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Resistance spot welding of steels with individual thicknesses up to 3 mm
Overview

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1 Purpose of the technical bulletin

With its parts:

1: Overview
2: Spot weldability of unalloyed and alloyed steels
3: Design and calculation
4: Preparation and execution

this technical bulletin is intended for setters, welding specialists, welding technologists, designers, employees of quality control bodies, welding engineers and students. With the relevant DVS technical bulletins (see Section 9), it should provide information about the possibilities of and the problems associated with resistance spot welding. Due to this objective and due to the peculiarities of the resistance spot welding process, it was necessary to also incorporate fundamental and theoretical deliberations into the technical bulletins.

In the following text, resistance spot welding is designated, in an abbreviated form, as "spot welding".

2 Scope of application

This technical bulletin applies to the spot welding of unalloyed and alloyed steels with individual thicknesses up to 3 mm.

3 Definition of spot welding

In the case of spot welding (a resistance forge welding process), the parts pressed on to each other are joined in a spot form after the sufficient heating of the joining point. The joint is created by the melting and solidification of the material at the joining point.

The electrical resistance heating (Joule's law, see Section 6) takes place in the parts pressed together by the electrode force. The welding current and the electrode force are transferred by spot welding electrodes [1].

4 Application of the process

Spot welding is an economically viable joining process which is proven not only in mass fabrication but also in single-item fabrication, e. g. in the manufacture of vehicles, household appliances, tanks and lamps, in electrotechnology and precision mechanics, in the metalware, radiator and steel furniture industries as well as in the building trade [2]. It is characterised by a high welding speed, versatile utilisation possibilities, rapid convertability for various tasks as well as mechanisation and automation possibilities, e. g. using robots. In addition to unalloyed steels, alloyed steels, light metals, nickel alloys as well as materials with metallic coverings and organic coatings can be spot-welded with restrictions [3 ... 10]. It is also possible to spot-weld combinations of different materials and steels. The sheet thickness range which can be mastered with the spot welding process is material-dependent. Unalloyed and low-alloyed steels (alloying content: ≤ 5 %) can be welded in a range from 0.1 + 0.1 mm to approx. 20 + 20 + 20 mm. The predominant area of application is to found in the sheet thickness range from 0.5 mm to 2 mm.

Depending on the application, it is possible to manufacture spot welds with different qualities. In every application, the particular needs of the spot welding technology must already be taken into consideration during the design and the material selection. The welding supervisors, the designers as well as the employees concerned with operations planning and scheduling and quality assurance must possess sufficient expert knowledge.

5 Prerequisites for the spot weldability of a component

The spot weldability of a component, Fig. 1, exists if a spot-welded joint adequate for the stresses can be achieved while paying attention to a suitable fabrication sequence [11].

The weldability depends on the three equally important influencing variables: material, design and fabrication. The properties relating to "the fabrication weldability of the materials", "the weldability for service of the design" and "the welding possibility of the fabrication" take effect between the three influencing variables and the weldability. Detailed information about this is included in [4; 12].

DVS, Technical Committee, Working Group "Resistance Welding"

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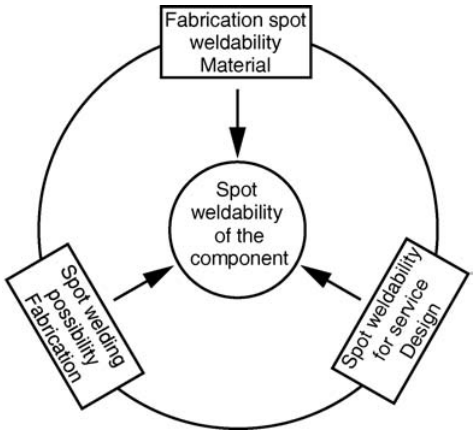

Figure 1. Schematic representation of the spot weldability with reference to DIN 8528-1 [11].

Spot welding is a welding process which mostly takes place with welding times from 2 to 15 periods (with 50 Hz alternating current: 1 period = 0.02 s). This means that, in contrast with manual metal arc welding, the operator cannot intervene in the welding process. Therefore, the prerequisites for the weldability must be borne in mind to a particular extent.

6 Spot welding as a fabrication process

Many influencing variables which are linked with each other by the "spot welding process" and must not be considered in isolation take effect in the case of spot welding.

The most essential objective during the manufacture of components is to achieve the adequate loadability in the terms of the design objective with sufficient certainty, in the necessary quantity and at the lowest costs. In order to be able to attain this objective during the production, it is necessary to guarantee the spot weldability of the component. If the prerequisites exist in these terms, the component can be joined together from the individual parts with the spot welding facility, Fig. 2. The aspects for the assessment of spot welding as a fabrication process are the target variables of the fabrication costs, the productivity, the safety class of the component (quality) and the avoidance of health hazards for people, e. g. during the welding of coated sheets. The objective of all the deliberations about the fabrication process is to provide a foundation for the optimisation of the target variables. Depending on the welding task, different significance may be attached to the target variables.

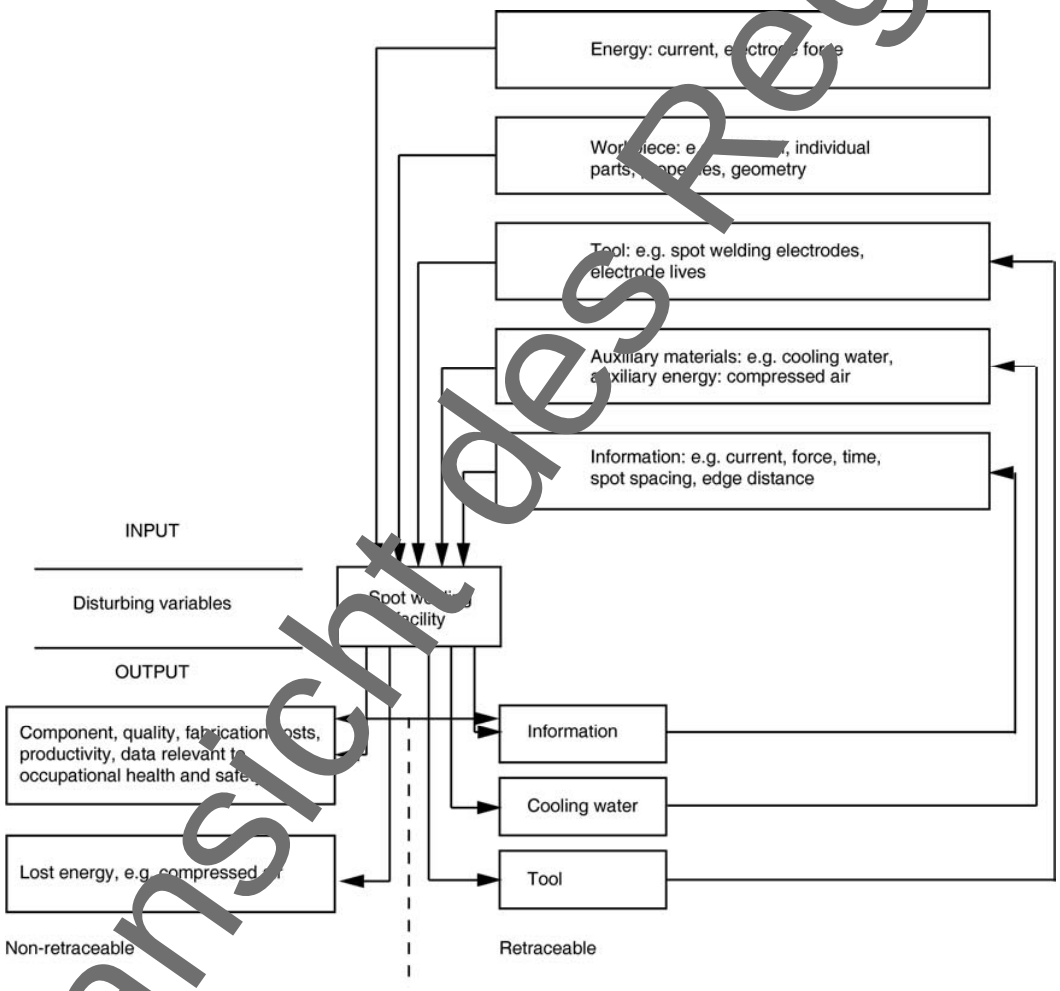

Figure 2. Spot welding as a fabrication process with input and output sides.