Glass Processing Technology
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Lecture - 52
Quality Testing

Now, we are going to see the quality plan that is applicable for a toughened glass.

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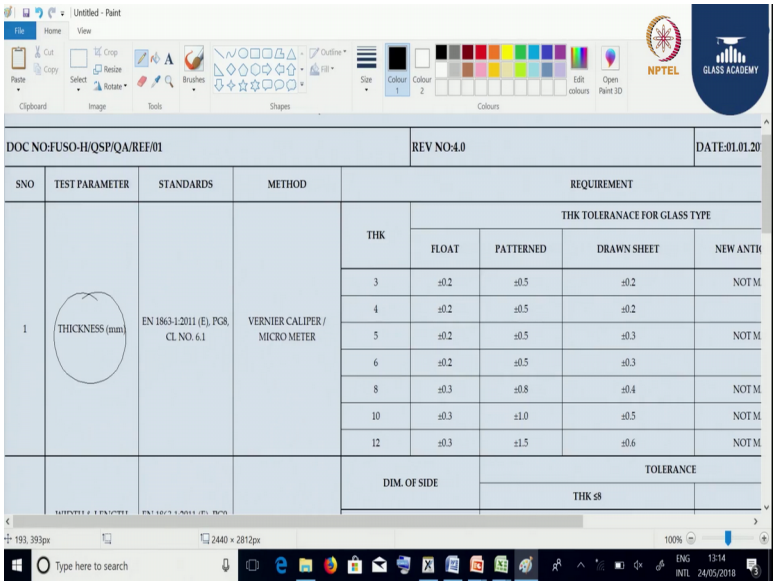

DOC NO:FUSO-H/QSP/QA/REF/01			REV NO:4.0				DATE:01.01.20
SNO	TEST PARAMETER	STANDARDS	METHOD	REQUIREMENT			
				THK	THK TOLERANACE FOR GLASS TYPE		
					FLOAT	PATTERNED	DRAWN SHEET	NEW ANTI
1	THICKNESS (mm)	EN 1863-1:2011 (E), PG8, CL NO. 6.1	VERNIER CALIPER / MICRO METER	3	±0.2	±0.5	±0.2	NOT M
				4	±0.2	±0.5	±0.2	
				5	±0.2	±0.5	±0.3	NOT M
				6	±0.2	±0.5	±0.3	
				8	±0.3	±0.8	±0.4	NOT M
				10	±0.3	±1.0	±0.5	NOT M
				12	±0.3	±1.5	±0.6	NOT M
				DIM. OF SIDE	TOLERANCE			
					THK ≤8			

And the standard what we follow is EN12150. If you see the glass coming to toughened glass, it is coming from cutting, grinding, washing.

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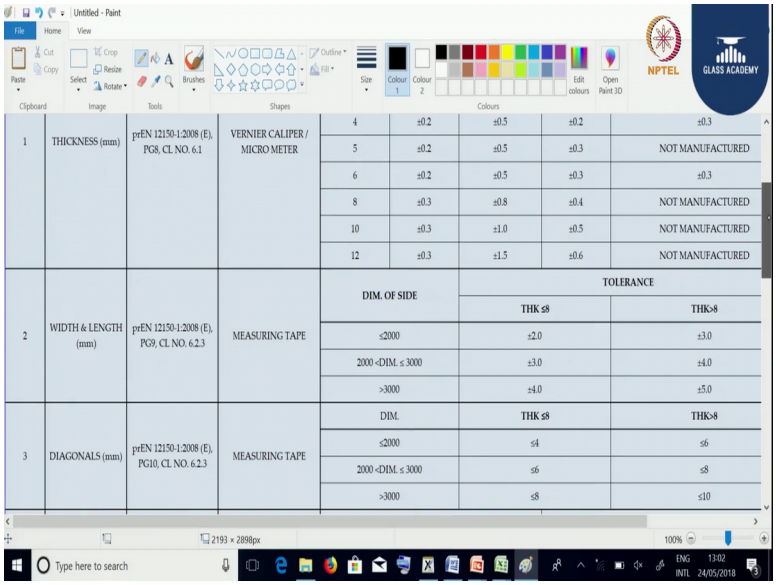

1	THICKNESS (mm)	prEN 12150-1:2008 (E), PG8, CL NO. 6.1	VERNIER CALIPER / MICRO METER	4	±0.2	±0.5	±0.2	±0.3
				5	±0.2	±0.5	±0.3	NOT MANUFACTURED
				6	±0.2	±0.5	±0.3	±0.3
				8	±0.3	±0.8	±0.4	NOT MANUFACTURED
				10	±0.3	±1.0	±0.5	NOT MANUFACTURED
				12	±0.3	±1.5	±0.6	NOT MANUFACTURED

2	WIDTH & LENGTH (mm)	prEN 12150-1:2008 (E), PG9, CL NO. 6.2.3	MEASURING TAPE	DIM. OF SIDE	TOLERANCE	
					THK ≤8	THK>8
				≤2000	±2.0	±3.0
				2000 <DIM. ≤ 3000	±3.0	±4.0
				>3000	±4.0	±5.0

3	DIAGONALS (mm)	prEN 12150-1:2008 (E), PG10, CL NO. 6.2.3	MEASURING TAPE	DIM.	THK ≤8	THK>8
				≤2000	≤4	≤6
				2000 <DIM. ≤ 3000	≤6	≤8
				>3000	≤8	≤10

So, what are all the standards applicable in cutting, grinding, washing, that will be measured in the tempering as well.

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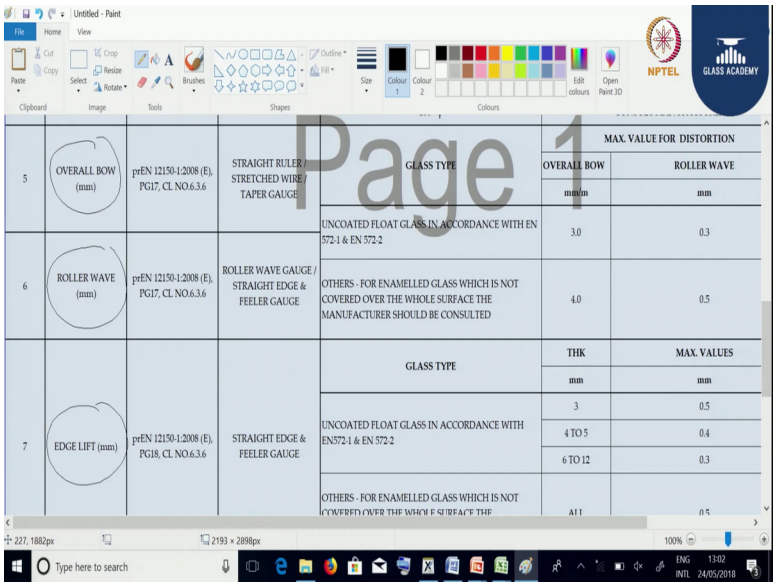

5	OVERALL BOW (mm)	prEN 12150-1:2008 (E), PG17, CL NO.6.3.6	STRAIGHT RULER / STRETCHED WIRE / TAPER GAUGE	GLASS TYPE	MAX. VALUE FOR DISTORTION	
					OVERALL BOW	ROLLER WAVE
					mm/m	mm
6	ROLLER WAVE (mm)	prEN 12150-1:2008 (E), PG17, CL NO.6.3.6	ROLLER WAVE GAUGE / STRAIGHT EDGE & FEELER GAUGE	UNCOATED FLOAT GLASS IN ACCORDANCE WITH EN 572-1 & EN 572-2	3.0	0.3
				OTHERS - FOR ENAMELLED GLASS WHICH IS NOT COVERED OVER THE WHOLE SURFACE THE MANUFACTURER SHOULD BE CONSULTED	4.0	0.5

7	EDGE LIFT (mm)	prEN 12150-1:2008 (E), PG18, CL NO.6.3.6	STRAIGHT EDGE & FEELER GAUGE	GLASS TYPE	THK	MAX. VALUES
					mm	mm
				UNCOATED FLOAT GLASS IN ACCORDANCE WITH EN572-1 & EN 572-2	3	0.5
					4 TO 5	0.4
					6 TO 12	0.3
				OTHERS - FOR ENAMELLED GLASS WHICH IS NOT COVERED OVER THE WHOLE SURFACE THE	ALL	0.5

And the main functioning in tempering that is the test parameters what we look at a tempering is overall bow, roller wave, edge lift, fragmentation test, and the strength that we are going to focus in this particular tempering department.

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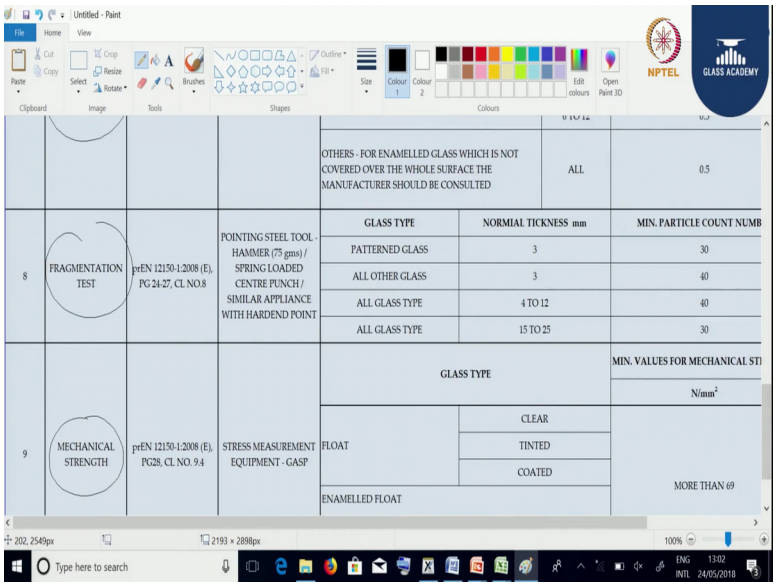

Now, let us understand one by one each test parameter. Let us take overall bow, the tool what we use to measure the overall bow is a straight ruler or a stretched wire. And, through the help of taper gauges we are going to measure the overall bow. And, how we are going to measure? We need to see whether it is a clear uncoated float glass and whether it is an enamel glass. In order to measure the overall bow the allowable tolerance what is given to us is 3 mm per meter.

So, if my glass length is the 1000 mm, the allowable bend in the glass is 3 mm and if my glass is an enamel glass the overall bow is allowed is 4 mm per meter. Now, let us take and the frequency of testing. The frequency of testing will be for every 2 hours or whenever there is a changeover. Now, let us take the next parameter that is the roller wave. The standard what we follow is EN12150, the tool what we use to measure the roller wave is a roller wave gauge or a straight edge and a filler gauge.

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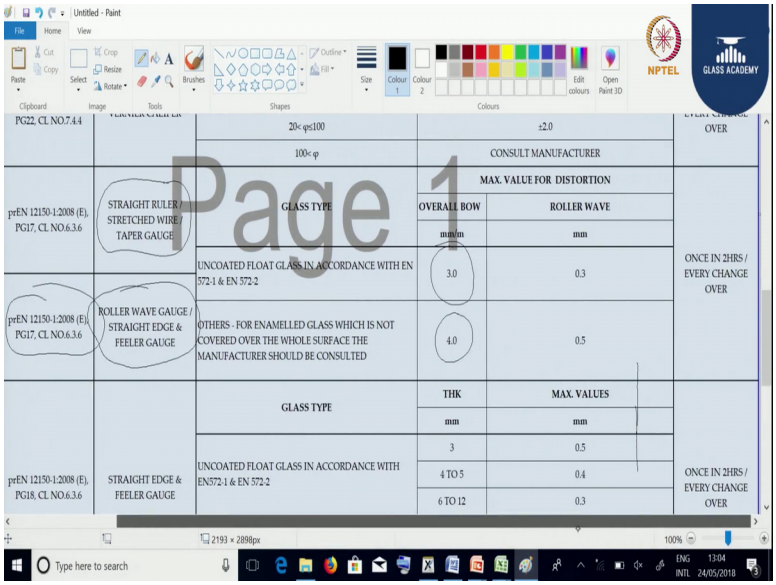

Here also if it is a clear float glass, then we need to the overall roller wave is allowed is 0.3 mm and for the enamel glass the roller wave allowed is 0.5 mm. Now, let us take the next test parameter that is the edge lift. The standard what we follow is EN12150, the tool what we use to measure the edge lift is a straight edge and filler gauge.

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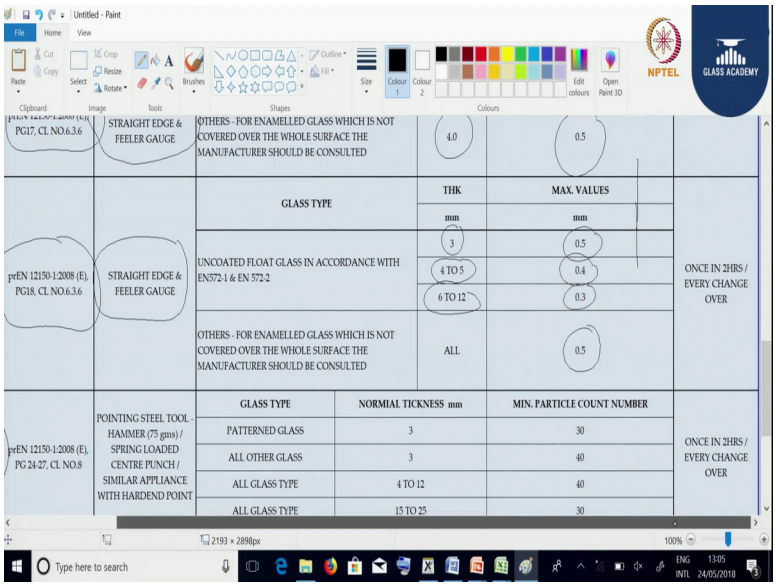

For this we need to see it is the edge lift is always dependent on the thickness of the glass. If my glass thickness is 3 mm, the maximum value allowed is 0.5 mm. If my thickness is between 4 to 5 mm, the maximum edge lift value is allowed is 0.4 mm. If my thickness is between 6 to 12 mm, the maximum edge lift value allowed is 0.3 mm. And,

for enamel glass the edge lift allowed is 0.5 mm and the frequency of edge lift measurement shall be for every 2 hours or whenever there is a changeover.

Next let us take the fragmentation test. Generally, by looking at the glass if you see any a toughened glass or a heat strengthened glass or a annealed glass; by looking at the glass you once one may not be able to distinguish which one is what type of a glass. Whether it is annealed or a edges or a toughened glass, that can be said through the help of fragmentation test or the through the help of non-destructive method, that is through the with the help of stress levels.

Let us take the destructive method of test that is the fragmentation test. The standard what we follow is EN12150 and the tools what we require is a hammer, pointing steel tool or a hammer which is weighing 75 grams or a spring loaded centre punch or a similar applicants that can be hardened for which is having hardened point. And, we need to see the type of glass.

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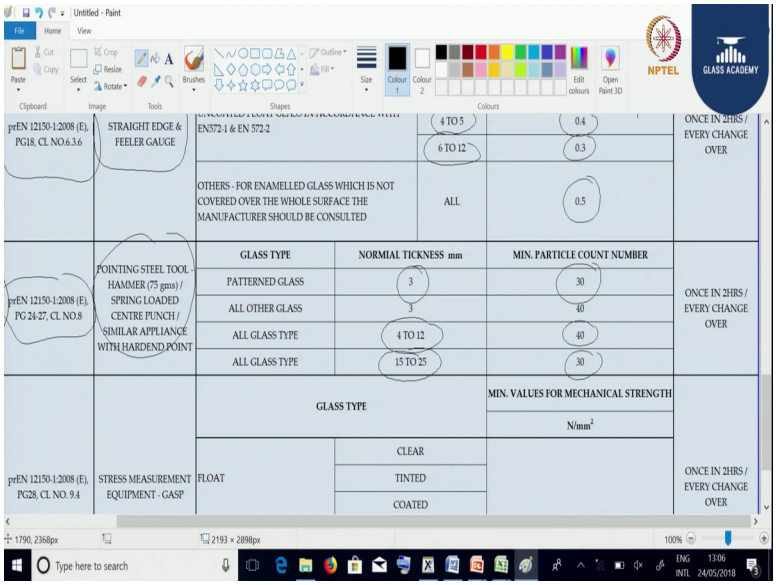

If it is a float glass and we need to see the thickness whether, it is a 3 mm or 4 mm or 12 mm or 15 to 25 mm. The minimum particle count, based on the particle count we will say whether it is a heat strengthened glass or a toughened glass. For a 3 mm thickness glass, the minimum particle count should be 30. For 4 to 12 mm, the minimum particle count shall be 40. And for 15 to 25 mm, the minimum particle count shall be 30.

And, the frequency of testing will be for every 2 hours or whenever there is a changeover. Next let us take non-destructive method of test that is through stress levels; measure of stress levels. The standard what we follow is EN12150. This we are going to measure through one equipment known as GASP.

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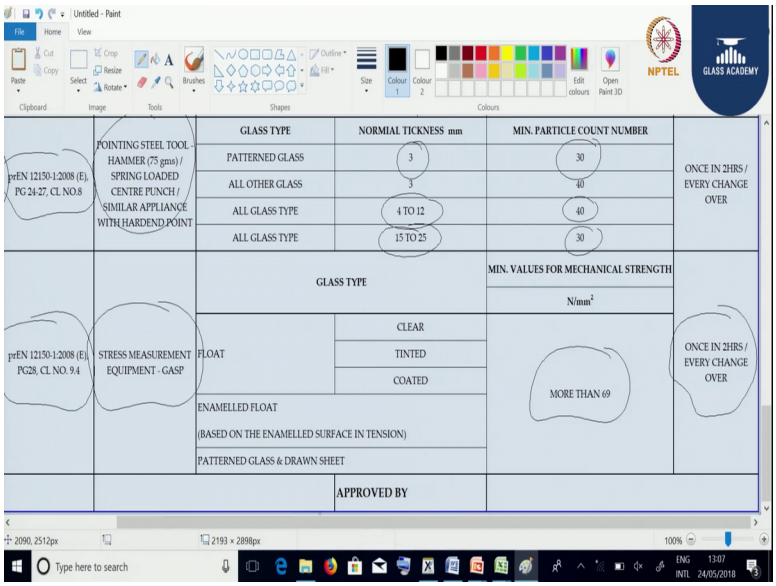

And we need to see whether it is a clear glass or tinted glass or coated glass. And, for a toughened glass the stress value should be more than 69 MPa or Newton per square millimetre. And, the frequency of testing will be every 2 hours or whenever there is a changeover. Now, we are going to see the quality plan for heat strengthened glass. And, the standard that is applicable is EN1863.

The parameters the what we need to check in heat strengthening process, is the thickness of the glass that we have already done in cutting, grinding. The width and the length of the glass that is already we have done in cutting and grinding. Diagonal measurement, whole diameter if at all the glass is fabricated. And, actual parameters what we need to check in heat strengthening process are overall bow, roller wave, edge lift, fragmentation and mechanical strength.

Now, we will understand one by one the tempering heat strengthening parameters. Overall bow, the standard that is applicable is EN1863; the tool what we use is a straight ruler or a stretched wire and we use taper gauge to measure the deformation. Now, we need to see what is the overall bow tolerance. If it is for a float glass in a meter the

overall bow allowed is 3 mm. And, for enamel glass the overall bow allowed is 4 mm per meter and the roller wave that is measured through roller wave gauge or a straightedge through with help of taper gauge.

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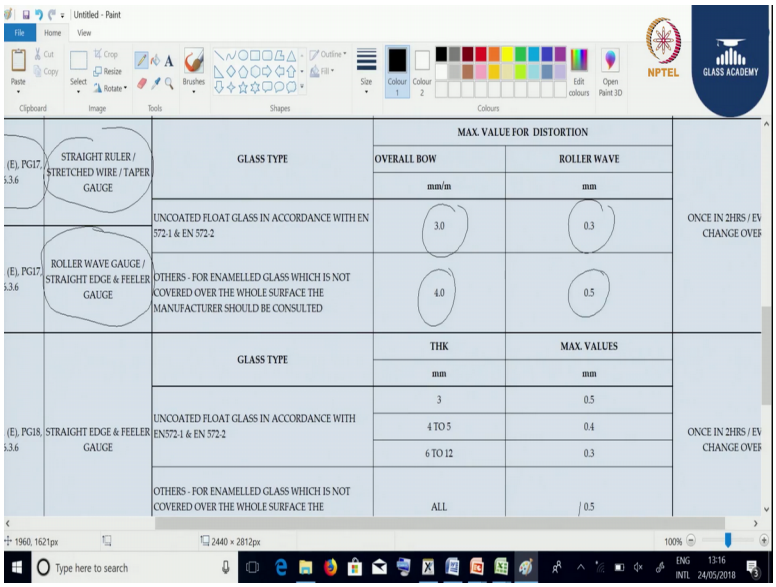

		GLASS TYPE	MAX. VALUE FOR DISTORTION		
			OVERALL BOW	ROLLER WAVE	
			mm/m	mm	
(E), PG17, 5.3.6	STRAIGHT RULER / STRETCHED WIRE / TAPER GAUGE	UNCOATED FLOAT GLASS IN ACCORDANCE WITH EN 572-1 & EN 572-2	3.0	0.3	ONCE IN 2HRS / EV CHANGE OVER
(E), PG17, 5.3.6	ROLLER WAVE GAUGE / STRAIGHT EDGE & FEELER GAUGE	OTHERS - FOR ENAMELLED GLASS WHICH IS NOT COVERED OVER THE WHOLE SURFACE THE MANUFACTURER SHOULD BE CONSULTED	4.0	0.5	

		GLASS TYPE	THK	MAX. VALUES	
			mm	mm	
(E), PG18, 5.3.6	STRAIGHT EDGE & FEELER GAUGE	UNCOATED FLOAT GLASS IN ACCORDANCE WITH EN572-1 & EN 572-2	3	0.5	ONCE IN 2HRS / EV CHANGE OVER
			4 TO 5	0.4	
			6 TO 12	0.3	
		OTHERS - FOR ENAMELLED GLASS WHICH IS NOT COVERED OVER THE WHOLE SURFACE THE	ALL	0.5	

Maximum roller wave for distortion is measured is 0.3 mm and for enamel glass it is 0.5 mm. Now, let us take the edge lift. The standard what we follow is EN1863, the tool what we use is a straight edge with the help of filler gauge. In order to the edge lift will be dependent on the thickness of the glass.

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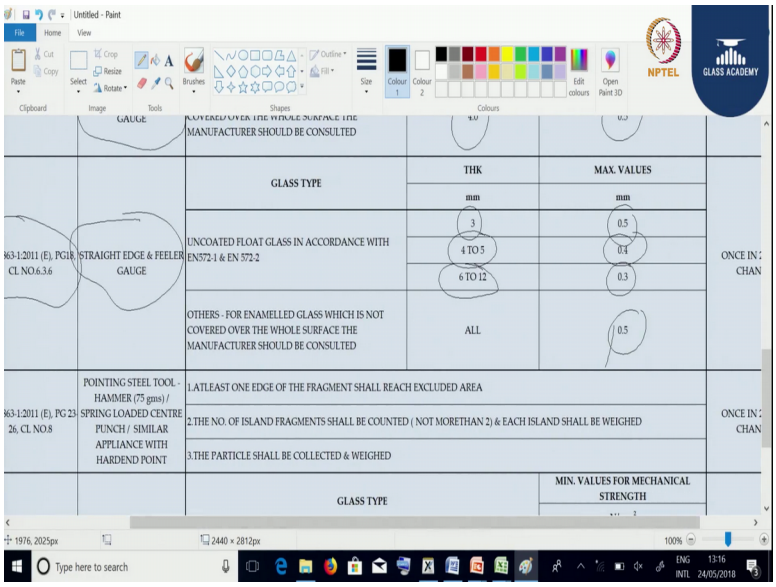

		GLASS TYPE	THK	MAX. VALUES	
			mm	mm	
863-1:2011 (E), PG18, CL NO.6.3.6	STRAIGHT EDGE & FEELER GAUGE	UNCOATED FLOAT GLASS IN ACCORDANCE WITH EN572-1 & EN 572-2	3	0.5	ONCE IN 2 CHAN
			4 TO 5	0.4	
			6 TO 12	0.3	
		OTHERS - FOR ENAMELLED GLASS WHICH IS NOT COVERED OVER THE WHOLE SURFACE THE MANUFACTURER SHOULD BE CONSULTED	ALL	0.5	
863-1:2011 (E), PG 23, 26, CL NO.8	POINTING STEEL TOOL - HAMMER (75 gms) / SPRING LOADED CENTRE PUNCH / SIMILAR APPLIANCE WITH HARDEND POINT	1.ATLEAST ONE EDGE OF THE FRAGMENT SHALL REACH EXCLUDED AREA			ONCE IN 2 CHAN
		2.THE NO. OF ISLAND FRAGMENTS SHALL BE COUNTED (NOT MORETHAN 2) & EACH ISLAND SHALL BE WEIGHED			
		3.THE PARTICLE SHALL BE COLLECTED & WEIGHED			
		GLASS TYPE		MIN. VALUES FOR MECHANICAL STRENGTH	

So, for a 3 mm thick, the maximum edge lift allowed is 0.5 mm. For 4 to 5 mm thick, the edge lift allowed is 0.4 mm and for a 6 to 12 mm thicker glass, the maximum edge lift allowed is 0.3 mm. And, for the enamel glass there is the maximum edge lift allowed is 0.5 mm. Now, let us see the fragmentation test values for the heat strengthened glass. The standard what we follow is EN1863, the tools what we use is a pointing steel tool, hammer weighing 75 grams, spring loaded centre punch or a similar applicance with a hardened point.

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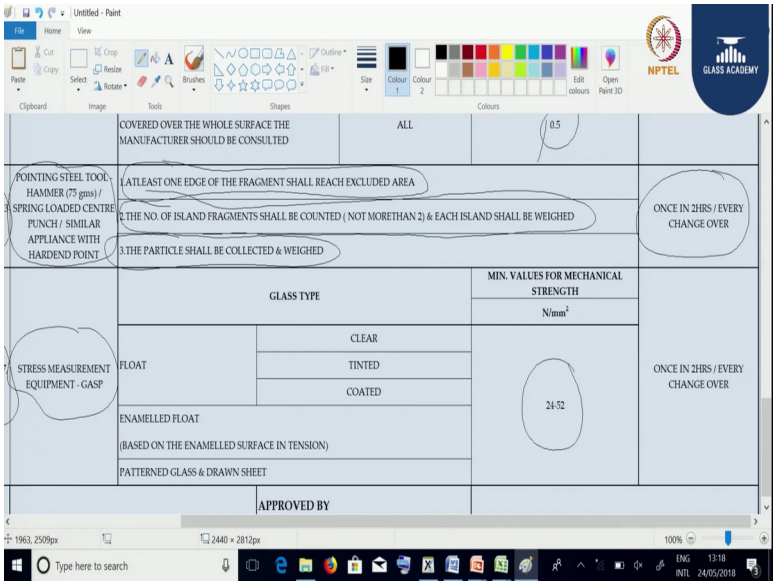

Here we need to understand; whenever we break any heat strengthened glass we need to understand 3 parameters, that is at least one edge of the fragment shall reach the excluded area. The number of islands, island fragments shall be counted and not more than 2 and each island shall be weighed. And, the third parameter is what we need to understand is the particles shall be collected and weighed.

So, in order to understand the breakage pattern for a heat strengthened glass, we need to consider 3 things. First one is whenever you break the glass, one of the edge, one of the crack should end at the other side of the edge. And, we need to see the number of islands and the particles. We need to weigh the islands and we need to weigh the particles to conclude, whether it is a straight strengthening or not. And, the frequency of testing shall be for every 2 hours or whenever there is a changeover. Now, this is a destructive method of testing what we have seen so far.

Now, let us take a non-destructive method of testing of heat strengthening that is the mechanical strength. That we are going to check through EN1863 and the tool what we use is a GASP. In order to measure the GASP the stress levels, what we require for a heat strengthening glass is 24 to 52 MPa or Newton per square millimetre. See and the frequency of testing shall be once in 2 hours or whenever there is a changeover.

Now, we will be understanding the quality plan for a toughened glass. And, the standard what we follow is EN12150. Similar, to heat strengthening glass the parameters remains the same; that is the overall bow, roller wave, edge lift, the fragmentation test and the mechanical strength. Now, let us describe everything in detail. Overall bow, the standard what we follow is EN12150. The tools what we use are straight roller or a stretched wire with the taper gauge. The overall bow allowed per meter is 3 mm and for enamel glass the overall bow allowed is 4 mm per meter.

In a similar way the roller for roller wave the gauge what we use is a roller wave gauge or a straight edge with a filler gauge. The maximum allowable roller wave value is 0.3 mm or and for enamel glass it is 0.5 mm. And, the frequency of testing shall be once in 2 hours or whenever there is a changeover. Now, let us take edge lift. The standard what we follow is EN12150 and the tools what we use a straight edge and a filler gauge.

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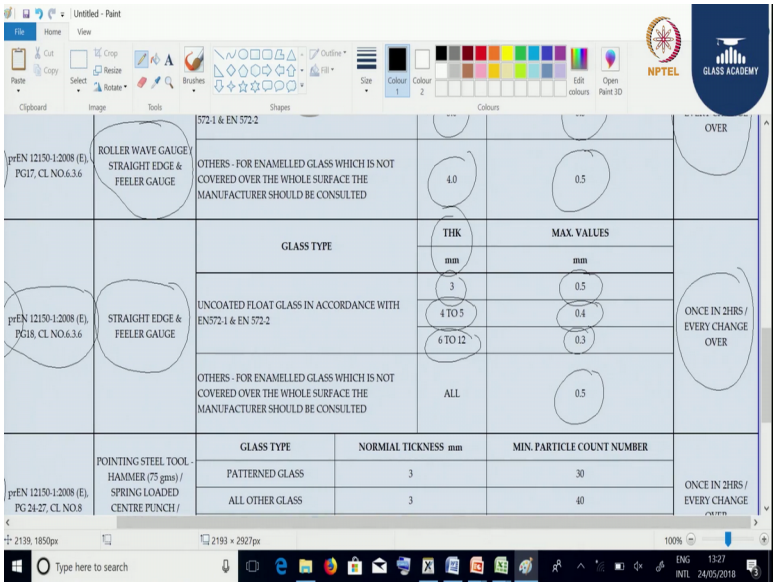

And the edge lift is dependent on the thickness of the glass. So, for a 3 mm glass the edge lift maximum value is 0.5 mm. For 4 to 5 mm, the edge lift maximum values are

0.4 mm. And, for 6 to 12 mm thickness the maximum values are 0.3 mm. And, for enamel glass the maximum edge lift allowed is 0.5 mm. And, the frequency of testing will be for every 2 hours or whenever there is a changeover.

Now, let us understand the fragmentation concepts of the toughened glass. The standard what we follow is EN12150. In order to do destructive method of testing, that is the fragmentation the tools what we use are pointing steel tool, hammer weighing 75 grams or a spring loaded centre punch, similar appliance with a hardened point.

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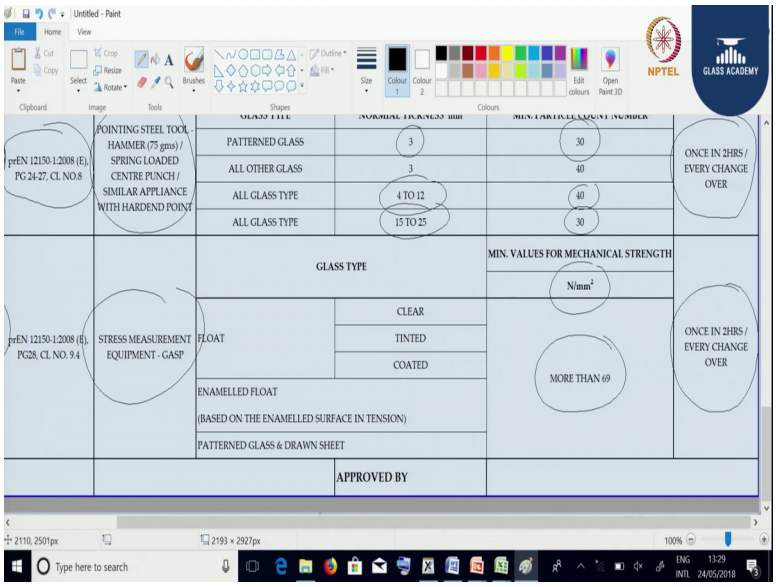

And here the fragmentation count is dependent on the thickness of the glass. For a 3 mm thickness, the minimum particle count shall be 30 numbers. For 4 to 12, the minimum particle shall be 40 numbers. And for 15 to 25, the minimum particle count shall be 30 numbers and the frequency of testing shall be for 2 hours or whenever there is a changeover. So, far we have see a destructive method of testing that is the fragmentation.

Now, let us see the non destructive method of testing that is the mechanical strength through with the help of GASP. The minimum values for a mechanical strength, for a toughened glass is more than 69 Newton per square millimetre or MPa. And, the frequency of testing shall be for every 2 hours or whenever there is a changeover. Now, we will understand the defects that are.