

## Group of Electron Beam Technologies (EBT)

Department of New Technologies



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Institute of Scientific  
Instruments  
The Czech Academy  
of Sciences

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*Electron guns for electron beam welding*

*Electron beam welding*



### THEMATIC RESEARCH FOCUS

#### Research area

- Electron beam welding
- Vacuum brazing
- Vacuum feedthroughs
- High-voltage DC power supplies
- Special electronics



*Electron beam welder*

**Excellence**

Electron beam welding of dissimilar metals; custom-made vacuum feedthroughs; precise high voltage supplies

**Mission**

Development of the new joining techniques of various metals, as well as design of the necessary equipment for such, as electron beam welders, vacuum furnaces and analytical electron-optics devices

**UP-TO-DATE ACTIVITIES**

**Research focus**

- Electron beam welding of dissimilar metals
- Development of electron beam welders including high-voltage power supplies
- High voltage power supplies for particle optics devices
- Brazing of metals with brittle non-metallic materials using pliable active filler metals
- Development of vacuum feedthroughs based on glass-to-metal seal

**Main capabilities**

**Basic research**

- Study of homogenous and heterogeneous joints of various metals

**Applied research**

- Design of technological devices such as electron beam welders, vacuum furnaces, etc.
- Development of high voltage powers supplies for both high power and precise electron optics
- Various types of vacuum feedthroughs based on glass-to-metal seal (matched kovar-glass or compression seal) both standard types (e.g. D-sub) or custom made

**Sub-fields of group activities**

- Precision engineering
- Automotive and aerospace industry
- Nuclear industry
- Vacuum technology
- Scientific instruments
- Semiconductor manufacturing

*Electrical vacuum feedthroughs*



## KEY RESEARCH EQUIPMENT

### List of devices

- Three electron beam welders (up to 60 kV, up to 2kW) developed and produced at ISI with two different types of vacuum chambers
- Upgraded vacuum furnace PZ-810 produced by former Czech company Tesla Rožnov
- Laboratory vacuum furnace for brazing and heat treatment of smaller parts (made by team)
- Furnace for glass-to-metal seal processing
- Helium leak detector QualyTest™ Dry HLT 270 by Pfeiffer Vacuum
- Precise 100 kV high voltage power supply with stability better than 2 ppm per 24 hours (made by team in collaboration with TESCAN Brno)
- Precise reference high voltage divider for voltage measurements up to 120 kV (made by team)

## ACHIEVEMENTS

- **We developed a new improved version of the welding electron gun. The new electron beam generator has improved functionality, better X-ray protection and lower manufacturing costs. A special version of the gun with output power of 6 kW was developed for nuclear research facility.**
- **Our partners from academic institutions and from industry bring continuously new challenges in the field of metal joining. We dealt with dissimilar metal welding and braising, e.g. welding of Inconel alloys, refractory metals, steels, copper alloys and lot of others.**
- **During the fruitful cooperation with the leading electron microscopy manufacturer TESCAN a new precise high voltage supply was developed. The device can generate up to 100 kV with long term stability better than 2 ppm per 24 hour period. For testing and calibration a highly stable precise reference voltage divider was built.**
- **New types of vacuum feedthroughs were developed, among others quad SMB connector on ISO-KF 25 flange, MIL-C-5015 14S-2P on ISO-KF 25 flange and 12 way circular Hypcon-type connector for welding.**
- **We replaced old manual control of our vacuum and glass-processing furnaces with state-of-the-art PLC control systems. The new control systems support easy temperature profiling, remote control, data logging and system diagnostics.**

## MAIN COLLABORATING PARTNERS

### Collaboration with academic partners

- Brno University of Technology (Brno, CZ)
- University of West Bohemia in Pilsen (Plzeň, CZ)
- Masaryk University (Brno, CZ)
- Institute of Physics of Materials AV ČR, v. v. i. (Brno, CZ)

### Collaboration with companies

- Focus GmbH (Hünstetten, Germany)
- TESCAN Brno, s.r.o. (Brno, CZ)
- První brněnská strojírna, a.s. (Velká Bíteš, CZ)
- PBS ENERGO, a.s. (Velká Bíteš, CZ)

*High voltage reference divider for voltages up to 120 kV*







*Improved vacuum furnace*

- Honeywell, spol. s r. o. (Brno, CZ)
- KOMO mark s.r.o. (Ostrava, CZ)
- ATEKO a.s. (Hradec Králové, CZ)
- Lavat a.s. (Chotutice, CZ)
- MESIT AEROSPACE, s.r.o. (Uherské Hradiště, CZ)
- Rigaku Innovative Technologies Europe s.r.o. (Praha, CZ)
- ŠKODA JS a.s. (Plzeň, CZ)
- VUES Brno s.r.o. (Brno, CZ)
- Glatt - Pharma, spol. s r.o. (Hradec Králové, CZ)
- VÚHŽ a.s. (Dobrá, CZ)
- ÚJP PRAHA a.s. (Praha, CZ)
- LAPP Insulators Alumina s.r.o. (Hradec Králové, CZ)
- Siemens, s.r.o., odštěpný závod Industrial Turbomachinery (Brno, CZ)
- FEI Czech Republic s.r.o. (Brno, CZ)
- DELONG INSTRUMENTS a.s. (Brno, CZ)
- Hanon Systems Autopal s.r.o. (Nový Jičín, CZ)
- Howden ČKD Compressors s.r.o. (Praha, CZ)

## EXPECTATIONS

### Offers

- Know-how in field of electron beam welding and vacuum brazing
- Welding and brazing equipment capacities for job shop production
- Development and small-lot production of vacuum feedthroughs
- Special electronics development skills, in particular high-voltage DC supplies design

### Requirements

- Collaboration with industrial partners in joint projects dedicated to applied science
- Knowledge and technologies for material analysis
- New complementary technologies