End-to-end quality monitoring in series production

Test automation
Automated test systems for mass-produced and series parts
Kistler – your partner for efficient automated testing processes

Kistler’s accumulated know-how provides the foundation for the Kistler Group’s test automation business field. Established in 1968 as a pioneer of sensor technology, Kistler Elektronik GmbH expanded its portfolio in the 1990s with the addition of automated test systems that feature camera-based image processing and laser marking systems. By pooling their lengthy experience of partnership with the automotive industry, Kistler and Kistler deliver the basis for efficient quality and process monitoring – the guarantee of success for industrial manufacturers.
Contents

On the safe side – with automated test systems for efficient quality monitoring 4

All-round solution expertise
Technical sales, image processing laboratory, software development and project management 6
Standardized, user-friendly solutions 8
Windows-based image processing software 9

Test systems: application areas and solutions
Testing principles and machine concepts 10
Automatic testing systems for continuous materials 12
Systems for continuous testing of single parts 14
Clocked test systems 16
Test systems with robot handling 17
Integration solutions 18
KLM 620 laser marking system 20
Accessories and additional components 21

Services 22

At our customers’ service across the globe 23
On the safe side – with automated test systems for efficient, end-to-end quality monitoring

21st-century series production sets demanding requirements for products and their manufacturing processes. Two goals have to be met: continuous quality improvements and continuous efficiency increases. And with its automated test systems, Kistler helps businesses to achieve both goals – always with the focus on added value.

Kistler’s Test Automation business field has a clear objective: efficient, 100 % testing and sorting of series parts by automated test systems – either in the production line or as standalone solutions. Kistler’s systems guarantee quality and prevent bad parts – but that’s not all. Test results from camera-based image processing also open up new possibilities for optimizing production – so users benefit from extra added value.

Kistler Elektronik GmbH has accumulated three decades of experience in image-processing test technology, which Kistler has now acquired. The technology deployed includes high-resolution optoelectronic sensors as well as digital camera systems, laser triangulation sensors and additional components. The overall concept combines technical sales support, image processing expertise, software development and highly-integrated solutions: factors that add up to guaranteed customer satisfaction.

All set for Industry 4.0
Specialized software, high-performance industrial computers and highly efficient controls allow direct access to the acquired quality data, which then undergoes statistical evaluation. Data is collected from all tested parts (every part is tested – there is no random sampling). The result: an invaluable basis for optimizing production processes.

This data is prepared for further processing (e.g. by CAQ systems) with the help of programmed interfaces. In all these ways, our automated test systems play a key part in helping our customers turn Industry 4.0 into a reality.

The machine hall at pro-sort GmbH, Keltern, Germany.
Benefits at a glance:
- In-depth advisory service with feasibility analyses of test assignments in our image processing laboratory
- 100% testing of series parts
- Large quantities and fast cycle times
- Enhanced process reliability and optimized process efficiency
- Comprehensive recording and transmission of quality data
- Reduced quality costs
- Increased plant efficiency and lower total cost of ownership (TCO)
- Rapid amortization (RoI)

In addition to its test automation portfolio, Kistler also offers a special laser marking system for continuously produced series parts (“marking on the fly”). The purpose of this system is to meet product traceability requirements – which are set to become far more demanding as Industry 4.0 is implemented.

Higher quality, lower costs
In its endeavor to give all its customers the best possible service, Kistler deploys various machine systems for its intelligent test cells: inclined planes, continuously rotating glass plates, clocked systems (with the option of robot handling) and test cells for continuously produced parts in strip form. To meet requirements for unusual applications, Kistler also develops special solutions with integrated robotics or additional components. The focus is always on optimizing processes and use of resources – with the goal of ensuring our customers’ business success.

Stricter standardization and more challenging specifications for industrial products, more frequent complaints about quality and – in the worst case – recourse claims advanced against companies: faced with these trends of our times, customers are definitely on the safe side when they choose test systems from Kistler.
All-round solution expertise from one single source

As camera technology becomes more powerful, increasing numbers of test assignments can be accomplished with automated solutions. But at the same time, industrial image processing projects are becoming ever more complex. This is why we see close dialog with our customers as absolutely essential. Exactly what needs to be tested? How precise and how fast must testing be? (Precision and speed are interdependent!) What special requirements must be met by the feed and the testing process? How is sorting to be handled? How can optimum protection for parts be ensured during testing? Our sales specialists provide clear answers to all these questions at the earliest possible stage of the process, because we know that advice for our customers – underpinned by technical expertise – is one of the key success factors.

Detailed feasibility analyses from our image processing laboratory

Customers often need clear-cut information about which of their quality problems can be solved, and which technology can be used to solve them. They also require binding quotations. To meet these needs, Kistler's image processing laboratory carries out feasibility studies as required. Our image processing laboratory has all the optical and mechanical equipment needed to issue reliable statements about the feasibility of meeting the specified requirements.
**In-house proprietary software development**
At its Karlsruhe facility, Kistler has inaugurated a center of competence to continue developing our KiVision image processing software. The experienced developers in our Vision Center focus their work on enhancing the existing software by adding customer- or application-specific routines as required. This facility ensures that development of Kistler’s image processing systems will continue long into the future.

**Complete systems from one single source**
Kistler solutions based on Kistler technology provide customers with a complete, coordinated package from one single source. We offer expertise in mechanical engineering, image processing and software, backed by precise laboratory analyses – a combination that ensures high vertical integration and paves the way for excellent quality assurance based on high-performance test automation.

---

**Solution**

**Result**

**Kistler VISIONcheck**

**Software**

**Data storage**
Cloud technologies as the basis for the interconnected applications of the future

**100% testing**
As regards software, our machinery and plant concept focuses on user-friendliness and intuitive operation. Our systems are equipped with cutting-edge control technology and Industry 4.0-compatible components; they feature a standardized user interface with matching image processing software. It goes without saying that all our test systems are compliant with the latest Machinery Directive and all relevant standards, and each of them undergoes plant-specific risk analysis and evaluation. In response to customers’ requests, additional software modules can be integrated to allow remote diagnosis and remote maintenance of our automatic testing and sorting systems.

The easy-to-operate user interface provides full information about the current test assignment, presented in graphic form; users also have various options to parameterize and configure the test system (on a system-specific basis in some cases).
The integrated image processing software is Windows-based – so test assignment setup is fast and simple. This software can handle all industrial processes commonly used in test technology based on image processing. Numerous tools and ready-made macros ensure high-precision measurements and easy handling of very complex surface tests – and thanks to high-performance subpixel algorithms, measurement accuracies in the µ-range can even be achieved. The optional MD60 “Statistics” add-on package allows evaluation of measurement data as a Gaussian distribution curve or an SPC control card.

As our customers would expect, data transmission to external CAQ systems and integration into their own corporate network are also possible. These features allow external programming of test programs at a PC workstation and central management of program data and measured values.
Test systems: application areas and solutions

Testing principles and machine concepts

As their track record shows, test systems in Kistler’s VISIONcheck (KVC) series ensure fast and precise 100 % control of series parts – especially when large production quantities are involved. We make a basic distinction here between automated testing systems for continuous materials, and those for single parts fed in as bulk or individually positioned workpieces. Depending on the type of feed and testing involved, there are six different testing principles that provide the basis for Kistler’s standard machine concepts (see opposite).

These solutions include conventional feed components such as vibratory and linear conveyors as well as belt conveyors that transfer the test objects onto an inclined plane or a rotary plate, depending on the type of system. Increasing use is also made of servo axes and robots if test criteria require these part handling technologies.

Modular structure for individual combinations
Kistler’s test systems are based on a modular structure, and they are generally designed as standalone solutions.

The punched-part test cells for strip material with continuous feed are usually positioned in line, directly downstream of the production process concerned. In consultation with the customer, and depending on the requirements and types of parts to be tested, an individual combination of testing principle and feed can be implemented together with the appropriate image processing components.

Test cell for punched parts (KVC 620)
100 % inspection of continuous material with continuous feed, including integrated drive and strip guide

Clocked rotary plate (KVC 820)
Variant of the KVC 821 automatic testing and sorting system with continuous feed, but test objects are clocked to pass through the individual test stations on the rotary plate
**Inclined plane (KVC 120)**
100 % inspection of single parts with continuous feed on an inclined plane, with a sorting separator

**Glass plate (KVC 821)**
100 % inspection of individual parts with continuous feed on a continuously rotating circular plate (usually made of hardened glass)

**Robot handling (KRC 950)**
Individual part handing with a SCARA or six-axis robot to feed and position the parts at each testing station

**Integration solutions (KVC 42x)**
Small systems or individual components for integration into the customer's existing production line, e.g. an assembly line
Equipped with digital camera technology, the KVC 620 test cell for punched parts is a universal, autonomous video measurement system for 100 %-inspection of continuously produced parts. Applications for this system include punching, lamination, galvanization and injection molding lines as well as rewinding processes. Customers benefit from the modular structure of the standard test cell, with up to six digital cameras in black-and-white or color versions offering different resolutions in each case. In this system, the integrated control and image processing components focus on high processing speeds for complex assignments with transmitted and reflected light.

**Individual testing and sorting options**
Users of these systems have a variety of options available to test their products. These range from conventional dimension checks on relevant areas and complete contour tracing for sporadic errors all the way through to detection of surface defects. Responses to errors can be set individually on the system: production can be halted, or bad parts can be either marked or segregated.

**Equipment features and options**
- Comfortable operator experience thanks to 24" touchscreen monitor
- Up to six CCD matrix and line-scan cameras (black-and-white or color) with resolution of up to 16 million pixels
- LED flash illumination, transmitted and reflected light (telecentric, coaxial, diffuse)
- Triggering by laser light barrier
- Loop control via sensor, or incremental regulation for each machine cycle
- Adjustable strip guide with programmable servo drive
- Telescopic slide-out with keyboard and touchpad
- Integrated control cabinet including USP
- Remote maintenance is possible

**How it works – in detail**
The punching strip is protected as it is transported through the test cell thanks to the precision-adjustable strip guide in conjunction with the integrated servo strip drive. Continuous testing is guaranteed by an upstream sensor which, together with the drive, ensures automatic loop control. A laser light barrier (also by Kistler) triggers imaging as the test objects pass through the system. Coupling to the process only requires a clearance signal – clutch on/off – from the press, and a connection to the machine's stop circuit.
Variable designs
As well as the standard version, test cells of different sizes are available to meet customers’ specific requirements: these include highly compact cells (for confined spaces) and versions with extended installation space (e.g. to accommodate additional cameras or to integrate a marking laser).

All the automatic testing systems presented here can be equipped with optional extra components such as a strip deflection roller which releases the features to be tested in the running direction.

Product groups
Test cells for continuous materials are suitable for 100% inspection of parts such as:
- overmolded stamped contacts
- formed plug contacts
- flat-stamped contacts
- leadframes

Test automation with Kistler – now online!
View our animation to experience convincing, first-class Kistler solutions – the sure way to 100% control of your production:
Automatic testing and sorting systems in our KVC 120 series ensure high throughput rates for small turned, pressed and molded parts. The inclined-plane principle is applied here, depending on the part geometry and the testing assignment: test objects are fed in and separated via a vibratory conveyor; an inclined prism or flatbed rail then carries them past the test stations at a defined angle, followed by sorting with the help of a separator. Key factors in choosing the test rails are the size, center of gravity and geometry of the parts to be tested.

**Contactless dimensional checks, contour tracing and surface testing**

These systems also deploy high-grade illumination components using both transmitted and reflected light, as well as telecentric precision lenses. Thanks to these features, dimensional and forming errors can easily be detected from the contour, and surface defects can be identified – with reproducibility ensured in each case.

The basic configuration of the KVC 120 automated testing system can be expanded on a modular basis by adding up to four digital cameras with different resolutions. Depending on the size and weight of the parts to be tested, they are fed in via an integrated feed system. The actual testing procedure is entirely contact-free.

**Equipment features of series KVC 120**

- Testing rates of up to 250 parts/min
- Comfortable operator experience thanks to 24” touchscreen
- Up to four CCD matrix cameras (black-and-white or color) with resolutions of up to 16 million pixels
- LED flash illumination, transmitted and reflected light (telecentric, coaxial, diffuse)
- Adjustable vibratory conveyor for the part feed
- Separating device with swarf separator
- Triggering by laser light barrier
- Telescopic slide-out with keyboard and trackball
- Control cabinet and 19-inch USP
- CAQ connection
- Remote maintenance is possible

Source: pro-sort GmbH, Keltern, Germany.
Automatic rotary plate testing systems in our KVC 821 series are the ideal choice to meet the increasing requirements for attributive surface testing, and they are equally suitable for dimensional checks on individual parts. Testing is performed on a continuously rotating plate with a glass ring attachment and a regulated servo drive with a friction clutch.

Depending on their size and weight, the test pieces are fed in via an integrated or separate feeder system. As an option, the basic versions of both designs can be expanded by adding up to eight digital cameras with different resolutions. The optimum target feed rate can be set via the integrated software.

For complex surface testing in particular, the trevista® reflected-light dome illumination unit based on “shape-from-shading” technology delivers impressive results. Additional options are also available, including a hardness testing module, intelligent feed systems and 3D triangulation sensors.

**Equipment features of series KVC 821**
- Testing rates of up to 700 parts/min
- Comfortable operator experience thanks to 24" touchscreen
- Up to eight matrix and line-scan cameras (black-and-white or color) with resolutions of up to 16 million pixels
- LED flash illumination, transmitted and reflected light (telecentric, coaxial, diffuse)
- trevista® dome illumination unit
- Rotary plate with glass ring attachment
- Adjustable vibratory conveyor for the part feed
- Separating device with swarf separator
- Triggering by laser light barrier
- Telescopic slide-out with keyboard and trackball
- Control cabinet and 19-inch USP
- CAQ connection
- Remote maintenance is possible
Clocked test systems

Clocked test systems are mainly used when the test criteria call for parts to be handled in this way. For example, these systems are chosen if the parts for testing have to be presented to one or more cameras in different positions, or if a test object has to be rotated through 360° to scan for external surface defects.

Also: tactile, pneumatic and endoscopic tests
The central component of the VISIONcheck KVC 820 automated testing system is a rotary index plate on which the test objects pass through all the required test stations in sequence. This concept also makes it possible to integrate tactile, pneumatic or endoscopic tests into the automatic test lines. As well as conventional feed components, a SCARA robot can be used to place the test objects on the rotary index plate and remove them from it.

Especially when combined with the trevista® dome illumination unit, this makes the KVC 820 automatic testing system ideal for complex testing of sealed or coated surfaces, for example on highly complex punched and deep-drawn parts for the automotive sector.

Equipment features of series KVC 820
- Comfortable operator experience thanks to 24” touchscreen
- Up to eight matrix and line-scan cameras (black-and-white or color) with resolutions of up to 16 million pixels
- LED flash illumination, transmitted and reflected light (telecentric, coaxial, diffuse)
- trevista® dome illumination unit
- Rotary index plate with workpiece holders
- Feed via vibratory conveyor, linear conveyor, SCARA robot or handling system
- Triggering by laser light barrier
- Telescopic slide-out with keyboard and trackball
- Control cabinet and 19-inch USP
- CAQ connection
- Remote maintenance is possible
Test systems with robot handling

On the automatic testing systems in our ROBOCheck KRC 950 series, a SCARA or six-axis robot carries out all the part handling. The robot presents the test objects to the various cameras and test stations precisely according to the requirements for the test criteria, positioned as necessary.

Six-axis robots for demanding test assignments
Robots pick the test objects (e.g. from the accumulation section of a linear conveyor) and deposit them correctly in the respective crates or trays. This individual part handling makes the KRC 950 automatic test system especially suitable for complex test assignments and surface checks – for example, complete inspection of the outer surface on turned parts such as banjo bolts.

When six-axis robots are deployed, parts can also be presented to the image processing components in different positions so that multiple characteristics can be captured in one test cycle.

Equipment features of series KRC 950
- Comfortable operator experience thanks to 24” touchscreen
- Up to eight matrix and line-scan cameras (black-and-white or color) with resolutions of up to 16 million pixels
- LED flash illumination, transmitted and reflected light (telecentric, coaxial, diffuse)
- trevista® dome illumination unit
- SCARA or six-axis robots for part handling
- Triggering by laser light barrier
- Telescopic slide-out with keyboard and trackball
- Control cabinet and 19-inch USP
- CAQ connection
- Remote maintenance is possible
Integration solutions

Compact systems for general image processing assignments
Solutions in our KVC 42x series allow integration of camera stations in plants without the use of a complete automatic testing system. These solutions require an industrial PC for image processing and a control cabinet assembly, both integrated within one common housing.

This arrangement has multiple benefits for users:
- unrestricted functionality of current image processing software for varied applications in industrial punched and turned part production, also general automation
- simple integration into existing production lines thanks to compact dimensions and industry-compliant peripherals
- uniform user and menu interfaces
- no additional external network components are required
- image processing components and IPC are interchangeable within the KVC product line
For example: the KVC 426 test system is available for installation on the customer’s rewinding station, and a special version for galvanization lines (KVC 915) can also be supplied.

100 % control – even when testing is more complex
Our KVC 350 automated system for testing safety-critical fasteners such as preloading bolts includes multiple test stations (mostly camera-based) that are successively approached with a linear axis. In the basic version, good parts are fed to and removed from the workpiece holder manually, but these operations can be automated at any time with a suitable handling system. 360° dimensional and external surface checks are complemented by a hardness test and identification of good parts by a printer. The plant is fully enclosed and is locked when in automatic mode. Thanks to its part handling system, the KVC 350 automated testing line is ideal for complex test assignments and surface checks – especially in combination with the highly stable trevista® dome illumination unit, which is utilized twice in this case.
Suitable for universal use, the LASERmark KLM 620 laser marking cell is an autonomous system for marking continuously manufactured punched and hybrid products. It is mainly used for complete marking or coding of all manufactured parts in order to ensure traceability. The KLM 620 is usually positioned directly in a production line, and is equally suitable for use in punching, injection molding and assembly lines. Process coupling in a punching line is implemented via the clutch signal from the press and the machine’s stop circuit.

Marking on the fly for over 1 500 parts per minute
When the KLM 620 is combined with the KVC 620 test cell for punched parts, the result is an exceptionally efficient solution for 100% control and documentation of punched and hybrid parts. Hallmarks of the diode-pumped marking laser used here are excellent beam quality and a very high beam deflection velocity. Thanks to these features, even the smallest parts can be marked with a very high cycle rate of over 1 500 parts per minute. Marking takes place while the parts are moving – a mode known as “marking on the fly”.

The KLM 620 laser marking cell is positioned between the KVC 620 test cell for punched parts and the recoiling station. Depending on requirements, a printer is also integrated into the recoiling station to print the interleaf paper. Additional information can be added to the interleaf paper, such as the customer, supplier or barcode (in alphanumeric plain text or code form).

### Equipment features and options
- Diode-pumped YVO, laser
- Marking with high cycle rates
- Alphanumeric plain text (eight characters), barcode, data matrix code, logos
- Alternating marking is possible
- Extraction equipment with spark trap
- Batch change, day, time stamp
Accessories and additional components

An extensive range of accessories is available for all Kistler automatic testing and sorting systems – so optimum operability and reproducibility of results is guaranteed in line with requirements.

Examples include components to optimize processes such as part assembly, packaging or marking, as well as removable portals (the entire unit can easily be replaced) and electric actuators for the focal plane and aperture. Customers can also choose from a range of bunker and charging systems, as well as intelligent feed systems.

Intelligent feed systems detect the feed-in position
Intelligent feeds with a line-scan camera (KIZ 100) or matrix camera (KIZ 200) are available to ensure correct positioning of parts as they are fed into the test line. These systems detect the different positions of the test objects on the conveyor belt; depending on the preferred position, they only feed in parts that are lying correctly on the belt, while incorrectly aligned parts are returned and extraneous parts are already segregated.

Two different versions of our charging systems are available: the “rotary chargers” in series KCR 100 and KCR 150, and the KCL 300 “linear chargers”. With the rotary charger, parts counted out in packaging units are transferred to the appropriate containers which are positioned over a rotary indexing table; when the container is exchanged, they are cycled forwards until all of them are full. On the linear charger, the containers are positioned in line behind one another on a conveyor belt.

There are two types of bunker system: belt-type and vibratory bunkers. Bunkers also differ as regards size and related capacity. Lifting and swiveling devices or elevators are available as options to ensure efficient filling.
Services

Comprehensive advice before making a purchase is the key to success in deploying test automation to optimize your processes. But after you have made your purchase, we will still continue to assist you with services tailored to your specific system types. And in addition, all our customers benefit from the Kistler Group’s global service network.

A member of our sales force will be assigned to you, and he or she is the right person to contact for all questions relating to your test systems and solutions. If the necessary technical conditions are met, we may be able to respond to your inquiries via remote access, especially if automatic test systems are in very distant locations or if access is difficult. Where this is impossible, our service staff are standing by to carry out on-site assignments.

On request, we will also reconfigure and retrofit existing plants; depending on the scope of work, we provide these services either directly on site or, after the plant is returned, at Kistler’s premises. An extensive training program provides our customers’ staff with the skills they need to operate Kistler test systems efficiently and adapt them optimally to meet specific requirements.

All our services at a glance

- Your personal contact partner, plus telephone service
- Training courses on products and test programs, also training on user interfaces and use of software
- Remote maintenance via TeamViewer (optional; depends on compliance with technical access requirements, e.g. VPN)
- By agreement, we can develop new test programs and adapt test programs via TeamViewer (optional)
- On-site service at customers’ premises (available worldwide, by agreement)
- Rental systems are available to ensure plant operation in case of key component outages (e.g. IPCs for image processing)
- Reconfiguration and retrofitting of existing systems (either at customers’ premises or in-house at Kistler)
At our customers’ service across the globe

Thanks to Kistler’s global sales and service network, we are always close to our customers. Approximately 1900 employees at 61 locations are dedicated to the development of new measurement solutions and offer customized on-site support of individual applications.

Our representatives are here to help
Whether you would like a consultation or require support during installation—our website provides the contact information for your local representative.

Data sheets and documents
Use our Online Search to download data sheets, brochures or CAD data.

Education and training events
Education and training courses, during which our sensors and measuring systems are explained by Kistler experts, are the most efficient way for you to obtain the required user knowledge.
Plastics processing
Optimized process transparency for injection molding
Increased cost efficiency with cavity pressure-based systems

Composites
Process transparency and quality assurance in the production of fiber-reinforced composite structural elements.
For more cost-effective production: manufacturing processes based on cavity pressure

Kistler Group
Eulachstrasse 22
8408 Winterthur
Switzerland
Tel. +41 52 224 11 11

Kistler Group products are protected by various intellectual property rights. For more details, visit www.kistler.com. The Kistler Group includes Kistler Holding AG and all its subsidiaries in Europe, Asia, the Americas and Australia.

Find your local contact at www.kistler.com