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Anisotropy & roller wave measurement systems

Riku Färm
Glaston Finland Oy

Quality challenges: Distortion

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GPD Navi 2014 Dubai



Quality challenges: Distortion

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Intent or Accident?



SOURCE: www.gpd.fi © M. Patterson, Enclos

Quality challenges: Distortion

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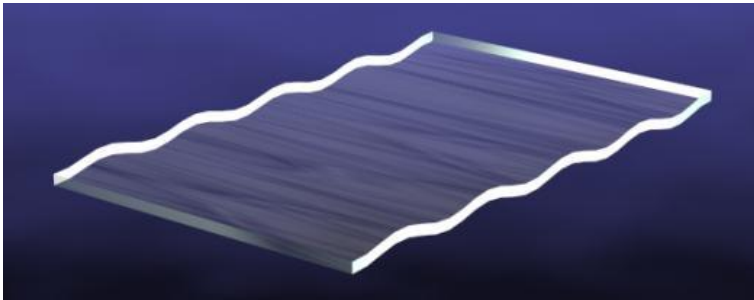


Most common heat-treatment glass quality indicators

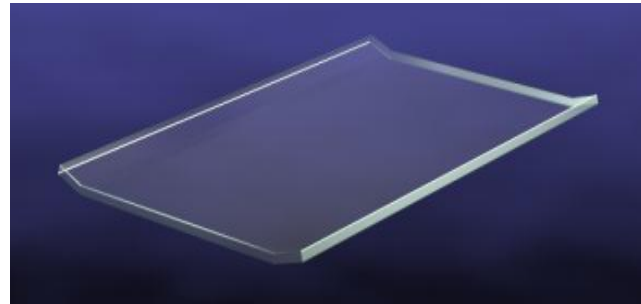


What criteria we have for heat-treated glass

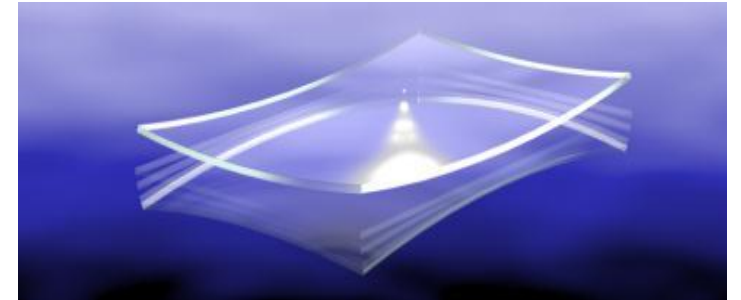
Rollerave



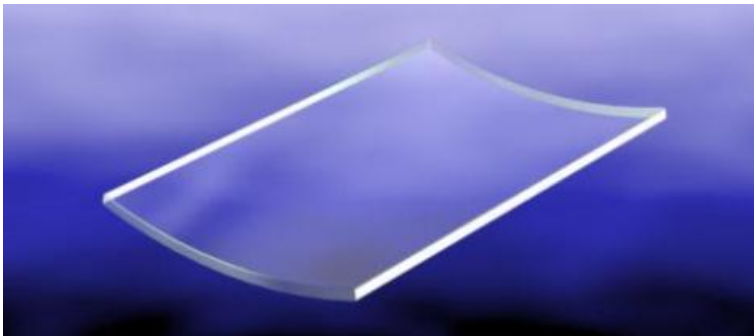
Edge lift



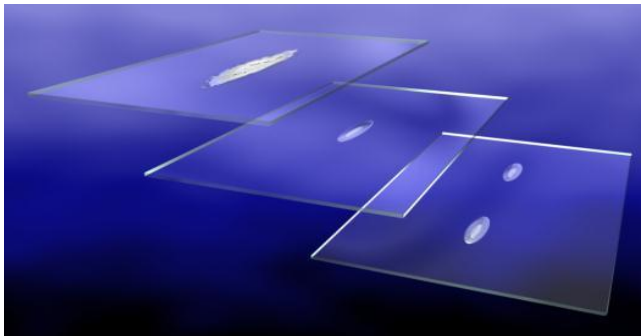
Bi-stable glass



Overall bow



Local haze, local distortion



Saddle bow



What can be measured

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- Distortion
 - Roller wave
 - Edge lift
- Anisotropy
- Scratches
- Surface defects

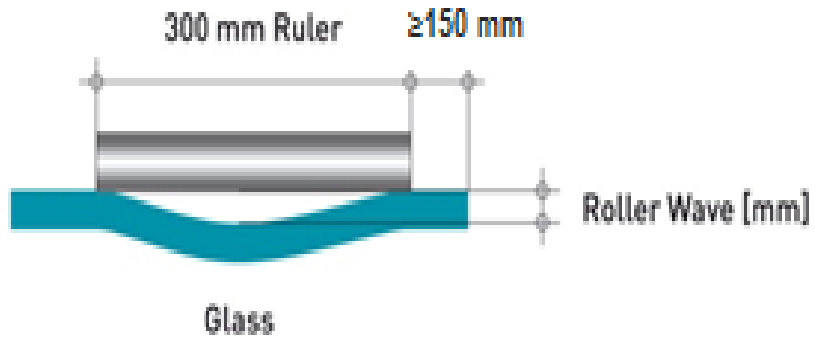


Distortion: what is measured

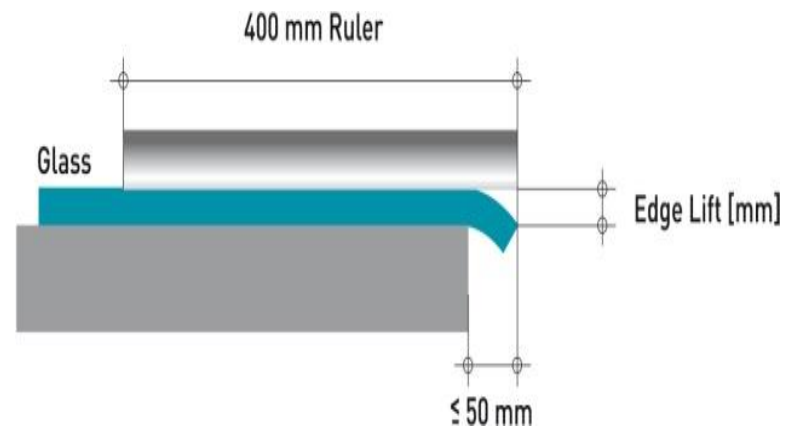
EN-12150-1



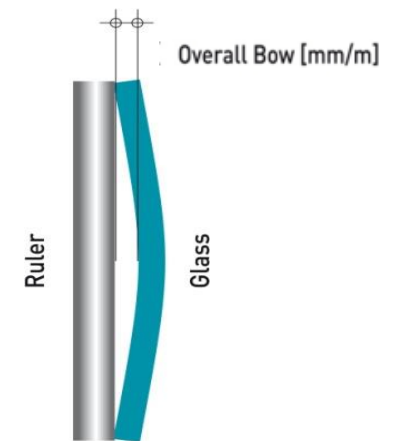
Roller wave



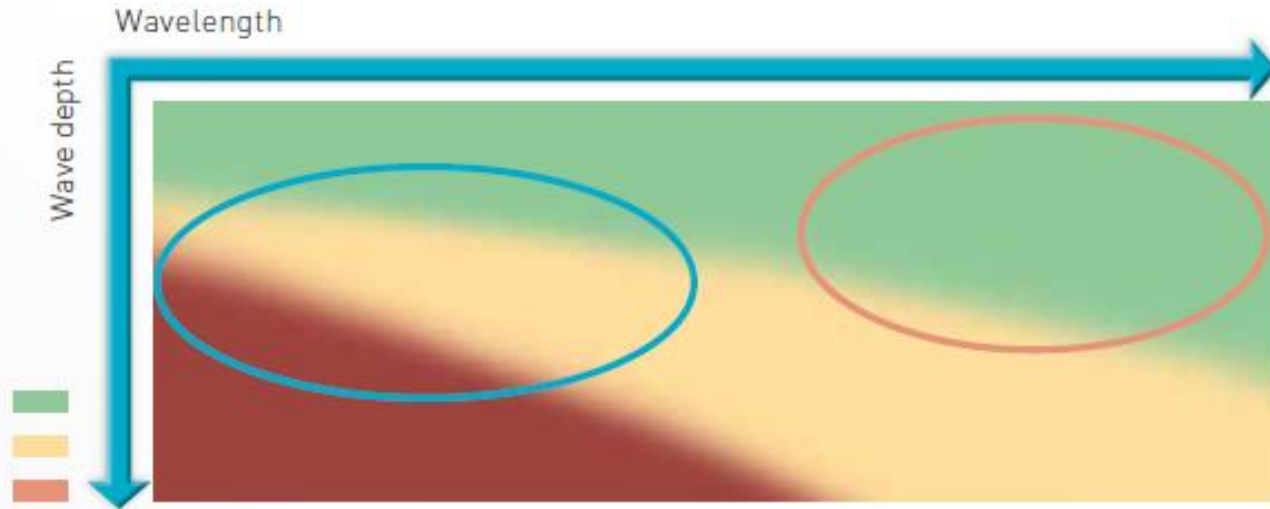
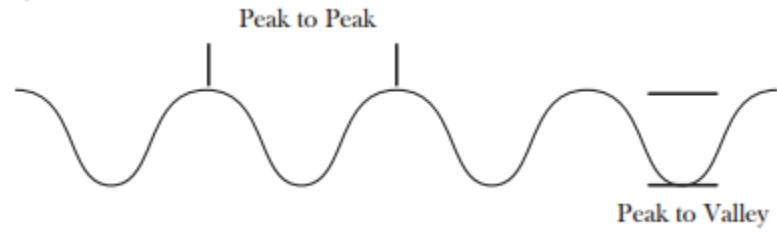
Edge lift



Overall bow



Measuring distortion: Millidiopter vs mm



The impact on optical quality
from short roller waves



The impact on optical quality
from long roller waves



Rollerwaver 0,2
Mpdt ~300



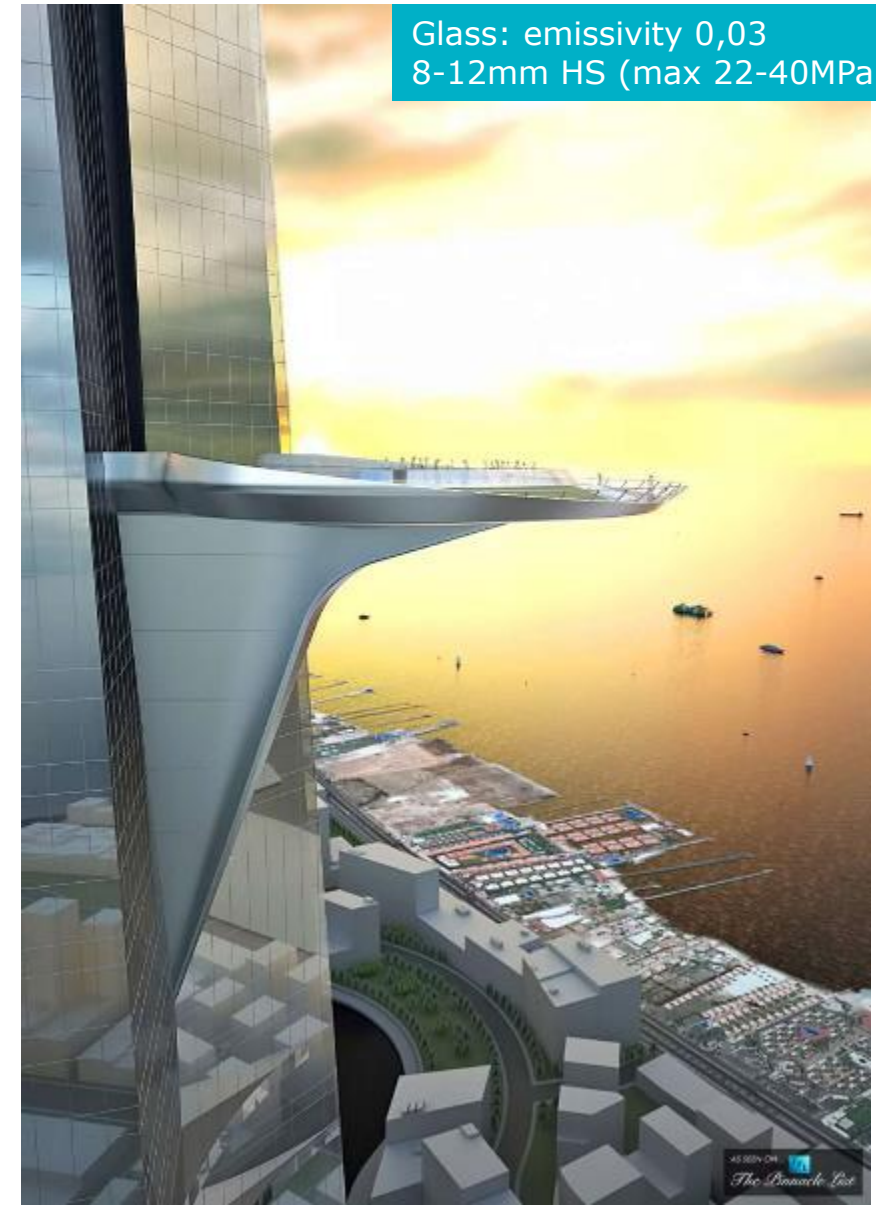
Rollerwave 0,1
Mpdt ~130



Rollerwave 0,07
Mpdt ~100

The market requirements for heat-treated glass

”at any peak to valley the deviation shall not exceed 0,076mm”



Glass: emissivity 0,03
8-12mm HS (max 22-40MPa)

Online measurement of distortion

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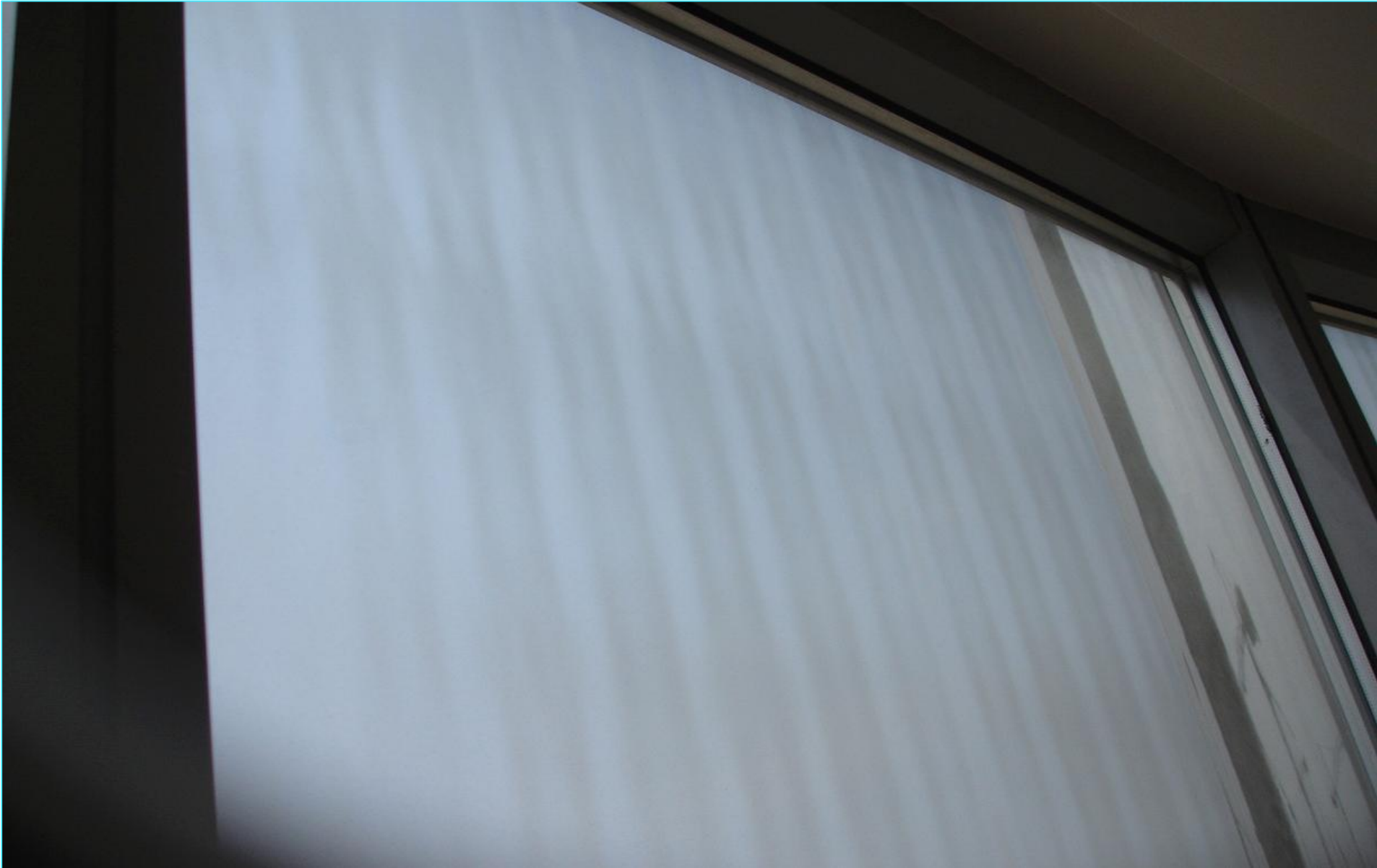
Quality challenges: Anisotropy



Source: Vehmas, J., GLASTON

Quality challenges: Anisotropy

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Anisotropy

birefringence, iridescence, stress pattern, strain pattern, leopard spots

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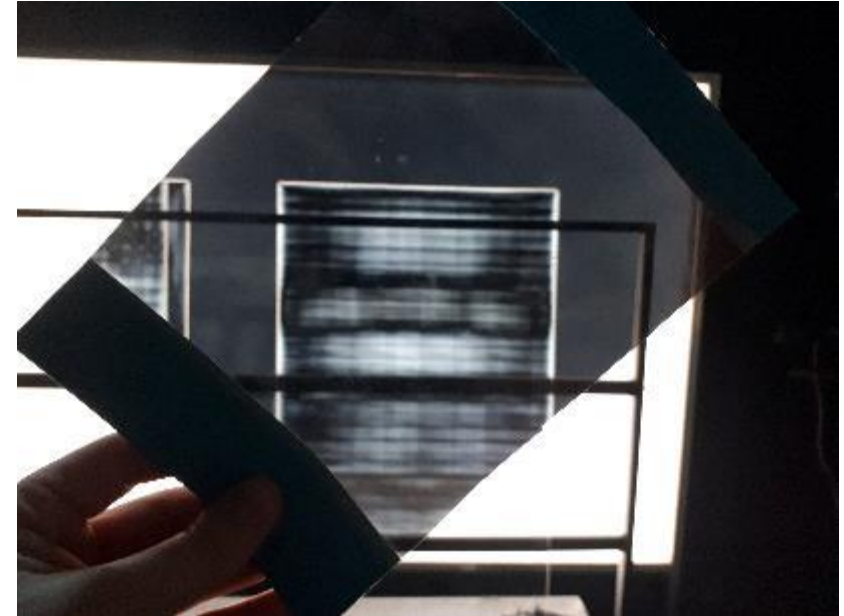
- Birefringence color or light effect
- Characteristic for tempered glass
- Caused by stress differences inside glass
- Stress differences are caused by local temperature/heat transfer differences during tempering process.
- Intensity of anisotropy depends on
 - Amount and direction of polarized light
 - Level of stress difference
 - Thickness of glass
- Visibility of anisotropy depends on
 - Location
 - Time of day / time of year
 - Weather



Observation of anisotropy

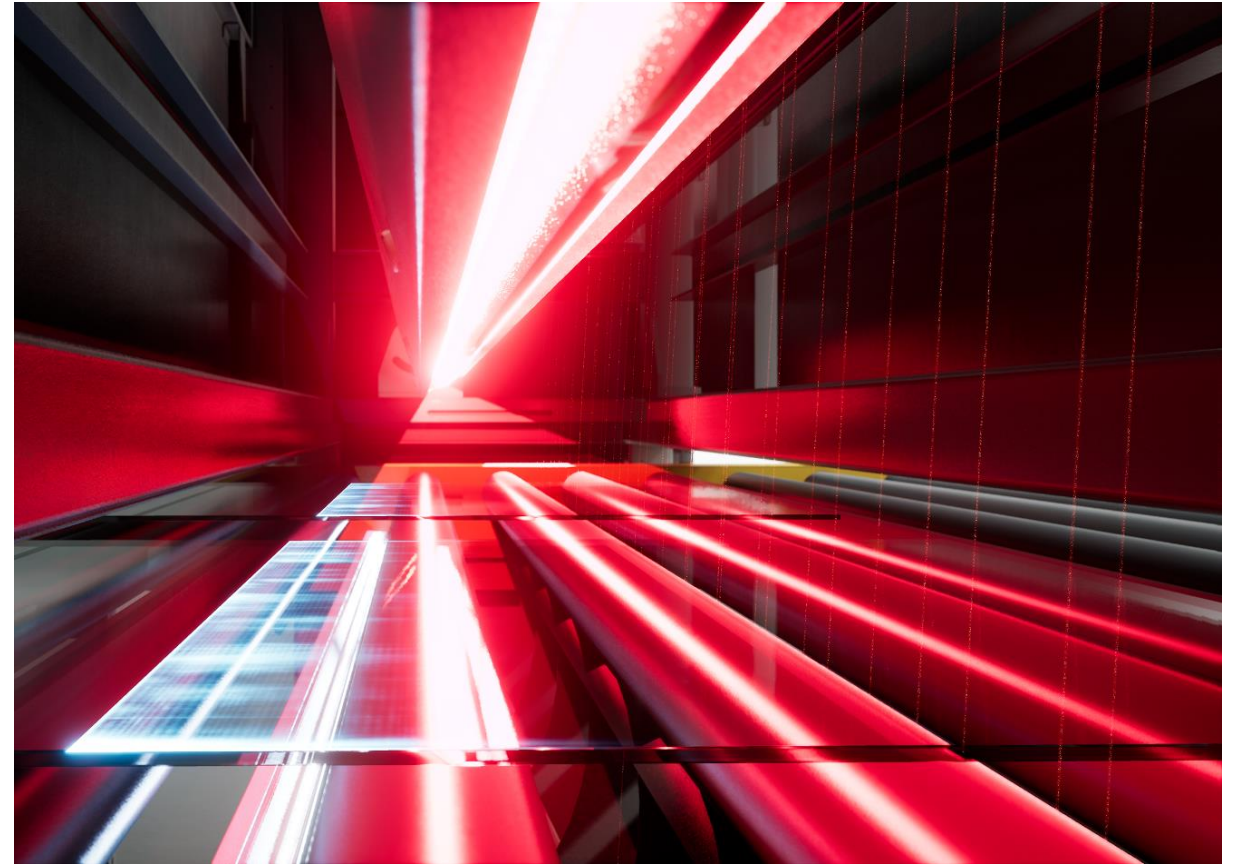
- Polarized light is needed to observe anisotropy
- Anisotropy pattern depends on the angle between polarization direction of light and the glass stresses
- Typical way to observe anisotropy is to use plane polariscope where two polarized filters are on both side of glass in 90° angle to each other

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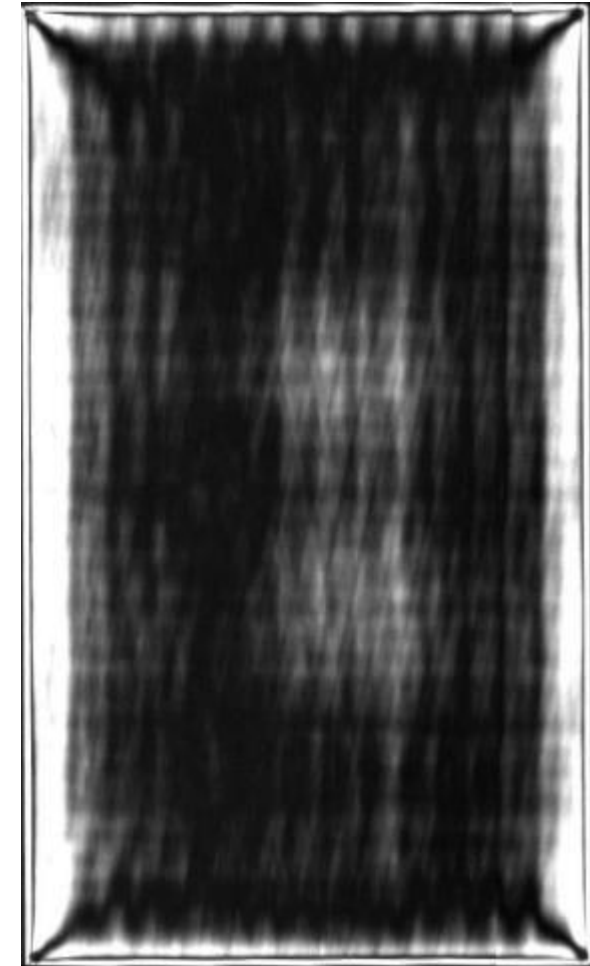
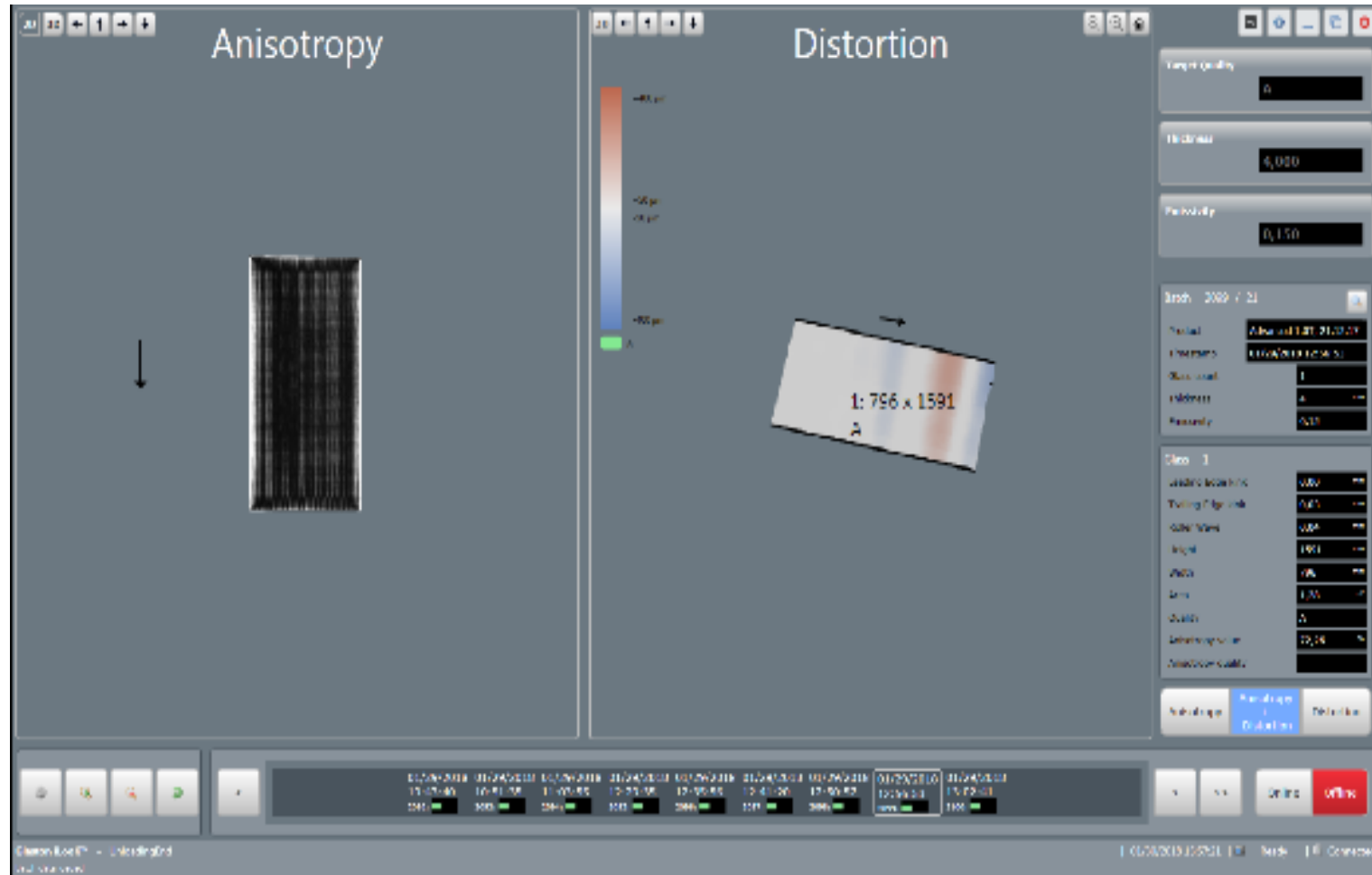
Online measurement of anisotropy

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Measuring of anisotropy

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No standards for anisotropy

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Building owners
have created their
own standards for
anisotropy

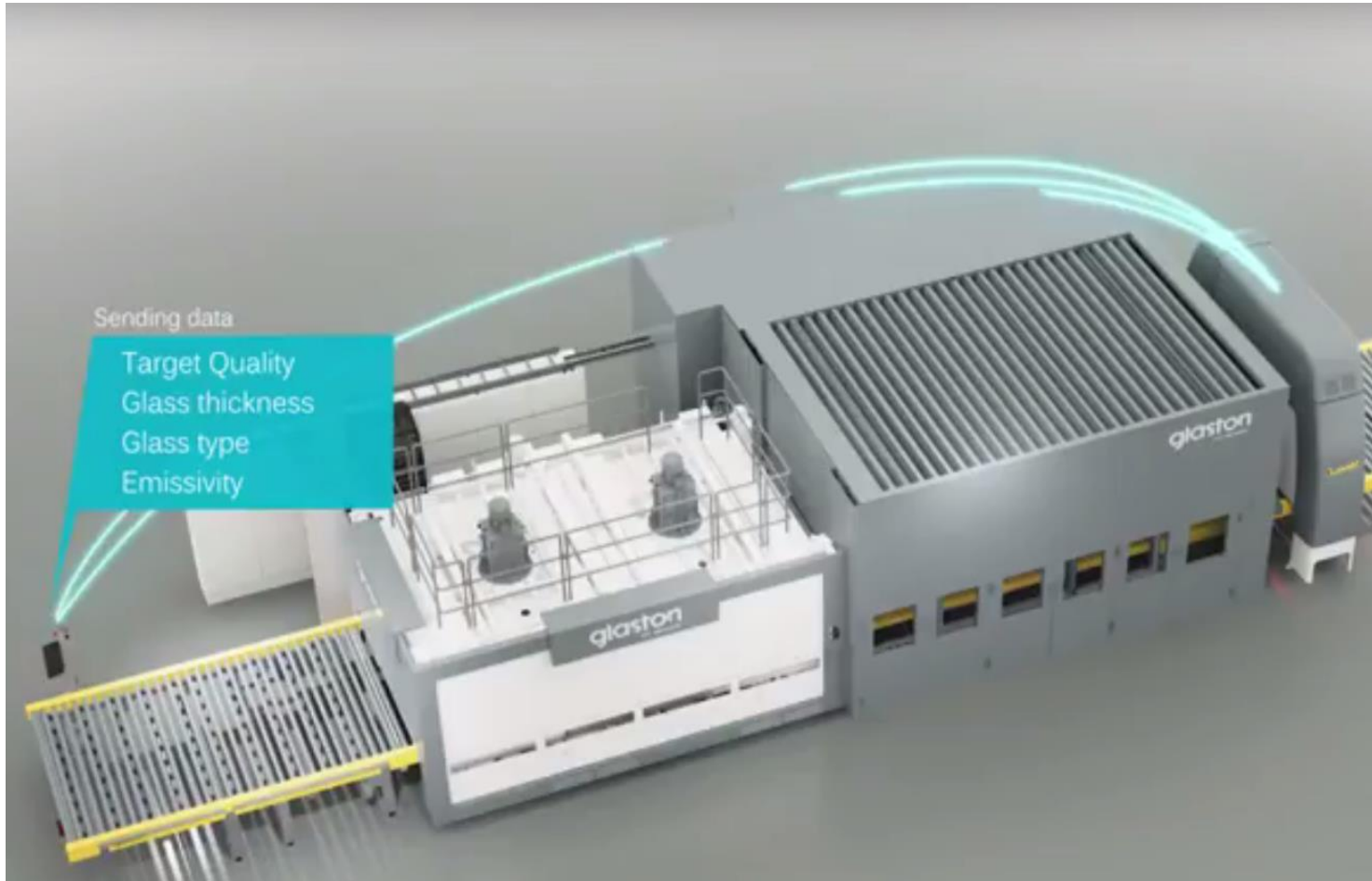
Online quality control – use cases





- Automatic quality control
 - Enables project specific quality criteria
- Reporting – proven quality
- Traceability in case of problems
- Production / process development



Advantages of integration



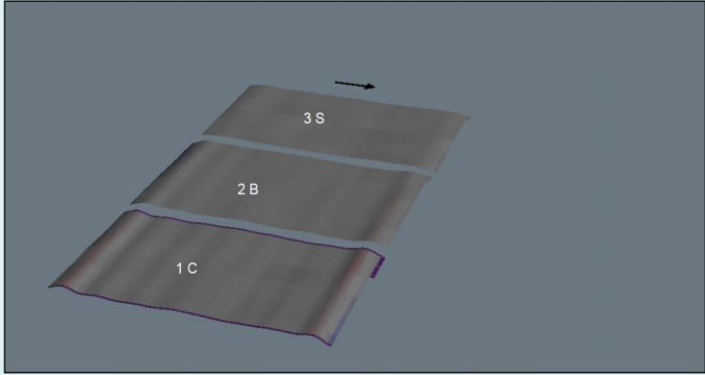

iLook REPORT
Rochester Insulated Glass


FC500 2400x4800

LOADING INFO

Product name 6 mm Clear FT	Loading size 5.4 m2 (47%) 2400 mm (50%) Target Quality Super	Glass count 3 Limit values for target quality Roller wave: 0.2 mm Edge kink: 0.5 mm
Unloading time 2010-12-24 18:00		

MEASUREMENTS



#	DIMENSION	AREA	EDGE KINK LEADING	TRAILING	MAXIMUM ROLLER WAVE	QUALITY
1	2400x690 mm	1.656 m2	0.43 mm	0.25 mm	0.043 mm	C
2	2400x690 mm	1.656 m2	0.37 mm	0.35 mm	0.034 mm	B
3	2400x690 mm	1.656 m2	0.25 mm	0.24 mm	0.026 mm	SUPER

Demand traceability for each glass – Demand quality





iLook REPORT

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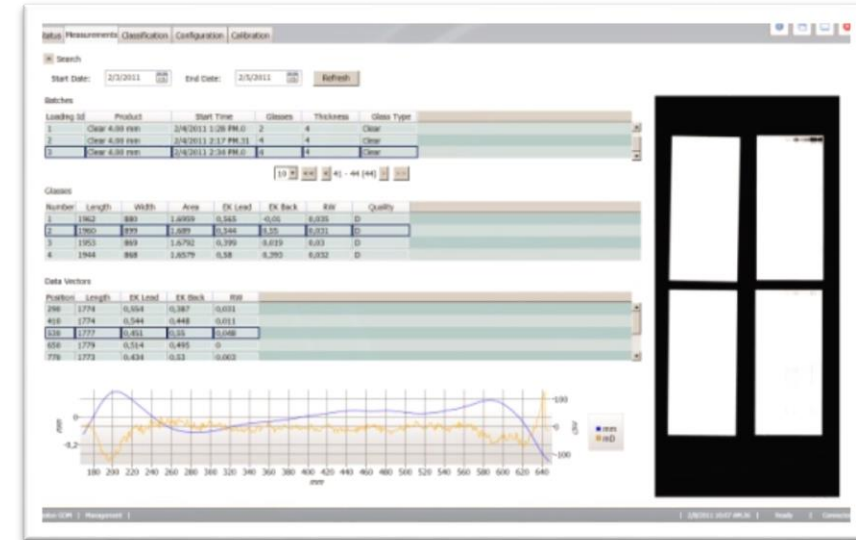
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How to ensure your project glazing does not end up in the beginning of my presentation

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- Demand a mock-up
- Right specification for the application
- Is the heat treatment technology up-to-date for today's requirements?
- How is the quality control arranged?
- See reference projects





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Thank you!

