



L A S E R

**PROJECTION AND NON-CONTACT
MEASUREMENT**



CALIX S & XL

Innovative Design of Laser Based Thickness Gauges

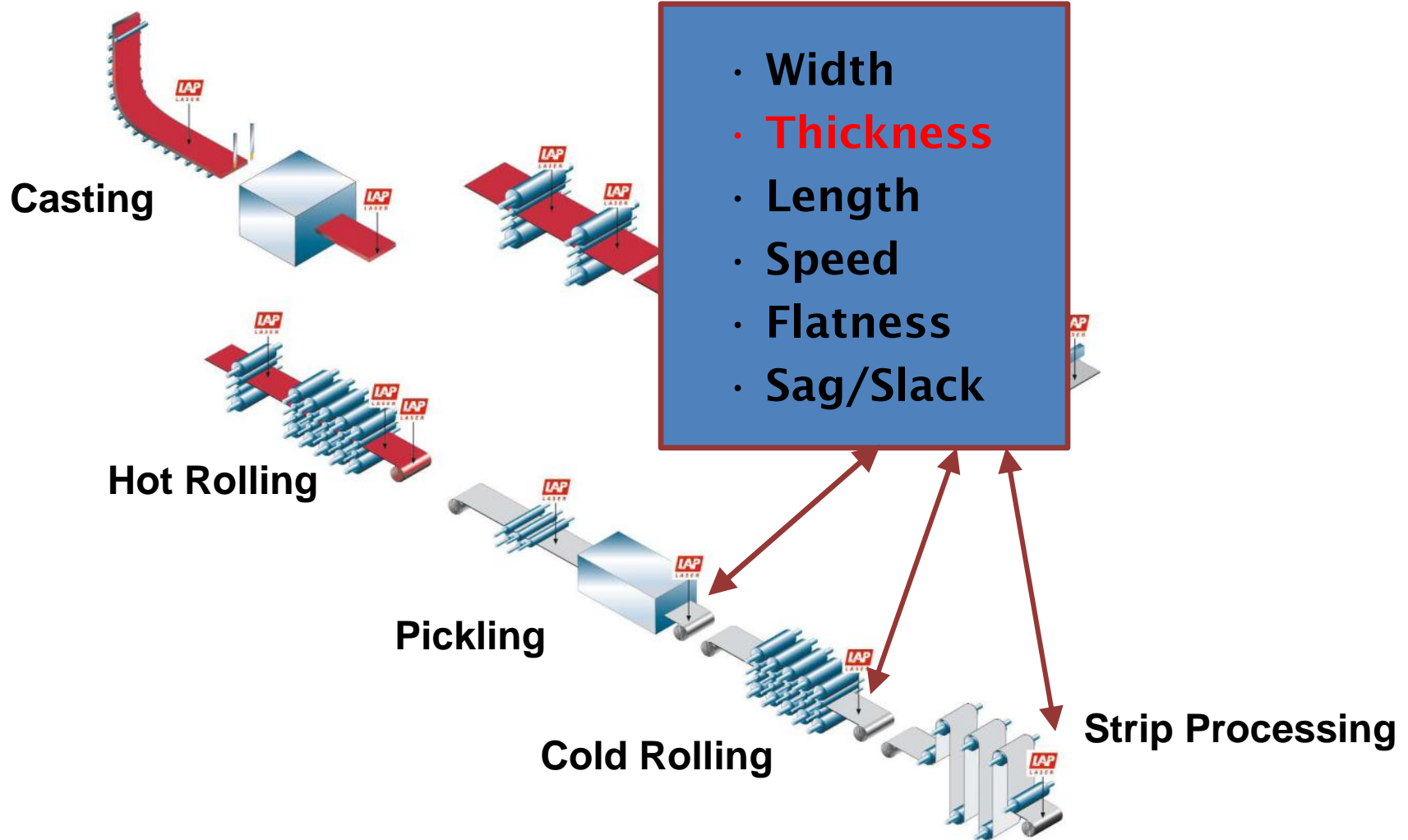
CALIX XL

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)



MG2598/10

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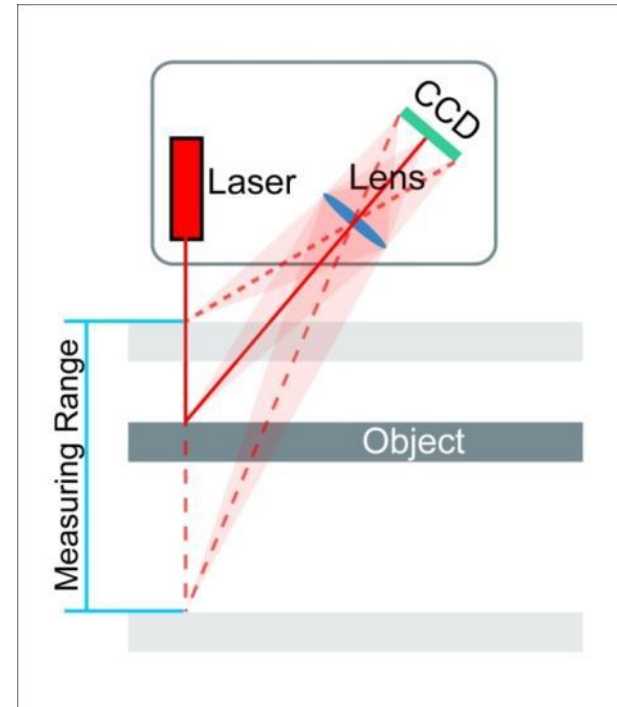
Benefits:

- 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

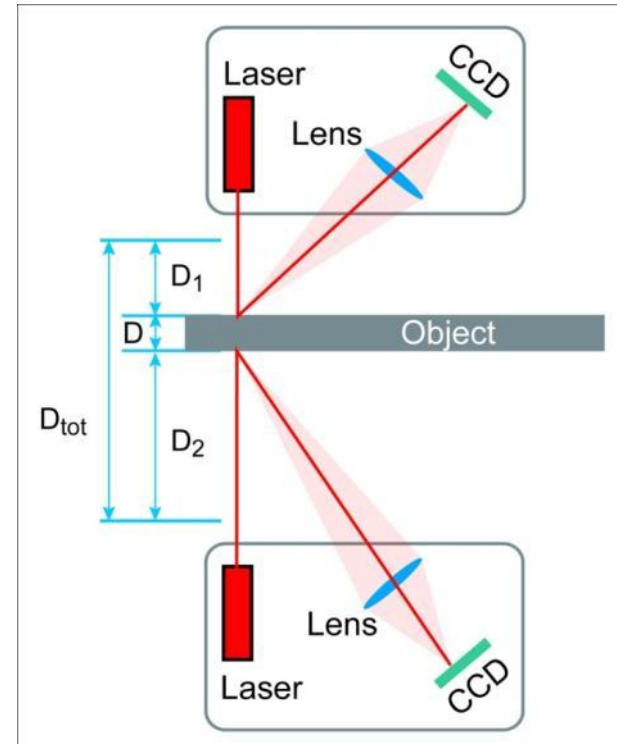


OPERATIONAL PRINCIPLE

Thickness Measurement using top and bottom sensor

■ Using differential measurement

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



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MECHANICAL STABILITY

■ Material

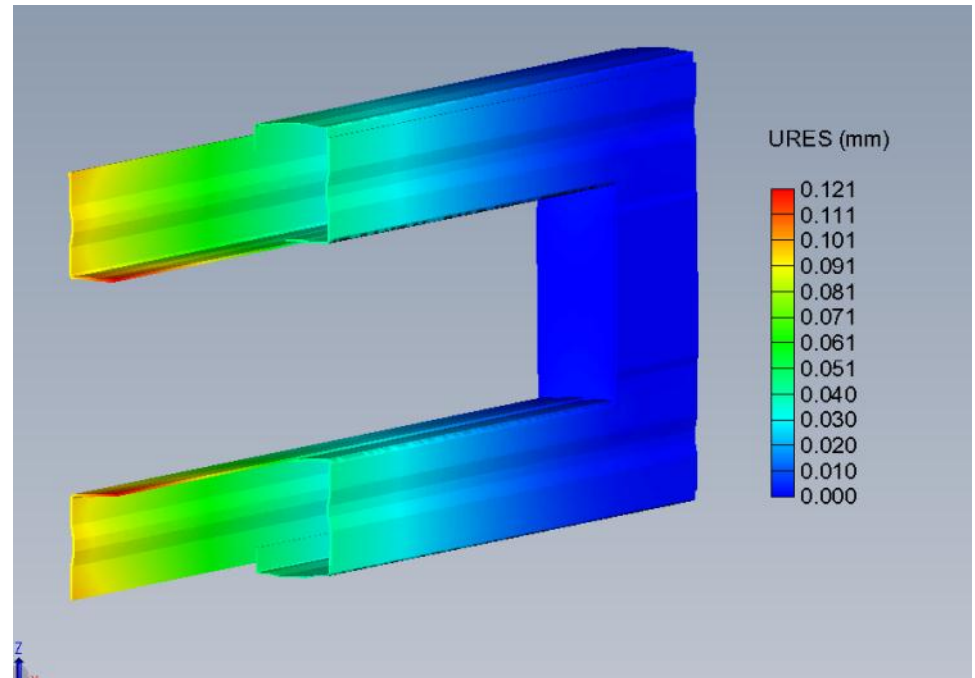
- With very low impact by temperature changes

■ Construction

- Very rigid
- No internal stresses
- Can withstand processing line environments
 - Protection from dirt, steam, etc.

■ Result

- $D_{\text{tot}} = \text{constant}$



CALIX S & XL 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 ($\Delta T < 5^{\circ}\text{C}$)
 - 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



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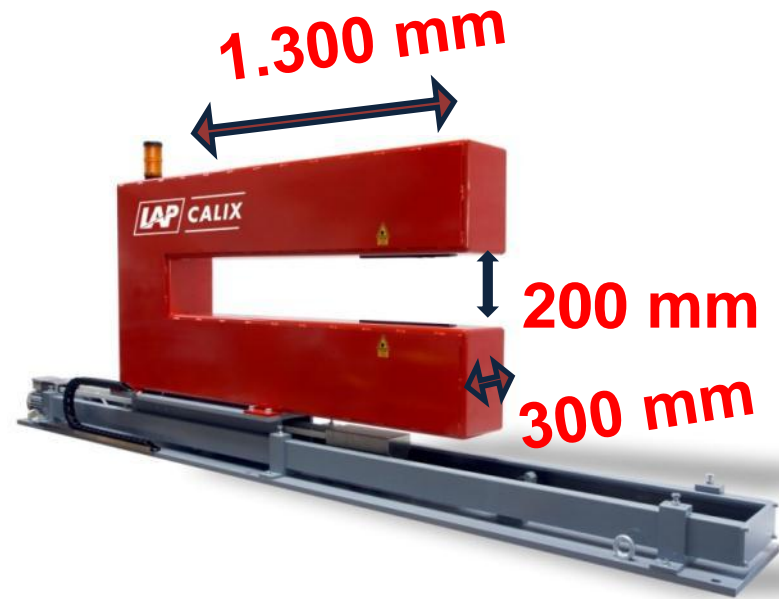
CALIX S & XL INSTALLATION



CALIX S & XL

INSTALLATION OF CALIX XL

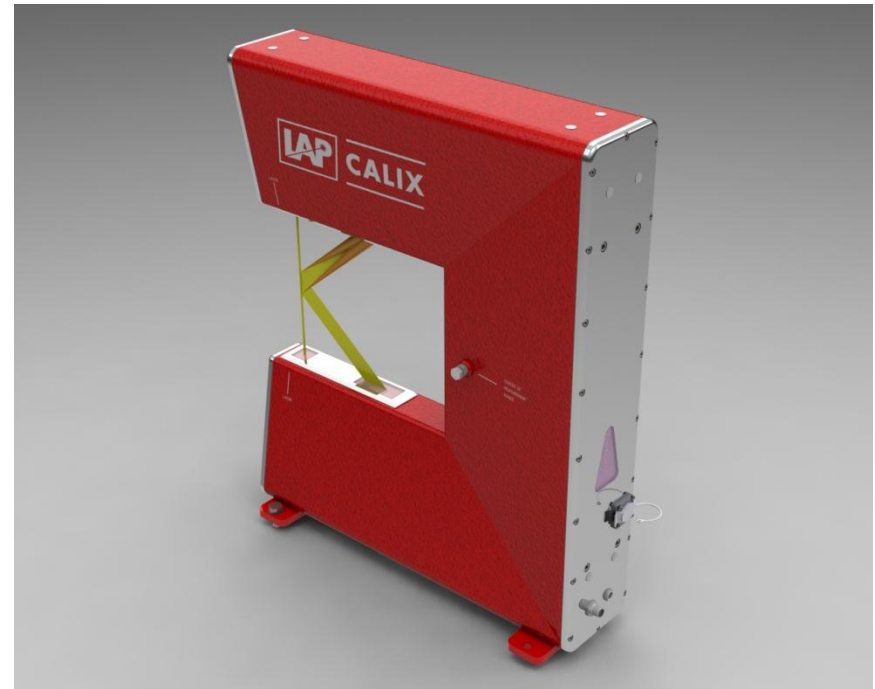
- Throat depth up to 1,300 mm
 - Material width over 2,000 mm
- Air gap up to 200 mm
 - Wavy material can be measured
- Thickness range up to 30 mm
 - Insensitive to passline fluctuation
- Width of C-frame 300 mm
 - Can easily replace old gauges with little mill or line modification
- Electronic Integration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



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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

LAP GMBH LASER APPLIKATIONEN



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INSTALLATION STRIP PROCESSING



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INSTALLATION CALENDER



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CALIX CERTIFIED CALIBRATION DEVICE



MG3356/en/0

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Semi-automatic calibration unit

SOFTWARE



SOFTWARE

Single track static sensor



MG1823/en/0



SOFTWARE

Profile evaluation with moving sensors



SOFTWARE

Profile evaluation with moving sensors

The screenshot displays the LAP Server software interface for profile evaluation. The top status bar indicates 'System is online', 'Measurement is running', and 'FE MEASURE_RUN 0x08'. The 'Presets' section shows '1838-EP-1582' as the current preset and '1838-EP-1571' as the next.

Product/Coil-Data:

- Coil-Number: 1838-EP-1581
- Steelgrade: S355MC
- Commission: 0.0
- Start time: 4/16/2012 4:44:40
- Length (m): 253.083
- State: Bad
- No. of cross profiles: 33
- No. of strips: 34
- Seam: Yes

Presets:

- Thickness: 6
- Width: 1516
- Dtg/Utg: 0.5
- Dwg/Uwg: 0.2

Profile statistic (all) current strip x

	Width	Thick. (all)	Strip1
Min.	1525.333	5.863	5.194
Max.	1534.118	6.274	6.085
Average.	1530.856	6.070	5.906
Errors	67	0	32

Raster profile 1 Start = 0.000 End 2.000

	Width	Thick. (all)	Strip1
Min.	0.00	5.98	5.64
Max.	0.00	6.10	5.98
Average	0.00	6.05	5.94
Errors	0	0	0

Overview Lines Table:

Strip(mm)/CP(m)	ALL	mirr	0.00	2.00	4.00	6.00	8.00	10.00	20.00	30.00	40.00	50.00	60.00
T-All	---	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.2	6.2	6.1	6.1	6.2
W-All	1534.1	---	---	1527.9	1529.1	---	---	1532.9	---	1531.3	1529.7	1529.7	1531.5
S 1	---	5.639	5.643	5.647	5.338	5.432	5.525	5.477	5.413	5.236	5.226	5.421	5.421
S 2	5.946	5.980	5.945	5.939	5.922	5.910	5.898	5.960	5.946	5.897	5.889	5.910	5.910
S 3	5.859	5.998	5.922	5.923	5.938	5.924	5.910	5.966	5.948	5.906	5.899	5.921	5.921
S 4	5.869	5.010	5.928	5.933	5.946	5.920	5.912	6.017	5.940	5.918	5.911	5.931	5.931
S 5	6.114	6.018	5.940	5.954	5.955	5.924	5.935	6.041	5.958	5.938	5.935	5.946	5.946
S 6	6.117	6.024	5.956	5.973	5.969	5.940	5.944	6.055	5.975	5.945	5.956	5.963	5.963
S 7	6.129	6.039	5.960	5.976	5.985	5.959	5.968	6.060	6.016	5.964	5.981	6.021	6.021
S 8	6.154	6.050	5.971	5.991	6.029	5.975	5.974	6.080	6.036	6.025	6.026	6.046	6.046
S 9	6.173	6.062	5.990	6.030	6.040	6.042	6.071	6.097	6.046	6.049	6.027	6.063	6.063
S 10	6.187	6.066	6.024	6.036	6.048	6.048	6.056	6.112	6.075	6.066	6.036	6.080	6.080
S 11	6.207	6.072	6.025	6.054	6.060	6.059	6.068	6.117	6.093	6.076	6.076	6.085	6.085
S 12	6.220	6.072	6.078	6.058	6.067	6.069	6.083	6.125	6.108	6.084	6.100	6.088	6.088
S 13	6.227	---	6.084	6.061	6.070	6.068	6.088	6.130	6.118	6.091	6.101	6.101	6.101
S 14	6.242	---	6.079	6.073	6.078	6.081	6.098	6.141	6.133	6.112	6.102	6.143	6.143
S 15	6.240	---	6.129	6.079	6.084	6.081	6.105	6.156	6.144	6.115	6.098	6.148	6.148
S 16	6.245	---	6.104	6.082	6.092	6.089	6.117	6.154	6.156	6.107	6.106	6.160	6.160
S 17	6.268	---	6.109	6.088	6.104	6.089	6.114	6.149	6.155	6.096	6.106	6.157	6.157
S 18	6.274	---	6.108	6.089	6.097	6.079	6.118	6.156	6.150	6.094	6.110	6.159	6.159
S 19	6.265	---	6.110	6.089	6.095	6.078	6.112	6.156	6.156	6.098	6.111	6.153	6.153
S 20	6.263	---	6.111	6.089	6.095	6.079	6.101	6.160	6.155	6.108	6.114	6.152	6.152
S 21	6.253	---	6.106	6.085	6.094	6.082	6.101	6.156	6.143	6.122	6.112	6.125	6.125
S 22	6.235	6.101	6.103	6.078	6.092	6.083	6.093	6.160	6.130	6.122	6.113	6.127	6.127
S 23	6.232	6.097	6.078	6.075	6.090	6.083	6.090	6.162	6.124	6.104	6.113	6.113	6.113
S 24	6.226	6.090	6.076	6.065	6.084	6.070	6.079	6.157	6.112	6.089	6.065	6.108	6.108
S 25	6.216	6.090	6.070	6.060	6.078	6.067	6.062	6.138	6.108	6.083	6.062	6.108	6.108
S 26	6.204	6.074	6.066	6.040	6.072	6.057	6.050	6.129	6.086	6.074	6.068	6.105	6.105
S 27	6.189	6.070	6.056	6.038	6.057	6.042	6.057	6.120	6.079	6.067	6.060	6.102	6.102
S 28	6.175	6.062	6.048	6.030	6.052	6.034	6.040	6.123	6.070	6.052	6.068	6.099	6.099
S 29	6.170	6.045	6.034	6.013	6.035	6.019	6.029	6.112	6.060	6.057	6.052	6.061	6.061
S 30	6.157	6.021	6.019	5.973	5.972	5.975	5.948	6.096	6.043	5.921	6.032	6.044	6.044
S 31	6.179	5.988	5.994	5.966	5.999	5.944	5.929	6.080	6.026	6.034	6.020	6.030	6.030
S 32	6.176	5.983	5.973	5.963	5.955	5.937	5.919	6.071	6.017	6.026	6.012	6.020	6.020
S 33	6.186	5.969	5.960	5.950	5.935	5.922	5.909	5.990	6.036	6.045	6.031	6.040	6.040

MG3319/en/0

SOFTWARE

Profile evaluation with moving sensors



SOFTWARE

Profile evaluation with moving sensors



MG3320/en/0

SOFTWARE

Profile evaluation with moving sensors



MG3321/en/0



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.



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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**

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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!

