



# Forging a Better Solution with Induction Heating

## Why Ambrell?

Ambrell has over 10,000 systems installed in over 50 countries, being used every day worldwide in forging as well as many other industries and applications.

We offer exceptional customer service before and after the sale. Your specific forging application will be analyzed and tested in the nearest Ambrell Applications Lab. There is no charge, and you will receive a system recommendation designed to deliver the best possible solution for your forging requirements. Ambrell delivers the expertise, innovation and system quality to give your company a competitive edge.

## What is forging?

Forging is a process where metal is formed into shape using pressure applied by an impact hammer or press. It is one of the oldest known metalworking processes. Metals can be forged cold, warm or hot. Cold forging is used for forming softer materials and smaller steel parts, but this process hardens the material making it brittle and difficult to process after forging.

Hot forging is when a part is heated above the material recrystallization temperature before forging, typically 1100°C (2012°F). Hot forging allows a part to be formed with less pressure, creating finished parts with reduced residual stress that are easier to machine or heat treat. Warm forging is forging a part below the recrystallization temperature, typically below 700°C (1292°F).

Some processes require a whole part to be forged, called billet heating, such as manufacturing automobile crankshafts. In other applications, only one end of a part needs to be forged, called bar end heating, such as manufacturing automobile steering components or hot heading fasteners.

## Why Induction Heating?

A superior alternative to furnace heating, induction heating provides faster, more efficient heat in forging applications. The process relies on electrical currents to produce heat within the part that remains confined to precisely targeted areas. High power density means extremely rapid heating, with exacting control over the heated area.

**Recent advances in solid-state technology have made induction heating a remarkably simple and cost-effective heating method.**

**Benefits of using Induction for forging are:**

- Rapid heating for improved productivity and higher volumes
- Precise, even heating of all or only a portion of the part
- A clean, non-contact method of heating
- Safe and reliable – instant on, instant off heating
- Cost-effective, reduces energy consumption compared to other heating methods
- Easy to integrate into production cells
- Reduced scaling



# Induction Heating for Forging

Technical considerations and typical applications when heating for forging.

Induction heating is commonly used for heating bar ends and metal billets prior to forging. There are several critical considerations when using induction heating for forging.

## Size of The Heated Part

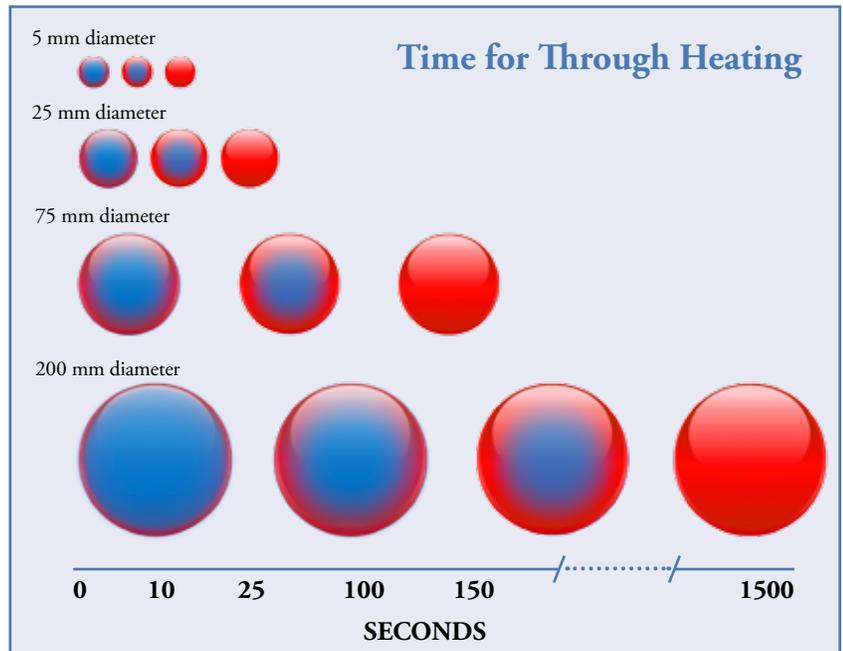
In addition to the amount of energy required to heat the part to the forging temperature, the size of the part will also dictate the required operating frequency of the induction system to optimize operating efficiency.

## Time for Through-Heating

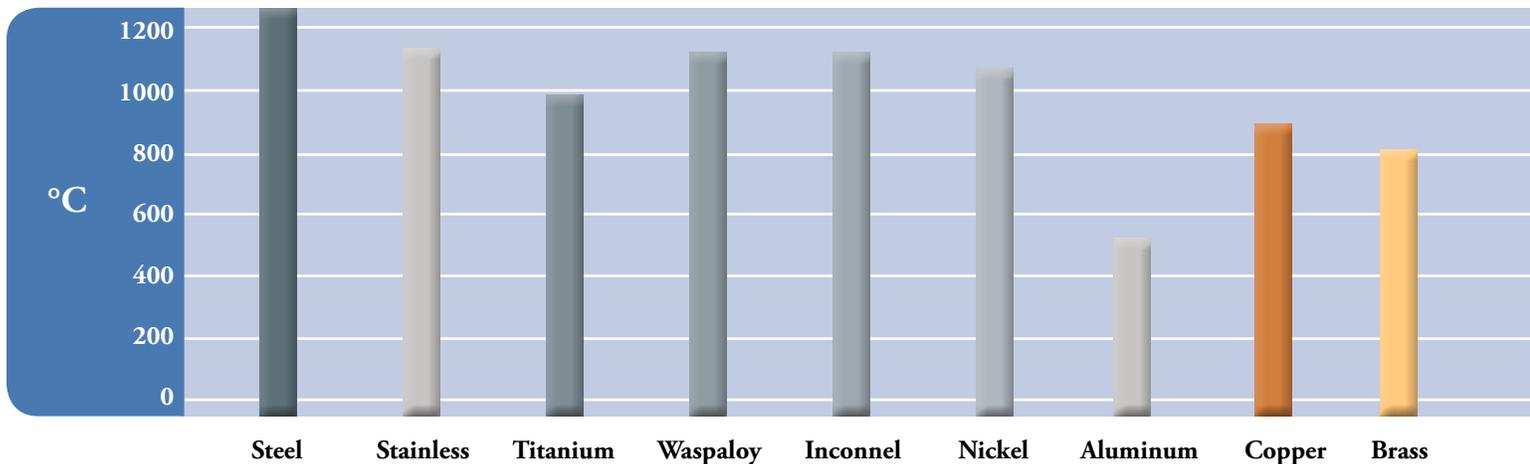
The induction process produces heat within the part, but the heat is generated near the outside surface and will take time to conduct to the center of the part. Typically, bar ends up to 20 mm in diameter through-heat in less than 10 seconds, whereas a 75 mm diameter bar will take 150 seconds to heat to the center.

## Radiation Loss

Energy loss due to radiation from the hot part becomes significant with forging temperatures in the 1000°C (1832°F) to 1200°C (2192°F) range and can be controlled by using thermal insulation during the manufacturing of the induction coil.

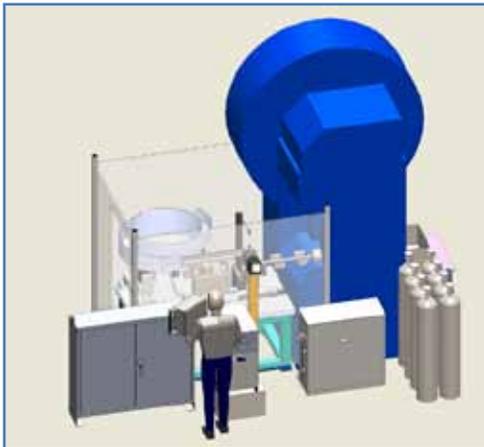


## Required Temperature for Hot Forging Different Materials



# Bar End Heating

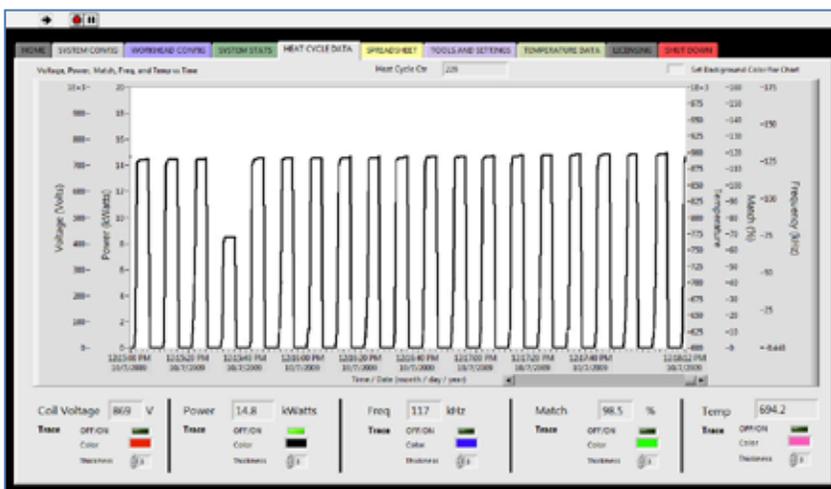
Ambrell manufactures an extensive line of induction heating products for bar end heating. Our systems provide operating frequencies up to 400 kHz for hot heading of small diameter fasteners and down to 750 Hz for larger cross-section beams or bars. We also offer heating process expertise for high-volume manufacturing of consistent, high quality parts.



*A work cell with an automated feed to a hot header for large bolts. Ambrell works with expert integrators to provide a turnkey solution to customers.*



*Heating a 75 mm diameter bar to 1100°C (2012°F) for hot heading. An eight-position coil was used to provide one hot bar end every 20 seconds to the robot for loading into the press.*



*A screen view of eVIEW software monitoring a fastener hot heading process showing one part heating to only 750°C instead of the correct process temperature of 900°C.*



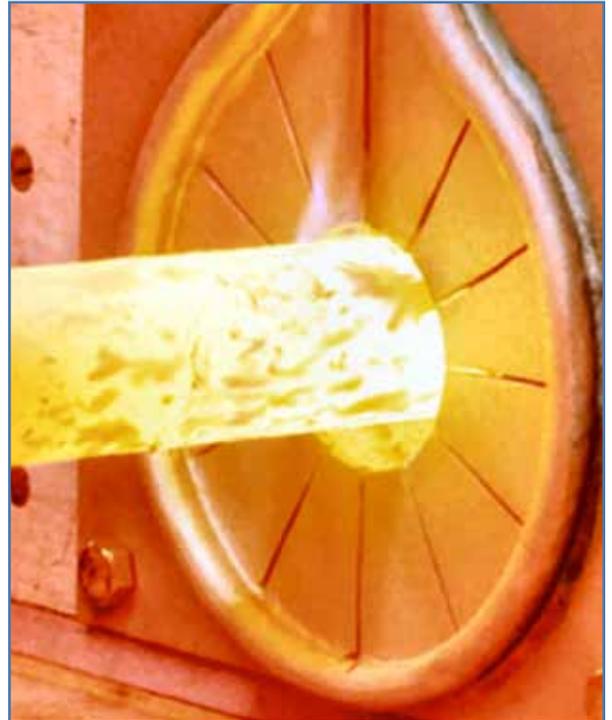
## Ambrell eVIEW Software

In some industries, such as aerospace fastener manufacturing, part quality, reliability and the repeatability of the manufacturing process is critical.

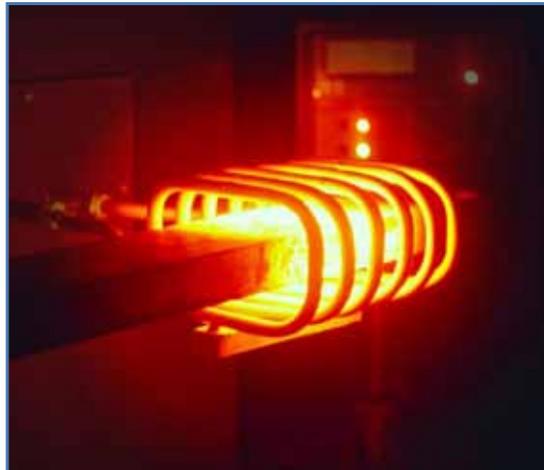
To help identify and record a part-by-part process, Ambrell's eVIEW software is utilized to capture the process data for each heated part. Our eVIEW software records the operating details of the induction system as well as the temperature and other critical process parameters.

# Billet Heating

Ambrell manufactures an extensive line of induction heating systems for billet heating operating at frequencies down to 750 Hz and up to 15 kHz. The modular design allows a versatile approach to each customer's application giving a much finer and accurate control over the billet temperature. Modular building blocks are available in power levels from 125 kW up to 500 kW.



*A billet heater for heating 48 mm diameter x 350 mm long steel billets producing a billet every 12 seconds. Ambrell works with expert integrators to provide a turnkey solution to customers.*



# Ambrell Induction Heating Systems at a Glance



## **EASYHEAT™** **4.2, 6, 9, and 10 kW**

Typically used in many small wire applications in the fastener industry.



## **EKOHEAT™** **30 and 45 and 50 kW**

Typically used at operating frequencies of 20 to 125 kHz for the fast heating of wire up to 25 mm in diameter for fastener hot heading.



## **EKOHEAT™** **125, 250 and 400 kW**

Typically used at operating frequencies from 750 Hz up to 15 kHz for bar end heating and small billet heating.



## **EKOHEAT™** **500 kW**

Typically used at operating frequencies from 2 kHz up to 15 kHz for bar end heating and billet heating.

With our EASYHEAT and EKOHEAT induction heating systems we offer a wide range of power and frequency. Whether you're forging large or small parts, Ambrell can help you maximize cost efficiencies and productivity.

Our modular EKOHEAT systems can be configured to operate at the correct frequency for your forging process and can be cascaded to allow for the correct soak-through time. They can be configured for stage heating in 50, 125, 250 or 500 kW steps, and in single shot heating up to 500 kW.

Ambrell's systems are versatile with multiple capacitor and tap transformer configurations. They offer efficient power conversion that will minimize your energy costs. Our systems are user-friendly, offer agile frequency tuning for repeatable heating, and can be easily integrated into your existing process.

## **Systems Include:**

- **Ease of integration into production processes with small workheads – easily located in the work area**
- **Wide frequency ranges allowing forging of different part sizes with the same power supply**
- **Multiple capacitor and tap transformer configurations for a more versatile heating tool**
- **Agile frequency tuning for accurate, repeatable heating**
- **Efficient power conversion minimizes energy expenses**
- **Expert coil designs that maximize power delivery and save production time**
- **User-friendly operator interface in five languages (EN, ES, FR, DE, IT)**

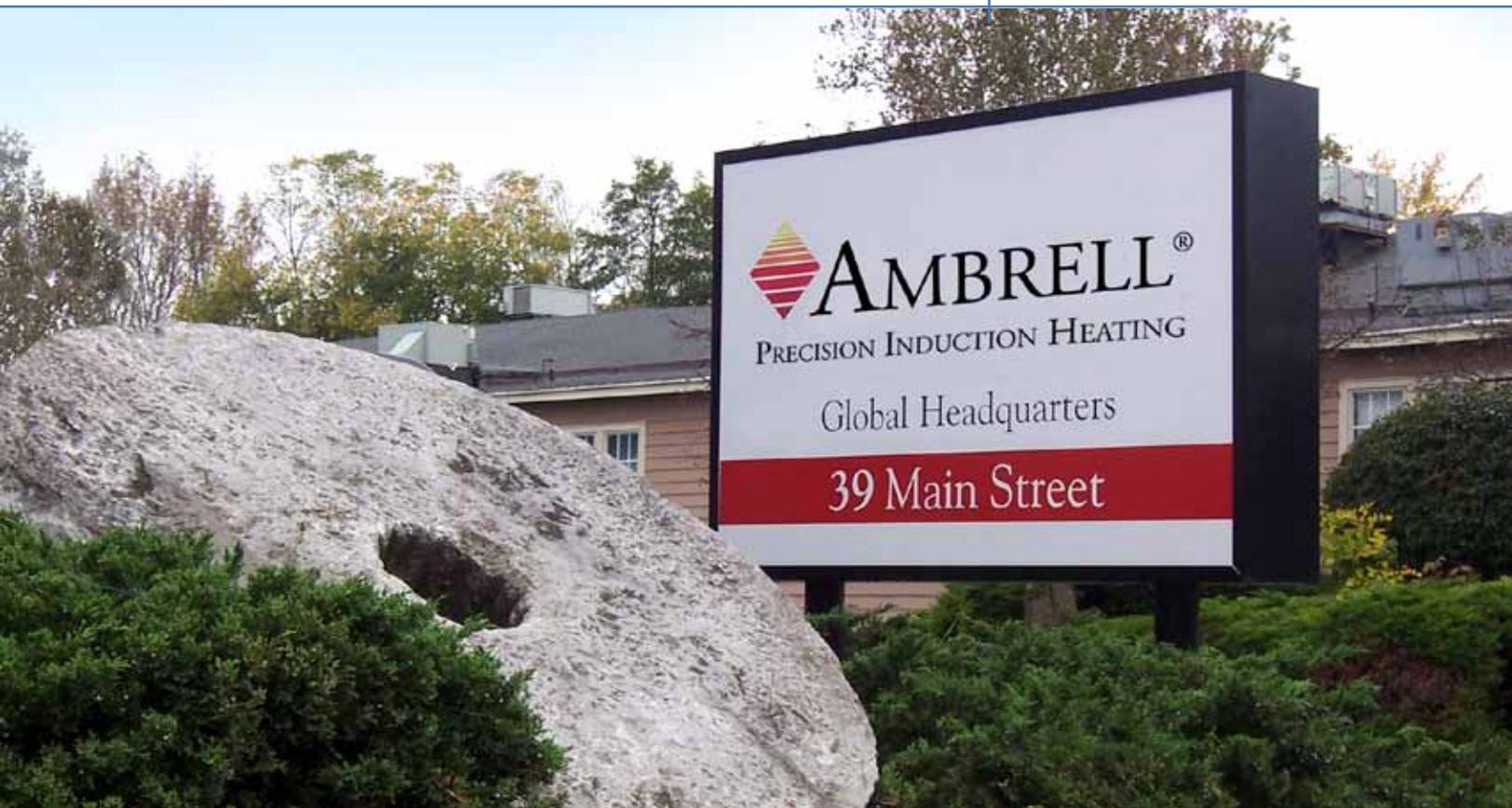
# A Partner Committed to Your Success

We understand that your ability to compete hinges on reducing costs and increasing performance of your manufacturing operations. That's why we are committed to delivering quality products, innovative solutions, and exceptional customer service designed to maximize your ROI.

## When you choose Ambrell as a partner you will get:

- A team of induction heating experts that work with you to understand your unique forging requirements.
- Application testing, in our labs, to determine optimal equipment for heating your parts to forging temperature.
- An expert organization optimized to configure and manufacture the most appropriate power supplies and coils for your forging line.
- A CE marked system designed, built and tested at our ISO 9001:2008 factory in the United States.
- Worldwide support through the Ambrell companies in the USA, Europe, and the United Kingdom, as well as by authorized Ambrell distributors.

**Ambrell stands by a firm commitment to provide an induction heating solution to your business along with service and support that goes well beyond the sale. The service department is always on-call for preventative maintenance and timely emergency support. We are there to maintain operational excellence and to be sure our solution continues to meet your needs – now and in the future. With Ambrell, you'll get timely support before, during, and after the sale.**





## About Ambrell

As a pioneer in solid-state induction heating technology, with over 25-years of innovation, Ambrell provides industry-leading heating solutions. Our equipment, installed in over 50 countries, is supported by our network of dedicated induction-heating experts. With a firm commitment to innovation and continuous improvement,

we are proud to deliver quality products and solutions for a variety of industries and markets. Ambrell is an Ameritherm company headquartered in the United States with worldwide operations including Ambrell Ltd. in the United Kingdom, Ambrell SARL in France and Ambrell B.V. in the Netherlands.



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