



 **SOFTSOLUTION**

LiteSentry™

Setting the Standard in Glass Inspection

WHERE ULTIMATE INSPECTION TECHNOLOGY IS BORN

one partner

global
presence

technological
leadership

WHERE ULTIMATE INSPECTION TECHNOLOGY IS BORN

▶ for all your quality needs

▶ global support hubs
with local experts

▶ true scanning,
brightfield, darkfield,
reflection, spectrometer



Coating Type Optical Distortion
Glass Thickness Logo Position
White Haze Edge Stress
Muntin Bars Surface Quality
Coating Check Distortion Logo Quality
Anisotropy Load Validation Site Line Check
Dimension Check Overall Bending

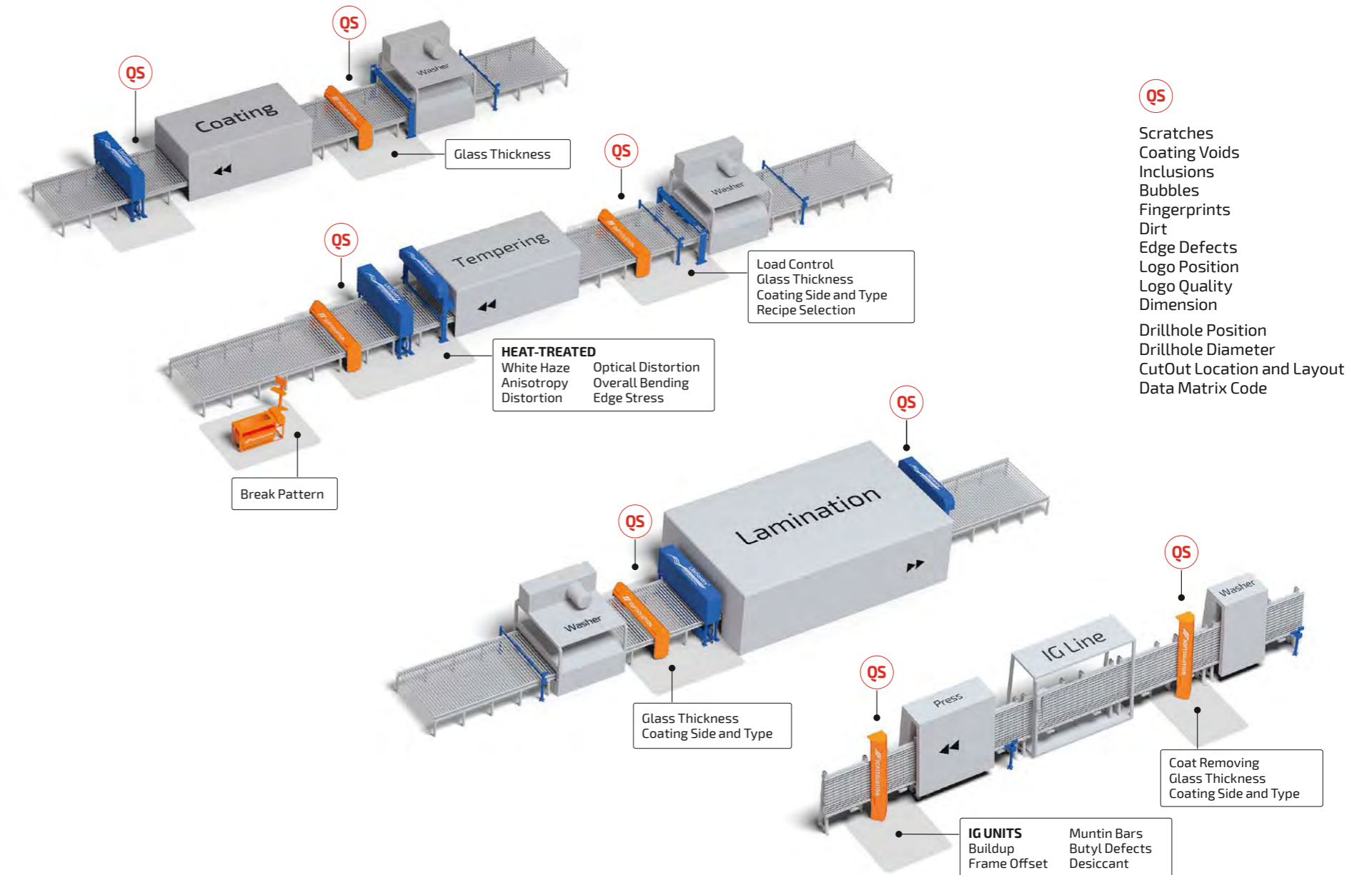
www.glassquality.com

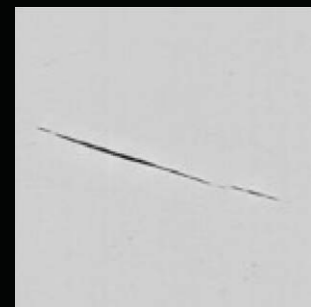
 LiteSentry™
Setting the Standard in Glass Inspection

 SOFTSOLUTION

- ▶ 90° telecentric light technology
- ▶ patented bright- and darkfield technology
- ▶ reflection based scattered light technology
- ▶ spectrometer, image acquiring with polarization filter

all technologies available

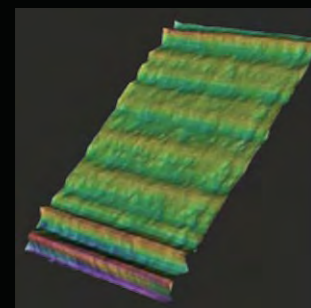




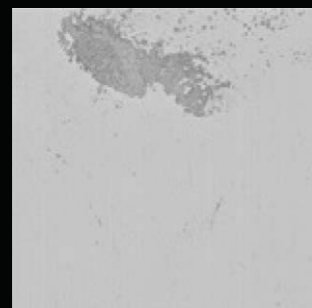
Scratches



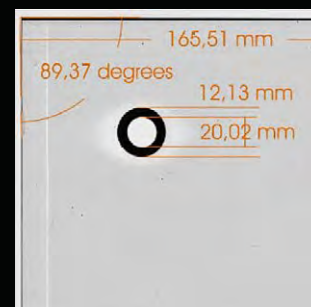
Logos



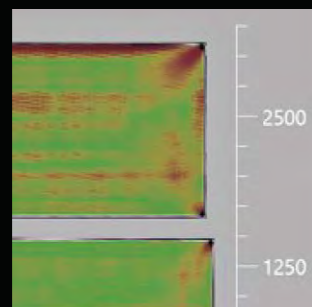
Distortion Check



Coating Defects



Drillhole Position



Anisotropy

HEAT-TREATED

All Forms of Distortion
White Haze
Anisotropy
Optical Distortion
Overall Bending
Edge Stress

Load Control
Glass Thickness
Coating Side and Type
Recipe Selection

Break Pattern
Defect Detection

LAMINATED

Distortion
Glass Thickness
Coating Side and Type
Defect Detection

QS

Scratches
Coating Voids
Inclusions
Bubbles
Fingerprints
Dirt
Edge Defects
Logo Position
Logo Quality

Dimension
Drillhole Position
Drillhole Diameter
CutOut Location and Layout
Data Matrix Code

COATING

Load Validation
Glass Thickness
Coating Side and Type
Defect Detection

IGU

Buildup
Site Line Check
Muntin Bars
Butyl Defects
Desiccant

Coat Removing
Glass Thickness
Coating Side and Type
Defect Detection

AUTOMOTIVE SPECIAL

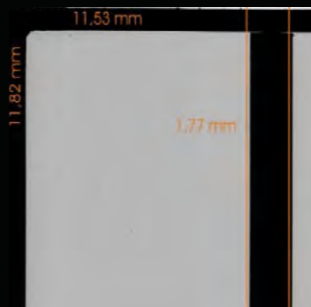
Logo Quality
Pinholes
Screenprint Position
Defect Detection



DMC Code



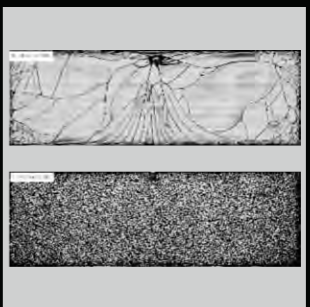
Others



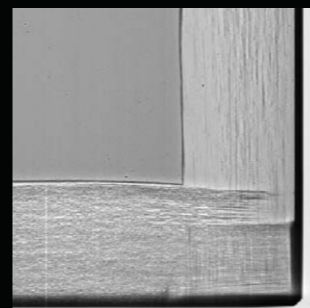
IG Unit



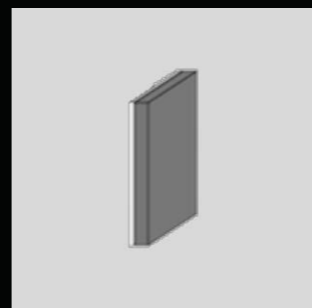
Butyl Defects



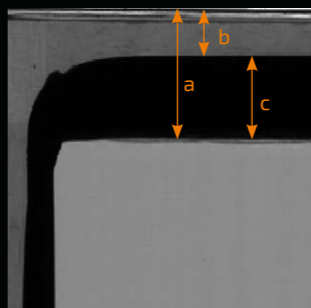
Break Pattern



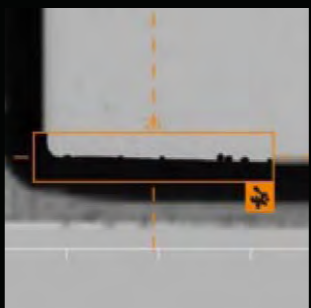
Coat Removing



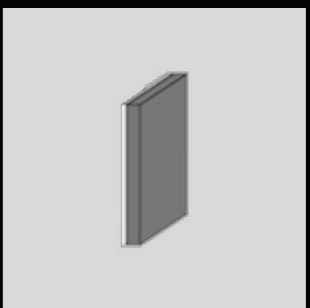
Coating Side



Frame Offset



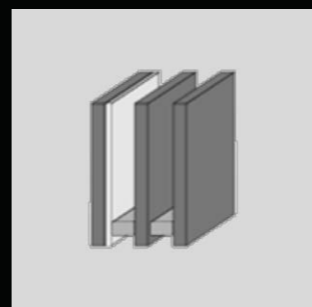
Particles in Air Space



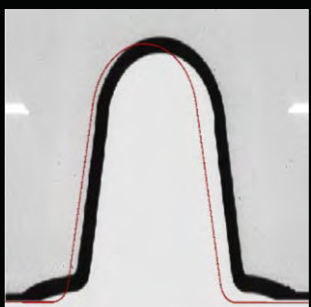
Glass Thickness



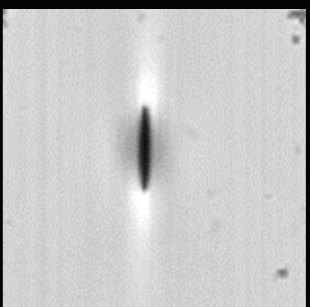
Inclusions



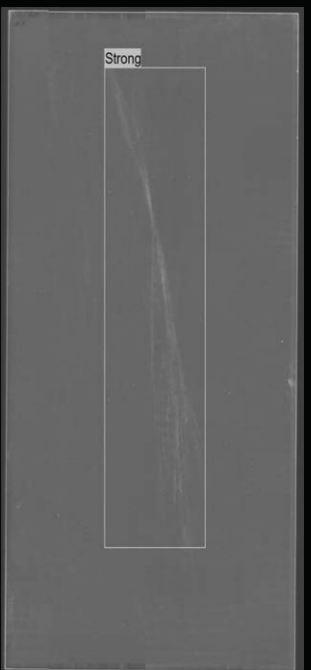
IG Buildup



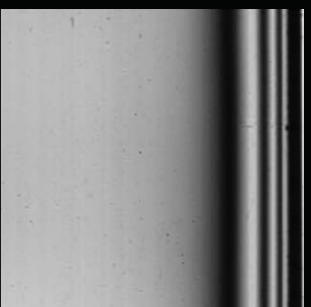
CutOut Position



Bubble



White Haze



Edge Stress

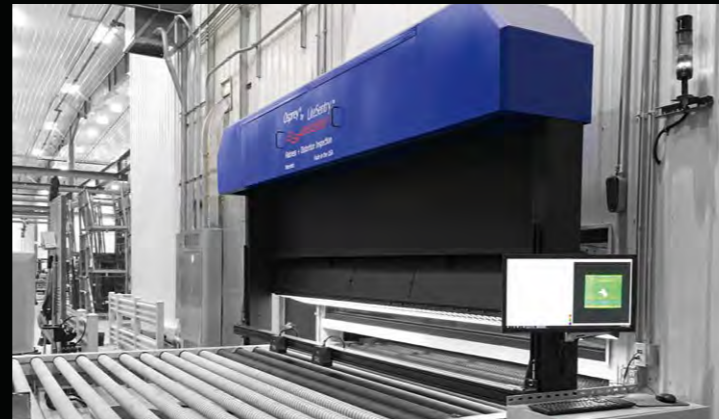
Range of Products



LineScanner

All-in-one quality inspection with true scanning technology

▶ 14



Osprey

The only optical technology that measures all forms of distortion together with anisotropy and overall bending

▶ 10



LineScanner R

Detecting white haze on tempered glasses with Softsolution *LineScanner Reflection*

▶ 18



Hawk

Specifically for coated glass, detects a wide range of defects

▶ 20



Load Validator

Prevents breakage in the furnace and quench

▶ 22



CulletScanner

Automatic fragmentation image analysis

▶ 24



Owl

Furnace optimization system

▶ 21



VirtualDigitizing

Software application for flexible digitization of templates

▶ 25



Osprey[®]

Distortion/Complete



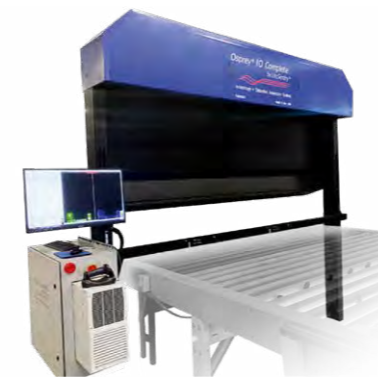
The only optical technology that measures all forms of distortion together with anisotropy and overall bending

- ▶ because quality matters
- ▶ imperative for lamination products
- ▶ not running furnace "blind"
- ▶ less dependency on human inspection
- ▶ 100 % of the glass area is checked

Millidiopter (mD) + peak-to-valley



Top glass fabricators use mD to produce flat glass because it is a better representation of distortion as shown below. The Osprey provides accurate results for both mD and peak-to-valley in mm or inches.



- ▶ all kind of distortion measured including edge kink, center kink, rollerwave, pocket distortion
- ▶ optical distortion measurement in mD and peak-to-valley
- ▶ optical distortion and anisotropy in a single footprint
- ▶ overall bow recognition
- ▶ 2D and 3D images of each glass
- ▶ improves tempering quality
- ▶ 100 % machine inspection replaces human inspection
- ▶ provides real time process control

Watch the Osprey video online ▶
www.glassquality.com/products/osprey/#osprey-video



▲ The Osprey quantifies the distortion at the tail of the plane and the iridescence on the glass facade in single footprint

Osprey interface

Profile Name: Guardian Select Elite 20200608

Profile Description: Guardian Select Elite Program requirements as of 08 June 2020. User is responsible to monitor and update Osprey with the latest spec from the Guardian Select Program.

TESTS BY THICKNESS RANGE: [6.0-10.0] [0.0-3.0] [12.0-30.0]

Distortion (mD) Tests:

| Test # | Distortion (mD) Tests | % mD | Area % | Max mD | Area |
|--------|-------------------------------------|-------------------------------------|--------|--------|--------------|
| 1 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 95 | 100 | A) All Areas |
| 2 | <input type="checkbox"/> | <input type="checkbox"/> | 0 | 0 | A) All Areas |
| 3 | <input type="checkbox"/> | <input type="checkbox"/> | 0 | 0 | A) All Areas |
| 4 | <input type="checkbox"/> | <input type="checkbox"/> | 0 | 0 | A) All Areas |
| 5 | <input type="checkbox"/> | <input type="checkbox"/> | 0 | 0 | A) All Areas |

PV Tests:

| Test # | PV Tests | Max (inches) | Area |
|--------|-------------------------------------|--------------|------------------|
| 8 | <input checked="" type="checkbox"/> | 0.003 | M) Middle Area |
| 9 | <input checked="" type="checkbox"/> | 0.008 | L) Leading Area |
| 10 | <input checked="" type="checkbox"/> | 0.008 | T) Trailing Area |

Cross Conveyor Distortion (XmD): Max mD: 70

Suggested Heat Adjustment:

Less Heat (-1) if < 80 % of measurements are between [-200 ... 200] mD M) Middle Area

More Heat (+1) if > 95 % of measurements are between [-100 ... 100] mD M) Middle Area

▲ Edit QC profile – setting tolerances for testing

| Lite mm | 95/150M (mD) | 95/300E (mD) | 95/80C (mD) | 0.120/PVM (mm) | 0.200/PVE (mm) | 100/95%C (nm) | 1650/HP1 | 92/OBR |
|---------|--------------|--------------|-------------|----------------|----------------|---------------|----------|--------|
| 163 | 8.0 | 48 | 144 | 0.06 | 0.08 | 71 | 510 | 84 |
| 162 | 8.0 | 57 | 121 | 0.05 | 0.07 | 141 | 1810 | 76 |
| 161 | 8.0 | 107 | 62 | 0.13 | 0.09 | 83 | 920 | 59 |
| 160 | 3.0 | 76 | 110 | 0.07 | 0.06 | 40 | 380 | 48 |
| 159 | 9.0 | 57 | 98 | 0.07 | 0.08 | 97 | 810 | 87 |
| 158 | 9.0 | 40 | 64 | 0.05 | 0.06 | 100 | 850 | 75 |
| 157 | 9.0 | 47 | 66 | 0.03 | 0.07 | 50 | 510 | 35 |
| 156 | 9.0 | 43 | 67 | 0.03 | 0.04 | 155 | 1540 | 96 |
| 155 | 10.0 | 25 | 28 | 0.01 | 0.01 | 82 | 830 | 69 |
| 154 | 10.0 | 22 | 26 | 0.00 | 0.00 | 11 | 120 | 34 |
| 153 | 4.0 | 50 | 82 | 0.07 | 0.05 | 72 | 370 | 85 |
| 152 | 4.0 | 74 | 118 | 0.05 | 0.06 | 33 | 330 | 45 |
| 151 | 4.0 | 79 | 95 | 0.08 | 0.09 | 73 | 720 | 85 |
| 149 | 4.0 | 61 | 95 | 0.05 | 0.05 | 41 | 340 | 58 |
| 150 | 4.0 | 59 | 91 | 0.03 | 0.04 | 71 | 460 | 83 |
| 148 | 4.0 | 67 | 82 | 0.08 | 0.04 | 71 | 540 | 64 |

Statistics: PV - M

Summary:

| First Shift | Lites |
|-------------|-------|
| TOTAL | 175 |
| Measured | 175 |
| Quality OK | 118 |
| Quality OK | 67% |

Distortion: Graphical display showing distortion levels for parts #151 and #152.

Anisotropy: Graphical display showing anisotropy levels for parts #150, #149, and #148.

▲ All at a glance: details, summary & graphical display of distortion, anisotropy and statistics

LineScanner


All-in-one quality inspection with true scanning technology




LineScanner H


SURFACE AND EDGE QUALITY
 Scratches, inclusions, coating voids, edge chips, ...


TEMPERING QUALITY
 Anisotropy, edge stress, white haze

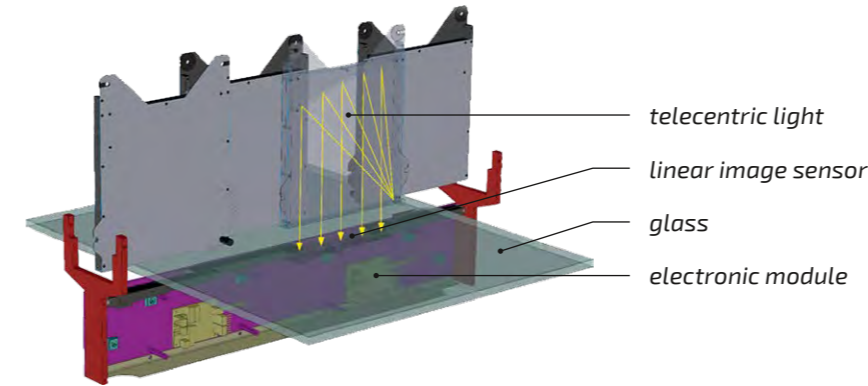

DIMENSION
 Overall dimension, cut outs, drill hole position and diameter


SPECIAL QUALITY CHECKS
 Grid alignment, data matrix code, angularity, bending control, glass thickness, side of coating


INSULATING
 Frame offset, muntin bars, angularity, butyl defects, coating side


LAMINATING


ANISOTROPY



- ▶ 90° telecentric light technology
- ▶ engineered for vertical and horizontal installation to fit any production line
- ▶ quality, dimension, anisotropy
- ▶ all kinds — float, heat-treated, laminated, IG unit
- ▶ AI technology included
- ▶ easy and transparent monitor display
- ▶ archive database, certificates
- ▶ smallest footprint ever

Watch the LineScanner video online ▶

Scan the code or visit www.glassquality.com/products/line-scanner/#tscneu-video



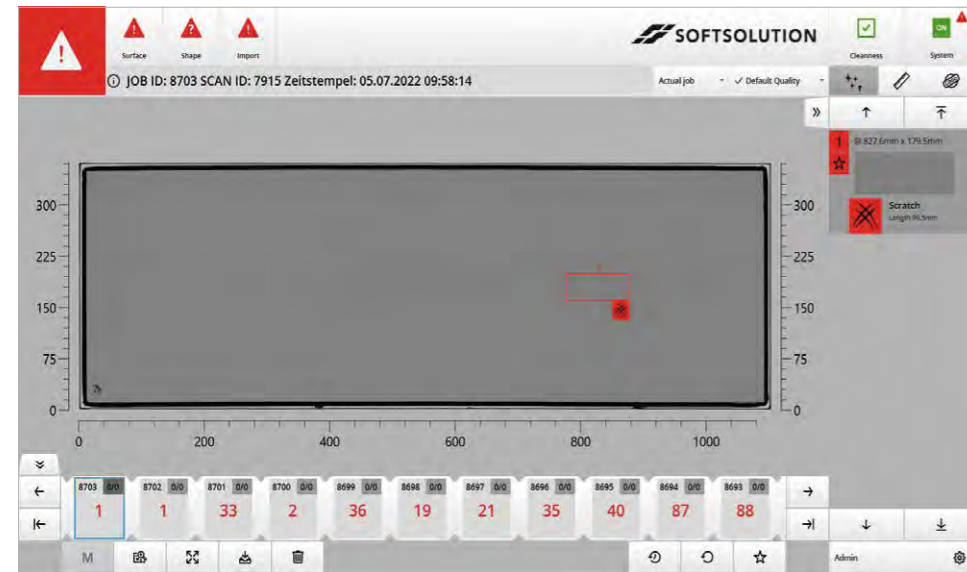
LineScanner V



User-friendly interface



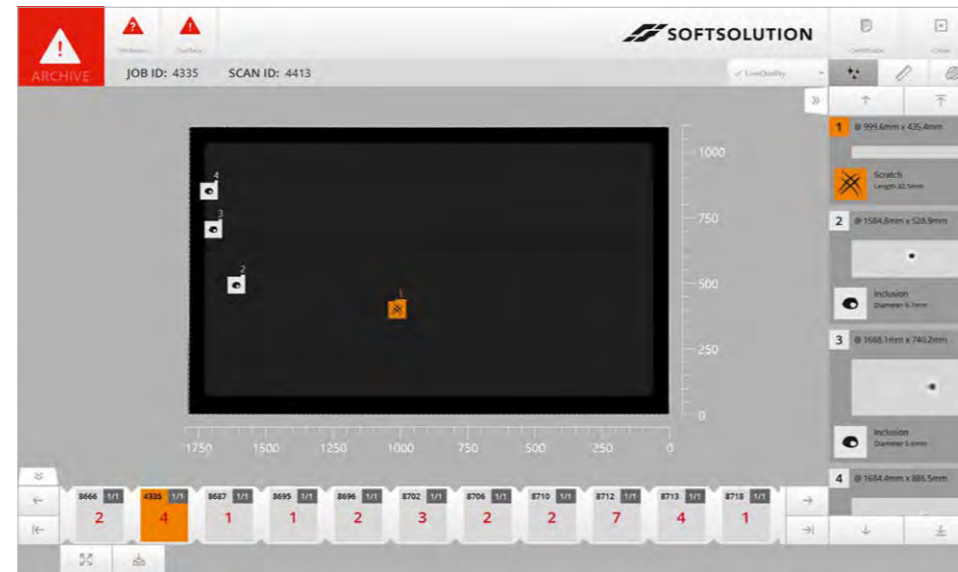
▲ Monitor image: Dimension control



▲ Monitor image: Coating defects



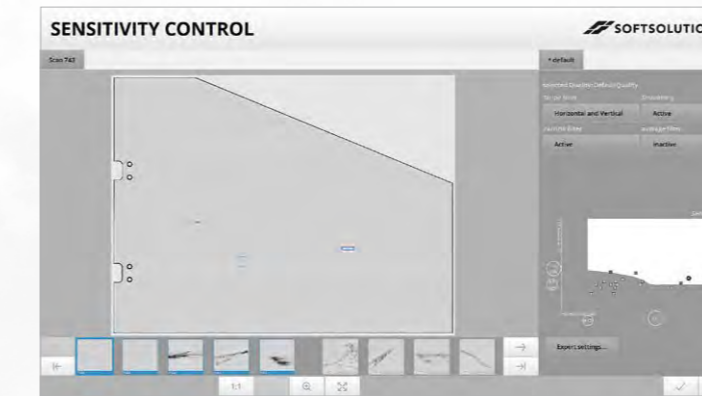
▲ Monitor image: Anisotropy



▲ Monitor image: Surface & Edge Quality

Sensitivity settings

Different types of glass have different quality requirements. Using this knowledge, the LineScanner was equipped with a new technical feature – **THE SENSITIVITY CONTROL TOOL**.

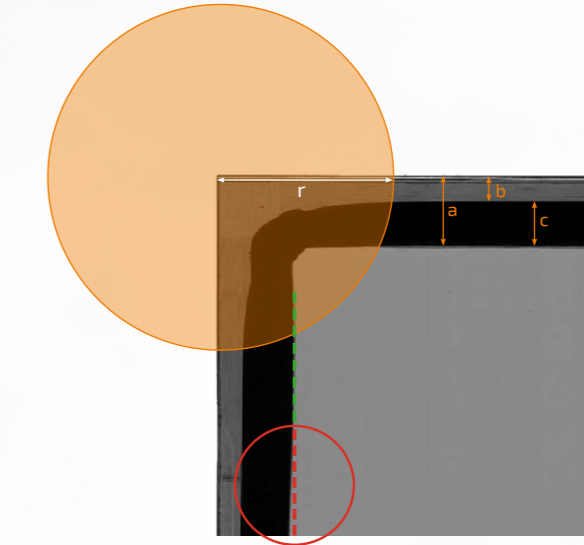


Here, slide controls and other settings are adjusted to filter which defects are shown to the operator.

The operator sees the changes they made immediately within the tool. The new tool makes it easy to adjust these settings and for the operator to quickly see the results.

This revolutionary new development makes the LineScanner as easy to use as a smartphone.

LineScanner sight-line check



- Positions to be checked**
- a edge to inner contour
 - b edge to outer contour
 - c width of spacer
 - r ignore area – radius to be defined

- ▶ different positions of spacer as shown on the sketch
- ▶ target positions can be provided via DXF contour
- ▶ target position can also be provided via transferfile (without DXF) for a, b or c
- ▶ ignore area can be defined via distance from the edge (rectangles only)

Tolerances

- ▶ can be defined as distances from target position

LineScanner R

Detecting White Haze on tempered glasses with Softsolution LineScanner Reflection

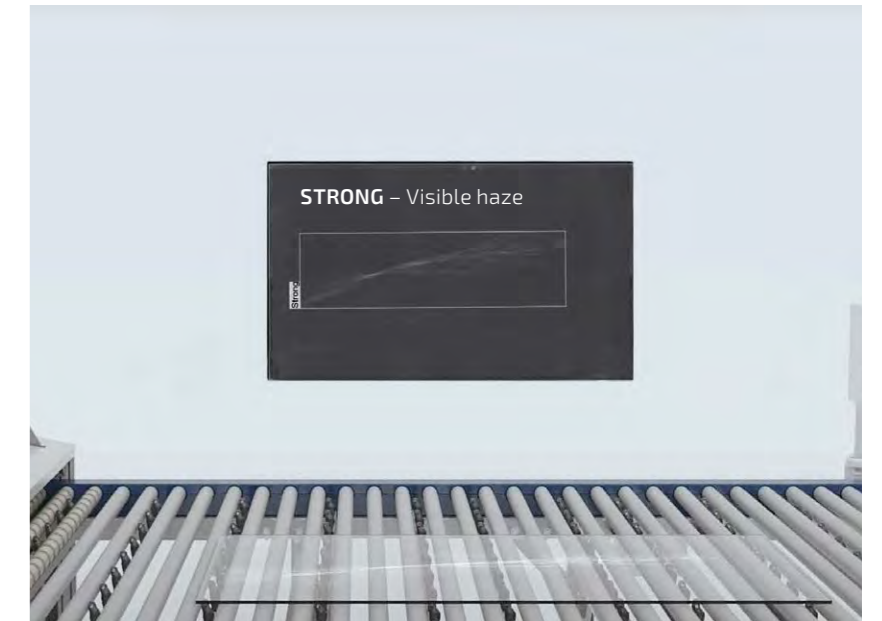
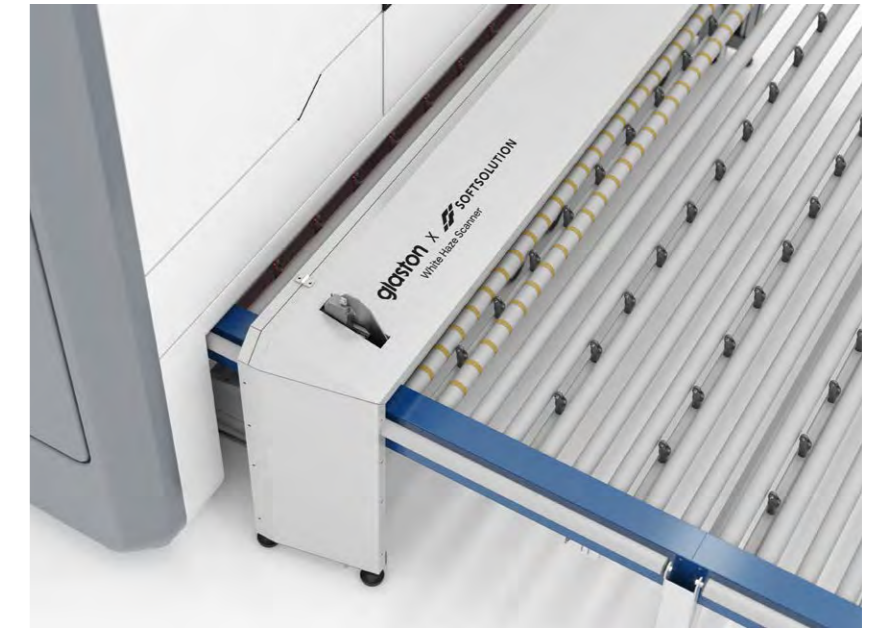


- ▶ white haze detection in different levels
- ▶ unique reflection-based scanning
- ▶ AI based software algorithm
- ▶ invented and developed in cooperation with **glaston**
- ▶ smallest footprint ever



White haze scanner – classification

| MILD | MEDIUM | STRONG | Strong |
|---|--|--|--------|
| <i>Visible with external light source</i> | <i>Visible haze with closer inspection</i> | <i>Visible haze</i> | |
| Not considered a problem in glass industry, can often be easily rubbed off the glass surface. | Can be rejected especially for quality oriented customers. | Typically rejected especially in high value installations. | |



True scanning technology

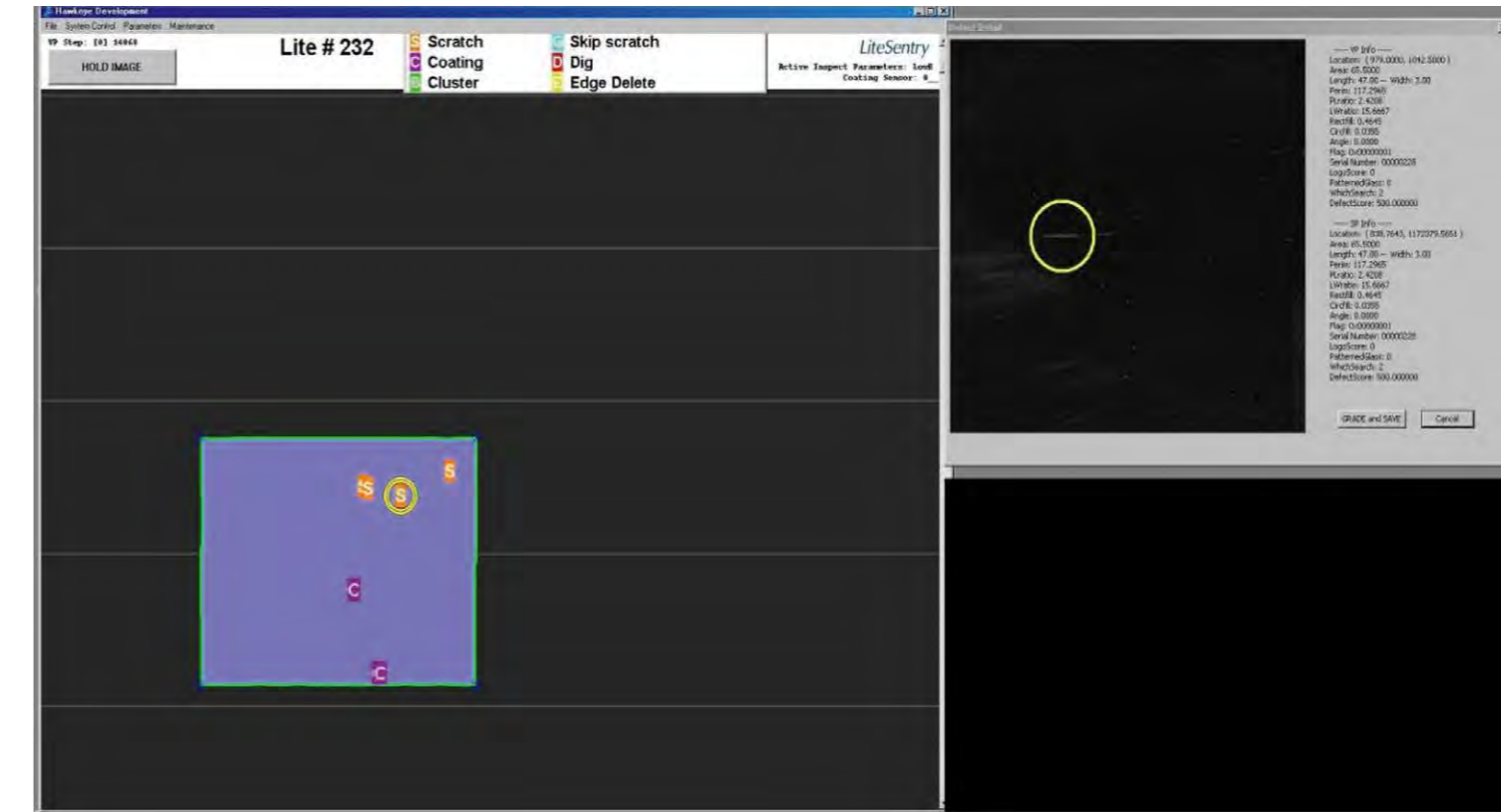
Hawk[®]

Scratch + Defect Inspection



Specifically for coated glass detects a wide range of defects

- ▶ true brightfield and darkfield inspection
- ▶ engineered for vertical and horizontal installation to fit any production line
- ▶ modular design of sensors, lights and cameras for ease of maintenance
- ▶ detects pinholes, arc marks, edge grind skips and misses, skip scratches and cluster defects
- ▶ patented technology differentiates low-E coated glass from non-coated glass and sets unique inspection criteria for each type of glass



▲ Monitor image: a wide range of different defects detected on glass along with legend (top) and pop-up detail (right)



▲ Detects pinholes, arc marks, edge grind skips and misses, skip scratches and cluster defects

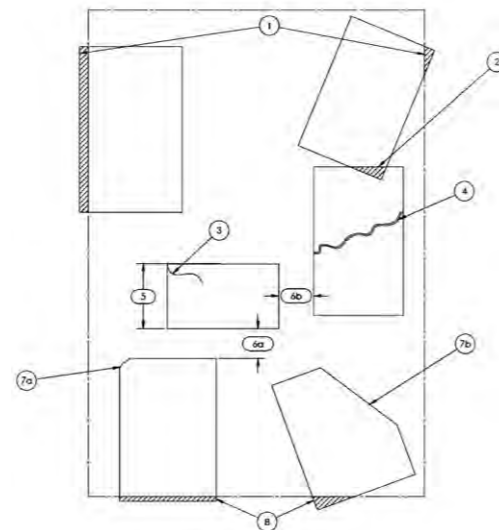
Load Validator™

Geometry + Fault Detection



*Prevents breakage
in the furnace and quench*

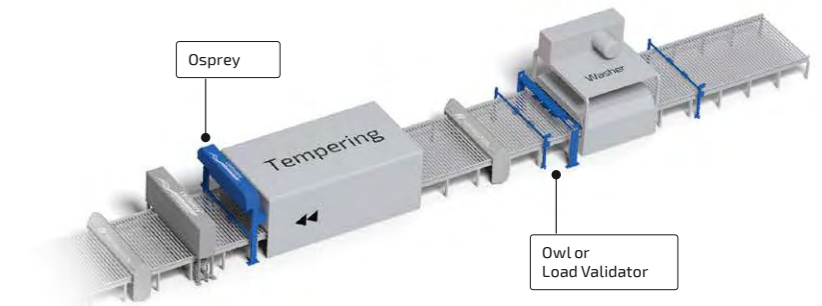
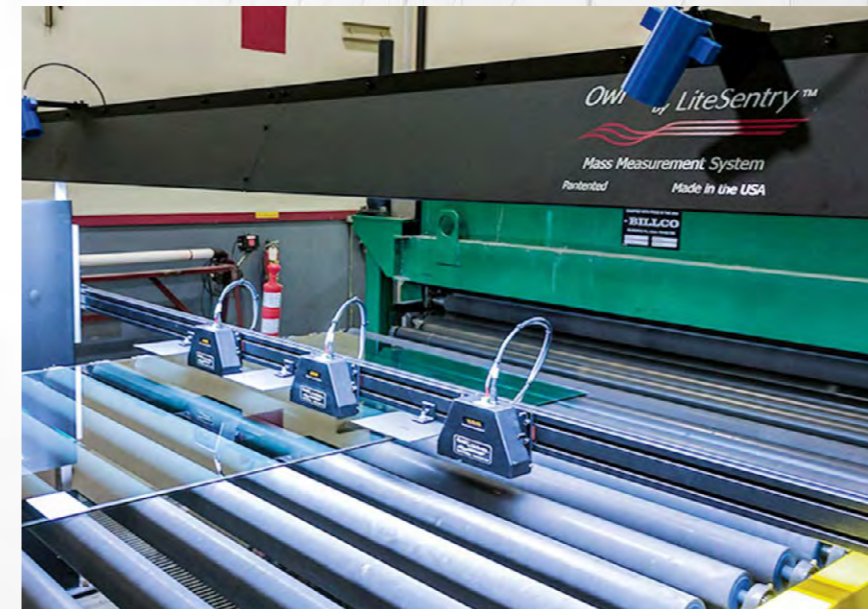
- ▶ ensures correct load geometry
- ▶ detects long load, overlapping, broken corner, wide load, minimum distance
- ▶ non-conforming loads or defective glass triggers
- ▶ alarms that stop the conveyor system



▲ Different types of load errors: broken corner, overlap, wide load, long load, min distance

Owl®

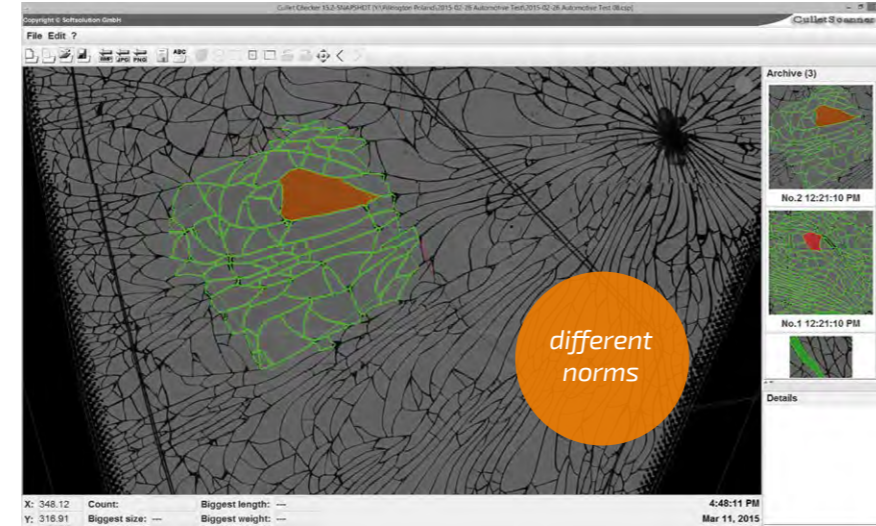
Recipe Selection + Fault Detection System



- ▶ automatic furnace control
- ▶ optimize heat time and other furnace parameters by coating, thickness, glass color, bed utilization and location of parts
- ▶ ensures correct load geometry
- ▶ glass thickness, color and coating automatically measured
- ▶ detects long load, overlapping, broken corner, wide load, minimum distance
- ▶ eliminates operator errors
- ▶ communicates with an Osprey to confirm all parts in a load are present

CulletScanner

Automatic fragmentation
image analysis



- ▶ automatic break pattern analysis
- ▶ only system which checks the entire part
- ▶ automatically finds worst areas
- ▶ prevents operator errors
- ▶ 3 sizes available
- ▶ several norms available
- ▶ certificates and digital images

Watch the CulletScanner video online ▶

Scan the code or visit
www.glassquality.com/products/culletscanner/#cs-video



VirtualDigitizing

Software application for
flexible digitization of templates



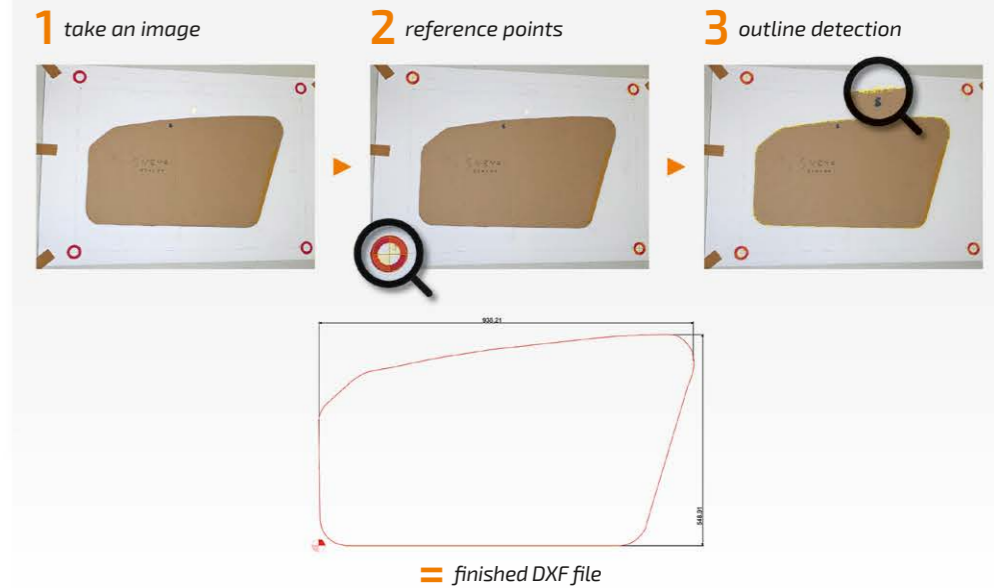
Watch the VirtualDigitizing video online ▶

Scan the code or visit
www.glassquality.com/products/virtual-digitizing/#vd-video



- ▶ digitization solution for templates
- ▶ automatic conversion to DXF format
- ▶ spline optimization
- ▶ auto corner tool
- ▶ safe time and money by getting the template right the first time – everytime

In 3 steps to DXF



finished DXF file

Archive Database

Single database to store all scan and quality results

| Id | Line | Timestamp | Result | Surface | Barcode | Barcode | Edge err... | Dirt erro... | Scratch ... | Scratch ... |
|----------|------|-------------------------|--------|---------|--------------------|---------|-------------|--------------|-------------|-------------|
| Scan 175 | L1 | Feb 14, 2018 7:56:10 AM | ✓ | ✓ | 181100992x11818401 | ☑ | 0 | 0 | 0 | 2 |
| Scan 176 | L1 | Feb 14, 2018 7:58:53 AM | ⚠ | ⚠ | 181100987x11818501 | ☑ | 0 | 0 | 1 | 12 |
| Scan 177 | L1 | Feb 14, 2018 8:01:19 AM | ✓ | ✓ | 181100987x11818601 | ☑ | 0 | 0 | 0 | 0 |
| Scan 178 | L1 | Feb 14, 2018 8:03:11 AM | ✓ | ✓ | 181100987x11818701 | ☑ | 0 | 0 | 0 | 0 |
| Scan 179 | L1 | Feb 14, 2018 8:05:29 AM | ✓ | ✓ | 181100987x11818801 | ☑ | 0 | 0 | 0 | 0 |
| Scan 180 | L1 | Feb 14, 2018 8:11:36 AM | ✓ | ✓ | 181100987x11818901 | ☑ | 0 | 0 | 0 | 0 |
| Scan 181 | L1 | Feb 14, 2018 8:12:45 AM | ✓ | ✓ | 181100987x11819001 | ☑ | 0 | 0 | 0 | 0 |
| Scan 182 | L1 | Feb 14, 2018 8:18:00 AM | ✓ | ✓ | 181100987x11819101 | ☑ | 0 | 0 | 0 | 0 |
| Scan 183 | L1 | Feb 14, 2018 8:19:21 AM | ✓ | ✓ | 181100995x11819201 | ☑ | 0 | 0 | 0 | 0 |
| Scan 184 | L1 | Feb 14, 2018 8:20:27 AM | ✓ | ✓ | 181100987x11819301 | ☑ | 0 | 0 | 0 | 0 |
| Scan 185 | L1 | Feb 14, 2018 8:30:13 AM | ✓ | ✓ | 181100987x11819401 | ☑ | 0 | 0 | 0 | 0 |
| Scan 186 | L1 | Feb 14, 2018 8:31:49 AM | ✓ | ✓ | 181100987x11819501 | ☑ | 0 | 0 | 0 | 0 |
| Scan 187 | L1 | Feb 14, 2018 8:34:27 AM | ✓ | ✓ | 181100987x11819601 | ☑ | 0 | 0 | 0 | 0 |
| Scan 188 | L1 | Feb 14, 2018 8:36:06 AM | ⚠ | ⚠ | 181100995x11819701 | ☑ | 0 | 0 | 0 | 0 |
| Scan 189 | L1 | Feb 14, 2018 8:38:31 AM | ✓ | ✓ | 181100987x11819801 | ☑ | 0 | 0 | 0 | 0 |
| Scan 190 | L1 | Feb 14, 2018 8:40:04 AM | ✓ | ✓ | | ☑ | 0 | 0 | 0 | 0 |
| Scan 191 | L1 | Feb 14, 2018 8:46:20 AM | ✓ | ✓ | 181100987x11820001 | ☑ | 0 | 0 | 0 | 0 |
| Scan 192 | L1 | Feb 14, 2018 8:47:41 AM | ✓ | ✓ | 181100873x11820101 | ☑ | 0 | 0 | 0 | 0 |
| Scan 193 | L1 | Feb 14, 2018 8:55:31 AM | ✓ | ✓ | | ☑ | 0 | 0 | 0 | 0 |
| Scan 194 | L1 | Feb 14, 2018 9:01:02 AM | ✓ | ✓ | 181100873x11820301 | ☑ | 0 | 0 | 0 | 0 |
| Scan 195 | L1 | Feb 14, 2018 9:02:09 AM | ✓ | ✓ | 181100873x11820401 | ☑ | 0 | 0 | 0 | 0 |
| Scan 196 | L1 | Feb 14, 2018 9:03:18 AM | ✓ | ✓ | 181100873x11820501 | ☑ | 0 | 0 | 0 | 0 |
| Scan 197 | L1 | Feb 14, 2018 9:04:26 AM | ⚠ | ✓ | 181100873x11820601 | ☑ | 0 | 0 | 0 | 0 |
| Scan 198 | L1 | Feb 14, 2018 9:05:39 AM | ✓ | ✓ | | ☑ | 0 | 0 | 0 | 5 |

- ▶ list of scans (1 line per scan)
- ▶ individually configurable columns
- ▶ use filters and change the order
- ▶ search for a particular glass/lite
- ▶ includes LineScanner and Osprey data

◀ Archive Database interface
▼ Example for weekly statistics — Microsoft Excel export based



- ▶ accept data from LineScanner and Osprey
- ▶ lookup specific parts
- ▶ combine individual ERP data
- ▶ print certificates
- ▶ auto reporting based on schedules
- ▶ individual statistics to minimize critical workflows

Glass detail, operator action, base quality settings for all glass pieces are stored in PostgreSQL database. This knowledge base will allow users to optimize the production process while increasing quality.

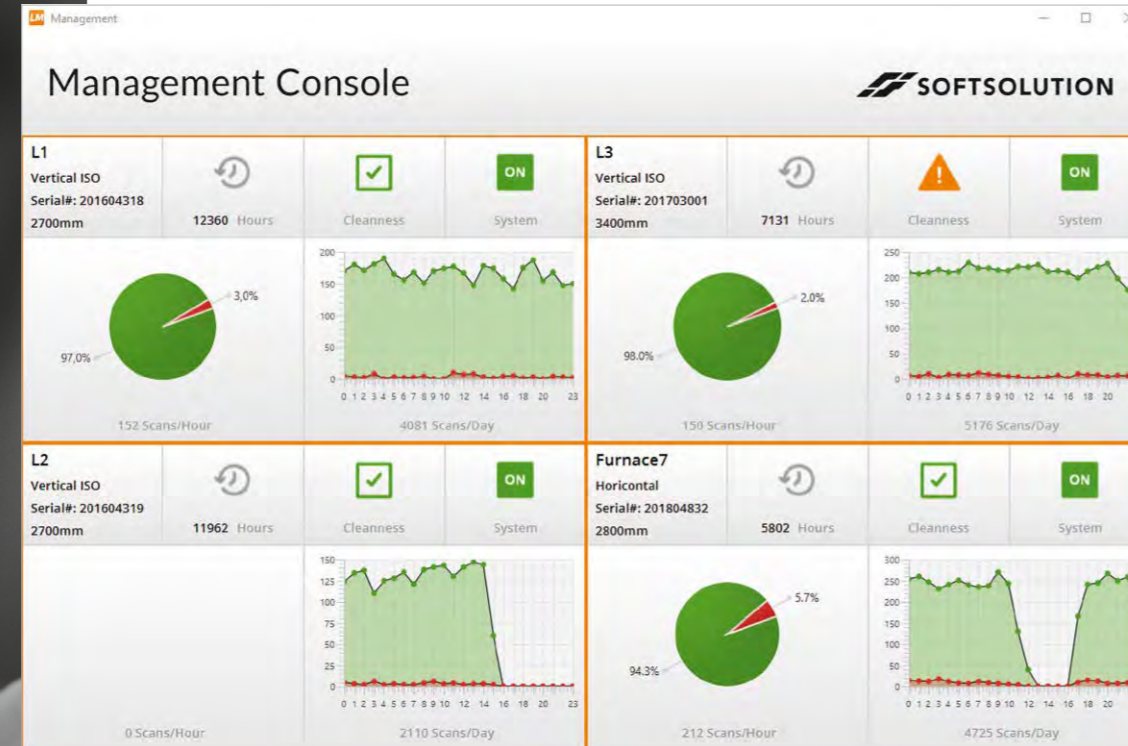
The user can search for a specific glass by customer, barcode, order number, order item, etc, along with scanned image of the glass by the LineScanner.

Additional statistics provided include:

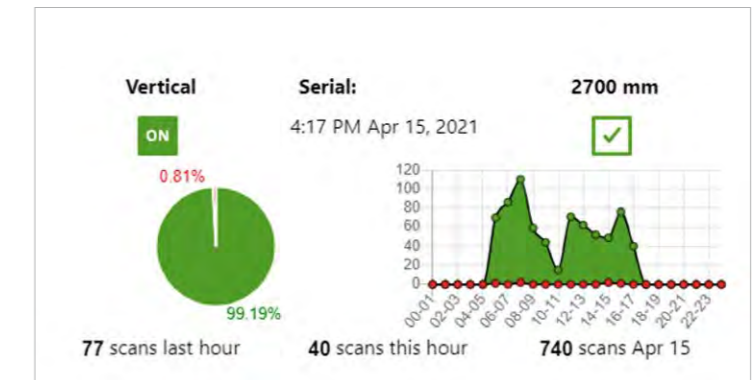
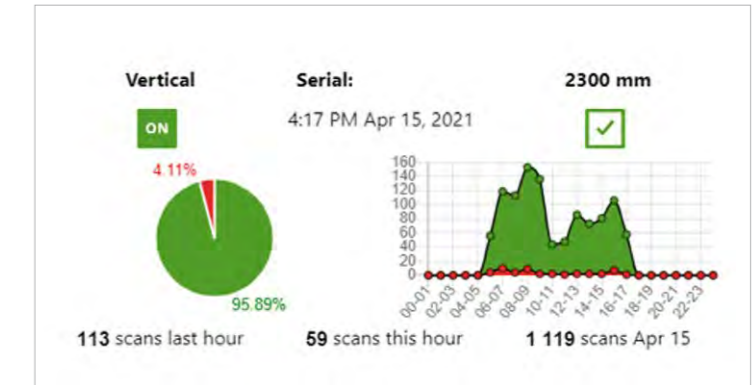
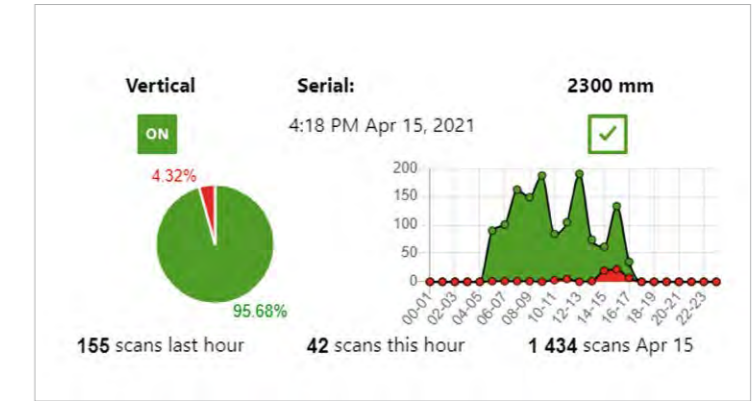
- ▶ production control
- ▶ good/bad analysis
- ▶ defect type by percentage

Management Console

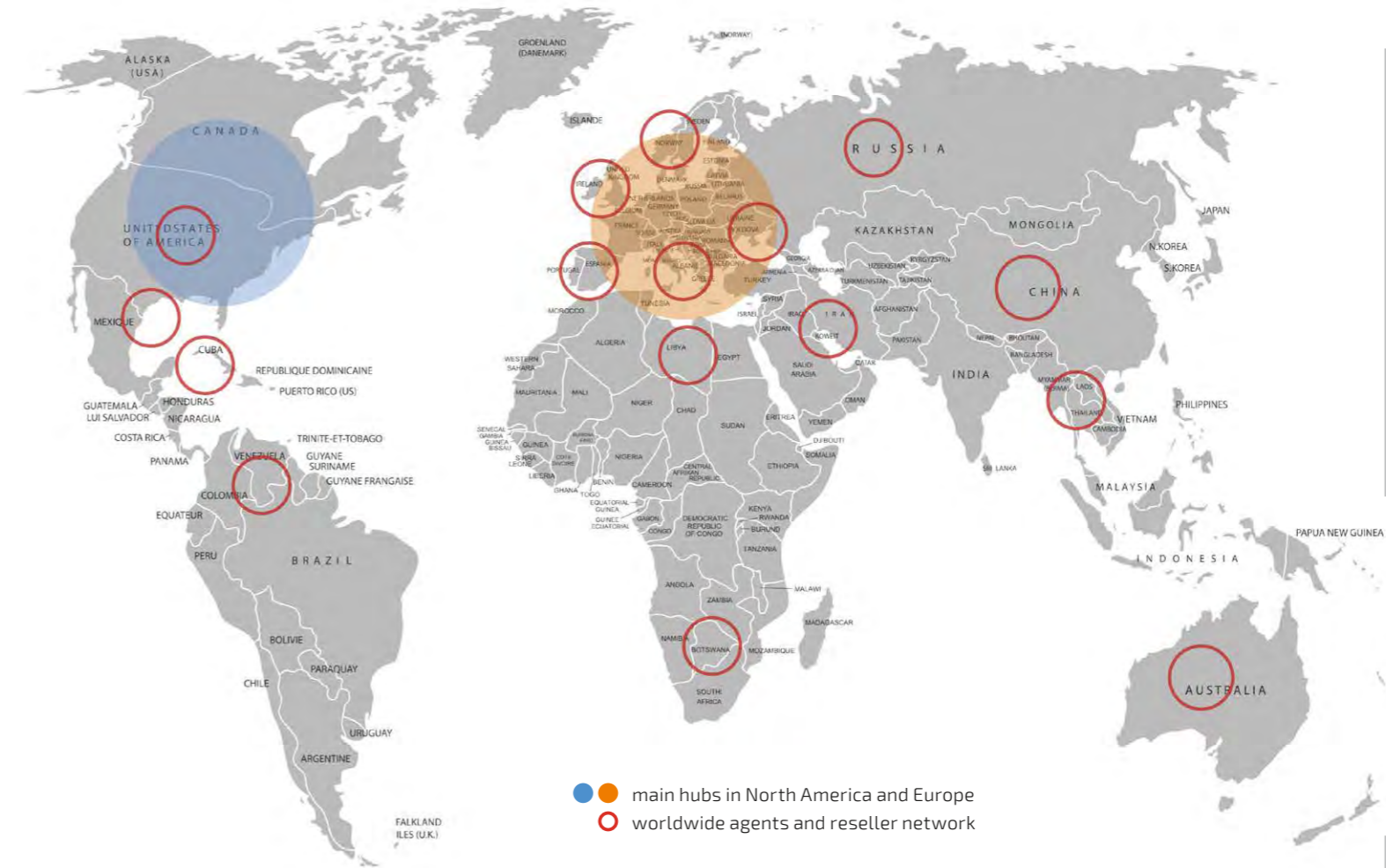
Real time machinery status



- ▶ accept data from LineScanner and Osprey
- ▶ real-time status of numerous inspection systems
- ▶ accessible via any mobile device — worldwide
- ▶ production overlook
- ▶ good / bad information



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