

K-SET: Paton Electron Beam welders are serviced by K+S Services, Inc. whose headquarters and repair facilities are located in Southgate, MI. There are 7 additional facilities located in North America where 150 service technicians are available to assist customers.

K S E T

Electron Beam Welding



PATON ELECTRIC WELDING INSTITUTE

Studying the possibilities of electron beam welding (EBW) and the principles of construction of equipment for electron beam welding, led by academician Boris Evgenyevich Paton, began at the E.O. Paton Electric Welding Institute (PWI) in 1958. It resulted in development of the first EBW laboratory-scale plant and welding facility for different small workpieces. One year later the method of electron beam welding turned out to be in great demand: in nuclear power engineering, in production of electric vacuum devices and liquid-fuel rocket engines. In 1961–1962 due to the effective coordination of work performed at the government level, the first production machines for electron beam welding were put into operation at a number of branch enterprises.

Within the next few years the application of electron beam welding became wider, first of all in the above mentioned industries, and simultaneously electron beam welding began to be accepted by aircraft and power engineering industry. In 1960-s PWI organized the full-scale production of power units, developing these (guns, power sources and control systems) on the basis of Sumy Factory of Electron Microscopes.

- *72 complete sets of power source units of SP-30 type (25 kV, 500 mA),*
- *330 complete sets of U-250A (30 kV, 450 mA),*
- *320 complete sets of ELA-60 (60 kV, 250, 500 and 1000 mA)*
- *ELA-120 (120 kV, 1000 mA) were manufactured in different periods of time.*

EBW is now firmly established in aerospace engineering, due to a possibility of reducing the weight and manufacturing time of critical products. Commissioning of more than 116 machines made by industrial organizations, with PWI participation, clearly demonstrates the successful application of EBW in this industry.

In 2010 there are currently eighty employees directly and exclusively engaged in electron beam welding at PWI working in our 3000 square meter facility. The scope of work is as follows:

- *Designing of mechanical and electrical sections of machines*
- *Development of electron guns, power sources and control systems*
- *Manufacturing the power units, welding guns, power sources and control systems*
- *Installing the produced machines for commercial operation*
- *Assembly and testing of complete machines and power units*

For the last 10 years, 56 complete sets of diverse EBW systems, including machines with up to 100 m³ volume of vacuum chambers, have been put into commercial operation and are being successfully used in multiple manufacturing industries now.

What is Electron Beam Welding?

- Electron beam welding is a reliable and cost effective method of joining a wide range of metals making the Electron Beam welding applications in industry almost limitless. The welding is performed in a vacuum, therefore welds are clean and free from oxidation.
- The attraction of the Electron Beam process is the high depth to width ratios that can be achieved.
- The beam is generated by an "Electron Gun", the stream of electrons travel at up to 60% of the speed of light. Its kinetic energy is converted into extremely high temperature on impact with the work piece. Because the power density (watts per square inch) is so high difficult welds can be performed.
- With low total energy input to the work piece distortion and deformation are reduced to an absolute minimum. The fusion zone is deep but very narrow as compared with other welding processes. Ratios as high as 20:1 are obtained.
- The high purity of the electron beam process permits welding of reactive materials that are very sensitive to contamination. Electrons have no chemical or material properties and because the welding is performed in a hard vacuum the fusion zone is kept contamination free.

Machine Features

RASTR: Real Time Automatic Seam Tracking

The control allows tight joint (less than 0.001") with no break edges to be tracked accurately at surface speeds of up to 4 meters per minute without pre-programming the path.

This electron beam controller becomes a Scanning Microscope when using the RASTR mode. Guide the weld path by quickly aligning true position with the electron beam, each point can be programmed with welding parameters and then stored in a file for production, or set the control for true precise automatic tracking.

This tracking system could also be used in combination with programmed path files to correct for minor deviations or weld distortion on very large assemblies.

Internal Moveable Guns

Internal moveable guns have positioning accuracy of +/- 0.0004" along coordinates on the X, Y and Z axis.

Internal 3 Gun Designs

The three gun is designed to reach three weld points at the same time or for quick change to a new hard to reach part position.

High Voltage Cables

Four power supply lines (acceleration voltage, bias, filament and bombardment) are contained in a single piece cable. This cable is small in diameter, light weight, very flexible and durable. The cable connects from the high voltage tank directly to the gun with no intermediate connections at the chamber penetration. This type of design minimizes the risk of damage and eliminates arcing at these points.

Supply Both High Voltage and Low Voltage Systems: 60Kv and 120Kv

We utilize a full range of kW power to fit the desired application

Control System

The system utilizes open architecture principles that provide PC use at all control levels. Microsoft graphics controls are incorporated to eliminate the operator learning any custom programming. Simply enter the parameters of the work piece. The system shows the piece then you answer questions on axis, movement etc. and the screen shows what the part will look like with the parameters entered.



RASTR KL134



Internal Gun KL115



3 Gun KL 117-013

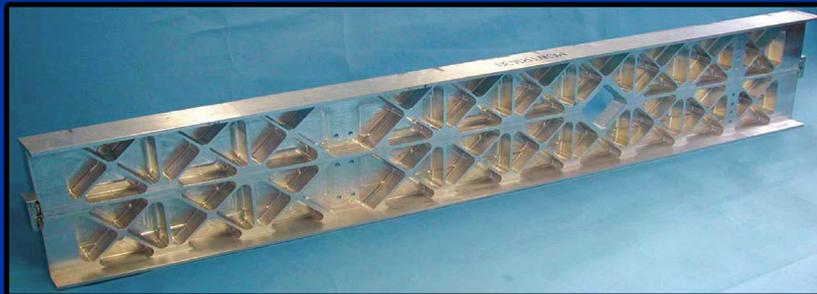


Graphic Controls

Special Parts

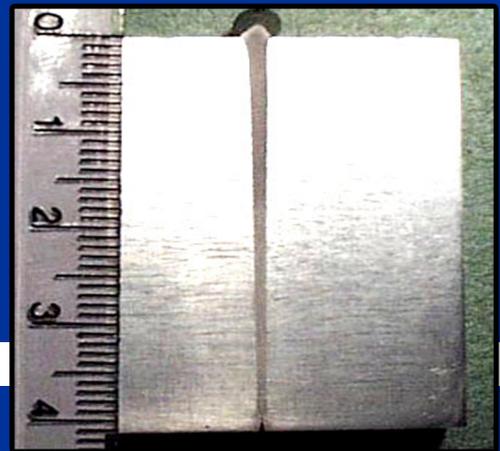


This is a special aerospace part EB welded in a model KL 115 system. There are multiple hard to reach welds made in several locations on the finished part. This was performed with one pump down. Machine is located in California, USA



An EB welded beam of a wing section made of high strength aluminum 4" (100mm) thick.

This picture shows the penetration of a high voltage EB weld in 4.000" thick high strength metal.



A highly efficient 3-gun machine Model KL 117 is used to EB weld the drill bits on three sides at the same time. This machine is located in Oklahoma, USA