
 - Insulated Glass (EN1279)
 - Laminated Glass(EN12543)



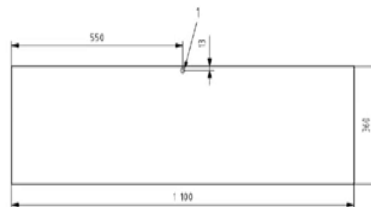
So, the agenda of today's presentation is processing on glass standards and checks we will be covering fully tempered glasses, then second we will be covering heat strengthened glasses. Then we will be covering insulated glasses and then we will be covering that laminated glasses. The tempered glass standard in European norms is EN EN 12150.

(Refer Slide Time: 01:19)

Fragmentation Test(EN 12150)



- ≍ Dimension of Test Sample – 360 mm X 1100 mm
- ≍ Each test specimen shall be impacted, using a pointed steel tool, at a position 13 mm in from the longest edge of the test specimen, at the mid point of that edge, until breakage occurs.
- ≍ The fragments shall be held at the edges, by a small frame or adhesive tape.



So, first test what we are doing is the fragmentation test. So, for the standard specification of the sample to be tested is 360 by 1100. So, along with every lot we need to set one glass for testing and this is the destruction test and this test is called fragmentation test.

So, we have what we have to do is we have to break the glass at the centre of 1100 mm sizes. So, from the centre you have to come at the 30 millimeter distance and then you have to break the glass with the help of a small tool.

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Fragmentation Test(EN 12150)



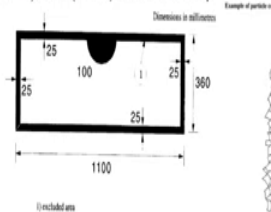
The particle count and measuring of dimensions of the largest particle shall be made between 3 min to 5 min after fracture.

Examples of steel tools are a hammer of about 75 g mass, a spring loaded centre punch, or other similar appliance with a hardened point. The radius of curvature of the point should be approximately 0.2 mm.

The particle count shall be made by placing a mask of (50 ± 1) mm x (50 ± 1) mm on the test piece

Table 8 – Minimum particle count values

Glass type	Nominal thickness, d mm	Minimum particle count number
Patterned glass	3	30
All other glass types	3	40
All glass types	4 to 12	40
All glass types	15 to 25	30



For the fragmentation test you have to break the glass at the centre as I said in the earlier slide. And you can see from the point of breakage you have to exclude the area around 100 mm from the centre. And from the edges you can reduce 25 millimeter all across the thing.

And you can count in a am I putting a mask at a in a dimension of 50 mm by 50 mm plus minus 1 mm. And you have to count the number of particles in EN says from 3 millimeter to 12 millimeter the minimum particle count should be 40 and for all other glass thickness is from 15 to 25 which would be minimum 30.

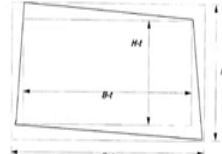
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Dimensional Tolerances(EN12150)



Below are the allowable tolerance

Dimensions in millimet



Nominal dimension of side, B or H	Tolerance, t	
	nominal glass thickness, d ≤ 8	nominal glass thickness, d > 8
≤ 2000	± 2.0	± 3.0
2000 < B or H ≤ 3000	± 3.0	± 4.0
> 3000	± 4.0	± 5.0

Dimensions in millimetres

Limit deviation v on the difference between diagonals		
Nominal dimension B or H	nominal glass thickness, d ≤ 8	nominal glass thickness, d > 8
≤ 2000	± 4	± 6
2000 < B or H ≤ 3000	± 6	± 8
> 3000	± 8	± 10



Also EN also says about the dimensional tolerance of the glasses.

So, you can see the chart of depending upon the thickness if it is a with the thickness is less than 8 millimeter and. If the dimension of the glass is less than 2 meter. The thickness tolerance should be plus or minus the dimensional tolerance should be plus or minus 2 millimeter.

So, EN also says about the dimensional tolerances for any glass. So, there are standard you can see this thickness tolerances dimensional tolerances if the thickness is less than or equal to 8 millimeter for a glass of length or a width 2 meter. The dimensional tolerances plus or minus 2 millimeter is possible is allowable when the dimension thickness goes more than 8 millimeter, the same for the same 2 meter or less length the

dimensional tolerance of 3 millimeter also possible.

Similarly, for better than 2 meter and less than 3 meter dimension tolerances of plus or minus 3 millimeter for a thickness of 8 millimeter or less. And for a 8 more than 8 millimeter thickness the dimensional tolerance of 4 millimeter are acceptable.

Similarly for better than 3 meter length or width for a glass of 8 millimeter or less dimensional tolerance of 4 millimeter plus or minus 4 millimeter acceptable. For a class of more than 8 millimeter thickness dimension tolerances of plus or minus 5 millimeter acceptable.

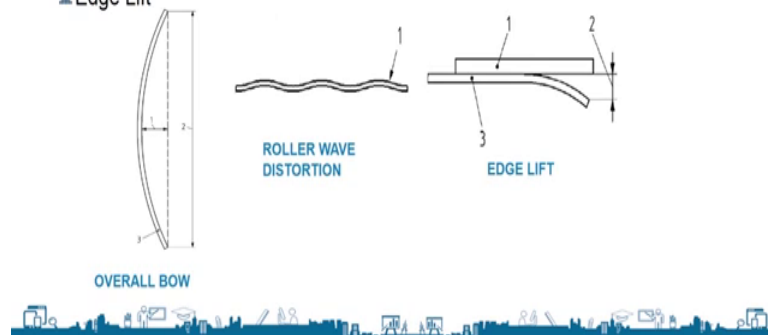
Similarly, you can see the table showing the deviation for diagonals also.

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Optical Distortion(EN12150)



- ≡ There are 3 types of optical distortions
 - ≡ Overall Bow
 - ≡ Roller wave distortion
 - ≡ Edge Lift



So, in this slide I am going to discuss about the optical distortion there are basically there are three kinds of optical distortion. One is the overall bow which is the overall bend in the glass, second kind of optical distortion is the roller wave distortion, and the third is the edge lift.

(Refer Slide Time: 05:05)

What EN 12150 says



The below table summarizes the max. values for overall bow/roller wave in a glass pane :

Table 4 — Maximum values of overall bow and roller wave distortion for horizontal toughened glass

Glass Type	Maximum value for distortion	
	Overall bow mm / m	Roller Wave mm
Uncoated float glass in accordance with EN 572-1 and EN 572-2	3,0	0,3
Others ^a	4,0	0,5

^a For enamelled glass which is not covered over the whole surface the manufacturer should be consulted

Note: Dependent upon the wave length of the roller wave an appropriate length of gauge has to be used



So, EN says the norms for overall bow and roller waves for uncoated glass or a normal clear glass or a tinted glass. The overall bow as per EN is acceptable is 3 millimeter for a meter distance. That means, if the glass length is 1 meter the bend of 3 millimeter is acceptable. For the other coated glasses or a ceramic fitted glass is the bend of four millimeter acceptable.

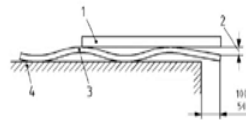
So, you can see in the right hand side roller wave is also mentioned for the clear glass it says 0.3 for 300 millimeter distance is acceptable, for a coated glass or a ceramic fitted glasses 0.5 millimeter of roller wave is acceptable for a every 300 millimeter distance.

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Edge Lift – How to Measure?



The glass shall be placed on a flat support with the edge lift overhanging the edge of the support by between 50 mm and 100 mm
The gap between the ruler and the glass is measured using a feeler gauge.



Key
1 straight edge
2 edge lift
3 thermally toughened glass
4 flat support

Figure 9 — Measurement of edge lift



For edge lift how do you measure edge lift. The glass shall be placed in the flat support with a edge lift overhanging the edge of the support between 50 millimeter to 100 millimeter, the gap between the roller and the glass is measured using a feeler gauge.

(Refer Slide Time: 06:16)

What EN 12150 says



☞ The following are the limiting values for edge lift in accordance with EN 12150 :

Table 5 — Maximum values for edge lift for horizontal toughening

Type of glass	Thickness of glass	Maximum values
	mm	mm
Uncoated float glass in accordance with EN 572-1 and EN 572-2	3	0.5
	4 to 5	0.4
	6 to 25	0.3
Others ^a	all	0.5

^a For enamelled glass which is not covered over the whole surface the manufacturer should be consulted.
Note: Dependant upon the wave length of the roller wave an appropriate length of gauge has to be used



And EN says for a uncoated glasses thickness of 3 millimeter the maximum value of that edge lift is 0.5 millimeter. Similarly for 4 to 5 millimeter thickness it is 0.4 and for 6 to 25 millimeter glasses it is 0.3. For other glasses like coated and all it is covered it is acceptable up to 0.5 value.

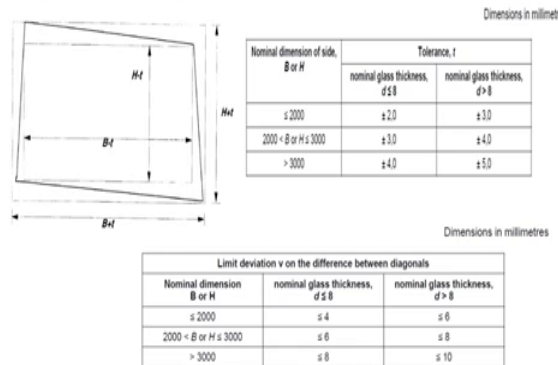
Next we come to that heat strengthening glasses standards the EN standard for this is EN a 1863.

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Dimensional Tolerances(EN1863)



Below are the allowable tolerance



So, the dimensional tolerances are similar to tempering what we have discussed in the earlier slides.

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What EN 1863 says



The below table summarizes the max. values for overall bow/roller wave in a glass pane :

Table 4 – Maximum values of overall bow and roller wave distortion for horizontal heat strengthened glass

Glass Type	Maximum value for distortion	
	Overall bow mm/m	Roller Wave mm
Uncoated float glass in accordance with EN 572-1 and EN 572-2	3,0	0,3
Others ^a	4,0	0,5

^a For enamelled glass which is not covered over the whole surface the manufacturer should be consulted.

Note: Dependant upon the wave length of the roller wave an appropriate length of gauge has to be used

Similarly for a for heat strengthened glasses also the overall bow and roller wave is same like your tempered glasses which you have discussed in previous slides.

(Refer Slide Time: 07:09)

Edge Lift (EN1863)



➤ The following are the limiting values for edge lift in accordance with EN 1863 :

Table 5 — Maximum values for edge lift for horizontal heat strengthening

Type of glass	Thickness of glass mm	Maximum values mm
Uncoated float glass in accordance with EN 572-1 and EN 572-2	3	0,5
	4 to 5	0,4
	6 to 12	0,3
Others ^a	all	0,5

a For enamelled glass which is not covered over the whole surface the manufacturer should be consulted.

Note: Dependant upon the wave length of the roller wave an appropriate length of gauge has to be used



The edge lift also similar to tempered glasses.

(Refer Slide Time: 07:15)

Fragmentation Test(EN 1863)



- Dimension of Test Sample – 360 mm X 1100 mm (5 samples)
- Each test specimen shall be impacted, using a pointed steel tool, at a position 13 mm in from the longest edge, of the test specimen, at the mid point of that edge, until breakage occurs.
- The fragments shall be held at the edges, by a small frame or adhesive tape.

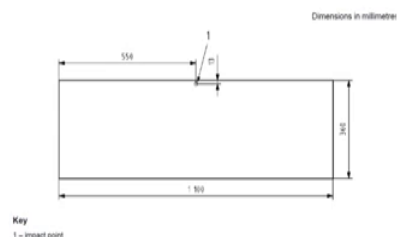


Figure 21 — Position of impact point



The fragmentation test for a heat strengthened glass is similar to tempered glass. The dimension of the sample is same like 360 by 1100, but in this case we have to take five samples and we have to break the same position like fully tempered glasses.

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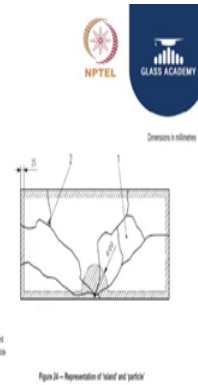
What EN 1863 says

Each test specimen shall be inspected for its fragmentation pattern.

An area of radius 100 mm centered on the impact point, and a border of 25 mm, round the edge of the test specimen, shall be excluded from the test. The examination shall be completed within 5 min of fracturing glass.

Each fragment shall be assessed as follows :

- 1) At least one edge of the fragment shall reach the excluded area.
- 2) Where no edge of the fragment reaches the excluded area, either an "island" or "particle" is produced..
- 3) The number of 'Island' fragments shall be counted & each island shall be weighed
- 4) The 'Particles' shall be collected and weighed



1 – Island (size $\geq 100 \text{ mm}^2$)

2 – Particle(size $< 100 \text{ mm}^2$)



And each test specimen shall be inspected for fragmentation pattern and an area of radius 100 millimetres centre to the impact point and the border of 25 millimeter around the edge of the stress specimen shall be excluded from the test. The examination shall be completed within 5 minutes of fracturing the glasses.

Each fragment shall be assessed as follows at least one edge of the fragment shall reach the excluded area as shown in that photograph.

Where no edge or fragment reaches the excluded area either an island or a particle is produced what is an island? Island is an area of size more than 100 millimetres square whereas, the particle is an area of size less than 100 millimetre square.

The number of island fragment shall be counted and each island shall be weighted.

(Refer Slide Time: 08:44)

What EN 1863 says



At least 4 of the 5 specimens tested should meet the following requirements to qualify as Heat Strengthened glass.

Each test specimen :

- 1) Shall have no more than 2 "island" fragments.
- 2) Shall not have any "island" fragments with area/mass equivalent exceeding 1000 mm², and
- 3) Shall not have the area/mass equivalent of all particles exceeding 5000 mm².

If only one of the 5 specimen fails to meet these requirements, then it shall match the below specimen to qualify as Heat Strengthened glass :

- 1) It shall have no more than 3 "island" fragments, and
- 2) The area/mass equivalent of all "islands" and "particles", shall not exceed 50000 mm²

1 – Island (size ≥ 100 mm²)

2 – Particle(size < 100 mm²)



The particle shall be collected and weighted at least 4 of the 5 specimen tested should meet the following requirements to qualify as a heat strengthened glasses. Each test specimen shall have no more than two island fragments. Shall not have any island fragments within the area or must equivalent to exceeding 100 millimetres square.

And shall not have areas or mass equivalent of particles exceeding 5000 millimeter square. If only one of the five specimen fails to meet the requirements, then it shall match the below specimen to qualify as heat strengthened glass. It shall have no more than three island fragments and the area or mass equivalent of islands and particle shall not exceed 50000 millimeter square.

Now, we will be going through insulated glass standards.

(Refer Slide Time: 09:46)

THICKNESS TOLERANCE(EN1279)



Table 4 — Thickness tolerances on the insulating glass units (IGU) when float glasses are used

First pane (note 1 of this table)	Second pane (note 1 of this table)	IGU thickness tolerance
a Annealed glass	Annealed glass	± 1.0 mm
b Annealed glass	Toughened or strengthened glass (note 2 of this table)	± 1.5 mm
c Annealed glass thickness ≤ 6 mm and total thickness ≤ 12 mm in other cases	Foil laminated glass (note 3 of this table)	± 1.0 mm ± 1.5 mm
d Annealed glass	Patterned glass	± 1.5 mm
e Toughened or strengthened glass	Toughened or strengthened glass	± 1.5 mm
f Toughened or strengthened glass	Plastic sheet laminated glass	± 1.5 mm
g Toughened or strengthened glass	Patterned glass	± 1.5 mm
h Plastic sheet laminated glass	Plastic sheet laminated glass	± 1.5 mm
i Plastic sheet laminated glass	Patterned glass	± 1.5 mm

NOTE 1 Pane thicknesses are expressed as nominal values.
NOTE 2 Thermally toughened safety glass, heat strengthened glass or chemically strengthened glass.
NOTE 3 Laminated glass or laminated safety glass, consisting of two annealed float glass sheets (maximum thickness 12 mm each) and plastic sheet interlayer. For different assemblies of laminated glass or laminated safety glass, see EN ISO 12543-5, and subsequently the calculation rule as given in 5.4.3 should be applied.



So, insulated glasses it says EN 1279. So, it says some thickness tolerances for the insulated glasses. If both the glasses are annealed and there is a air gap and the thickness tolerances plus or minus 1 millimetres acceptable.

If one of the pane is annealed and the another glass pane is toughened or heat strengthened, then is the dimensional thickness tolerances of 1.5 millimeter is acceptable. Similarly for the other combination it is mentioned in the table.

(Refer Slide Time: 10:24)

Tests For Insulated Glasses



Dessicant Test.			
S N	PROCEDURE	Figure	KEY POINT
1	Take 50 ml of water in a test tube / beaker		1] Note down the supplier name, date of receipt of desiccant lot, Diameter of granules before each test
2	Insert a thermometer ranging from 0° to 100° Centigrade in to the test tube / beaker		2] Keep record copy of the test certificate received from supplier for each lot.
3	Take 50 g of desiccant in a separate Test Tube / Beaker & add this water in to the desiccant.		3] Ensure Secondary sealant is applied after confirming the correctness of Butterfly test only
4	Check the initial water temperature & note down in deg. centigrade		
5	Add the water in desiccant & note the water temperature of water		
6	Measure the temperature difference of initial reading & risen temperature reading the difference must be not less than 22°c		
7	If the Temperature rise is less , then inform the QA incharge & materials incharge for the abnormality .		Keep a check whether the drum of desiccant is properly sealed all the time during production.




Now, test for insulated glasses; the first test what we do is with the second test in that


procedure is you have to take 50 millimeter of milli milliliter of water in a test tube or beaker. Insert a thermometer ranging from 0 to 100 degree centigrade in the test tube or beaker. Measure the temperature then take 50 grams of desiccant in a separate test tube for a beaker and add that 50 ml of water on the top of it.


You have to check the initially what is the temperature of water and after adding that water on that desiccant beaker you have to measure the temperature after 1 minute and you should see the rise of temperature should be more than 32 degree centigrade. If it is more than 32 degree centigrade rise in temperature is there, then it is the desiccant is good enough for using in a aluminium spacer.

(Refer Slide Time: 11:29)

Tests For Insulated Glass



Shore - Hardness Test.			
#NO	PROCEDURE	FIGURE	KEY POINT
1	Take the hardness master sample & check the correctness by taking readings of 25 Shore A master block		
2	Take the hardness master sample & check the correctness by taking readings of 50 Shore A master block		
3	Take the hardness master sample & check the correctness by taking readings of 75 Shore A master block		
4	Check the correctness & confirm the same		
5	Next Put the Hardness Meter on the dried sealant area or on the dried sealant of the glass & press it as shown in figure		<div style="border: 1px solid #0056b3; padding: 2px; font-size: 8px; margin-bottom: 5px;">Shore A Hardness Meter</div> <div style="border: 1px solid #0056b3; padding: 2px; font-size: 8px;">Meter Head In Vertical Position</div>
6	Take the reading & Assess the correctness of the Test as follows : The cured Sealant must have the hardness between (35 to 60 Shore A Hardness - For Silicone)		Ensure the meter edge do not rests on the glass surfaces during inspection the pointer must completely touch the rubber part . This same Test can be done Online on the Insulated Glass at the site or in Factory premises also.



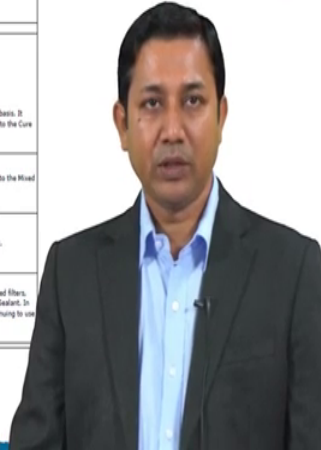
The second test what we do is the shore hardness test for silicone for that you need to have a shore a hardness tester. This shore a hardness you have to check on the secondary sealant like silicone or polysulphide whichever use you are using in a insulated glass unit. And this you should check after 24 hours of applying the silicone. For silicone the range of the shore a hardness is from 35 to 60.

(Refer Slide Time: 12:02)

Test For Insulated Glass



Pot Life Test.		
S.NO.	PROCEDURE	KEY POINT
1	Take a small container and fill it half with the Sealant which is to be Tested.	
2	Place a Stick, Pencil in to the Sealant as shown in Figure.1 and Note the Time in Record book.	Ensure that this Test is Performed on Daily basis. It relates to the Base to Catalyst Mixing Ratio to the Cure rate of the Sealant.
3	Every 5 - 10 minutes, Pull on the Stick as shown in the Figure.2	Do not Stir the Sealant or Incorporate Air in to the Mixed Sealant.
4	If the Sealant does not tear itself (Cohesively) when the stick is pulled out, the Sealant has Not Snapped.	Note down the Time of SNAP in record book.
5	The Time at which the sealant Tears Cohesively when the stick is pulled out, the Sealant is Snap. The Snap Time will vary depending upon Atmospheric condition, Temperature, Humidity and the Individual doing Test. A Snap Time varying more than 45 minutes from what is Expected may Indicate an Equipment or Sealant Problem.	Such problems include Plugged Hoses, Clogged Filters, Bad Check valves or Out of Shelf Life of the Sealant. In such cases consult the supplier before continuing to use this Material.







The next test is pot life test for this we have to take small container and fill half with this sealant to be which is to be tested. you can place a stake or a pencil in the sealant as shown in the figure and note the time in record books. So, every 5 to 10 minutes pull on the stick as shown in the figure.

If the sealant does not tear itself cohesively when the stick is pulled out the sealant has not snapped. The time at which the sealant tears cohesively when the stick is pulled out the sealant is snap the snap time will vary depending on the atmospheric condition temperature humidity and the individual doing the test a snap time varying more than 45 minutes from what is expected may indicate that the equipment or the sealant is having problem. So, you have to retested.

(Refer Slide Time: 13:11)



Test For Insulated Glass

Butterfly Test.		
S NO.	PROCEDURE	KEY POINT
1	Take a Test format paper fold it as shown in Figure.1	 
2	Apply a minimum 150.0 mm bead of sealant to the Crease of the folded paper as shown in Figure.2	
3	Press the paper together, ensuring the Sealant bead to a Thin Film.	 
4	Next pull the paper apart and Visually inspect the sealant ensure Homogeneous as in Figure.3	
5	Assess the correctness of the Test as follows : Properly mixed sealant should have No White Streaks (Refer Figure.4) if streaks are present then more material must be pumped through the line to improve the Mixing Quality. If Sealant smear is a consistent Black colour (Refer Figure.3), The Sealant is Properly mixed and is ready to use.	If Grey or White streaks continue, Equipment maintenance may be needed. Changing or Changing the mixing system, Dispensing the hose, Dispensing Gun or Ratio system but check valve can often correct this Problem.



Next test we call it the butterfly test. Normally it is to check the homogeneity in a mixing of silicon. So, you have to put a silicone in a paper and then you have to fold the paper and immediately you have to take open the paper again.

So, you can see in your in the table there are figure three and figure 4. One you can see complete black and the figure 4 you can see there is a white patches are there. So, if figure three appears after the when you open the paper then your mixing is proper the figure four shows there is a white patches that means, the mixing homogeneity is not there. So, you have to remix it again.

Now, we will cover the laminated glasses what are the test we are doing for laminated glasses.

(Refer Slide Time: 14:07)

Test For Laminated Glass(EN12543)



High Temperature Test-

- ⌘ The purpose is to check whether laminated unit can withstand exposure to high temperature over an extended period of time
- ⌘ The changes in properties are judged by the occurrence of bubbles, delamination & cloudiness
- ⌘ The sample size should not be smaller than 300mm x 100mm
The high-temperature test may be carried out using either an oven or boiling water. The test temperature is 100 °C. The tolerances of the test temperature depend on the test method used and are as follows:

a) Oven $(100 \pm 2) ^\circ\text{C}$

b) Boiling water $100 \left(\pm \frac{1}{2} \right) ^\circ\text{C}$

To remove the risk of thermal breakage in the boiling water, test samples should be placed in water at 60 °C for 10 min before transferring to the water at 100 °C.



The standard for laminated glass in EN is 12543. The first test is high temperature test the purpose is to check whether the laminated unit can withstand exposure to high temperature over an extended period of time. The changes in properties are judged by the occurrence of bubbles delamination or cloudiness. For this test the sample size should not be smaller than 300 by 100 ml. It should be plus 0 or minus 2 degree centigrade to remove the risk for thermal breakage in boiling water test sample should be placed in water at 60 degree centigrade for 10 minutes before transferring to the water at 100 degree centigrade.

How do you test it for each test we take three specimens procedure a in a oven and procedure b in a boiling water. in a procedure a in oven heat three specimen to a temperature of 100 degrees maintain the test temperature.

(Refer Slide Time: 15:13)

High Temperature Test



Procedure A (Oven)	Procedure B (Boiling Water)
1.Heat 3 specimen to a temperature of 100°C	1.Heat 3 specimen to a temperature of 100°C
2.Maintain Test Temperature for 16Hrs	2.Maintain Test Temperature for 2 hrs
3.Take the specimens out and allow them to cool to room temperature naturally keeping them vertically	3.Take the specimens out and allow them to cool to room temperature naturally keeping them vertically
4. Assessment of the test samples may be carried out when the temperature is lower than 30°C	4. Assessment of the test samples may be carried out when the temperature is lower than 30°C
INSPECTION :inspect the samples at a distance between 300mm to 500mm in front of a white diffuse back ground	
NOTE : Bubbles,delamination,haze & Cloudiness indicate faults but discolorations does not	
Disregard all faults within 15mm from original edge and 20mm from the cut edge.	
Individual bubbles in the immediate vicinity of inlaid wires are permissible.	
Disregard a test specimen showing cracks & perform test on a new test Specimen in its place	



For 16 hours take the specimens out and allow them to cool the room temperature and naturally keeping them vertically. For the boiling water heat the three specimen to a temperature 100 degrees. First as I told earlier we have to keep it at 60 degree centigrade then you have to transfer it for 200 degree centigrade water. Maintain the test temperature for two hours. Similarly you take the specimen out allow them to cool in a room temperature naturally keeping them vertically.

After that we do assessment when the temperature goes down to 30 degree centigrade the inspect the samples at a distance between 300 to 500 millimeter in front of a white diffused background. Note bubbles delamination haze cloudiness indicates faults, but discoloration does not disregard all faults within 15 millimeter of the original edge and 20 millimeter from the cut edge individual bubbles in the immediate vicinity of inlaid wires are permissible. Disregard a test specimen showing cracks and perform test on a new test specimen in its places this is what high temperature test says.

Next test is a bake test. So, as mentioned in EN 12543 only bubbles delamination or cloudiness are taken into account it defects at distance lower than 15 millimeter from the original edge or lower than 20 millimeter from the cut edge is not taken into account.

(Refer Slide Time: 16:48)

Test For Laminated Glass(EN12543)



⌘ Bake Test-

- ⌘ The purpose is to check whether laminated unit can withstand exposure to high temperature over an extended period of time
- ⌘ The changes in properties are judged by the occurrence of bubbles, delamination & cloudiness
- ⌘ The sample size should not be smaller than 300mm x 100mm
- ⌘ Test parameters:
- ⌘ The following cycle and inspection method are applied:
 - ⌘ After 2 h at 100 °C: first inspection according to EN 12543-4 § 4
 - ⌘ After next 14 h at 100 °C: second inspection
 - ⌘ After next 1 h at 145°C: third inspection
- ⌘ As mentioned in the EN 12543, only bubbles, delamination or cloudiness are taken into account; a defect at a distance lower than 15 mm from an original edge or lower than 20 mm from a cut edge is not taken into account.

After 1h 145°C		
	No bubble	OK
	If bubbles appear full face	OK except if the bubbles are countable
	If bubbles appear close to the edge	OK



So, after one hour at 145 degree centigrade, if no bubble appears this ok if bubble appears in the full face it is except if the bubbles are countable. If bubble appears close to the edge it is said to be the. So, your land whatever you are laminating is ok.

Next test for laminated glasses is humidity test the purpose is to check whether the laminated unit can withstand exposure to humidity over an extended period of time. This change in properties are judged by the occurrence.

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Test For Laminated Glass(EN12543)



⌘ Humidity Test-

- ⌘ The purpose is to check whether laminated unit can withstand exposure to humidity over an extended period of time
- ⌘ The changes in properties are judged by the occurrence of bubbles, de-lamination, haze & cloudiness
- ⌘ The sample size should not be smaller than 300mm x 100mm
- ⌘ This is further divided into
 - ⌘ Test with Condensation
 - ⌘ Test without Condensation



Of bubbles de-lamination haze and cloudiness. Sample size should not be smaller than


300 by 100 millimeter. This is further divided into two categories test with condensation and test without condensation.


Humidity test humidity test with condensation. So, we need to keep three samples vertically closed in a container for two weeks and we have to maintain for at a temperature of 50 degree plus 5 degree centigrade.

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Humidity Test

Humidity Test with Condensation	Humidity Test without Condensation
1.Keep 3 test specimen vertically in a closed container for 2 weeks	1.Keep 3 test specimen vertically in a climate chamber for 2 weeks
2.Maintain the temperature of the air in the container at 50 (+5)°C	2.Maintain the temperature of the air in the container at 50 (+5)°C & relative humidity (80±5)%
3.This condition gives a relative humidity of about 100% and lead to water condensing on the test specimen	
INSPECTION :inspect the samples at a distance between 300mm to 500mm in front of a white diffuse back ground	
NOTE : Bubbles,delamination,haze & Cloudiness indicate faults	
Disregard all faults within 15mm from original edge,20mm from the cut edge & 10mm from any crack	
Individual bubbles in the immediate vicinity of inlaid wires are permissible.	





The conditions for test with condensation is about 100 percent humidity. And lead to water condensing on that test specimen for the humidity test without condensation we have to main keep three samples vertically up in a climatic chamber for two weeks. We have to maintain a temperature of 50 degree 50 plus 5 degree and relative humidity of 80 plus or minus 5 degree centigrade.

So, for both the cases we have to do the inspection from similarly at a distance of 300 mm to 500 millimeter against a white diffuse background. Bubbles de-lamination haze and cloudiness indicates faults. So, we have to disregard all faults within 15 millimeter from the original edge, and 20 millimeter from the cut edge. And 10 millimetre from any crack. Individual bubbles in the immediate vicinity of the inlet wires are permissible.