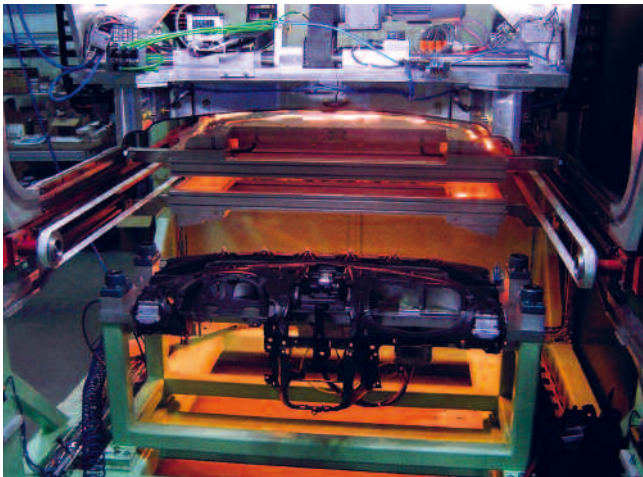
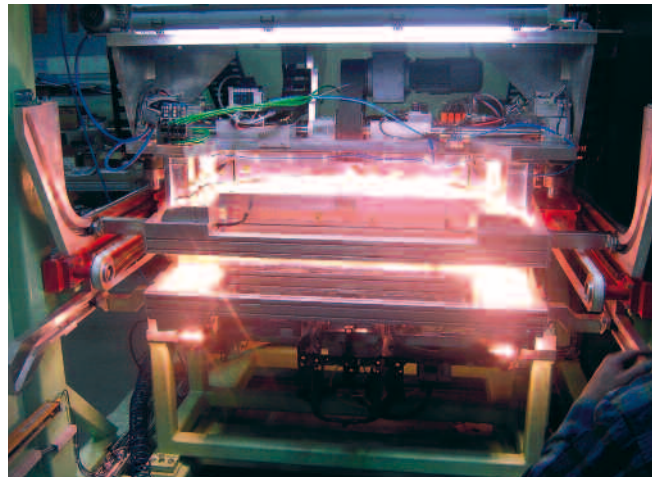
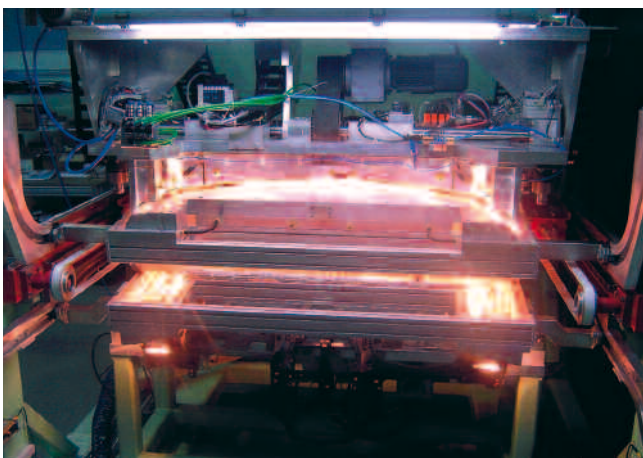




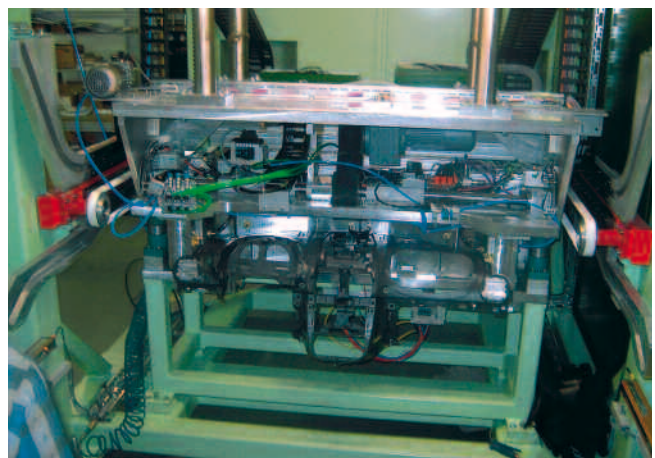
Preheating of the workpieces in the upper tool



Melting on and welding



Welding and cooling down afterwards



Now, the finished instrument panel can be removed

Joining Technology. It has for a short time been possible to make use of welding with IR even for relatively large-area plastic parts thanks to precise control of heat introduction for a short time. This technology is characterised by numerous advantages over accepted plastic welding methods.

PE103692

Welding Large-area Components with Infrared Radiation (IR)

OLE SCHMIDT

Large-area plastic components, such as those used, for instance, in the automotive industry, generally consist of

numerous individual components. Thus, the instrument panel of a car may be composed of twenty or more single parts made up of several plastics. To join those components, which are usually thermoplastics, in a secure manner, joining technologies such as hot stamping-, vibration- and ul-

trasound welding or laser welding have been used up to now. Each of these methods has pros and cons for specific applications. Consequently, precise analysis of both the manufacturing goals and the technology to be applied should be done in the initial planning stage.

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For production engineering reasons, the manufacturing department is often not able to implement the ideas designers have for parts of the car's interior. For instance, so much effort is required to run ultrasound-welding equipment with numerous stations (welding positions in different directions with overlapping, several welding layers etc.) that its use is no longer profitable.

Here, low-cost infrared welding technology opens up new possibilities. One challenge here is to implement the precise control of heat input. The heat source has to be placed exclusively on the regions of the workpiece which are to be heated, without affecting other, frequently sensitive areas. Variations in size may occur if a thermoplastic component is heated along its entire length. The larger the component, the more significant the deviations will be. For this reason, infrared applications have been limited to relatively small components up to now.

Quick and Profitable

In association with the car supplier Peguform, the Lühr group, headquartered in Hamburg, has developed a manufacturing concept able to solve this problem. IR technology is now being used for complex three-dimensional components whose dimensions are greater than 1000 mm. Thus, for instance, at Opel, the instrument panel of the current Corsa model is manufactured at the newly designed facilities at relatively low cost and with high manufacturing accuracy.

This is made possible by the innovative use of specially designed reflectors and precisely fitted shadow masks. This way, infrared radiation only gets to those areas of the component which have to be heated. The plastic parts are heated without contact and joined without the use of any other auxiliary material, such as glue, clips or screws. Within a few seconds, the heat melts a thin layer on the surface of the plastic, which can subsequently be joined using extremely low pressure.

Depending on the purpose and the construction of the facility, the energy of the IR source can be directed onto the entire surface, that is, onto a large area, or only targeted onto defined weld spots or lines of the workpiece. These special heating sources make short heating times possible, and the heat output may be measured very precisely. Particularly in comparison with heated tool-welding technology, where the tools have to be constantly kept at a high temperature, in-



Easy and quick exchange of an IR source

frared technology demands far less energy and thus reduces costs. Welding with IR also does not generate additional noise. Immediate comparison with conventional plastics joining techniques emphasises the benefits and potential of infrared welding.

Advantages in Comparison with Heated Tool Welding

This welding method works with tool temperatures of up to 450°C. The welding surfaces of the workpiece come into immediate contact with the welding tool, whereas IR welding units generally work in a contact-free manner. Because energy is introduced without contact, no material residues are deposited on the moulds.



In Profile

Over the past few years, the Hermann Lühr GmbH has extended itself to become the **Lühr Group**. The group now consists of the Hermann Lühr GmbH in Hamburg, the tooling and milling company WFT Werkzeug und Frästechnik GmbH in Cöpenbrügge, and the Southern subsidiary Lühr Niederlassung Süd in Laufen. The enterprise is established as a manufacturer of special machines and a mould maker, particularly in the field of plastics joining. The Lühr group's core competencies range from engineering and design of plastics joining devices, to model- and mould making, production of gages, all the way to complete small-batch production. The Lühr group offers all plastics welding techniques and is especially interested in close collaboration with its customers. The group also offers engineering and design of foaming plants and tools. Many well-known car manufacturers, car-subcontractors and companies from the aircraft and space travel industries, as well as medical engineering firms, are among the group's customers.

The moulds remain clean, and it is not necessary to wash them. At the same time, this manufacturing method protects the material being processed, since the welding procedure does not mechanically affect the components.

Advantages in Comparison with Vibration Welding

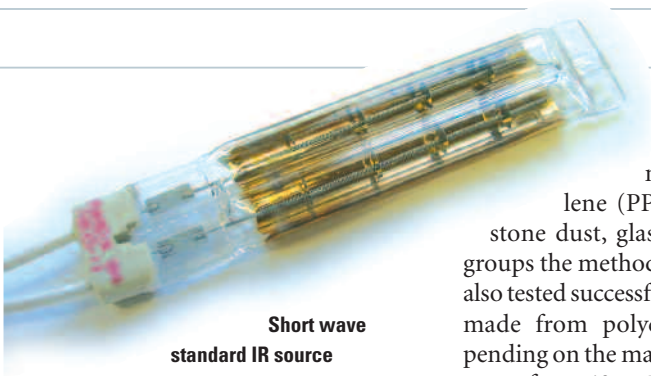
In vibration welding, two workpieces are ground against each other under high pressure. Surfaces melt as a result of the heat generated by the abrasion. The disadvantage of this is that lint sometimes forms, since tiny plastic filaments or pellets result from the rubbing process. This can cause tremendous difficulties, for instance in the air-ducts of an instrument panel. Moreover, three-dimensional contours can only be produced to a very limited extent by means of vibration equipment, the more so as the required force strongly affects the components. Both problems caused by this method may be overcome by using the IR technology.

Advantages in Comparison with Ultrasound Welding

The welding heads of an ultrasound (US) welding device with sonotrodes are caused to vibrate by a generator. When the sonotrodes make contact with thermoplastic material, the plastic material melts and is thus welded. However, sound wave transmission onto the workpiece greatly limits the shape of the sonotrode, so that primarily all individual spots or short lines can be welded. In contrast, infrared technology can be used for continuous welding lines which are airproof at the same time.

Advantages in Comparison with Laser Welding

This relatively new technology also uses a light source to melt the workpiece surfaces. The laser beam incorporates more energy than the infrared source and thus is hazardous to the user's health and to material. For this reason, it is necessary to use special safety precautions when running a laser facility. Moreover, in this technology, one of the parts to be welded must be made of translucent material. The high joining pressure involved in compressing the parts usually demands that large presses be equipped with hydraulic units. An infrared device demands a relatively low joining pressure. Consequently, a press may be very precisely positioned by



**Short wave
standard IR source**

means of a servo-controlled electric motor. The parts to be welded may consist of identical or similar materials and may have the same colour.

Application in Practice

Infrared technology may be used in many fields. Thus, many injection moulded parts made from commonly used thermoplastics can be welded excellently. The

technique was applied not only to polypropylene (PP) and filled PP (talc, stone dust, glassfibres), the material groups the method was designed for, but also tested successfully on GMT and parts made from polycarbonate (PC). Depending on the material used, cycle times range from 40 to 70 seconds. Almost all thermoplastics that may be welded with other methods are also suitable for IR welding.

The Lühr group has filed a patent for the draft of the infrared device. In comparison with other manufacturers of special-purpose machines, the group expects a great advantage from the robust, low-cost, technically manageable and easy-to-run facilities. For two decades, this medium-sized company has been designing and building machinery and moulds for

plastics processing, in particular for joining technology.

Stefan Lühr, who belongs to the fourth Lühr generation to work in the company, states: "Infrared joining has been controllable until now. But the problems that occur when processing large components can only be solved by a great deal of experience and comprehensive know-how. As a small traditional company, we have developed a technology to solve a problem the big firms failed to solve, and it is ready to market, which makes me proud. We have engineered a very flexible and low-cost new procedure through our commitment and creativity – therefore I am very grateful to our personnel." ■

THE AUTHOR

OLE SCHMIDT, born in 1973, is freelance journalist in Hamburg.