

ELOTHERM

SMS group

ModuLine™

Induction Hardening: Automotive



SMS GROUP

Leaders in plant construction and mechanical engineering

The SMS group ranks among leading companies in the field of plant construction and mechanical engineering for the industrial processing of steel, aluminum and nonferrous metals. It consists of the two Business Areas SMS Siemag and SMS Meer. Both areas offer integrated solutions for metallurgical process technology, casting and rolling technology as well as other shaping and refining processes.

FAMILY-OWNED AND WORLDWIDE PRESENT

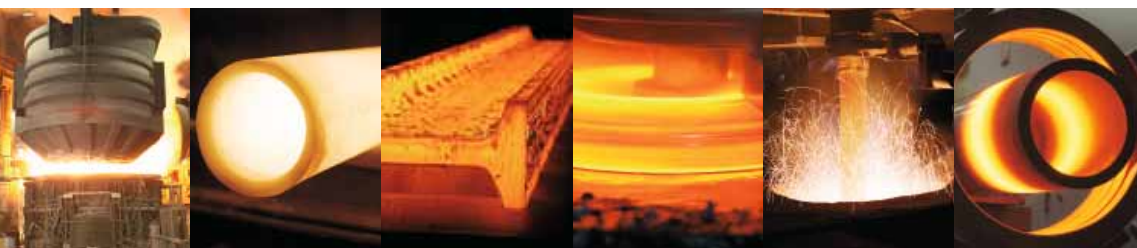
As a family-owned company, the SMS group has built on solid values and a culture of responsibility for four generations. It holds a strong market position while its decentralized structure ensures a fast and efficient response to individual customer demands. The SMS group combines the flexibility of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

BUILDING ON A STRONG BASIS

A long-term view, careful financial management, focus on values, plus knowledge about the cycles of the machine and plant construction market have, for decades, informed the group's strategic planning. Also high on the agenda is investment in the areas of energy and environment technology, service and modernization 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 the customers to keep well ahead of the competition.

**SMS
SIEMAG**

SMS group



**SMS
MEER**

SMS group

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
- Laser technology
- 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

CLEAN, ENERGY-EFFICIENT INDUCTION TECHNOLOGY

During induction heating the metallic workpiece is exposed to an electromagnetic alternating field by means of a current-carrying coil. Consequently, eddy currents are generated in a non-contact manner and heat is resulting. This process can be specifically influenced. Depending on the current penetration, temperature and cooling rate by the quenching process the microstructural properties of carbonaceous metals can be adjusted with the induction technology. In this way, precise hardening can be performed according to customer requirements.

TAILORED EFFICIENTLY WITH MODULINE™

With ModuLine™, Elotherm offers two modular hardening plant series: EloCrank™ and EloFlex™. Owing to this modular system, cost-effective tailor-made and suitably dimensioned hardening systems can be realized. With the so-called configurator developed by Elotherm a system is selected from individual modules fulfilling all customer requirements. In this case, the EloCrank™ series have been designed for hardening of crankshafts and EloFlex™ for steering, axle and gear components and many other workpieces.

REDUCING ADDITIONAL COSTS

Another savings potential results from the integrated effective power measurement in the hardening machines of Elotherm which allow for a complete quality control of the hardened workpieces. Complex examinations for example on cut bearing segments can thus be dispensed with.

TECHNOLOGY LEADER WITH OUTSTANDING PROCESS COMPETENCE

- Experience spanning more than 70 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 CO₂
- 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

INDUCTION HARDENING

CONTROLLING THE COMPLETE PROCESS

Generally, induction hardening is a clean process. In addition, the facilities of Elotherm do not require hydraulic equipment which might result in contaminations of the quenching medium. In hardening, the process sequence normally consists of heating, holding, quenching and possibly tempering. Elotherm has detailed knowledge of the interrelated effects of these processes and their influence on metallurgy. Based on this know-how, the effectiveness of machine technology has been continually optimized so that the consumption of electrical energy was reduced considerably.

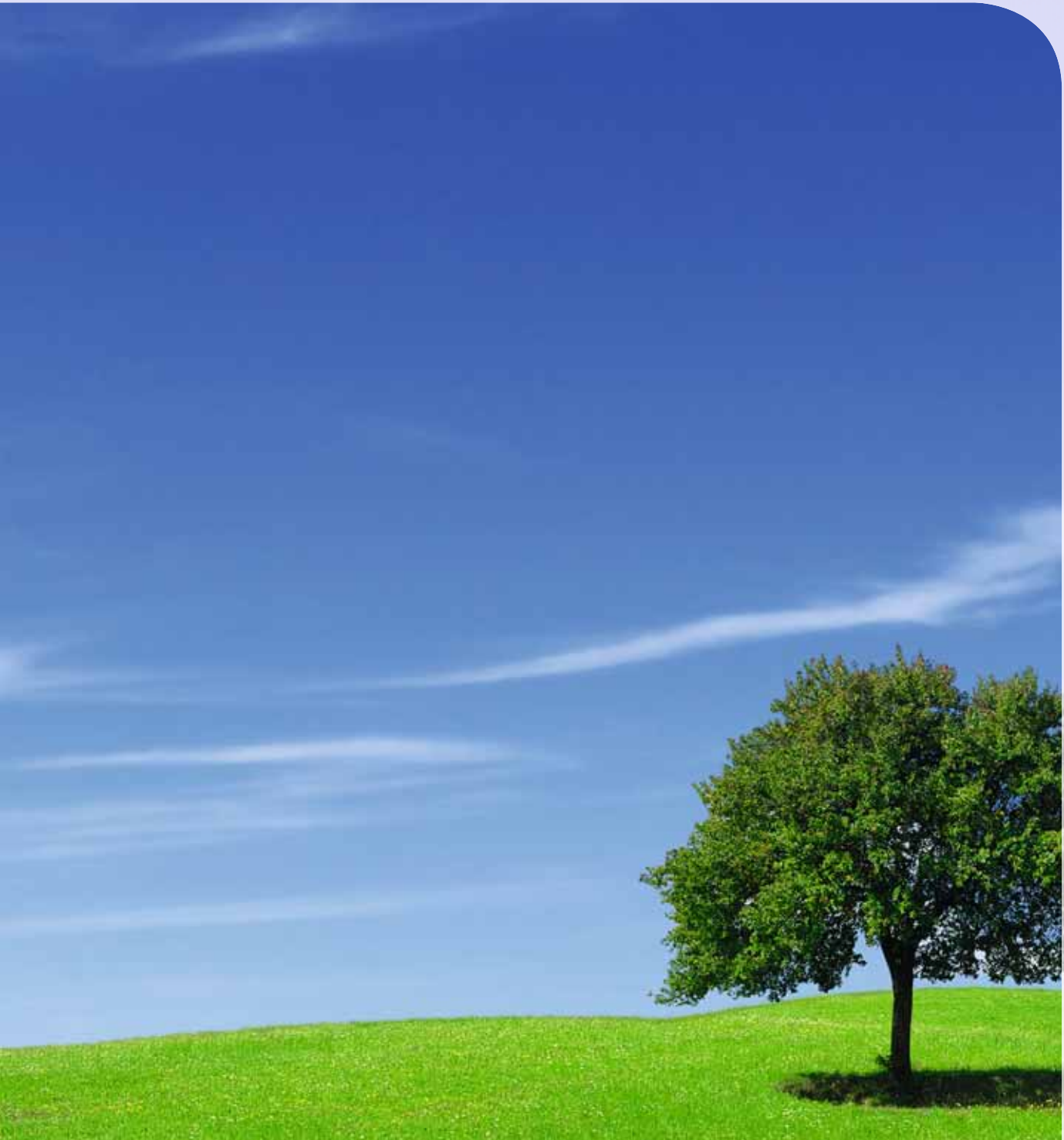
CONVINCING EFFECTIVENESS

Elotherm has improved the hardening process continuously and has implemented it in a highly energy-efficient way. One example of this is the new converter generation with a constantly high power factor ($\cos \varphi$). Induction plants of Elotherm require about 20 percent less energy than comparable facilities.

The main reason for this is that the converters for power generation and the inductors for power provision at Elotherm are all from one single source and are perfectly harmonized with each other. Therefore, Elotherm achieves the highest efficiency on the market which protects the environment and reduces the unit costs.

DECISIVE OVERALL BALANCE

If one compares the induction hardening processes with traditional furnace technique, induction hardening requires much less energy, it is performed much faster and it additionally minimizes distortion. A time-consuming and cost- and energy-intensive preheating as with the furnace is no longer necessary. And when the induction hardening plants are not used they simply switch into energy efficient standby mode.



CRANKSHAFTS

HARD SHELL, ELASTIC CORE

In engine construction, the crankshaft is a key component. New demands posed by light-weight automotive construction and a higher effectiveness of motor technology ask for precision within ever closer tolerances. In addition, the crankshafts must have combined material properties: highly accurate hardened surfaces for wear-free and long-lasting running properties and an elasticity of the component body for high torque take-up.

LOW-DISTORTION HARDENING

In the field of hardening plants for crankshafts, Elotherm is one of the market leaders and has built up a unique know-how.

This means that the patented low-distortion hardening plants are far superior to conventional methods.

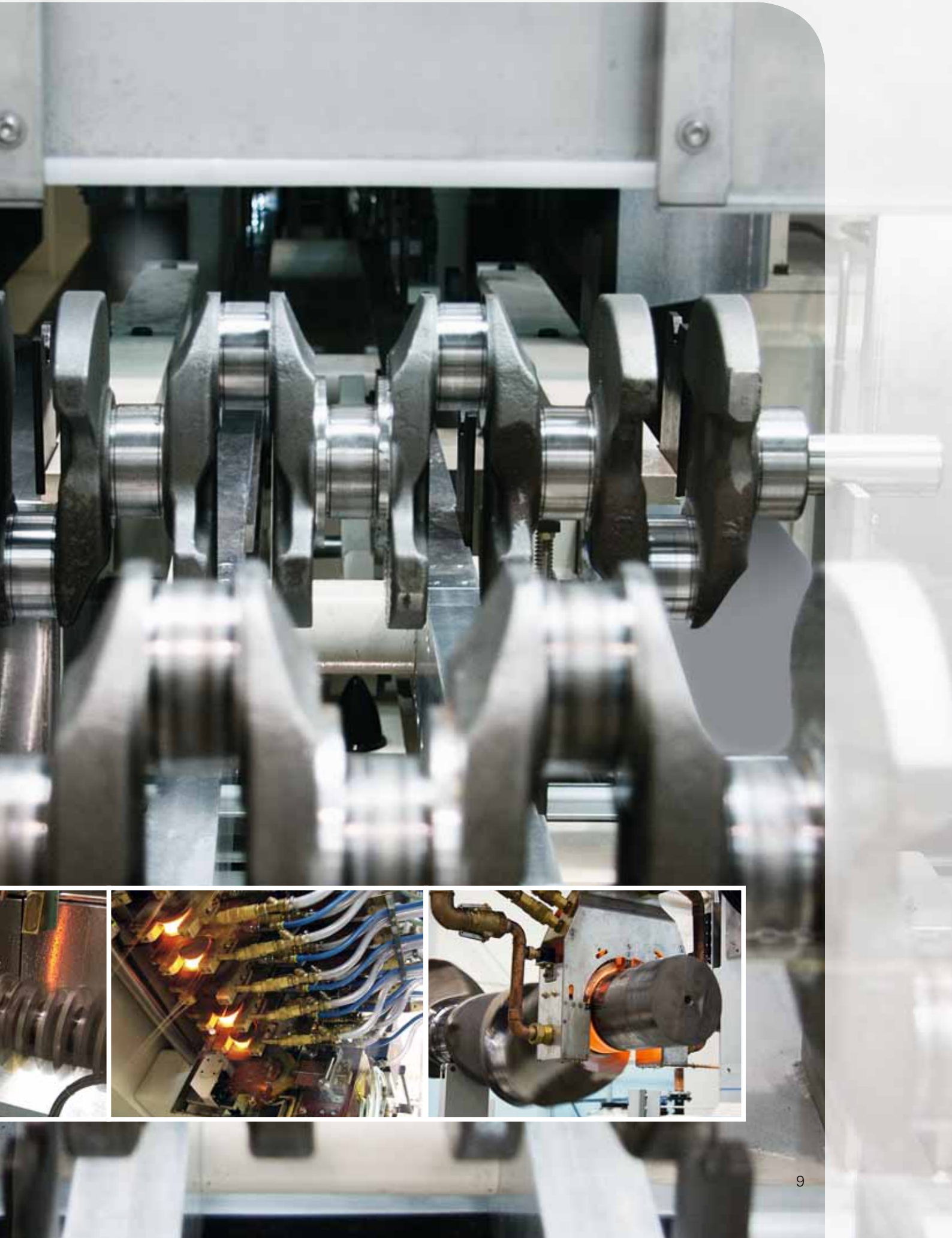
MODULARITY ALL ALONG THE LINE

Within the scope of the ModuLine™ hardening plants, the EloCrank™ series has been particularly designed for the hardening of crankshafts. Depending on the purpose and the size of the crankshafts, three different EloCrank™ machine types are generally available. One of the special advantages of the EloCrank™ series is an easy adaptability by additional system modules. This ensures that the facility can be suited to the individual requirements of the plant operator and easily retrofitted or revamped later at moderate costs.

- Low or adequate investment costs through modular plant concept
- High productivity and quality at low energy and operating costs
- Future security through flexible and cost-effective adaptations

KEY FEATURES





REACHING THE TARGET WITH MODULARITY

EloCrank™ for large series

FOR CHANGING GEOMETRIES

EloCrank™ represents the system solution for surface hardening of passenger car crankshafts and the machine can be realized with one or two stations. EloCrank™ with one station is suited primarily for medium and small series and focuses on hardening of different workpieces. EloCrank™ with two stations is ideal for large series and thus for hardening with high throughput.

With EloCrank™, Elotherm has created highly efficient conditions required for a flexible plant structure and use.

FOCUSED ON VERSATILITY

The option packages make the two machines expandable in a varied way. With basic equipment they can be loaded and unloaded from one location. Additionally, the machines can be connected to a gantry loader and are of course equipped with continuous transport.

Thanks to the flexible package, the plant can also be adjusted fully automatically to various workpiece lengths and different gages. The machining range is just as diverse and all crankshafts are machined with high cycle rate.





EloCrank™: SIMPLY CONVINCING

The EloCrank™ hardening machine is convincing in its compact structural shape and high flexibility as well as in its simple changeover capability to other shaft geometries. By control command the plant changes fully automatically to different distances of the main and pin bearings.

Manual adjustment can be dispensed with and the productive time of the plant is significantly increased.

120 CRANKSHAFTS PER HOUR

On continuous duty in industrial environments, the EloCrank™ with two stations attains cycle times of less than 30s for a four-cylinder passenger car crankshaft.

It means a profitable throughput of up to 120 crankshafts per hour – namely in constantly high quality and within closest tolerances.



HIGH-PRECISION CRANKSHAFT SERIES

Component warpage due to heating particularly during hardening of the radii are minimized by a combination of warp simulations, suitable hardening sequences and specific mechanical workpiece guides. The consequences: low-warpage crankshafts with a precisely hardened surface and desired microstructural properties.





MINIMIZED CONSUMPTION

Owing to advanced technologies, the energy and the media consumption have been reduced to a minimum.

For example, EloCrank™ enables to completely dispense with hydraulic auxiliaries.

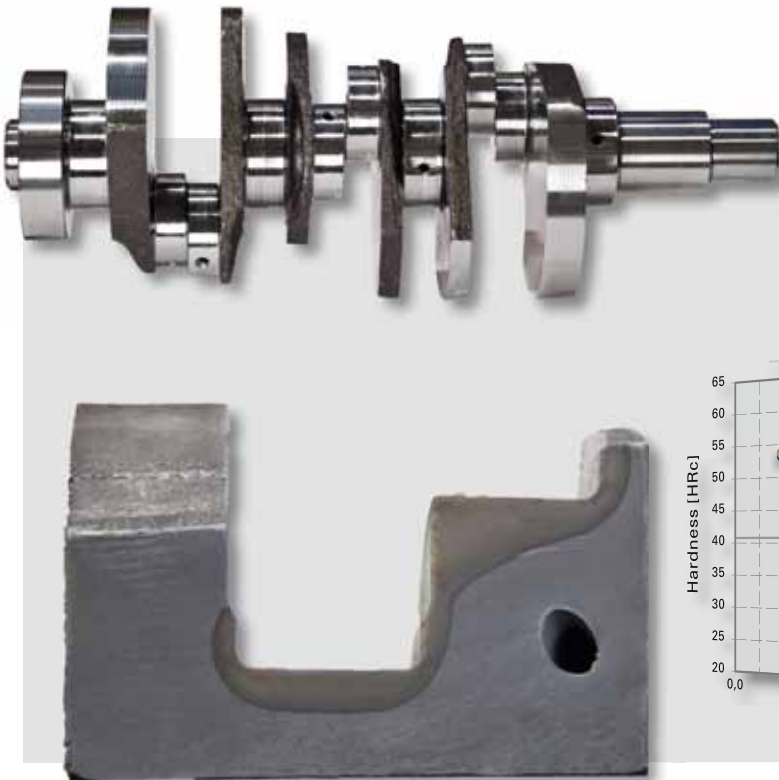
As a result, the electrical consumption is considerably reduced, the noise level is diminished and the risk of contaminations by hydraulic oil is excluded.

WORKPIECE DATA

Clamping length up to 650 mm and maximum workpiece weight of 30 kg.

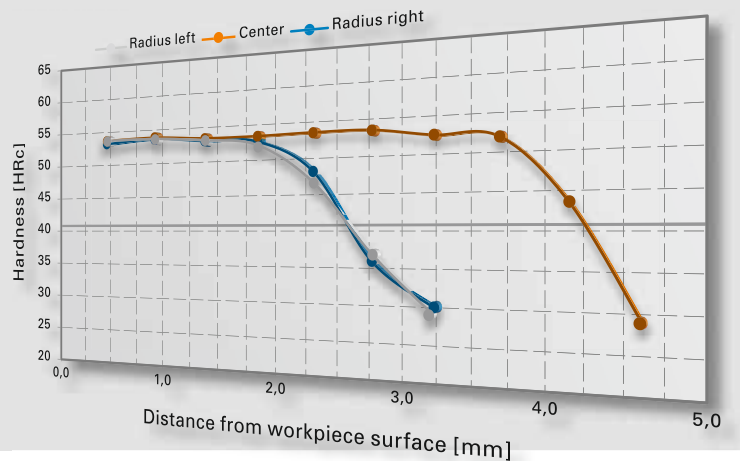
- Short changeover times
- No hydraulic components
- Integrated effective power measurement for quality check

KEY FEATURES



APPLICATION EXAMPLE

Hardening of pin bearing of a V6 split-pin passenger car crankshaft



FLEXIBLE PRODUCTION

EloCrank™ L for a wide range of applications

FOR GREAT DEMANDS

With the hardening of up to 1500mm-long crankshafts, EloCrank™ L is literally opening a wide range of applications – for example in the field of trucks or similar large-size vehicles and of many stationary units. This enables the customer to select the required performance dimensioning and to make sure that over-capacities or further investments are prevented.

PRECISION WITH HIGHEST CYCLE RATE

EloCrank™ L can be equipped with up to 13 transformer/inductor suspensions, depending on cycle time requirements. A highly productive configuration with six converters can also be used for simultaneous hardening of six bearings with different parameters. The result: shortest cycle times even with large crankshafts.

Thanks to the patented technologies of Elotherm, the crankshafts are hardened with minimized warpage.

With an optional auxiliary station, also ring seal seats can be hardened on flanges and post end or sprocket hardening can be performed.

WORKPIECE DATA

Clamping length 500 to 1500mm with maximum workpiece weight of 250 kg.



- Manual or fully automated loading, depending on customer requirements
- Tempering from residual heat or induction tempering possible
- Integrated effective power measurement for quality check

KEY FEATURES



CLEAR PLANT CONCEPT

EloCrank™ L provides interfaces for factory automation. The maintenance-friendly plant concept also stands out due to easy access of all assembly groups and thus reduces the setup times significantly contributing as a whole and once more to the high availability for the customer.

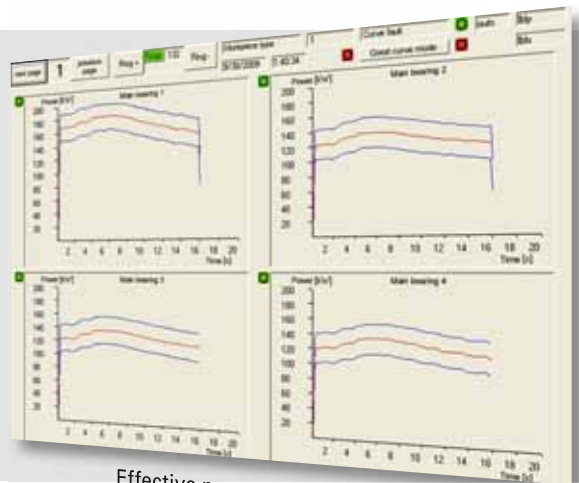


APPLICATION EXAMPLE

Process monitoring by means of effective power measurement on the main bearings of a passenger car crankshaft with hardening of the radii.

- Diameter of main bearing: 114 mm
- Width of main bearing: 40 mm
- Output of main bearing 1: 180 kW
- Output of main bearings 2–4: 135 kW

The main bearing 1 is the thrust bearing and is, in contrast to the other main bearings, designed on both sides with a 15-mm-high stop collar.



Effective power measurement

ONE SIZE BIGGER

Hardening of large crankshafts with EloCrank™ XL

LARGE-SCALE HARDENING

Crankshaft hardening with a length of up to 12000 mm and a weight of up to 8t – these are the breathtaking dimensions of the EloCrank™ XL from Elotherm.

This will enable the giants of the crankshafts to harden in a highly precise and above all economical manner. Examples include crankshafts for marine applications, locomotives or large diesel engines of generators, compressors and pumps.

FROM LARGE PART TO LARGE-SCALE PRODUCTION

For this large machine series, the economic use of the EloCrank™ XL system solution results also from a completely modular plant concept of Elotherm.

The customer decides whether basic investment-friendly equipment is chosen or an advanced expansion stage with significantly reduced cycle times.

The equipment may possibly include up to six transformer/inductor suspensions and two converters for patented hardening of split-pin crankshafts or for parallel hardening of two bearing areas. For all bearings the hardening process can be separately adjusted and is fully automatic.

The inductors are monitored by means of coding which prevents costly damage due to confusion errors on the clamping positions.

WORKPIECE DATA

Clamping length 1500 to 12000 mm with maximum workpiece weight of 8000 kg.

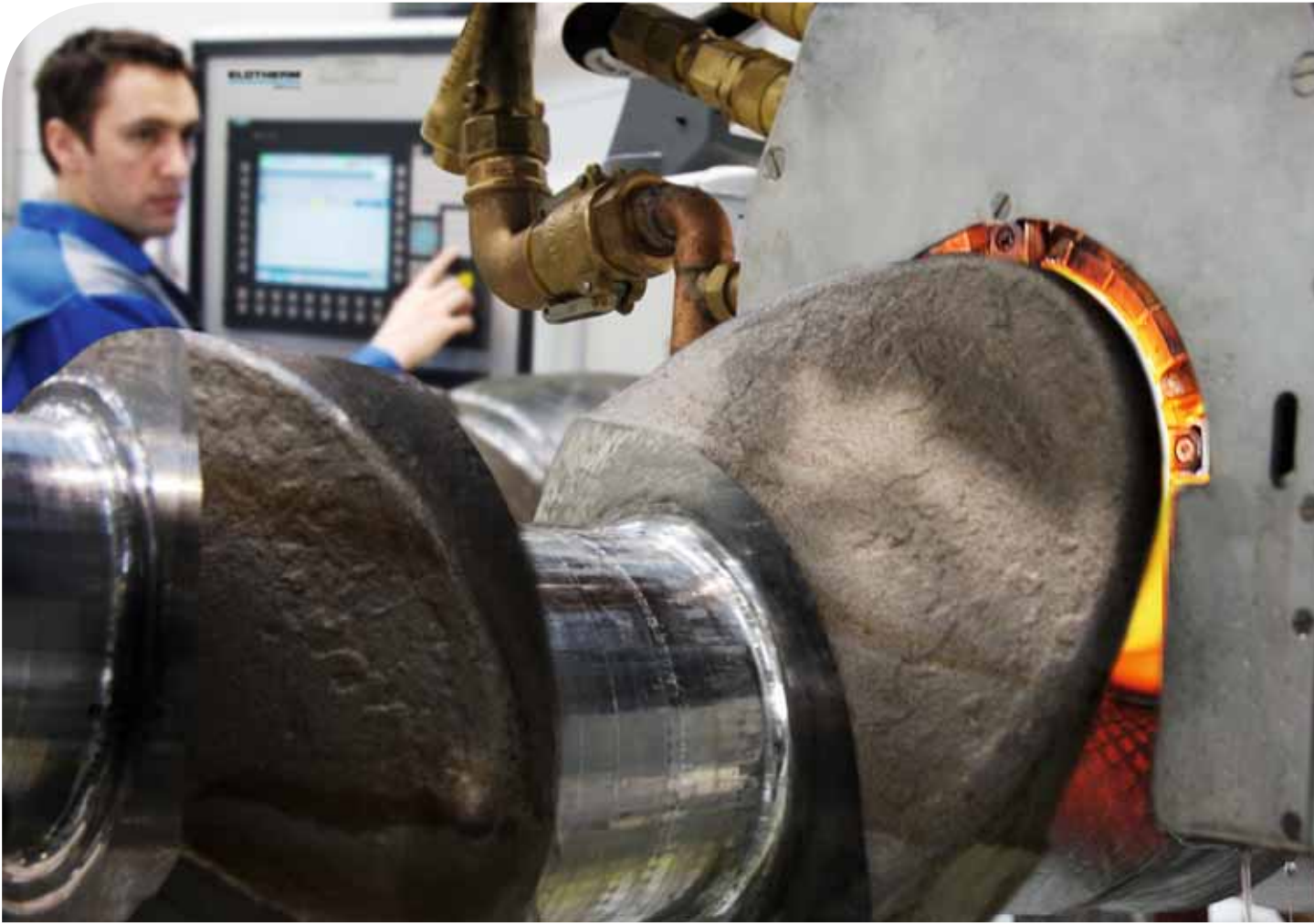
APPLICATION EXAMPLE

Large crankshafts for locomotives

Workpiece: V16 crankshaft with relieved radii on all pin bearings
Length: 3700 mm
Machining: Hardening of all bearings

Special feature: the relieved radii were completely hardened over the entire surface.





- Simultaneous operation of two converters for parallel hardening of split-pin crankshafts or two bearing areas
- Integrated runout measuring device
- Integrated effective power measurement for quality check

KEY FEATURES

STEERING, AXLE AND GEAR COMPONENTS

MADE TO BE TOUGH, PRECISE IN HANDLING

Surviving potholes and bumps without damage and always providing a feeling of direct control. For axle and steering components this means: to withstand highest everyday stresses with robustness on the one hand, and to convey sensitivity for the road and for vehicle dynamics to the driver by highly precise mechanical properties on the other hand. The only solution to overcome this contradiction are modern and hardened vehicle components.

ALWAYS ONE GEAR HIGHER

For the drive train, similarly contradictory and permanently increasing demands apply since the forces of constantly higher torque motors have to be transmitted, space has to be downsized, lifetime extended and every possibility to reduce fuel consumption has to be made use of. Here again, the targeted hardening of highly-stressed components is the key to the solution and the induction hardening technology must not only keep pace with developments in the field of steering, axle and gear components but rather enable and support new solutions.

THE SUITABLE VERSION

The EloFlex™ hardening plants within the scope of the ModuLine™ series enable the customers to be oriented to both current and future requirements. This applies to complex as well as to simple components with an excellent precision by means of patented process technologies and with cycle times which can be harmoniously integrated into the entire process chain. Thanks to the computer-aided plant configurator of Elotherm, each customer gets to needs-appropriate and technical solutions in a quick and above all well-founded manner.

- Modular plant structure for custom-made, integrable solutions
- Highest availability and constant quality
- Early return on investment



MODULARITY IN EACH DIMENSION

EloFlex™ hardening plants

To help you get the most from your modular Elotherm machine we have created a robust system selection tool to guide you to a perfect, tailor-made induction solution for your application.

The Elotherm Configurator offers a direct path to the optimum system setup.

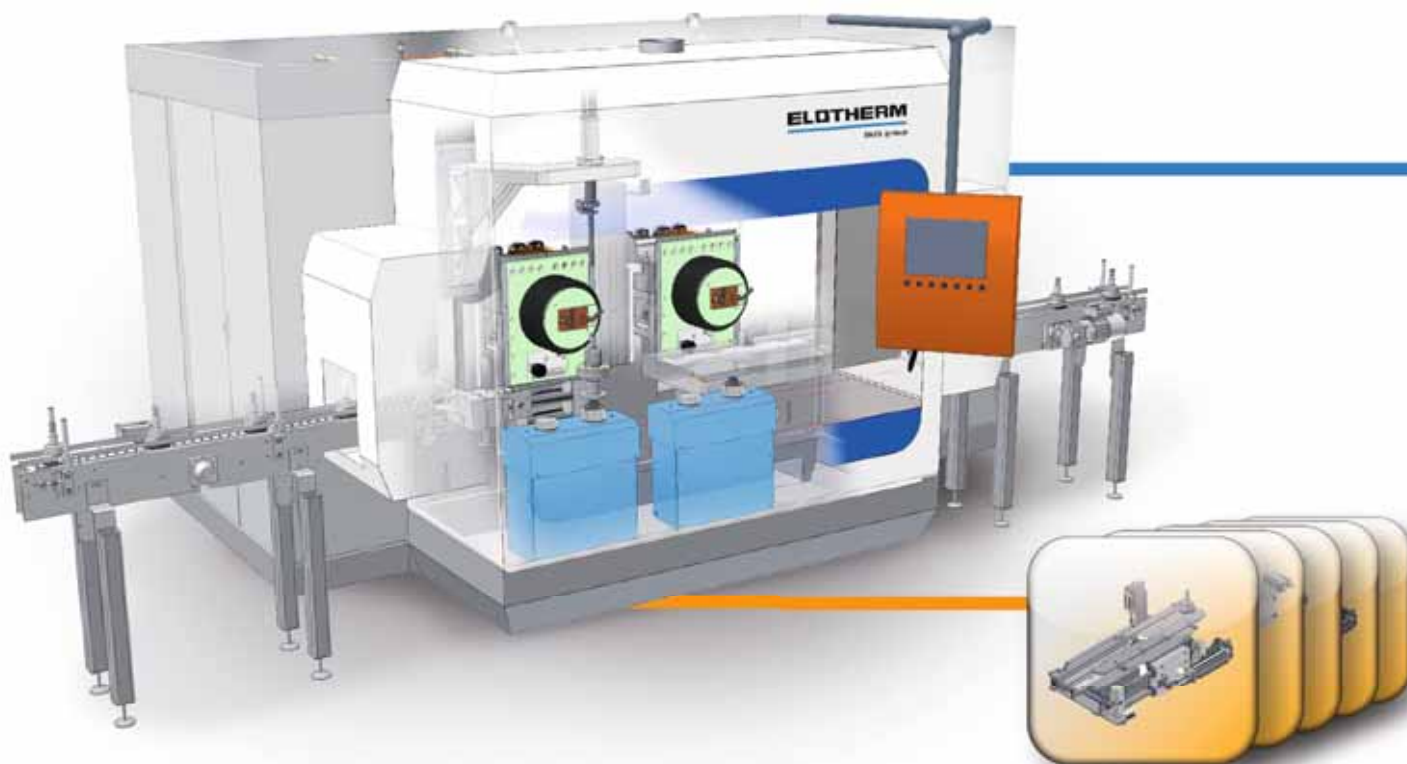
With just a few inputs you are well on your way to specifying the right machine type for your application, leading to the most cost effective and efficient machine for your production process.

Modular and flexible configurability – use the Elotherm Configurator to quickly and simply select the right building blocks to construct your system according to your individual requirements and concept.

Of course our application engineers also welcome your questions and the opportunity to assist you with process and system selection advice.

- Fast, accurate decision-making
- On site consulting
- Ideal machine type for your application
- Individually configured systems

KEY FEATURES





THE ALL-ROUNDER

EloFlex™ for changing requirements

VARIOUS TASKS AND GEOMETRIES

The cost-efficient modular system solution EloFlex™ has been specifically designed for customers with frequently changing hardening tasks. This solution makes it possible that components of most varied geometries are hardened in a quick and safe manner. The product range comprises among others axle arms, axle beams, axle shafts and journals as well as starter shafts, drive and balance shafts, but it also includes chain links, machine knives, tools and much more.

PREPROGRAMMED FOR CHANGE OVER

Due to a readily accessible design and a programmable control, EloFlex™ can be changed over and is ready for use within a very short time so that an above-average annual output is achieved in a mixed production. Already the semi-automatic standard equipment is characterized by quick loading and unloading and it can be expanded by a robot for fully automated application.



APPLICATION EXAMPLE

Workpiece: Drive shaft
Length: 560 mm
Feed: 1000–1200 mm/min

Frequency: 5.4 kHz
Cycle time: 25 s





INTEGRABLE AND COST-REDUCING

EloFlex™ can be harmoniously integrated into production. Thanks to its efficiency at a high level, this solution convinces with permanently low operating costs.

- Manual or fully automatic operation
- Multi-frequency technology for section hardening
- Integrated effective power measurement for quality check

KEY FEATURES

FROM A CUSTOMER PERSPECTIVE

"SMS Elotherm is a reliable and competent partner in regard to any challenging hardening demands that supports Shanghai GKN Drive Shaft Co., Ltd. (SDS) with suitable advanced process solutions at profitable costs."

Mr. Zhang Lei, Purchasing Manager of SDS



FULLY AUTOMATED

Short cycle times with EloFlex™ Inline

WHEN HIGH PERFORMANCE COUNTS

Wherever fully automatic operation with short cycle times is required, the modular system EloFlex™ Inline is the right decision.

EloFlex™ Inline is seamlessly integrated into the existing production lines. Depending on the hardening task, the machine can be equipped with one, two or three heating stations.

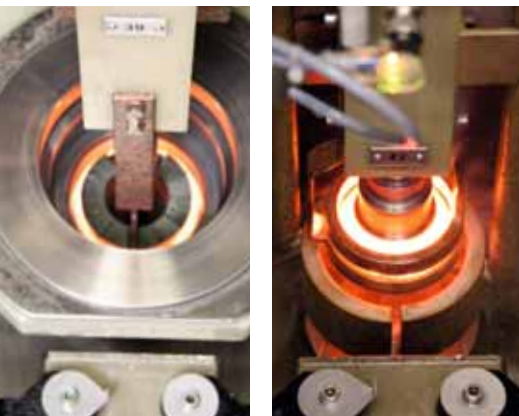
COMPLEX MACHINING, SIMPLE DESIGN

The hardening system provides a fully automated workpiece handling and the hardening sequence is also program-controlled. As a result, the manpower requirement is reduced on the one hand, and process reliability and yield is increased on the other hand.

Especially for journals, tripods and joint parts with sophisticated geometries particularly the productivity benefits of EloFlex™ Inline become noticeable. Thanks to the patented techniques of Elotherm, the use of energy has been reduced to a minimum, namely without losing quality and performance.

- Fast setup times
- Chaining on a production line
- Integrated effective power measurement for quality check

KEY FEATURES





UNINTERRUPTED PRODUCTION

Through the interaction of the effective power measurement and other systems for quality monitoring the parts with tolerance deviations are detected automatically and then ejected so that a high degree of automation of the EloFlex™ system is continuously maintained. This ensures that an uninterrupted and a profitable continuous operation are achieved.



APPLICATION EXAMPLE

Shaft- and tulip- hardening of tripods

Process data tulip hardening	
Power:	337 kW
Frequency:	10 kHz
Process data shaft hardening	
Power:	140 kW
Frequency:	9.8 kHz

Cycle time for overall hardening: 23 s

SHAFTS AND TOOTHED RACKS

EloShaft™ for single shot or scan hardening

LIGHTER BUT MORE EFFICIENT

The key requirements for camshafts, axles, shafts and other long cylindrical parts can be summarized in one sentence: weight saving, improved vibration behavior, increase in useful load and thus reduction of fuel consumption as well as durability of the components.

TIME SAVING DUE TO SINGLE SHOT HARDENING

To harden these parts in serial production, the induction single shot hardening is the appropriate technology.

In this respect, Elotherm has comprehensive and up-to-date process know-how enabling complicated geometries and sophisticated materials to be subjected to a safe and highly productive hardening process, while tempering, by induction or from residual heat, can be integrated.

360 WORKPIECES PER HOUR

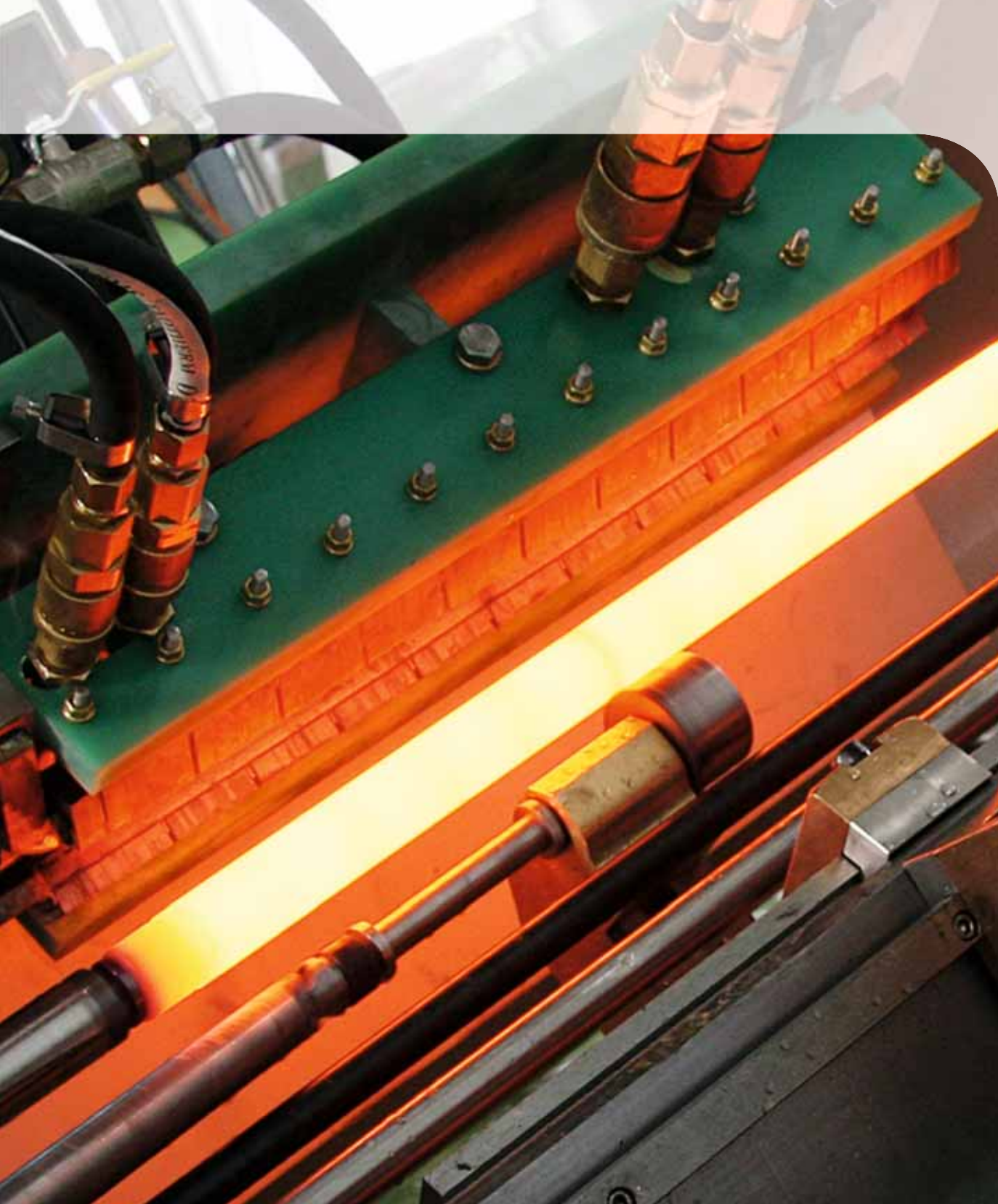
The fully automated machine series EloShaft™ single shot and EloShaft™ Inline achieve a throughput of up to 360 workpieces per hour. Due to additional devices for induction annealing and tempering, the machines can be expanded into flexible heat treatment centers with interfaces harmonized with each other.

EloShaft™ single shot is designed for single shot hardening of axle and drive shafts. EloShaft™ Inline enables horizontal single shot and scan hardening for camshafts, toothed racks, axle and drive shafts.

- Short heat treatment times
- High and measurable efficiency
- Highest quality assurance

KEY FEATURES





SPECIAL APPLICATIONS

INDIVIDUALITY IS THE STANDARD OF THE FUTURE

Our modern high-tech world is increasingly demanding application-specific components with designs and defined material properties, tailored precisely to the application purpose.

For this wide range of most varied shapes, sizes and weights, Elotherm provides special custom-made solutions. In this area with exceptional hardening processes, Elotherm relies on its modular system engineering since a special solution must not necessarily imply extraordinary costs.

COST-OPTIMIZED, RELIABLE DEVELOPMENT

The specialists of Elotherm sit down with the customers and develop hardening plants giving the products their wear resistance and fatigue strength in a cost-optimized way. For these tasks, our own research and development lab is available to develop innovative hardening processes in challenging process tests and to bring them to reliable maturity.

- Profound experience in designing special-purpose machines
- Own laboratory and test field
- Comprehensive after-sales support

KEY FEATURES





CONVERTERS AND INDUCTORS

Knowing what is important

COMPETENCE FOR MORE PROFITABILITY

Converter, oscillating circuit, inductor – together they are the heart of each induction plant. These factors mainly determine the process reliability and the economy for the customer. Therefore, Elotherm has brought together all key components under one roof – from in-house development to in-plant manufacture.

OPEN FOR THE FUTURE

Also with the EloMat™ converters, a modular architecture ensures efficiency, durability and serviceability. The EloMat™ converters for series and parallel oscillating circuits provide an optimal power source for any application.

EloMat™ converters stand out due to their modern digital control and a user-friendly operator concept. Interfaces for various bus systems enable a harmonic integration into process control systems and higher-level plant controls.

PERFECT WORKPIECE ADAPTATION

Inductors of Elotherm combining highest precision with high efficiency and process reliability are the interface between machine and workpiece and they are designed at Elotherm in realistic computer simulations. Then, comprehensive test series are performed in the laboratory to ensure the quality. This includes for example hardness measurements and microstructural examinations.

- Output up to 4500kW per unit
- Frequencies up to 600kHz
- Converters and inductors of our own manufacture
- Converters with multiple inverters and constant power factor
- Future-oriented further 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 worldwide service network which is continuously further extended. Current locations are in Germany, France, North America, China and Brazil. 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