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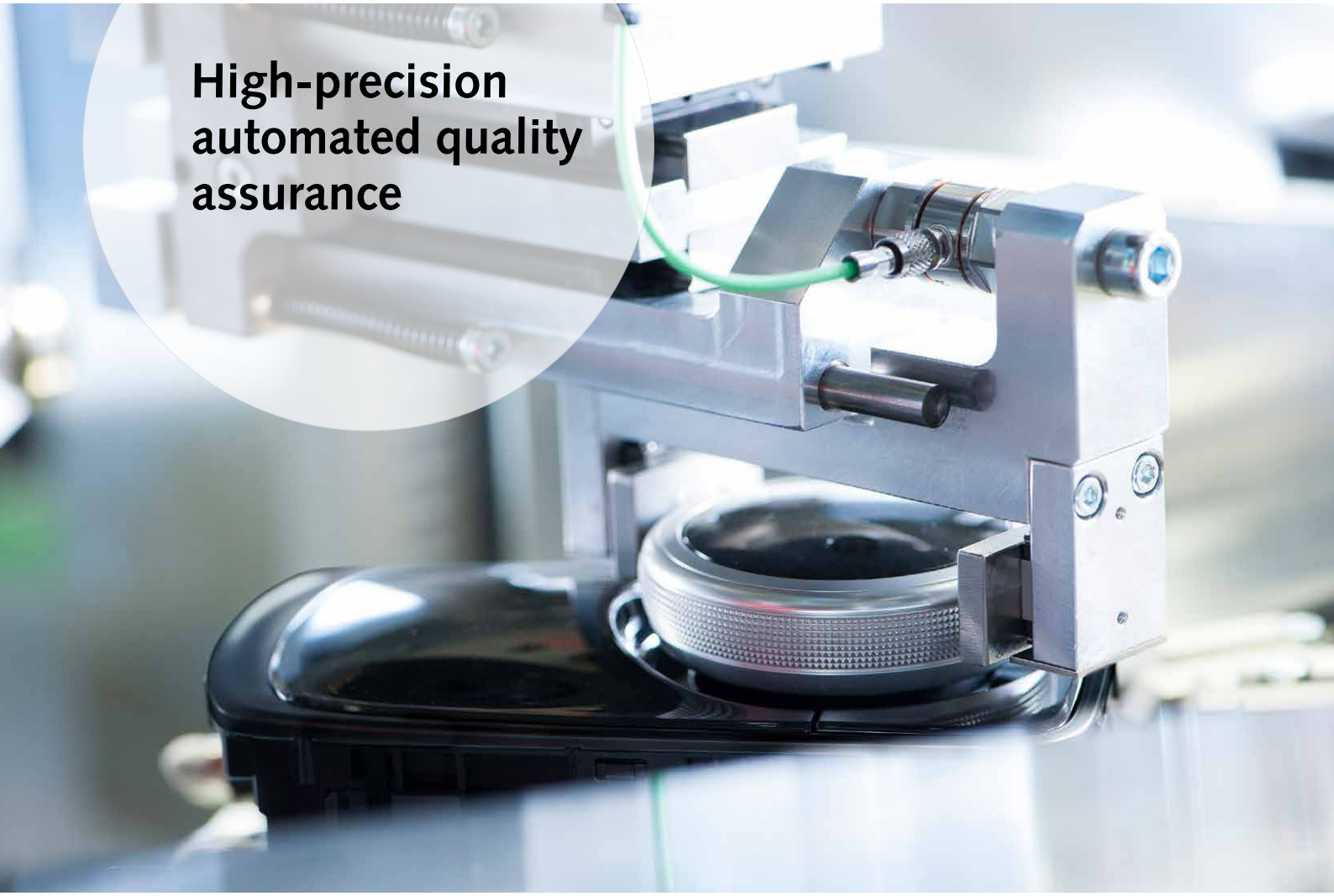

High-precision automated quality assurance

Technological lead with piezoelectric sensors from Kistler

Reliable testing of in-vehicle control elements

SCHUHRIEMEN MASCHINENBAU GmbH

Ingenieurbüro GmbH BORRMANN

www.kistler.com

When it comes to designing special-purpose machines to test in-vehicle control elements, Schuhriemen Maschinenbau GmbH puts its trust in force and torque sensors from Kistler. Piezoelectric sensor components prove their excellence for high-precision automated quality assurance to meet the standards that automobile manufacturers require.

Many car drivers appreciate navigation systems that are integrated into an onboard computer – they offer convenient control with just one button, known as the rotary actuator. Various functions of other onboard systems such as the air conditioning and radio can also be controlled intuitively by turning, tilting or pressing the button. To ensure the quality of these control elements, the automotive industry relies on automated end-of-line testers. As their name suggests, these special-purpose machines are deployed at the end of the production line. Thanks to automated haptic testing, they guarantee that multifunctional switches meet the required quality standards – even when large quantities are being produced.

Automated haptic testing units are built by special-purpose machinery manufacturers such as Schuhriemen Maschinenbau GmbH. This family firm has been active on the market for over 20 years, supplying its machines to automobile manufacturers of all sizes across the globe. Hans-Julius Schuhriemen, the company's CEO, notes: "Speed is the key to success. Our cycle times are often shorter than anything our competitors can offer … and of course, that's rewarded." These special-purpose machines are generally bought by the end customers – i.e. the automobile manufacturers. But Mr. Schuhriemen's initial contact is usually with suppliers to the automotive industry: they have to fulfill the car manufacturers' quality requirements, so they are reliant on high quality backed up by evidence.

Schuhriemen Maschinenbau GmbH is based in Sommerloch (Germany) and in the field of measurement technology and automation, the firm has cooperated for many years with Ingenieurbüro Borrmann GmbH, located in nearby Ingelheim. Andreas Borrmann, the owner of this engineering company, points out: "We've been using Kistler sensors in our machines since 1990. The key benefits for us are overload protection, wide measuring ranges, rigidity and – above all – long service lifetimes." Mr. Schuhriemen adds: "Plant safety and reliability are absolutely the top priorities in the automotive sector, and machinery outages must be avoided at all costs. In all the years we've been working together, we've never had a defect on a Kistler sensor."

Haptic test using a Type 9039 piezoelectric torque sensor.

One machine offers integrated testing of tilting, turning and pressing

The latest project involved realizing an automated test for the tilt-turn-press movement on the rotary actuator of a central control unit. The automated tester built by Schuhriemen Maschinenbau GmbH comprises eight stations that capture up to 450 test characteristics. A cycle based on a revolving transfer table lasts about 20 seconds, corresponding to annual output of over 300 000 control elements. Kistler's piezoelectric force or torque sensors are used in three of the eight stations. At station 4, a piezoelectric torque sensor with resolution of up to 0,1 Nmm tests the number of detents and the detent torques when turning the rotary actuator – values outside of the defined limits indicate assembly errors or material defects.

Station 5 is intended to test vertical compression forces. Thanks to Kistler sensors, resolutions of 0,02 N (force) and 0,002 mm (displacement) are attained here. "High resolution and accuracy are critical reasons for deploying Kistler's products in our machines," Hans-Julius Schuhriemen states with conviction. The same is true of station 7, where the haptic measurement of the tilting movement is

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Andreas Borrmann, owner of the engineering company Ingenieurbüro Borrmann GmbH
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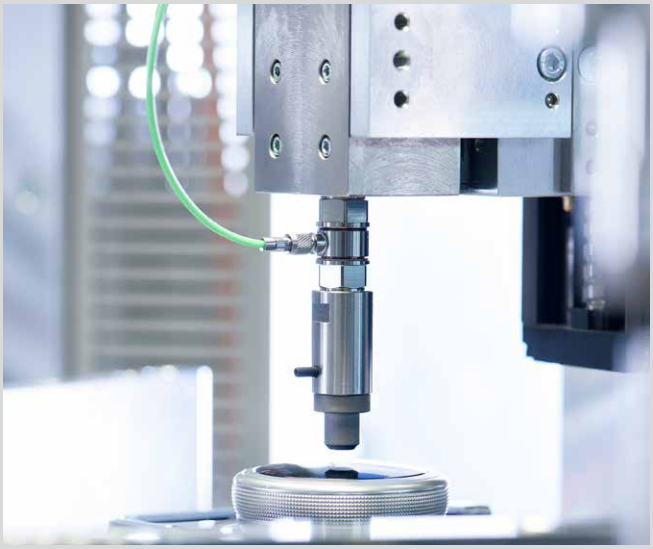
The torque sensor supplies data with a resolution of up to 0,1 Nmm at rotational speeds of as much as 180 degrees/s.

performed on the test bench. What design challenges had to be overcome here? "The rotary actuator is considerably larger than on previous products. So when horizontal movements take place, disruptive transversal forces act in the vertical direction. They are compensated by vertical compensation elements," Andreas Borrmann explains. "A design of this sort is extremely difficult. So we're pleased that Kistler offers a choice of many different product versions and installation options."

Machines are replaced – but the sensors are kept

The end-of-line testers developed by Schuhriemen Maschinenbau GmbH since 1989 have so far performed over a billion haptic tests on vehicle control elements. Schuhriemen began using Kistler's sensor technology back in 1990 and ever since then, the sensors have proven their merits time after time in a variety of projects: "We're highly satisfied with these products – so until further notice, we shall be using Kistler sensors again for every new order," Mr. Schuhriemen affirms. It's clear that end customers in the automotive sector are changing their product versions more and more often. At present, an automated end-of-line tester will be in service for seven or eight years. After that, the machines are scrapped because converting them is not a viable business model, Hans-Julius Schuhriemen notes. "Except that the sensors are dismantled first, and placed in storage for maintenance."

Piezoelectric sensor technology – one step ahead



Vertical compression force measurement with a Type 9311 piezoelectric force sensor.

Kistler's sensors make use of what is known as the piezoelectric effect. If a mechanical load is applied to quartz that has been processed for this purpose, it will produce an electrical charge that is directly proportional to the acting force. This can be adjusted with a charge amplifier (as patented by Walter P. Kistler in 1950) so it can be used as a measurand – regardless of strain or displacement. As well as proportionality, this method offers key advantages over other technologies – low measuring deflections (up to several kilonewtons per micrometer), wide measuring ranges, rugged design and long service lifetimes. Piezoelectric sensors also offer impressive flexibility as regards adaptation to the relevant measuring range.

Kistler's portfolio comprises an extensive range of piezoelectric sensors for various measurands: force, displacement, pressure, torque and acceleration. Flexibility is also the keynote when it comes to installing the components: measurements can be taken either

- directly (the entire force is measured),
- partially (part of the force is measured),
- indirectly (the force is measured on the C-frame press) or
- on a combined basis (together with other measurands such as temperature).

Yet more advantages of piezo technology include high output voltages (5 or 10 volts with an ICP output) and wide operating temperature ranges (-73 °C to 204 °C), as well as low acquisition and life-cycle costs.

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