What you should know about Ipsen's vacuum technology.

Vacuum furnaces across the entire treatment range.

With Ipsen vacuum furnaces, not only can you carry out conventional heat treatments, you can also carry out more demanding treatments. Transformation of the grain structure under vacuum as well as the subsequent quenching with cooling gas result in optimum hardness and a bright workpiece surface.

External view on a vacuum furnace Type VHFC

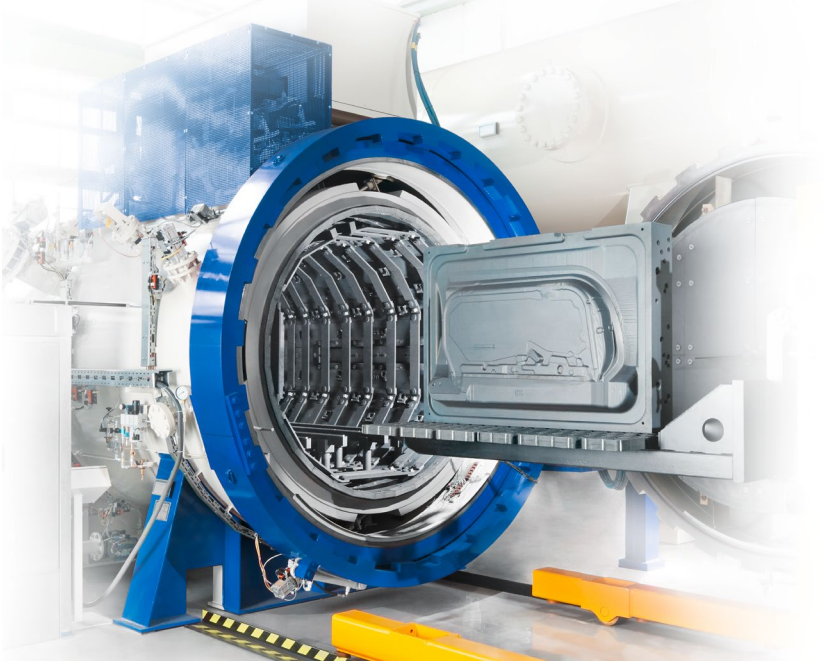
Where does the use of Ipsen vacuum technology make sense? Basically wherever special steel grades are to be produced by hardening or where it is desired to keep as large as possible a number of usage options open. For example, vacuum furnaces enable the braising of joints which can be thermally or mechanically highly loaded. Therefore, the most important applications for Ipsen vacuum technology are in the aviation and aerospace industries, in jet engine assembly, nuclear technology, medical technology, not to mention contract heat treatment shops or automotive engineering.

The advantages of heat treatment in an Ipsen vacuum furnace are obvious: the edge zones of the workpieces remain free of oxidation and decarburisation, also complex geometry workpieces can be treated with minimal or no distortion. Ipsen vacuum technology stands out in particular because it provides a high, constant quality level and with it ensures that desired, repeatable treatment results are always achieved.

In addition the following processes can also be carried out (in alphabetical order): AvaC® (low pressure carburisation), AvaC®-N (low pressure carbon nitriding), bright hardening, bright annealing, solution annealing, bright tempering, degassing, hard and high-temperature brazing, sintering and SolNit®.

How is a vacuum furnace constructed? At the centre of Ipsen's vacuum technology is a round or rectangular heating chamber. Its heat insulation is based on various steel plates and graphite layers. If graphite is used, it is either completely protected or protected in critical positions using a CFC (carbon-fibre reinforced carbon) barrier – a high-performance composite fibre material, because during high pressure gas quenching there is a high degree of surface wear. This considerably extends the service life of the heating chamber.

The ribbed and, therefore large surface area, copper heat exchanger ensures intensive recooling of the cooling gas flow.



Loading SuperTurbo

To heat the chamber, Ipsen uses low voltage heating elements made from molybdenum or graphite, which are distributed over the inside of the chamber walls. To achieve optimum uniformity and through heating of the workpieces, even with high charge densities, the heating circuits can be subdivided into several zones and controlled independently of each other. As a rule, Ipsen vacuum furnaces with graphite insulation are equipped with a convection heating system. In this system, after evacuation of the furnace, nitrogen is added to accelerate heating up because the nitrogen permits convection heating up to a temperature of 850 °C. As a result, not only is the heating-up time greatly reduced, but tempering cycles can also be carried out at low temperatures with very even temperature distribution.

Which explains how Ipsen's vacuum technology can be so optimised that its energy and resource consumption is extremely low. Thus, not only are the latest environmental standards met, but also a particularly economic operating mode is made possible.

High gas flow speeds and uniformity, quick and precise control of the gas flow. Its only when everything is right here that the result is also right: an optimally quenched charge. Which is why Ipsen equips all its vacuum furnaces with an optimised cooling system. Here, you can select from vertical or horizontal cooling gas flow. If workpieces are annular, large volume or especially long, use of a radial cooling gas flow may also be advantageous. To achieve this cooling, gas inlet to the heating chamber takes place via a plenum and gas nozzles, which are arranged around the entire cylindrical surface of the heating chamber.

Ipsen's research and development have paid particular attention to gas dynamics within the heating chamber, as it is only by optimising the cooling gas flow that distortion can be strongly reduced or even avoided altogether. Ipsen worked closely with external institutes to investigate the cooling gas flow using mathematical models (CFD) and experimental verification in test furnaces. The results gained were, in particular, used to optimise the construction of the gas introduction equipment, the design of the gas distribution grid and the arrangement of the heat exchanger. The result: gas dynamics which ensure that the cooling gas flows uniformly through the charge across its entire extent.

Flow coupling into a vertical vacuum furnace

There’s a better alternative: Vacuum Brazing.

The cost-effective and environmentally friendly manufacture of many high-quality products made of stainless steel, ceramics or aluminum can be done only in a vacuum. For these applications, Ipsen offers manual, semi-automatic and fully automatic single- or multi-chamber furnaces.

Two processes are used here: Brazing, primarily of aluminum in a high vacuum, and high-temperature brazing.

The fluxless brazing process for aluminum uses brazing alloy containing magnesium, in the form of brazing strips. Here – before the brazing alloy begins to flow – when the aluminum-oxide skin heats up, it cracks open and is then stripped off by the vaporizing magnesium.

High-temperature brazing under rough, medium or high vacuum is particularly appropriate for joints that will be subject to high thermal and mechanical loading. As a rule, nickel-based, copper-based or noble-metal-based brazing alloys in the form of
crystalline foils, thin plating, powder or pastes with a liquidus temperature of over 900 °C are used.

The fluxless brazing process is particularly en-vironmentally friendly, since no aggressive fluxes are applied, the removal of fluxing agent residues is not an issue and in addition no after-treatment of the components is required. The quality of the brazed joints is also better: By preventing flux inclusions at the interface between the base metals, which can affect the mechanical strength or corrosion resistance, they provide significantly more reliable joint strength.

So the advantages of vacuum brazing in Ipsen brazing systems are obvious: They offer precisely configurable furnace atmospheres and fast temperature control and guarantee exemplary temperature uniformity. Moreover, Ipsen’s vacuum technology also offers outstanding efficiency for brazing.

Turbo²Treater® – Single-chamber vacuum furnace

Ipsen's Turbo²Treater continues to set new standards in quality, versatility and efficiency. In addition, with high quench speeds and uniform cooling and heating, enhanced part quality is consistently achieved. Re-engineered for ease of installation and global operation, the Turbo²Treater now offers the latest technical solutions. Its reliable, cost-effective design and standardized production process allow us to provide quick delivery times and pass on savings to you.

Turbo²Treater At-A-Glance

- Global system capable of operating in 23-plus languages and meeting the most common industry standards
- Compact design
- Fits into a standard truck or shipping container
- Short standard delivery time
- Rapid startup at customer site
- Cost-effective pricing, delivery and operation
- A variety of standard processes offered – bright hardening, bright annealing, bright tempering, brazing and more
- A range of optional process available – vacuum carburizing (AvaC®), carbonitriding (AvaC-N), high temperature solution nitriding (SolNit®), sub-zero and more
- Quench pressure up to 12 bar is also suitable for hardening low-alloyed materials
- Offers several advanced standard features, including high vacuum preparation and a Variable Frequency Drive for the cooling fan blower
- Standard vertical cooling gas flow
- Optional alternating flow direction of cooling gas helps increase quench uniformity and minimize part distortion
- Intuitive control software Ipsen Vacu-Prof® with an extensive material database and an optional process simulation
- Energy efficient design with the use of intelligent pumps, enhanced isolation and more
- Excellent temperature uniformity of ±5 °C during convection and vacuum operation
- Capable of meeting AMS 2750E and CQI-9 requirements

Type	Max. load width	Max. load length	Max. load height	Max. load weight
S - Size	455 mm	600 mm	455 mm	400 kg
M - Size	610 mm	910 mm	610 mm	800 kg
XL - Size	910 mm	1.220 mm	910 mm	1.500 kg; 2.000 kg (optional)

Patented processes: AvaC® and SolNit®.

Ipsen proudly presents: Two innovative, patented processes, which can only be run using Ipsen vacuum furnaces – the low pressure carburisation process AvaC® as well as the SolNit® process. Both controlled using the process software Vacu-Prof®.

Vacu-Prof® enables precise and individual control of the process.

AvaC®, acetylene low pressure carburisation, is a proven alternative to conventional carburisation processes. The advantages in comparison with gas carburisation are obvious: AvaC® offers, alongside a completely oxide-free surface, the highest possible level of carbon transfer. The process can be easily controlled, while at the same time yielding highly reproducible results – amongst other things, particularly uniform carburisation, even with complex geometries such as blind holes.

In addition it stands out because of its favourable environmental credentials – both process gas and energy consumption are comparatively low. In addition, the dry, high pressure gas quenching minimizes any distortion tendency, while washing of the workpieces after quenching is not necessary.

If the carburisation process is run at high temperature (e. g. 1,050 °C), then the cycle duration(taking into account the grain structure requirements) can be considerably reduced in comparison with conventional processes.

The process variant, AvaC®-N, offers low pressure carbon nitriding with acetylene and ammonia. It combines the advantage of low pressure carburisation with those of carbon nitriding. The steels hardened with this process display higher temperature resistance, improved hardness and increased resistance to wear. Both processes can be directly integrated into any production line without any special adaptations.

The innovative SolNit® process is particularly suited to the production of corrosion-resistant and, at the same time, particularly hard steels. By nitriding the surface layer up to a depth of 0.1 to 3 mm, austenitic as well as martensitic rustproof steels can be surface layer hardened. In so doing, inclusion of nitrogen atoms leads to markedly higher strength and, at the same time, improved corrosion resistance. The two process variants, SolNit®-M and SolNit®-A, can thus be used to produce highly loadable steels for use in roller bearings and tools, pumps and turbines as well as for medical instruments and chemical installations.

Moreover, these processes can be controlled using the Ipsen Software Vacu-Prof®, which is remarkable for its ease of use and high reliability and accuracy.

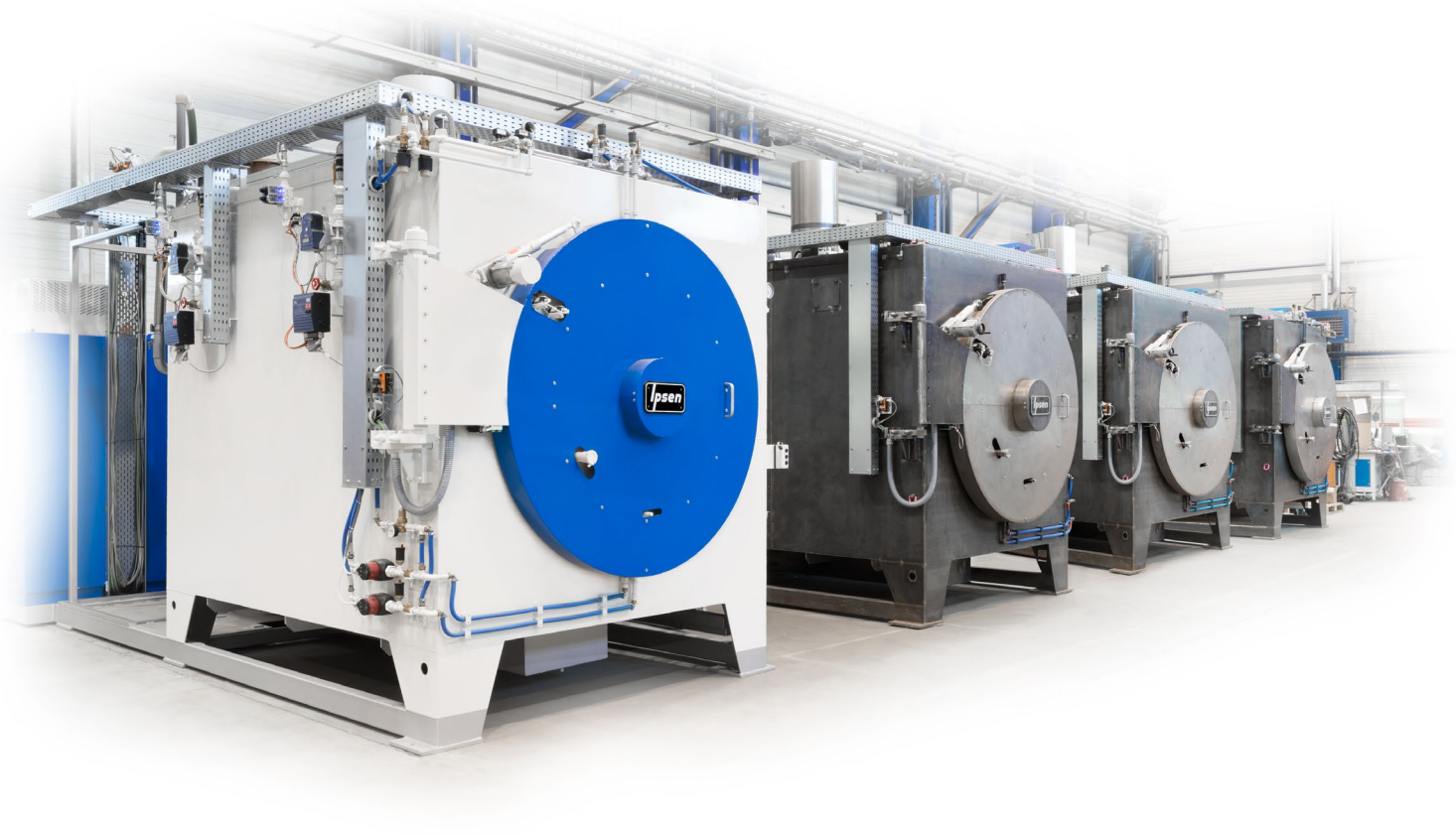
VDR / VDR (N)® Vacuum purge retort furnace

The vacuum purge retort furnace VDR of Ipsen also puts furthermore new graduations in the matter of quality, versatility and efficiency. Beside bright annealing, bright tempering and pre-oxidizing with air other heat treatments like gas nitriding, nitrocarburizing with NH_3, N_2 and CO_2 as well as post-oxidizing are optionally possible. With the help of the Ipsen high speed cooling system you increase your productiveness. With a temperature same uniformity from ± 5 °C as well as with the fulfilment of the norms AMS 2750 and CQI-9 you receive the highest component quality and ability for reproduction.

VDR / VDR (N) At-A-Glance:

- Global system capable of operating in 23-plus languages and meeting the most common industry standards
- Compact design
- Short standard delivery time
- Rapid startup at customer site
- Cost-effective pricing, delivery and operation
- A variety of standard processes offered – bright annealing, bright tempering, pre-oxidation and more
- Ipsen ProNox® (controlled post oxidation)
- Control of KN-value (process reliability)
- Retort with innovative gas guiding system, hot gas circulator with increased gas volume flow (inside and outside retort)
- Optional, Ipsen high speed cooling, reduces cooling time down to 35% of the normal cooling time
- Intuitive control software Ipsen Nitro-Prof®
- Energy efficient design with the use of intelligent pumps, enhanced isolation and more
- Excellent temperature uniformity of ±5 °C during convection and vacuum operation
- Capable of meeting AMS 2750E, Nadcap and CQI-9 requirements

Type	Max loading width	Max loading depth	Max loading height	Max loading weight
514	610 mm	910 mm	610 mm	1.000 kg
1714	910 mm	1.220 mm	910 mm	2.000 kg



About Ipsen

Backed by 70 Years of experience, it is our mission to strengthen heat treatment through expert-driven solutions. We are committed to delivering proven technology for a range of applications that enable you to transform space exploration, improve titanium medical implants and develope more efficient cars and jet engines.

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