



Induction Hardening

The more productive hardening process

Hardening—an introduction

Hardening uses heat and rapid cooling (quenching) to increase the hardness, strength and/or durability of steel. Heating steel or iron above their upper critical temperatures modifies the crystal structure of the metal to a form called Austenite. With this atomic arrangement the carbon can then freely migrate to a new location. When hardening, the aim is to quickly quench the Austenite, thus trapping the carbon atoms in their new positions in the crystalline structure. The transformed structure, called Martensite, is extremely hard. In addition, hardening creates important internal residual stresses that can be either beneficial or disadvantageous. Depending on requirements, tempering can be carried out after the induction hardening process.

With induction hardening, only the material in the heating zone is heated. There's no need to treat the whole mass of the component, thus saving energy. The hardening result depends upon a complex interaction of process parameters such as coil and quench design, material analysis, component geometry, heating frequency and power and quenching cycles. At EFD Induction we have all the expertise required in electromagnetism, power electronics, metallurgy and induction hardening process setup.



Perfect results for challenging workpieces. Our range of hardening machines, together with customized coils and patented multi-frequency technology, can handle the trickiest gear hardening tasks.



At EFD Induction you'll find experienced metallurgists, engineers and quality control experts. In fact, you'll find all the competence needed to ensure you get the most reliable, most cost-effective hardening solution possible.

Why choose EFD Induction?

It might be our 65-plus years' experience in the industrial induction business with our vast application knowledge. Or perhaps our global network of factories, workshops and representatives. It could be our range of pre- and after-sale services. Or that we are the world's largest induction hardening company, with customers that include the most prestigious names in the automotive, aviation and metals industries. Perhaps it's all of the above. But whatever your hardening needs, there is no shortage of reasons for contacting EFD Induction.

Proven solutions

EFD Induction hardening systems can be found at some of the world's most demanding and quality- and cost-conscious companies. Many of our hardening customers appreciate our integrated approach—the fact that we develop, test, install and maintain complete hardening solutions.

The people behind the process

Like any other industrial process, induction hardening is only as efficient as its human operators. That's why EFD Induction provides full and regular training programs. We get your people up to speed, and make sure they have the skills and knowledge to make the most of their EFD Induction solution.

Making it right before making it for real

At our labs and R&D centers we design, validate and optimize hardening solutions. Using simulation software we can explore various scenarios to find the best possible answers. Then we translate them into functioning solutions.

Meeting new demands

The ever-increasing demand for lighter vehicles and lower emissions is accelerating the need for innovative hardening solutions. At EFD Induction we have pioneered some major technical advances to make induction hardening more efficient and flexible. State-of-the-art control systems, and our patented Multi Frequency Concept are just two examples.



An EFD Induction vertical hardening machine in action. The chuck connection behind the workpiece lets you use the same machine for either high or medium frequency hardening.



Inductor for surface hardening of tripods. The inductor head is equipped with magnetic flux controllers, main quench and screen quenches.

Induction hardening. What makes it so effective?

More and more companies are opting for induction-based hardening solutions. Here are four key reasons that make induction hardening such an attractive choice.

1. High throughput

Induction hardening is ideal for integrating into production lines. Once installed, you can exploit the equipment's high throughput, accurate controllability and reproducibility—even for workpieces with complex geometries. And if components need tempering, we offer different solutions such as induction or furnace tempering.

2. Shorter leadtimes

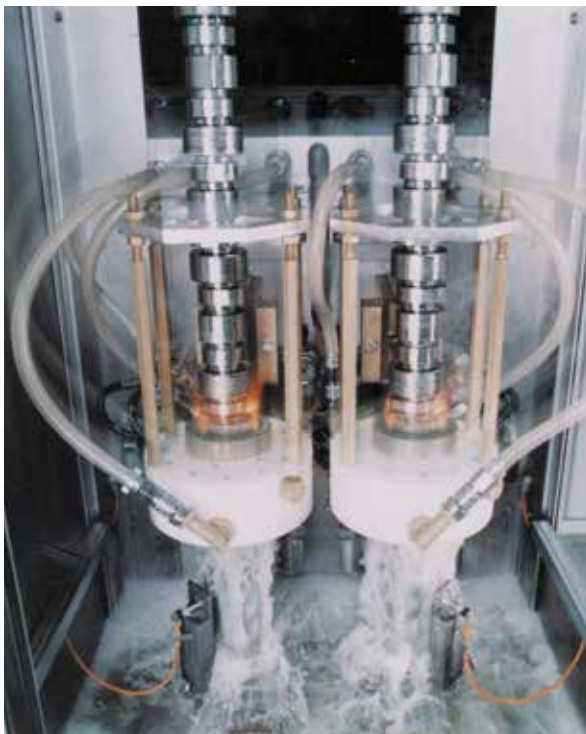
The in-line integration made possible by induction hardening not only boosts output—it slashes lead-times. Components no longer need be sent away to hardening shops or separate hardening areas. Transportation times and costs are reduced. Administration is streamlined.

3. Minimal environmental impact

Induction heating is a clean, flameless, no-contact technology. And since it precisely delivers heat only when and where it's needed, induction hardening is extremely energy-efficient—particularly when compared to wasteful methods such as furnace carburizing. Also, induction hardening typically uses a polymer emulsion; thus avoiding the use of environmentally unfriendly oil baths. These features are not only good news for the environment, they also contribute to a safer, healthier and more productive workplace.

4. Complete control

Induction hardening treats each workpiece individually. This means each and every workpiece is hardened to very precise specifications. Nothing is left to chance. With EFD Induction's PLC/CNC control systems you determine the heating pattern, heating time, throughput speed and quenching process for each hardened component. Parameters for each component can be supervised and stored on your server via a network connection.



Double hardening for double productivity. The quenching phase inside a single cabinet hardening machine with twin tailstocks and centers.

Innovative induction



Slewing ring without soft zone

Hardening of big rings is not done with single shot hardening because the required power would be extremely high. However, traditional scanning hardening results in a 'soft' zone in the start/stop area. But with EFD Induction's innovative and patented solution, three independent coils work together to create a seamless induction-hardened ring.



Specialized crankshaft hardening

Car crankshafts, truck crankshafts, marine crankshafts — EFD Induction systems are used worldwide to harden every imaginable type of crankshaft in a wide range of production volumes. Many of the world's leading car and truck makers use our patented coil design to ensure the consistent high quality and productivity essential in their industry.



High throughput horizontal hardening

Our centerless horizontal hardening systems combine exceptionally high throughput rates with high reproducibility. Ideal for mass producing plain shafts, EFD Induction centerless systems feature control software with a reaction time of only 1/1000s.



Vertical hardening of shafts and flanges

Hardening a shaft is relatively straightforward. But what about hardening shafts and shaft flanges in one fast operation? Our universal vertical hardening systems are a proven method for hardening axel flanges. We also offer vertical indexing table machines that can be robot loaded for high production volumes.



Multi Frequency hardening

EFD Induction's patented 'Multi Frequency Concept' (MFC) ensures simultaneous delivery of two different frequency ranges to the same induction coil. The result is a system that always allows an optimized heat distribution in the workpiece. The exact mix of high- and medium-frequency power delivered by MFC makes it ideal for the contour hardening of complex geometries.

Complete hardening solutions



EFD Induction has been developing induction-heating solutions for more than 65 years. Today, we're the world's largest induction hardening equipment maker, with manufacturing plants, R&D centers and sales companies around the world. Our strength is complete, tailored systems. We usually start in the lab, with materials analysis and computerized simulation of various solutions. We also look at coil design, and determine which quenching, loading/unloading and control systems best suit your needs. And of course, we don't consider our job done until your systems—and your operators—are up and running 100%.



Hardline is our complete range of heat treatment systems from vertical, horizontal, rotary table and centerless systems to customized, one-off solutions. In fact, custom-engineered solutions account for more than half of all the hardening systems we deliver. Major components in our systems are EFD Induction Sinac Universal Heat Generators. Sinac is the market's widest range of generators, offering an unrivalled spectrum of frequencies. And of course, we also offer tempering options, either as stand-alone options, or fully integrated into the equipment.

Designing, making and installing equipment is only the first phase in a hardening solution. That's why we offer comprehensive maintenance, repair and operator training services. Many of our hardening customers also benefit from our induction coil support program. This ensures optimal performance during the lifetime of the coil, and minimal downtime during coil replacements.