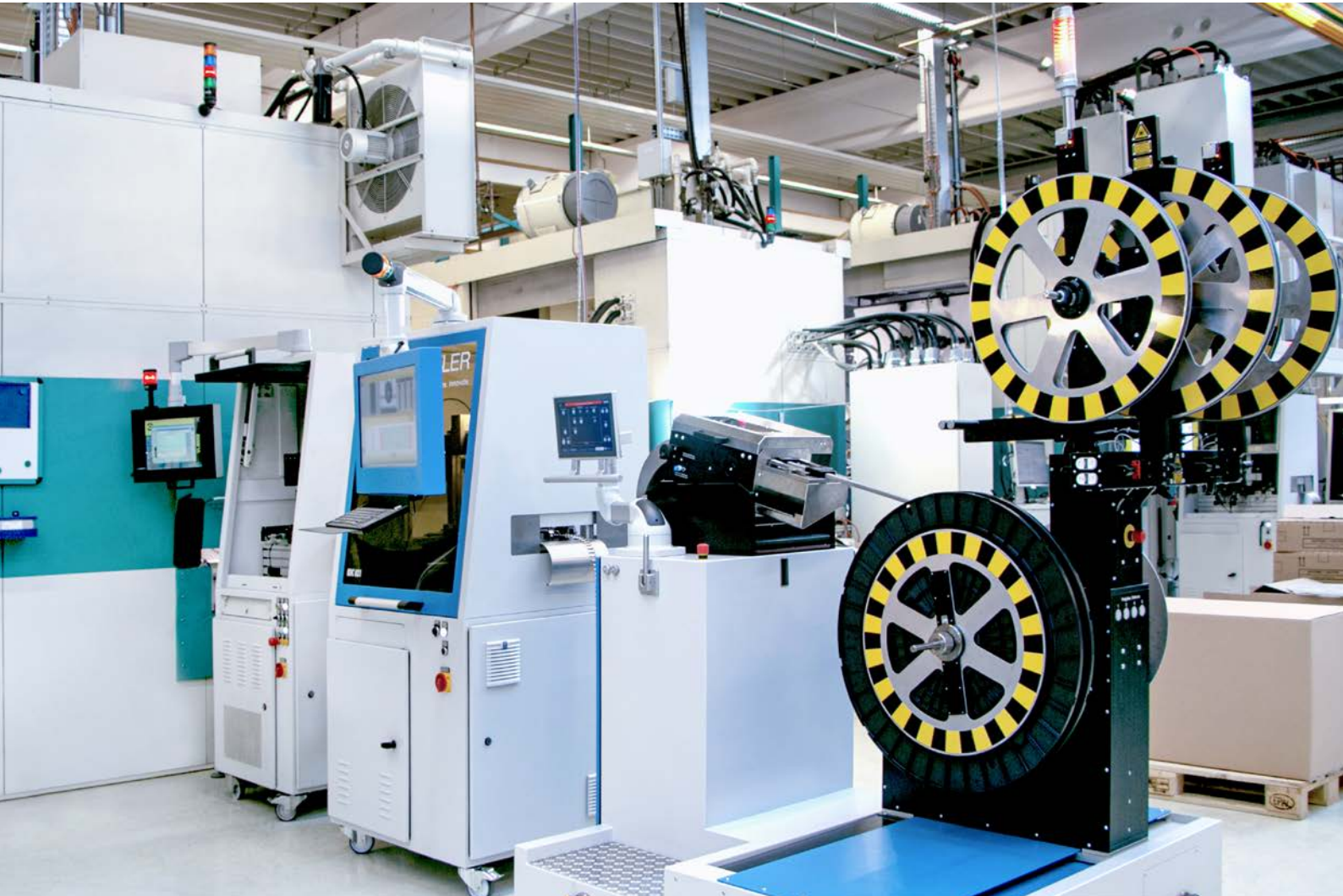


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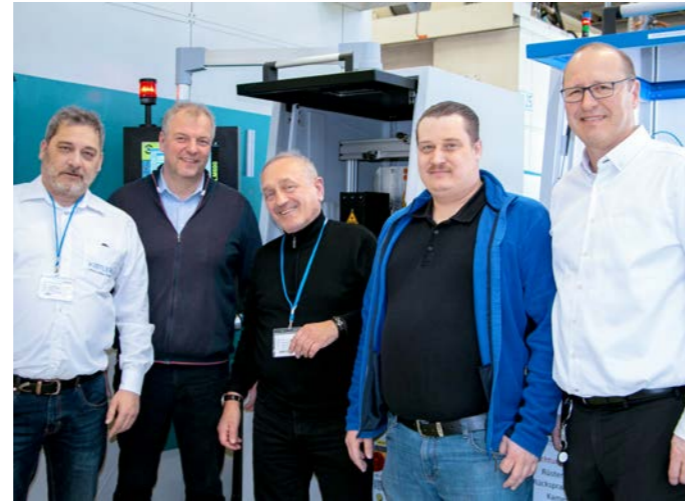
Inline process monitoring for stamping

KRAMSKI boosts manufacturing quality of connectors by closely partnering with Kistler

KRAMSKI



KRAMSKI GmbH, headquartered in Pforzheim, manufactures complex stamped and hybrid parts, e.g. connectors for the automotive industry – and now with inline process monitoring from Kistler.



The successful partnership continues: Klaus Weser and Jürgen Bodamer from Kistler (first and third from left) together with Jörg Carle, Christian Reeb and Felix Nussbaum (second, fourth and fifth from left) from KRAMSKI.

For the production of a safety-critical high-voltage connector ordered by Hirschmann Automotive GmbH, the stamping and hybrid technology specialists at KRAMSKI rely on force sensors and process monitoring from Kistler – the miniaturized piezoelectric force transducer is directly integrated into the progressive tool.

Connectors have continually evolved in recent decades. The driving force behind this evolution has mainly been the automotive industry: performance, signals and data must be transmitted quickly, securely and as resistant to interference as possible – especially if cars are going to be self-driving in the future. This sets strict requirements for parts, components and production processes for complex connectors.

KRAMSKI GmbH, headquartered in Pforzheim, Germany, is a technology leader in this field. The company operates in four locations worldwide, including Sri Lanka (since 1993), the US (since 2002), and India (since 2008). With a team of 700 employees, KRAMSKI produces highly complex stamped and hybrid components, enabling its customers to gain a competitive advantage. "Our top priorities are quality and innovation. Together with partners like Kistler, we're working at the forefront of technological development," says Felix Nussbaum, Head of Sales and Marketing at KRAMSKI. In addition to cutting-edge stamping and injection molding machines, this is mainly due to their in-house tool manufacturing. Trainees at KRAMSKI frequently win awards at both the state and federal level, and often go on to have successful international careers within the company.

Every year, KRAMSKI produces around three billion parts worldwide on behalf of its customers. Important trends in the industry include digitalization and miniaturization as well as traceability all the way down to the individual part. Nussbaum continues: "In terms of connectors in particular, the continually expanding range of variants must be considered. We continuously improve our processes in line with the principles of Industry 4.0 in order to offer our customers the greatest possible quality,

transparency and efficiency." The complexity of the projects should, however, not be underestimated: "Depending on the task and the work required, lead times can run as long as two years."

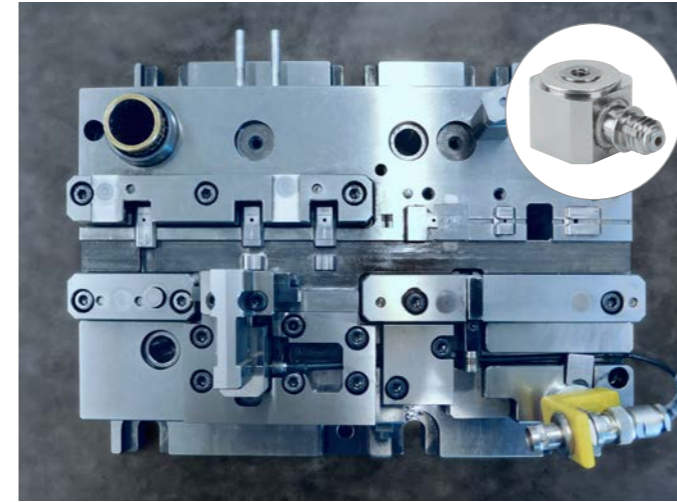
Precise inline process monitoring

A recent project for the automotive supplier Hirschmann Automotive GmbH involved the production of a high-voltage connector that would later be used in a variety of auxiliary equipment in electric vehicles. During the production of the safety-critical hybrid component – made from metal and plastic – KRAMSKI used inline process monitoring from Kistler for the first time. The closed circular contact was fixed inline with a laser weld point and then fitted with a plastic protective cap that offers touch protection and is also manufactured by KRAMSKI.

A piezoelectric force sensor from Kistler is used to ensure that the cap has been attached correctly. The miniaturized sensor is integrated directly into the stamping tool and, in connection with the maXYmos TL process monitoring system, allows for precise monitoring of the force-displacement curve. This solution offers KRAMSKI 100 percent control of up to 300 produced parts per minute. Jörg Carle, Technical Director at KRAMSKI, explains: "Compared to the previous solution, we are able to achieve a much higher quality of the measurement signal with output of the peak value of the applied force – in this case between 20 and 22 newtons. This allows us to immediately detect deviations and to sort out bad parts. The process monitoring system automatically evaluates the quality and enables easier documentation and traceability of all measured values."

"In addition to Kistler's leading technology, we also appreciate the close working relationship and the mutual understanding we have built. Over the years, this has evolved into a true development partnership that benefits both sides."

Felix Nussbaum, Head of Sales and Marketing at KRAMSKI



The miniature force sensor (not visible) from Kistler is directly integrated into the stamping tool from KRAMSKI (cable outlet on the left underneath the center of the image).

Highly compact force sensor installed in the stamping tool

One point to note here is that both the finished connector and the sensor must be extremely compact. "In order to implement the testing of insertion forces in the production process, the sensor is installed directly in the progressive tool – it's not even visible from the outside. Thanks to its compact size of just over 10 mm, the miniaturized force transducer 9313AA1 from Kistler is ideal for this purpose," continues Carle. "Furthermore, the square sensor body with dual-side force application via axial threaded holes is ideal for this application." In addition, piezoelectric force sensor technology from Kistler offers other favorable characteristics that have now also proven themselves in automated stamping applications: for example, overload capacity, high stiffness and sensitivity, and – most importantly – longevity. "Once the sensors have been installed in the stamping tool and the line is in operation, we need to be able to rely on them over the long term," adds Carle.

With the help of this new inline process monitoring as well as additional test steps that have been integrated into the production line (see the text box for more information), KRAMSKI was able to optimally satisfy the strict requirements of Hirschmann



The quality of the continuously produced high-voltage connector from KRAMSKI – the black plastic cap is on the left side of the connector in this photo – is guaranteed with the help of process monitoring and further test systems from Kistler.

Automotive GmbH. "In addition to Kistler's leading technology, we also appreciate the close working relationship and the mutual understanding we have built. Over the years, this has evolved into a true development partnership that benefits both sides," emphasizes Felix Nussbaum. "Together, we are operating at the limits of what is technically feasible and continue to push these limits further and further. This fits very well with the extremely high quality standards at KRAMSKI and should be described as a win-win relationship." The positive experiences with the integrated force sensor technology and process monitoring from Kistler are also demonstrated by the fact that KRAMSKI has now commissioned a second solution for an additional production line that will be implemented in the near future.

Fourfold testing plus marking on the fly

In addition to the insertion force testing integrated into the tool, KRAMSKI worked with Kistler to implement the following additional test steps:

- feed control during conveyor belt feeding
- checking for stamping waste (double sheet control)
- laser marking of finished parts (marking on the fly)
- optical end-of-line testing (contour, dimensions, surface)

These tests are carried out using additional technologies from Kistler, such as optical sensors that have been specifically designed for stamping technologies for stamping technology, a laser marking cell and an automatic testing system that includes camera systems and industrial image processing.



Reliable control of production processes with maXYmos

maXYmos XY monitors from Kistler monitor and evaluate the quality of a production step using two measurands, e.g. force and displacement. The benefits:

- easy integration into existing systems and processes
- intuitive, uniform operating concept
- high-performance evaluation objects
- extensive diagnostic possibilities so causes of NIO can be tracked down quickly
- standard interfaces
- identical signal and data formats

maXYmos is available in the variants BL (basic level), TL (top level) and NC (specifically for joining process), depending on the application.

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