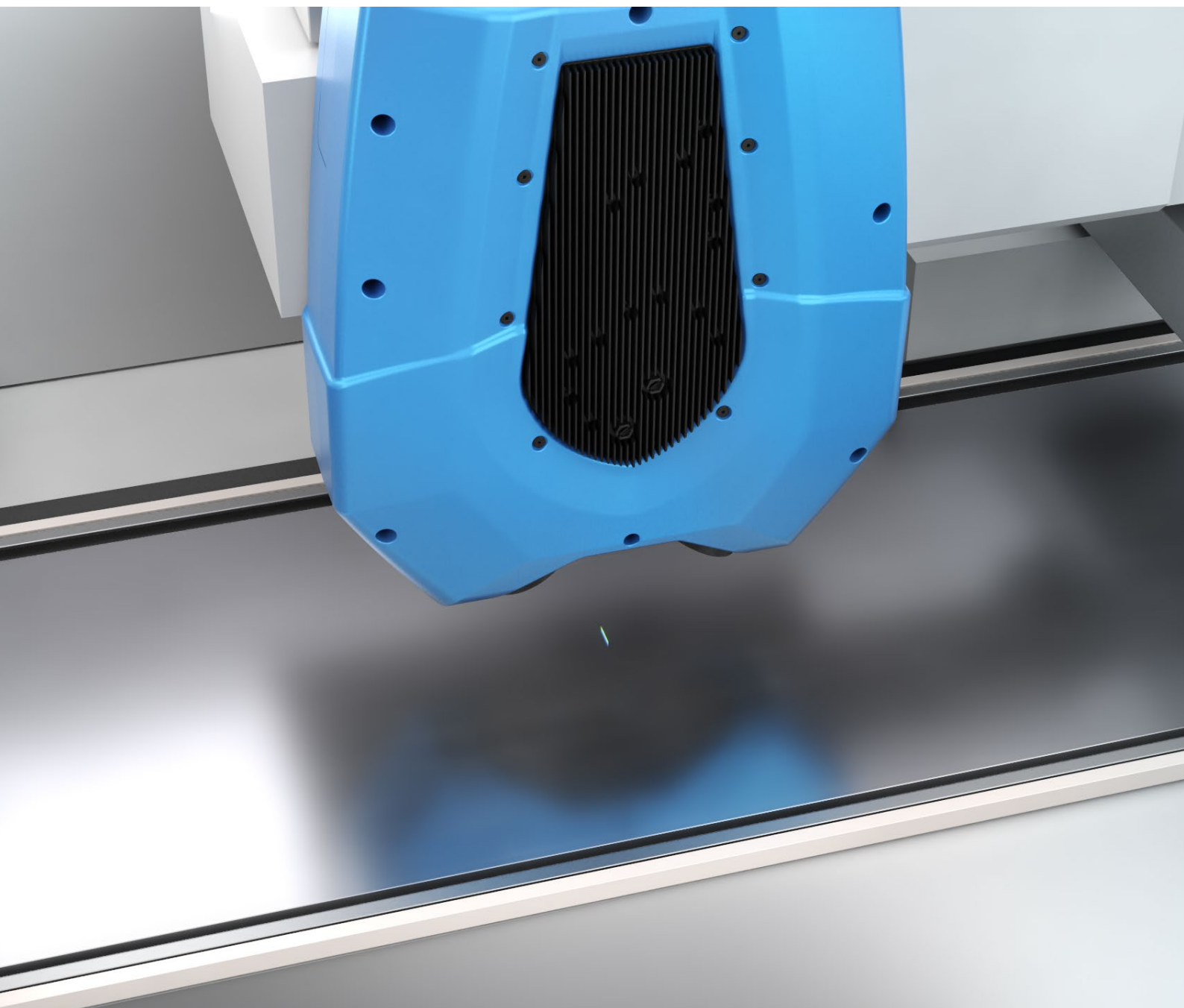
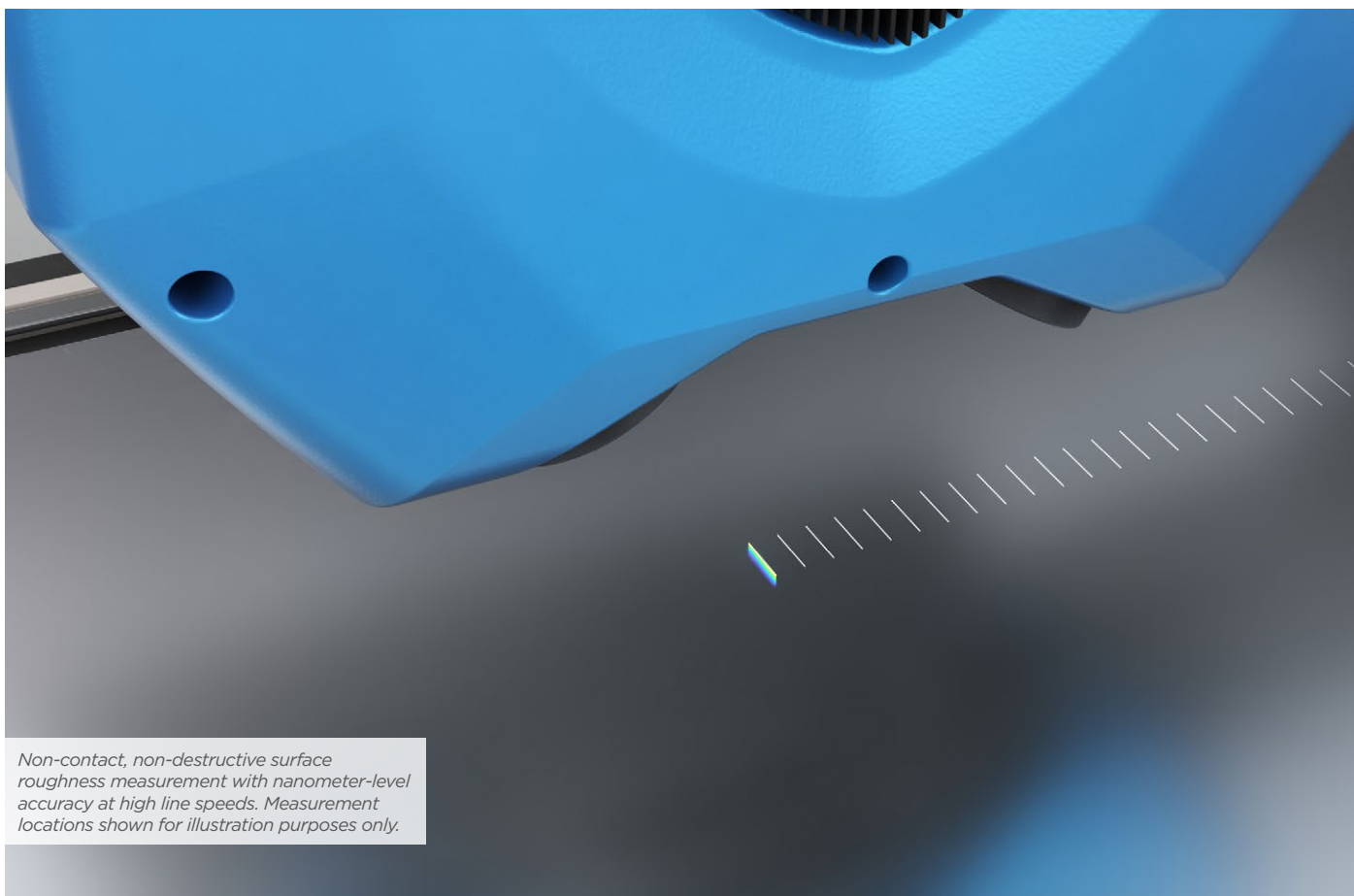




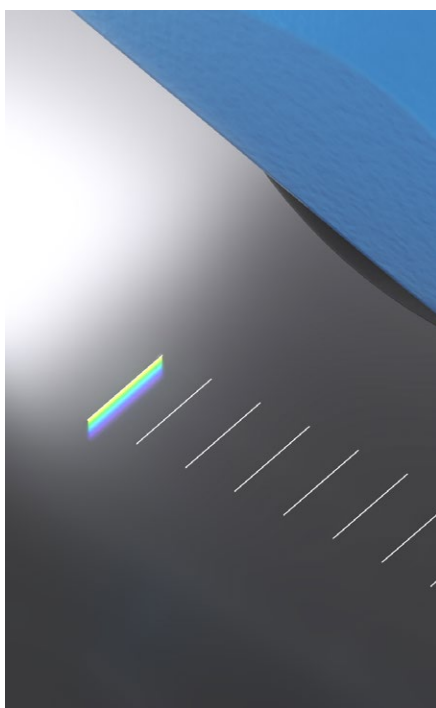
INDUSTRY APPLICATION:
**INLINE ROUGHNESS MEASUREMENT OF
MOVING SURFACES WITH FOCALSPEC® 3D
LINE CONFOCAL SENSORS**

CONTENTS

3	Sensor Capabilities
4	Line Confocal Imaging (LCI) Technology
5	Real-Time Surface Roughness Analysis
6 - 8	Surface Roughness Applications
9	Competing Technology Comparison
10	Technical Specifications



Non-contact, non-destructive surface roughness measurement with nanometer-level accuracy at high line speeds. Measurement locations shown for illustration purposes only.



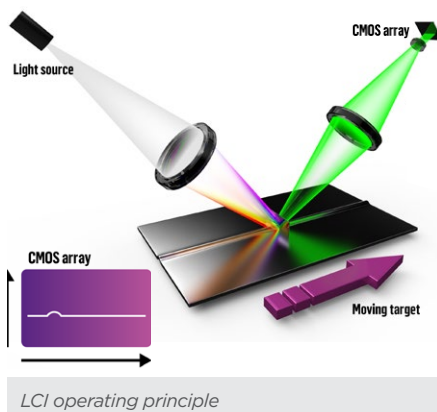
Surface roughness of many parts, assemblies and continuous products must be monitored to ensure product quality and functionality and to optimize various stages of the product manufacturing process.

Inline Surface Roughness Inspection. At Production Speed.

FocalSpec® sensors offer a unique solution for inline roughness characterization of moving surfaces that allows manufacturers to achieve 100% inline quality control with laboratory accuracy. These sensors are easy to integrate into existing manufacturing lines, and deliver continuous non-contact, ultra-fast scanning and analysis of surface microtopography with real-time reporting for a range of automated production processes.

Sensor Capabilities

- Thousand of Ra, Rz, or other roughness parameter values acquired each second
- Real roughness calculation from actual 3D surface profile
- Single-shot profile capture minimizes error caused by vibration
- Scans continuous and discrete surfaces

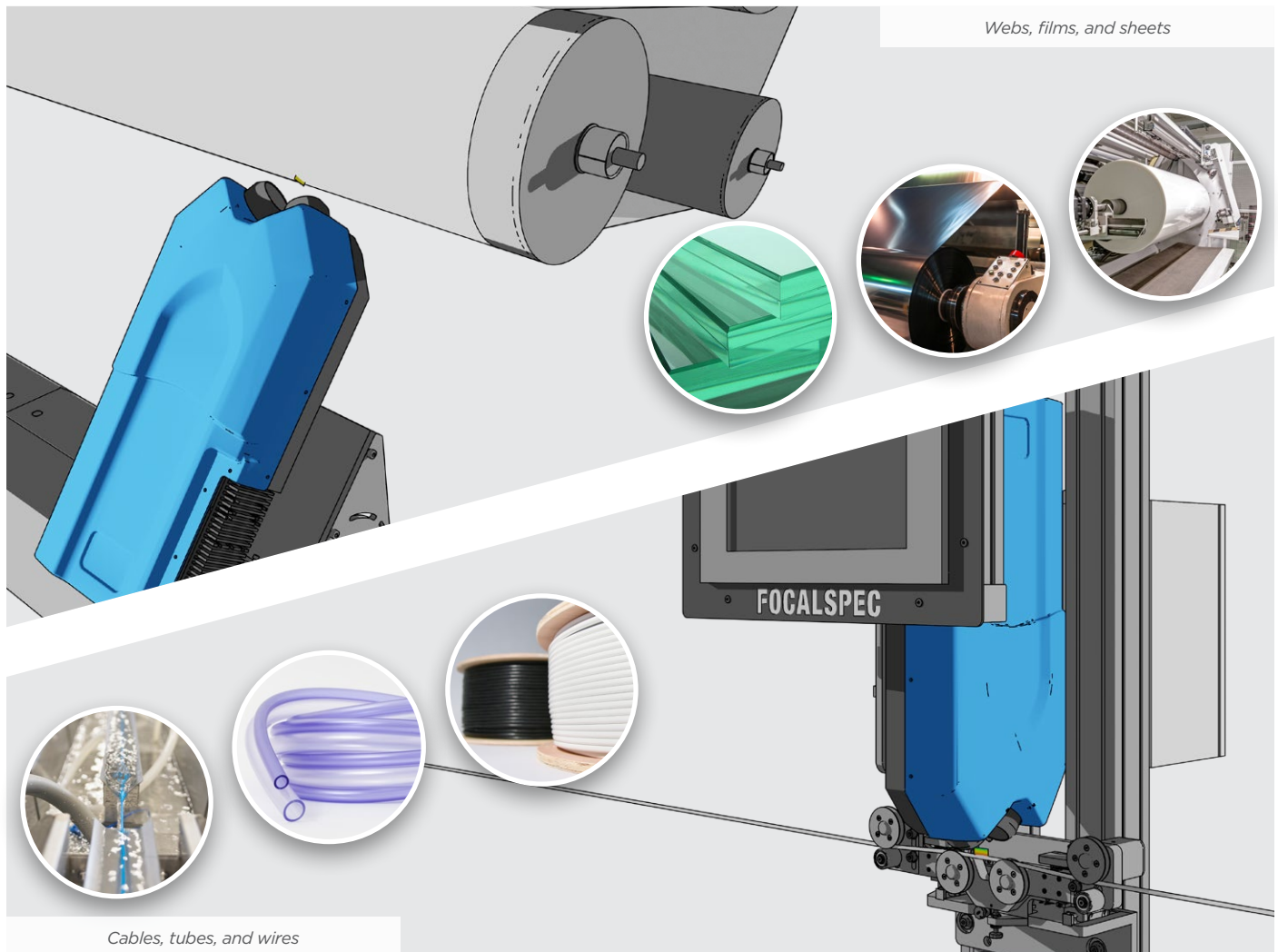


Line Confocal Imaging (LCI)

FocalSpec® sensors use line confocal imaging technology, a patented optical technique where white light emitting from a sensor's transmitter is split into a continuous spectrum of wavelengths. The reflected wavelengths that are "in focus" return to the sensor's optical receiver that maps wavelength variation to height or distance variation. The sensor's off-axis design allows it to simultaneously carry out 3D topography, 2D intensity, and multi-layer 3D tomography scanning.

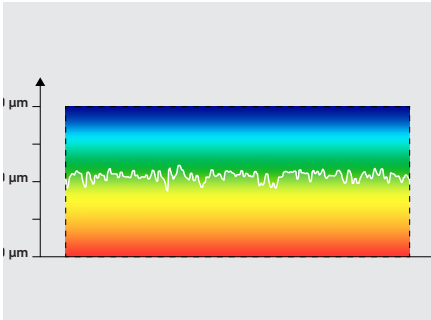
Inspect a Wide Variety of Surface Types

- Discrete & continuous surfaces
- Abrasives
- Metal sheets and foils
- Etched & sandblasted surfaces
- Films & sheets
- Tubes, pipes, & rods
- Wires & cables
- Tapes & belts
- Profiles & filaments
- Paper & board
- Membranes
- Ceramics
- Uncoated and coated surfaces



Real-Time Surface Roughness Analysis

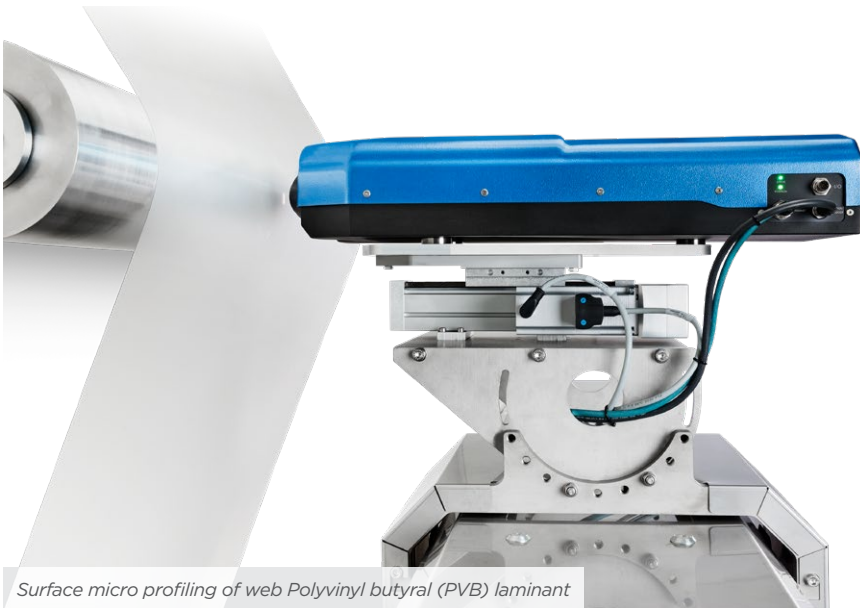
Profile data is processed by the sensor's dedicated application software and results are displayed in real-time along with Standard Deviation and Process Capability indices. Continuously updated trend and histogram charts are also available. Real-time data can be used to alert an operator of any unusual process change, and results can be fed back to the process control for automatic real-time adjustment (eg., closed-loop control system).



Perform calculations of R_a (average distance of roughness profile to center line) and R_z (average maximum peak to valley of the roughness profile)



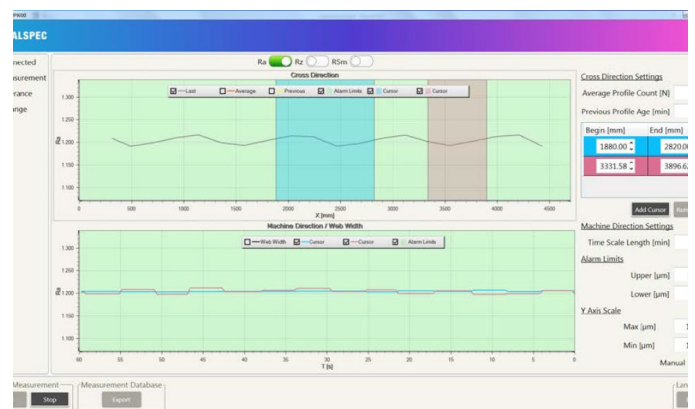
Cable smoothness measurement system



Surface micro profiling of web Polyvinyl butyral (PVB) laminant



Real-time single-profile R_a reporting



Real-time cross direction and machine direction roughness charts

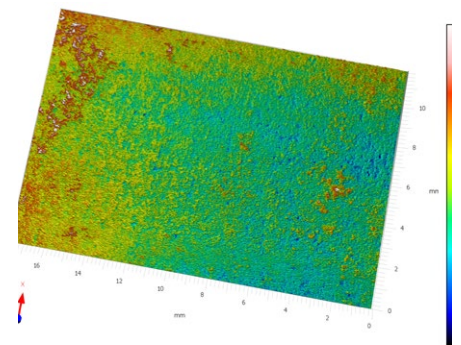
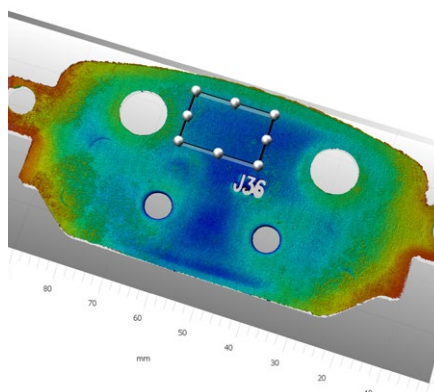
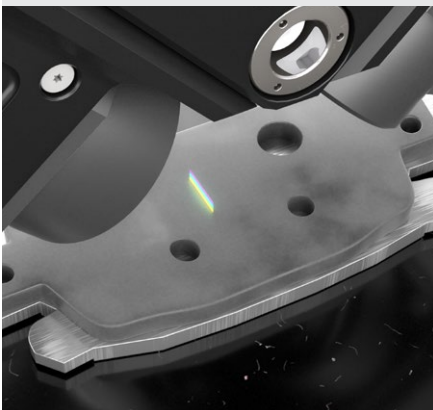
SURFACE ROUGHNESS APPLICATIONS

Assembly - Component Fit

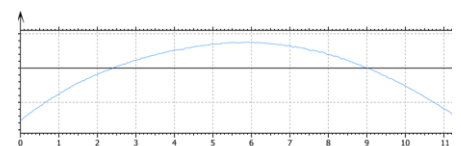
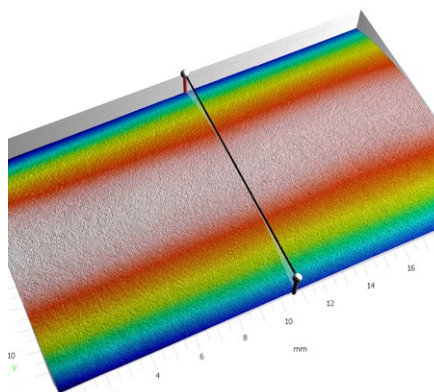
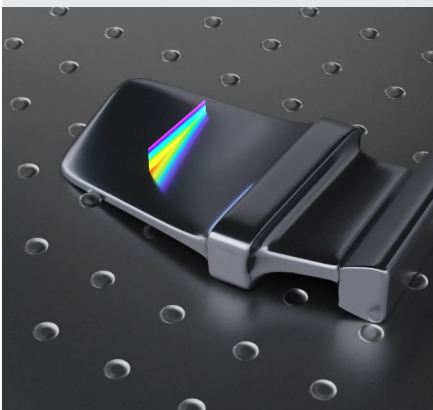
Variations in surface roughness have a significant impact on the amount of wear, the ability to form a seal when a part makes contact with another surface, and the thickness of the paint needed to coat a part.

Line Confocal Imaging can be used in a variety of industrial applications to measure and inspect surface roughness to ensure tight manufacturing tolerances are met.

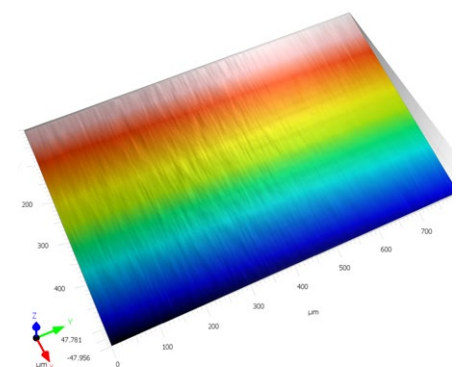
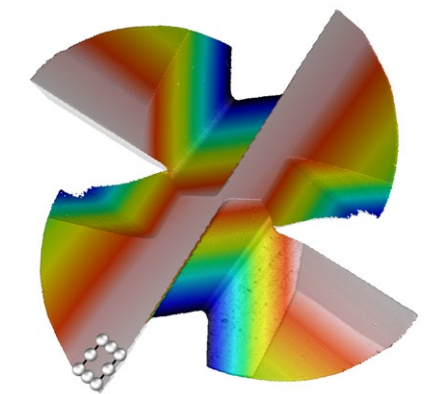
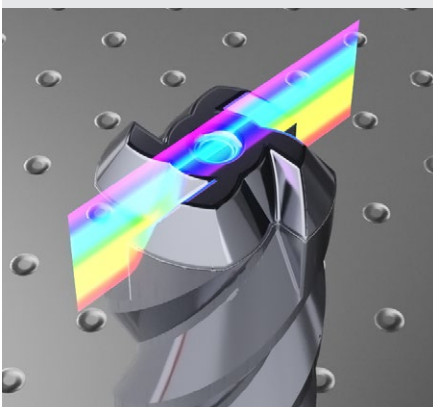
Automotive - Brake Pad Inspection



Aerospace - Aircraft Engine Blade Inspection



Consumer Products - Drill Bit Inspection

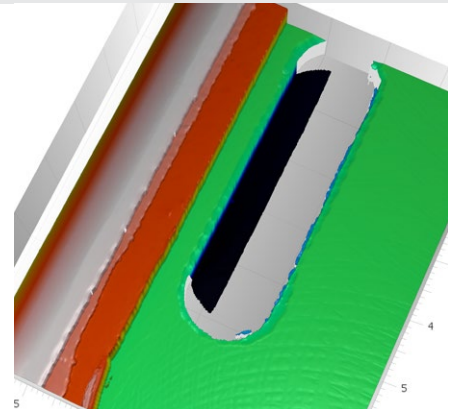
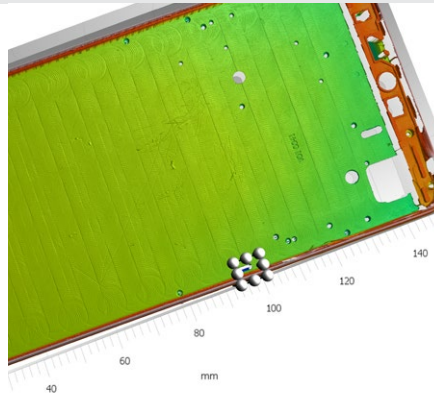
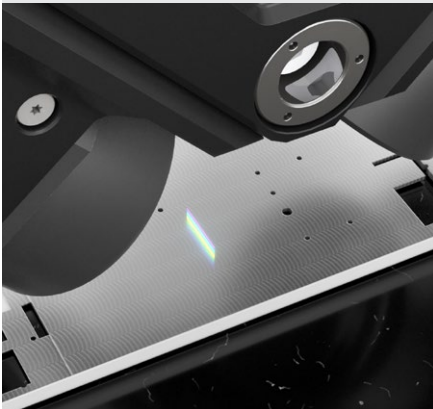


Assembly - Bonding Strength

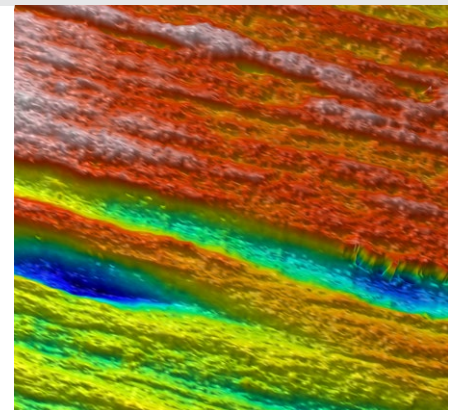
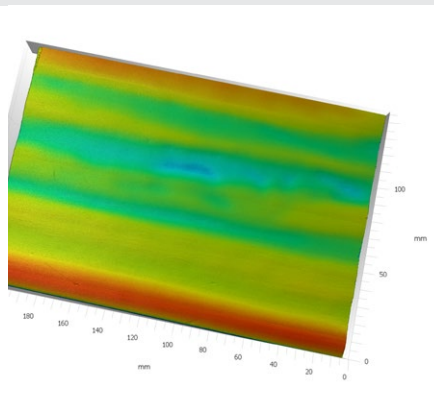
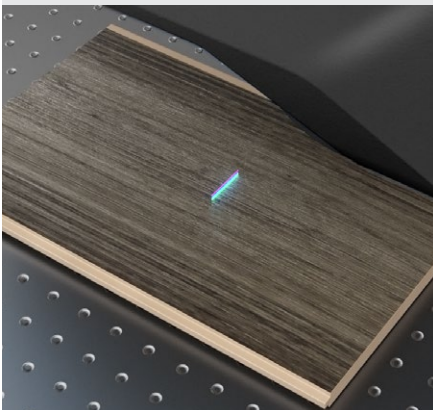
Bonding strength is directly related to surface roughness. The specific area of the bonded surface and the adhesive is critical. As a rule, bonding strength increases linearly across the bonding area, so manufacturers use laser etching, polishing, and sandblasting to ensure the surface is smooth as possible. However, if the surface is too rough, the glue will not completely adhere and bubbles are likely to form, which greatly reduces the strength of the bond.

Line confocal imaging sensors are used to achieve 100% quality control by preventing insufficient contact area and air bubbles, resulting in maximum bonding strength and adhesive integrity.

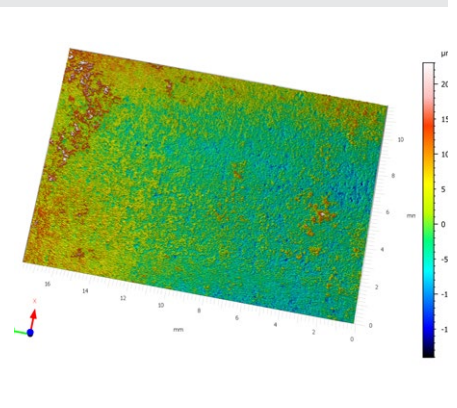
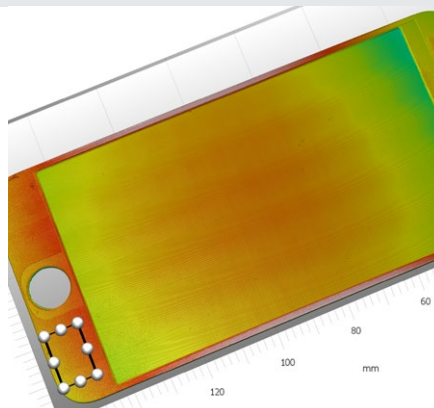
Consumer Electronics - Mobile and Smartwatch Inspection



Wood Inspection



PVB Film Inspection

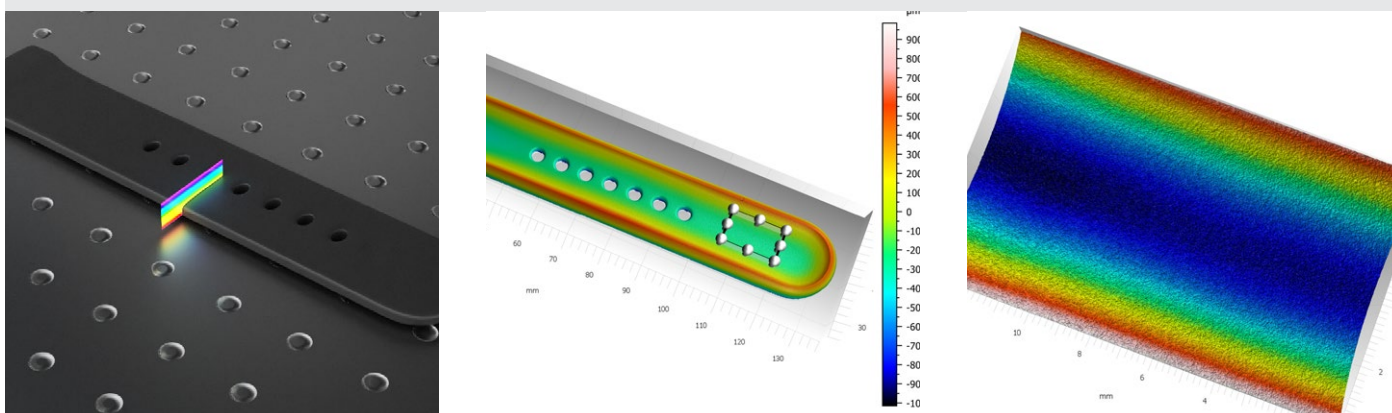


Assembly - Surface Finish

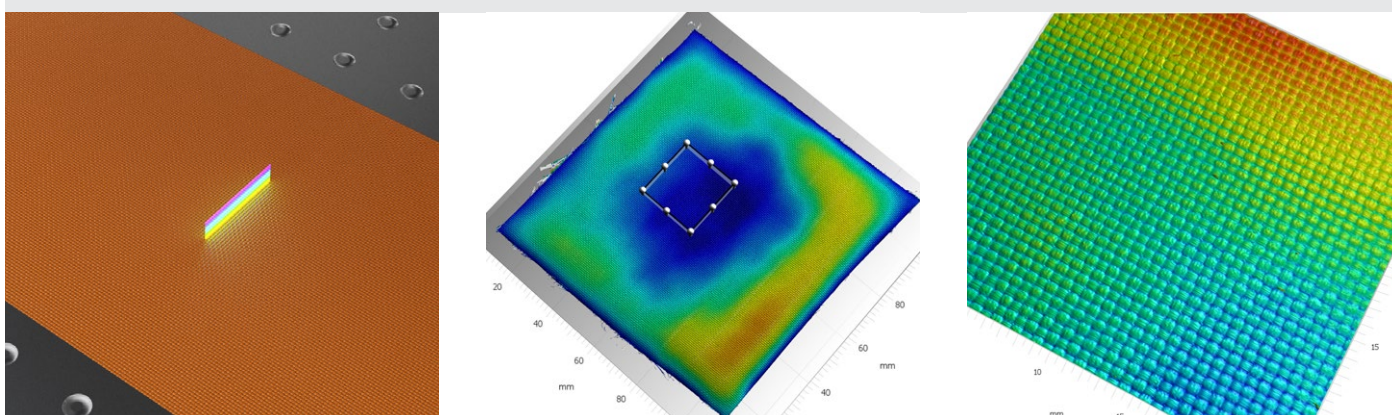
Many wearable consumer products need to be inspected for the quality of their surface finish, and how they feel to the human touch. This is a critical part of product quality—delivering the smooth tactile experience that customers have come to expect.

Line confocal imaging sensors deliver the high-resolution surface roughness measure required to evaluate consumer products as aesthetic objects.

Consumer Electronics - Watch Strap Inspection

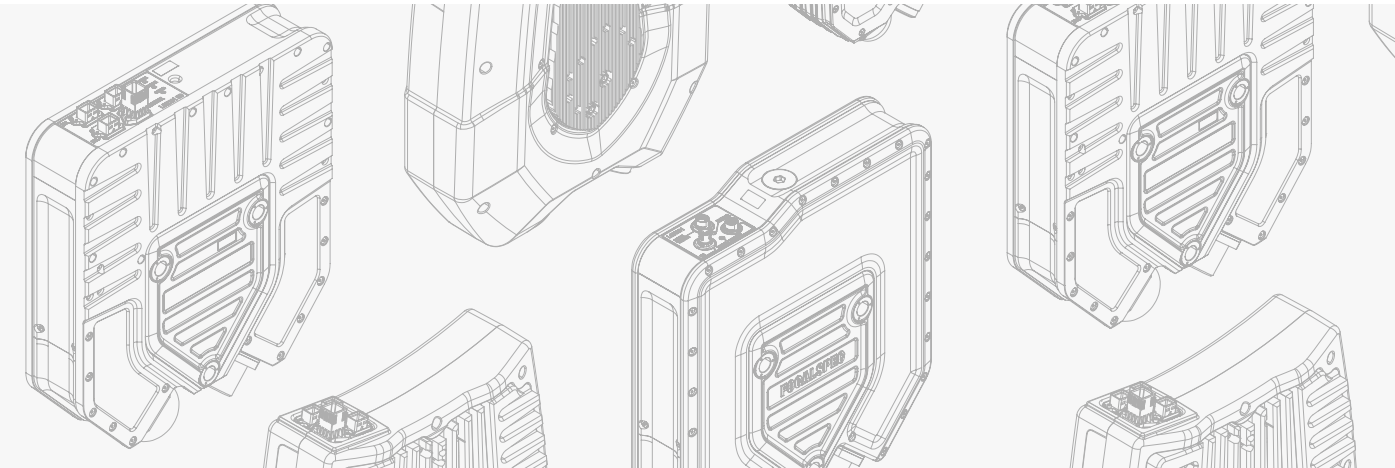


Clothing - Fabric Inspection



COMPETING TECHNOLOGY COMPARISON

	Surface Roughness Gauges	White Light Interference, Laser Confocal	Line Confocal Imaging
Method	Contact	Non-contact	Non-contact
Speed & Accuracy	Low repeatability	High accuracy	High-speed, high accuracy and repeatability
Price	Low	Expensive	Cost-effective
Measurement Speed	Slow	Slow	Inline speed
Compatibility	None	Not good	Good
Environment	Highly affected by the environment	Highly affected by the environment	Strong adaptability to the environment. Can be used in various applications on any material, surface and product type (inline, at-line, or off-line).
Sample Processing	Destructive sample processing is often required. Working distance is very close, so in order to get a flat enough surface the user must physically extract a sample from the actual target	Destructive sample processing is often required. Working distance is very close, so in order to get a flat enough surface the user must physically extract a sample from the actual target.	100% non-destructive. No sample processing required.
Customization	Not allowed	Not allowed	Yes and very flexible



Technical Specifications

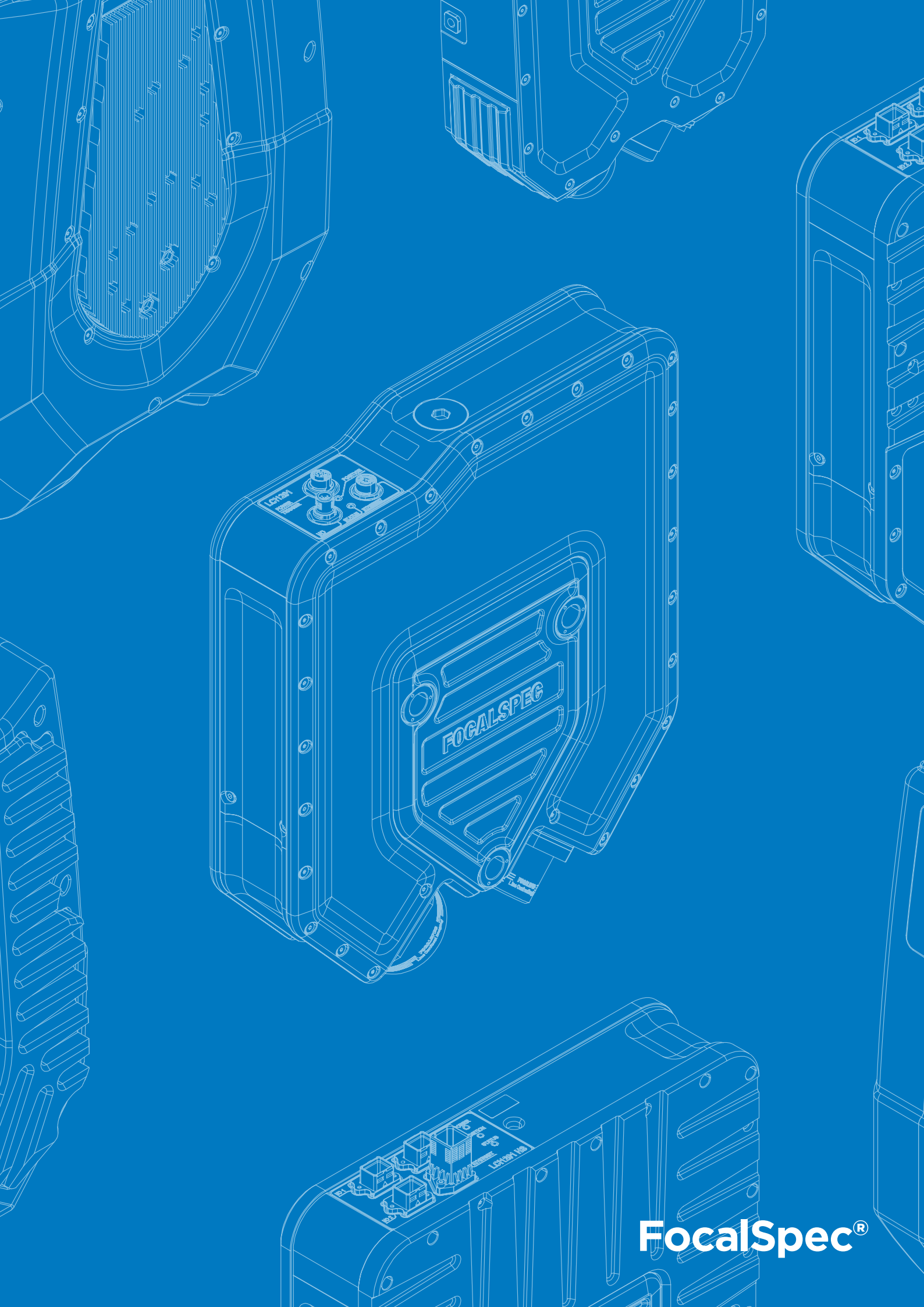
Sensor technology	Optical, line confocal imaging (LCI)
Sensor models	LCI401, LCI1201, LCI1600, LCI1220, LCI1620
Points per profile	2048 or 1728
Roughness parameters	Ra, Rz, RSm, Rv, Rc, Rz JIS 94
Scan rate (nominal)	250 roughness values per second
Surface speed	Stationary to 500+ ft per minute
Roughness range	-0.1 to 80 µm (Ra)
IP Classification	IP30/IP55

FocalSpec® Feature	Inspection Benefit
Non-contact method	Non-destructive, results not subject to operator influence
High-speed scanning captures entire line of ~2000 points simultaneously	Eliminates error caused by machine vibration as relative point heights within the captured profile are unaffected. Competing technologies such as point confocal sensors are slow and vulnerable to measurement error caused by surface vibration between captured data points.
High-speed line scanning	Increased sampling, improved process control, nullifies effects of machine vibration
Versatility	Can be used in various applications on any material, surface and product type (inline, at-line, or off-line)
Automatic Operation	Reduced need for manual measurement and analysis
Automated alerts, connectivity to factory networks	Improved open loop or automated closed loop control for increased process stability
Continuous surface monitoring	Minimize surface roughness or maintain specified level



Benefits of Factory Automation:

- Enable instant detection of process changes and abnormal variation
- Reduce time and labor needed for manual product sampling and quality control checks
- Provide reliable results without manual measurement and recording errors
- Generate quality reports of entire batches automatically
- Improve product surface quality, reduce claims, waste, and rejects



FocalSpec®

It's Better to Be Smart.

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