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Focus on IFA's work

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Electromagnetic fields on hand held spot-welding guns

Problem

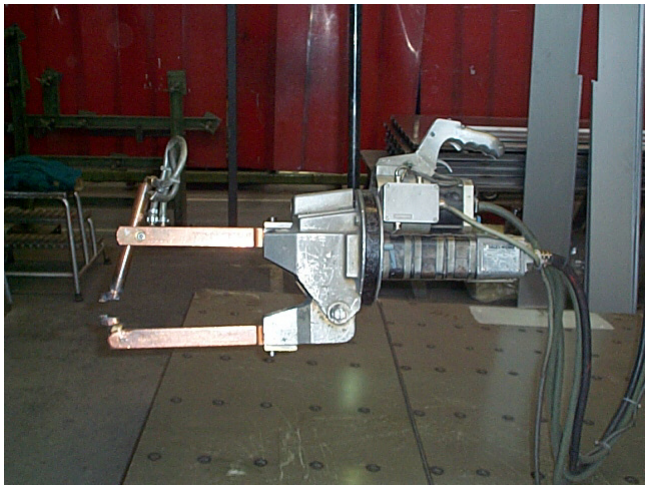
Hand held spot-welding guns are widely used in the metalworking industry for the jointing of metals. The spot-welding guns consist of two electrodes of suitable geometry for the task, and an integral or discrete DC or AC source. The heat generated by the flow of current through the electrodes is exploited for the welding process.

During a welding operation, short-term currents of over 20 kA may flow, depending upon the task. Since the welder is located in direct proximity to the welding gun and, in particular where integrated current sources are used, touches the cables to the electrode, a correspondingly high exposure to magnetic fields may be anticipated.

Excessively high exposure may stimulate nerves and muscle cells in the human body. In a worst-case scenario, this may lead to fibrillation. In order to protect the welder, the magnetic fields must not therefore exceed the permissible values stated in DGUV Vorschrift 15 (formerly: BGV B 11) governing electromagnetic fields.

Activities

In conjunction with the German Statutory Accident Insurance Institutions, the magnetic field strengths on hand held spot-welding guns were measured in a number of plants. For the purpose of measurement, areas selected on the spot-welding guns were limited to those normally in the proximity of the operator or with which he comes into contact during operation of the gun.



Hand held spot-welding gun with integral power supply (transformer gun)

The hazard presented to the operator by magnetic fields was assessed by comparison of the measurement results with the permissible values stated in the DGUV Vorschrift 15, in consideration of the prevailing plant conditions. In addition, the exposure during welding with hand-held spot-welding guns with separate 50 Hz AC power supply (without integral transformer) was evaluated for the first time by the analysis of body current densities in a body model. The work was conducted in conjunction with the German Social Accident Insurance Institutions for the metalworking industry. For this purpose, body current densities were calculated and visualized three-dimensionally in layers, for example in the head, neck and torso, for common work situations.

Results and Application

At workplaces featuring hand held spot-welding guns, two magnetic field impulses lasting several hundred milliseconds generally occur during a welding operation. The magnetic flux density is at its highest in the vicinity of and between the electrodes of the welding gun. Depending upon the type of gun employed, the peak values for the magnetic flux density lie between 3 millitesla (mT) and over 20 mT. The measured peak values and the maximum and average change in the magnetic flux density frequently exceed the values permitted for the extremities under DGUV Vorschrift 15 (Section 3, Tables 14 and 15) for the increased exposure range.

Magnetic fields may therefore present a health risk to persons coming into contact with the electrodes or remaining in the proximity of spot-welding guns during welding; prevention measures are consequently necessary. A reduction in exposure is possible if the observance of an adequate distance is attained by other measures, such as barrier bars and handles on the electrodes.

The results of studies on spot-welding guns without integral transformer showed that the computed body-current densities are within the applicable limits for the central nervous system (brain and spinal cord) irrespective of the distance, position and orientation of the spot-welding gun with respect to the body model. In the work situations studied, no more than 10% to 20% (1 mA/m^2) of the basic restriction was reached in the central nervous system. The magnetic flux densities lay above the values permitted by the DGUV Vorschrift 15, however.

Area of Application

German Statutory Accident Insurance Institutions, safety professionals, appliance manufacturers

Additional Information

- Elektromagnetische Felder (DGUV Vorschrift 15, bisher: BGV B11, 06.01). Hrsg.: Hauptverband der gewerblichen Berufsgenossenschaften (HVBG), Sankt Augustin 2001, DGUV-Publikationen siehe www.dguv.de/publikationen

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- Beurteilung magnetischer Felder von Widerstandsschweißeinrichtungen (DGUV Information 203-038, bisher: BGI 5011, 10.06). Hrsg.: Hauptverband der gewerblichen Berufsgenossenschaften (HVBG), Sankt Augustin 2006

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Expert Assistance

IFA, Division 4: Ergonomics – Physical environmental factors

Literature Requests

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