THERMOPROCESSING PLANTS AND EQUIPMENT

OTTOJUNKER
WE UNDERSTAND METALS

... FOR CAST AND FORGED PARTS

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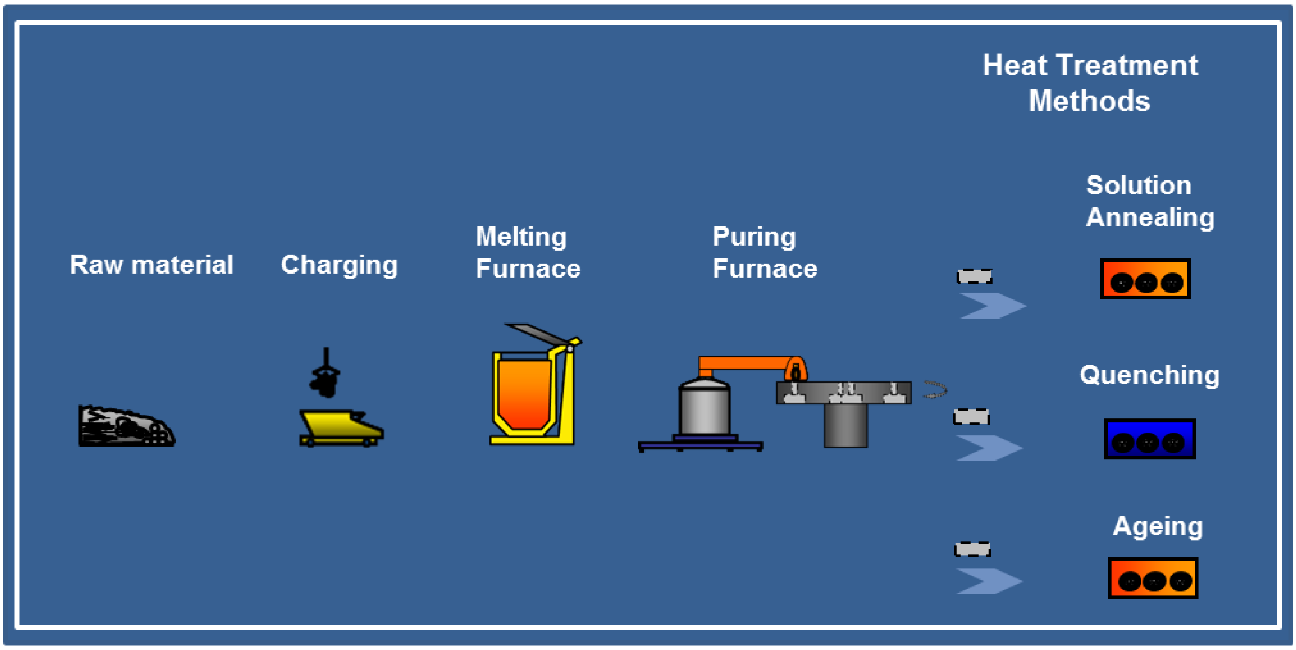
Manufacturing Range
Furnace Systems for Aluminium Cast and Forged Parts

OTTO JUNKER supplies all necessary heat treatment, melting and holding furnaces for the entire casting and forging workflow, including foundry, hot-rolling, cold-rolling and foil-rolling applications:



Our company is noted for its extensive operating experience in all heat treatment technologies required in the aluminium industry – from efficient pre-heating furnaces for forging applications to complete heat treatment lines for wheels, cylinder heads, engine blocks, suspension components, etc.
These systems are available either for fully automatic continuous operation or for discontinuous batch operation. Cooperation with other furnace manufacturers is an option, depending on the furnace type.
All systems are developed, designed, delivered, installed and commissioned by OTTO JUNKER experts from the respective disciplines (sometimes jointly with our cooperation partners).
Furthermore, OTTO JUNKER builds all requisite ancillary equipment and handling systems for these furnaces, e.g., loading or unloading manipulators and conveyor systems.

The entire process responsibility rests with OTTO JUNKER's highly skilled specialists. For every product, we have an expert team covering all fields of specialization.

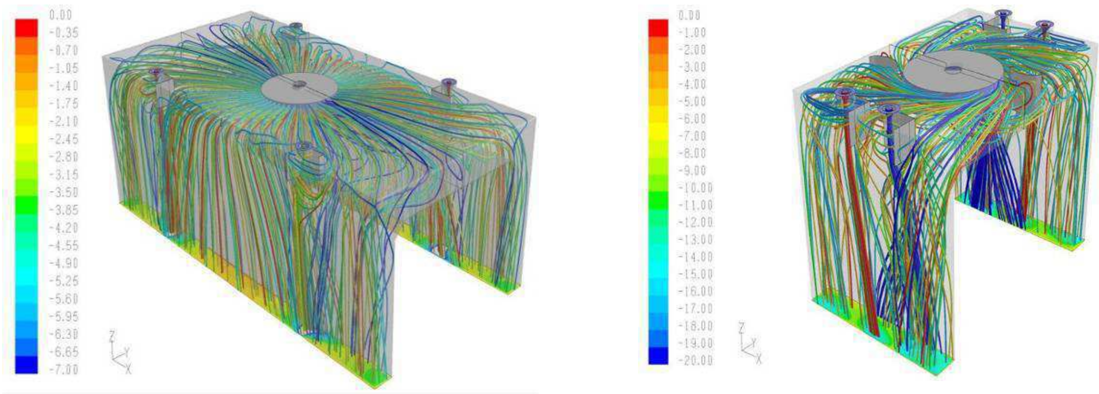
OTTO JUNKER is committed to the objective of supplying its customers with high-grade technology. Energy efficiency and environmental compatibility are among our first and foremost concerns, in addition to our ongoing pursuit of improvements in power consumption, process management and general equipment design.

All equipment types embody the latest state of the art, whether in flow management, heating technology, enclosure design and mechanical engineering. For the customer, these benefits translate into high plant availability and low maintenance and operating costs – needless to say, in conjunction with low energy consumption and ultra-close temperature tolerances.

Development

Advanced simulation methods are used to maximize the heat transfer and temperature uniformity levels while reducing flow losses. Our clients will thus benefit from reliable, long-lived equipment based on rugged and dependable OTTO JUNKER design.

Following their successful engineering, mechanical and flow model validation, new technologies are subjected to hot and cold trials in the test-bay before being refined and progressed to production maturity.



Illustrations: Numeric flow modelling aimed at achieving absolute temperature homogeneity in practice

Flow-optimized heat treatment system

After-sales service

OTTO JUNKER's after-sales departments rely on experienced installation supervisors, electricians and software specialists trained for worldwide on-site assignments.

Apart from the supply of spare parts and classic support services such as the inspection and maintenance of existing installations, our range includes equipment overhauls, upgrades and revamps. Such conversions are carried out following a detailed review aimed at boosting performance, modifying functionalities and improving the energy efficiency of your system. Each project will be successfully completed within the shortest possible shutdown time.

Pre-heating Furnaces for Forging Operations

Otto Junker supplies high-performance continuous belt conveyor furnaces for heating aluminium ingots/ billets to the forging temperature.

These furnaces provide holding capacities up to 60,000 kg at throughput rates of 8,000 kg/h. A forced convection system with individually adapted flow management ensures that all parts placed on the conveyor will be heated in a most uniform and reproducible manner.

The furnaces are heated either electrically or with natural gas, depending on the customer's choice. Heating is achieved by intense recirculation of the furnace atmosphere covering the entire surface area. However, to ensure optimum heating conditions, the atmosphere flow regime must be adapted to the geometry of the forgings and specifically to their loading pattern on the conveyor belt.

Small parts are commonly loaded automatically from a magazine. Larger parts are typically fed into the furnace by a robot; their subsequent removal and delivery to the forging press being likewise robotized. For very large forgings, travelling manipulators are used.
To minimize the length of the system, dual-track plate conveyor systems with mutually autonomous track control may be employed.

This furnace type is used also in wheel manufacturing for heating the cast or forged wheel blanks before the flow forming operation.

Heating of cast automotive suspension parts for a downstream forging operation (COBAPRESS® process), loading side
2.5 t throughput, open natural-gas heating

Interior view of the furnace with jet heating nozzle beams, dual-track conveyor, independent track control

Features and characteristics of OTTO JUNKER continuous belt conveyor furnaces for heating aluminium forgings:

- A plate conveyor made of highly alloyed CrNi steel is designed to support large weights and diverse part geometries and sizes.
- Even high belt tension is accommodated uniformly and over the entire conveyor width. A long service life and high operating reliability are thus ensured. Full-area conveyor supports made of solid cast elements with good anti-friction properties provide additional wear resistance and improved maintenance-friendliness.
- Conveyor can be run in oscillating mode.
- The use of recuperative burners results in substantial energy cost savings.
- Input of the heating gas via manifolds and mixing devices ensures high flow temperature uniformity. Localized hot currents – and hence, overheating – are thus avoided.
- Intense forced circulation of the furnace atmosphere, covering the entire surface area, ensures high temperature accuracy.
- The interior furnace casing, plenum ducts, air baffles and fans are made of high chromium-nickel steel. Wear of heat-resistant components and the entrainment of oxide or insulation particles are prevented or minimized.
- The furnace insulation is essentially made up of heat-resistant mineral fibre panels with a low thermal inertia.
- Consistent with tough forging environments, all furnaces are of very rugged, heavy-duty design.

Pre-heating furnace for forgings, 8 t/h throughput, open natural-gas heating

Max. furnace capacity: 60 tonnes, max. weight per forging: 2 tonnes

Wheel heating furnace before flow forging

Loading operation by means of a manipulator

Heat Treatment Systems for Forgings

The loaded trays are placed in a baseframe by the customer's loading system. This baseframe is positioned on the charging car. Once the car has been loaded by the customer's equipment, all subsequent steps are automatically executed by the control system in line with the specific recipe. The loaded car moves under the furnace and the furnace's winching mechanism lowers the receiving fixture, then engages the baseframe at the predetermined points to pull the charge into the furnace.

For the entire treatment time, the charge remains suspended in the furnace. At the end of the programmed cycle duration the furnace bottom is opened rapidly and the charge is lowered into the water bath for quenching. After the programmed quench time, the charge is pulled out of the water again and allowed to drip-dry for a defined period of time. The charging car then moves under the charge, takes it over and delivers it to the customer's unloading system.

Consistent with aircraft industry requirements for the production of safety parts, all of the above systems meet all Aerospace Material Specifications (AMS) and thereby ensure absolute process management repeatability. This is achieved through the following furnace characteristics:

- high temperature uniformity and very precise temperature control throughout the furnace chamber;
- minimum pre-cooling of parts between opening of the furnace door and start of quenching, achieved through rapid part transfer;
- high degree of automation, avoiding manual intervention if at all possible.

All process and handling sequences are controlled at plant level by PLC-equipped switchgear. Man/machine interfacing is based on a master visualization system. Various annealing parameters are stored in the form of recipes. Current charge data are written to memory and recorded at the end of the process.

Examples: Drop-bottom furnace systems for solution annealing large forgings for the aircraft industry. Direct electric heating, stationary water quench in a pit, charging car serving as load and unload station and for charging the furnace.

Heat treatment units for small forgings

Heat Treatment Systems for Forged Wheels

Heat treatment systems for forged aluminium wheels, consisting of the solution annealing furnace (2 tracks), water quench, artificial ageing furnace (4 tracks), loading and unloading manipulators

Interior view of the solution annealing furnace; two tracks; all-internal chain conveyor

Heat treatment system for forged aluminium wheels, directly linked to the flow forming process

Wheel rim forgings are moved through the solution annealing furnace in two rows. They are carried by a four-strand chain conveyor. In the event of a malfunction the conveyor can oscillate. The conveyor chain passes through the entire nozzle field of the solution annealing furnace and returns to the loading point inside the furnace chamber.

The unloading position is exactly above the axis of the chain return wheels. Light barriers are provided for part presence checking. The furnace door openings at the entry and exit ends allow two wheels to be loaded and unloaded side-by-side at a time.

The furnaces are heated either electrically or with natural gas, depending on the customer's choice. The wheels travel horizontally through the furnace in two single-level rows and are heated by the high convection impingement flow principle. To this end, close-pitched hot-gas nozzles are uniformly arranged above the conveyor plane, delivering gas at a very high velocity. The nozzle array is designed to suit the shape of the parts being heated so as to ensure a uniform, rapid heat transfer.

The heated furnace length is divided into mutually independent control zones. Each control zone is fitted with one (solution annealing furnaces) or two (artificial ageing furnaces) circulating fans in the furnace roof. All components inside the furnace chamber of the solution annealing furnace, as well as the panels covering the furnace insulation, are made of high-alloyed, heat resistant CrNi steel. The same holds true for the chain conveyor, its deflection wheels, and the guide and support system.

Heat Treatment Systems for Cast Wheels

This furnace type is built specifically for solution annealing, quenching and artificial ageing of cast aluminium wheels. Energy efficiency, maintenance-friendliness and flexibility were particularly important considerations in developing its design.

The wheels are conveyed through the entire line without racks, using a multi-tier walking beam system.

Heat-treatment system for solution annealing and artificial ageing of cast aluminium alloy wheels

The furnace is operated in mixed mode, i.e. the wheel diameter may vary between 14“ and 24“ between any two wheels. Heating is effected directly using natural gas burners in the furnace chamber. Thanks to an optimized combustion process and the use of recuperative burners in the first zones, this configuration provides an unsurpassed energy efficiency.

Contrary to conventional systems relying on annealing racks, the system has been designed without racks in order to save energy. The parts to be heat-treated are fed into the furnace via a roller table on which they are also aligned, measured and positioned. Once the complete charge has been assembled, it is placed in the furnace by the loading manipulator.

The charge is moved through the furnace by a walking-beam system. This is a further development of the walking beam conveyor used in steel heat-treatment applications which are noted for their particularly exacting demands regarding ruggedness and reliability of the conveyor system (refer to the description below). The charge is moved at low speed, making full use of the cycle time, to prevent damage to the product in its contact area.
At the exit of the walking beam furnace, the wheels are removed by a manipulator which immerses them into the quench tank. From here the parts are conveyed into the artificial ageing furnace for completion of the heat treatment.

At the end of the artificial ageing cycle the wheels are picked up by a manipulator which places them on the exit roller table. From here they are moved to a cooling station for cooling with cold air.

The entire system is controlled by a PLC which monitors all motion sequences, temperatures and motor functions. A PC with visualization software monitors all operating parameters and stores all equipment operating data.

Benefits:

High energy efficiency due to the following features:

- no use of annealing racks ("dead weight") to be heated with the charge
- no need for wall openings due to the specific conveyor design
- very maintenance-friendly design, since all components are externally accessible
- very compact footprint (in line or U-shaped configuration)

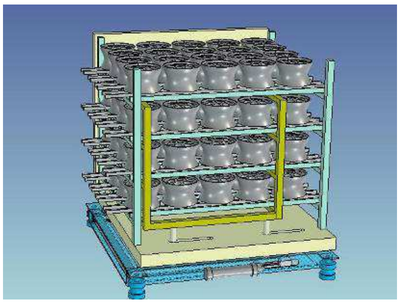
Particular equipment characteristics:

Description of the conveyor motion sequence inside the furnace:

All movements are performed very slowly to prevent vibrations and consequential damage or surface marks on the wheels.

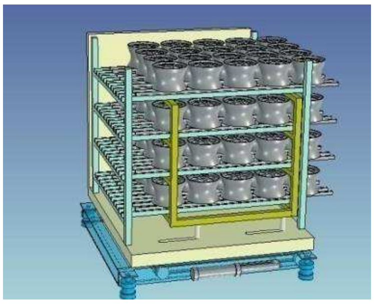
Phase 1 – Lifting

The mobile inner frame is raised with all wheels, thus lifting the wheels off the stationary frame.



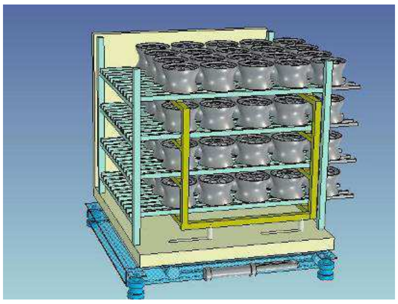
Phase 2 - Advancing

The inner frame is moved forward in accordance with the preset advance step. The advance step depends on the maximum product dimensions.



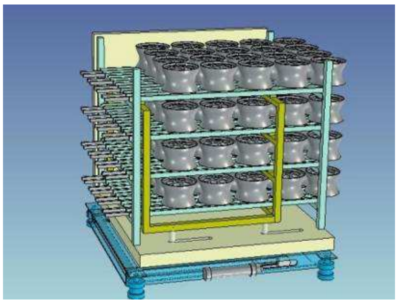
Phase 3 - Lowering

The inner frame is lowered, thus placing the wheels back on the stationary frame.



Phase 4 - Return

The inner frame moves away from under the wheels and returns to its home position for the start of the new cycle.



Heat Treatment Systems for Cylinder Heads and Engine Blocks

The system consists of the loading section (forklift loading area), the solution annealing furnace, the water quench, the artificial ageing furnace and an unloading section. The air inside the furnace is recirculated by means of powerful fans. Energy efficiency and maintenance-friendliness were key considerations in designing this system.

The furnace atmosphere is directly heated by natural gas burners. The artificial ageing furnace is commonly operated in the 160 – 240°C range; the maximum temperature is 300°C.
In the solution proposed here, the exhaust gases from the solution annealing furnace are conducted to the artificial ageing furnace via a single, appropriately insulated duct. This exhaust gas is fed into an external combustion chamber (booster) which is intended to provide additional heating power if required to heat up the artificial ageing furnace (starting from cold at commencement of operations).
Thereafter, the exhaust gases are distributed to the individual zones near the circulating fans. The energy potential of the exhaust gas exiting the solution annealing furnace is thus used for heating the artificial ageing furnace.
Maximum flexibility of the artificial ageing furnace is achieved by installation of four modulating burners in the entry section. These ensure a high input of heating power when required.

Each furnace has its own conveyor system. The two doors can be opened independently of each other to prevent excessive cooling of the furnace during loading and unloading operations (chimney effect).
An intermediate door separating the heat-up section from the holding zones prevents a cold charge from affecting the temperature homogeneity in the holding zones.
The quench tank is made of stainless steel. The lifting/lowering platform is actuated via a hydraulic cylinder. Transferring the charge from the furnace into the quench takes less than 15 seconds. Propeller-type circulating pumps ensure uniform quenching of the charge and a homogeneous temperature distribution in the water. The tank is equipped with both heating and cooling system.

Heat Treatment Systems for Suspension Components

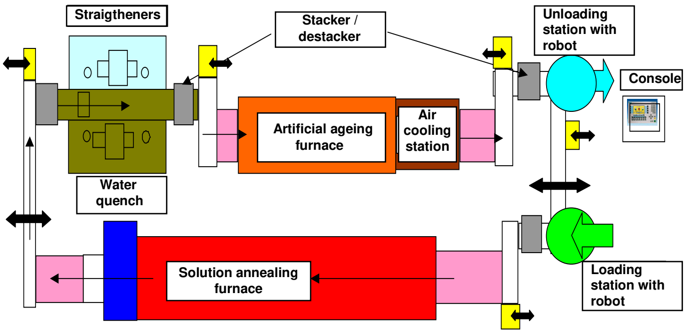
The system operates fully automatically. It consists of a loading station, a solution-annealing furnace, a water quench tank with lifting/lowering platform and attached drip-drying station, a traversing car, a straightening area, an artificial ageing furnace, an air cooling section and the unloading section.

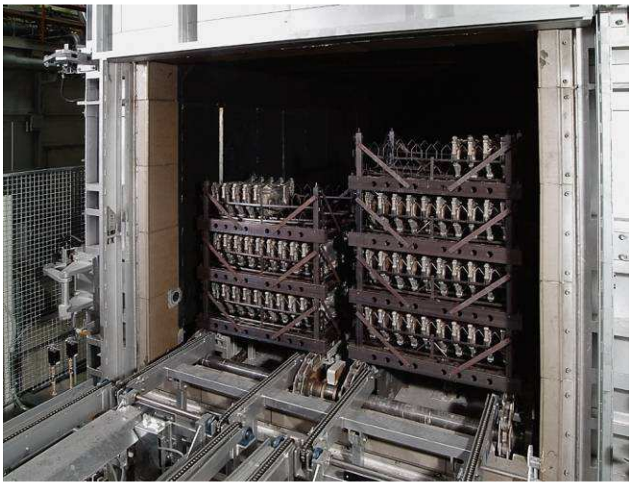
All part handling operations are fully robotized. The recirculating air is directly heated using natural gas, with burners installed in the ducting. Inside the furnace the air is recirculated by powerful fans mounted on the furnace roof. The hot furnace atmosphere is applied to the charge from all sides. Heating is achieved by the high-convection principle. The entire furnace consists of multiple sections which can be separately controlled.

Automotive manufacturers require absolute repeatability in the process management of safety part manufacturing. To this end, the furnace system complies with the following requirements:

- high temperature uniformity and very precise temperature control throughout the furnace chamber;
- rapid and uniform heating of each part and of the entire furnace charge;
- rugged and reliable low-wear conveyor system;
- minimum pre-cooling of parts between opening of the furnace and immersion in the quench, achieved through rapid part transfer;
- minimum possible deformation of castings in the water quench;
- high degree of automation, avoiding manual intervention if at all possible;
- All process and handling sequences are controlled at plant level by PLC-equipped switchgear. Man/machine interfacing is based on a master visualization system. Various annealing parameters are stored in the form of recipes. Current charge data are written to memory and recorded at the end of the process.

Heat treatment of automotive suspension parts





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OTTO JUNKER GMBH
Jägerhausstr. 22
52152 Simmerath
Germany

Phone: +49 2473 601 0 | Fax: +49 2473 601 600
E-Mail: sales@otto-junker.com

WWW.OTTO-JUNKER.COM

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