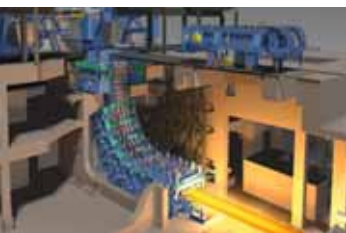


## ELOTHERM MetalLine™

Induction Solutions: Metallurgy



# SMS GROUP

## Leaders in plant construction and machine engineering

The SMS group unites global players in the construction of plants and machines for the processing of steel and NF metals, operating under the roof of SMS Holding GmbH. It consists of the two business areas, SMS Siemag and SMS Meer, as well as industrial participations. SMS Holding GmbH is responsible for strategic planning and control. The sole owner of the SMS group is Siemag Weiss GmbH & Co. KG, the holding of the Weiss entrepreneurial family.

### **FAMILY-OWNED AND WORLDWIDE PRESENT**

As a family-owned company, the SMS group has built on solid values and a culture of responsibility for four generations. It holds a strong market position, while its decentralised structure ensures a fast and efficient response to individual customer demands. The SMS group combines the flexibility of company units that operate as medium-sized enterprises with the broad resources of an internationally active company – all to the benefit of the business partners. The decentralised corporate culture ensures that not only the individual units, but also the employees always think and act in an entrepreneurial manner.

### **BUILDING ON A STRONG BASIS**

A long-term view, careful financial management, the focus on values, plus an understanding of the cycles of the machine and plant construction market have guided the group's strategic planning for decades. Also high on the agenda are investments in the areas of energy and environment technology, service and modernisation of plants as well as on-the-job training and qualification of core employees. On this basis, the SMS group creates tailor-made plant solutions which enable its business partners to keep well ahead of the competition.





## **SMS MEER BUSINESS AREA**

The SMS Meer Business Area bundles its activities in the fields of steelmaking plants and continuous casting technology (long products), tube plants, long product rolling mills, forging technology, nonferrous metals plants, heat treatment technology and service. Starting with advisory services, followed by implementation and commissioning, and finally modernisations – the employees of the business area always combine their specialist knowledge with approachability and flexibility.

## **TOP QUALITY**

The innovative solutions provide our customers with measurable benefits in their challenging markets. Whether steel for automotive parts, pipelines, heavy structural profiles, wheels for high-speed trains or aluminium for façade structures: the machines and plants tailored by the SMS Meer Business Area ensure the cost-efficient and flawless production of the necessary components.

## **INDIVIDUAL SOLUTIONS**

The SMS Meer Business Area concentrates the competence of globally successful specialist firms under one roof to create a unique, full range of supplies and services for metal processing and associated fields. In doing so, the employees focus consistently on the needs of their business partners. They find individual solutions and fulfil the plant operators' expectations, both flexibly and reliably. This is verified by 17000 successful reference projects the world over – in the last 50 years alone.



# SMS ELOTHERM

Your partner for induction heating solutions

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

All your benefits at a glance

## RAPID AND PRECISE HEATING

When applying the induction heating method a metal workpiece is exposed to an electromagnetic field in a non-contact manner by means of a coil. As a result, a current is generated in the material which produces heat, i.e. directly in the workpiece itself. Therefore, the workpiece must not be heated by heat transfer as in a conventional furnace. Consequently, the heating times are very short and the temperature can be set precisely.

## NEW POSSIBILITIES

Due to their technical advantages, the electromagnetic stirring techniques and the induction heating technologies of Elotherm are more and more frequently integrated into the process chains for metal production – particularly for the production of steel and stainless steel. With these technologies, manufacturing steps can be carried out more efficiently, more productive and more eco-friendly. In addition to that, the induction method with precisely adjustable process parameters provides highest productivity.

## INTEGRATED OFFER

Elotherm combines all competences of the induction technology under one roof and thus offers its customers tailor-made, integrated services from one source with a responsible contact person. The spectrum of services ranges from giving advice via engineering, plant construction up to commissioning, training courses and comprehensive customer care.

## SOLUTIONS FROM A SINGLE SOURCE

Together with our sister companies of the SMS group, we offer our customers integrated solutions for the whole process chain.

## TECHNOLOGY LEADER WITH OUTSTANDING PROCESS COMPETENCE

- Experience spanning more than 75 years
- Innovative system partner for the automotive and supplier industry as well as the steel, rolling mill and pipe production industry
- More than 6000 plants worldwide in continuous operation for decades
- Sales and service around the globe
- Fast delivery by local manufacturing and stock-keeping facilities

## INDIVIDUAL CUSTOMER CONFIGURATIONS

- High efficiency thanks to modularized plant components
- Tailor-made manufacturing solutions

## ENERGY-EFFICIENT, ECONOMIC INDUCTION

- Minimized energy consumption through intelligent technologies
- Sustainable and eco-friendly due to reduction of CO<sub>2</sub>
- Quick change of production and increased productivity
- Low manufacturing costs
- Integrated effective power measurement for efficient quality control

## IN-HOUSE INDUCTOR AND CONVERTER MANUFACTURING

- All competences under one roof
- Optimal technical interfaces to existing customer systems
- Individual design and layout to attain optimum results
- Innovative converter development with low and resource-saving energy demand

## PRECISION IN PROCESSING

- All relevant certificates, e.g. VDA, DIN/ISO
- Continuous project and quality management from the initial enquiry through field service

# OUR SOLUTION SPECTRUM

From the liquid phase up to the strip

## COMPREHENSIVE SOLUTIONS

The portfolio of Elotherm in the area of metallurgical induction solutions ranges from the liquid phase up to treating strips. One of the greatest benefits for the customer is the overall expertise of Elotherm for stable processes harmonized with each other.

### EloKinetic™

Electromagnetic systems in continuous casting plants

- Mold stirrers
- Strand stirrers
- Final stirrers
- Electromagnetic brakes
- Damping systems for strip casters

### EloHeat™

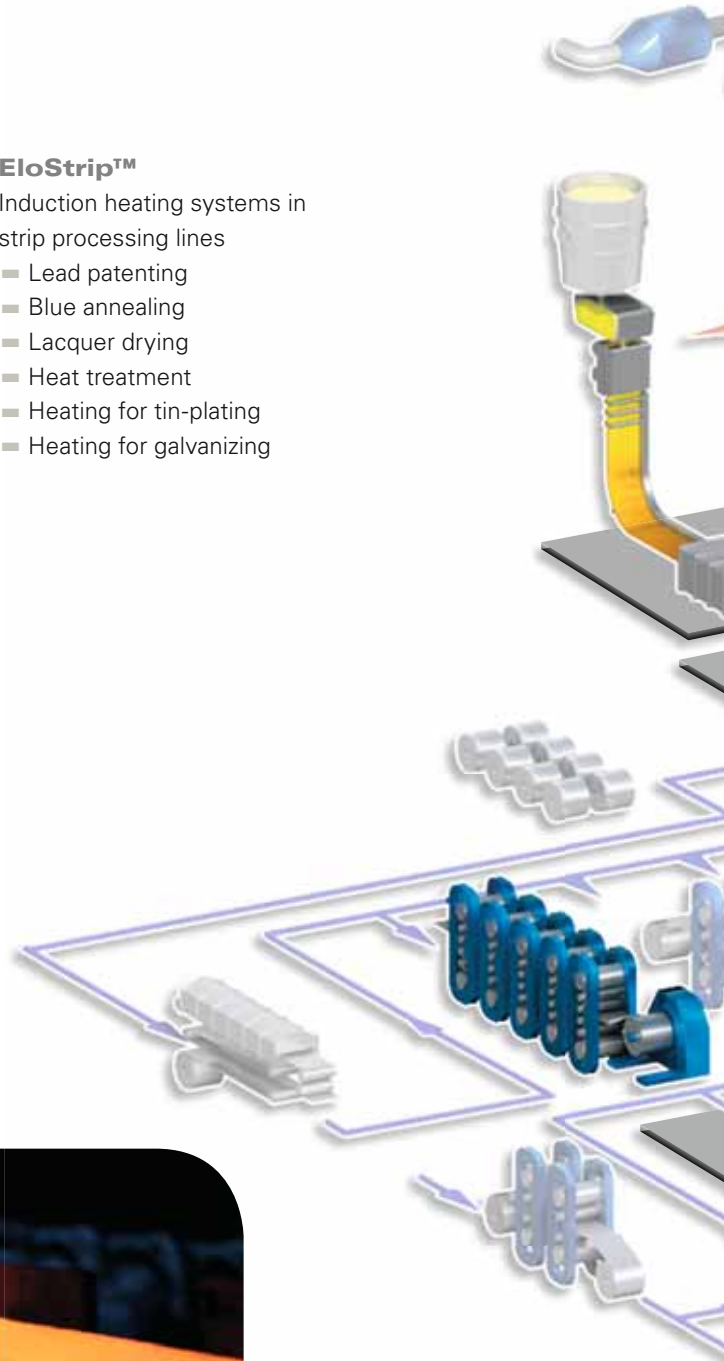
Induction heating systems in hot and cold rolling mills

- Boosters for strip heating
- Strip edge heating

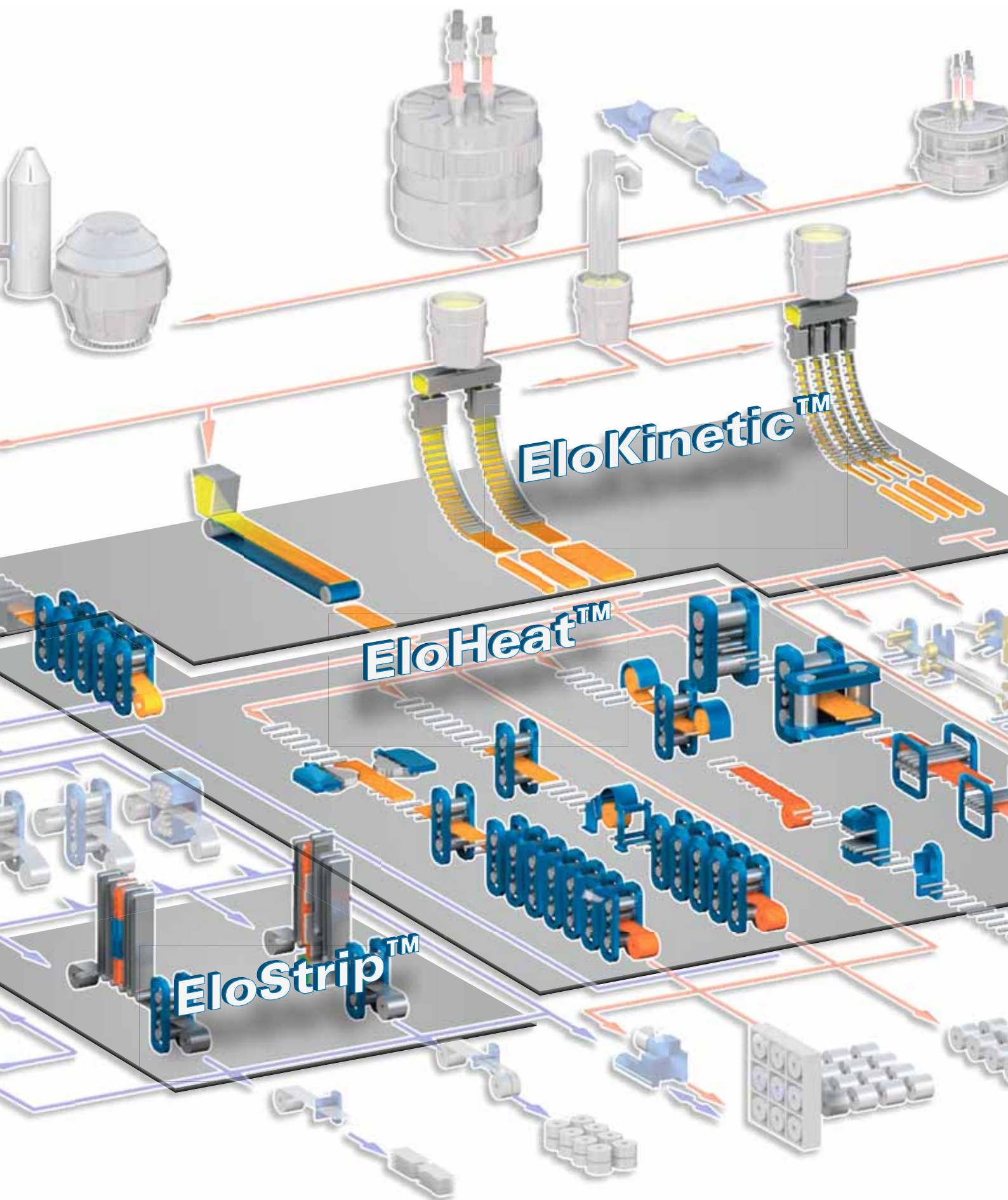
### EloStrip™

Induction heating systems in strip processing lines

- Lead patenting
- Blue annealing
- Lacquer drying
- Heat treatment
- Heating for tin-plating
- Heating for galvanizing







# HOMOGENEOUS STRUCTURE

## EloKinetic™ improves material properties

### UNIFORMLY UP TO THE CORE

The task of the electromagnetic stirrer EloKinetic™: improvement of the microstructure. This is achieved by controlling the crystallization speed during the solidification process. Elotherm has built up comprehensive process know-how of influencing melt and strand so that an isotropic structure free of segregation with globulitic grain structure is created.

### DESIGN SUITABLE FOR STEEL PLANTS FOR HIGHEST AVAILABILITY

Elotherm has continuously upgraded the electromagnetic stirring technology. Depending on application, the EloKinetic™ series offers the suitable stirring technology. Due to linear, rotary or helicoidal stirrers, a homogeneous structure is created and thus a steel grade of highest quality is attained.

- Design suited to steel work environments
- High availability

### KEY FEATURES





### **EloKinetic™ MOLD STIRRER**

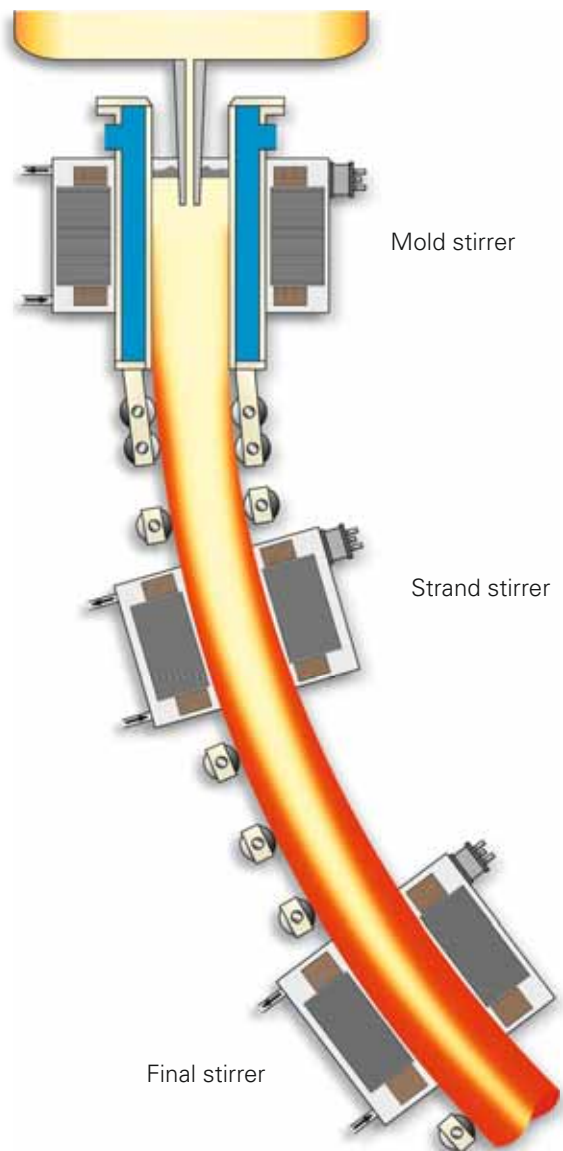
In the area of the mold the use of a stirring coil has the greatest metallurgical effect since the steel is completely liquid with the exception of the surface zone. The stirring coil can either be arranged within or outside the mold.

### **EloKinetic™ STRAND STIRRER**

With increasing solidification of the cast strand, the stirrers cause the inner liquid strand to form a globulitic microstructure.

### **EloKinetic™ FINAL STIRRER**

Final stirrers of the EloKinetic™ type are used in the area of final solidification, i.e. at the solidification point and the formation of segregations and middle shrink holes is prevented by electromagnetic stirring.







### **EloKinetic™ ELECTROMAGNETIC BRAKE**

In the liquid phase, the brake stirrers represent another field of application of Elotherm's induction technology. They are used for CSP® plants and slab casters in the area of the mold. The facilities of Elotherm generate a targeted braking effect on the particles in the melt by means of an electromagnetic field. This has a variety of positive effects namely the melt and the melting powder is more evenly distributed in the mold, the casting speed can be increased, the microstructure is improved and the risk of a breakthrough is reduced. Since EloKinetic™ as electromagnetic brake is not firmly connected to the mold the oscillation system remains unaffected.

- Extremely reliable design suited to steel work environments
- Decades of experience in the design and construction of stirring coils
- Latest converter technology with up-to-date control components
- Constant power factor  $\cos \varphi$  in all partial load ranges

#### **KEY FEATURES**

### **DAMPING SYSTEM FOR STRIP CASTERS**

The equipment for the implementation of the strip casting technology on a production scale jointly developed with SMS Siemag is a decisive step towards the economic production of near net-shape, HSD® steel strips (High Strength and Ductility) without any bending stresses, with high strength and high formability at the same time.

The electromagnetic stirring system consists of two stirring coils with different characteristics enabling an even distribution of the melt over the cast strip gage as well as stabilization and damping of liquid steel immediately before its solidification. Through the generation of an exactly controllable electromagnetic field, the flow velocity of the melt is specifically influenced over a wide range.

stirred



non-stirred





# PRECISE ROLLING RESULTS

## EloHeat™ optimizes hot and cold rolling processes

### SYSTEMATIC SOLUTIONS

Due to the modular system, EloHeat™ can be economically adapted to all rolling mill types. Induction solutions can be applied for steel, aluminum and NF metals. In general, Elotherm's induction solutions in rolling mills ensure productivity increases, improved surfaces, minimization of roll wear through reduced rolling forces and homogeneous microstructure adjustments. In addition, a lower strip gage can be achieved with additional heating.

### COMBINING WITH EXISTING FURNACES

Modern induction technology is highly suitable for a supplement or expansion of the existing furnace technology and can be used as so-called "booster heating method". The adaptation inertia of traditional furnaces can be compensated by the boosters in an effective, efficient and space-saving manner. Consequently, the induction technology enables higher processing speeds with constant product quality. This results in an increase in production and at the same time reducing costs.

### CROSS AND LONGITUDINAL FIELD HEATING

Depending on application, either the classical longitudinal field or the technically more demanding cross field heating is used. For longitudinal field heating, the inductor surrounds the strip to be heated and for cross field heating the inductors are mounted laterally, or positioned above or below. The application of the respective method is dependant on strip thickness and temperature.





## INDUCTION HEATING IN CSP® FLEX PLANTS

CSP® means Compact Strip Production and has been developed by SMS Siemag as an integrated process of a continuous procedure from liquid steel up to the finished coil.

On various positions in the CSP® flex lines there is the need of an intelligent increase of temperature. For this purpose, the induction heating is used and thus creates an added value for the end customer.

- Precise digital controllability
- High power density on short process length, e.g. 9MW on a length of less than 2.5m.
- Competitive price (investment and follow-up costs)
- Independent of gas and oil as fuel
- Reduction of CO<sub>2</sub> footprint of complete plant

In modern CSP® flex lines, the roller hearth furnace is only used for holding the temperature. Upstream induction heating allows for the elimination of the heating zone of the roller hearth furnace. In this way, the furnace will be shorter and gas consumption and thus CO<sub>2</sub> emissions are directly reduced.

Downstream of the roller hearth furnace, the induction heating system is capable to increase the slab temperature up to 200°C and to flexibly control the entry temperature into the rolling process to an optimal level. This ensures that specific processes such a thin-strip rolling can also be performed on the CSP® flex line.

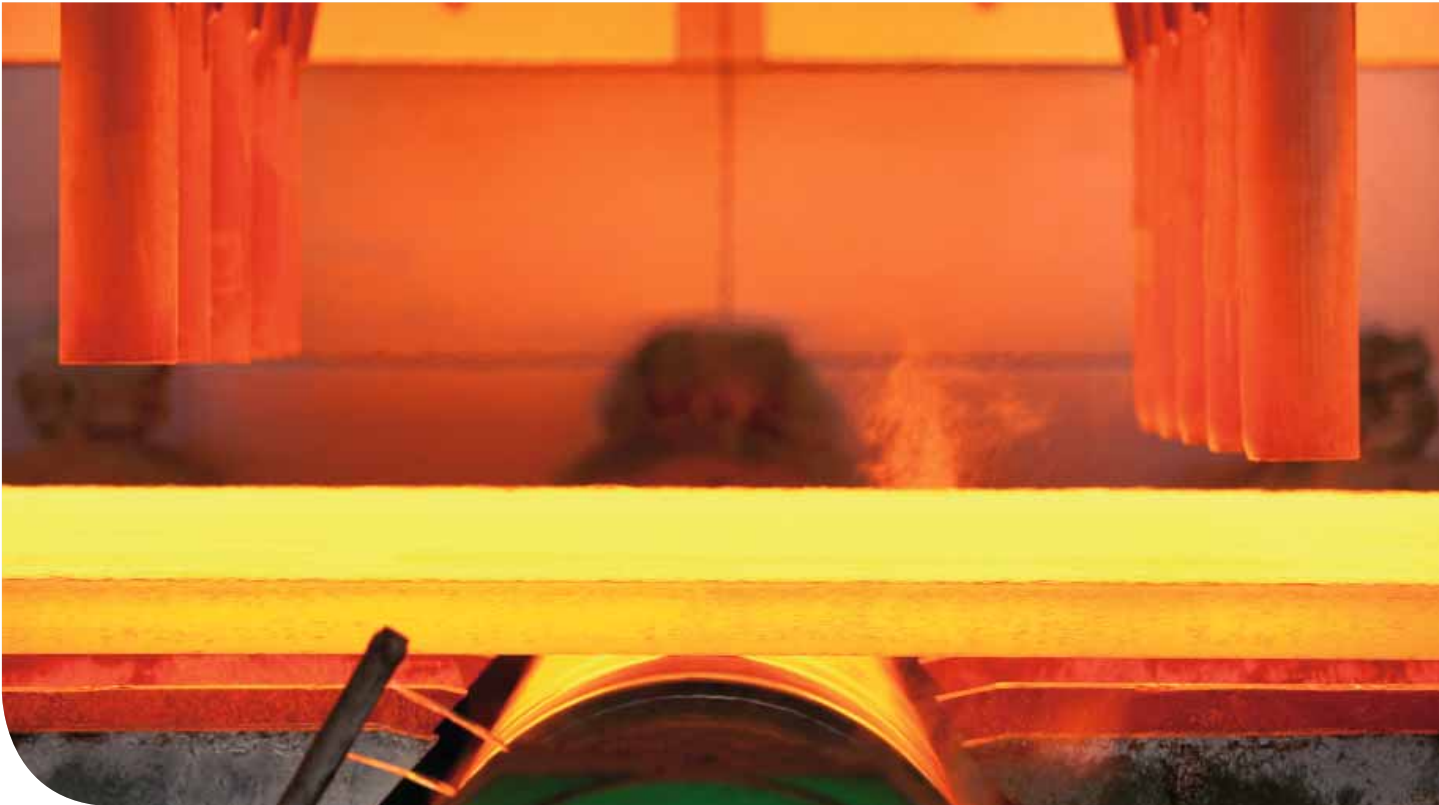
The benefits of induction heating downstream of the roller hearth furnace are that the furnace can be operated at low temperature. Besides a sustainable reduction of fossil fuel consumption, this leads to a longer service life of the refractory material and the transport roller of the roller hearth furnace. Moreover, the scale amount is decreased and the yield is increased.

- High flexibility during change of production
- Low energy consumption
- Compact design
- Quick delivery time and commissioning
- Integration and retrofitting in CSP® lines
- Improved competitiveness particularly for API and silicon steels

### KEY FEATURES







### **INDUCTION HEATING IN VARIO ROLLING MILLS**

Here, induction heating is applied between mill stands 1 and 2 and it concerns an innovative technology for the production of micro-alloyed steel grades of the API quality.

Induction heating provides an even temperature level between the first two mill stands so that a higher relative thickness reduction is reached. Owing to a high temperature level, correspondingly higher forming degrees can be achieved. Furthermore, the cast structure is fully removed and a very homogeneous microstructure is caused by recrystallization – even for slabs up to a thickness of 20 mm.

Also in the rear section of compact hot rolling mills the advantages of an induction intermediate heating is apparent. In the endless rolling process for very thin strip grades or silicon steels, the temperature loss is compensated by compact, integrated induction units ensuring the proper temperature level at the end of the finishing mill.

### **INDUCTION HEATING IN COLD ROLLING MILLS**

For cold rolling of thin strips, the strip geometries as well as the material properties have to be adjusted within close tolerances. Due to its precise controllability, induction heating is particularly important for thin strips. In cold rolling mills, the complete heating with boosters as well as partial heating is applied.

During complete heating, boosters are used for the improvement of the deep-drawing properties of steel strip heating the strip from room temperature to about 550 to 700 °C.

Partial heating is among others used to heat the strip edge. Another field of application is the preheating of cutting edges in front of slitting and trimming shears. Heated cutting edges have superior properties and the service life of the blades is extended at the same time.

# REFINING IN MULTIPLE WAYS

## EloStrip™ for treating of strips

### **FLEXIBLE HEATING BELOW 700 °C**

Heating of thin steel strips for further strip processing steps below 700 °C is normally achieved by longitudinal field heating. In this process, the inductor surrounding the strip generates a magnetic field in longitudinal strip direction. That way, the strip is induction heated. The modular structure allows the EloStrip™ heating plants to be adapted to the production parameters simply by a number of heating coils. The process is clean, adaptable to various strip geometries and enables high strip velocities.

The induction heating tasks for a temperature range up to 700 °C include:

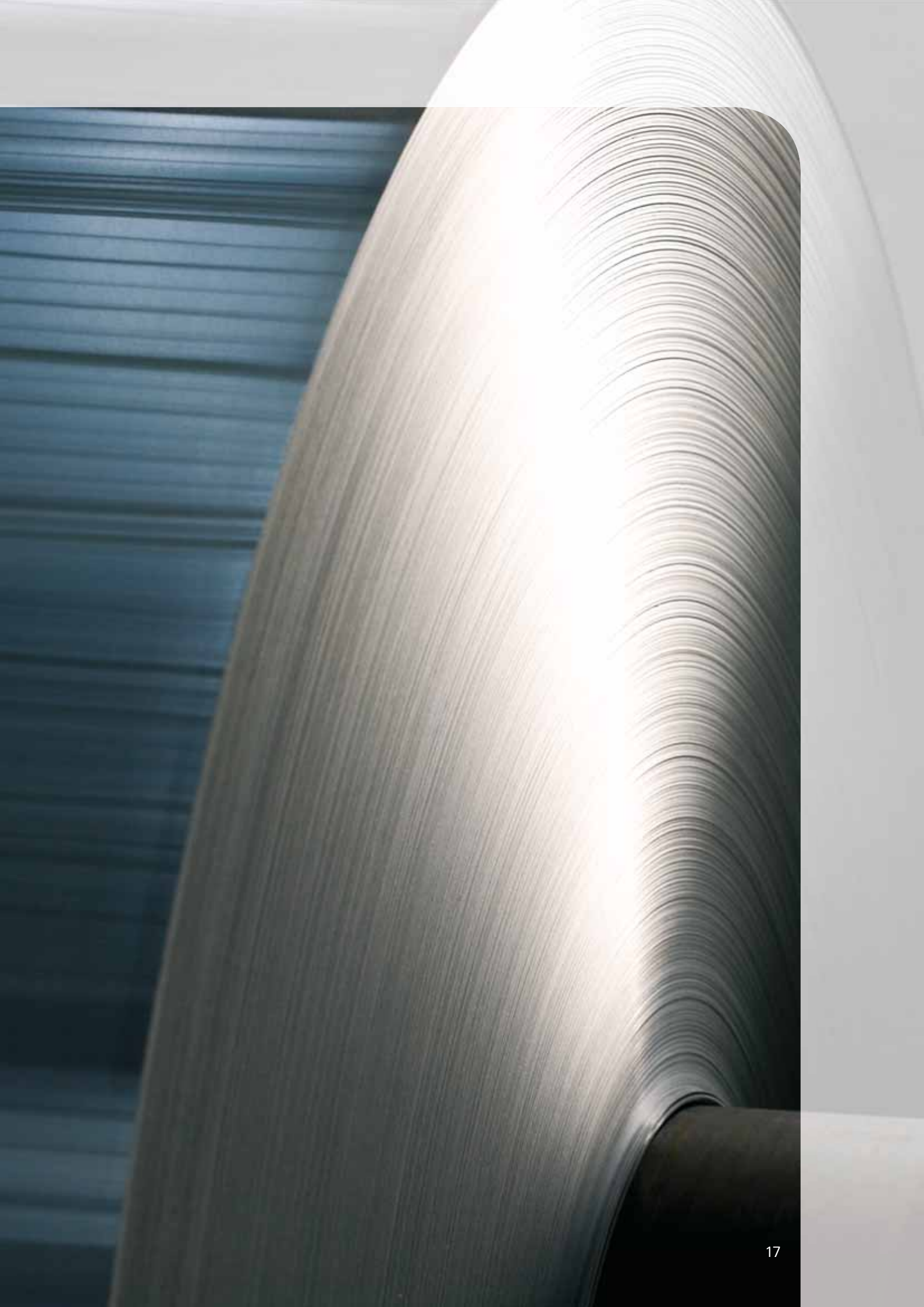
- Lacquer drying
- Galvanizing
- Tin-plating
- Blue annealing

### **PRECISE METALLURGICAL TREATMENT ABOVE 700 °C**

During the induction heating method for metallurgical processes above 700 °C, cross field heating is among others also applied. Elotherm helps its customers with selecting the right, future-proof and adequate method. Generally, the induction plants of Elotherm achieve more precise heating over the entire material cross-section than other processes. The results are high-quality strip products with desired material properties.

For the generation of temperatures above 700 °C, the induction heating process is applied with the following areas of application:

- Metallurgical treatment
- Lead patenting





Treatment methods below 700 °C:

### **LACQUER-DRYING**

Here the induction technology convinces in comparison with the infrared process by higher efficiency, better controllability and high surface quality (without skin formation).

### **GALVANIZING**

In this process, steel strips are preheated under hydrogen atmosphere by means of the induction technology. Compared to a gas furnace, induction heating is better controllable and can be directly disconnected in case of a strip standstill. A precise preselection of performance and frequency makes it possible that temperature and heating depth are adjusted.

### **TIN-PLATING**

For tin-plating, the induction solutions of Elotherm create the basis for high strip velocities and excellent surface quality since the tin layer can be controlled and homogenized by the influence of the solidification time.

### **BLUE ANNEALING**

Blue annealing of strips relieves internal stresses, increases the elasticity and protects against corrosion. The process takes place at temperatures between 350 °C and 450 °C and the induction capacity may also be controlled depending on strip velocity.

### **GRAIN-ORIENTED ELECTRICAL STEEL SHEETS**

Upstream of the gas furnace, transformer sheets or grain-oriented cut sheets are induction preheated under protective gas to max. 700 °C. A faster induction preheating process makes it possible that the gas furnace route is reduced and induction technology has also the advantage that the power can be precisely adjusted, whereby an exact temperature is achieved.



- Drying advantages due to material heating from the inside
- Shortest heating rate for high productivity
- Application under protective gas atmosphere
- Low operating costs since energy is not required at idling speed compared to traditional furnaces

### **KEY FEATURES**



Treatment methods above 700 °C:

### HEAT TREATMENT OF STRIPS

The induction plants of Elotherm enable a more homogeneous, precise strip heating over the entire material cross-section than other methods resulting in high-quality products with desired material properties.

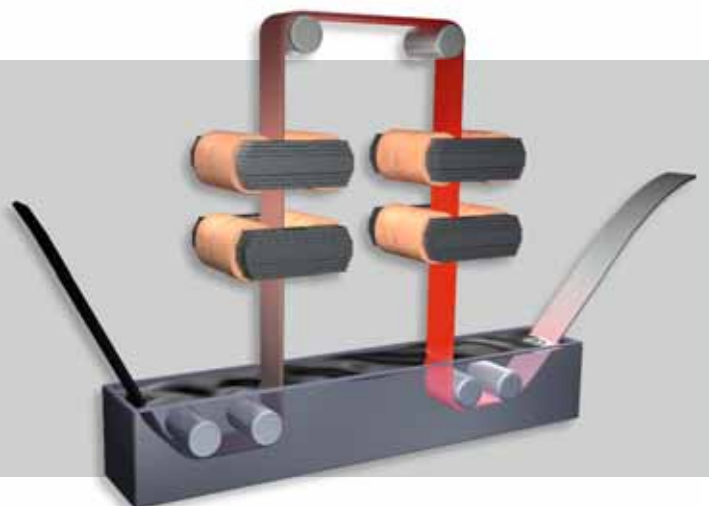
Additionally there are high power density, compact plant structures and free access to sheet metal. Where occupational safety is concerned, the induction plants of Elotherm are convincing – open flames and pollutant emissions do not exist.

### LEAD PATENTING

In this transformational heating process, the strip is heated to approx. 900 °C and then specifically cooled in a lead bath to 400 °C giving the strip improved strength and drawability.

### APPLICATION EXAMPLE

In the production of packaging strip, the metallurgical treatment as well as the strip coating is combined with each other. In the process, the strip can be induction patented, quenched and tempered or blue annealed. The induction lacquer-drying process evenly dries the lacquer from the inside and thus provides reliable corrosion protection.



# PRECISE GALVANIZING

## Electromagnetic strip stabilization systems

### OPTIMIZED STRIP GALVANIZING SYSTEMS

Together with Fontaine Engineering as well as SMS Siemag, Elotherm has developed the electromagnetic strip stabilization systems. They are used with good success in strip galvanizing systems. Even older galvanizing systems with a FOEN air knife can be easily retrofitted with an Elotherm strip stabilization system.

The electromagnetic strip stabilization, located directly behind the zinc pot, provides a constant distance between air knife and the passing zinc-coated strip. Due to the electromagnetic forces this happens touch less. Undesired deviations from the ideal passing line and strip form are reduced to a minimum. This ensures a very exact thickness of the zinc layer as well as prevents excessive zinc coating.

Depending on the strip width, three to five inductor sets located on the front and backside of the strip directly next to the air knives, stabilize and position the passing strip. Induction sensors detect and control the exact strip position. The result: a stable passing strip.

Besides considerable savings of zinc plating material the strip stabilization reduces the risk of contact between strip and air knives – the process stability increases and the scrap rate decreases. Additionally the zinc-plating system can be operated with higher speeds.







# CONVERTERS AND INDUCTORS

## Knowing what is important

### SOLUTIONS FROM A SINGLE SOURCE

Converter, oscillating circuit, inductor – together they are the heart of the MetallLine™ induction plants. These factors substantially determine the process reliability and economy for the customer. For that purpose, Elotherm has brought together all core competences under one roof – from in-house development to in-plant production. Based on the process parameters of the customers and the required temperature, a specific heating process is developed. Modern simulation techniques are used and metallographic examinations are performed.

### ECONOMIC POWER DIMENSIONING

Also for parallel and series oscillating circuit converters, modular design and standardizations of the EloMat™ converters make sure that efficiency, durability and serviceability are achieved.

### PERFECT WORKPIECE ADAPTATION

Inductors of Elotherm are combining highest precision and high efficiency with process reliability. For the different tasks of strip heating, cross field and longitudinal inductors are used and for the stirring systems rotary, linear or helicoidal stirrers with corresponding coil arrangement are available, depending on application.

- Converters and inductors of our own manufacture
- Durable, easy-to-service components
- Future-oriented continuous development through our own research

### KEY FEATURES



# SERVICE

For top customer satisfaction

## CUSTOMER-ORIENTED ORGANIZATION

For the service area, Elotherm has created an organizational structure which optimally supports the customers. In addition, Elotherm provides a world-wide service network which is continuously further extended. Current locations are in Germany, Brazil, China, France, India, Mexico and North America. The result for the customers: highest availability and shortest reaction times.

## SERVICE FROM PLANT MANUFACTURER

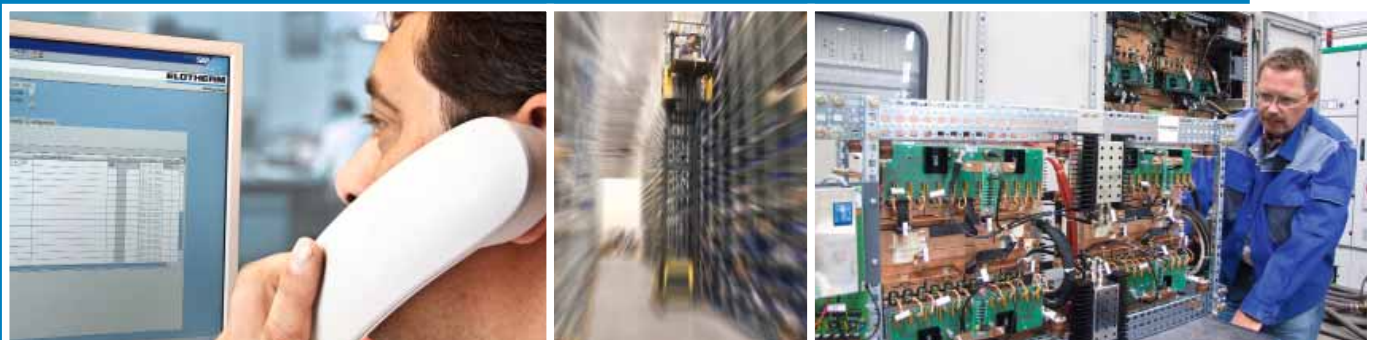
The service customers of Elotherm benefit from an in-depth know-how of the plant manufacturer. The advantages:

- Rise in productivity
- Increase in plant availability
- Improvement in product quality
- Reduction in operational costs
- Safeguarding of plant value
- New fields of application for older facilities

## ALL-INCLUSIVE SERVICE OFFERING

Depending on customer needs, Elotherm provides appropriate services. Similar to the actual plants, the customer can economically use individual or several harmonized modules.

- Assembly and commissioning
- Production assistance
- OEM spare parts service
- Consignment stores
- Repairs
- Maintenance
- Operating advice
- Modernizations
- Maintenance services
- Quality checking
- After-sales service
- Training courses
- Service hotline





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**MEETING your EXPECTATIONS**