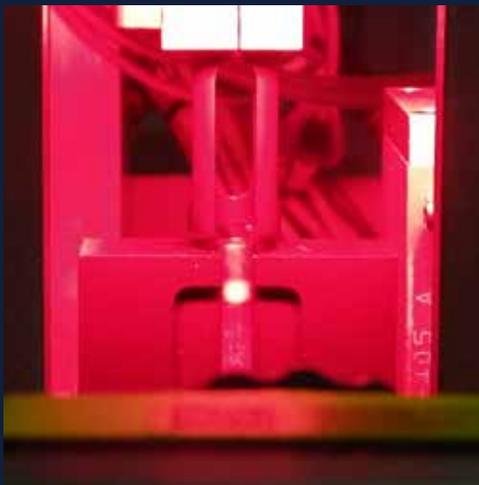


Annealing Small Caliber Ammunition Casings



Experience the Excellence.™

What is Induction Heating?

Induction heating is the process of heating an electrically conductive object (usually a metal) by electromagnetic induction, where eddy currents are generated within the metal and resistance leads to Joule heating of the metal.

An induction heater consists of a coil, through which a high-frequency alternating current (AC) is passed. Heat may also be generated by magnetic hysteresis losses in materials that have significant relative permeability. The frequency of AC used depends on the object size, material type, coupling (between the work coil and the object to be heated) and the penetration depth.

Most people aren't aware of induction heating when thinking about the manufacture of cartridges.

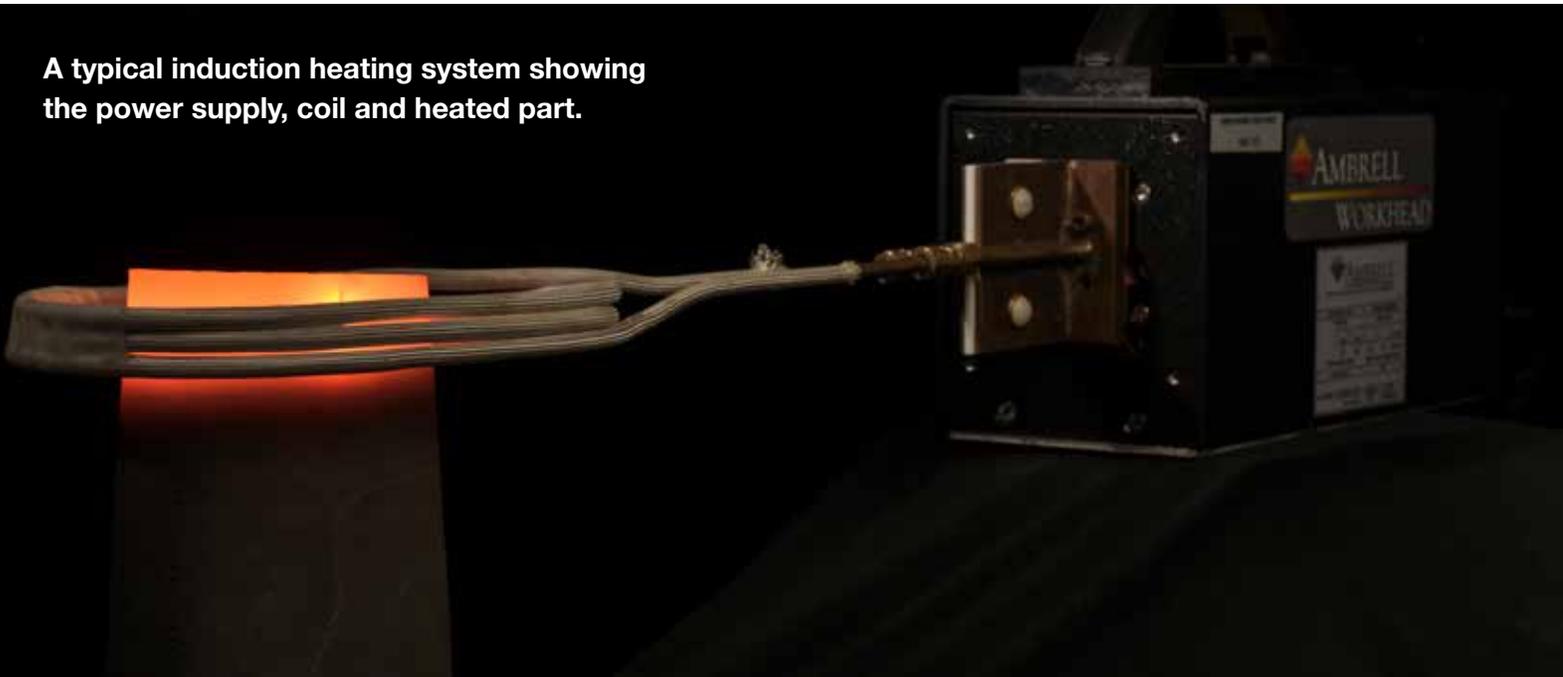
Induction heating is a power supply and a specially designed coil that provides fast, consistent heat for a cartridge case. Induction consumes less energy than oven heating and flame methods, yet produces precisely controlled temperatures. It is so precise that the amount of heat can be varied along the length of the shell.

The consistency and uniformity of the cartridge casing's hardness profile surpasses that available with traditional annealing procedures.

This allows us to set up different coils to achieve different hardness profiles throughout the case. Body annealing is typically done to prepare brass to be formed. Mouth and neck annealing prepares the case for accepting the projectile and subsequent crimping operations required to secure it to a specific seat depth. Additionally, case head stress relief can be achieved through induction annealing.

Although the basic principles of induction are well-known and taught in many engineering institutions, modern advances in solid state technology have made induction heating a remarkably simple, cost-effective heating method for applications which involve joining, heat treating, drying, curing and materials testing.

A typical induction heating system showing the power supply, coil and heated part.



Induction Annealing Gives You Less Waste and More Control.



Induction annealing systems allow ammunition manufacturers to eliminate excessive part handling and inventory, thus producing less scrap and achieving a higher yield for less cost.

The ammunition industry has been annealing cartridge casings the same way since the start of WWII by utilizing large inefficient open gas flame or conveyor-oven style processing.

These methods are highly inefficient, require large amounts of floor space, lack consistency, create excess inventory carry costs, and don't permit in-process inspections.

Today, technology has changed everything—from simple hand weapons to advanced rifle sights—and has had an impact on shell annealing as well. There is an easier method for the production of ammunition—called induction heating. The method does not use pans, torches, revolving wheels or conveyor type ovens. Each and every case is annealed to exacting specifications, reducing variation and damage typically found in mass annealing processes.



But, this is just the beginning of the benefits.

Our induction annealing systems are able to control case sidewall gradient hardness values more accurately than ever thought possible before.

For more than two decades, Ambrell produced induction heating systems for all kinds of applications, including cartridge case annealing. With this experience, many users have realized the significant advantages of incorporating induction heating into their process. Most important, consistency means less scrap and more profit.

**How hot can it get?
800°F in 800
milliseconds.**

**A 7.62 mm cartridge case
can be body annealed in
0.8 seconds and a Cal .50
case in 1.2 seconds.**

Case Study: U.S. Ammunition Manufacturer

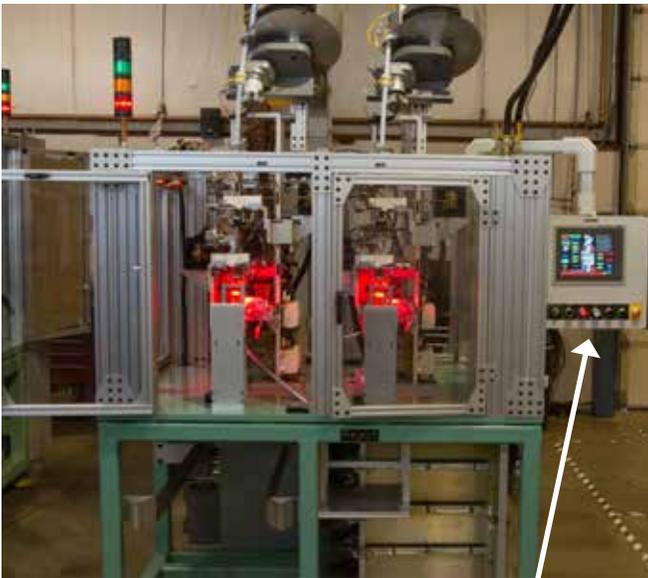
JR Automation

JR Automation (formerly Setpoint) an automation integrator located in Ogden, Utah, and Ambrell assisted in modernizing a small caliber ammunition manufacturing plant through a variety of technological innovations.

The goal was to replace 60-70 year old technologies with modern equipment that would provide the U.S. military reliable, efficient resources to continue producing ammunition for our troops.

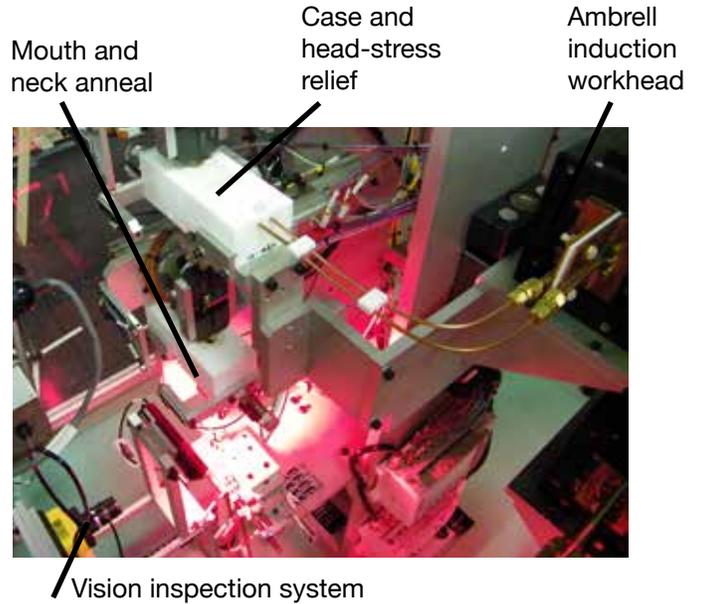
The facility has the capability to produce millions of small-caliber ammunition rounds annually.

Front view of the Mouth and Neck Anneal Machine with optional head-stress relief. Runs at 100 parts per minute.

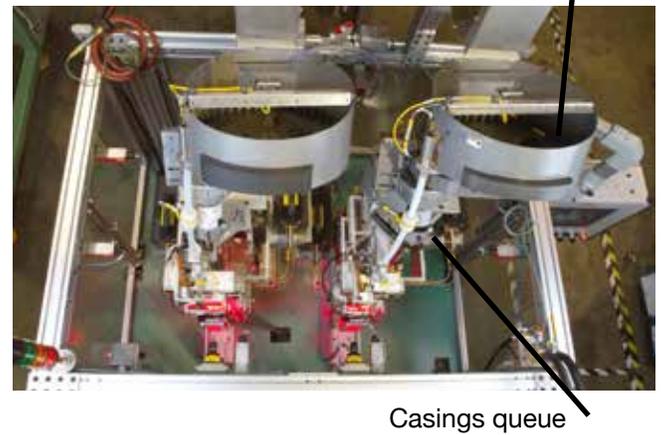


HMI control panel

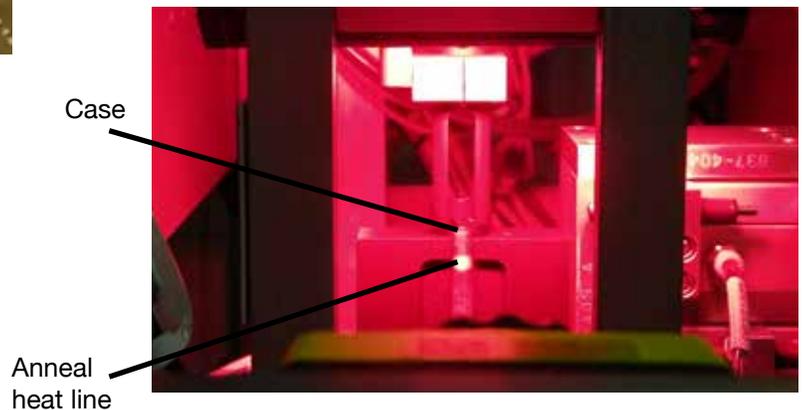
Close-up of Anneal Machine



Top View



Heat Line Vision Inspection System

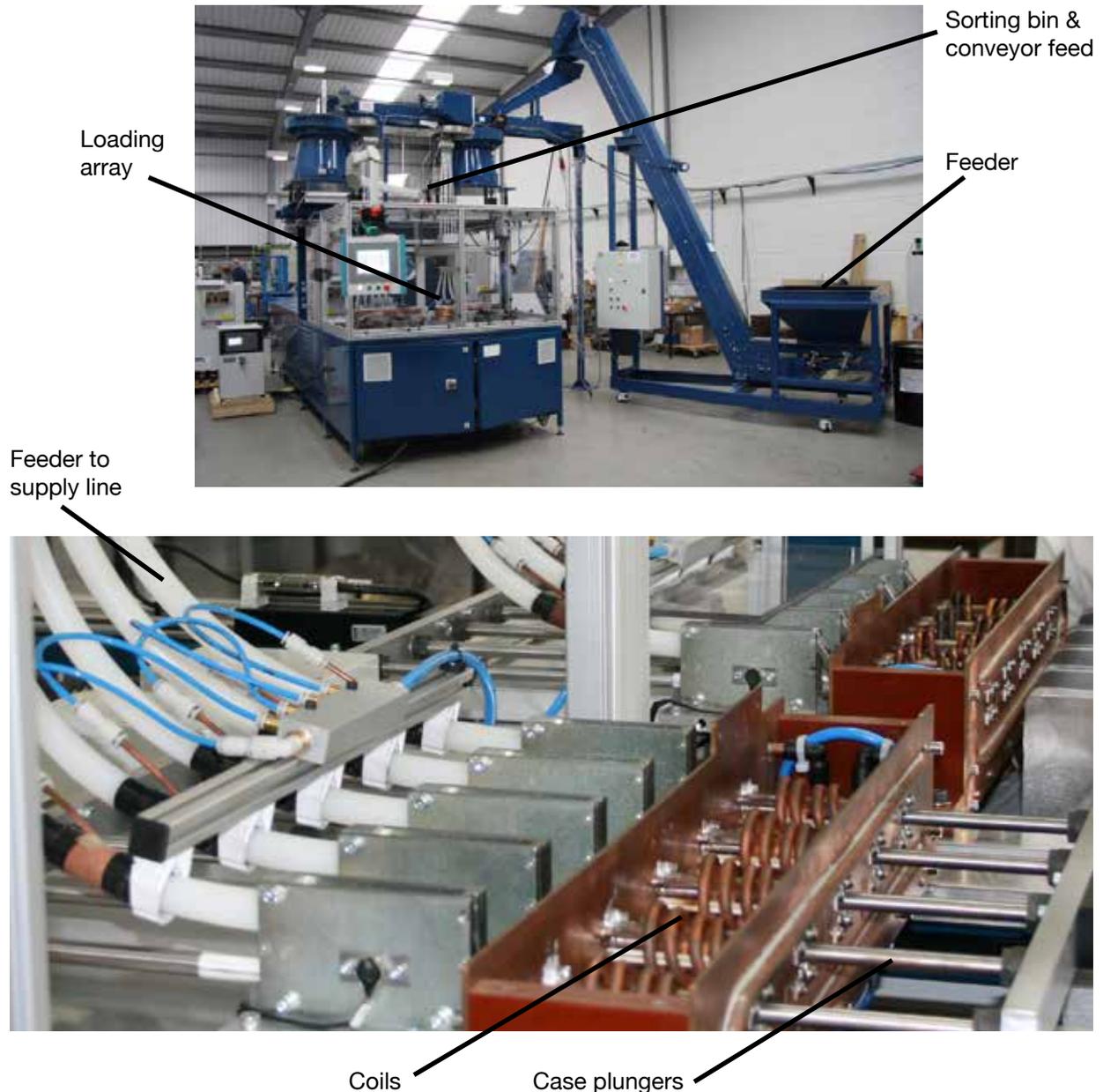


Case Study: U.K. Ammunition Manufacturer

Mecelec Design

Ambrell Ltd. and Mecelec Design, an automation integrator in Gloucester, England, produced a solution to speed the annealing of 5.56 and 7.62 caliber casings for a large UK ammunition manufacturer. Together they created an automated annealing system capable of processing 10 shells every 4 seconds. The picture below shows the system during the pre-production test run.

"The feedback from the project has been positive. We are thrilled with what Ambrell Ltd. has been able to do for us. Many thanks!"
~ Tom Mecelec, Mecelec Designs



Every Annealing Application is Customized

Ambrell products are custom-designed to fit each of our customers' unique applications. Our systems are continually replacing outdated heating methods worldwide for their speed, consistency and precision.

The systems on the previous pages might not represent the challenges you have, but they offer a view into what is possible, even on a large or small scale.

Every company has their own set-up for running cartridges; changing your existing system might seem like a big project. Ambrell can help work with you to be sure the solution is scaled to your specific needs.

One thing is certain: adding this induction heating equipment can eliminate batch processing, inventory carrying costs and part handling damage while increasing your overall throughput and lowering your energy bill.

But don't take our word for it. Here is what others have said about us:

"For our ...application we replaced a gas-fired oven with an Ambrell induction heating system. We see significant advantages to this approach. The cost-to-own and operate our induction heating system is significantly less than the oven, especially during these times of rising fuel prices."

Randy Oliver
Robert Bosch Corporation

"We replaced our old units ...Not only are we running our product lines at faster rates, we are also achieving more consistent quality."

Tom Wheeler
President, Muskegon Tool

"Ambrell's induction heater was perfect for our ...application. The induction heater was straight-forward and easy to use. I had the induction heater up and running and ready to begin my testing in no time."

Nicholas Linley, BSEE
Electrical Engineer, Wendell Hull & Associates, Inc.

Ambrell Induction Heating Systems at a Glance

With our EASYHEAT and EKOHEAT we offer a wide power and frequency range with our induction heating systems that can help you maximize cost efficiencies and productivity.

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. With their small footprint, they free up valuable floor space in your facility.

Systems Include:

- Ease of integration into production processes with a small workhead – easily located in the work area
- Wide frequency ranges allowing brazing of different assemblies with the same power supply
- Multiple capacitor and tap transformer configurations for a more versatile brazing 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)

EASYHEAT 4.2, 6, 9, and 10 kW



Used in many annealing applications where parts are small or thin walled, or several parts are annealed at the same time.

EKOHEAT 15 kW



Used in many annealing applications where several parts are annealed at the same time.

Need to scale to your operation to match your needs for automation?

Ambrell can help.

We have partnered with JR Automation (formerly Setpoint), a trusted Automation Integrator that specializes in the adaption of our equipment. They have modified many of our systems for production lines and can do the same for you. Save the engineering effort and give us a call (+1.585.889.9000) to see what will work for you.

First, visit our website shells.ambrell.com for any details that you would like more information.

Second, pick up the phone: **+1.585.889.9000** or email us at sales@ambrell.com and describe your process, tell us what is most important to you, and we will provide you with our best advice.

We'll look forward to working with you on a precision heating solution!



About Ambrell

Founded in 1986, Ambrell Corporation, an inTEST Company, is a global leader in the induction heating market. We are renowned for our application knowledge and engineering expertise. In addition, our exceptional product quality and outstanding service and support are at the core of our commitment to provide a superior customer experience.

We are headquartered in the United States with additional operations in Europe including the United Kingdom and the Netherlands. All Ambrell products are designed, engineered and built at our manufacturing plant in the United States, which is an ISO 9001-certified facility. Over the last three decades we have expanded our global reach through an extensive distribution and OEM network, and today we have more than 15,000 systems installed in over 50 countries.



Ambrell[®]
INDUCTION HEATING SOLUTIONS
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