

ISSN 2300-1674

BIULETYN

INSTYTUTU SPAWALNICTWA



Łukasiewicz
Instytut
Spawalnictwa



No. 3/2021

INSTITUTE OF WELDING BULLETIN
BIULETYN
INSTYTUTU SPAWALNICTWA

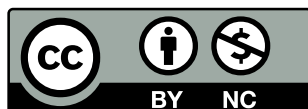
No. 3

BIMONTHLY

CONTENTS

- **Electron Beam Melting of Thermally Sprayed Layers – Overview**
Marek St. Węglowski, Robert Jachym, Krzysztof Krasnowski, Krzysztof Kwieciński, Janusz Piłkuła, Piotr Śliwiński 7
- **High-Performance Methods for Welding Steel P460NL2**
Marcin Kempa..... 21
- **New Weldable Steel for Rebars**
Stanisław Klusek, Piotr Sędek, Kamil Kubik..... 29
- **Quality Criteria for G3Si1 and G4Si1 Electrode Wires**
Eugeniusz Turyk..... 39
- **Selected Properties of High-Frequency Electric Arc Initiators and Stabilisation Oscillators. Part 2. Devices with Compressed Electric Arc**
Antoni Sawicki 49
- **Unconventional Methods of Non-Destructive Tests. Part 3**
Łukasz Rawicki..... 61

This work is licenced under



Creative Commons Attribution-NonCommercial 3.0 License



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



Summaries of the articles

Marek St. Węglowski, Robert Jachym, Krzysztof Krasnowski, Krzysztof Kwieciński, Janusz Pikuła, Piotr Śliwiński – Electron Beam Melting of Thermally Sprayed Layers – Overview

DOI: [10.17729/ebis.2021.3/1](https://doi.org/10.17729/ebis.2021.3/1)

Thermal spraying is one of the most common methods enabling the deposition of variously-purposed layers on surfaces of structural elements. However, in certain cases, the process of spraying itself is ineffective in terms of the stability and properties of protective layers. One of the possible solutions making it possible to reduce the porosity and improve the adhesion of surfaced layers involves their melting using the concentrated electron beam. The article contains an overview of reference publications concerning electron beam melting technologies.

Marcin Kempa – High-Performance Methods for Welding Steel P460NL2

DOI: [10.17729/ebis.2021.3/2](https://doi.org/10.17729/ebis.2021.3/2)

The article discusses comparative test results concerning two welding methods, i.e. SAW and MAG. The tests involved the making of welded joints in steel P460NL2, the verification of the chemical composition of supplied steel, the comparison of the quality of joints (in accordance with PN-EN ISO 5817) as well as the performance of macroscopic tests and the comparison of mechanical properties and hardness.

Stanisław Klusek, Piotr Sędek, Kamil Kubik – New Weldable Steel for Rebars

DOI: [10.17729/ebis.2021.3/3](https://doi.org/10.17729/ebis.2021.3/3)

A new steel grade, developed at the CELSA steelworks in Ostrowiec Świętokrzyski and used in the production of rebars, contributes greatly to the development of industrial and civil engineering. Steel B600B is characterised by yield point $f_{yk} = 600$ MPa and immediate

tensile strength $f_{tk} = 700$ MPa. Tests revealed that the steel satisfies all requirements of related standards, both in terms of strength and processing properties. The mechanical properties of the new steel grade are higher by 20% than those of currently produced steels characterised by the highest mechanical properties (characteristic yield point $Re = 500$ MPa). As a result, the application of the new steel provides notable technical and economic advantages. The new steel grade meets requirements concerning technical class C in accordance with PN-EN 1992-1-1, which indicates that the steel has a significant yield point margin (being an important advantage in terms of limit state design). Plastic steels are easier to weld and less susceptible to welding crack formation. Technological (research-related) tests revealed the favourable welding properties of the new steel. Welding tests were performed using the manual metal arc welding method, i.e. the most common welding process used when making structural reinforcements. The welding tests involved the making of butt, overlap and cruciform joints. The strength and technological tests revealed that the steel satisfied the requirements specified in the PN-EN ISO 17660-1 standard.

Eugeniusz Turyk – Quality Criteria for G3Si1 and G4Si1 Electrode Wires

DOI: [10.17729/ebis.2021.3/4](https://doi.org/10.17729/ebis.2021.3/4)

The article presents test results concerning the quality of ISO 14341-A-G3Si1 and G4Si1 electrode wires based on electrode wire-related quality criteria in accordance with the requirements specified in the PN-EN ISO 14341 and PN-EN ISO 544 standards. The article discusses the critical defects of the wires (non-compliances with standard requirements) as well as defects not covered by the requirements of the standards, yet decisive as regards the assessment of electrode wires by the user.

Antoni Sawicki – Selected Properties of High-Frequency Electric Arc Initiators and Stabilisation Oscillators. Part 2. Devices with Compressed Electric Arc

DOI: [10.17729/ebis.2021.3/5](https://doi.org/10.17729/ebis.2021.3/5)

The second part of the overview article discusses general features of the design and operation of selected industrial arc plasma torches. Because of their structural and operating differences, plasma torch power supply systems with internal and partly external arc are discussed separately. Particular attention was paid to the design of electric systems used for the initiation of arc discharges. Because of the fact that the operation of plasma torches with partly external arc is often accompanied by the formation of double arc, the article also presents measures and methods enabling the prevention of the aforesaid unfavourable phenomenon. In

addition, the article discusses selected technological properties of plasma torches and micro-plasma torches used for joining, cutting, surfacing and hardening.

Łukasz Rawicki – Unconventional Methods of Non-Destructive Tests. Part 3

DOI: [10.17729/ebis.2021.3/6](https://doi.org/10.17729/ebis.2021.3/6)

The article presents some testing methods applicable in the aviation industry. In addition to popular non-destructive methods, NDT methods used in the aviation industry (and discussed in the article) include optical holography or shearography. Structural materials used in the aviation industry as well as the importance of analyses, both at the manufacturing stage and during operation, require the performance of regular tests as a negligent approach to such activities could end up in a catastrophe.

Biuletyn Instytutu Spawalnictwa

ISSN 2300-1674

Publisher:

Lukasiewicz - Instytut Spawalnictwa

Editorial Board:

Editor-in-Chief: dr hab. inż. Mirosław Łomozik

Deputy Editor-in-Chief: dr hab. inż. Zygmunt Mikno

Editorial Secretary: mgr Marek Dragan

Honorary Founder Editor: Prof. dr hab. inż. Jan Pilarczyk

Editorial Team:

Technical Editor: mgr Joanna Gubernat

Proofreader of Text in English:

mgr Barbara Dobaj-Tumidajewicz

Proofreaders of Scientific Text in Polish:

mgr inż. Antonina Ślęzak, mgr Justyna Szmyt

Translator: mgr Wojciech Cesarz

Section Editors (in alphabetical order):

Prof. Janusz Adamiec (Silesian University of Technology, Katowice, Poland) – New and advanced materials

Dr inż. Krzysztof Krasnowski – Destructive testing in welding engineering

Dr inż. Michał Kubica – Training and certification in welding engineering

Dr inż. Dawid Majewski – Brazing and soldering

Dr inż. Jolanta Matusiak –

Ecology in welding engineering

Dr inż. Jerzy Niagaj – Welding consumables

Dr inż. Tomasz Pfeifer – Arc welding technologies

Dr inż. Adam Pietras – Resistance and friction welding processes

Dr inż. Janusz Pikuła – FEM analysis in welding engineering

mgr inż. Adam Pilarczyk – IT systems for welding technologies

Prof. Jacek Słania – Non-destructive testing in welding engineering

Dr inż. Sebastian Stano – Robotics and laser welding processes

Dr hab. inż. M. Stępień, Prof. at Silesian University of Technology – Welding equipment and monitoring of welding processes

Dr inż. Aleksandra Węglowska – Adhesive bonding

Dr inż. Marek St. Węglowski – Electron beam welding technologies and surface engineering

International Scientific Committee

(in alphabetical order):

Dr Fernando Mañas Arteché – General Manager of Asociación Española de Soldadura y Tecnologías de Unión (CESOL), Spain

Dr Peter Brziak – Director of the Research and Development at the Welding Research Institute, Bratislava, Slovakia

Dr Luca Costa – Istituto Italiano della Saldatura, Genova, Italy, Chief Executive Officer International Institute of Welding (IIW)

Prof. Dorin Dehelean – Executive Director of Romanian Welding Association, Timisoara, Romania

Prof. Stanisław Dymek – AGH University of Science and Technology Kraków, Poland

Dr hab. inż. Dariusz Fydrych, Prof. PG – Gdańsk University of Technology, Gdańsk, Poland

Dr hab. inż. Grzegorz Golański, Prof. PCz – Częstochowa University of Technology, Częstochowa, Poland

Dr hab. inż. Jacek Górka, Prof. Pol. Śl. – Silesian University of Technology, Gliwice, Poland

Prof. Carter Hamilton – Miami University, Oxford, USA

Prof. Andrzej Kolasa – Warsaw University of Technology

Prof. Slobodan Kralj – Faculty of Mechanical Engineering and Naval Architecture, Department of Welded Structures, University of Zagreb, Croatia

Prof. Igor Vitalievich Krivtsov – Director of the E. O. Paton Electric Welding Institute, Kiev, Ukraine, academician of the National Academy of Science of Ukraine

Prof. Jerzy Łabanowski – Gdańsk University of Technology, Poland

Prof. Leonid M. Łobanov – E. O. Paton Electric Welding Institute, Kiev, Ukraine, academician of the National Academy of Science of Ukraine

Dr Cécile Mayer – Institut de Soudure, Yutz, France

Dr hab. inż. Krzysztof Mroczyk, Prof. UP – Pedagogical University of Kraków, Poland

Prof. Tomasz Węgrzyn – Silesian University of Technology, Poland

Dr hab. inż. Adam Zieliński – Director of Łukasiewicz – Institute for Ferrous Metallurgy, Gliwice, Poland



Łukasiewicz
Instytut
Spawalnictwa