

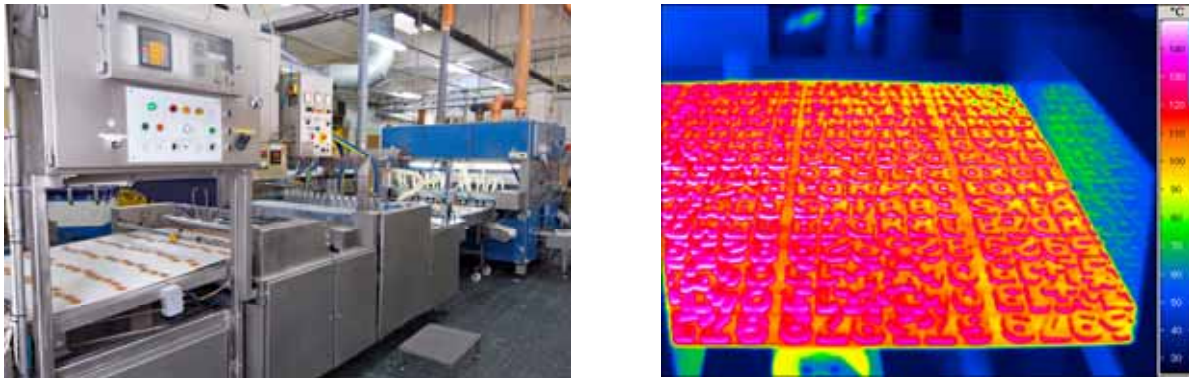
## Thermography

Automated infrared thermography for industrial processes

### Objective – save time, reduce costs, minimise downtime

Optimising industrial processes is a fundamental task for industrial companies to perform permanently on a competitive basis. The increase of productivity on a consistently good or even improved quality with low costs is one of the most frequent demands for process engineers in the industry.

The realisation of this task is very often achieved only through intelligent and sophisticated automation solutions which are optimally customised to the respective requirements. Temperature within its local and temporal progress is almost always a determining parameter for further optimisation of industrial production processes. In several cases, opportunities of conventional temperature measurement methods are insufficient in order to record crucial temperature deviation continuously in the required amount of data and rate without any process interferences.



**Fig. 1:** Process optimisation in food industry – Monitoring the temperature of bakery products

### Advantages of infrared thermography

Imaging infrared systems are preferentially used in numerous branches of industry in order to monitor processes. Infrared thermography, as a procedure for extensively displaying temperature distributions of object surfaces, represents a very efficient method for recording surface temperatures of the to-be-tested products and plant components in a non-contact, non-destructive and non-reactive manner. Following, the evaluation of their current state as well as revealing deficient process parameters can be realised. This process is based on the physical context of solid objects radiating at a temperature above absolute zero, and therefore sending electromagnetic waves. On recording this radiation and its intensity, surface temperatures of the device under test can be determined with respect to its emissivity. Modern advanced thermographic systems are capable of converting received radiation intensity into temperature values in a fast and precise manner through highly sensitive cooled or uncooled focal-plane-array-detectors. Temperature values can be further illustrated as cross-fade with false colour in order to display fast dynamic processes with high data density. One essential advantage of infrared thermography is that it is not necessary to interrupt any operation while monitoring temperature distribution and the fact that these processes can be fully automated.

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### Thermographic automation solutions based on process heat

Typical applications, where temperature distribution is monitored inline with the help of infrared thermography, are especially process monitoring of manufacturing processes with critical temperature states, in particular injection moulding and die casting, compression moulding and thermoforming as well as numerous processes including treatments of materials and joining techniques, such as hardening, thermal spraying, welding, soldering and bonding. Another complex is to be found in the field of quality assurance, for instance with the final inspection of electronic, electromechanical respectively mechanical components, assemblies and complete systems.



**Fig. 2:** Automated thermographic measurement system INDU-SCAN for process control – continuous temperature control for sheet metal manufacturing, on-site thermographic camera installation in protective housing with water cooling and air flushing



**Fig. 3:** Thermogram of roller mill for further analysis in a special software

InfraTec GmbH, situated in Dresden, is specialised in products and services in the field of infrared technology. The range of services includes among others the delivery of turnkey thermography automation solutions – starting from problem analysis up to the delivery of turnkey systems as well as their maintenance and additional training for operators.

The modular designed infrared monitoring system INDU-SCAN, based on most advanced thermographic technology of different performance categories, represents an ideal system for stationary control of industrial processes. Various demands can be fulfilled through a very flexibly configured modular construction system consisting of diverse industry proven components. Therefore, it is always possible to configure the integrated thermographic system which is optimally adjusted to the individual requirements of the respective measurement and testing task involving continuous real-time analyses of generated thermograms. Normally, thermographic camera units are installed in close distance to the monitored process. This frequently requires a special protective camera housing (see figure 1) for withstanding adverse ambient conditions. A synchronisation of image acquisition with process rate can be integrated on demand without any problems.

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Data is transferred onto an industrial PC-based evaluation unit via data cable variable in length or as optic fibre cable.

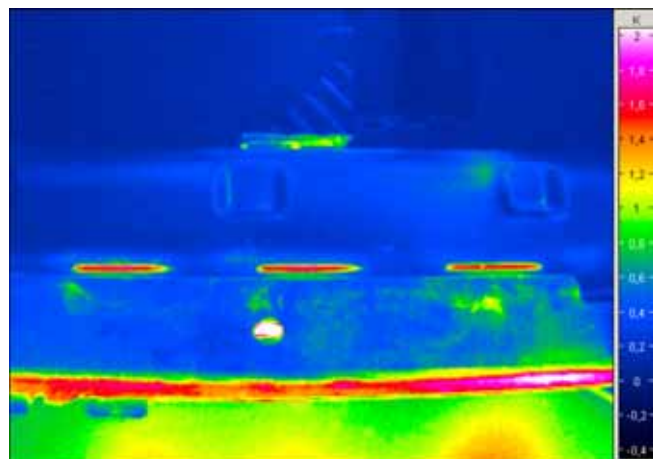
In this evaluation unit, current data analysis is realised according to the predefined criteria. Statistical parameters, such as average value, maximum, minimum or standard deviation of parts of the thermogram can also be monitored just as single measured points. Measurement data can be continually recorded ensuring complete documentation of the temperature distribution during a specific stage of production. Furthermore, on exceeding or deceeding preset threshold values, the following activation of switch contacts may serve as possible warning signal. If measured temperature is needed for regulating process variables, it can also be transferred as analogue or digital signal. Systems, especially adjusted to the respective measurement task, monitor processes continuously, alert in case of thermal deviation or separate defectively manufactured items out. Depending on system, data storage is carried out with or without reaction on the production process.

### Thermographic automation solutions for non-destructive material testing through heat flow thermography

Apart from process heat-based system installations within or immediately after the process of production, product properties can also be tested, through a thermal pulse subsequently injected into the test object. This procedure is also known by the term heat flow thermography. In recent years, it has been established as an efficient infrared testing method which, for instance, covered defects can be localised with. There are various ways for injecting thermal energy into a test object. Approaching this, typical excitation-sources are formed by radiant heater, flashbulbs and hot air stimulation.



**Fig. 4:** *InfraTec's automated thermographic testing system for non-destructive testing of body panels in the automotive industry*



**Fig. 5:** *Thermographic image of a laser weld seam on a body panel*

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Geometry and thermal properties determine the heat flow's temporal and local distribution of the test object. Over the course of time, a respective temperature distribution on the test objects' surface is formed which is recorded with an efficient thermographic camera. Acquired thermal images are analysed with a special software, evaluated according to specific criteria and further edited to a cross-fade with false colour. Heat flow thermography, as imaging method, enables a fast detection of defects and simple test result documentation. It is applied in various manufacturing technologies both for testing offline as well as inline in serial production. The scope of application encompasses not only quality assurance for bonding, welding, soldering and other joining processes but also detection of cavity (e.g. interior parts of motor vehicles), material defects of composites and cracks in metals.

### Performance characteristics of appropriate camera technology

Whereas cooled high-end thermographic systems with focal-plane-array-photon-detectors featuring highest detectivity and frame rate are deployed to advanced measurement tasks in heat flow thermography, process heat-based thermographic automation solutions mainly rest on compact and very robust uncooled microbolometer camera technology. Depending on the type of camera, available image formats range from (120 x 160) up to (1,280 x 960) IR pixel, and furthermore, it is possible to identify smallest temperature gradients up to few millikelvin. On acquiring very fast processes, frame rates up to 3,000 Hz can be achieved.

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