

Quality Assurance for Plates and Sheets with Measuring Equipment-capable Systems

By Günter Lauven

Meeting standards and guidelines in modern metal processing requires strict adherence to demanding requirements. Quality assurance for plates and sheets, essential in numerous industries, is of critical importance. For high-precision materials, continuous monitoring and measurement of quality are indispensable. Increasingly, measuring equipment-capable systems are being utilized to automate and accelerate processes.

The production of plates and sheets places increasing demands on quality assurance. These materials must meet specific dimensions, flatness, and surface properties to fulfill the needs of downstream industries. Particularly in the case of heavy plates or rolled sheets, adherence to flatness and thickness tolerances is crucial, as these materials are often used in safety-critical sectors like engineering industry, automotive, and aerospace industries. One of the greatest challenges in quality assurance is the recording and evaluation

of the flatness of the sheets produced. Irregularities can lead to stresses and deformations in the finished products, which severely limits their suitability for use. In addition the uniform thickness of the sheets is crucial for further processing, as deviations can lead to problems with assembly and functionality.

The technology of a measuring equipment-capable system

Measuring equipment-capable systems offer a modern and efficient solution

for quality assurance in sheet metal production. These laser measuring systems are characterized by high precision, real-time data acquisition and the possibility of inline integration which leads to a significant improvement in product quality and process optimization. Such measuring systems are used in particular in the process chain from the rolling mill to the final inspection. A prerequisite for a measuring equipment-capable system working with small tolerance values is that the sheets must lie still on a ca-

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librated measuring table during measurement and the sensors integrated in a portal move over the entire length of the sheet. The basis of flatness measurement is the laser light section method: light section sensors arranged side by side project laser lines onto the surface of the material to be measured so that they cover the entire width of the measurement table. The measuring range of the sensors is designed according to the required measurement accuracy. To prevent neighboring laser sensors from interfering with each other, they are either mounted with a slight offset or are triggered at different times.

While the gantry moves over the sheet on precision rails, the cameras of the sensors mounted at an angle capture the corresponding laser line. In this case a line laser and a camera form a sensor unit. The flatness is calculated from the height information. The height is determined by the angle from which the cameras recognize the lines on the sheet. A magnetic sensor detects the position of the gantry along the table during the scan, resulting in a complete height profile. The measuring table is precisely aligned during installation. A laser tracker can be used to check whether the specified maximum permissible flatness deviation is adhered to. After the measuring equipment has passed the



Figure 1: Measuring equipment-capable system for laser flatness measurement of sheets and blanks (Copyright: nokra, now part of KELK)

test, the flatness of the measuring table can be checked at any time by moving the measurement gantry once over the empty table. In doing so the software automatically hides the openings like disc rollers and slots automatically.

Integration into the process line

Depending on the area of application, the measuring system is integrated and installed in the production process. Once the sheet reaches the measuring position, depending on the production process, it is stopped, and in a customized solution the roller

table is lowered so that the sheet rests completely on the measuring table. During the measurement, the gantry moves over the entire length of the sheet and records the height profile of the specimen. The sensors automatically detect the end of the sheet, the measurement stops, and the gantry returns to its starting position. The disk rollers are then lifted when using a customized solution, and the sheet leaves the measuring table. Experience in production operation shows that the system works reliably despite low-frequency vibrations in the foundation,



Figure 2: Sensor unit with line laser and camera integrated in the system gantry as the basis for flatness measurement using the laser light section method (Copyright: nokra, now part of KELK)



Figure 3: The gantry moves over the sheet metal on precision rails. The servo-controlled linear guide ensures precise measuring operation (Copyright: HIWIN)

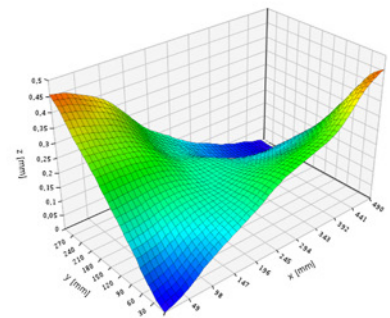
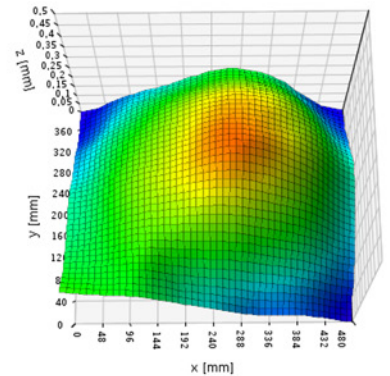
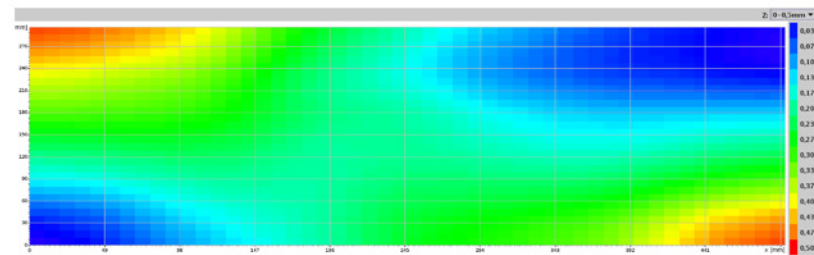
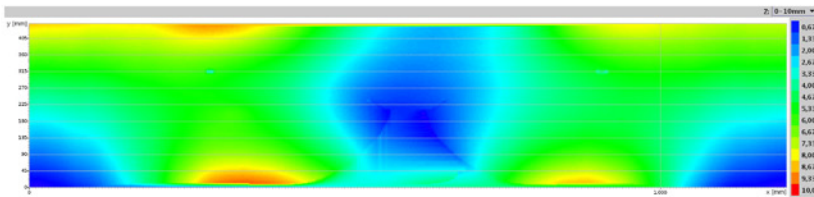
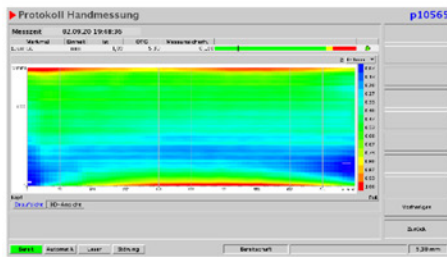


Figure 4: 2D and 3D visualizations of rectangular sheets in the GUI with feature overview

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caused by the sheet metal transport in the surrounding area and an unavoidable dust load in the air. At 0.5 m/s, the scan speed of the gantry is comparatively high, so that, for example, a 24 m long (heavy) plate can be measured in under 50 seconds. The sensors measure at a frequency of up to 400 Hz. At this speed, the system delivers a complete height cross profile every 2.5 mm. An even finer resolution can be achieved by reducing the scan speed accordingly. The data recorded during the measuring process is automatically saved, evaluated and displayed graphically on monitors for inspection. This ensures traceability and the digital measurement data can be subsequently viewed and made available to other departments online, for example. The high resolution of the data recorded with the system enables evaluations that would not be possible without the use of this measuring system. Depen-

ding on the (heavy) plate length and the requirements profile, the duration for a manual measurement can even take up to two operating shifts. A laser measuring system, on the other hand, delivers information from more than one million measuring points at a scan speed of 0.5m/s. The precise, high-resolution data is objective and more meaningful. Due to the time required for the measurement, the throughput in production is significantly increased. In addition, a laser measurement system is very easy to maintain, and the effort required is low compared to other measuring methods. Apart from lubricating a few mechanical drive components and the replacement of filters in the heating/cooling circuit, no regular maintenance work is required. Regular referencing of the calibrated sensors is carried out including the subsequent inspection every few weeks.

In addition, referencing and inspecting can be carried out automatically during the measuring process and do not require any manual intervention.

Case studies from the industry

Various companies in the steel industry use measuring equipment-capable systems from nokra for quality assurance. The following case studies describe the operation of the measuring systems in practice.

Case study: Flatness measurement at thyssenkrupp Steel Europe (tkSE)

A measuring equipment-capable system for flatness measurement is used in plate production at thyssenkrupp Steel Europe (tkSE). This system is able to measure the topology of thin plates at the outlet of the descaling and paint spraying line. As part of the final quality inspection, edge and center waves,

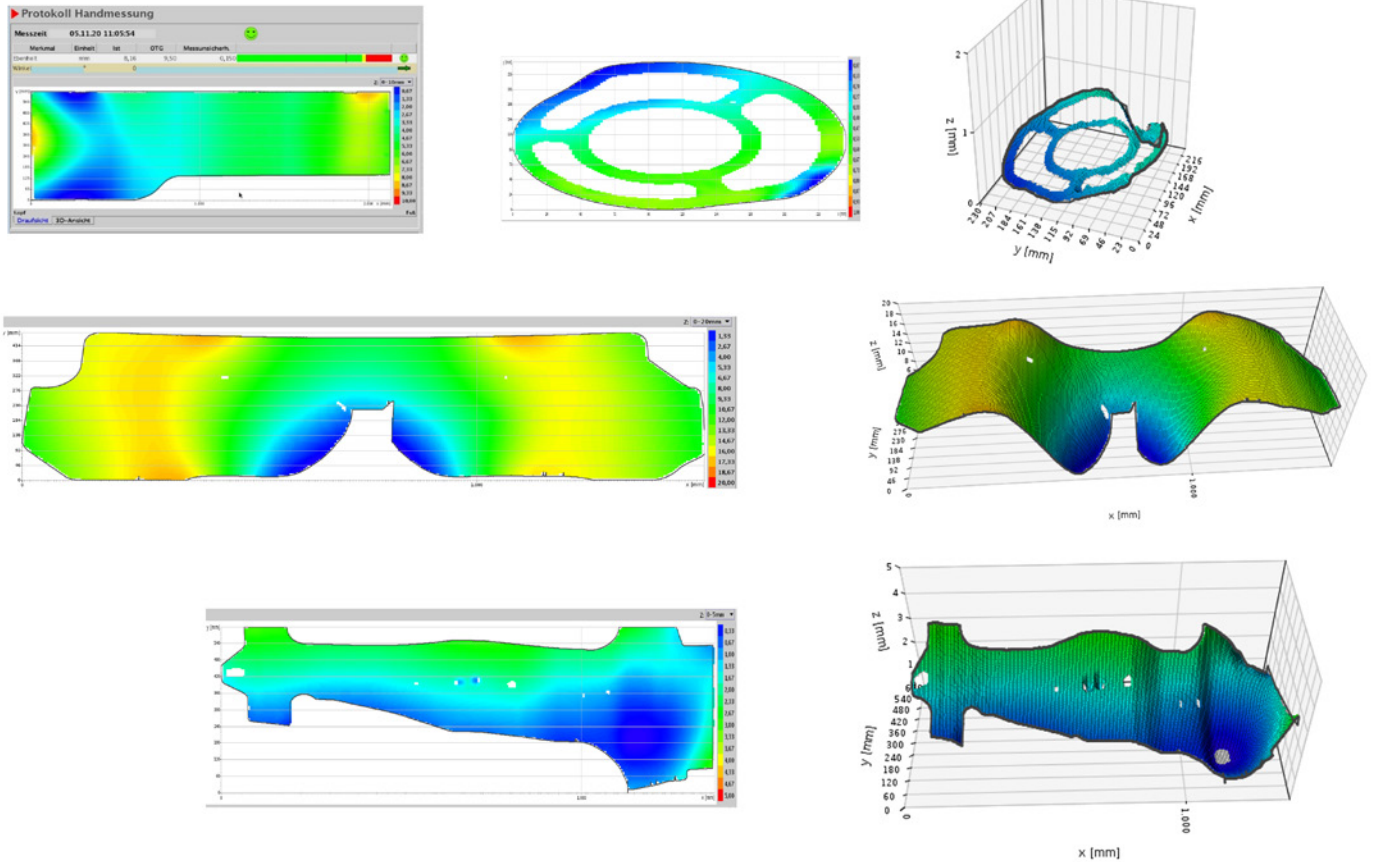


Figure 5: 2D and 3D visualizations of arbitrarily shaped flat bodies, also with cut-outs

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dents or “skis” are classified and evaluated. The plates are then automatically separated into “good” or “bad”. During this process, the requirements of the standards DIN EN 10029 and ASTM A20 for the evaluation of flatness are met in full.

Case study: Flatness measurement at Ilsenburger Grobblech GmbH

Another example of the use of a measuring equipment-capable flatness measurement system can be found at Ilsenburger Grobblech GmbH. Here, the laser measuring system was installed behind the outfeed of the straightening machine in order to measure the flatness of the fine-levelled plates in accordance with DIN EN 10029 and to generate a test certificate. The visualization of the measured values for the inspection personnel was adapted according to the customer’s specifications. You can see at a glance whether

the measured plate meets the specified flatness tolerances.

Case study: Roll-bonded plates at voestalpine

voestalpine AG relies in its production of plates on a laser measuring system for the final inspection. The measuring equipment-capable system not only records flatness, but also measures the thickness of the plates during the rolling process.

The measurements were automated and accelerated with the help of the new measuring system, thereby increasing the production throughput. The digitalization of the processes and the storage of all quality-relevant data led to precise documentation of the quality of the plates. The process sequences were optimized while maintaining tolerances for the plates: for flatness, standards according to DIN EN 10029 for hot-rolled plates, SEL408 for roll-bon-

ded plates and the American standard ASTM A20 are met. The thickness of the plates must meet the requirements in accordance with DIN EN 10029.

Advantages of measuring equipment-capable system

If companies have to comply with norms and standards, they often also define their own, even tighter tolerance limits to ensure the quality of their sheet and plate products. To ensure that tolerances are guaranteed, the systems used have to be traceable and achieve repeatable and reliable measurement results. Laser measuring systems from nokra, which is now part of KELK, fulfil these requirements and offer a number of advantages: The contactless measuring method offers significantly higher measuring accuracy compared to conventional tactile or other optical methods. In addition, the continuous recording of the geo-

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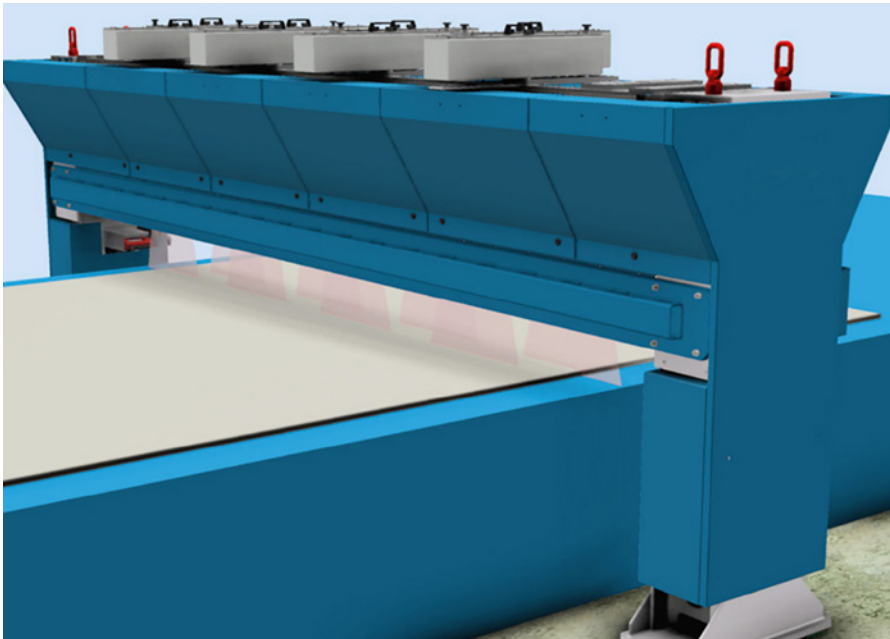


Figure 6: The principle of the laser light section method for scanning the topology of thin plates at the outlet of a descaling and colour spraying system (Copyright: nokra, now part of KELK)

metry parameters in real-time enables immediate feedback to the production line control systems. Deviations from the target values can be seen immediately and corrective measures can be initiated immediately to reduce rejects. As quality control is directly integrated into the production process and no longer has to be carried out as a separate step, production speed is increased. In summary this leads to an optimized use of resources and reduces overall production costs.

Conclusion

Measuring equipment-capable systems present a modern and efficient solution for quality assurance in sheet and plate production. Their precision, real-time data capabilities, and integration potential significantly improve product quality and process efficiency. Despite initial investment costs, the long-term benefits outweigh the expenses, making this technology increasingly relevant in an evolving industry.

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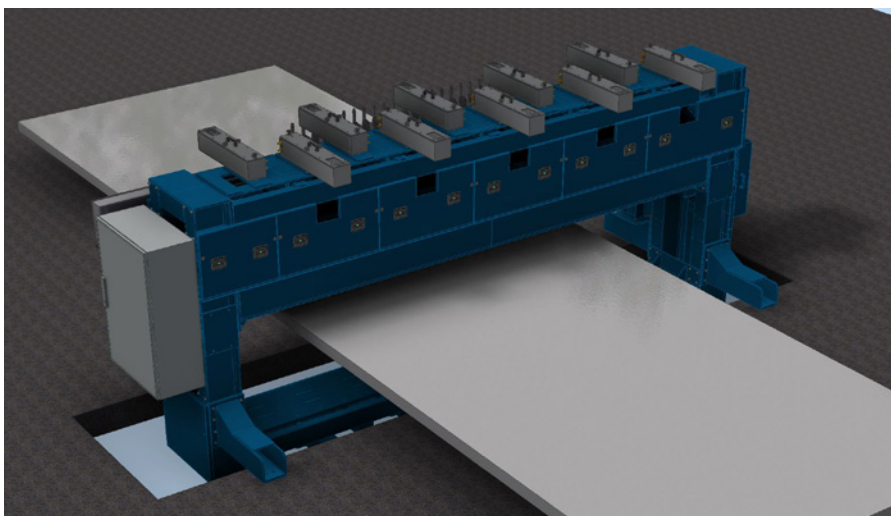


Figure 7: General view of the measuring equipment-capable laser measuring system for the final inspection of roll-bonded plates (Copyright: nokra, now part of KELK)

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