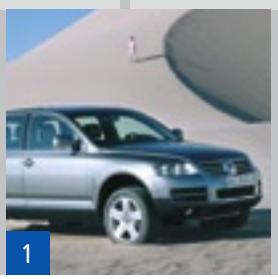
Electron beam systems – the wild card in the production line

equipment technology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1. Automobile business 2. Aircraft construction 3. Construction of machines and commercial vehicles

The advantages of pro-beam equipment technology

Productivity and profitability
- Short cycle times from utilizing multi-chamber and load lock concepts
- High degree of automation
- Can be fully integrated in production processes
- Low operating costs

Flexibility
- General-purpose systems for varying applications (technologies and part assortments)
- Single-purpose systems, optimized for individual requirements

Reliability
- The results of processing can be reproduced very reliably
- The systems are very available
- Functions for online process monitoring
- Little maintenance required

Environmentally friendly
- Excellent energy efficiency
- Free of emissions, no environmental impact

pro-beam primarily designs and builds systems for electron beam welding, drilling and boundary layer treatment. Our techniques and system designs can be readily used in mass production, because we have ourselves used the technology for three decades in our job shops. pro-beam is happy to provide this know-how to its customers.

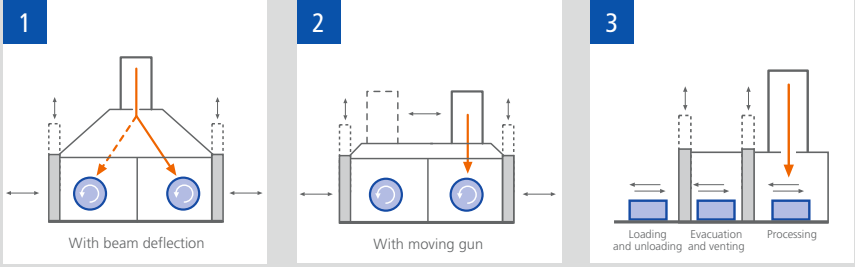
Flexibility ■ General-purpose systems are advantageous for use in labs, design work and small-volume production. This is especially true if a system is to be used for multiple applications. Generally speaking, chamber type machines are best suited to this type of usage. Pallets for accepting several work pieces simultaneously and jigs for moving them relative to the electron beam (such as multiple-spindle rotary devices) reduce the idle times for each part which is produced.

Mass production ■ For mass production, pro-beam optimizes special systems of various sizes with intelligent load lock concepts chosen for maximum productivity. Load lock machines reduce dependency from loading, unloading and pumpdown times from the process cycle. With a fully-automatic operating cycle, these systems are economic solutions for mass production, which can be completely integrated in the production line.
Load lock shuttle and load lock transfer machines are the heart of fully-automatic, flexible systems, developed by pro-beam for use in large-volume production. An entire system is created from production steps such as cleaning, joint preparation, demagnetizing, pre-heating, welding, cooling, testing and cleaning of finished parts.

Economy ■ Using an electron beam system is often more economic than competing techniques. In recent years, innovative load lock concepts and creativity in jig construction have tremendously enhanced the productivity of the machines. Compared with conventional designs, idle times have been drastically reduced. Today, cycle times of a few seconds per part are feasible. This makes it possible to achieve and even exceed the required production quantities.

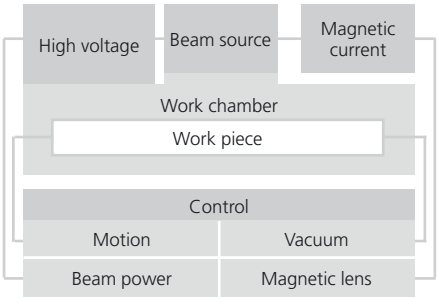
pro beam

1 and 2 Twin-chamber systems
3 Load lock shuttle system



Flexible machine concepts for complex tasks

Components of an electron beam system



Scope of delivery

Based on the customer's needs, pro-beam develops and delivers:

- single machines
- tailor made machines according to customer requirements
- automated system solutions and
- entire production lines, with integrated electron beam technology.

Components

- chamber sizes from approx. 20 liters to 600 m^3
- high-voltage generators: 60 – 150 kV
- beam power of the systems: 1 – 70 kW for welding corresponds to seam depths of 0.1 to 200 mm in steel
- viewing systems: light-optical, electron-optical and video viewing system
- systems for automatic seam- and edge-tracking
- online process and quality monitoring
- systems for automatic temperature regulation

In order to control electron beam processes, the system concept must appropriately combine numerous parameters. Four to six mechanical axes of motion, position and speed monitoring are often interrelated and interpolated with the beam parameters. Each system contains four control modules. They regulate electron beam generation, beam shaping, the pumps for the vacuum chambers (beam gun and work chambers) and the motions of the work piece.

Reliability and quality

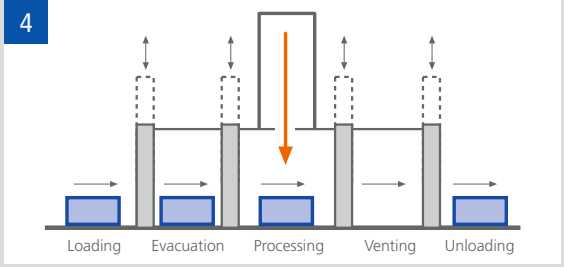
The reliability of all system parts is a decisive quality criterion. That ranges from the design concept to testing the produced parts. The electron beam generators are extremely reliable and the beam is exceptionally stable, ensuring reliable production and reproducible results. All machine types are equipped with state-of-the art high-speed CNC control systems. On request an online quality monitoring system can be implemented.

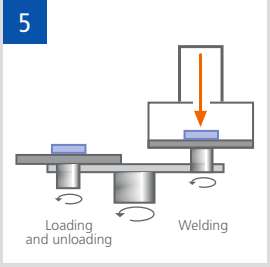
The load lock concept

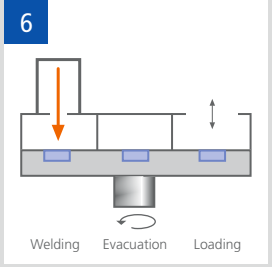
pro-beam offers a wide range of general-purpose systems of various sizes. With specially-tailored load lock concepts, each system can be optimized for the application while retaining its flexibility. If the production requirements change, it usually suffices to modify or replace the jigs for securing and moving the work pieces in the work chamber, and to change the processing programs.

Precise, high-speed beam control

A number of important factors must be optimized for the processing concept, including the electron beam current, deflection and focal position. The electron beam itself can be moved along any random curves, virtually without inertia. A freely selectable oscillation can be superimposed on the beam sweep. For welding, high-speed deflection technology makes it possible to join even problematic material combinations, using pre- or post-heating. It is even possible to store a complex energy transfer pattern in the matrix memory of the CNC control. With high-speed control systems, this pattern is then applied to the work piece.





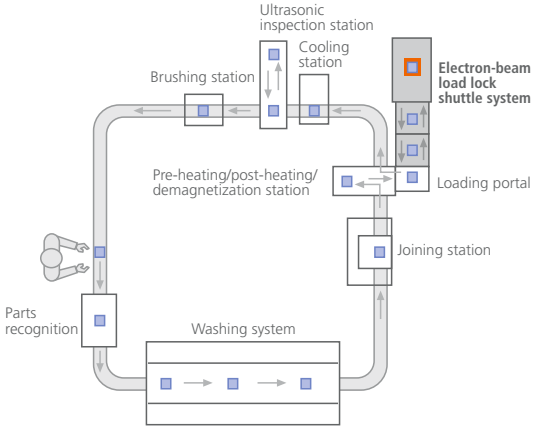


4. Load lock transfer system
5. Cycle machine
6. Cycle lock load machine

Clean production of sensors for Bosch

Bosch is a supplier to the automotive industry. At its plant in Eisenach, Germany, the company manufactures pressure sensors for diesel injection, using electron beam machines from pro-beam. During a test phase, various suppliers of laser and electron beam techniques became acquainted with the technical challenge. pro-beam was then put on the short list for supplying the manufacturing facility. Finally, pro-beam's machines were chosen, due to the load lock concept. It parallels the pump-down time to the processing time. The pressure in the work chamber is always around 10^{-4} mbar. Hence, parts are processed completely independent of external influences, such as humidity. As a result, the manufactured parts can be reproduced very reliably with constant cycle times.

There is another advantage to high-vacuum manufacturing – no problematic metal vapor is deposited on the surface of the work piece. Thus, the sensors exit the welding system clean and without coating layers. This machine concept has proven its worth: The facility in Eisenach produces sensors stably, reliably and efficiently. To increase capacity, a second electron beam system has been supplied to Bosch for this application.



Reliable production of gear wheels at VW

When new gear boxes designed in Wolfsburg, Germany, are mass-produced, one of VW's world-wide locations is given the job of preparing manufacturing. Since 2002, the VW plant in Kassel, Germany, has been producing gear boxes with several electron beam systems from pro-beam. The task is this: Speed gears must be welded with synchronizing rings – up to 5,000 parts per day. For standard gear wheels, the electron beam welding systems designed by pro-beam have cycle times of 12 to 20 seconds.

The systems operate fully automatically and require little maintenance. They execute several related steps. After both original parts are washed, they are located, joined by applying external pressure, pre-heated to a process temperature of around 160 to 200 °C and welded in a vacuum.
After it cools, each electron beam welded gear wheel is inspected by ultrasonic. For this process, pro-beam has designed closed and open transfer systems, partly in collaboration with specialized mechanical engineering companies. The system concept is being employed successfully at VW.

1. Main shaft for 750 Nm gear box, e.g. in VW Touareg and Porsche Cayenne

2. Audi aluminum 2-liter four-cylinder engine block with welded cooling duct

Intelligent manufacturing concepts

The design of an electron beam system is based on the manufacturing requirements. pro-beam not only advises you regarding a suitable electron beam machine type, but can suggest entire system concepts, and develop solutions for integrating the system in the production chain – from jigs to automatic loading and unloading as well as complete process integration. Smart solutions for securing and moving the work pieces contribute decisively to optimizing cycle times.

Competent advice, from design
to full service for your
electron beam system

Service ensures flexibility

pro-beam system technology

- Service is available around the clock
- We eliminate your bottlenecks by subcontracting your work
- Upgrading of old system technology
- We can continue to manufacture your parts, when your own production ceases.
- We offer our own production models or run other manufacturers systems on your behalf

Certifications

Location Neukirchen/Chemnitz (Germany)
DIN EN ISO 9001

Development ■ Since the beginning of the 1990s, pro-beam has been developing electron beam systems. This is based on the know-how we gained from the multifaceted requirements of subcontracting work. Once the systems were ready for mass production, they were first tested exhaustively in our own manufacturing facilities. Since 2000, we have been manufacturing electron beam systems for external clients. They are in use in well known large industrial corporations.

Training ■ Your production reliability hinges on having well-trained personnel and exceptionally reliable systems from pro-beam. For this reason, we thoroughly prepare your team for use of electron beam technology. We also give you in-depth understanding of the technology. Your operating and maintenance personnel are taught how to use the hardware and software. Initially, pro-beam's own manufacturing facilities are used for this training; later, we switch to your system.

Operating models ■ If so desired, pro-beam can operate its own facilities at the customer's site. We can also provide a team which operates your equipment at your site. Having us subcontract your work with our machines at our site can eliminate capacity bottlenecks. This complete package of services allows you to utilize the full potential of electron beam technologies, while ensuring a high degree of manufacturing flexibility. In many cases, this gives you a decisive competitive edge.

Service, from your initial inquiry to the final work piece
pro-beam sees itself as the partner of its customers. This means we are available at any time. We support you whenever you need competent advice and technical support for the operation of your systems. A service engineer can be reached quickly for your special requirements. We promptly and reliably supply you with replacement parts and consumables.

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