International Scientific-Technical and Production Journal





Published Monthly Since 2000

English translation of the monthly «Avtomaticheskaya Svarka» (Automatic Welding) journal published in Russian since 1948

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Address E.O. Paton Electric Welding Institute, International Association «Welding» 11 Kazimir Malevich Str. (former Bozhenko Str.), 03150, Kyiv, Ukraine Tel.: (38044) 200 60 16, 200 82 77 Fax: (38044) 200 82 77, 200 81 45 E-mail: journal@paton.kiev.ua www.patonpublishinghouse.com

State Registration Certificate KV 4790 of 09.01.2001 ISSN 0957-798X DOI: http://dx.doi.org/10.15407/tpwj

Subscriptions \$348, 12 issues per year, air postage and packaging included. Back issues available.

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Avtomaticheskaya Svarka Journal is 70



March, 1948 is believed to be the time of birth of the Journal, when the first issue of the collection «Transactions on Automatic Submerged-Arc Welding» was published.

Academician Evgeny Oscarovich Paton was the initiator of its publication. The collection publication became systematic and in June, 1950 it was transformed into «Avtomaticheskaya Svarka» (Automatic Welding) Journal — a monthly publication of the E.O. Paton Electric Welding Institute.



Appearance of collections, and then also of the Journal was pre-

ceded by issue of individual brochures on the topics of the work of the Electric Welding Laboratory, and then also the Electric Welding Institute. Academician E.O. Paton always attached great importance to operative scientific and technical information. The new specialized periodical was created with the purpose of regular coverage of research results and experience of practical application of the rapidly developing technologies of welding metallic materials. Compared to regular academic journals it featured broad coverage of the considered problems — from deep scientific research up to practical application of their results in various branches of the national economy.

Appearance of «Avtomaticheskaya Svarka» Journal immediately attracted the attention of all those interested in welding, and specialists of not only PWI, but also many other USSR research institutes, plants and enterprises become its authors.

From 1959 till 1986 the English version of «Avtomaticheskaya Svarka» Journal was published by the British Welding Institute under «Automatic Welding» title. In the period from 1991 till 1999 the Journal was reedited in Great Britain by private publisher Riecanksy under the title «The Paton Welding Journal». Since 2000 its publication at PWI under the same title was organized.

During the first several years the Journal, in keeping with its title, published predominantly the investigation results and experience of application of automatic submerged-arc welding. The fundamentals of the theory of welding and welded structures were established taking this technological process as an example. At the same time, starting from the very first issues, other welding processes, as well as related processes, were given due attention on its pages. However, even later the Journal retained its initial title of «Avtomaticheskaya Svarka», as a tribute to the tradition established by its founder Evgeny Oscarovich Paton.

During these years papers, devoted to study of the causes for brittle fracture, evaluation of weldability of carbon and low-alloyed steels, non-ferrous metals and alloys, were published. These and subsequent studies led to formation of scientific ideas about welding as a metallurgical process, substantiation of the need to develop new structural steels and alloys, allowing for process and metallurgical features of welding.



The Journal covered the work on fundamentals of the theory of automatic regulation, considering the arc power source, consumable electrode, feed mechanism and the arc as one system; on creation of equipment for mechanized welding processes. After the death of E.O. Paton in August,



1953, the Editorial Board was headed by Boris Evgenievich Paton. During the subsequent years the range of publication subjects was widened. In particular, the Journal started publishing information about application of welding heat sources to produce super high quality metallic materials. This second main scientific direction of PWI activity has been covered in another publication of the Institute since 1960s — «Problemy Sovremennoj Elektrometallurgii» Journal (now «Sovremennaya Elektrometallurgiya»).

Starting from 1960s, in connection with the fact that PWI was entrusted with the functions of the head organization on welding and special electrometallurgy in the USSR, the Coordination Council on Welding, Scientific Council of USSR SCST, and Scientific Council of USSR



AS were set up at the Institute. The Journal started publishing materials on organization of welding production, coordination of scientific research, problems of information, training welding specialists, etc.

Journal publications had considerable influence on development of fabrication of welded structures and products for power, heavy and chemical engineering, in industrial construction, rocket-, shipbuilding, railway and pipeline transportation, tank building, radio electronics and many other fields of modern engineering.

Reflecting the results of achievements of PWI and other organizations, the Journal was the first in the world to highlight many outstanding developments and followed-up their progress. The following should be regarded as such developments:



Space Technologies





Electroslag Welding Plasma Technologies



Laser Technologies

Pressure Welding

Explosion Welding

• arc welding with forced formation of the weld, allowing application of mechanized welding in site;

• electroslag welding, which allows producing single-pass joints of items of practically unlimited wall thickness, and which was the base for one of the new metallurgical process*es* — *electroslag remelting;*

• technology of sheet structure fabrication by coiling;

• technology of fabrication of multilayer structures:

• technology of fabrication of forge-welded and cast-welded structures:

• CO₂, welding with small-diameter wire as one of the most widely accepted methods of mechanized welding up to now;

• welding over activating flux and with activated wire;

ISSN 0957-798X THE PATON WELDING JOURNAL, No. 3, 2018

Proceedings of the International Conferences







Welding Consumables



Modern Welding Technologies



Surfacing. Science. Production. Prospects



Robotization and Automation

• consumable electrode pulsed-arc welding, which is especially effective in manufacturing aluminium alloy products;

• multielectrode arc welding into a common pool which became the main technology in industrial production of large-diameter pipes;

• continuous flash-butt welding of rails, pipes and other items of a large cross-section, which allows solving a number of complex and important engineering problems;

• electron beam welding which turned out to be highly efficient in fabrication of critical thick-walled items;

• vapour-phase technologies with electron beam heating;

• microplasma welding — for items of thickness from hundredth of a millimeter up to 1 mm;

• underwater mechanized welding in «wet» variant;

• plasma cutting;

• explosion welding and cutting;

• technology of manufacturing cryogenic engineering products based on modern high-alloyed steels;

• welding in space;

• *electric arc surfacing with alloys improving service properties of items;*

• welding of dissimilar composite materials;

• plasma and thermal spraying of protective and other materials on products.

The Journal systematically publishes the results of studying the physical features of diverse phenomena occurring in the molten metal; application of various heat sources; studying the interaction of molten metal with gases and slags, as a base for creation of efficient welding consumables; hygiene and labour safety in welding production.

On the pages of «Avtomaticheskaya Svarka» Journal one can find extensive information about welding processes and properties of welded joints of alloys based on iron, aluminium, copper, nickel, titanium, niobium and other metallic materials, as well as plastics, ceramics, etc. The breadth of factual data and depth of investigation of the structure and properties of various materials allow us to consider the Journal not only a welding, but also a materials science publication.

Many published articles reflect the results of studying the residual stresses and strains, as well as the methods to reduce them. The Journal regularly publishes articles on the subject of strength of welded joints and structures. This work resulted in development of efficient methods of determination and controlling the stress-strain states, methods of flaw detection and diagnostics of welded structures. At present developments related to monitoring and diagnostics of diverse weldments, are published in one more PWI Journal — «Tekhnicheskaya Diagnostika i Nerazrushayushchij Kontrol», issued since 1989.

It should be noted that in 1960s and 1970s the number of publications devoted to development of new and improvement of traditional kinds of welding consumables — electrodes, wires, fluxes, and organization of their mass production, has greatly increased in the Journal.

During the same period, the Journal systematically published articles on automatic control of welding processes, many of which can be regarded as pioneering, as well as investigation of power systems and peculiarities of design of electric welding machines. Readers are regularly provided with information on development of new samples of welding equipment and consumables.

Information about coating processes, coating properties, and development of materials required for this purpose, appears more and more often on the Journal pages.

Journal circulation during these years reached 8000 copies. It is received on a subscription basis in many countries of the world.

In 1992 «Avtomaticheskaya Svarka» acquired the status of international scientific-technical and production journal. Its editorial board includes leading specialists from Germany, Israel, China, Poland and RF.

In the new millennium «Avtomaticheskaya Svarka» Journal, similar to many other scientific journals, is going through difficult times, but it still continues to act as the initiator of qualified informing of welding production specialists about the status and development of individual technologies of welding production. Thematic issues of the Journal in the areas of «Electroslag Welding» (No.9, 1999), «Space Technologies» (No.10, 1999), «Plasma Technologies» (No.12, 2000), «Laser Technologies» (No.12, 2001), «Pressure Welding» (No.7, 2002), «Explosion Welding» (No.11, 2009) are published, as well as Journal issues which are the proceedings of International Conferences on «Welded Structures» (Nos 9–10, 2000), «Current Problems in Welding and Life of Structures» (Nos 10–11, 2003), «Welding Consumables» (Nos 6–7, 2014), «Surfacing. Science. Production. Prospects» (Nos 5–6, 2015), «Modern Welding Technologies» (Nos 5–6, 2016), and «Robotization and Automation of Welding Processes» (Nos 5–6, 2017). Individual issues of the Journal contain selections of articles of scientists and lecturers, devoted to jubilees of welding departments and profile chairs of technical universities of Ukraine. The Journal describes best practices and major developments of leading West European and US companies, many of which founded subsidiary companies in Ukraine in this period.

Over the 70 years the Journal has published more than 12 thousand papers, dealing with different problems of welding production and all the aspects of the science of welding, as well as many problems of related technologies. A wide range of publications added up into a kind of chronicle, which allows judging the achievements and dynamics of development of welding science and technology over the 70 years. By the breadth and depth of coverage of the highlighted topics, the Journal issues can be considered a welding encyclopedia. The information contained in this publication has served and continues to serve scientific and technical progress.

At present «Avtomaticheskaya Svarka» Journal is presented in INSPEC (Great Britain), EBSCO (USA), Weldasearch Select (France) databases; Google Scholar (USA); Dzherelo (Ukraine), Svarka (Russia), Welding Abstracts (Great Britain) abstract journals; it is abstracted in Rivista Italiana della Saldatura (Italy); highlighted in reviews in Japanese Journal of Light Metal Welding, Journal of the Japan Welding Society, Quarterly Journal of the Japan Welding Society, Journal of Japan Institute of Metals, and Welding Technology journal. Starting from 2016 Journal articles are included into CrossRef, and are assigned DOI index (Digital Object Identifier). An urgent goal at the modern stage is Journal inclusion into international scientometric bases. The archive of articles from «Avtomaticheskaya Svarka» Journal in Russian and in English has been open access on the Journal web-site www.patonpublishinghouse.com/rus(eng)/journals/as since 2000.

Welding processes in the third millennium still remain a key technology of joining materials and creating structures. They will be further improved through development of high-efficient automated and robotic energy-saving technologies. And «Avtomaticheskaya Svarka» professional Journal will still have an important role of informational support of welding production professionals.

Journal Editorial Board

Poland Institute of Welding in Gliwice



Building of Welding Institute in Gliwice

The Poland Institute of Welding has started its operation in a period directly after the end of the Second World War. The Institute was founded in 1945, and its first task was training of gas- and electric welders, which were desperately necessary for the country ruined as a result of war.

Since 1949 the Institute started to be transformed into a scientific-and-research organization. The first research departments were created. They solved the problems in the field of welding technologies, weldable materials and consumables.

The deciding step in the Institute development was formation in 1954 a department on design of welding and auxiliary equipment as well as department of pro-

totypes of welding equipment. After the war the material resources of welding engineering in Poland included only one plant on welding electrode production, one factory on manufacture of gas welding equipment and several tens of enterprises on production of oxygen and acetylene. There was no production of electric equipment for welding at all and the most widespread method of joining in manufacture of heavy steel structures (boilers for power engineering, vessels, ships, bridges) was riveting.

Both departments were located in the Institute premises. Their first achievements were development of a series of pressure resistance welding machines of 2, 6 and 10 kV·A power for wires and acetylene vessel valves as well as 500-ampere welding transformer based on Soviet sample of that period. Two years later both departments were joined in one titled a department on welding equipment production (ZBUS), which designed and developed the prototypes of welding engineering in Poland. Replicated and improved prototypes were sent into serial production at commercial enterprises created in Poland. The examples of the first prototypes are welding transformers, welding power sources based on internal combustion engines, high-pressure acetylene generators, automatic machines for electroslag welding, semi-automatic machines for oxygen cutting, machines for resistance butt welding of rods and tubes, oxygen reducing units including mains ones, flux collectors, devices for welding wire winding and many others.

Due to systematic and purposeful work, all the conditions were created in the Institute for successful development of modern welding engineering in Poland. At the end of 1958–1959 the Institute had an effective system of training and education of welding staff, department on design and manufacture of welding equipment, a team of researches carrying multiple investigations in the field of welding as well as the whole complex of premises and laboratories equipped with not bad equipment and apparatuses for researches. In this period the leaders of the country after carrying the evaluation of work of industrial research centers, took a decision that the Welding Institute should keep the status of the research institute.

The Institute has been carrying multiple, very interesting and quite often complex research works since 1960. Different welding equipment was also developed and manufactured in great volumes.

A bright example can be a flow line, including 12 welding automatic machines, for automatic welding of walls of coal vessel carriages at wagon works. The line was implemented in industry in 1962. The Institute organized the conferences and meetings of the welding specialists, during which the Institute staff presented their reports. It was the period when the first foreign business trips took place, including for participation in the congresses of the International Institute of Welding, in which the Welding Institute in Gliwice is the official representative of Poland since July 1, 1956.

The next expansion of the Institute took place in a period of 1966–1968. Earlier existing and constructed close to them buildings have been modernized a lot of times after that, but they are successfully used in that layout and size up to the moment.

In 1968 the Institute was the organizer of the XXI Congress of the International Institute of Welding. The chairman of Organizing Committee was Prof. Jozef Pilarczyk, the main founder of the Institute in 1945 and its Director for many years. In 1967 Prof. Jozef Pilarczyk decided to concentrate only on activity of a welding chair of the Silesian University of Technology as its leader, keeping at that the position of the chairman of Scientific Council of the Welding Institute.

A lot of new had appeared in the 1970th. In this period Poland got the foreign credits, which in addition to other was used for construction of many modern for that time enterprises as well as promoted significant technological progress. A series of new methods of fusion and pressure welding appeared in the field of welding engineering and the Institute intensively worked with them. The investigations were carried out on CO_2 welding, then in gas mixtures, plasma welding and cutting, electroslag and electrogas welding, friction welding, mechanized and automatic thermal cutting etc. In parallel a wide spectrum of investigations was carried out in the field of weldability of a series of modern structural steels, which were manufactured by Poland metallurgical industrial complexes, as well as consulting services and surveillance of performance of critical welded structures was provided when realizing large investment programs. Multiple stations and lines for mechanized welding and cutting were developed and implemented in commercial production. Significant changes also took place in the field of science due to funding of large research projects within five-year periods directed on so-called key problems (later on Central Research Programs) covering a wide topics of the whole branches. The Institute actively participated in these programs realizing.

An important event in the Institute live was organizing and realizing in cooperation with the Silesian University of Technology the carrier enhancement courses for welder-engineers. The lectures and practical activities for course listeners took place in the Institute premises and the staff members of the Institute with rich scientific and production experience performed duties of the trainers. The courses were hold during 10 years till 1980.

The 1980th were difficult years in the Institute live. A martial law declared in Poland on December 13, 1981, heavy social and political situation, dramatic reduction of commercial production, loss and break of connections, dismissal of large amount of staff members, retirement or termination on health grounds, all these result in the fact that the work in the Institute was performed with jerks, irregularly, and financial situation was very bad that adversely affect low salaries and absence of investments for development. Staff problems were also great, which were explained by absence of young engineers. The consequences of this situation was observed for a long time since in a course of several years the Institute was lack of staff members brought up in the Institute and inspired by its patriotism.

Regardless the difficulties in 1981–1985 the Institute continued coordination of the key problem «Methods and means of mechanization and automaton of welding works» and in 1986–1990 the Central Scientific-Research Program «Welding technologies». Together with the Institute all the most significant scientific-and-research Poland centers working in the field of welding were engaged in these programs realizing.

The Institute has started functioning in completely new conditions since 1990. In 1989 Poland turned to the way of free development and passed from center-controlled low-effective socialistic economy to competitive market economy. Everyone was dreaming about such changes, however, not everybody realized the principal difference between the life in modest, but nevertheless socially guaranteed conditions of socialist state, and life probably on higher level under market economy conditions, that, though was related with heavy and responsible every day work.

In 1990 the Institute was the innovative institute. The same year a decree about such enterprises was published. It provided them larger freedom of action, but simultaneously formed the grounds for complete self-financing and responsibility for taken decisions. Thus, the funds stopped arriving on the Institute accounts for their functioning and corresponding ministries providing in the last vital activity and surveillance over these organizations, remained only as their founders. A lot of scientific-and-research institutes couldn't survive under such new conditions.

The changed decree on the innovative institutes indicated that new director would not be appointed anymore, but should be selected for a position by running a competition, besides the period was not unlimited anymore, but made 5 years. The Director should express the agreement to take up the position not by order, but based on his/her own choice with complete understanding that the destiny of the Institute is determined based on his/her individual decisions.

As a result of first in the history carried competition the Director of the Institute on November 1, 1990 became Prof. Jan Pilarczyk, son of Prof. Jozef Pilarczyk. The Institute started rapidly adapting to new situation passing the difficult way from flexible transformation and work in accordance with the principles of free competitive market. Big rearrangement of the Institute covered the organization structure, personnel, activity topics, available equipment and condition of the premises.

The Institute buildings constructed in a period from 1945–1970 were fundamentally modernized in 1990–2015 and got a new modern appearance and were filled with state-of-the art apparatuses and equipment. All the elements of Institute infrastructure were also repaired. New staff, which could work on new principles taking into account new requirements, was searched.

The Institute intensified its activity directed on development and improvement of different methods of welding and welding technologies, structural materials, welding consumables and equipment as well as made the new steps, exclusively in the field of welding, bringing income to the Institute. Among them are training of welding personal in accordance with national and European programs, surveillance of welding education in Poland, evaluation and certification of the enterprises producing welded structures, performance of the tests in certified and accredited laboratories, examination and qualification of welding technologies, certification of welding products, personal and quality systems, development of PN-EN standards, implementation in practice the rules and legal acts as well as elaboration of instructions and requirements. Simultaneously, the Institute stopped development and implementation in commercial production of welding equipment, stations and production lines for mechanized and automated welding and cutting. Professional welding companies, Poland and foreign ones, which stated to appear in Poland, became engaged in these matters.

The main task of the Institute. i.e. work in accordance with the principles and requirements of the free market, was expanded by no less important second task, namely rearrangement of Institute functioning taking into account European standards. European Union was formed in 1992 and Poland got the status of observer-state. A series of European organizations appeared in scope of the Union. One of them was the European Welding Federation (EWF). The main task of the Federation was creation of the single system of training and education of welding personnel recognized by all partners. The system was then distributed due to cooperation with the International Institute of Welding in the countries out of the European Union borders, and in 2001 was recognized as a global system for welding staff training. The Welding Institute as an exclusive body in Poland was included in a harmonized system for education, testing, qualification and certification of welding personnel and had the right to issue European and international diplomas and certificates to the enterprises and welding staff. Several thousand of such documents have been issued up to the moment. They allow enterprises to function in European market and struggle for receiving export contracts.

On October 1, 2010 the Institute changed the status from «innovative» to «research». It became possible due to acceptance of a new decree on research institutes.

The Institute is equipped with very good level modern equipment and apparatuses, which are not inferior to similar in the welding institutes all over the world. The Institute has got up-to-date equipment for arc welding, very good lasers with wide spectrum of possibilities for performance of welding, cutting and many other related processes, new unit for electron beam welding, machines for modern pressure welding by all methods, equipment for brazing and, besides, wide spectrum of reference and measurement devices as well as unit and software for welding thermal cycles simulation. The Institute has good data base, which was developed in course of last decades, and creates good working conditions for all members of the Institute providing direct contact with all the most important clients and external partners.

The Institute realizes a series of research projects in cooperation with the National Research Center and National Science Center as well as many industrial partners and foreign research centers. After more than 70 years of active work, the Welding Institute in Gliwice can be proud of a series of meaningful achievements. Such a progress in the research departments, laboratories and centers of the Institute were received due to fruitful and self-denying work of several generations of the Institute staff.

Prof. Jan Pilarczyk

WELDING OF TITANIUM

AND ITS ALLOYS

A team of experts in the field of welding of titanium and alloys on its basis has been working at PWI for more that 30 years. For the first time in the world the unique technologies of non-consumable argon-arc welding of titanium with halogenide fluxes; narrow-gap argon-arc tungsten electrode welding with controlling magnetic field; press welding of titanium with copper and aluminum with steel were developed in course of these years.

The technologies for titanium and its alloys welding developed at the PWI have found wide application in aircraft- and rocket construction as well as at enterprises of chemical machine building of CIS countries. Currently, PWI fulfills contract-based complex works on development of technology and equipment for titanium welding and engineering maintenance at manufacture of specific products.



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MICROPLASMA SPRAYING OF BIOCOMPATIBLE COATINGS ON IMPLANTS

PWI has developed a technology and equipment of microplasma spraying of biocompatible coatings on the surface of different implants, including hip implants, dental implants, intervertebral cages etc.

This technology allows depositing coatings from hydroxyapatite powder (HA), titanium cellular coatings as well as double-layer biocermet (titanium-hydroxyapatite) coatings. Spraying of biocompatible coatings is done on microplasma spraying unit MPN-004. PLASMATRON FOR SPRAYING OF COATINGS Pub. No.:WO/2004/010747, International Application No.: PCT/UA2003/000014, Publication date: 29.01.2004. (IRP4).



Unit for microplasma spraying MPN-004 with powder batchbox

Spraying of Ti-layer with regulated porosity (5–30 %, pore size 50–300 μ m) and minimum oxidation level is carried out by means of microplasma spraying of Ti-wire. Combination of cellular Ti-coating with external HA layer provides coating cohesion strength with implant surface satisfying ISO 137779-2 and high level of biocompatibility.

> Based on complete complex of mechanical and biomedical tests the implants with microplasma biomedical coatings are used in practice for hip replacement.



a b c Products with biocompatible coatings made by microplasma spraying: *a* — parts of hip implant; *b* — cermet implant for interbody spinal fusion; *c* — dental implant

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«The Paton Welding Journal» is Published Monthly Since 2000 in English, ISSN 0957-798X, DOI: http://dx.doi.org/10.15407/tpwj. «Avtomaticheskaya Svarka» Journal (Automatic Welding) is Published Monthly Since 1948 in Russian, ISSN 005-111X, DOI: http://dx.doi.org/10.15407/as. «The Paton Welding Journal» is Cover-to-Cover Translation of «Avtomaticheskaya Svarka» Journal into English.

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