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# BIULETYN
## INSTYTUTU SPAWALNICTWA


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**INSTITUTE OF WELDING**

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

## Z. Mikno – Cross Wire Projection Welding of Aluminium Alloy Bars (FEM 2.5D Calculations)

**DOI:** *10.17729/ebis.2017.4/1*

The research described in the article involved the analysis of the cross wire projection welding of bars in relation to a conventional, i.e. pneumatic and a servomechanical electrode force system. The analysis was performed using Sorpas (2.5D model) software. Numerical calculations involved bars made of aluminium alloy 5182 (ϕ 4.0 mm) as well as to various values of electrode force (pneumatic system) and electrode travel (servomechanical system). The analysis involved the projection height reduction before and during the flow of current, the waveforms of static slope resistance, momentary power, weld diameter and the volume of molten material. The research aimed to optimise the process in relation to electrode force and/or electrode travel control in order to obtain such control of welding power space distribution so that energy could be concentrated in the central zone of the weld, where the use of the pneumatic system resulted in the obtainment of incomplete fusion instead of penetration. The article provides general recommendations concerned with the optimisation of a welding process involving the use of a servomechanical electrode force system.

## M. St. Węglowski, S. Sikora – Ultrasonic Tests of FSW Joints

**DOI:** *10.17729/ebis.2017.4/2*

The article presents ultrasonic test results concerning FSW joints deliberately provided with welding imperfections. The research aimed to determine the usability of ultrasonic tests in controlling the quality of FSW joints made of aluminium alloy 6082. The research-related tests involved the use of an Epoch 600 defectoscope and a slant transducer. The testing procedure applied in the tests enabled the detection of welding imperfections and, consequently, the quality control of welded joints.

## A. Gradzik, J. Nawrocki, G. Mrówka-Nowotnik, J. Sieniawski – Laser Surfacing of Superalloy Inconel 738LC-Based Alloy Stellite 694 – Overlay Weld Imperfections

**DOI:** *10.17729/ebis.2017.4/3*

The research involved the analysis of test results concerning the effect of laser surfacing process conditions on the characteristics of an overlay weld made of alloy Stellite 694 on the substrate of nickel superalloy Inconel 738LC as well as the determination and specification of the most common overlay weld imperfections. The overlay weld subjected to the tests was made using a Yb:YAG disc laser having a power of 1 kW and a filler metal in the form of powdered Stellite 694 cobalt alloy. The research led to the development of process conditions and the identification of major overlay weld imperfections including lacks of penetration, gas pores and microcracks in the base material. The formation of above-named imperfections could be ascribed to low laser radiation power density (< 30 kW/cm$^2$), the excessive overlap of consecutive tracks (> 60% of the single track width) and the insufficient gas shielding of liquid metal in the weld pool.

## J. Czuchryj – Analysis of Fatigue Fractures in Elements Surfaced Using Various Methods and Tested in Relation to Complex Stresses

**DOI:** *10.17729/ebis.2017.4/4*

Research-related fatigue tests at one stress level involved the simultaneous bending and torsion of elements made of steel C45, subjected to various surfacing methods and various post-surface heat treatment as well as having surfaced

layers of various thicknesses. Fractures obtained in fatigue tests were subjected to visual and scanning microscopy-based analysis. The article presents the results of the above-named analysis and related concluding remarks.

## A.V. Moltasov, S.I. Motrunicz – Tests of Local Stresses in the Geometric Heterogeneity Area of Butt Welded Joints with One-Sided Excess Weld Metal

**DOI:** *10.17729/ebis.2017.4/5*

The article is concerned with the development of analytical testing method related to stresses in stress concentration areas in butt welded joints with one-sided excess weld metal. The innovativeness of this research work consists in taking into consideration the shift of joint cross-section centres of inertia located in the excess weld metal area. The research led to the obtainment of formulas describing stresses in geometric heterogeneity areas triggered by tensile force and bending moment induced by the shift of the inertia centre. The formulas obtained in the research coincide with the results of stress-related numerical modelling. It was ascertained that an increase in eccentricity combined with the distance from the excess weld metal base could lead to greater stresses in the weld root area than those on the weld face side. The research involved the performance of fatigue tests in the high-cycle area of TIG butt welded joints of sheets made of aluminium alloy 1460. It was ascertained that in the specimens having the gentle toe (between the weld and the base material) the crack was initiated in the weld root, which was consistent with calculation-based forecast.

## A. Sawicki, M. Haltof – Determination of Parameters of Selected Mathematical Models of Arc in Circuits with Actual Energy Sources

**DOI:** *10.17729/ebis.2017.4/6*

The article provides general justification concerned with the performance of simulation tests of processes in circuits. The simulation tests aimed to identify the effectiveness related to the use of modified integral methods used in the experimental determination of parameters of arc mathematical models. In addition, the article specifies conditions for the performance of experiments, i.e. involving the numerical or physical elimination of near-electrode arc voltage drops. The research described in the article also involved the modification of integral dependences into HL-type (hyperbolic-linear) parameters of the Mayr and Pentegov models by providing the above-named dependences with corrective functions. The performance of simulations of processes in circuits with arcs and with actual energy sources (with a variable parameter, i.e. internal inductance) generating sinusoidal current or voltage waves, resulted in the obtainment of diagrams of the family of correction factor function. Those of the above-named functions which significantly differed from unity were subjected to approximation.

## P.N. Tkacz, A.W. Moltasow – Development of a Method for the Assessment of Stresses in Welded Structures. Part 1. Conventional Methods

**DOI:** *10.17729/ebis.2017.4/7*

Various machinery parts or welded structure elements are characterised by significant cross-sectional changes along their length, leading to locally increased or accumulated stresses. The concentration of stresses is often of vital importance when determining structural stresses and strains, affects the service life of elements exposed to cyclic loads as well as influences the initiation and propagation of fatigue cracks. The article is an overview of works concerning conventional methods enabling the determination of maximum local stresses present in the stress concentration area triggered by the geometrical shape of welded joints.

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