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The International Institute of Welding
and The European Federation for Welding,
Joining and Cutting member

Summaries of the articles

Mateusz Przybyła, Jacek Górka: **The Effect of High-Frequency Peening on Properties of MAG-Welded Joints Made of Steel S960QL**

DOI: *10.17729/ebis.2023.2/1*

The study discussed in the article aimed to analyse the effect of the peening of each bead on properties of butt joints made of steel S960QL and welded using the robotic MAG welding method (135) and a ceramic backing strip. In addition, the objective of the study was to identify the effect of the peening treatment on the level of stresses. The analysis involved the comparison of three butt joints in the post-weld state (i.e. only after welding), subjected to peening (preceded by welding) and to post-weld heat treatment (stress relief annealing). The purpose of the high-frequency peening (90 Hz) of each bead was to reduce stresses in the welded joint by introducing tensile stresses into the latter. The study-related tests involved the use of a Weld Line 10 air hammer (PITEC GmBH). The tests required by the EN ISO 15614-1 standard were supplemented with measurements of stresses involving the use of the Barkhausen effect (based on a testing procedure proposed by the technology provider, i.e. the NNT company). The tests revealed that the performance of high-frequency peening following the making of each bead did not lead to the obtainment of negative results of all the tests required during welding procedure qualification concerning the plate made of steel S960QL (in comparison with test plates after welding and stress relief annealing). The interpass peening of the weld face and that of the HAZ reduced post-weld residual stresses at a distance of 15 mm away from the joint axis (in comparison with stresses measured in the specimens after welding). The test results justified the positive assessment of peening in respect of tensile stress reduction in the fusion line area and in the HAZ.

Maciej Wojtaszak, Katarzyna Baluch, Katarzyna Łyczkowska, Michał Urbańczyk, Janusz Adamiec: **Application of Advanced Welding Methods in the Production of Rims for Special Purposes**

DOI: *10.17729/ebis.2023.2/2*

Special rims belong to structural elements determining the safety and service life of vehicles. Because of the fact that welded joints are integral parts of rims, the quality of the former affects the service life of the entire element. In turn, welding, as a special process, is decisive for the quality of joints. Advanced high-performance welding methods (such as laser or hybrid welding) can increase the efficiency and improve the quality of welded joints. The article presents results of technological tests involving the laser and hybrid welding of steel grades DD11 and DD14 (used in the production of rims). The reference technology was MAG welding. The welded joints were subjected to non-destructive and destructive tests. The test results revealed that both laser and hybrid welding enabled the obtainment of joints meeting strength-related requirements. However, the laser welding process led to the lowering of the weld face and the formation of significant weld porosity.

Piotr Śliwiński, Marek St. Węglowski, Janusz Pikuła, Tomasz Tański, Andrzej N. Wieczorek, Emilia Skołek: **Electron Beam Hardening of Nanobainitic Steels**

DOI: *10.17729/ebis.2023.2/3*

Because of the unique combination of their properties, nanobainitic steels containing Si are particularly attractive materials for use in gear manufacturing. However, in order to achieve desired results, it is first necessary to obtain a surface of sufficient hardness (i.e. to increase the hardness of the surface layer using surface hardening techniques). One of such techniques is electron beam hardening. Due to the high power of electron beam welding machines and properties of the electron beam itself, the above-named technology makes it possible to harden workpieces within a wide range of thicknesses. Research-related tests discussed in the article involved the hardening of blocks made of nanobainitic steel (30 mm × 150 mm × 20 mm) using the oscillation-deflected electron beam. Test specimens were subjected to surface hardening with the electron beam using different beam settings. Surface hardening techniques involved both moving the specimen relative to the heat source and quenching only with beam oscillation. As part of the study, finite element simulations were performed along with the validation of results. The test specimens were then subjected to Vickers hardness tests as well as to light microscopic and microstructural tests (using scanning electron microscopy). The test results revealed that the electron beam hardening method made it possible to obtain hardened layers having a thicknesses of up to 1.9 mm. The distribution of hardness in the hardened zone was uniform, whereas the specimens hardened without movement were characterized by a higher average hardness of 674

HV0.1. The average hardness value of the hardened layer amounted to 626 HV0.1 in terms of the sample hardened at a speed of 250 mm/min. The results of the FEM numerical calculations were consistent with the results of the actual measurements, indicating that the assumptions and boundary conditions in the FEM modelling of the electron beam quenching process were defined correctly.

Jerzy Kozłowski, Jakub Kozłowski: **Fabrication of Steel Structures in Accordance with the Requirements of the New ZTV-ING Regulations – Selected Issues**

DOI: *10.17729/ebis.2023.2/4*

The fabrication of steel structures imposes on the manufacturer obligations to comply with requirements of appropriate standards and regulations. This article discusses examples of German market requirements applying to the fabrication of civil engineering structures (made of steel) in accordance with the German ZTV-ING regulations [1]. In addition, the article provides examples of requirements concerning materials, design, welded joints, fabrication and acceptance documentation of steel structures described in ZTV-ING Part 4, Chapter 1. The article also discusses requirements concerning the corrosion protection of structures described in Chapter 3. Particular attention is paid to the necessity of meeting requirements concerning the competence of personnel involved in the fabrication of structures and the corrosion protection of the latter. Because of the fact that many Polish manufacturers fabricate civil engineering structures for the German market, the knowledge of the new issue of the ZTV-ING regulations (2022) is essential.

Krzysztof Kudła, Krzysztof Makles, Kwiryn Wojsyk, Michał Macherzyński: **The Reduction of Stresses and Strains in High-Quality Welded Structures through the Application of Innovative Welding Methods**

DOI: *10.17729/ebis.2023.2/5*

The study discussed in the article aimed to compare the high-performance robotic MAG TANDEM process with the partly mechanised MAG STANDARD process. Experimental tests involved comparisons concerning the heat effect of the dual-electrode MAG TANDEM process with that accompanying the single-electrode MAG STANDARD process. The tests also included comparisons of linear welding energy (heat input) and its effect on stresses and strains generated during the fabrication of welded structures.