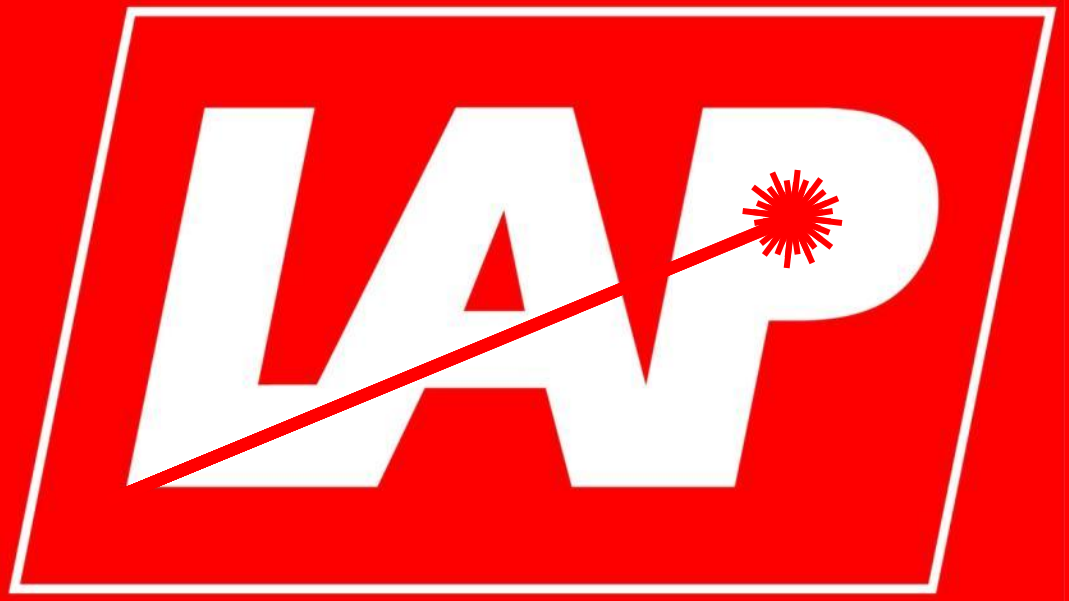


LASER

PROJECTION AND NON-CONTACT MEASUREMENT

CALIX S & XL
Innovative Design of Laser Based Thickness Gauges

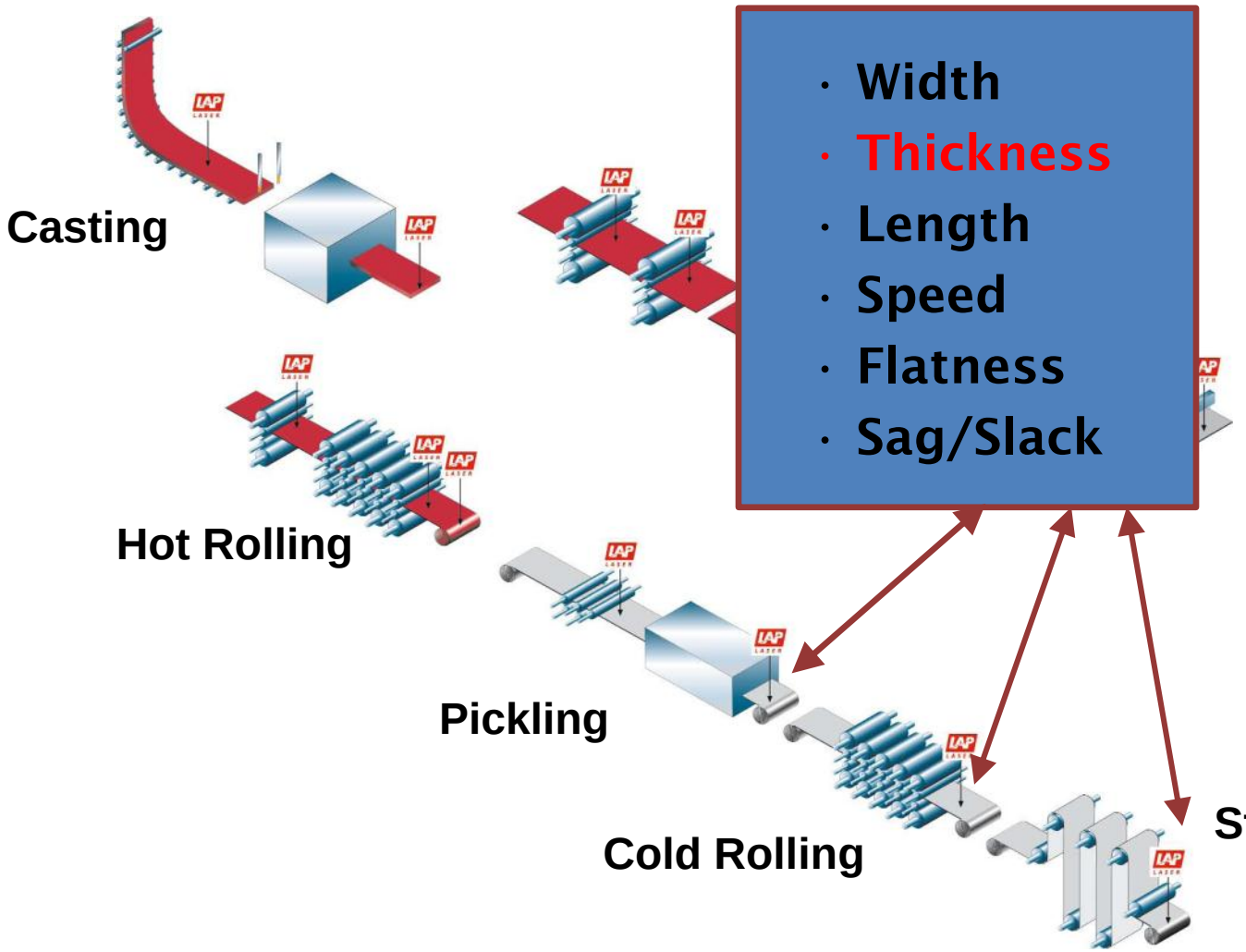
LAP LASER

CALIX XL

Optical Thickness Measurement for:

- **Pickling Lines**
- **Cold Mills**
- **Annealing Lines**
- **Temper/Skinpass Mills**
- **Galvanizing and Tinning Lines**
- **Organic Coating Lines**
- **Inspection Lines**
- **Slitters**

THICKNESS MEASUREMENT USING LASERS



CALIX S

Optical Thickness Measurement for:

- **Calander (rubber / tire)**
- **Pasting (battery)**
- **Inspection Lines**
- **Slitting Lines (strip)**
- **Feeding (tube welding)**

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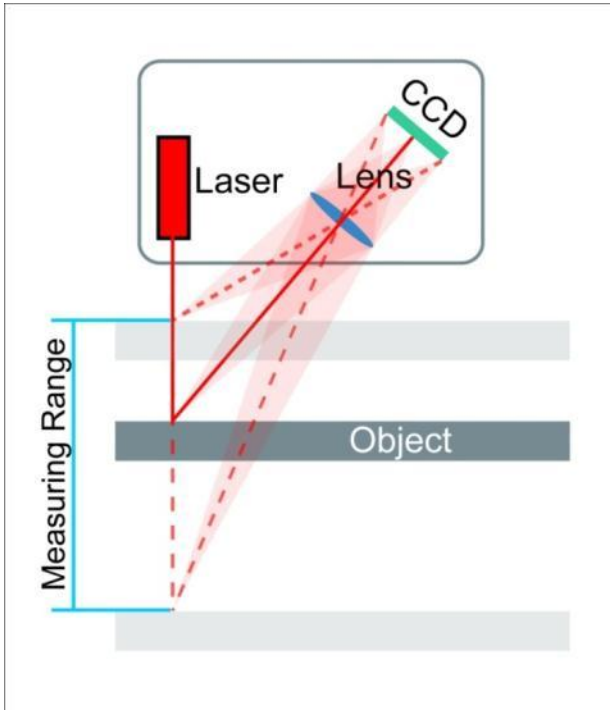
Benefits:

- **Precise results**
- **High-resolution thickness profiles over the entire length of the strip**
- **Fast thickness control**
- **Detection of short-time events**
  - **Roll eccentricity**
  - **Welding joints**

OPERATIONAL PRINCIPLE

- *Laser Triangulation*

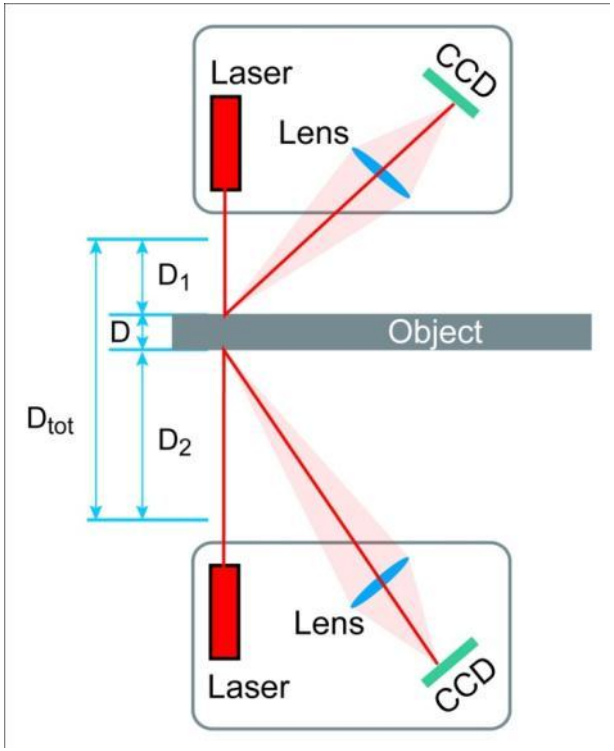
- **Uses only light**
  - **Laser shines spot on surface**
  - **CCD line camera “sees“ the spot**
  - **at an angle**
  - **Digital Signal Processor collects**
  - **signal**
  - **Distance is calculated**



OPERATIONAL PRINCIPLE

Thickness Measurement using top and bottom sensor

- **Using differential measurement**
  - **Distance to top**
  - **Distance to bottom**
  - **Both distances calculated**
  - **$D = D_{tot} - D_1 - D_2$**
  - **→ Distance of the sensors D_{tot}**
  - **must be constant!**



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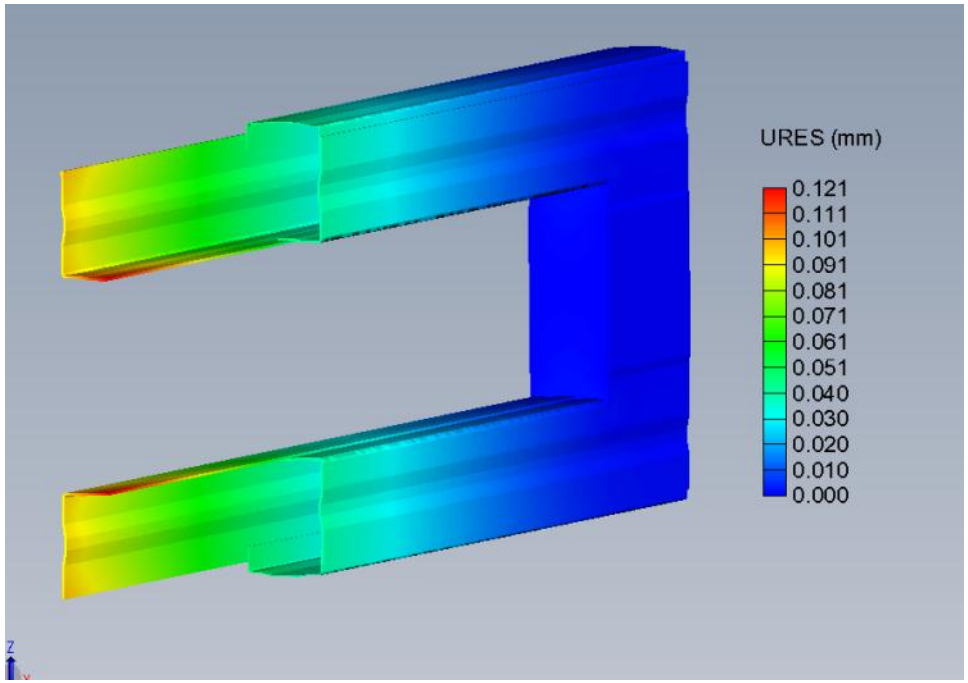
MECHANICAL STABILITY

- **Material**
  - **With very low impact by temperature changes**
- **Construction**
  - **Very rigid**
  - **No internal stresses**
  - **Can withstand processing line environments**
    - **Protection from dirt, steam, etc.**
- **Result**
  - **D_{tot} = constant**



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SYSTEM

Basic System consists of:

- **Sensors and smart processors in a rugged C-frame**
- **Cables**
- **Software Packages for use in PC**

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EVERYDAY OPERATION

- **Absolute Measurement**
  - **No alloy compensation needed**
  - **No influence of surface properties**
- **Factory Calibrated**
  - **At constant ambient temperature field calibration usually not necessary ($\Delta T < 5°C$)**
  - **But if so, takes only a few seconds**
  - **Best Calibration using rotating disk**
- **Safety**
  - **Class 2 Lasers (1 mW)**
  - **No NRC requirements**
  - **No X-ray or Gamma radiation**
  - **No high voltage electronics**

CALIX S

CALIX S

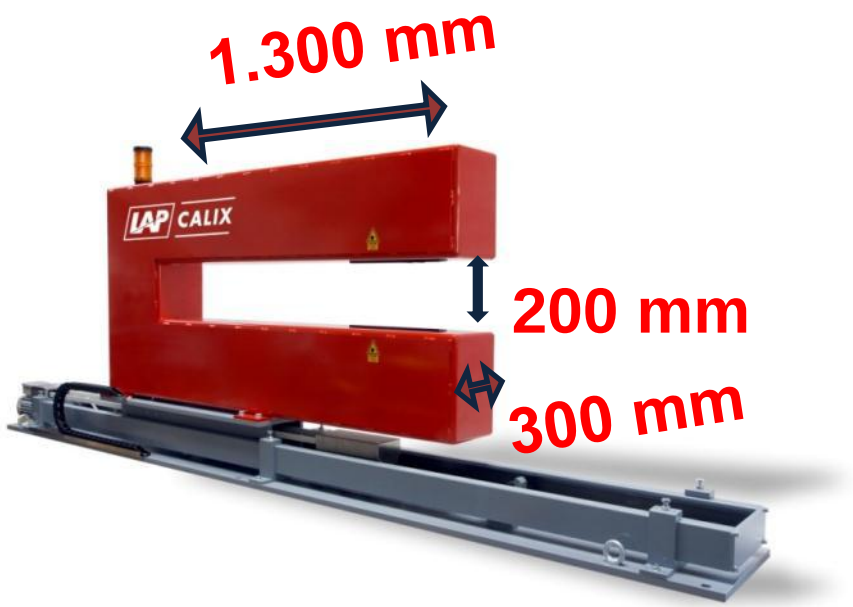
CALIX S & XL

INSTALLATION

CALIX S & XL

INSTALLATION OF CALIX XL

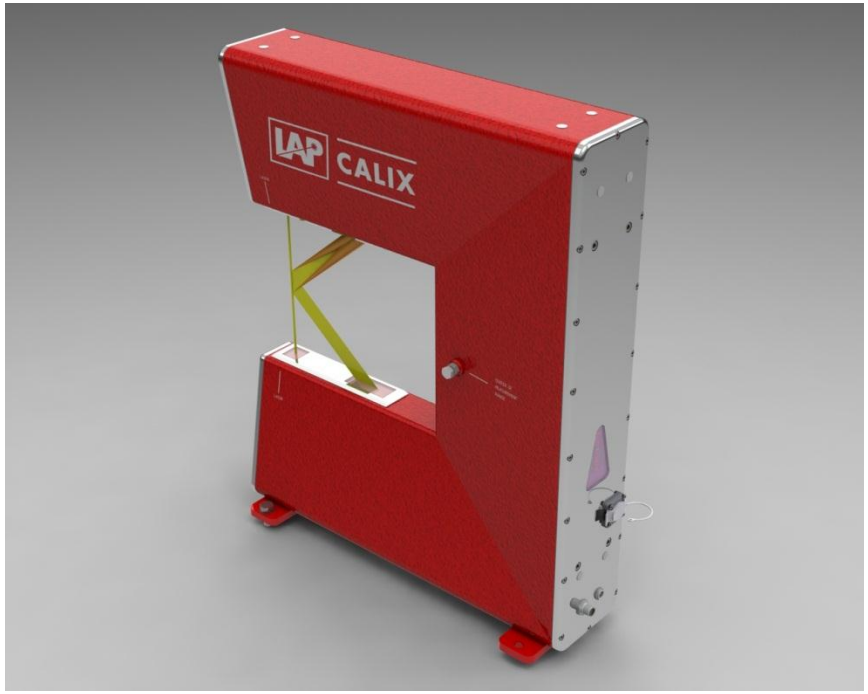
- Throat depth up to 1,300 mm
  - Material width over 2,000 mm
- Air gap up to 200 mm
  - Wavy material can be measured
- Thickness range up to 30 mm
  - Insensitive to passline fluctuation
- Width of C-frame 300 mm
  - Can easily replace old gauges with little mill or line modification
- Electronic Integration
  - 2 cables; signal and power
  - No electronic cabinet necessary for basic system



CALIX S & XL

INSTALLATION OF CALIX S

- Throat depth up to 300 mm
  - Material width over 400 mm
- Air gap up to 200 mm
  - Wavy material can be measured
- Thickness range up to 30 mm
  - Insensitive to passline fluctuation
- Width of C-frame 164 mm
  - Can easily replace old gauges with little mill or line modification
- Electronic Integration
  - 2 cables; signal and power
  - No electronic cabinet necessary for basic system



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R&D PROJECT

Together with ThyssenKrupp

- **Commissioned at German site in 2009**
- **Results confirmed**
- **Eight systems ordered for their Alabama galvanizing lines**
- **Production starts at the first quarter of 2011**

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PRINCIPLE

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INSTALLATION STRIP PROCESSING

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INSTALLATION CALENDER

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CALIX CERTIFIED CALIBRATION DEVICE

MG3356/en/0

IAP LASER

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Semi-automatic calibration unit

SOFTWARE

LAP LASER

SOFTWARE

Single track static sensor

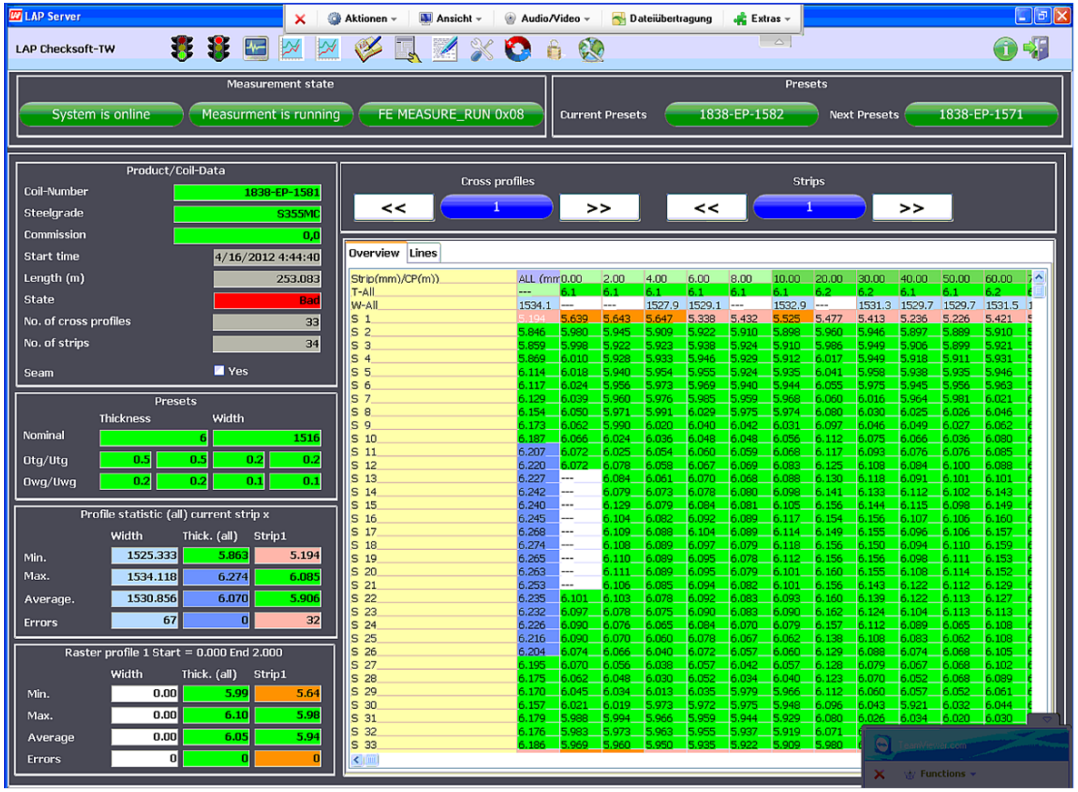
MG1823/en/0

SOFTWARE

Profile evaluation with moving sensors

SOFTWARE

Profile evaluation with moving sensors



MG33319/en/0

SOFTWARE

Profile evaluation with moving sensors

1. Headline
2. Menu
3. Measurement rate
4. Presets / Actual status
5. Cross profile navigator
6. Line graph
7. System status
8. Actual measurement
9. Presets (numerical values)
10. Status display: Active/online
    Not active/offline

MG3322/en/0

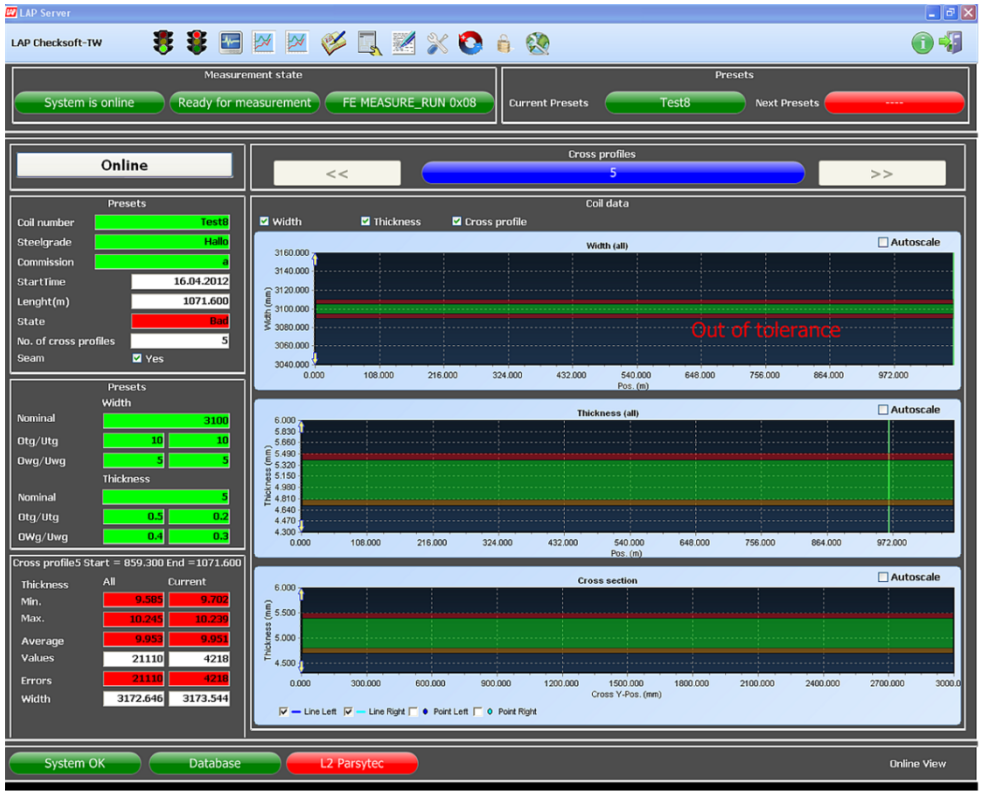
SOFTWARE

Profile evaluation with moving sensors

MG3320/en/0

SOFTWARE

Profile evaluation with moving sensors



SOFTWARE

Profile evaluation with moving sensors

MG3307/en/0

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SUMMARY

Alternative to conventional thickness gauges

- **Accurate**
  - **By maintaining constant distances between the sensors**
  - **+/- 4,5 µm accuracy S-type**
  - **+/- 2 µm accuracy XL-type**
  - **+/- 0.4 µm (2 σ) repeatability**
- **Accuracy:**
  - **Same accuracy on any thickness**
  - **Absolute accuracy and no relative**
- **Material independent**
  - **By absolute measurement to the surfaces**
- **Fast**
  - **4 kHz sampling rate**
- **Maintenance**
  - **Virtually maintenance free**

CALIX S & XL

ADVANTAGES VS. CONTACT, ISOTOPE, AND X-RAY GAUGES

- **Laser Safety:**
  Our Class 2 lasers do not pose any type of safety risk or concern. Isotope and x-ray gauges are governed by various NRC, OSHA, federal and state regulations because of safety issues.
- **Safe**
  - **no high voltages**
- **Maintenance:**
  The CALIX involves very little hardware as opposed to isotope and x-ray gauges. Less hardware equals less maintenance. Also, since the CALIX is non-contact, the frequent calibration and upkeep of contact gauges is not necessary.
- **Component Failure:**
  The hardware makeup of the CALIX is minimal and simple. Less hardware equals less components to fail. Most x-ray sources only last a few years.

CALIX S & XL

ADVANTAGES VS. CONTACT, ISOTOPE, AND X-RAY GAUGES

- **Alloy Composition:**

  Since we measure to the surfaces, alloy composition and variation is not applicable to the CALIX.

- **Coatings:**

  For the reason stated above, this is not an issue for the CALIX.

- **Non-contact:**

  No marking of the strip, no damage from bad shape, no frequent calibration needs.

- **Noise:**

  The CALIX exhibits essentially a “noiseless” signal as opposed to isotope and x-ray gauges.

- **No cost for disposal of nuclear waste as for ISOTOPIC gauges**

CALIX S & XL

ADVANTAGES VS. CONTACT, ISOTOPE, AND X-RAY GAUGES

- **Low Voltage:**
  There are no high voltage components in the CALIX. The base system runs on 24 VDC.

- **Price: In general, the CALIX costs much less than contact, isotope, and x-ray gauges.**

- **For all of these reasons, the CALIX is the thickness gauge of choice in many applications!**

Thank you very much for your attention!