Induction brazing

A guide to key features and benefits

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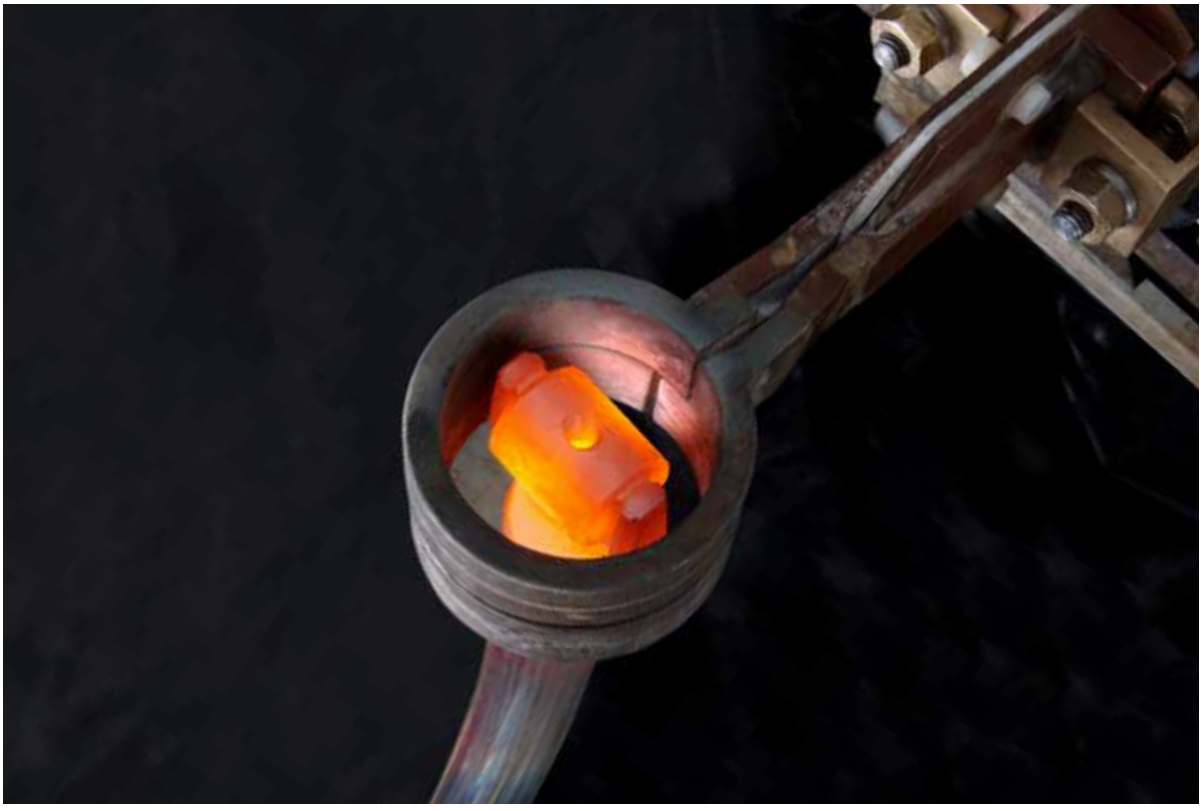
Welcome

Almost everyone in manufacturing knows something about brazing. But sadly, too few fully appreciate the potential and benefits of induction brazing—a technology with many advantages over traditional flame-heating.

Moreover, many have only a hazy idea of just how versatile induction brazing can be. For example, you probably didn't know that EFD Induction brazing solutions range from compact, mobile systems to automated machines complete with loading robots and controlled atmospheres.

A document like this can present only a few of induction brazing's many benefits. And there's a good chance it won't discuss your specific needs and conditions. But that's why we have a worldwide network of induction brazing experts. Just contact them and they'll answer any questions you may have.



Induction brazing is fast, precise, clean, energy efficient, controllable and repeatable.

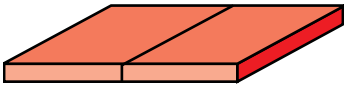
Brazing basics

What is brazing?

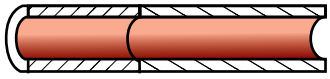
Brazing uses heat and a filler metal (alloy) to join metals. Once melted, the alloy flows between close-fitting base metals (the pieces being joined) by capillary action. This molten filler alloy interacts with a thin layer of the base metal to form a strong, leak-proof joint.

Types of braze joints

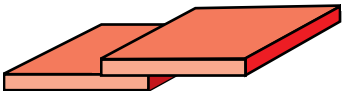
There are many kinds of joints, but most braze joints are variations of one of two basic types – the butt joint and the lap joint.



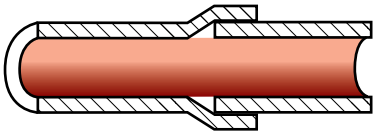
Butt joint - flat parts



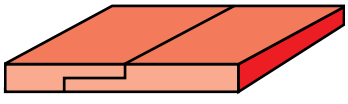
Butt joint - tubular parts (cutaway)



Lap joint - flat parts



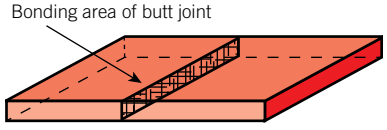
Lap joint - tubular parts (cutaway)

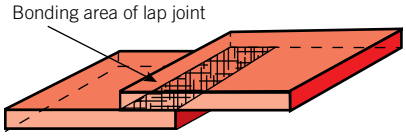


Butt-lap joint - flat parts

You will find many different modifications of the two basic joints, depending on the parts' varying geometries, assembly and functions.

A joint's strength depends largely on the bonding area, which can be thought of as the overlap zone where two surfaces of base material rest against each other. The greater the bonding area, the higher the strength.





Heat sources and brazing methods

Different heat sources can be used for brazing:

- Induction
- Resistance heaters
- Ovens and furnaces
- Torches/flame

There are three common brazing methods:

- *Capillary*
- Notch
- Moulding

Induction brazing is concerned solely with the first of these.

Soldering

Induction heating is also used in soldering, a process similar in many ways to brazing. The former process, however, uses much lower temperatures (below 450°C) than brazing (typically 450 - 1150°C). But induction soldering offers many of the same benefits as induction brazing: high heat density, short heating times, minimal heat seepage to adjacent components, no-contact heating, and controllability.

Induction brazing step-by-step

Some questions should be investigated—and answered—in order to assure successful, cost-effective joining.

For instance:

- How suitable are the base metals for brazing?
- What type of braze joint should be designed?
- What's the best coil design for specific time and quality demands?
- Should the brazing be manual or automatic?
- Is edge polishing and deburring needed?

At EFD Induction we answer these and other key points before suggesting a brazing solution.

The brazing process

The induction brazing process can be broken into the following steps:

- Ensure the correct gap between the base materials
- Clean the base materials by removing residues, oxides, etc.
- Apply flux to the joint area
- Position, and if necessary clamp the parts to be brazed
- Apply the brazing filler alloy
- Induce the desired heat in the joint area
- Remove any remaining oxides or flux residue

What we can braze:

Copper	Tungsten/Wolfram
Steel	Carbides
Brass	Chromium
Aluminum	Diamonds
Stainless steel	Nickel
Iron	Cobalt
Hard metals	Noble metals
	Stellites

If you want to join any of these materials, then chances are we at EFD Induction can devise a brazing solution tailored to your exact needs.

Brazing with an EFD Induction system. Note how the heating zone is fully visible, something that is practically impossible with flame brazing.

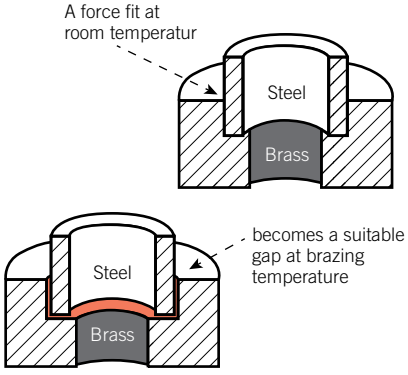
Mind the gap!

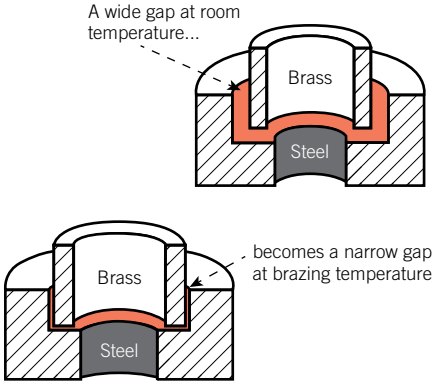
Having the correct gap between the base metals is crucial. Tensile and shear strengths depend on having the correct clearance between the base materials.

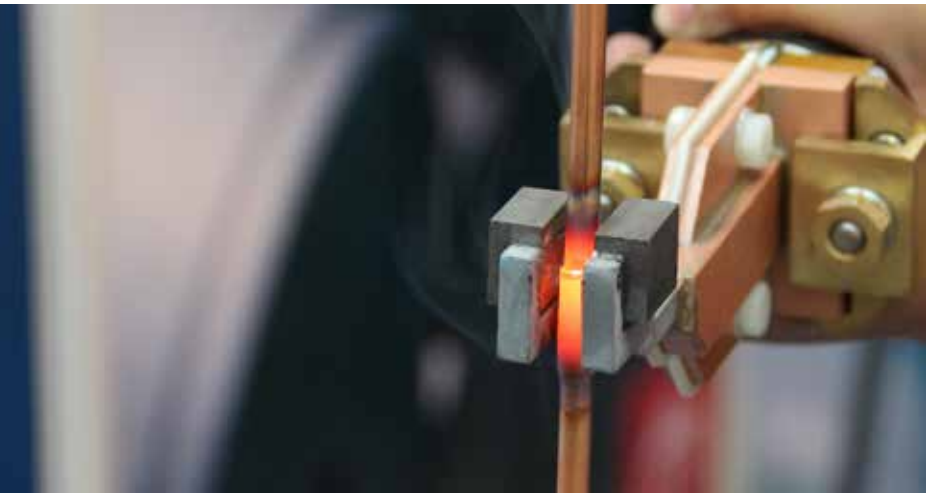
Too small a gap, and the alloy will not spread properly through the joint. Too large a gap, and the joint's strength will be concentrated in an alloy 'bridge' between the base materials—leaving the joint susceptible to failure. A too-large gap minimizes capillary force and leads to weak joints and porosity.

Thermal expansion

Thermal expansion means gaps have to be calculated for metals at brazing, not room, temperatures. Optimum spacing is typically 0.05 mm – 0.1 mm for materials with a high silver content.







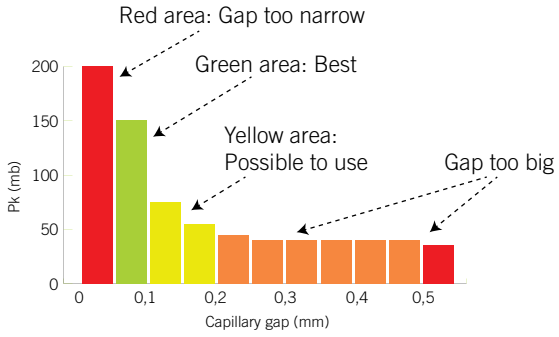
Usually, the strongest joints are made by allowing just enough space for the filler metal to flow into the joint area. Wider spacing will generally result in a weaker joint.

Approx. coefficients of linear expansion at 20°C

Material	**10^{-6}m/°C**
Copper	16.5
Brass	18.5
Steel	12.0
Tungsten	4.5
Silver	19.7
Quartz glass	0.5
Ceramic	4.0
Aluminium	23.8

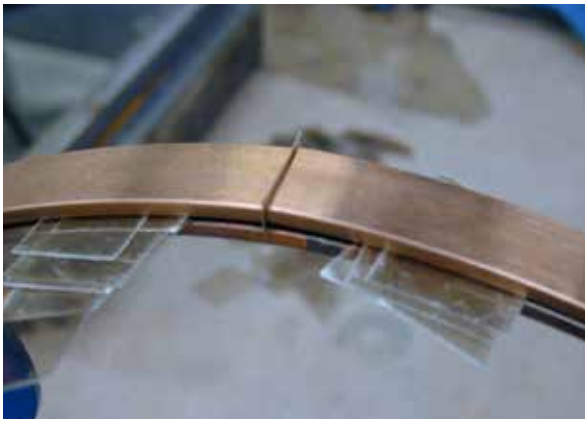
Capillary action

But how to determine the optimum gap? First, one must understand the interplay between temperature, gap width, alloy viscosity and capillary pressure. Put simply, the correct temperature makes the liquid alloy 'float', enabling its distribution by capillary action throughout the joint. The rate of this capillary action depends on the gap between the parts, and the viscosity of the heated alloy.



Silver content / AG%	GAP mm
>40	0,05 - 0,1
32 - 40	0,08 - 0,15
<32	0,1 - 0,2
Aluminium	0,08 - 0,3

Capillary pressure (Pk) as a function of the distance between the parts to be the joined. The interplay between gap width, capillary action, filler viscosity and temperature highlights the need for specialist knowledge when devising induction brazing solutions.



Alloy viscosity influences tensile and shear strength. Silver, copper and aluminum alloys are commonly-used filler metals. This photo shows brazing with phosphorous alloy without external flux.

Bars of silver filler about to be heated for brazing bars to a short-circuit ring. Once heated to the correct temperature, the filler will appear to 'float' on the surface of the metal, before being distributed throughout the joint by capillary force.

Focus on flux

Base metals must usually be coated with a solvent known as flux before they are brazed. A flux coating:

- Cleans the base metals
- Prevents new oxidation
- Wets the brazing area prior to brazing
- Protects the alloy and improves the flow

It is crucial to apply sufficient flux. Use too little and the flux may become saturated with oxides and lose its ability to protect the base metals.

Flux must normally be removed from the part once the filler alloy has solidified, usually below 400°C. Different removal methods are used, the most common being water quenching.

Phoshporous-bearing filler

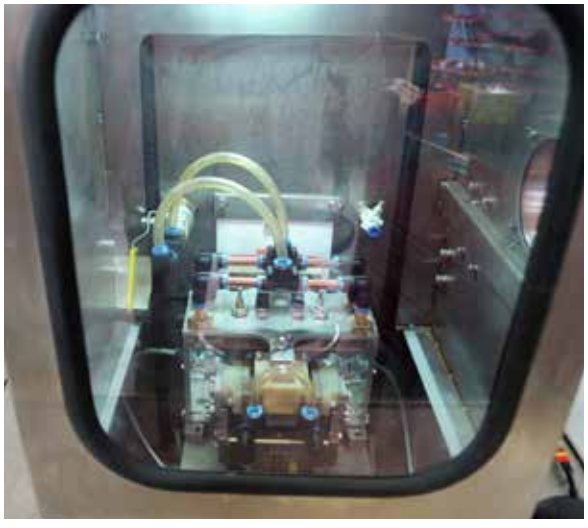
Flux is not always needed. Phosphorous-bearing filler can be used to braze copper alloys.

Controlled atmospheres

One flux-free solution being increasingly used—particularly for high-volume production of mission-critical components—combines induction brazing with some form of controlled (also known as active) atmosphere. Controlled atmosphere solutions fall into two main groups:

- Gas chamber brazing (non-furnace)—The atmosphere inside the chamber is controlled by external vacuum pumps and the introduction of inert gases. This method is usually reserved for mission-critical components destined for aeronautical, medical or other demanding fields.
- Bell jar / glove box—These involve brazing inside a sealed environment in which the atmosphere is controlled. Glove box brazing allows manual handling of the parts. Selecting the correct type of gas must take account of: the type of metal filler, the base materials, brazing temperature, cost considerations and so on.

It is crucial to apply sufficient flux. Use too little and the flux may become saturated with oxides and lose its ability to protect the base metals.



Controlled atmosphere brazing at an EFD Induction production facility. This method is increasingly used for large-volume production of high-quality, mission-critical components.

Why induction brazing is better

Brazing produces strong, shock-resistant and visually attractive joints. But why select induction over flame brazing? There are at least seven compelling reasons:

1. Speedier solution
Induction heating transfers more energy per square millimetre than an open flame. Induction can therefor braze more parts per hour than alternative processes. Rapid and precise heating results in less mass to be heated. And there is less damage to surrounding insulation.

2. Quicker throughput
Induction is ideal for in-line integration. Batches of parts no longer have to be taken aside for separate brazing or sent off site.

3. Consistent performance
Induction heating is controllable and repeatable. Enter the desired process parameters and the induction equipment will repeat the heating cycles.

4. Unique controllability
Induction lets operators view the brazing process, something that is difficult with flames. This and precise heating minimize the risk of overheating.

5. More productive environment
Open flames create uncomfortable working environments. Induction is quiet and clean. It is easy to extract fumes and there is virtually no increase in ambient temperature.

6. Compact footprint
EFD Induction brazing equipment has a small footprint. Induction stations slot easily into production cells and existing layouts. And our compact, mobile systems let you work on hard-to-access parts.

7. No-contact process
Induction produces heat within the base metals—and nowhere else. Unlike flame heating the base metal never comes into contact with the heat source. The homogeneous and controlled heat minimizes distortion, and there is no danger to create hydrogen embrittlement.

Induction is a high throughput, no-contact heating method. It helps ensure strong yet barely visible joints—and the outstanding aesthetics expected by today's customers.

Induction heating is one of the most energy efficient and environmentally friendly heating technologies. The secret is its precision—induction does not waste energy heating ambient air or adjacent components.

When and where to braze

EFD Induction brazing solutions are used in numerous industries worldwide. Most systems can however be categorized in the following areas:

- Electricity generation and distribution
- Automotive industry
- Appliances (includes white goods and HVAC)
- Tools
- Specialist areas

The following pages take a closer look at each area. To learn more about our expertise in any particular industry, just contact your nearest EFD Induction office.

Electricity generation and distribution

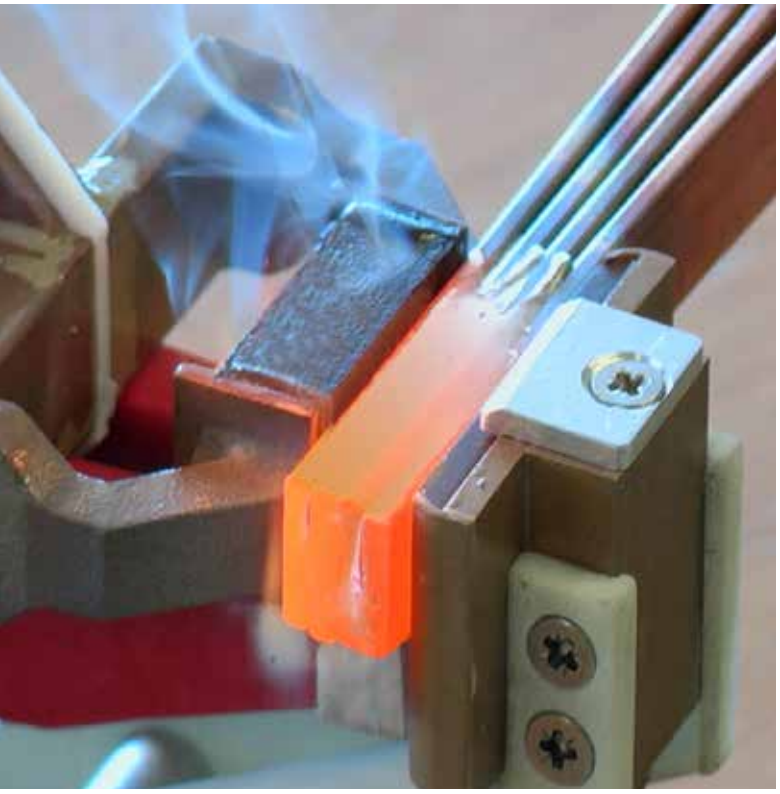
Within the power industry our equipment is used mainly for the following components:

- Generators
- Transformers
- Turbo generators
- Switch gears
- Motors
- Short-circuit rings (squirrel cage)

Induction brazing is the perfect choice for such parts. First, the heat is localized. This means that precise Heat Affected Zones can be defined in advance. Second, high density, no-contact heat in precisely demarcated zones means:

- Minimal heat spread
- Minimal risk to insulation materials
- Minimal risk of deformation

When mobility is needed coils can be attached to compact handheld power outputs. As easy to operate as a regular power tool, these handheld units feature long and flexible power cables and are easily attached to commonly available balancers or positioners for extra comfort and productivity.



Induction brazing is the perfect choice for brazing of bars, strands, rings and wires in motors, generators and transformers. This photo shows brazing of strands.

Customized solution for brazing of pool windings.

Unique design; a heat transformer with built-in clamps ensures correct positioning of parts.

The versatility of EFD Induction brazing solutions. The top picture shows a stationary coil during brazing of a short-circuit ring for one of the world's leading power generation equipment companies. The middle left photo shows brazing of generator windings and the bottom left photo shows a contactor being brazed. The photo bottom right shows brazing of serial connections of stator windings.

Brazing solutions for the automotive industry

Most EFD Induction automotive brazing solutions are used for high-volume production of fuel lines and air-conditioning. We have a long track-record in devising brazing solutions for:

- Aluminum parts for air-conditioning systems.
- Evaporator and condenser connections (tube-to-tube, tube-to-block, tube-to-tank).
- Steel and copper components such as brake linings and fuel injection pipes.
- Short-circuit rings for electric motors.

Automotive components must be brazed to the very highest standards and solutions must meet the automotive industry's tough cost-control demands. Satisfying these demands has resulted in EFD Induction becoming the leader at devising brazing systems unmatched for productivity and reliability.

Aluminium brazing

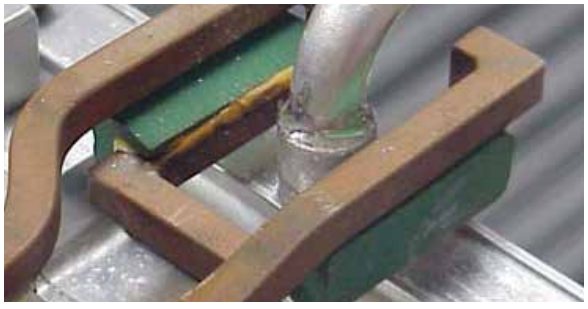
Brazing of aluminium is frequently used in the automotive industry. Brazing aluminium is a demanding task. The reason is the need for exact temperatures, as the gap between the brazing temperature and the melting point of aluminium can be as low as 20-50° C. Achieving and maintaining such precise temperatures demand outstanding coil design and a high degree of coil fabricating skill. And because any instability in the workpiece during the brazing process can have disastrous effects, it also requires excellent fixtures. EFD Induction has unrivalled expertise in this demanding application and is the world's leading developer of induction heating solutions for aluminium brazing. Much of this is due to the full spectrum of EFD Induction's capabilities—which include everything from initial computer simulation to coil design and integrated turnkey brazing machines featuring automated handling systems.

Design of your brazing system

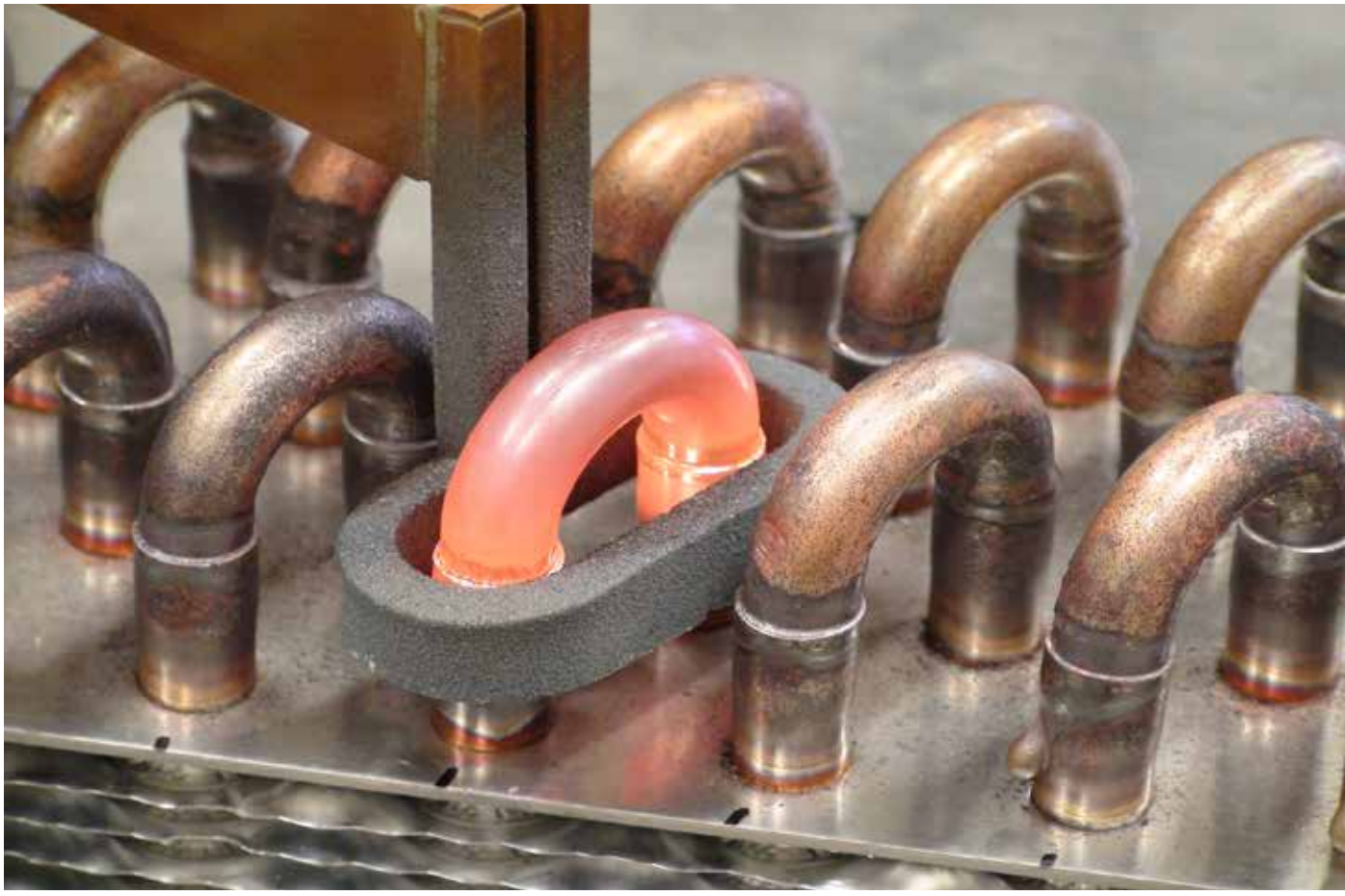
The design of your brazing system depends on your specific conditions, but here is a partial list of what it might feature:

- Integration into existing or planned production lines. Maximizes throughput, and reduces 'parts in process'.
- Controlled atmosphere. Achieves the consistent quality demanded in the automotive industry.
- Multi-station systems. Ideal for high-volume production.
- Robotic handling and automated processes. Examples include robotic loading/unloading systems, automatic filler input mechanisms and post-braze cleaning operations.
- Process control and record-keeping software options. This software can be customized.
- After-sales support programs that include: training, coil repair, coil supply, preventive maintenance programs, etc.

Induction heating is a perfect method for high throughput brazing of evaporator and condenser connections.



Brazing aluminium is a tough job. EFD Induction has unrivalled expertise in making efficient solutions for this demanding application.



The top photo shows brazing of a heat exchanger. The bottom left photo shows high-quality banjo nipples being brazed under a controlled atmosphere in a customized EFD Induction brazing machine. Bottom right photo: Brazing of brake linings.

Brazing solutions for the appliances industry

The appliances industry (includes white goods and HVAC) has for decades been a major user of EFD Induction brazing solutions. EFD Induction supplies equipment and processes to the world's leading producers of refrigerators, freezers, dishwashers and washing machines as well as plumbing and household fixtures industries. Refrigerators and freezers contain many compressor parts that need brazing. Dishwashers and washing machines too contain numerous heating elements. EFD Induction brazing solutions for appliances include brazing of tube-to-tube, tube-to-block and tube-to-valve connections and involve brazing copper to copper, copper to aluminium and aluminium to aluminium.

Brazing aluminium to copper

Induction heating is ideal for brazing aluminium to copper, a key challenge in the industry. As aluminium melts at around 650°C, and copper at 1,080°C, it is essential that heat input is according to melt temperature—and as precise and as fast as possible. It is this precision and speed that is so difficult to consistently achieve with flame brazing.

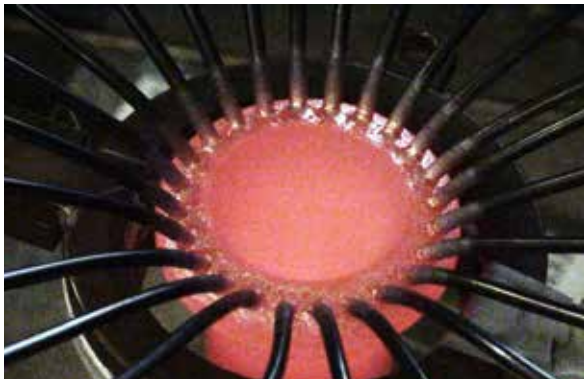
Other factors that make EFD Induction popular in the white goods industry include:

- Compact, mobile converters
- Handheld, easy-to-use heat output units
- Safe and comfortable. The voltage at the coil of a mobile Minac unit is typically below 50 V.
- Long-life coils and coil maintenance support

Our solutions for domestic appliances industry range from mobile, single-output Minac systems to brazing machines featuring multiple heating sources and work stations. Such machines may also feature controlled atmospheres and automated loading and unloading systems.

Brazing of a copper tube to an aluminium heat exchanger. Note the automatic filler material feeder.

Fast, precise, controllable and easy to use. Induction is perfect for faucet brazing—whether it's tube-to-socket, tube-to-tube or thread insert brazing.



Induction brazing in the appliances industry. Note the convenience of our handheld heat output unit (centre left). Brazing of compressor parts (top left), heating element (top right) and heat distributors (bottom left and right)

Brazing solutions for the tools industry

Drilling, mining, cutting. Even the words sound tough. So when it comes to choosing manufacturing processes, it's easy to see why induction brazing is often used to braze carbide tips, bits and blades onto saws, shanks and so on. In fact, only induction brazing has the consistent precision and controllability needed for making such tools.

Minimal heating cycles and accurate Heat Affected Zones are essential for tool brazing. Get the temperature too low, and the joint won't have the required strength. Quickly overheat the joint, and there's a risk of inducing stresses and cracks. Get the temperature wrong, and there is a risk of unwanted grain growth in the base materials.

An EFD Induction Sinac heat generator in action brazing a plough share. EFD Induction products range from standard heat sources, through customized solutions to complete manufacturing processes.

Devising brazing systems for carbide tips, blades and bits is an EFD Induction speciality. Such brazing must meet high technical standards, as the brazed joints must function in extreme working conditions.

Brazing solutions for specialist areas

This document gives you an overview of the main areas for EFD Induction brazing solutions. However, our equipment is used for a vast array of other brazing solutions in industries as diverse as:

- Wire and cable
- Aviation
- Furniture
- Tube and pipe
- Shipbuilding
- Rail
- Agriculture

Many commercial service and maintenance companies use our mobile Minac units. These systems can be easily moved from job to job and of course, Minacs are not restricted to brazing. A single Minac can be used for other heating tasks such as annealing, bolt removal, shrink-fitting\ and so on.

A single specialist system can be designed to handle a range of materials; or it can be built to only handle specific materials and components—the final design depends on your particular needs and conditions.

Manufacturing customized brazing solutions requires a range of competencies. At EFD Induction you'll find R&D centres and specialist workshops staffed with experts—people who have dedicated their careers to induction heating. You'll also find a worldwide network of factories and offices, and unrivalled after-sales support.

An EFD Induction Minac brazes parts for the aviation industry. Induction is ideal for brazing fan blades, blades for casings and numerous parts in fuel and hydraulic systems.

Just a few examples of EFD Induction specialist brazing solutions; brazing of a cable shoe (top), a microphone (left) and steel support bars for sofas.

Systems built for better brazing

EFD Induction brazing systems can be divided into three groups:

- Minac-powered systems
- Sinac-powered systems
- Customized brazing machines

'Minac' mobile converters feature output power of 10-220 kW (6-140 kW continuous) and automatic electronic matching. Highly versatile, Minacs perform practically any brazing task. Some Minacs come in 'Twin' versions, meaning a single converter has two independent power outputs. Power outputs are also available as handheld 'power pistols'.

'Sinac' stationary generators feature power outputs up to 2000 kW. Sinac is a truly comprehensive range that includes parallel and serial-compensated converters suitable for virtually any induction heating application. Twin versions with two indpendent power outputs are also available.

The EFD Induction *Setpoint Recorder* can be installed with all Minac and Sinac systems. The unique 'teach-in' solution lets you record and re-play your exact heating patterns.

Customized brazing machines are designed for one particular type of workpiece or closely related workpieces. For instance, an automated pole coil brazing machine can feature loading and unloading equipment, a rotary working table, double brazing heads, and two 'press heads' for squeezing the brazed joints together (this eliminates the need for further finishing).

Mobile, flexible and easy-to-use. The Minac brings the benefits of induction heating to tough-to-access workpieces.

Our turnkey brazing machines are pre-assembled and ready-to-work. They come complete with induction heater, coil, braze material, flux, fixtures, cooling and temperature control.

Minac-powered brazing systems

Our lower-power brazing systems are powered by a 'Minac', one of our compact, mobile, solid-state converters. Minacs feature:

- Output power of 10-220 kW (6-140 kW continuous),
- Continuous automatic matching
- Supports a virtually unlimited range of coil designs
- Suitable for numerous induction heating tasks

Many Minacs are available in 'Twin' versions, meaning a single converter has two fully independent power outputs. Minac power outputs are available as stationary units or as 'power pistols', handheld transformers connected to the Minac by long, flexible cables.

Minacs are versatile induction systems for heating of practically any electrically conductive material. They can be fitted with various coils and coil fixtures, single or twin output, flexible cables, closed or separate cooling systems, specially designed heating cables, etc. We equip the Minac to fit your heating need.

Sinac-powered brazing systems

Many EFD Induction brazing systems are powered by one of our 'Sinac' stationary universal generators. Like the Minac, the Sinac range offers a wide variety of configurations, including the 'Twin' power output option. Available in serial- and parallel-compensated versions, each Sinac features:

- A diode rectifier with a constant power factor of 85-87% from the input at the rectifier to the output at the coil
- A constant power factor of 0.95 at all power levels
- Automatic load matching

The low, medium and high-frequency Sinac systems are available with both parallel and serial-compensated converters.

Customized brazing machines

Our customized brazing machines integrate EFD Induction power sources with magazines, handling mechanisms and other features as needed. Our turnkey brazing solutions are pre-assembled and ready-to-work. They come complete with induction heater, coil, braze material, flux, fixtures, cooling and temperature control. The brazing machines can be automatic, semi-automatic or manual.

Automatic brazing equipment

A fully automatic brazing machine will typically include:

- Automatic loading and unloading
- Automatic flux and brazing process
- Automatic temperature control
- Automatic coil centering device
- Customized coil design
- Complete system diagnostics
- Touch screen, menu-based and multi-language control panels
- Advanced PLC control
- Closed loop cooling system

All our brazing machines are powered by EFD Induction heat generators.

The top left photo shows a complete system for controlled atmosphere brazing of refrigeration components. Top right: A manual loading/unloading system for brazing of contactors. The bottom photo: A fully automatic solution with double brazing heads and rotary working table for brazing of pole coils.

The world's best induction coil company?

Sub-standard coils can have a major negative impact on a heating system's efficiency. The danger is that many are tempted by quick 'Do-It-Yourself' coil designs and fixes. Sure, they look like they save time and money in the short-term. But the long-term truth is that homemade coils and coil repairs may increase costs and threaten quality.

Using EFD Induction coils will help you get the most out of your EFD Induction equipment. After all, they are made for each other. But even if you use non-EFD Induction power sources, we can still design and build new, more efficient coils for you. We can also re-condition existing coils. And we offer services that ensure you always have enough coils at hand and replace coils before they pose a threat to productivity.

Designing and testing coils is often the process with the longest lead time when devising an induction heating solution. Moreover, such testing requires the kind of specialist equipment and personnel that you'll find in our worldwide network of labs and coil workshops.

Specialist equipment and skilled personnel are needed when designing and making induction coils. At EFD Induction you'll find plenty of both at our plants and workshops across the world.

A crash course in coils

Designing efficient induction coils is demanding. Take for example a coil's cooling water, in theory it sounds easy: cooling water simply flows through the coil's hollow copper tubing, but miscalculating the throughflow rate could be costly. High-power-density coils are especially risky, as low throughflow will result in insufficient thermal transference. Competent designers also determine if a booster pump is needed to maintain the desired flow and they will specify a purity level for the cooling water in order to minimize coil corrosion.

Designing magnetic flux concentrators is also a challenge. As the name suggests, the concentrators' function is to concentrate current in the coil area facing the workpiece. Without concentrators much of the flux will propagate around the coil. This flux will then 'engulf' adjacent conductive components. But a concentrator restricts the flux to precisely defined areas of the workpiece.

Concentrators are made from laminates, or from pure ferrites and ferrite or iron-based powders. While each material has its advantages laminates have the highest flux densities and magnetic permeability, they are also less expensive than iron and ferrite-based powders. However, laminates are only produced in a relatively small range of shapes and sizes and are therefore less versatile.

Pure ferrites can provide outstanding magnetic permeability but they suffer from low saturation flux density and their brittleness makes them difficult to machine. Iron powders are easy to shape and offer high flux densities but care must be taken to avoid overheating. Internal losses or heat transfer mean such powders have a relatively low working temperature.

Designers must achieve correct impedance matching between the coil and power source. They also need to take account of the fact that coils need five to ten times as much reactive as active power. Then there is the choice of insulation, should a coil be dipped in an epoxy coating, or should it be moulded with high-temperature concrete? Answering these questions requires specialist equipment and expertise yet too many manufacturers see coils as low-tech copper tubes—leading to inefficient or even dangerous designs, or process and equipment failure.

Get more out of your equipment. With help from those who build it.

With EFD Induction you benefit from the world's most comprehensive range of after-sales support programs. Here's a partial list of what's available in addition to the services typically available under guarantees and warranties:

Operator training
Give us one of your operators and we'll give you back a skilled, value-adding employee—one who has the know-how to maximize output and extend equipment life.

Logistic programs
Never run short of critical parts and consumables. We can for example devise a system that circulates your coils in 'stock-use-repair cycle'.

Telemetric monitoring
Keeping a remote watch on your key process parameters can alert us of potential problems. We get to act pro-actively; you get even more uptime.

Scheduled preventive maintenance
Together with you we can devise a maintenance program best suited to your technical and commercial conditions.

Facetime means uptime. EFD Induction offers a task force of experienced technicians—seasoned experts who'll go almost anywhere at any time to keep your induction equipment hard at work.

Three cases from a world of brazing success

Congratulations. You've read all the way to the end of this brochure. So the least we can do is show you three success stories from our induction brazing files. We have plenty more in stock. But to learn about them, you'll first have to contact your nearest EFD Induction office. You'll find all the details at www.efd-induction.com.

Airborne AC

What have Augusta of Italy, Stork Fokker of the Netherlands and Eurocopter of France and Germany in common? NHIndustries, the joint venture that makes the revolutionary NH90 helicopter. And guess which heating technology they insist upon for the helicopter's air conditioning assembly?

There's never been anything like the NH90 helicopter project. The largest initiative of its kind ever undertaken in Europe, the initiative brought together four national governments to make one of the world's most advanced flying machines. The results have been dramatic. Since production was green-lighted in 2000, NHIndustries has received 357 firm orders and options for a further 86.

The NH90 is a prestigious project for any sub-contractor, even one as experienced as David Hart Aerospace Pipes (DHAP) of Salisbury in southern England. An approved supplier for customers such as BAE, Airbus and Raytheon, DHAP is responsible for the air-conditioning (AC) unit assembly for the NH90—a process for which they use an EFD Induction Minac.

'This is the first time we've used induction brazing,' comments DHAP Managing Director Simon Dootson. 'But we're extremely pleased with the results. More importantly, so is our customer. Induction delivers the controllability and process repeatability needed for this project.'

Founded in 1999, DHAP is known for its specialist welding, brazing, soldering and fabrication capabilities. Dootson continues: 'Obviously, with the kind of customers we have, safety is top of the agenda. We have stringent quality control, and our induction brazing has passed successfully.'

Certified to ISO 9001:2000, DHAP boasts pressure testing to 18,000 psi, and level-two NDT penetrant flaw detection. For the Minac-brazed AC units, leak testing is performed in nitrogen gas at 45 bar.

'Induction has speeded up our brazing process while maintaining high quality standards,' concludes Dootson. 'It has enabled us to participate in the NH90 project, something that all of DHAP is immensely proud of.'

Record-breaking brazing

Stefano Chieregato of ABB (r.), together with Alessandro Mariani of EFD Induction Italy.

Power generation and distribution giant ABB has installed one of the largest single-shot short-circuit ring brazing system yet delivered by EFD Induction. The system, which was installed at the ABB plant in Vittuone outside Milan, Italy, can braze rings with a diameter in excess of 1,500 mm.

According to Stefano Chieregato of ABB, he and his colleagues examined proposals from six companies before opting for the EFD Induction solution. 'There were several reasons behind our choice of EFD Induction. First, their proposal made technical and economic sense. Second, the company has deep expertise in the field. Thirdly, ABB in Italy has had positive experiences with EFD Induction solutions for other applications.'

For Alessandro Mariani of EFD Induction Italy, the system represents a milestone, 'It's always a thrill when we innovate and of course, to be selected by such a renowned company as ABB is always a great endorsement.'

The system comprises customized coils, an EFD Induction Sinac 250 kW power source and a mounting table. The system's first project was brazing a 1,500 mm diameter short-circuit ring for a wind tunnel motor. 'The end user,' says Mariani, 'is one of the world's most famous sports car manufacturers, which further testifies to our ability to meet the toughest quality demands.'

Royal approval for induction brazing

Thermo King is the leader in transport temperature control systems for trucks and trailers. The company employs an EFD Induction automatic brazing machine to braze vibration absorbers, components used in the suction lines of air-conditioning and refrigeration systems.

When asked why EFD Induction was selected for this particular project, Michael Corcoran, Project Manager at Thermo King Ireland, says: 'We examined several proposals. But the EFD Induction solution was the soundest, both technically and financially. Also, they are experts in induction brazing, especially in customized solutions. Finally, EFD Induction's pan-European presence means we have after-sales support on our doorstep.'

The machine devised for Thermo King features an innovative separable coil. 'This coil design was decisive in winning the Thermo King order,' says EFD Induction's Bjørn Røsvik. 'It is what allows the machine to ramp up from manual to fully automated and continuous production mode.'

The machine is powered by a Sinac 18/25 'Twin' generator. This means it features two independent power outputs, each of which has a split transformer function that makes it possible to use separable coils. The complete system is made up of the generator, a chiller and an automatic handling system.

The Thermo King machine features an innovative 'separable' coil design. It was essential for the whole automation process, making it possible to go from manual brazing to a fully automated, continuous production flow.

Equipment for every need

Our range of induction heating equipment is organized into product families. Together, they perform virtually any industrial heating task. And in the unlikely event they don't meet your specific needs, we can sit down with you and devise a customized induction heating solution.

We also build and install mechanical handling equipment, coils and software control systems. And supporting it all is our worldwide service program. To learn more about EFD Induction—and how we can help your business—just contact your nearest EFD Induction representative.

Sinac®

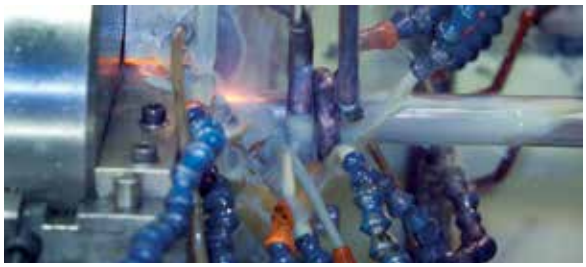
Universal heat generators

Minac®

Mobile heat generators

Weldac®

High-output solid-state welders



HardLine®

Industrial heat treatment systems

HeatLine®

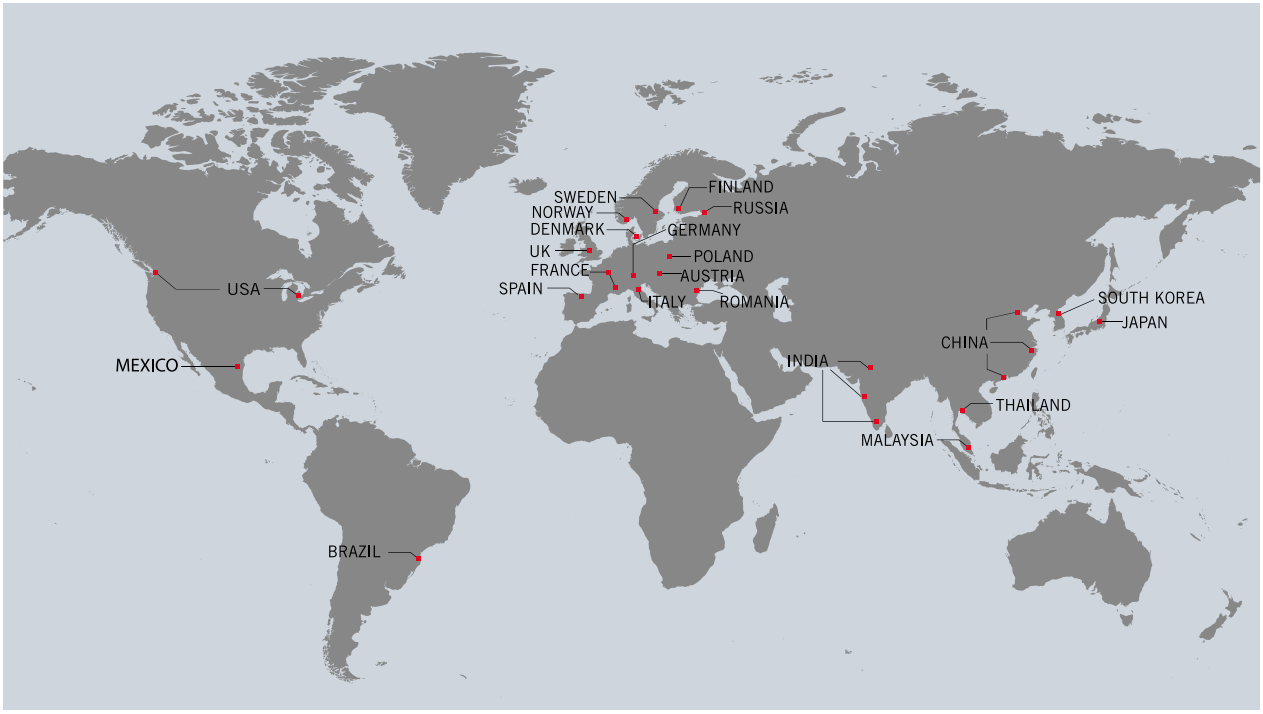
Industrial heat processing systems

Terac®

Deck and bulkhead straightening

EFD Induction

EFD Induction has to date installed thousands of heating solutions for a wide range of industrial applications —bringing the benefits of induction technology to many of the world's leading manufacturers and service companies. EFD Induction has manufacturing plants, workshops and service centers in the Americas, Europe and Asia.



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