



ENGINEERING CENTER OF ELECTRON BEAM WELDING OF E.O. PATON ELECTRIC WELDING INSTITUTE

The Department 57 of «Physical Processes, Machinery and Equipment for Electron Beam and Laser Welding» of the E.O. Paton Electric Welding Institute of the NAS of Ukraine and the Engineering Center of Electron Beam Welding for many decades have been specialized in the development of electron beam welding (EBW) technologies for many advanced structural alloys, as well as in the development of equipment for EBW and related processes for aerospace industry, power and chemical engineering, instrument manufacture and medicine.

Main directions of activity:

- development of technology and processing methods of EBW of materials and products with a thickness of welding edges from 0.5 to 250 mm;
- study of physical processes in welding pool during joining different metals and alloys of up to 250 mm thick;
- development of repair technologies for aircraft engine components and gas turbines;
- development of additive technologies for manufacture of products of a set shape by using the methods of layer-by-layer filler electron beam surfacing in vacuum with the use of powder materials (EBM — Electron Beam Melting) and wire (DM — Direct Manufacturing), manufactured in Ukraine;
- development and production of equipment for implementation of additive technologies in industry;

- improvement of welding guns and power sources for EBW;
- development of software for control of EBW installations;
- development, manufacture, putting into operation, warranty and post-warranty maintenance of electron beam equipment in accordance with the customer specifications and designated purpose of products on the territory of Ukraine, Europe, America and Asia;
- using of the own production facilities for manufacturing experimental batches of parts and assemblies for which the use of EBW is the optimal solution.

In recent years, a new generation of electron beam installations developed by the E.O. Paton Electric Welding Institute on the base of a model-oriented control has been mastered at twenty enterprises of aerospace and power industries, as well as at mechanical engineering enterprises in the USA, China, South Korea and India.

All the installations developed and delivered by the Department can be divided into several types according to the volume of a welding chamber: «small», «medium», «large» and «superlarge». At the same time, a characteristic feature of the installations, developed for EBW of large-sized parts is intrachamber mobile electron beam gun, which has from 3 to 5 axes and positioning accuracy of not worse than 0.08 mm.



General appearance of production area



Small-sized electron beam installation

This, of course, allows maximizing the capacity factor of internal volume of the vacuum chamber.

The presence of the 2000 m² production area, equipped with a gantry crane with a lifting capacity of 5/30 tons allows performing assembly and adjustment of installations for EBW with a volume of vacuum chambers of up to 100 m³. If dimensions or mass of the vacuum chamber are beyond the admissible limit for transportation, then it is divided into sections with corresponding connecting flanges. The use of a box-like structure of walls and doors instead of a conventional T-shape structure provides a two times higher moment of inertia for the same thickness and, as a result, lower bending of the wall during pumping of the chamber. This, in turn, increases the accuracy of movement of the welding gun.

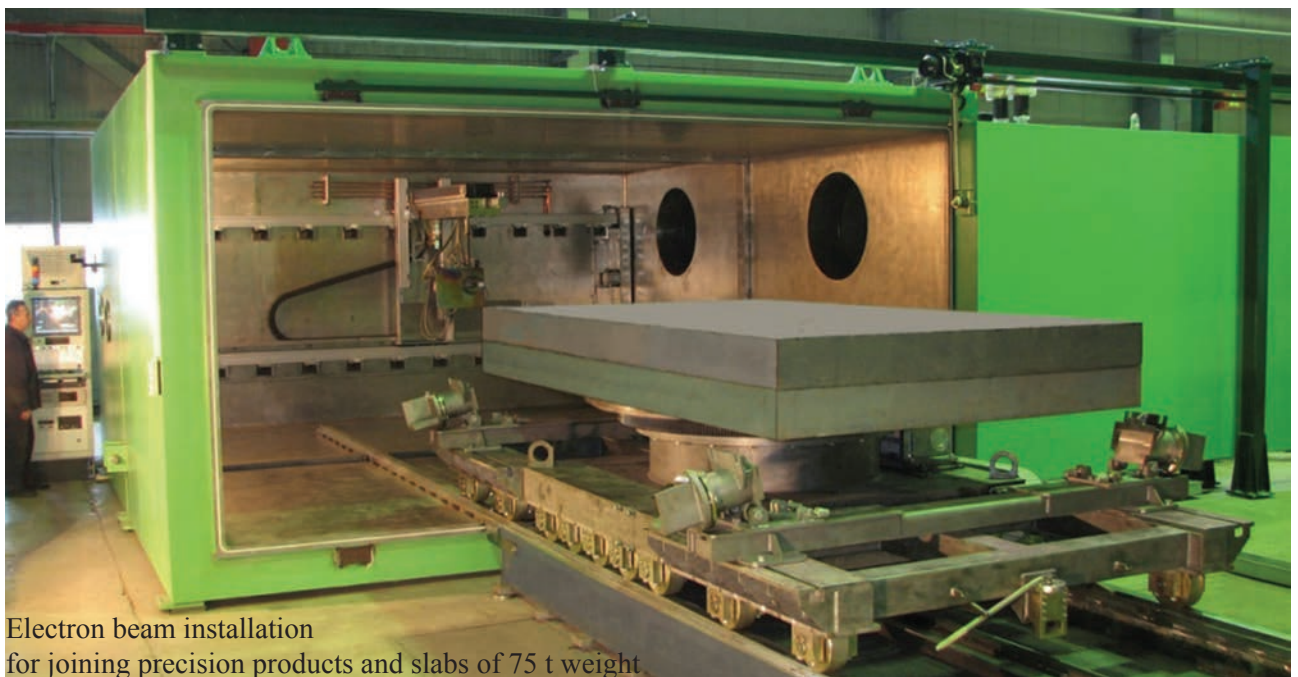
To control electron beam installations, distributed computer systems were developed and successfully used, for communication of whose elements industrial interface buses are used. For real-time monitoring and tracking of a joint, in the installations secondary emission RASTR electron systems are successfully used.

The power complexes of electron beam installations have high-voltage power sources and welding guns of up to 120 kW at an accelerated voltage of 60–120 kV.

In addition to the typical nomenclature of installations for specific tasks of the Customer, namely, dimensions and shape of components to be welded, type and location of welded joints in the component, PWI designs and manufactures many variations of dimensions of welding chambers, configurations of vacuum system, mechanism for moving electron beam gun and parts to be welded. Moreover, besides the equipment itself, the technology of welding structures is developed. It means that the Customer purchases the equipment together with the technology for EBW of specific parts.

By 2020, more than 150 sets of electron beam equipment have already been developed and delivered to different countries of the world. Our customers and partners are: Airbus Industry (France), Boeing (USA), British Aerospace (United Kingdom), Hitachi Works (Japan), MHI (Japan), GKN (USA), Halla Industrial Co. (South Korea), BIAM (China), The Harbin Institute of Technology (China), Doosan Heavy Industries & Constructions Co. (South Korea), Harbin Boiler Plant (China), SC SPKG «Zorya–Mashproekt», Lutsk Repair Plant «Motor», SE «Ukroboronprom», JSC «Motor Sich», PJSC «Poltava Machine-Building Plant», SE «Makarov Production Association Yuzhny Machine-Building Plant», SE Plant «Generator», etc.

Using the scientific potential of scientists of the National Academy of Sciences of Ukraine, the E.O. Paton Electric Welding Institute of the NAS of Ukraine is constantly improving the equipment and electron beam technologies in accordance with actual orders of industry.



Electron beam installation for joining precision products and slabs of 75 t weight