



Clean Machine!

Vacuum brazing – highest purity and stability without atmospheric impacts for the toughest conditions.

Vacuum Perfectionists

A vacuum is the best available “protective gas”. The atmosphere in a vacuum furnace contains significantly fewer impurities (measured in ppm) compared with even the purest cylinder gases available.

Vacuum brazing is not only efficient, cost effective and environmentally friendly – working in a vacuum also allows brazing without aggressive and environmentally damaging fluxing agents. It also makes it possible to do without complex reworking or finishing of the treated components. The lack of flux inclusions in the base material improves its mechanical stability and corrosion resistance, thereby improving its joint strength and the durability of the treated components. Vacuum brazing with Ipsen furnace technology is simply perfect!

The advantages of high temperature brazing in fine or high vacuum make it predestined for use in producing joints that must stand up to intense thermal conditions and heavy mechanical loads. The use of vacuum brazed components has become well established in safety-critical aerospace technologies.

Whether you are talking about jet engine components and control systems, turbine blades, heat exchangers and heating coils, honeycombs and fasteners, or medical implants and instruments, the list of products that achieve their incredible performance characteristics thanks to vacuum processing is extensive.



Masters of the Vacuum

Ipsen's technicians are constantly improving our equipment, making it more productive, more efficient in its use of energy and resources, and easier to use and control.

Ipsen's Vacu-Prof® 4 process control system features many process steps and special functions, especially developed for vacuum brazing:

- Optimal temperature control, dependent on component temperature, for homogenous heating and reduced overall process time
- Automatic leak test
- Process control for guaranteed reproducible results
- Ipsen Digitrim® for fine adjustment of heating control areas, as well as comfortable regulation of control parameters
- Thermocouple calibration
- Compliance capabilities: NADCAP, AMS2750 (Aeronautic), CQI-9 (Automotive) and many more.

Various fine and high vacuum pump systems are available to produce vacuum conditions:

- Single- or multi-stage mechanical vacuum pump systems (oil-sealed or dry screw-pumps)
- Oil diffusion pumps
- Turbo-molecular- or cryo-pumps for hydrocarbon-free vacuums

The state-of-the-art in modern furnace design is the Ipsen VHFC enhanced high vacuum furnace, which can produce ultimate vacuums down to 10^{-7} mbar and achieve leak rates in the range of 10^{-5} mbar l/s through the use of special components and sealing systems.

The most commonly used process and cooling gases are nitrogen (N_2), argon (Ar), hydrogen (H_2), or forming gas (N_2 with $<5\%$ H_2). Ipsen vacuum furnaces can be equipped with additional high partial pressure or with convective heating systems. These increase throughput performance by accelerating the heating phase and also minimize deformation of sensitive components.

The design of the heating chambers and the construction of the furnace interiors provide optimal evacuation and reduction of deposits during the brazing process (thereby lengthening service intervals) as well as homogenous and efficient cooling.

Ipsen's equipment catalog can provide the optimal model and option combinations for every application and material characteristic.

Burning Hot – High-Temperature Brazing

High Temperature brazing in rough, fine or high vacuum is suited for thermally and mechanically stressed joints between 900° and 1200°C.

Some of the advantages of Ipsen's high temperature brazing equipment include:

- Defined adjustable furnace atmosphere
- Excellent temperature uniformity
- Rapid temperature control
- Environmentally friendly, flux-agent-free brazing
- No reworking or finishing of components
- No flux residues
- Protection of the furnace interior through avoiding of flux
- Best-possible mechanical stability and corrosion resistance, thanks to lack of flux inclusions in the brazed joints
- Excellent brazing purity
- Highly reproducible results
- Usable for a wide range of materials
- Vacuum brazing and high pressure gas quenching can be combined in a single treatment cycle (for example, when producing rock drills, chisels, or tool holders)



Can Increased Efficiency and Low Pressure be Combined?

Horizontal Single-Chamber Brazing Furnaces (fine and high vacuum)

- ✓ Batch dimensions up to 1200 mm x 2200 mm x 1200 mm (W x L x H) (other sizes on request)
- ✓ Unit weights up to 10 tons
- ✓ Temperature uniformity better than $\pm 5^{\circ}\text{C}$
- ✓ Working vacuum from 10^{-2} to 10^{-6} mbar
- ✓ Graphite or metallic heating chamber
- ✓ Furnace housings in regular or stainless steel, design below the pressure vessel guidelines available

Vertical Single-Chamber Brazing Furnaces

- ✓ Top- or bottom-loaders for large batch dimensions (on request)

Three-Chamber Brazing Furnaces

(for example, for brazing catalytic converters)

- ✓ Batch dimensions up to 860 mm x 1820 mm x 760 mm (W x L x H)
- ✓ Fully automated through-feed operation with vacuum-tight internal and external doors
- ✓ Throughput: 200 to 3200 components per batch
- ✓ Total batch weight up to 1000 kg
- ✓ Total processing time 110 minutes (varies by process)
- ✓ Pre-heating chamber working vacuum $< 10^{-3}$ mbar
- ✓ Brazing chamber operating vacuum in the range of 10 mbar
- ✓ Brazing chamber operating temperature ca. 1200°C
- ✓ Unloading temperature from cooling chamber $< 100^{\circ}\text{C}$



Fanatical Purity – Aluminum Brazing

There are very specific demands that must be met to make brazing aluminum under vacuum possible. Ipsen's furnace technology is flexible and can be individually configured for any given brazing process.

The advantages of brazing aluminum in Ipsen furnaces:

- Environmentally friendly, flux-agent-free brazing
 - No reworking or finishing of components
 - No flux residues
 - Protection of the furnace interior through avoiding of flux
 - Best possible mechanical stability and corrosion resistance, thanks to lack of flux inclusions in the brazed joints
 - Excellent brazing purity
 - Especially good mechanical stability in the area surrounding the base material
- Combination possible with thermal component degreasing systems
 - Defined adjustable furnace atmosphere
 - Excellent temperature uniformity
 - Rapid temperature control



Technology from Another World for the Best Quality on Earth

One of Ipsen's specialties is incorporating cryogenic traps within the vacuum furnaces. These allow for targeted collection of process-related waste deposits in the furnaces like magnesium, significantly improving ease of maintenance. The use of additional cold traps to bind humidity from the air can reduce the furnaces' evacuation time, as well as improve their operating and ultimate vacuums.

Furthermore, Ipsen heating elements have been designed to guarantee excellent temperature uniformity and optimal heat radiation even at lower temperatures. This significantly lengthens the service life of the heating elements.

Both single- and three-chamber furnaces can be equipped with internal or external, automatic transport systems. Excellent pump, measurement and control components guarantee optimal working conditions. Among the many individualized configurations possible for various brazing processes and batch characteristics, the pre-heating chamber can be fitted for thermal degreasing of the batch components.

Single-Chamber Brazing Furnaces

- ✓ Individual components up to 1600 mm x 10000 mm x 2400 mm (W x L x H)
- ✓ Unit weights up to 50 tons
- ✓ Temperature uniformity better than $\pm 5^{\circ}\text{C}$
- ✓ Brazing chamber working vacuum in the range of 10^{-5} mbar to 10^{-6} mbar range

Triple-Chamber Brazing Furnaces

- ✓ Throughput up to 2000 kg per hour
- ✓ Brazing chamber operating vacuum in the range of 10^{-5} mbar to 10^{-6} mbar range
- ✓ Brazing chamber temperature uniformity better than $\pm 3^{\circ}\text{C}$
- ✓ Pre-heating chamber equipped to clean batch components (thermal degreasing)
- ✓ Fully automated through-feed operation with vacuum-tight internal and external doors



Creative Capital



For more than 60 years, Ipsen has stood for advances in heat treatment and is one of the leading international manufacturers of heat-treatment furnaces and equipment. Our atmospheric- and vacuum-furnaces are used for a wide variety of applications, from brazing to sintering, and much more. Ipsen has a global list of clients from the automotive and aerospace industries, as well as in Tooling, Machining, Medical Engineering and Commercial Heat Treatment.

Furthermore, Ipsen is constantly improving thanks to continuous research and development. This makes us industry leaders, but also guarantees quality.



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