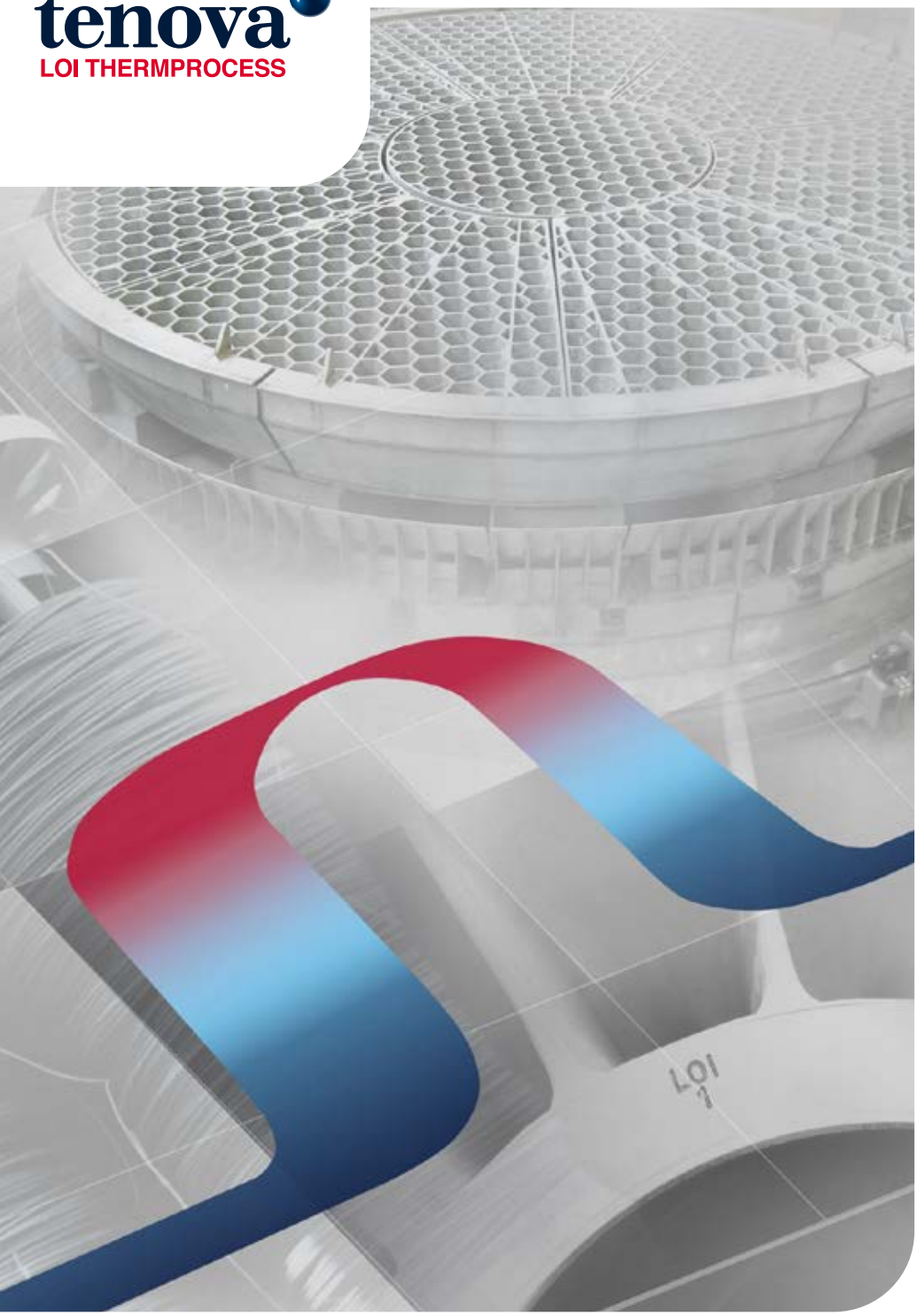
tenova
LOI THERMPROCESS



HPH®
High Performance Hydrogen

HPH® Bell-type Annealing Plants and Processes
for the Heat Treatment of Rod and Wire

TENOVA
LOI THERMPROCESS

Tenova LOI Thermprocess 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 backed by a history of over 100 years representing the entire know-how in the field of material properties and secondary metallurgy. 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 thermoprocessing 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 for reheating and heat treatment plants meets the most demanding market requirements.

As digitalization is one of the key drivers in our business, all our processes are enhanced by our smart digital solutions. We provide the full range of solutions for the whole life-cycle of the equipment from a single source: from new plants to modernization, maintenance and service.

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.

Tenova Companies for Heat Treatment Processes and Plants for Rod and Wire:

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ITALIMPIANTI

Chamber Furnaces ▶ for solution annealing with all kinds of quenching technologies

Semi-continuous Heat Treatment Plants

Walking Beam and Pusher type Reheating Plants

tenova
LOI THERMPROCESS

HPH® Bell-type Annealing ▶ Plants (batch type)

Rotary-type Furnaces for solution annealing with all kinds of quenching technologies

▼ Roller Hearth Annealing Plants (continuous type)

LOI EXPERTISE FOR BELL-TYPE ANNEALING PLANTS

Tenova LOI Thermprocess, including the activities of its predecessors Matthias Ludwig and Nassheuer, has been a technological market leader in Bell-type Annealing Furnaces for more than 70 years. Throughout the world, more than 8,500 LOI annealing bases have been installed. About 5,000 operate with an HNx controlled atmosphere. More than 3,500 bases use HPH® annealing technology with pure hydrogen.

Tenova LOI Thermprocess is therefore also a market leader in the field of high performance hydrogen annealing plants for steel strip and steel wire.

R&D AND PROCESS TECHNOLOGY

Tenova LOI Thermprocess has comprehensive expertise in HPH® Bell-type Annealing technology and is continuously developing this expertise through R&D and practical tests.

HIGHLY EFFICIENT SPACE UTILIZATION

is ensured by different charging possibilities.

- Useful diameter: 1,500 – 4,600 mm
- Useful height: 1,500 – 5,400 mm
- Charge weight: up to 90 t
- Coil diameter: 300 – 1,500 mm

MAXIMUM ENERGY EFFICIENCY

is ensured by features including

- Individual heat exchangers for each burner of the heating hood
- HPH® High-convection heat transfer

ATMOSPHERE GAS COSTS

are minimized by selecting the best atmosphere gas for the process, e.g.

- Nitrogen for spheroidizing hot rolled wire
- Hydrogen for recrystallizing drawn wire

OPTIMUM PROCESS RELIABILITY

"Zero Defect" philosophy

DESIGN FEATURES:

- Seal components installed only on the base
- Atmosphere gas supply systems with redundant sensors for safety purposes and redundant valves on the valve stand

PROCESS FEATURES:

- Automatic adaptation of annealing atmosphere purging to the annealing process selected
- Sophisticated process control system including plausibility checks, malfunction logging and automatic safety responses

◀ HPH® Bell-type Annealing Plant for wire coils with the largest usable dimensions in the world

HPH® FURNACE FEATURES

- Tenova LOI Thermprocess market share over the past 10 years approx. 50 %
- Both multi-stack and single-stack plants available
- Plants with recirculation up to material temperature of 900 °C
- Hot-rolled or drawn wire coils can be treated. The materials treated include:
  - Mild steels
  - Chain and spring steels
  - Unalloyed and alloyed steel grades (CHQ and ball bearing steel)
  - Tool and high-speed steels (HSS)
  - High-alloyed stainless steels
  - Non-ferrous metals
- The annealing processes available include soft annealing, recrystallizing and spheroidizing without decarburization or oxidation
- In N2, HNx or 100 % H2 atmosphere
- Dew point below -60 °C
- Reliable reproducibility of high-quality annealing results with regard to uniform mechanical and metallurgical properties ensuring excellent cold working conditions

▲ HPH® Bell-type Annealing Plant for CHQ wire

BEST QUALITY WIRE

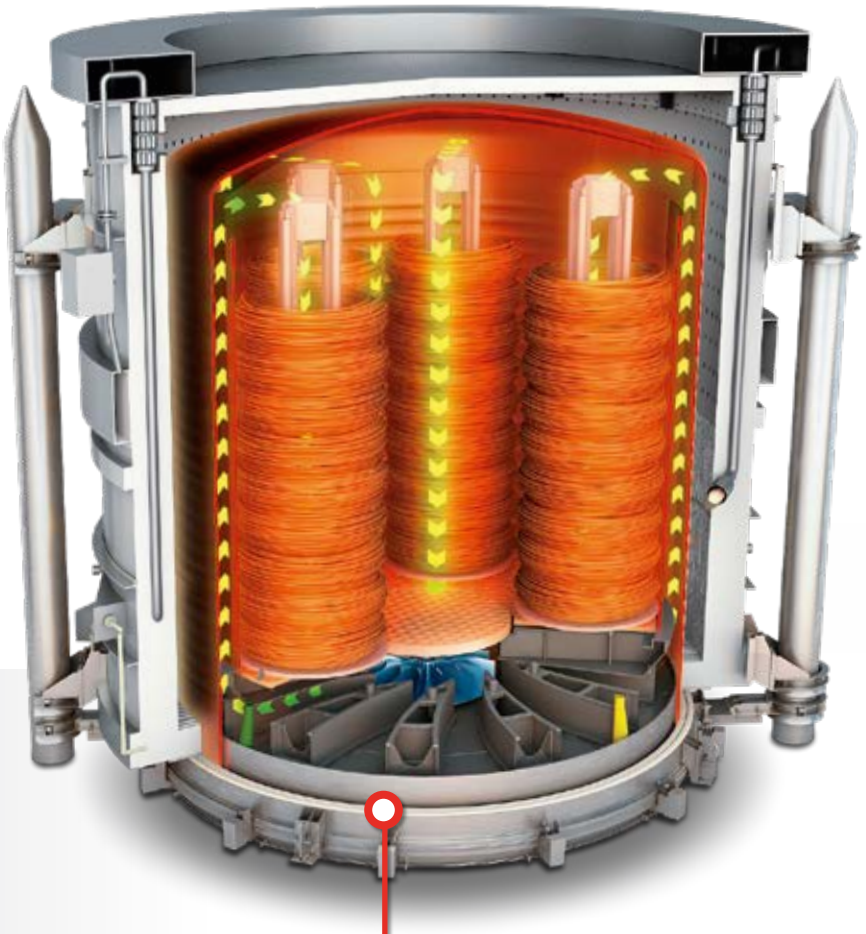
Annealed wire of the highest quality can only be produced with an extremely clean controlled atmosphere. At Tenova LOI Thermprocess the base plate of the annealing base is designed to provide a fully gas-tight seal between the annealing space and the surrounding air. Controlled atmosphere dew points of -60 °C and better can be reached.

HIGH PROCESS RELIABILITY

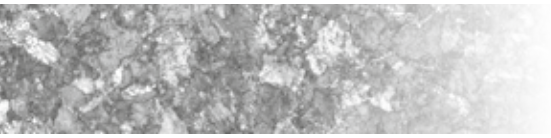
Tenova LOI Thermprocess Bell-type Annealing Plants for steel wire are equipped for HPH® (High Performance Hydrogen) technology. They can be operated either with a controlled atmosphere of nitrogen (or HNx gas) or with pure hydrogen.

The annealing time required for the spheroidizing of rolled wire is determined mainly by metallurgical factors. It is recommended to use a controlled atmosphere of nitrogen. For recrystallizing drawn wire, which has a layer of grease on its surface, hydrogen is used as the

Heating hood with heat exchangers ▶
for high heating efficiency



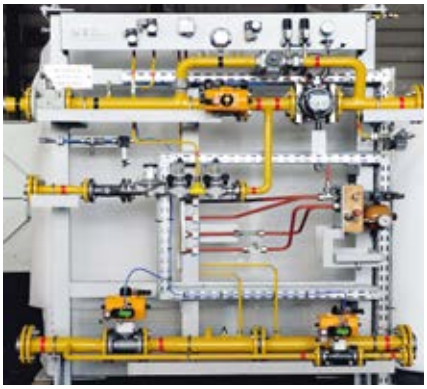
▼ Microstructure of wire in hot-rolled condition



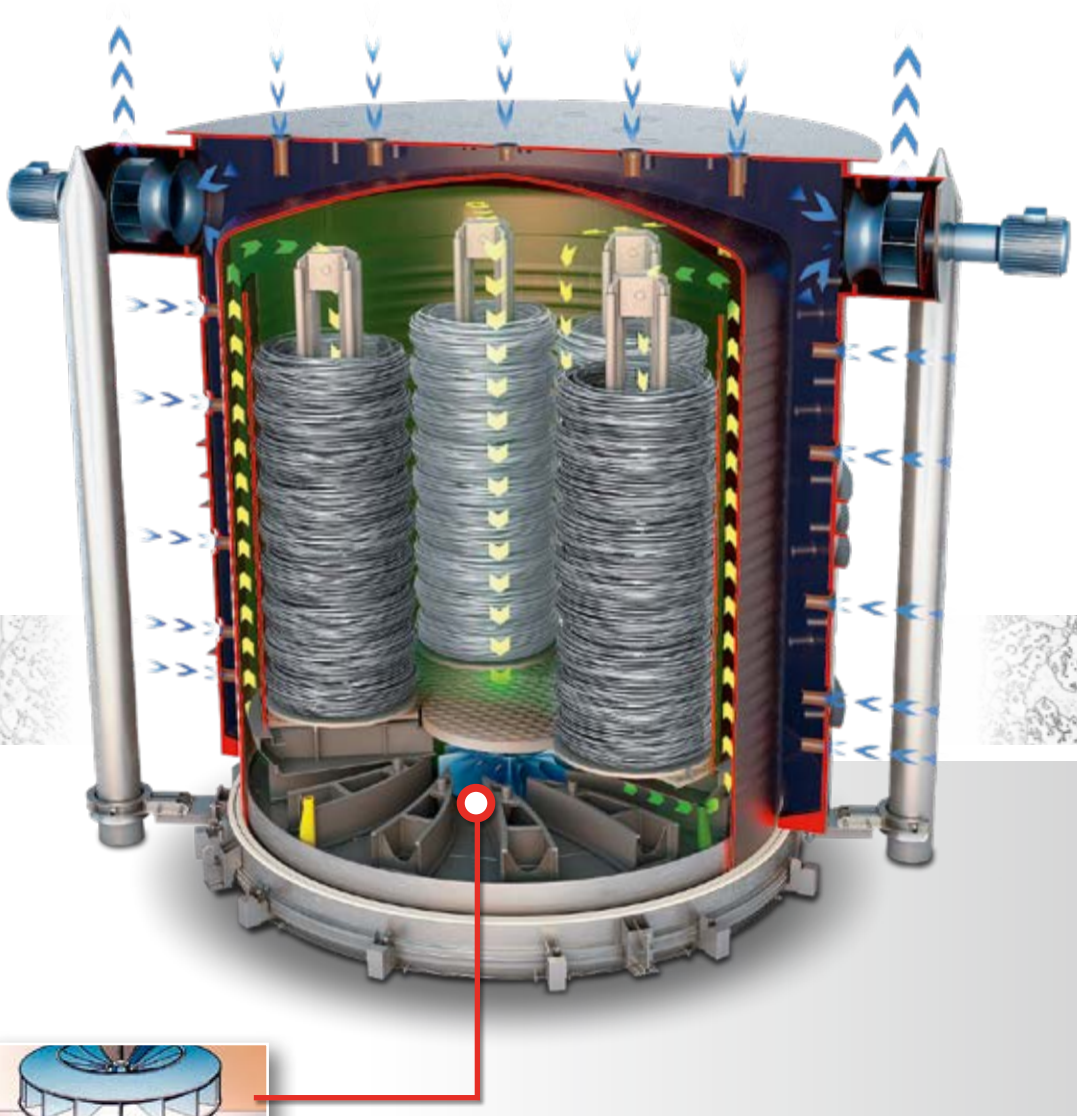
◀ Hydraulic or pneumatic clamping

controlled atmosphere. The grease evaporates and reacts with the hydrogen, ensuring a clean surface. The high heat transfer rate possible with hydrogen also contributes to excellent annealing results with minimum annealing times.

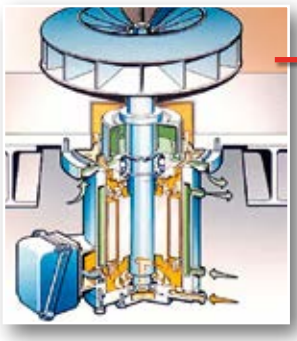
Hydrogen and nitrogen can be mixed in any proportions (0 -100 %) with the Tenova LOI Thermprocess valve stand ▶



Cooling hood with Jet cooling for high cooling efficiency ▶



▼ Spherodising for stress relieving/ lowest tensile strengths/ best elongation properties



◀ Gas tight, water cooled, base recirculation motor, variable frequency controlled, up to 55 kW

TYPICAL CHARGE ARRANGEMENTS

▲ Annealing of non-ferrous wire coils

▲ Flat wire annealing

▲ Charging of spools of drawn wire

▲ Single-stack arrangement of wire coils

Rod annealing

TYPICAL PLANT TYPES

Coil outer diameter (~ d in mm)	No. of stacks	Inner cover diameter (mm)	Plant type (~ D)
1000	1	1800	160
	4	2950	260
	7	3600	320
1200	1	1800	160
	3	2950	260
	4	3600	320
	7	4700	420
1300	1	1800	160
	4	3600	320
	7	4700	420

D = 2.154 x d

D = 2.414 x d

D = 3 x d

BASES DESIGNED FOR A LONG SERVICE LIFE

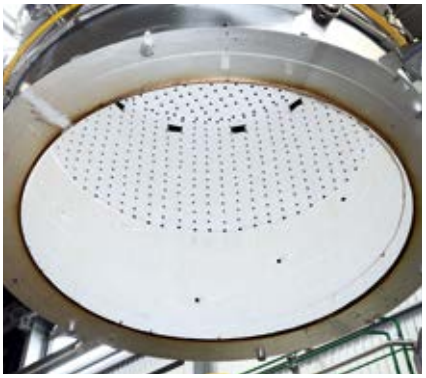
Tenova LOI Thermprocess bases are extremely sturdy and are designed for a virtually unlimited service life as well as very easy cleaning and maintenance:

- Tried and tested annealing base design
- High recirculation rate for high annealing capacity and best temperature uniformity
- Unique design of recirculation motor and impeller
- Strategies for ensuring a very clean wire surface

▲ Annealing base for nitrogen and hydrogen annealing with honeycomb grating and set of confusor/ diffusor parts made from heat-resistant material

▲ Base designed with FEM strength modelling, equipped with fixed charging stations for extremely high stability

▲ Electrical heating with different zones, thyristor or on/off-controlled



▲ Tangential layout with 12 burners in three different levels. Each burner has a capacity of 150 kW; one burner for H2 and lubricant residues after burning. All are equipped with individual heat exchangers.

HPH® HEATING HOOD

The heating hood may be heated either by burners or by an electric system. Burners for natural gas (high and low calorific value), coke oven gas and light fuel oil are available. High-grade insulation minimizes heat losses at the same time as ensuring highly homogeneous temperatures over the entire height of the stack.

A hydrogen atmosphere combined with high-performance recirculation systems makes for rapid heat transfer to the charge, allowing high heat input values and burner ratings.

The short annealing times which are possible mean that energy consumption is reduced to a minimum.

With advanced burners and highly effective on-off control and process firing systems, HPH® plants reliably comply with applicable emission limits throughout the annealing cycle. Emissions are significantly below the limits.

◀ HPH® Heating hood placed over the inner cover with baffle inside

HPH® JET COOLING HOOD

Bell-type Annealing Plants for the heat treatment of steel wire coils mainly use Jet cooling. This type of cooling system is especially well suited for plants with long annealing times (e.g. spheroidizing or high-temperature processes.)

The Jet cooling hood developed by Tenova LOI Thermprocess is patented (EP 0894150, US 6177044). Cooling is provided by air jets targeted directly at the outside of the inner cover. These jets are generated by a large number of air nozzles installed on the steel casing of the Jet cooling hood. For highly effective cooling, nozzles of different diameters are distributed over the height of the cooling hood. In addition, the top of the hood has a large number of air nozzles for intensive cooling in this area.

Two or three radial-flow fans extract air from the cooling hood. Compared with a parallel-flow air cooling hood, heat transfer with a Jet cooling hood is three times more intensive.

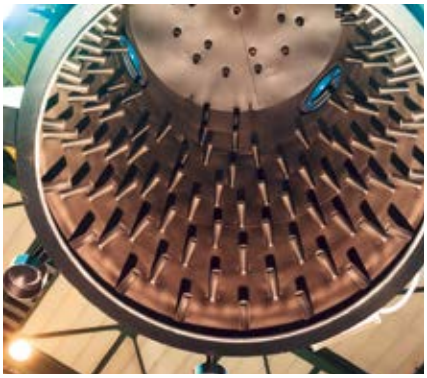
Jet cooling hoods are an attractive alternative for improving the performance of existing Bell-type Annealing Plants.

JET COOLING ADVANTAGES

- Relatively low capital cost
- No cooling water required
- Optimized nozzle configuration, ensuring homogeneous cooling of all coils
- Low noise output
- 10 % capacity increase for existing plants
- Energy savings compared to conventional cooling hoods

On the basis of its extensive plant and process expertise, Tenova LOI Thermprocess can offer the ideal cooling system for any application:

- High-performance air cooling (Jet cooling)
- Conventional air cooling
- Water spray cooling (air/water)

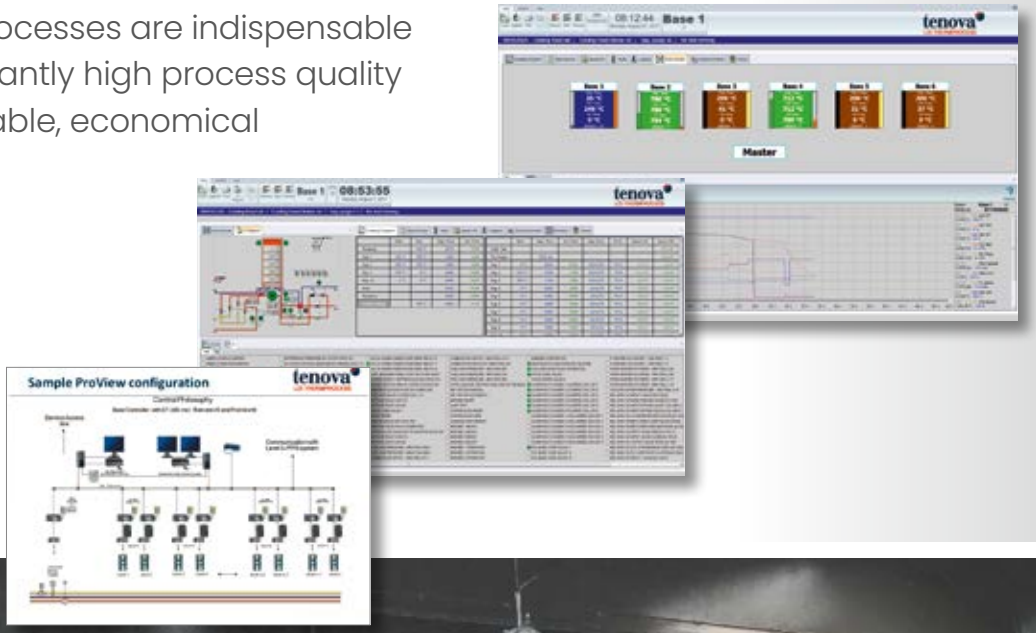


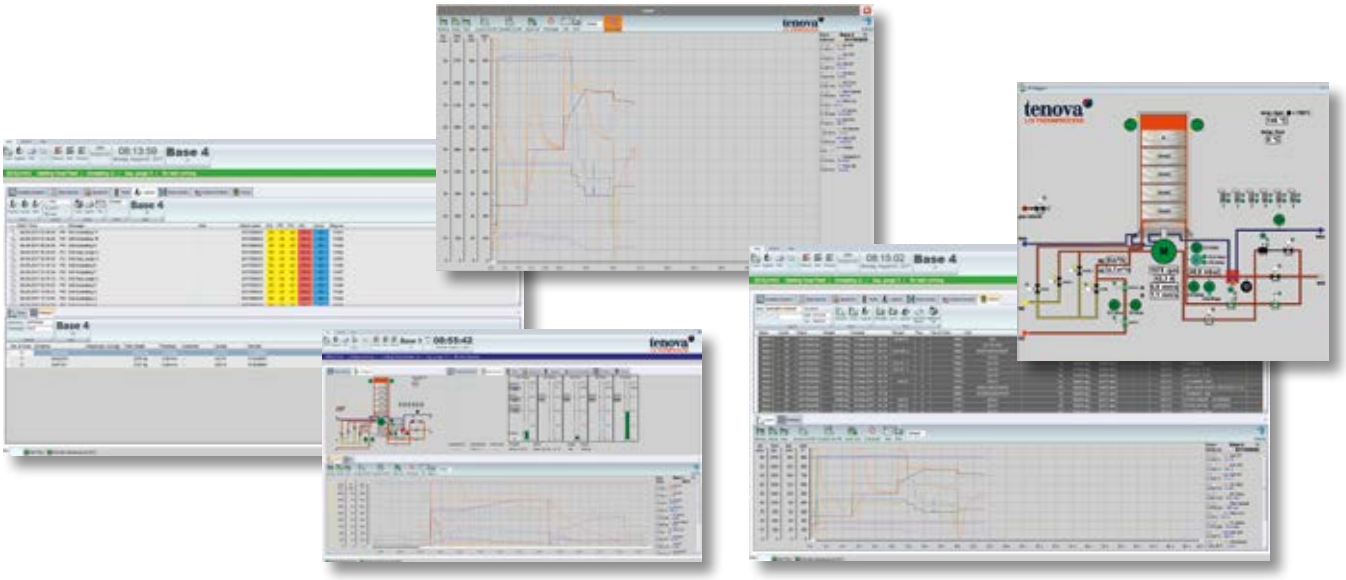
▲ Jet cooling with computer-optimized nozzle design results in 20 % higher cooling capacity.

Jet cooling hood ▶ for optimum cooling results

CONTROLS FOR FURNACES AND THERMAL PROCESSES

Fully automated processes are indispensable for achieving constantly high process quality combined with reliable, economical series production.





CONTROLS FOR FURNACES AND THERMAL PROCESSES

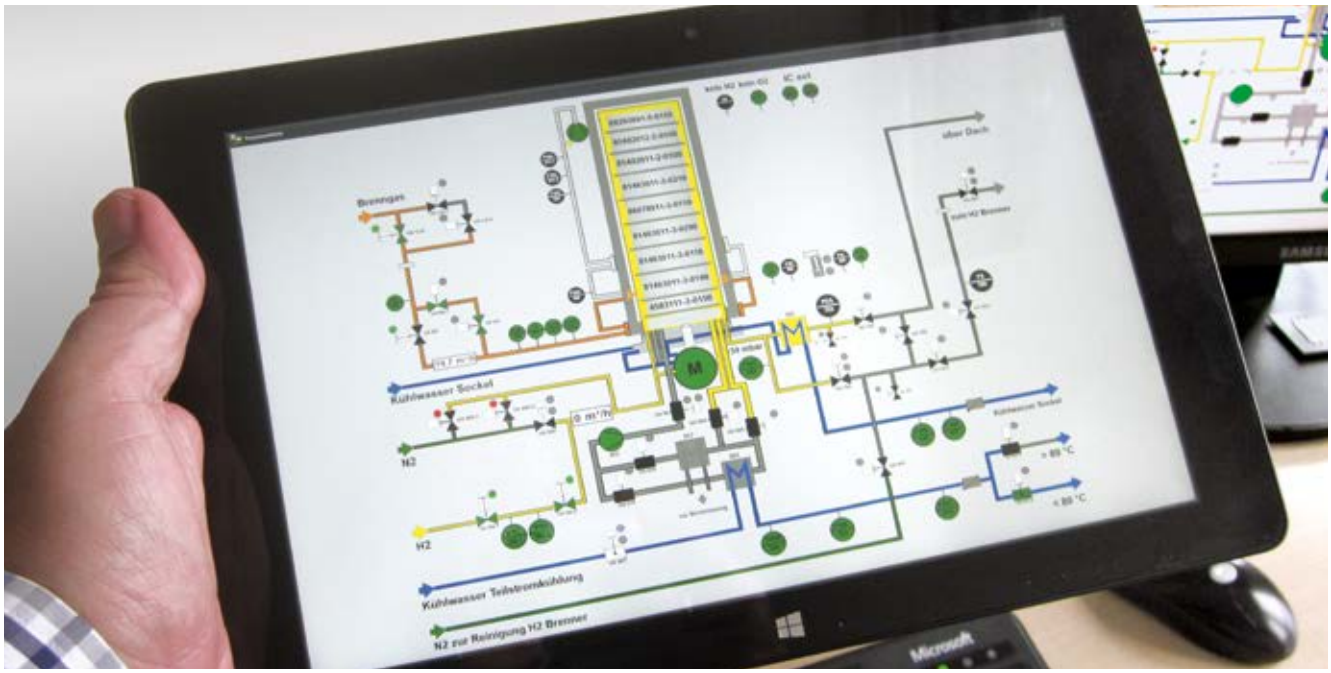
Modern control systems ensure:

- High safety levels
- 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. ProView® control systems are based on a modern application development system designed for the latest Windows operating systems. Mobile versions (ProView® Mobile) are available for use with the latest mobile phones and tablet systems.

- Comprehensive expertise in process electronics, control system engineering and automation
- Switchgear assemblies, components
- Automation
- ProView® supervisory system
- Throughput and material flow optimization

▼ ProView® Mobile supervisory system



SERVICE AND SPARE PARTS

Our dedicated service system makes the full know-how of Tenova LOI Thermprocess, which has been gathered over the decades and is still being developed, available to our customers at all times. The worldwide representation of Tenova means that our customers have direct access to our specialists for spare parts and services, as well as modernization, retrofit and relocation projects, all tailored to their specific needs.

MODERNIZATION, RETROFIT & RELOCATION

In cooperation with our qualified personnel, our customers are able to find the ideal optimizations for their equipment. Our specialized service solutions allow customers to operate their equipment at the highest possible productivity and efficiency levels at the same time as focusing on safety and sustainable development.

SERVICES

We provide our customers with tailor-made maintenance programs, regular technological updates, operation assessment and personnel training with the aim of keeping their equipment running at full capacity in line with best practices, avoiding unforeseen delays and unplanned interventions.

SPARE PARTS

The technical service personnel of Tenova LOI Thermprocess is well prepared to supply the right spare parts within the shortest time. Individual parts are available for delivery within 24 hours.

MAINTENANCE & REPAIR

Our experts are available for maintenance work on systems including:

- Mechanical furnace systems
- Electrical furnace systems
- Refractory linings
- Burner systems
- Heating systems
- Cooling systems
- Control systems
- Automation
- Mathematical models

MODEM & PHONE SERVICE

Control systems and connected plants can also be inspected online by remote maintenance. This approach allows any problems to be reliably identified and eliminated and new program tools and software updates to be uploaded immediately to our customers' systems.

CONSULTANCY

Our process engineers and our commissioning and control systems specialists are available to provide innovative and reliable advice and support to our customers in line with their requirements.

INDUSTRY 4.0

Tenova LOI Thermprocess 4.0 offers:

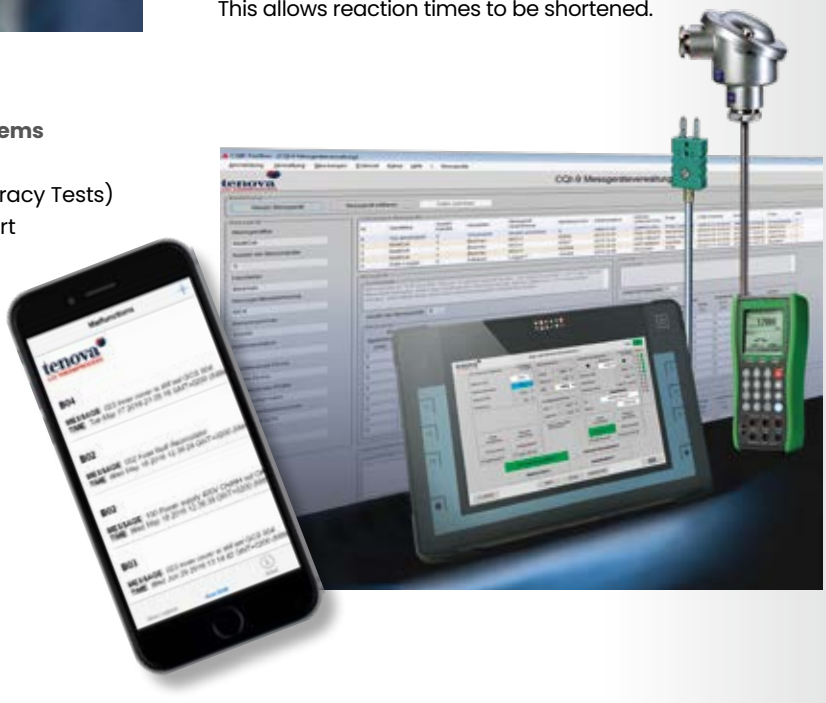
- Production data exchange with higher-level ERP / MES systems
- Production data recording and analysis at any time during and after the process
- Process and throughput optimization
- Alarm management via app / e-mail / SMS
- Mobile input of production or measuring data

As the mobile alarm management (MAM) can be implemented on various platforms, the alarms are available at any place and time. This allows reaction times to be shortened.

Integrable Certification System for CQI-9-systems

The automated evaluation of SAT (System Accuracy Tests) and TUS (Temperature Uniformity Surveys) is part of the integrable certification system.

- On-site data input mobile Touch Panel
- Import and evaluation of TUS measured data
- Permanent storage of measuring data
- Memory management for the next tests



Sustainable solutions *for a green transition of metals*

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