ELOATHERM RingLine
Induction solutions: Ring Hardening
The name SMS group stands for tailor-made metallurgical plants, machinery, and services. Applying innovative ideas and globally uniform standards, we join forces with our customers in the steel and NF metals industries to create all-new products – with pinpoint precision.

**COMBINED FORCES, WORLDWIDE EFFICIENCY**

SMS group is one of the leading global system suppliers of plants, machines and services along the entire metallurgical value chain. With a strong workforce of about 14,000 employees, we are able to present our customers with unique solutions, both technically and economically remarkable, to overcome any challenge.

In our complex world, safe and convenient infrastructures demand solutions in which steel, aluminum, and NF metals can demonstrate their wide range of applications.

**WE TRANSFORM ... THE WORLD OF METALS**

The plants, machines and services of SMS group provide its customers along the metallurgical process chain with outstanding solutions which help shape the global community.
With its developments and system solutions, Elotherm has set standards in induction technology for decades. The medium-sized internationally operating company is part of the SMS group. As a technology leader, Elotherm combines all competences when it comes to induction.

- Induction heating of metals for forging and rolling
- Induction hardening and quench & temper
- Induction welding, annealing and special technology for tubes
- Continuous induction strip heating
- Induction kinetics

CUSTOMIZED SYSTEMATIC SOLUTIONS

Elotherm’s technology is based on compatible modular plant components, which can be efficiently combined into individual configurations. This enables economic industrial heating solutions – irrespective of whether it is a single unit or a complete manufacturing line.
CORE COMPETENCES
Your benefits at a glance

CLEAN, ENERGY-EFFICIENT INDUCTION TECHNOLOGY
During induction heating, the metal workpiece is exposed to an electromagnetic alternating field using a current-carrying coil. As a result, eddy currents are produced in the material in a non-contact manner and heat is generated. This process can be specifically influenced to suit requirements. Using the induction technology, the microstructure of carbon-based materials can be selectively set by varying the frequency, the energy input and the quenching process. This allows precise hardening in line with the customer’s requirements.

EFFICIENT AND TAILOR-MADE WITH THE RingLine
With the RingLine, Elotherm offers an innovative machine concept for the hardening of gear parts and large bearings. Highly productive methods for hardening the teeth and raceways of large rings are available. For the hardening of the raceway, SMS Elotherm has developed and patented scan hardening process that avoids the otherwise common soft zone – a new standard in the field of ring hardening.

The SMS Elotherm configurator allows individual modules to be combined into a complete system meeting all the customer’s demands. The modular design allows economically tailored, appropriately dimensioned and tooling time-optimized hardening systems to be configured.

REDUCED ADDITIONAL COSTS
Further savings result from the integrated effective power measurement in the Elotherm hardening machines that allows a 100 % quality control of the hardened workpieces. Complex examinations can therefore be effectively dispensed with.

TECHNOLOGY LEADER WITH OUTSTANDING PROCESS COMPETENCE
- Innovative system partner to the automotive and supplier industry and the steel, rolling mill and pipe production industry for over 75 years
- More than 6000 plants worldwide in continuous operation for decades
- Sales and service around the globe
- Fast delivery thanks to local production and stock keeping

INDIVIDUAL CUSTOMER CONFIGURATIONS
- High profitability thanks to modularized system components
- Tailor-made production solutions

ENERGY-EFFICIENT, COST-EFFECTIVE INDUCTION
- Minimized energy consumption thanks to intelligent technology
- Sustainable and eco-friendly thanks to reduction of CO2
- Fast change of production and increased productivity
- Low unit production costs
- Integrated effective power measurement per workpiece for efficient quality control

IN-HOUSE INDUCTOR AND CONVERTER PRODUCTION
- All competences under one roof
- Optimum technical interfaces to existing customer systems
- Individual design and layout for optimum results
- Innovative converter development for low and resource-conserving energy demand

PRECISION IN THE PROCESSES
- All relevant certifications, e.g. VDA, DIN/ISO
- Continuous project and quality management from the initial enquiry through to field service
INDUCTION HARDENING

CONTROLLING THE COMPLETE PROCESS
Induction hardening is generally a clean process. The process sequence during hardening normally consists of heating, holding, quenching and possibly tempering, if required. Elotherm has a thorough understanding of the interrelated effects of these processes and their influence on the metallurgy. On the basis of this know-how, the effectiveness of the machine technology has been continuously optimized so that the consumption of electrical energy is significantly reduced.

CONVINCING EFFECTIVENESS
Elotherm has steadily improved the hardening process to make it highly energy-efficient. One example of this is the new converter generation with its constantly high power factor (cos ϕ). Induction systems from Elotherm require around 20 percent less energy than conventional systems.

The main reason for this is that with Elotherm, the converters for power generation and the inductors for power provision come from a single source and are perfectly harmonized with one another. That is why Elotherm achieves the highest efficiency.

DECISIVE OVERALL BALANCE
A comparison of hardening processes using conventional furnace technology and induction hardening shows that induction hardening requires significantly less energy, is far faster and also minimizes distortion. This benefit is of particular significance when it comes to the hardening of large rings. The time-consuming and costly energy-intensive preheating necessary with the furnace is also eliminated. And when the induction hardening systems are not required, they switch automatically to an energy-efficient standby mode.

THE BEST PROCESS FOR RINGS
When it comes to the hardening of large gear wheels and roller bearings, case hardening using the conventional furnace technology has limitations – with regard to the size of the furnaces, the investments and the process engineering. A furnace plant for gear wheels above 6 m diameter, for example, would require investments going into the millions. Furthermore, case hardening often involves distortion and poorly controllable layer thickness growth, leading to high metal cutting costs. These problems do not occur with induction hardening. It is therefore the process of choice for economic and ecological reasons.
RING HARDENING

FOR MAXIMUM CUSTOMER SATISFACTION
Whether in aggressive salt water environments on the open sea or in the dusty environment of mining – rings have to withstand extreme conditions. It is crucial that the components in offshore wind turbines or large mining machines function reliably and practically maintenance-free, despite the high dynamic loads.

The process for creating the necessary wear-resistant surfaces is induction hardening. For wind turbines, for example, three process principles of induction surface hardening are employed: Scan hardening with and without soft zone and single-shot hardening.

SELECTIVE MICROSTRUCTURE MODIFICATIONS
The defined induction heating and quenching with the coolant selectively modifies the microstructure of the steel – the material becomes hard. This physical effect is used for both teeth and raceways.

The solutions from SMS Elotherm induce exactly the amount of energy required for these processes. Systems such as the patented effective power measurement per workpiece or the sensor-aided position correction of the induction tool enhance the efficiency and precision of the hardening process and ensure a consistently high, reproducible quality of the workpieces.

INTELLIGENT MACHINE CONCEPTS
SMS Elotherm offers the optimum machine concept, depending on the ring type and size:

- EloRing Flexible for the hardening of gear rings
- EloRing Horizontal for the hardening of large gear wheels
- EloRing Vertical and EloRing Tilt for the hardening of large roller bearings
- EloRing Seamless for the scan hardening of raceways on large rings
**FIELDS OF APPLICATION OF THE EloRing SYSTEM**

The data indicated refer to standard machines. Deviating dimensions can be covered by special machines.

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>Max. height in mm</th>
<th>Max. weight in kg</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 – 1400</td>
<td>400</td>
<td>1500</td>
<td>EloRing Flexible*</td>
</tr>
<tr>
<td>1200 – 3500</td>
<td>800</td>
<td>3000</td>
<td>EloRing Horizontal</td>
</tr>
<tr>
<td>1000 – 3500</td>
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<td>4000</td>
<td>EloRing Vertical M</td>
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<tr>
<td>2200 – 4500</td>
<td>400</td>
<td>4000</td>
<td>EloRing Vertical L</td>
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<tr>
<td>900 – 3500</td>
<td>400</td>
<td>5000</td>
<td>EloRing Tilt M</td>
</tr>
<tr>
<td>2000 – 6000</td>
<td>600</td>
<td>20000</td>
<td>EloRing Tilt L</td>
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<tr>
<td>2000 – 8000</td>
<td>600</td>
<td>20000</td>
<td>EloRing Seamless</td>
</tr>
</tbody>
</table>

*For use with one or two machining tables (see photo, page 10)
MORE PRODUCTIVE MANUFACTURING
EloRing Flexible for gear rings

COMPACT WITH HIGH PRODUCTIVITY
An EloRing Flexible is the ideal solution for induction scan hardening and full surface hardening with shower quenching of gear rings. The compact hardening machine whose control cabinet, MF cabinet, converter, transformer and main switch can be mounted on a baseframe impresses in particular with its high precision and productivity.

FULLY AUTOMATIC PROCESS
The short cycle times are achieved through the use of two machining tables.

The workpieces are loaded and unloaded horizontally. The EloRing Flexible operates with a fully automatic NC system. The controlled infeed speed can be steplessly set according to the workpiece requirements. A sensor device for the tooth hardening inductor ensures the precision of the hardening process.

The workpiece is quenched for an optimum micro-structure by means of a shower mounted directly on the inductor. The flow rate for the respective workpiece is also controlled by the NC program.
TECHNICAL DATA
- Integrated machining tables with individual rotation axes
- For rings with internal and external teeth and for ball races
- Infinitely adjustable infeed speed
- Scan and single-shot hardening

APPLICATION EXAMPLE
Gear wheels for gearbox production

- Rotating diameter: 150 mm
- Processing: Hardening of gear wheel using the single-shot process

The machine equipped with two machining tables allows simultaneous loading and hardening for shorter cycle times.

KEY FEATURES
- Short cycle times thanks to satellite table principle
- Short changeover times
- No hydraulic components
MORE PRECISE HARDENING
EloRing Horizontal for tooth gap hardening

INVESTMENT AND ECO-FRIENDLY
The EloRing Horizontal hardening machine is used predominantly for the induction hardening of large gear wheels. An EloRing Horizontal requires less investments compared with conventional furnaces for case hardening. At the same time it offers greater process reliability and significantly higher energy efficiency – and hence greater eco-friendliness.

NC AND SENSOR-CONTROLLED INDUCTOR GUIDANCE
The challenge for ring hardening is that due to the upstream production steps, the rings no longer have the exact predefined dimensions. Hardening with present parameters alone therefore does not lead to optimum results.

SMS Elotherm therefore employs the combination of numerically controlled and sensor-aided inductor guidance. This technologically mature method ensures exact positioning of the inductor between two tooth modules, thus guaranteeing the perfect distance between inductor and material so that a consistently high hardening quality is achieved within the closest tolerances.

TECHNICAL DATA
- For rings with a rotating diameter of 1000–3500 mm
- For internal and external teeth
- Modulus 8 to 30
- Scan hardening

- Sensor-aided position correction of the inductor
- Integrated effective power measurement for quality control
- Energy-efficient and eco-friendly process
- Significant costs savings through the elimination of time-consuming metal cutting

KEY FEATURES
APPLICATION EXAMPLE

Gear ring

Rotating diameter 3500 mm
Processing Hardening of teeth

Detection of the exact position of the individual teeth using a sensor with subsequent hardening.
RACEWAY HARDENING
EloRing Vertical and EloRing Tilt

FROM VERTICAL TO TILTABLE:
SOLUTIONS FROM ELOTHERM
SMS Elotherm offers two solutions for raceway hardening: The standard machine, EloRing Vertical, with a fixed 70° workpiece position for the scan hardening of large roller bearings and the tiltable solution, EloRing Tilt, with workpiece position from 0° to 70° for scan hardening of both large roller bearings and large gear wheels.

COST-EFFECTIVE RACEWAY HARDENING
The standard version of the EloRing Vertical is the right choice when it comes to the hardening of single-race or multi-race raceways of large roller bearings. It allows scan hardening with soft zone. That means the ring rotates and is transported alongside the inductor with quenching unit. With this process, the ring is left with a soft zone which is not hardened at the end of the rotation. Rings of around 3 m diameter can be hardened in less than one hour.

TECHNICAL DATA
- EloRing Tilt is tiltable from 0–70°
- Sensor-aided position correction of the inductor
- Suitable for rings with teeth and raceways with a rotating diameter up to 6000mm
TILTABLE AND HIGHLY FLEXIBLE
EloRing TILT
The tiltable version, EloRing Tilt, is a masterpiece of machine engineering. Its tilting table can be moved from the horizontal position into the inclined position of 70°. The benefits: The machine can be individually adjusted to meet the specific requirements of the parts and thanks to the inclined position allows outstanding quenching of the heat-treated raceway. The EloRing Tilt is also suitable for the hardening of large gear wheels and thus offers plant owners the ultimate in flexibility.

KEY FEATURES
- Vertical solution for cost-effective standard applications
- Tilting solution for maximum flexibility
- Optimized quenching with tiltable machine
- High productivity and energy efficiency in both versions

APPLICATION EXAMPLE
Ring with double-row ball race for rotary joints
Rotating diameter 3000 mm
Processing Hardening of the double-row ball race with double inductor

Through the use of a special inductor, the web between the two ball races is not hardened and is selectively retained as a soft zone for strength reasons
COMPLETE HARDENING
EloRing Seamless for scan hardening without soft zone

WITHOUT PROCESS-SPECIFIC SOFT ZONE
SMS Elotherm has developed and patented the process for progressive scan hardening without soft zone for rings of any size. The EloRing Seamless allows the otherwise process-inherent soft zone to be avoided. The rings hardened on this machine are suitable for all heavy-duty applications, e.g. with vibration loads in magnetic resonance tomographs, with extreme mechanical loads in drill heads of tunnel boring machines or for weathering-resistant and permanently installed rings in the offshore sector.

TECHNOLOGICAL LEAD WITH JUST TWO INDUCTORS
The EloRing Seamless has only two instead of the otherwise normal three inductors. This makes the system less maintenance-intensive as it requires less mechanical and control engineering components.

In the starting sequence, the inductors are together. After a short common movement in the same direction, one of the inductors moves in the opposite direction. This prevents a soft zone at the start of the hardening sequence. After a half-revolution, the inductors meet again. The control of the quenching shower is crucial here in order to prevent a soft zone or tempering of the hardened area.

- Uninterrupted hardening zone
- For safety-relevant large roller bearings with high load-bearing strength and smooth running
- Significantly longer service life of the rings
- Investment and maintenance-friendly thanks to two inductors with showers, an independently controlled shower and a fixed shower head
- Integrated workpiece active power measurement
- Sensor-aided position correction of the inductor
- SMS Elotherm-patented process

KEY FEATURES
THE BENEFITS
The result of the final sequence of induction scan hardening without soft zone is a continuously formed hard zone without tempered sections.

SHORT PROCESSING TIMES
Scan hardening without soft zone with the EloRing Seamless requires less than two hours for a ring of 6 m diameter. Case hardening of the same ring in a furnace would take several hundred hours and necessitate subsequent metal cutting. The patented process from SMS Elotherm is thus the most cost-effective choice.

TECHNICAL DATA
- For rings with single-race and multi-race ball races
- Infinitely adjustable infeed speed
CONVERTERS AND INDUCTORS
Harmoniously matched

GREATER COST EFFICIENCY IS A MATTER OF COMPETENCE
Converter, oscillating circuit and inductor - together they form the core of any induction plant. These factors determine how reliable and cost effective the system is for the customer. Elotherm has therefore united all the core competences under one roof – from the in-house R&D through to the in-house production.

OPEN FOR THE FUTURE
With the ELOMAT converters, too, a modular design and standardization ensure efficiency, durability and ease of service. The ELOMAT converters for LCC, series and parallel oscillating circuits provide optimum power for every application. Frequencies up to 600 kHz and powers up to 4500 kW per converter unit are achieved with modern transistor groups. ELOMAT converters are characterized by their advanced digital control and the user-friendly operating concept. The versatile interfaces allow harmonized integration into process control systems and higher-level plant controls.

PERFECT ADAPTATION TO THE WORKPIECE
Inductors from Elotherm combine the highest precision with high efficiency and process reliability. Round and shaped inductors as well as line inductors which surround the workpiece are used as the interface between machine and workpiece. Simulation programs developed by SMS Elotherm ensure application-specific implementation and design – and hence the high process quality.

KEY FEATURES
- In-house production of converters and inductors
- Durable, service-friendly components
- Future-oriented further development thanks to in-house research
SERVICE
For maximum customer satisfaction

CUSTOMER-ORIENTED ORGANISATION
For field service, Elotherm has created an organizational structure that provides optimum support for the customer. Elotherm also has a worldwide service network that is being steadily expanded. Current locations are in Germany, Brazil, China, France, India, Mexico and North America. The result for the customer: Highest availability and shortest reaction times.

SERVICE FROM THE PLANT MANUFACTURER
Elotherm’s service customers benefit from the in-depth know-how of the plant manufacturer. The benefits:

- Increased productivity
- Increased plant availability
- Improved product quality
- Reduced operating costs
- Safeguarded plant value
- New spectrum of applications for older plants

ALL-INCLUSIVE RANGE OF SERVICES
Elotherm provides the perfect range of services to meet the customers’ needs. As with the systems, the customer can cost-effectively use individual or multiple harmonized modules.

- Erection and commissioning
- Production support
- OEM spare parts service
- Consignment stock
- Repairs
- Maintenance
- Process consultancy
- Modernization
- Maintenance service
- Quality control
- After-sales service
- Training courses
- Service hotline
The information provided in this brochure contains a general description of the performance characteristics of the products concerned. The actual products may not always have these characteristics as described and, in particular, these may change as a result of further developments of the products. The provision of this information is not intended to have and will not have legal effect. An obligation to deliver products having particular characteristics shall only exist if expressly agreed in the terms of the contract.