

KISTLER
measure. analyze. innovate.

Electrode force measurement

Spot welds
that stay

The crucial role of quality

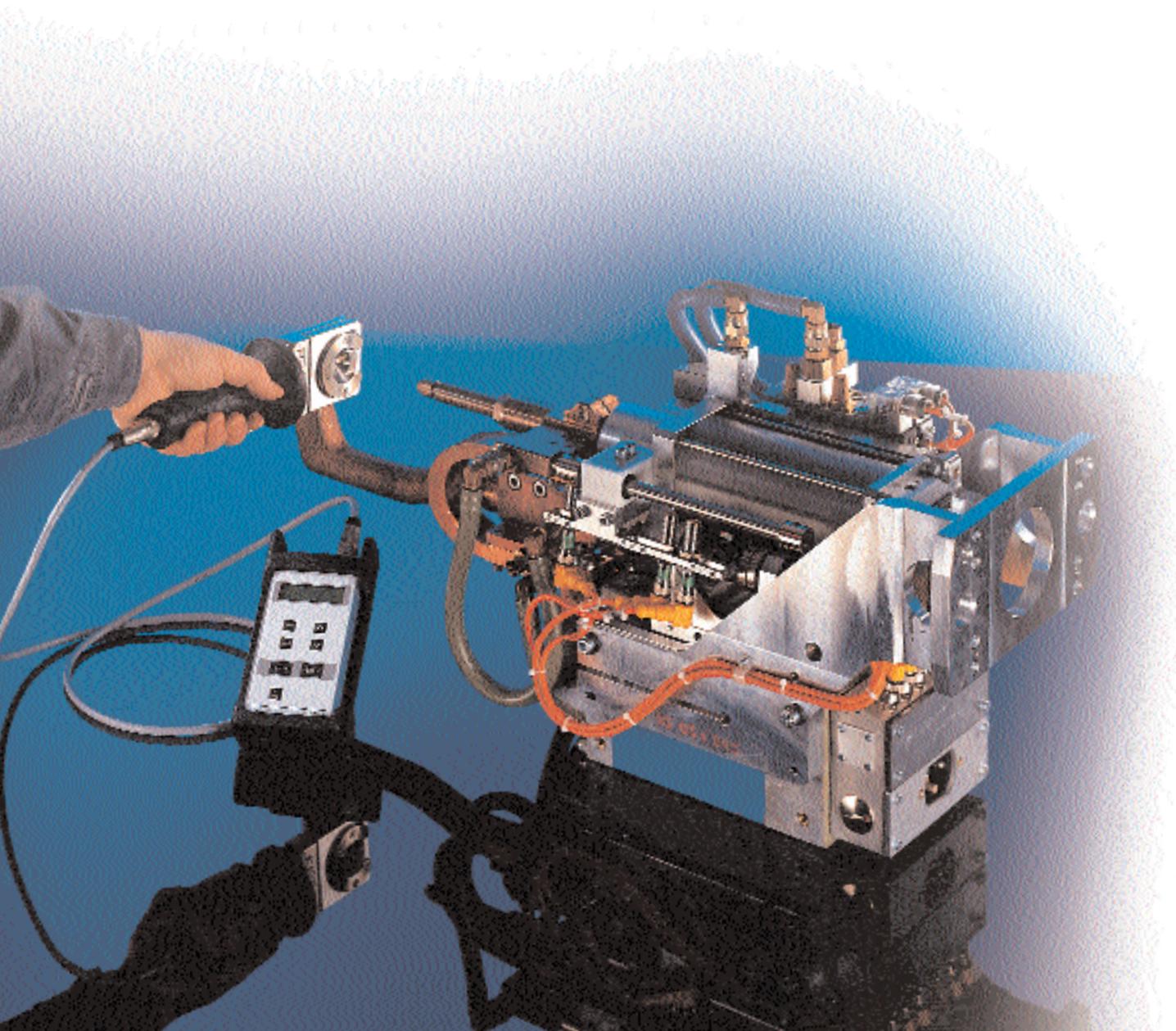
The crucial factors for quality spot-welding are the electrode clamping force, the welding current and its timing. The essential prerequisite for solid process control is an effective monitoring system, the quality of which will in turn depend on the measuring solution adopted. Kistler has developed a whole range of systems to measure electrode clamping forces:

- either indirectly from the strain on the electrode parts (sleeves) or in the machine structure
- or directly between the electrodes.

Monitor systems can be built into machines in combination with an analyzer unit to provide service stations and test stands with a highly reliable force measuring system.

Kistler's piezoelectric sensors offer a whole host of advantages:

- both dynamic and quasi-static measurements possible
- very wide measuring range
- high precision and repeatability of measured values
- practically impossible to overload
- highly stable, the calibrated values remaining constant for years on end
- extremely compact
- high rigidity so there is no weakening of the machine structure
- their robust build is suitable for industrial environments
- largely unaffected by electromagnetic fields
- extremely long service life



For welding clamps of every kind

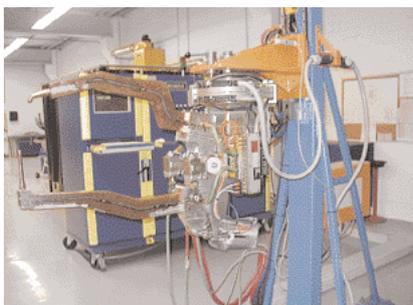
Measuring forces on test stands

Robot welding clamps need to undergo functional and measuring tests for process testing during development and after maintenance work has been carried out. For any such testing programme, the measurement of electrode clamping force is crucial. In this domain, the Type 9831A... sensor is the reference unit, accurately calibrating and recording the electrode forces with an extremely high degree of repeatability. Particularly when working with test stands, extreme conditions can arise, such as electrodes coming into asymmetrical contact or the occurrence of impacts. At such times, it is a big advantage to have the high overload safety margin of the piezoelectric force sensor.

Advantages

- use of the force sensor as a calibrated reference unit (direct measurement of forces)
- the forces can be documented in a test protocol
- high overload safety margin in the event of excessive electrode forces

 Adjusting and testing welding clamps on test stands. The Type 9831 force sensor serves as the calibrated reference unit.



Testing electrode forces in service stations

Because it is such a simple and flexible method, resistance spot welding has become a key process in the automobile industry. However, if welding clamp errors or incorrect joining process parameters go unnoticed, this can result in defective parts being produced or even to production being shut down. To avoid such problems, the Type 9833A welding force test sensor has been designed for the regular testing of production lines. Welding robots automatically check the electrode force on the basis of the number of cycles and the loads. The timing of the test can be determined manually on the machine control panel or by a command from the production facility control room.

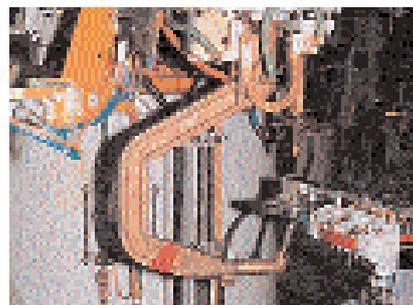
Force measurement is integrated into a service station. The welding robot regularly undergoes a so-called service cycle in which the electrode caps are re-dressed (cone and top), the electrode shape is optically checked, the clamping force is tested (with Kistler equipment) and the power is measured.

Advantages

- the forces measured in the joining process can be documented for statistical and quality management purposes
- if the welding clamp is not working properly, this can be detected in good time
- the timing of maintenance work can be optimized.



Measuring electrode force with the Type 9833A test sensor



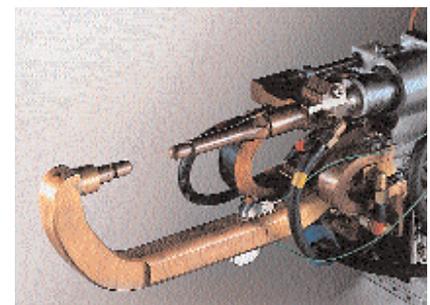
Online monitoring

Only an integrated system solution is capable of ensuring the continuous monitoring of the electrode clamping force in robot welding clamps. The extremely complex task of measurement requires the cooperation, flexibility and know-how both of the end user and of the clamp and control system manufacturers. Kistler's piezoelectric technology permits the welding cycle to be recorded and monitored through so-called «indirect force measurement» in accordance with the framework conditions. For example, the integrated sensor equipment permits conversions and retrofits of machine elements, electric servo motors and pneumatic cylinders. The precise measurements have to be processed and analyzed either online or from the machine control panel after the end of the cycle.

Advantages

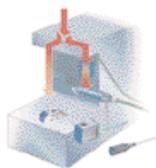
- the application of the electrode force can be regulated and monitored online (indirect force measurement)
- the forces measured in the joining process can be documented for statistical and quality control purposes
- if the welding equipment is not working properly or components are faulty, this can be detected in good time.

 Measuring force at the surface of the clamp with the Type 9232A strain sensor

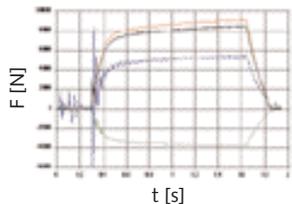


Stationary needn't mean static

Very few stationary welding machines are equipped with a practical electrode clamping force measurement system. As a general rule, the pneumatic pressure is read off from a manometer in combination with a conversion table. However, for precise measurement of the electrode force, it is necessary to take the measurements as close as possible to the joining process, independently of mechanical effects or fluctuations in the compressed air pressure.



Application of various force-strain sensors to the C-shaped structure



- Sensor 1
- Sensor 2
- Sensor 3
- Calibration with the Type 9831A... measuring system

Force-time ratio is measured with Type 9232A... strain sensor. Force is measured without welding current.



Electrode force is measured during welding and displayed on Type 5857A... control monitor.



Electrode force measurement considerably reduces cycle times in automatic installations.

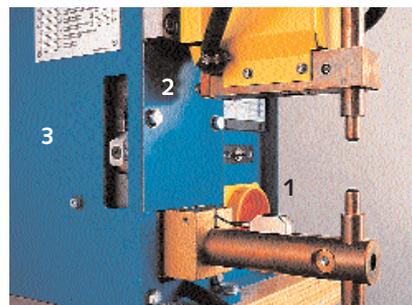
Using strain sensors to measure forces and monitor processes

It is very easy to retrofit welding machines with piezoelectric strain sensors. The measuring point may be placed on the armature close to the electrode or may be located at a suitable point on the back of the generally C-shaped clamp. The signal analysis is carried out by means of the machine control panel or by a Kistler control monitor.

Advantages

- welding machines can very easily be retrofitted with a measuring system
- the welding cycle can be optimized in terms of electrode force and the timing of the welding current
- the monitoring of the joining process ensures that the end product is of a consistently high quality

Stationary spot-welding machine. Type 9232A force-strain sensors are fitted at various points. Fitting the sensor requires nothing more than an M6 screw.



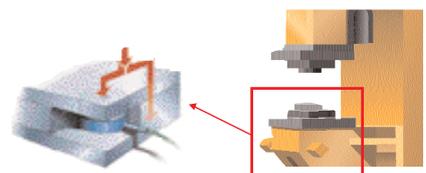
Using load washers to measure forces and monitor processes

Force measurements can also be carried out with the use of built-in load washers. This may be necessary for special machines or for welding equipment with specially shaped electrodes (e.g. projection welding machines) or where space is at a premium. In such cases, one or more force sensors will be built into machine components such as flanges or the push rods of pneumatic or electric servo motors, or will be fitted behind electrode plates. This type of arrangement is also based on «indirect force measurement». Using the Type 9831A... measuring system, the sensors can be calibrated at any time.

Advantages

- electrode force application can be monitored and regulated online
- the measurement of forces in the joining process can be documented for statistical and quality control purposes
- if the welding equipment is not working properly or components are faulty, this can be detected in good time.

Intégration de la rondelle de charge dans la structure de la machine. Avec le principe de la mesure indirecte des forces, on ne saisit qu'une partie de la force effective des électrodes.



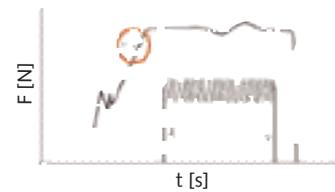
Total mobility

The Type 9831A... measuring system is designed to provide service on the spot. The force sensor and welding monitor record the electrode clamping force independently of the welding current switching signal (direct force measurement). The sensor's exchangeable electrode inserts permit measurements to be taken close up and with a minimal electrode gap. The monitor is able to store 11 digital parameters per cycle, thus providing the basis for an optimum force-time ratio for practically every type of spot-welding machine or welding clamp. Thanks to sprung suspension, hand protection and self-centring electrodes, the equipment is safe and easy to work with.

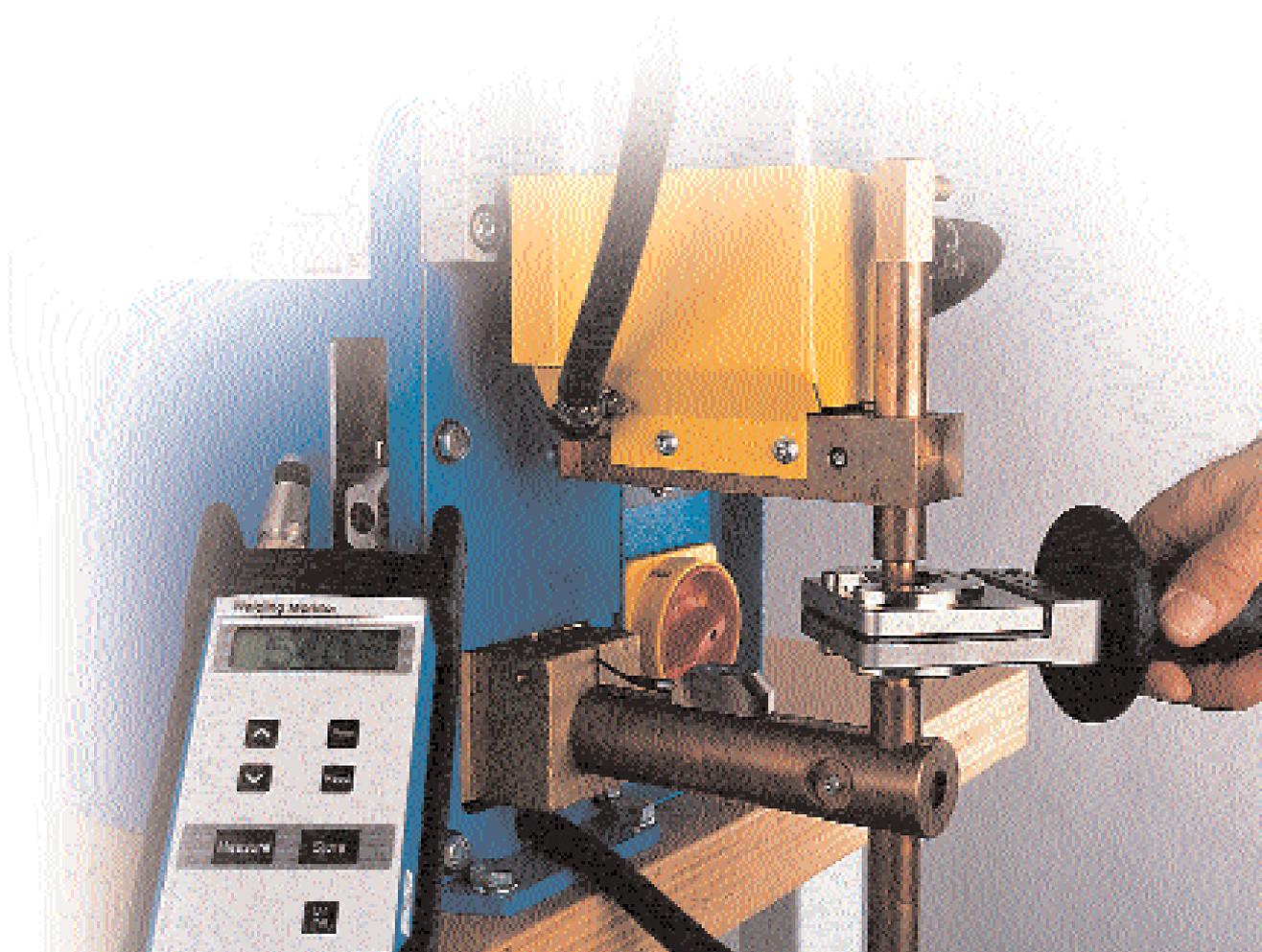
Advantages

- measuring, testing and calibrating electrode clamping forces (direct force measurement)
- optimization of the force-time ratio in the welding cycle
- can be used to service practically every type of welding machine and welding clamp.

Force-time ratio of a welding cycle. The timing of welding current switching is optimized (e.g. at 90% of maximum electrode force).



Type 9831A... mobile measuring system for measuring, testing and calibrating electrode clamping forces on welding machines and welding clamps.



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