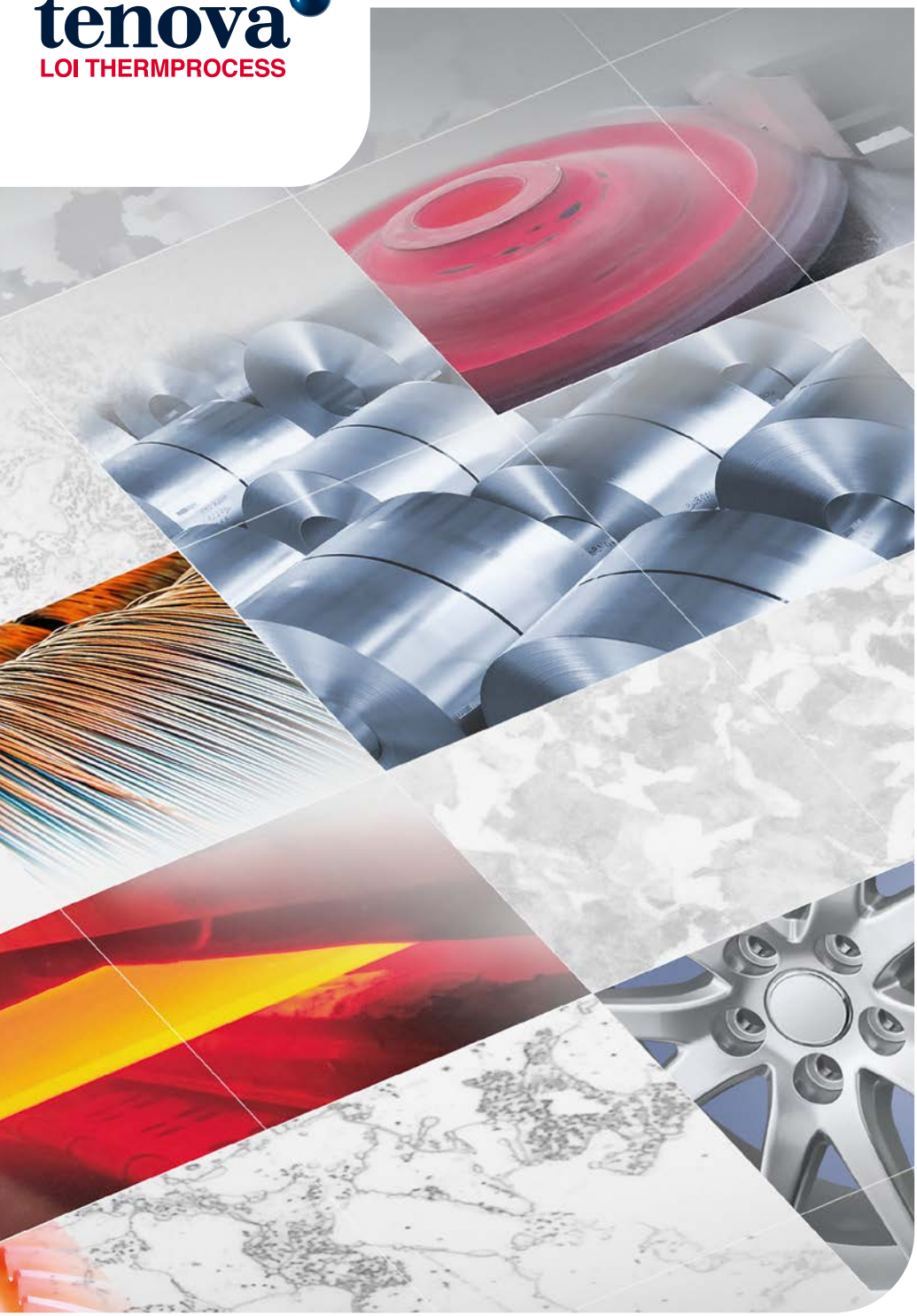
tenova
LOI THERMPROCESS



We drive the Transformation of the Metals Industry

Heat Treatment in Perfection

TENOVA
LOI THERMPROCESS

Tenova LOI Thermprocess with headquarters in Duisburg, Germany, is one of the leading companies in supplying industrial furnace systems for the heat treatment of metals. Worldwide clients from the steel, aluminium and automotive industries rely on the technical solution competence and thousands of references. With a history of over 100 years Tenova LOI Thermprocess represents the entire know-how in the field of material properties and thermal processing. Tenova LOI Thermprocess is a global partner represented in all major markets throughout the world.

Being a driver in the transformation of the metals industry towards decarbonization and sustainability, we implement proven thermoprocess solutions and focus on the development and implementation of fossil-free annealing technologies, especially Hydrogen, as well as electrical heating capabilities in new plants and revamps.

The wide portfolio of technologies meets the most demanding market requirements including batch and continuous heat treatment lines for steel strip, heavy plates, pipes & tubes and forgings. Tenova LOI Thermprocess technologies for production of grain-oriented (GO) and non-grain-oriented (NGO) electrical steel pave the way for e-mobility with state-of-the-art heat treatment equipment. Sustainable solutions such as melting and recycling furnaces for aluminium support reduction of waste and energy consumption. Innovative heat treatment lines for flat, cast and forged aluminium products complete the portfolio.

We drive the Transformation of the Metals Industry – Heat Treatment in Perfection

Tenova LOI Thermprocess offers the full range of solutions for the whole life-cycle of the equipment from a single source: Comprehensive process know how, design (mechanical, electrical and automation), project management and installation as well as modernization, maintenance and service.

Digitalization is one of the key drivers in our business. All our processes are enhanced by our smart digital solutions.

Tenova LOI Thermprocess offers reliable and green solutions that minimize the environmental impact and guarantee quality, production efficiency and safety. Tenova LOI Thermprocess is a trademark of Tenova.

REHEATING OF LONG OR FLAT PRODUCTS AND FORGINGS

As supplier, main contractor or in cooperation with other companies, we deliver the mechanical and electrical design of industrial furnaces and complete plants or lines together with Tenova Italimpianti.
Key competences include highly advanced burner technologies as well as production automation and optimization. We manufacture and source locally and globally.
We offer reheating furnaces for hot formed materials, furnaces in casting and rolling lines for thin slabs and heat treatment plants for heavy plates and forged products.

▼ Tenova Italimpianti Walking Beam Furnaces are suitable for heavy plates and heavy loads, especially if quenching is required.

CHAMBER/BOGIE HEARTH FURNACES

Reheating of large and heavy blocks or ingots

WALKING HEARTH FURNACES

Reheating of billets, blooms, beam blanks

ROLLER HEARTH FURNACES

Heating and holding of slabs

PUSHER TYPE FURNACES

Reheating of blooms, slabs, billets, intermediate products/pre-shaped blanks

WALKING BEAM FURNACES

Reheating for hot forming of long and flat products made from C steel, stainless steel, copper, grain oriented steel, titanium, special alloys

ROTARY HEARTH FURNACES

Reheating for hot rolling and forging of blooms and billets of C steel and stainless steel

Tenova Italimpianti is the world's leading supplier of Rotary Hearth Furnaces for a variety of process applications and product types (up to 67 m in diameter), with over 300 references in its portfolio.

▲ In the forging industry, Tenova LOI Thermprocess Bogie Hearth Furnaces represent well-known technology as well as solutions that have been tried and tested in industry.

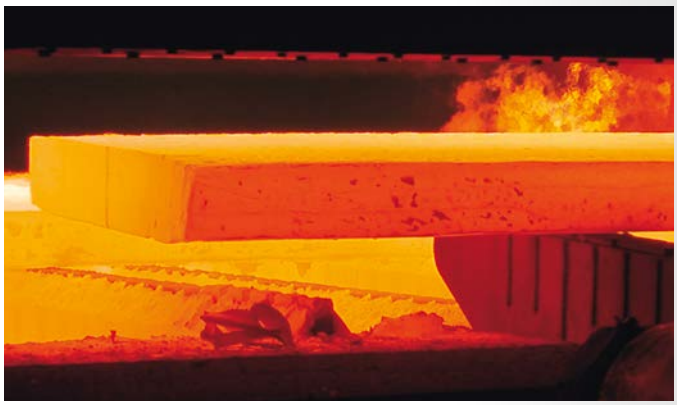
▼ Tenova LOI Thermprocess Rotary Hearth Furnace for long products with zone separation

ROLLER HEARTH FURNACES FOR THIN SLABS

Intermediate heating and holding for thin slab casting and rolling with slab lengths of 30-50 m and a thickness between 40 to 90 mm, endless rolling of bar lengths up to 300 m.

Tenova Italimpianti has supplied

- the longest furnace,
- the furnace with the highest temperature (up to 1,250 °C),
- the first operating furnace with three lines.



HEAT TREATMENT PROCESSES

DETERMINE THE MICRO-STRUCTURE OF METALS

Tenova LOI Thermprocess heat treatment furnaces feature advanced process technology which

- precisely meets the requirements for the microstructure,
- achieves a homogenous temperature distribution inside the parts,
- prevents shape distortion of the material and
- avoids high internal stresses.

DETERMINE THE SURFACE QUALITY

Tenova LOI Thermprocess heat treatment technology offers tailor-made surface quality.

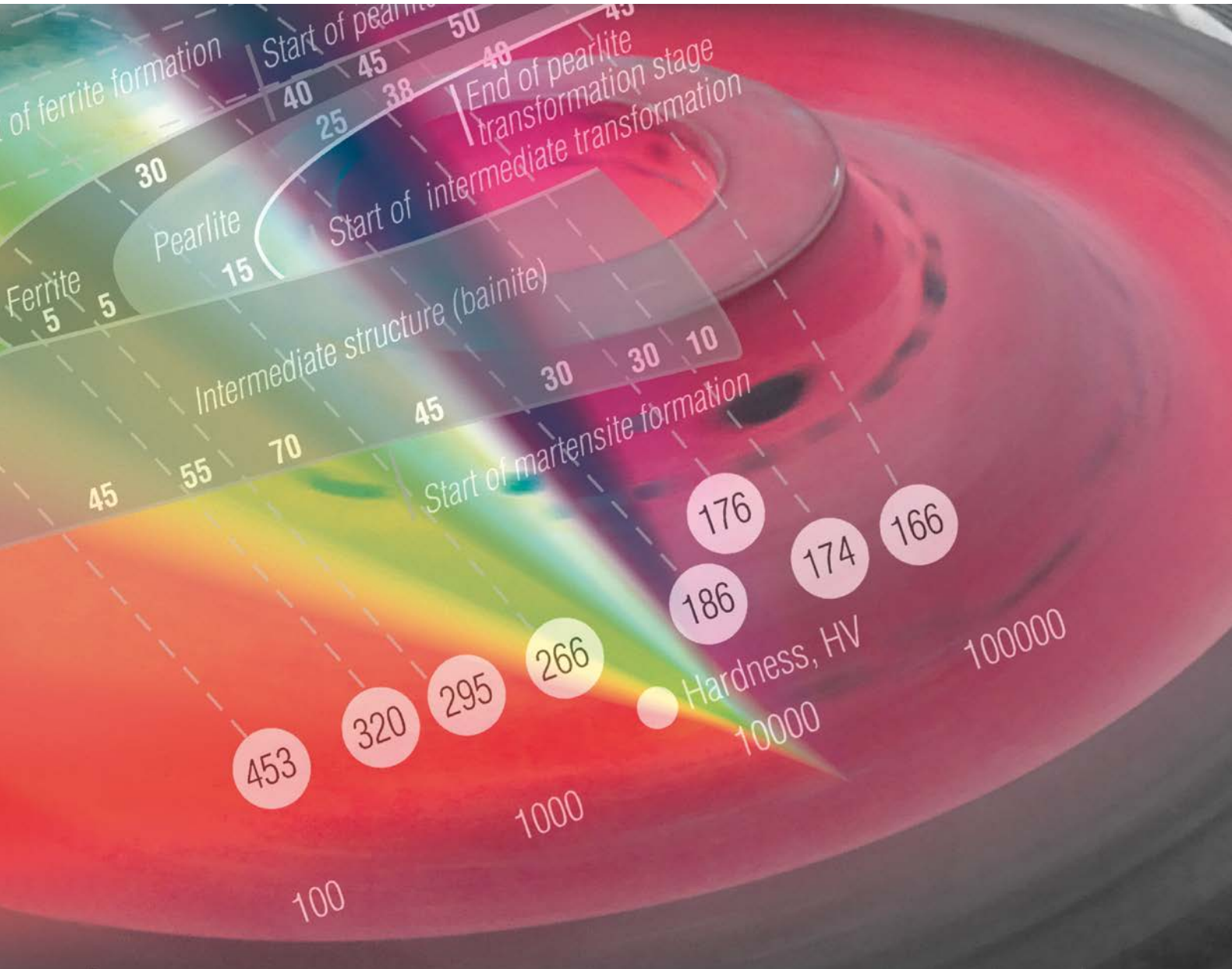
MODIFY THE SURFACE BY METALLIC AND NONMETALLIC COATINGS

Tenova LOI Thermprocess heat treatment furnaces galvanize, aluminize or coat.

MODIFY THE SURFACE LAYERS BY CHEMICAL PROCESSES

Several hundred Tenova LOI Thermprocess heat treatment furnaces for case hardening or austenitizing have been installed for the automotive industry.

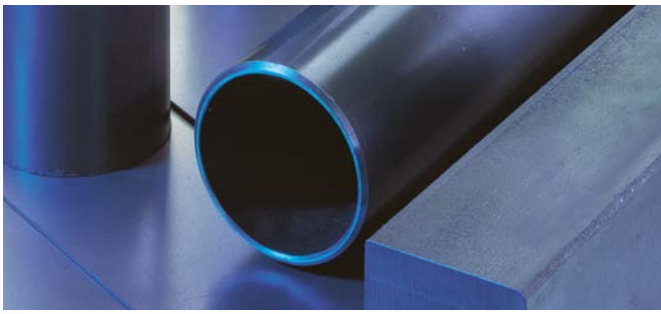
▼ The key to the definition of the micro-structure of metals is the cooling of the material. The behavior is described in TTT diagrams like the one shown below.



Tenova LOI Thermprocess Portfolio

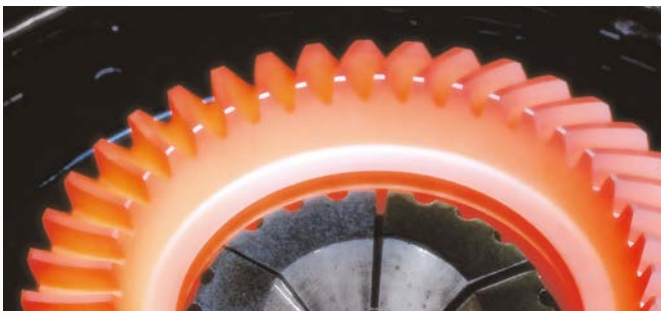
Hot Formed Materials
Reheating furnaces
Furnaces in casting and rolling lines for thin slabs
Heavy plate heat treatment lines
Heat treatment lines for forged components

Rod, Wire and Tube
Heat treatment plants for tubes and bars
Heat treatment plants for rods and wire



Strip
H_2 Bell-type Annealing Furnaces HPH®
Processing lines for electrical steel strip
Continuous strip galvanizing lines

Components
Atmosphere furnaces
Protective gas furnaces
Galvanizing plants



Aluminium
Melting and casting furnaces
Twin-Chamber Melting Furnaces TCF®
Heat treatment plants for Al components
Heat treatment plants for strip coils and foils

Customer Service
Modernization
Retrofit
Relocation
Technological service
Spare parts
Service

Q&T Quenching and Tempering Lines for Heavy Plates

hQuench®, iQuench®, sQuench® and tQuench® for C steel / stainless steel

▲ Tenova LOI Thermprocess heat treatment lines (austenitizing, quenching, tempering) presenting hQuench® for heavy plate, tQuench® for thin plates and sQuench® for strip.

▲ With the iQuench® tailored quenching technology Tenova LOI Thermprocess offers a wide variety of quenching modes and the full range of heat transfer combined with a powerful and unique mathematical material model and overall automation.

Tenova LOI Thermprocess Q&T Lines for Hardening, Normalizing and Tempering are ideal for mass producers as well as niche producers with small lots. The key equipment is the water quench. Our quenching technology is precisely tailored to customers' growing requirements for process security, quality and flexibility. Tenova LOI Thermprocess has been the leading company in this field since the 1990s with more than 30 quench installations and more than 50 furnace installations throughout the world. Tensile strengths of more than 1.500 MPa can be achieved by our Q&T technology. Reaching material hardness higher than 500 HBW, a Q&T Line is also the right tool for producing abrasion-resistant steel. Plates can be produced with widths up to 5 m, thicknesses from 3 mm up to more than 150 mm and lengths up to 30 m.

▼ Tenova LOI Thermprocess NF Roller Hearth Funace for normalizing of heavy plates

Heat Treatment Lines for Forged Products

Forgings, high-performance railway wheels

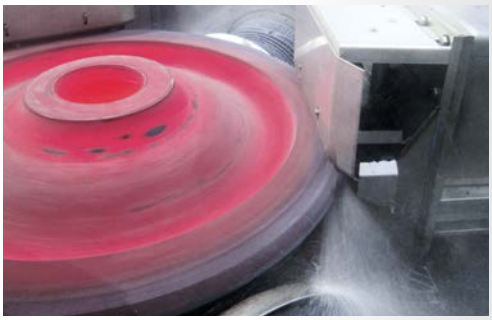
▲ Tenova LOI Thermprocess continuous heat treatment line for high-speed railway wheels

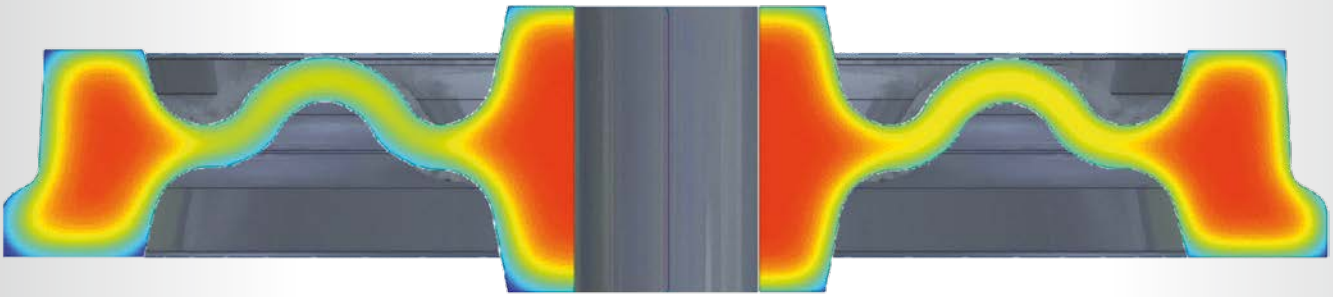
The example above shows one furnace for austenitizing and two furnaces for tempering (with an overall length of approx. 100 m) combined with 8 Hardening Tables.

The whole system is combined with auxiliary transportation and quality assurance systems and highly automated. It operates practically in line with a forging press, which means that a typical output of 70 wheels per hour can be reached. Different furnace dimensions and numbers of Hardening Tables are possible, depending on the customer's needs.

QUENCHING OF HIGH-PERFORMANCE RAILWAY WHEELS

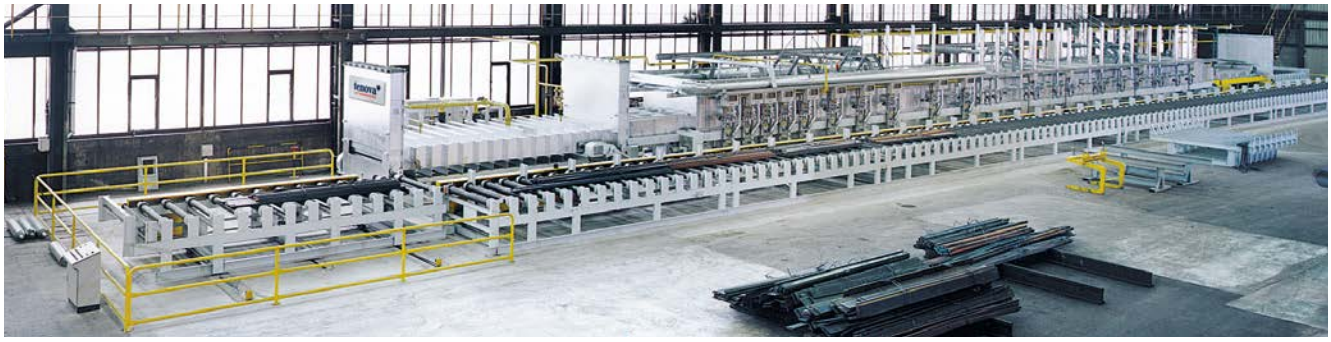
In order to reach a long service life, railway wheels must have a fine perlitic structure over a certain depth under the contact surface with the rails. A highly complex quenching process is necessary with a dedicated system of nozzles spraying water onto the wheel with different flows depending on the position of the wheel and time. A mathematical model adapts the quenching process to each individual type of wheel.





Heat Treatment Plants for Tubes and Bars

Carbon steel, stainless steel, non-ferrous metals for long products and coils



ROLLER HEARTH FURNACES

Tenova LOI Thermprocess offers continuous and semi-continuous Roller Hearth Furnaces with protective and reactive gas atmospheres as well as heat treatment processes to meet the highest requirements regarding chemical composition and mechanical properties.

The controlled atmosphere meets the requirements for bright annealing and prevents unwanted reactions like decarburization. Tenova LOI Thermprocess Roller Hearth Furnaces are available with electrical, hybrid and green gas fired solutions. Optionally, these plants can also be designed to meet CQI-9 standard used in the automotive industry.

STAINLESS STEEL

- up to 100 % H_2
- annealing temperatures up to 1,200 °C
- jet cooling gradient up to 5 K/sec between 900 - 400 °C

CARBON STEEL

- activity controlled carbon atmospheres
- annealing temperatures up to 1,050 °C
- highly efficient heat recovery systems available, if required

WALKING BEAM FURNACES

Tenova LOI Thermprocess provides tempering furnaces, hardening furnaces and innovative quenching systems.

▼ Tenova LOI Thermprocess continuous Roller Hearth Furnace for bright annealing of LWCs (level wound copper tubing)

▲ Tenova LOI Thermprocess Roller Hearth Furnace for bright and carbon neutral annealing of precision steel tubes in endogas-nitrogen atmosphere

Heat Treatment Plants for Rod and Wire

High quality rod and wire coils

ROLLER HEARTH FURNACES

Carbon, alloyed and stainless steel, copper wire

◀ Tenova LOI Thermprocess Roller Hearth Furnace plant with a protective atmosphere for wire coils

HPH® BELL-TYPE ANNEALING FURNACES

Carbon, alloyed and stainless steel, copper wire

These furnaces are equipped with HPH® (High Performance Hydrogen) technology. High-quality annealing results can be reliably reproduced. Uniform mechanical and metallurgical properties lay an excellent foundation for cold working.

▲ Schematic of Tenova LOI Thermprocess HPH® Bell-type Annealing Furnace

HIGH PERFORMANCE HYDROGEN BELL-TYPE ANNEALING PLANTS

Rolled or drawn wire coils of carbon or stainless steel as well as non-ferrous metals

- Tenova LOI Thermprocess market share over the past 10 years approx. 40 %
- Both multi-stack and single stack plants available
- N_2, HN_x or 100 % H_2 atmosphere
- Plants with recirculation up to material temperature of 900 °C
- High-performance atmosphere gas recirculation system
- Stack height up to 5,600 mm
- Charge weight: up to 90 t
- Patented HPH® JET Cooling Hood
- ecoBAF® with H_2 combustion and ultra-low NO_x HPH®-flameless technology
- Locally CO_2-free eBAF® with state-of-the-art electric heating system

Heat Treatment Plants for Steel Strip

HPH® BELL-TYPE ANNEALING FURNACES BAF FOR STEEL STRIP

Material: Hot and cold rolled, CQ to EDDQ, HSQ, high carbon steel, tinplate T1 – T4, AISI 400, stainless steel

Throughout the world, more than 8,500 Tenova LOI Thermprocess annealing bases have been installed. About 5,000 of these bases operate with HNx controlled atmosphere. More than 3,500 bases use HPH® (High Performance Hydrogen) annealing technology with a pure hydrogen annealing atmosphere.

Tenova LOI Thermprocess is therefore also the market leader in the field of high performance Bell-type Annealing Furnaces.

Tenova LOI Thermprocess HPH® technology ensures atmosphere dew points below -60 °C. An extremely pure hydrogen annealing atmosphere and precise temperature control bring considerable quality benefits with a wide variety of steel grades. The temperature uniformity inside the total stack at the end of soaking will be within a range of +/- 5K.

▼ Typical installation of an HPH® Bell-type Annealing Furnace plant for steel strip

HPH® BELL-TYPE ANNEALING FURNACES FOR NON-FERROUS STRIP

The atmosphere used depends on the specific alloys and the annealing process which is required. The gases which are available include pure hydrogen, nitrogen or mixtures of the two.

- Sophisticated plant design and process technology for high productivity and material quality
- References: first reference from 1949
- Both single-stack and multi-stack bases available
- Very high process quality: dew points below -60 °C
- Usual diameters 800 to 2,400 mm

Tenova LOI Thermprocess HPH® Bell-type Annealing Furnace plant for non-ferrous metals Material: non-ferrous metals, mainly copper and copper alloys ▶

MULTI STACK BELL-TYPE ANNEALING FURNACES MBAF FOR SILICON STEEL STRIP

The requirement for reduced losses in the transmission and transformation of electric power has created a huge demand for electrical steel (silicon steel). Especially the production of grain-oriented GO silicon steel requires various heat treatment routes in different continuous processing lines and high temperature batch-type plants.

Tenova LOI Thermprocess is the only company able to supply all types of heat treatment equipment required for silicon steel production.

▼ Tenova LOI Thermprocess Multi-Stack Bell-type Annealing Furnaces MBAF for silicon steel strip GO

BELL-TYPE ANNEALING FURNACE PLANTS FOR SILICON STEEL STRIP

- MBAF Multi-Stack Plants (up to four stacks per heating hood)
- Tenova LOI Thermprocess references: > 400 bases
- Single and double layer design available
- Process temperatures up to 1,250 ° C
- Electrically powered and gas fired heating hoods
- Annealing in a nitrogen, hydrogen or mixed atmosphere
- Cooling by cooling systems integrated in heating hood

Continuous Heat Treatment Lines for Carbon and Silicon Steel Strip

Carbon and silicon steel

▲ Tenova LOI Thermprocess Continuous Galvanizing Line CGL for carbon steel strip

▼ Tenova LOI Thermprocess Decarburizing and Coating Line DCL for grain oriented GO silicon steel strip

CONTINUOUS GALVANIZING LINE CGL

The heat treatment process for the strip includes heating, soaking, slow cooling and rapid cooling before it enters the coating pot containing the liquid zinc.

ANNEALING AND PICKLING LINE APL

The hot-rolled strips (non grain oriented NGO and GO) are initially annealed in a continuous process line. During annealing, the microstructure is changed in order to reduce brittleness and increase ductility before cold rolling. The annealing process is followed by

▲ Tenova LOI Thermprocess Flattening and Coating Line FCL for GO silicon steel strip

a controlled cooling stage with cooling rates tailored to the steel grade.

DECARBURIZING AND COATING LINE DCL

Cold-rolled GO silicon steel strip is annealed in a continuous process linefor primary recrystallization and decarburization. After the steel strip has passed through the DCL furnace, it is coated with magnesium oxide and dried.

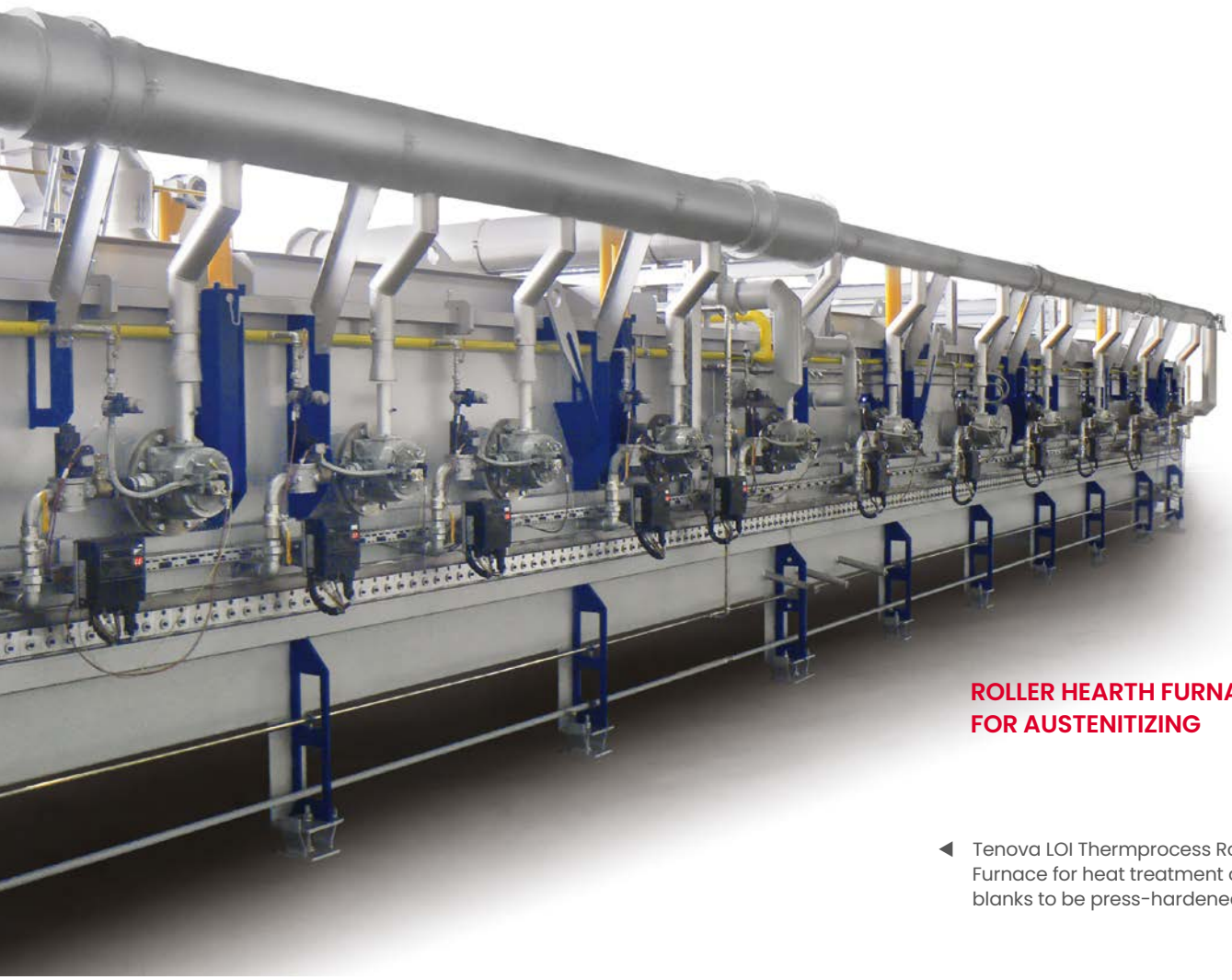
FLATTENING AND COATING LINE FCL

For the final heat treatment process the silicon steel strip is coated with insulating varnish in an in-line process, then dried in an indirectly heated furnace and straightened using the integrated hot stretching equipment. This stage is followed by a slow cooling process.

ANNEALING AND COATING LINE ACL

NGO strip is annealed in a radiant tube furnace using a continuous process after cold rolling to ensure recrystallization and controlled grain growth. Top-quality steel requires strip temperatures above 1,100 °C and a very dry atmosphere with a high hydrogen content.

Heat Treatment Plants for Automotive and Structural Parts

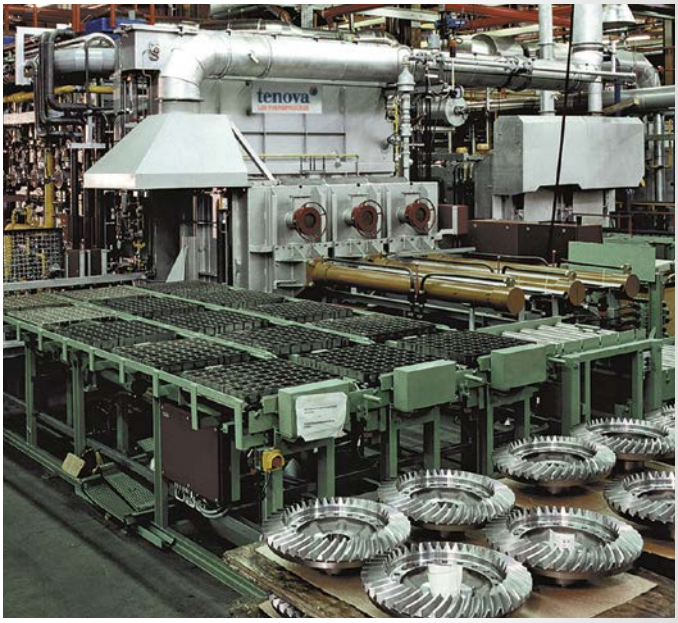


ROLLER HEARTH FURNACE FOR AUSTENITIZING

◀ Tenova LOI Thermprocess Roller Hearth Furnace for heat treatment of metal blanks to be press-hardened

HEAT TREATMENT OF AUTOMOTIVE AND STRUCTURAL PARTS

Since 1950 Tenova LOI Thermprocess has supplied several hundred case hardening lines for automotive parts with carburizing furnace, quench, washing machine, tempering furnace and fully-automated material handling: Comprehensive practical knowledge of carburizing, decarburizing, quenching, nitriding and other processes is combined with a wide range of mathematical models developed in-house.



ROTARY HEARTH FURNACE WITH ZONE SEPARATION FOR CASE HARDENING

Tenova LOI Thermprocess's original heat treatment technology for case hardening as well as for quenching and tempering steels has been continuously improved and developed into the Tenova LOI Thermprocess Rotary Hearth Furnace featuring zone separation, which allows optimum process control.

▲ Tenova LOI Thermprocess Rotary Hearth Furnace with zone separation for gas carburizing of gear parts and Q&T steels

GALVANIZING PLANTS

Galvanizing furnace for high temperature
Galvanizing furnaces with ceramic application areas are used for galvanizing small parts.

Galvanizing furnace with kettle
Galvanizing furnaces with kettle are used for galvanizing large structural steel components.

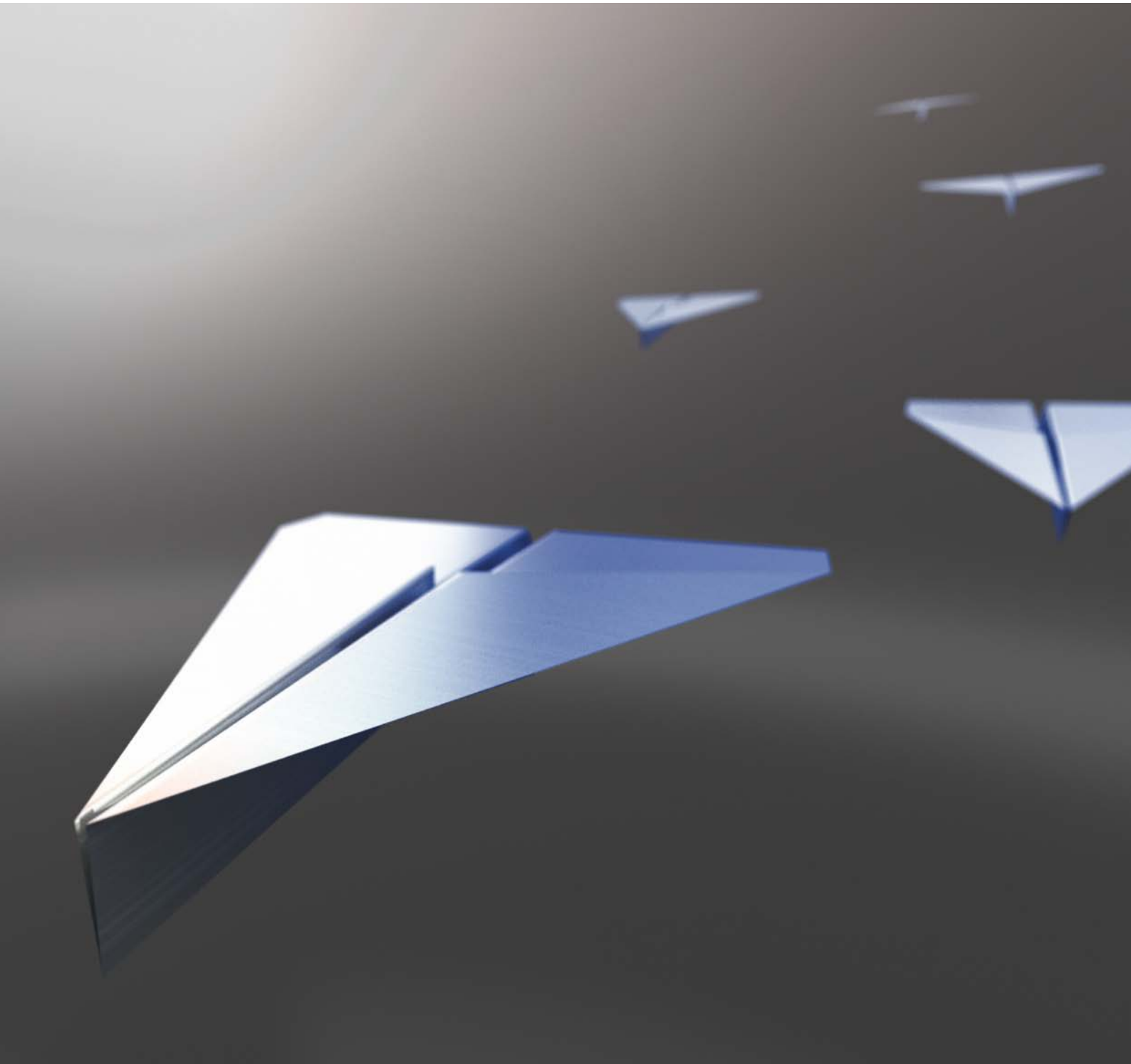
Drying furnace
The drying furnace is an integral part of the production line and is adapted to the overall material flow concept of the galvanizing workshop.

Zinc bath housing
The zinc bath housing collects all the fumes arising when the products are dropped into the liquid zinc. From the housing the fumes are extracted to the fume purification plant.

Tenova LOI Thermprocess high-temperature Galvanizing Furnace with Zinc Bath Housing ▶

ALUMINIUM – LIGHTWEIGHT, INNOVATIVE AND COMPLETELY RECYCLABLE

Due to its unique properties and the optimal recyclability of used aluminium components, aluminium is a trend-setting material in the automotive, mechanical engineering and aviation industries. Aluminium outclasses alternative materials with regard to many future-oriented solutions.



Aluminium Melting, Casting and Recycling Furnaces

TCF® AND MCF RECYCLING TECHNOLOGY

Contaminated scrap is recycled without pre-treatment. Organics are pyrolyzed and burned inside the furnace. The pyrolysis gas, which contains combustibles, contributes to heating the furnace. The salt-free melting process allows the environmentally compatible recycling of aluminium scrap.

TWIN-CHAMBER MELTING FURNACE TCF®

The Tenova LOI Thermprocess Twin-Chamber Melting Furnace TCF® provides a process for medium and higher contaminated scraps with high metal yield. Typical liquid metal production rates are in the range of 80 to 180 t/day.

MELTING CASTING HOLDING FURNACES MCF

These furnaces can be tilted for the controlled and reliable transfer of liquid metal to the casting equipment. The furnace is heated by natural gas or hydrogen or mixtures thereof. Recycling of light contaminated scraps is possible. The plant can be equipped with porous plugs, rotary gas injectors or electromagnetic stirrers.

▼ Melting Furnaces MCF with a bath capacity of 55 t each

Heat Treatment of Aluminium Automotive Components

▲ Tenova LOI Thermprocess AirQuenchSystem AQS for structural components

◀ Tenova LOI Thermprocess age hardening line (Overhead Annealing Line OAL) with MediaQuenchSystem MQS, quench baths move under the furnaces

▲ Tenova LOI Thermprocess multi-lane chain conveyor furnace with single-part quenching

HEAT TREATMENT LINES FOR CAST ALUMINIUM PARTS

The heat treatment of castings like engine blocks and suspensions is a combination of solution annealing, quenching and ageing.

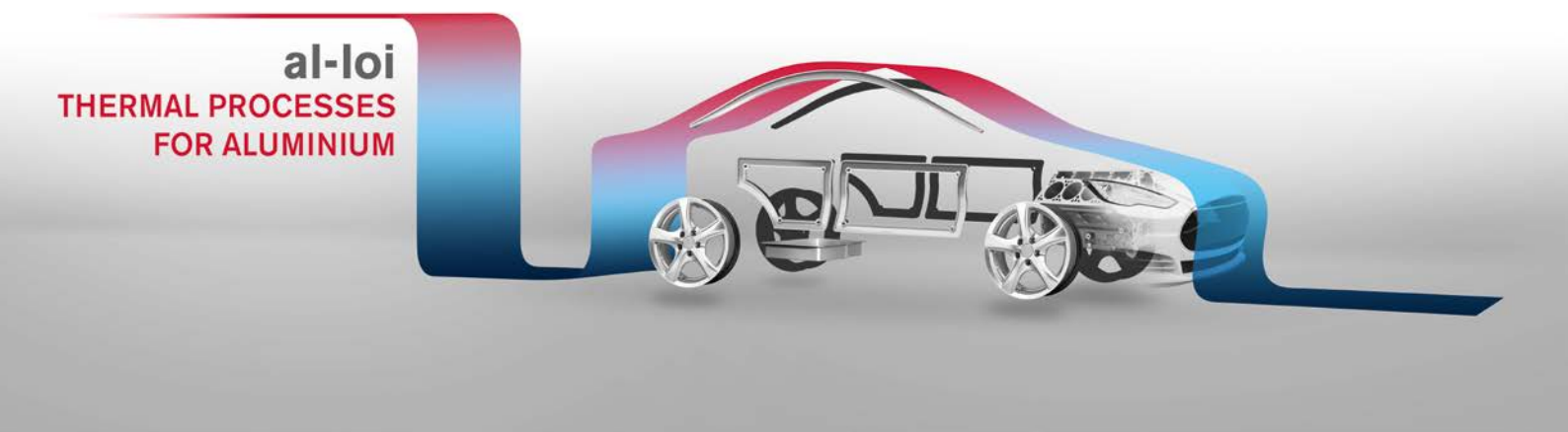
HEAT TREATMENT LINES FOR FORGED ALUMINIUM PARTS

The heat treatment of forgings is a combination of solution annealing, quenching and ageing, where accurate quenching of individual parts is required.

HEAT TREATMENT LINES FOR ALUMINIUM STRUCTURAL PARTS

For thin structural parts for automobiles air quenching is applied. This ensures less distortion and less residual stress. Sensitive cooling and adequate quenching technologies are required.

All lines can be offered as continuous or batch type.



Heat Treatment of Aluminium Strip Coils and Foils

▲ Tenova LOI Thermprocess Single-Coil Annealing Line SCL for aluminium strip

▲ Tenova LOI Thermprocess Final Annealing Line FAL for heat treatment of aluminium foil rolls

FINAL ANNEALING LINES FAL

FAL are used for the heat treatment of aluminium foil rolls. The multi-chamber furnace design combines several individual chambers in one furnace casing. One furnace consists of up to five individual chambers, which operate independently.

FURNACES FOR ALUMINIUM COILS

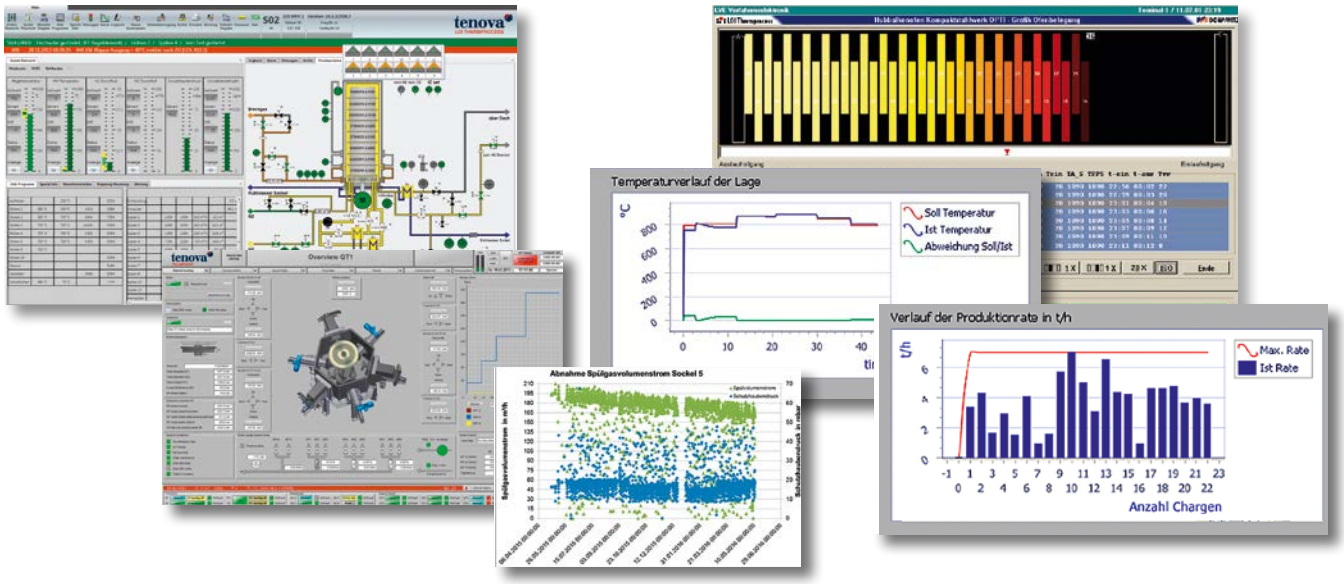
Single-coil annealing improves the flexibility of production schedules and avoids complex batches of different coils.

For larger batches of the same coils the Multi-Coil Annealing Line MCL is the right choice. Furnaces are loaded automatically with one batch con-sisting of several coils.

▼ Tenova LOI Thermprocess Final Annealing Line FAL for heat treatment of aluminium foil rolls

Controls for Furnaces and Thermal Processes

Fully automated control systems are indispensable. Modern control systems ensure:



- High safety
- Optimized processes
- Constant, high product quality
- High plant availability
- High productivity
- Optimum conditions for operation and maintenance
- Minimal energy and utility consumption
- Lower pollutant emissions

Tenova LOI Thermprocess offers control systems including all the hardware and software required from the switchgear assembly to the supervisory control system.

- Comprehensive expertise in process electronics, control system engineering and automation

- Switchgear assemblies, components
- Automation
- Supervisory systems
- Mathematical modelling online and offline
- Throughput and material flow optimization

SERVICE AND SPARE PARTS

Each furnace plant is unique. With know-how developed over many decades and backed by thousands of references worldwide, Tenova LOI Thermprocess supplies targeted and experienced services, as well as maintenance and spare parts specially aligned for your thermal process plant. The worldwide service network assures high availability and fast delivery.

SERVICES

We provide our customers with tailor-made maintenance programs, regular technological updates, operation assessment and personnel training.

SPARE PARTS

We supply original spare parts for LOI's wide portfolio of industrial furnace systems as well as third party equipment. With LOI-SIS® (Service-Information System), a web-based catalogue for new and old equipment can be created on demand to facilitate the identification of parts and simplify the procurement process significantly.

MAINTENANCE AND REPAIR

Our experts are available for maintenance work on process control systems including mathematical models and on systems including mechanical and electrical elements, refractory linings, burners, heating/cooling systems, controllers and automation devices.

DIGITAL SERVICE

LOI's wide portfolio of different digital services help you to improve product quality, minimize downtimes and enhance your production process. These are e.g.:

- Remote Services including Remote Assistance to offer live support at your plant and Remote Control for performance monitoring
- Digital Equipment Twins using Virtual Reality that allows you to experience your equipment before it is installed
- Digital Automation Twin to accelerate your plant commissioning
- Video Furnace Inspection to easily analyze your plant
- A variety of Intelligent Process Models and Monitoring Systems for performance increases

RETROFIT AND MODERNIZATION

Our innovative and sustainable modernization solutions allow customers to minimize the environmental impact of their plant and decarbonize processes. Productivity and efficiency levels are improved, while focusing at the same time on plant safety.

Sustainable solutions *for a green transition of metals*

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