PVT

An Inductotherm Group Company

Vacuum Aluminum Brazing and Vacuum Deoiling Furnaces

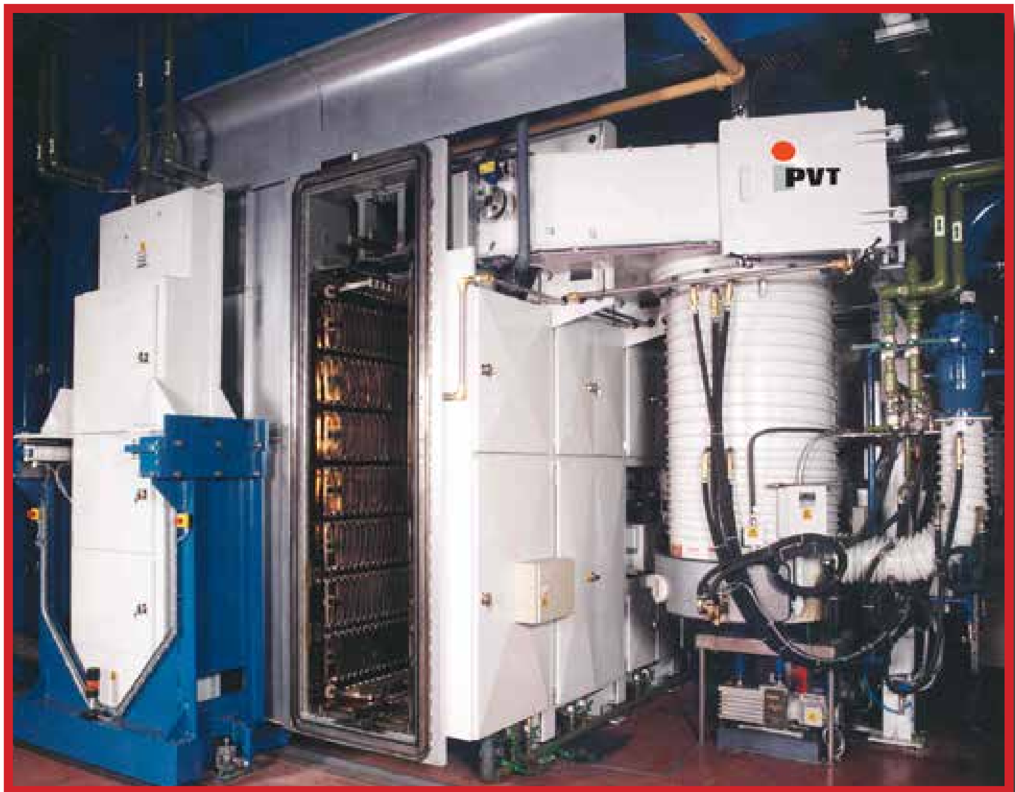
Efficiently Manufacturing to Your Requirements

PVT's expertise in the Vacuum Aluminum Brazing (VAB) furnace industry has kept ahead of the needs and requirements of manufacturers in the automotive and aviation industries, by consistently increasing the capacity, sophistication, operational efficiency and reliability of the equipment it manufactures.

While offering a wide range of vacuum aluminum furnace designs for a variety of applications, PVT also has the flexibility to cater for the individual needs of customers. Successfully aluminum brazing is dependent on vacuum level, temperature and time. PVT VAB furnaces have several unique advantages found in special features in the Vacuum System, Temperatures Uniformity & Control System.

Vacuum Pumping Systems

PVT has designed vacuum pumping systems to match the size of the furnaces and their corresponding charge loads. The systems offered by PVT are designed to achieve working vacuum in the low 10^{-5}mbar range. For superior vacuum performance, hot zone shields has gas passage louvers to permit easy escape of gases from the work assembly. Both the internal volume and surface areas of aluminum components must be evacuated free of moisture vapor and air, to ensure high quality brazing.

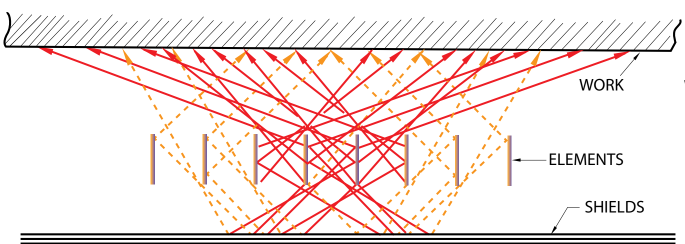


Temperature Uniformity

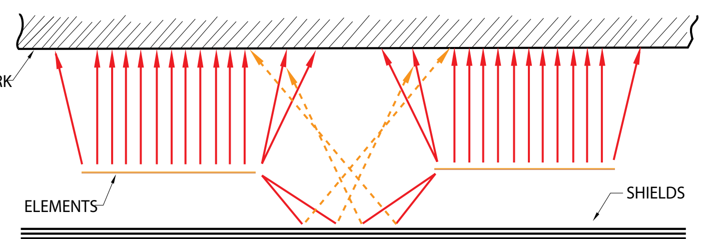
The best brazing results are obtained with the shortest cycles therefore it is essential that the rate of heat input is maximized while maintaining good uniformity. Uniformity values of +/-5°F (3°C) across the work zone at brazing temperature are typical for this process. Uniformity will be determined by the design of the hot zone heaters and the degree of accuracy of furnace instrumentation and controls. To give full utilization of the hot zone space most modern VAB furnaces are built with six sided heating element panels. Each side may also be sub-divided into multiple zones each with its own dedicated power supply and control loop. This gives the optimum design for fast and uniform heating of the workload.

Zone Trimming

The use of multiple 'trimmable' heating panels with individual power adjustments has been developed to allow for balance of heat input matching the workload and fixture thermal characteristics. Uniform heating is accomplished by adjusting the temperature profile both vertically and horizontally. This allows the heat input to be trimmed to match components/charge loads of varying height giving faster heating, more uniform temperatures and uniform brazing in the work assembly.



RIBBON ELEMENT - FACING EDGE



RIBBON ELEMENT - FACING FLAT

Hot Zone Design and Temperature Uniformity Control

The PVT heating element design (winding the nickel element on edge) offers more lines of radiation to the workload - both sides of the elements radiate towards the work. As can be seen above, reflected energy from the heat shield can pass between the elements to the work with little obstruction.

The Hot Zone is designed with separate, removable, individual modular heating element racks mounted in a removable frame. The element racks are arranged and powered to produce individually "trimmable" heating zones such that the optimum temperature uniformity can be guaranteed. The PVT Vacuum Aluminum Brazing furnace easily meets AMS2750E and NADCAP Class 1 standards of +/- 5°F (3°C).

System Controls

Modern Vacuum Aluminum Brazing furnace controls systems are fully automated. The braze cycle is carried out by recipe driven schedules that are optimized to the individual component being brazed. The controls incorporate a full SCADA package (supervisory control and data acquisition) which report and record all the pertinent data required by the latest pyrometry specifications. All data is electronically archived on the systems hard disc. The HMI (Human Machine Interface) is a graphical touch screen / mouse driven system which allows control of all systems and design of new braze cycles.

Temperature Control for Large Heavy Loads

For large batch VAB furnace systems, e.g. for brazing large petro-chemical heat exchangers, the control system has a fully automated heater zone continuously calculated offset system using workpiece thermocouples on the skin and body of the core being brazed. The temperature program will calculate and define, in real time, the temperature for each of the heating zone panels so that for each program step the core is heated as rapidly as possible following a sequence given for each program step.

The sequence will verify that the workpiece thermocouples are properly operating. In case of failure of one thermocouple, the sequence will issue an error message and offer the possibility to switch to another valid value coming from a chosen skin thermocouple.

Fault Diagnosis

The control systems complexity in a vacuum furnace is such that the ability to diagnose and recover from any fault scenario is difficult and time consuming, an issue affect furnaces in any environment.

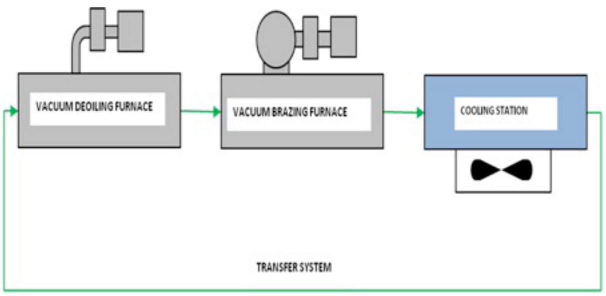
Modern VAB furnaces now include simple fault finding screens on the control system HMI. These function to highlight to operators the specific conditions that have not been made in an interlock to function a particular process (i.e. valve movement, etc).

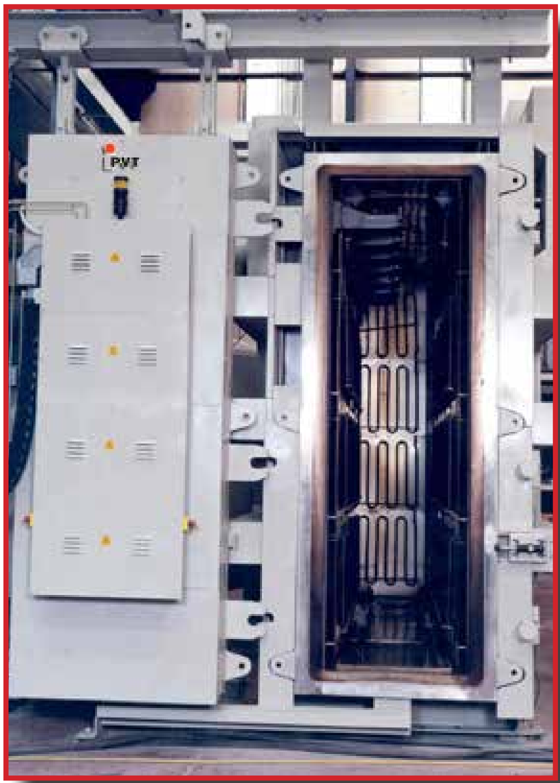
Further to this, furnaces shall have self-diagnostic leak detection systems that are built into the control of the furnace, such that leaks can be identified more readily and resolved quickly.

Online support is a relatively new facility available such that issues can be investigated remotely by the equipment manufacturer and resolved quickly or targeted advice offered.

High Volume Multi Chamber Designs

For high volume production environments, for example, in the automotive industry, it is common to use two or three chamber steps for brazing aluminum parts under vacuum. The diagram below shows the product flow in a three station system, together with an automated transfer system for high volume manufacturing operation. It is typical to have a VAB furnace in sequence with a vacuum deoiling (VD) furnace and cooling station. The vacuum deoiling furnace preheats the parts to 300°C and removes surface oil contamination. The parts are transferred to the brazing furnace and brazing is carried out. A final cooling station using forced air blast cooling takes the brazed parts from 300-500°C to ambient temperature for unloading and finishing. A three station concept inline reduces the brazing cycle time significantly giving a high productivity and preheating of the parts at the deoiling stage gives the best use of energy.





Production vacuum deoiling furnace

Vacuum Deoiling

The removal of forming oils from aluminum components prior to brazing is an essential step of the joining process. This has traditionally been archived using chemical washes, such as trichloroethane and CFC-based solvents. However, the phasing out of these ozone-depleting and hazardous solvents, has created a worldwide need for alternative deoiling processes.

Unlike aqueous cleaning processes, vacuum deoiling does not have any requirements for waste water treatment. Also, oil removed from the components can often be recycled.

For removal of the oil, furnaces can be fitted with a specially engineered dry vac pump systems.

In operation, the internal walls of the furnace are maintained in a hot condition to prevent condensation of oil vapors within the furnace.

Vacuum deoiling furnaces can be integrated with existing furnace installations and inline brazing system.

Cooling Systems

To improve the cycle time of VAB or to anneal the components (T2 condition), fast cooling systems can be employed. There are several configurations available to achieve this, the most effective being a separate external cooling station with circulation fans used to pass high velocity air over the components. Components are removed from the furnace post brazing at a temperature >500 C and are placed into the cooling station. The heat transferred to the circulating air from the hot parts is recoverable and can be used for general building heating. Closed loop internal cooling system with gas/water heat exchanger are also available.

Transfer Systems

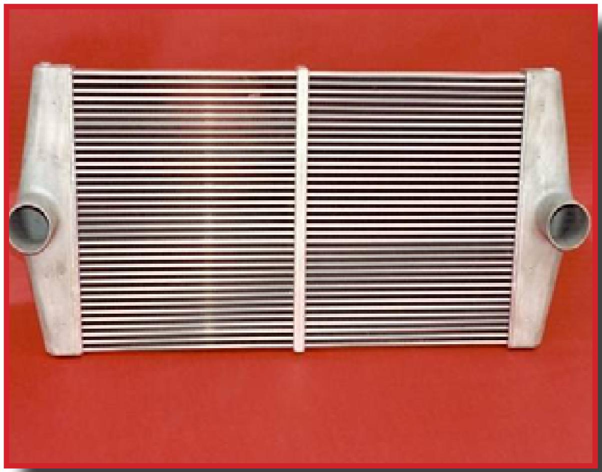
The degree of automation and complexity of the transfer system largely depends upon the size of the charge and the productivity requirements. For small single chamber furnaces a basic, manually operated load stacker truck usually is sufficient to transfer loads in and out of the furnace.

For very large and heavy loads, a transfer cart with hydraulic drive systems and rollers which align with serial rollers inside the furnace is the most practical solution. When the charge must be moved between multiple stations and chambers, a fully automated transfer system consisting of transversing loading carriages with push/pull pusher chains and drives is required. This transfer system is controlled by its own PLC and HMI interface. This system is typically used for small to medium size components found in high productivity environments such as the automotive industry.

Standard Furnace Models

Model No.	Aerospace/Automotive (Hot Zone Size)		
	Height	Width	Depth
VAB 22-24-22	22” (560 mm)	24” (610 mm)	22” (560 mm)
VAB 34-28-36	34” (865 mm)	28” (710 mm)	36” (915 mm)
VAB 34-28-60	34” (865 mm)	28” (710 mm)	60” (1525 mm)
VAB 36-28-48	36” (915 mm)	28” (710 mm)	48” (1220 mm)
VAB 36-41-60	36”(915 mm)	41” (1040 mm)	60” (1525 mm)
VAB 48-48-120	48”(1220 mm)	48”(1220 mm)	120” (3050 mm)

Model No.	Automotive (Hot Zone Size)		
	Height	Width	Depth
VAB 62-2x15-129	62” (1575 mm)	2x15” (2x380 mm)	129” (3275 mm)
VAB 64-2x18-48	64” (1625 mm)	2x18” (2x450 mm)	48” (1220 mm)
VAB 64-36-110	64” (1625 mm)	36” (900 mm)	110” (2795 mm)
VAB 88-24-157	88” (2235 mm)	24” (600 mm)	157” (4000 mm)
VAB 98-24-163	98”(2495 mm)	24” (600 mm)	163” (4140 mm)



Model No.	Cryogenic (Hot Zone Size)		
	Height	Length	Width
VAB 66-244-54	66”(1675 mm)	244”(6200 mm)	54”(1370 mm)
VAB 72-275-59	72”(1825 mm)	275”(7000 mm)	59”(1500 mm)

PVT INCORPORATED
100 Indel Avenue
P.O. Box 156
Rancocas, New Jersey 08073
Phone: +1 (609) 267-3933
Fax: +1 (609) 267-1366
E-mail: sales@pvt-vf.com
www.pvt-vf.com

CONSARC ENGINEERING LIMITED
9 Woodside Eurocentral
Holytown, North Lanarkshire ML14XL
Scotland, United Kingdom
Phone: +44 (0)1698 730430
Fax: +44 (0)1698 730431
E-mail: sales@consarceng.com
www.consarceng.com

The Company

PVT, an Inductotherm Group Company a manufacturer of vacuum melting, heat treatment, and brazing systems, was established in 1965 and became part of the Consarc Group in 2003. Our advanced vacuum and controlled atmosphere furnace systems are widely used by customers throughout the world for the processing of metals, special alloys, and engineered materials.

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For more information visit www.pvt-vf.com

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Leading Manufacturers of Melting, Thermal Processing and Production Systems for the Metals and Materials Industry Worldwic