

WHITEPAPER

Packaging Applications with Precision Induction Heating



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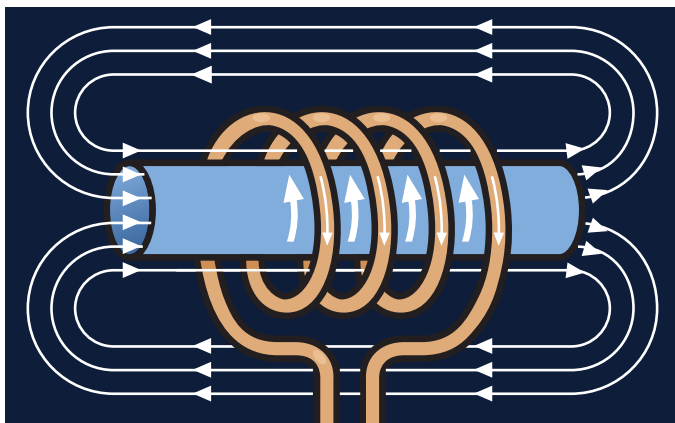


>> What is Induction Heating

Induction heating is a method of providing fast, consistent heat for manufacturing and research applications which involve bonding or changing the properties of metals or other electrically conductive materials. The process relies on electrical currents within the material to produce heat. Although the basic principles of induction are well known, modern advances in solid state technology have made induction heating a remarkably simple, cost-effective heating method for applications which involve joining, bonding, heating and materials testing.

The basic components of an induction heating system are an AC power supply, induction coil, and workpiece (the material to be heated or treated). The power supply sends alternating current through the coil, generating a magnetic field. When the workpiece is placed in the coil and enters the magnetic field, eddy currents are induced within the workpiece, generating precise amounts of clean, localized heat without any physical contact between the coil and the workpiece.

There is a relationship between the frequency of the alternating current and the depth to which it penetrates in the workpiece; low frequencies are effective for thicker materials requiring deep heat penetration, while higher frequencies are effective for smaller parts or shallow penetration. Power levels and heating times are closely related to the characteristics of the workpiece and the design of the induction coil. Coils are normally made of copper with appropriate water cooling and vary considerably in shape according to the application.



Induction heating is commonly used in the packaging industry.

Sealing and curing are particularly popular applications in industries such as food, pharmaceuticals and cosmetics. Induction heating lends itself to high production rates, thus speeding up packaging processes.

Induction can be used in packaging for an array of applications, including:

- **Sealing of caps to metal, glass or plastic containers**
- **Sealing to make tamper-proof packages**
- **Bonding aluminum foil to tubes**
- **Curing ink on materials**
- **Curing coatings**
- **Annealing prior to forming**

Not only is induction fast, but it's conducive to delivering aesthetically pleasing packaging. Induction is also contact-less and only targets the area that requires heat, making it highly repeatable. These benefits make induction ideal for many packaging applications. This brochure has just a sampling of induction applications in the packaging industry tested by THE LAB at Ambrell.



>> Metal to Plastic Bonding of Beer Kegs

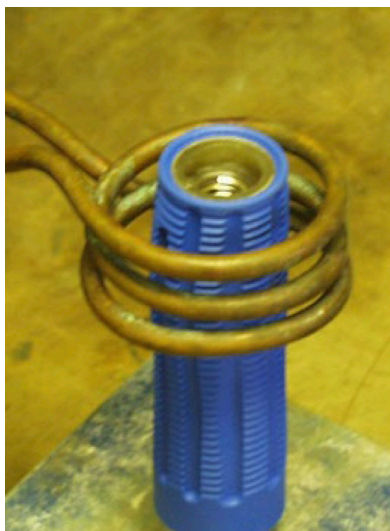
OBJECTIVE	Bond an aluminium mesh to a plastic beer keg.
EQUIPMENT	<p>Ambrell 2 kW, induction heating system, equipped with a remote workhead containing two .33μF capacitors (for a total of .66 μF).</p> <p>An induction heating coil designed and developed specifically for this application.</p>
FREQUENCY	207 kHz
MATERIAL	<ul style="list-style-type: none"> • Aluminium mesh • Plastic keg 320 mm (12.5") ID
TEMPERATURE	250 °C (482 °F)
PROCESS	<p>A single-turn solenoid coil is placed around the assembled beer keg and heated for 35 seconds as the keg is rotated.</p> <p>Pressure is applied with a press on the top rim whilst the keg is rotating, forming a seal between the aluminium mesh and the two halves of the beer keg.</p>
BENEFITS	<ul style="list-style-type: none"> • Quick, reliable, repeatable heat • Localized, precision heat to the mesh area





>> Bonding a Plastic Sleeve to a Stainless-steel Handle

OBJECTIVE	To heat the end of a stainless-steel handle with a plastic sleeve coated with heat adhesive for a bonding application in the food industry.
EQUIPMENT	Ambrell EASYHEAT™ 1.2 kW, 150-400 kHz solid state induction power supply with a workhead and coil specifically designed for this application.
MATERIAL	1" (25 mm) OD stainless steel handle, 0.30" (7.6 mm) thick, covered with a plastic sleeve that is coated with a heat adhesive between the tube and plastic cover.
TEMPERATURE	250 °F (121 °C)
FREQUENCY	170 kHz
PROCESS	A three-turn helical coil is used to heat the handle assembly. The assembly is placed in the coil and heat is applied for 10 seconds at the end of the handle to reach the required temperature of 250 °F (121 °C) to adhere the plastic sleeve to the handle.
BENEFITS	<ul style="list-style-type: none">• Speed: Induction met the client's time requirements and is often faster than other heating methods.• Repeatability: The client can expect the same result in the same amount of time every single time with induction heating.• Precision: Induction was able to heat the portion of the part that required heating at the required temperature.



Stainless steel tube
with a plastic sleeve.

>> Sealing Aluminum Foil Caps to Plastic Bottles

OBJECTIVE	To seal a 1.5" (38.1 mm) diameter cap with foil to a plastic bottle.
EQUIPMENT	Ambrell EASYHEAT™ 2 kW, 150-400 kHz solid state induction power supply with a workhead and coil specifically designed for this application.
MATERIAL	1.5" (38.1 mm) diameter cap with 1.5" (38.1 mm) diameter aluminum seal, plastic bottle.
TEMPERATURE	250-300 °F (121-149 °C)
FREQUENCY	309 kHz
PROCESS	A single turn helical coil of rectangular tube was designed to uniformly heat the entire perimeter of the aluminum foil. In production, the bottle passes under the induction coil. For testing, a silicon rubber was placed on the coil and then the aluminum seal was placed on the silicon rubber and heat was applied for .5 seconds. The bottle was placed on the aluminum seal and pressure was applied causing the aluminum to seal to the plastic bottle.
BENEFITS	<ul style="list-style-type: none"> • Speed: Induction met the client's time requirements and is generally faster than other heating methods. • Throughput: Induction's fast heating is conducive to production lines in the food industry thanks to its rapid heating and versatility. • Repeatability: The client can expect the same result in the same amount of time every single time with induction heating. • Coil Design: It can be designed to fit a wide array of production set ups.



Applying the plastic bottle to the heated cap.



The finished and sealed plastic bottles.





>> Sealing an Aluminum Disk Onto a Plastic Cap

OBJECTIVE	Heat an aluminum disk onto a plastic cap at a rate of 90 per minute for a cap sealing application in the bottling industry.
EQUIPMENT	<ul style="list-style-type: none">• Ambrell EKOHEAT® 30 kW, 50 to 150 kHz induction heating system equipped with a remote heat station containing six 1.0 μF capacitors.• A single position, one turn 12" helical coil designed and developed for this application.
FREQUENCY	80 kHz
MATERIAL	<ul style="list-style-type: none">• Plastic cap (top and bottom) with 1.85" (47 mm) outside diameter.• Aluminum disk with 0.8" (20 mm) outside diameter.
TEMPERATURE	300 °F (149 °C)
PROCESS	<p>The aluminum disk was placed into the top cap and the bottom cap was threaded onto the top. The cap was then placed 1/8" (3.2 mm) away from the coil. The EKOHEAT was turned on and the cap heated to the target temperature in three seconds.</p> <p>This process resulted in a strong bond between the plastic and the aluminum. With the 12" (305 mm) coil that can heat multiple caps at the same time and a heating time of three seconds, the targeted production rate of 90 caps per minute can be achieved and exceeded.</p>
BENEFITS	<ul style="list-style-type: none">• Precise heating: Induction heating enabled the aluminum to seal to the plastic cap quickly without the cap being damaged.• Speed: The customer desired a quick rate which would make in-sourcing the process worthwhile, and induction heating exceeded the targeted production rate thanks to its fast heating.• Clean and flameless heating: Given the plastic cap, clean, flameless heating was required to maintain its integrity.

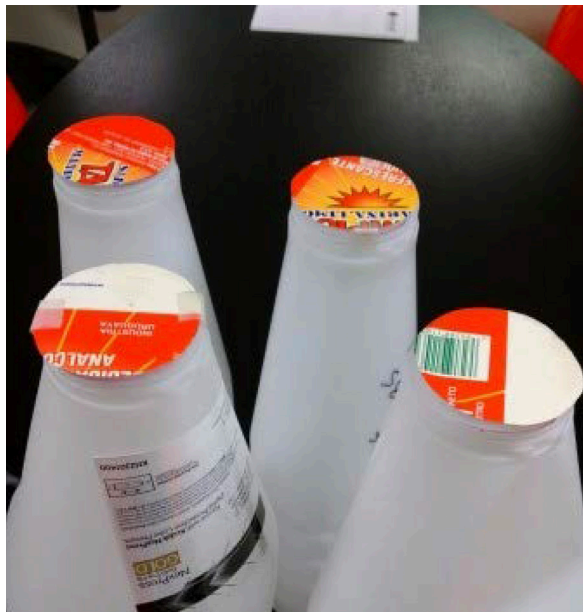
The 12" coil with six caps (top and bottom) and six aluminum disks (not seen in picture) prior to heating.



>> Sealing a Plastic Container

OBJECTIVE	Heat an aluminum seal for a plastic container for a cap sealing application.
EQUIPMENT	Ambrell EASYHEAT™ 1.2 kW, 150-400 kHz induction heating system with a workhead and coil specifically designed for this application.
FREQUENCY	250 kHz
MATERIAL	Plastic containers with aluminum seals.
TEMPERATURE	250 °F (121 °C)
PROCESS	A specially designed multiple-turn pancake coil was used for this heating application. Initial tests were conducted to optimize the power delivered to the part. After initial testing was completed, the part was placed into the coil and the power was turned on. The part reached temperature in just over one second.
BENEFITS	<ul style="list-style-type: none"> • Speed: The client was using a different method for sealing the bottle. It required more time and was more costly. • Footprint: An EASYHEAT and a workhead required a minimal footprint, saving the client floor space. • Efficiency: Induction is an energy efficient method for sealing that fits well into a production process.

The plastic containers after cap sealing with induction heating.





>> Sealing Aluminum Caps for the Beverage Industry

OBJECTIVE	To heat aluminum caps for a cap sealing application in the beverage industry; the application involves reusable caps on aluminum cans.
EQUIPMENT	Ambrell EKOHEAT® 45 kW 50-150 kHz induction heating system with a workhead and coil specifically designed for this application.
FREQUENCY	115 kHz
MATERIAL	Aluminum
TEMPERATURE	204 °C (400 °F)
PROCESS	A custom-designed single position hairpin coil was built to generate the required heating for this cap sealing application. Initial tests were conducted to optimize the power delivered to the part. Temperature indicating paint was then applied to the part, which dissolves when the part reaches the target temperature. It took 1.25 seconds to heat the 9 samples to temperature. This meets the client's required production rate.
BENEFITS	<ul style="list-style-type: none">• Speed: This is a new application for the client, and they turned to induction due to its speed for cap sealing applications.• Repeatability: Induction delivers the same result time after time, making it ideal for this high-volume manufacturing process.• Footprint: The space-efficient 45 kW EKOHEAT fits nicely into the client's floor plan.

The cap with temperature indicating paint activated after heating.



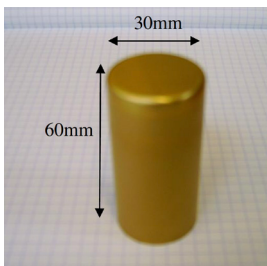
>> Curing the Inside Liner of Baby Food Bottle Tops

OBJECTIVE	Heat steel baby food bottle tops to 300 °F (148.9 °C) for curing the inside liner.
EQUIPMENT	<ul style="list-style-type: none"> • Ambrell 7.5 kW induction heating system equipped with a remote workhead containing two (2) capacitors equaling 0.125 µF • An induction heating coil designed and developed specifically for this application.
FREQUENCY	373 kHz
MATERIAL	Steel baby food bottle caps.
TEMPERATURE	300 °F(148.9 °C)
PROCESS	A three turn oval pancake coil is used to cure the inside liner of a baby food bottle cap. The bottle cap travels through the coil at 25" per second to cure 500 caps per minute.
BENEFITS	<ul style="list-style-type: none"> • Faster & more economical production times and cost • Low temperature avoids damage to components • Repeatable results

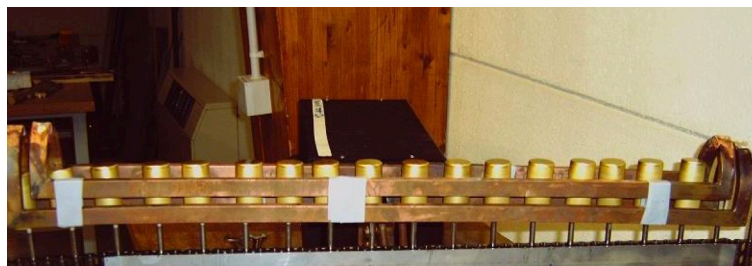


>> Curing Ink on Aluminum Bottle Caps

OBJECTIVE	Heat aluminum bottle caps to 428 °F (220 °C) for curing the ink.
EQUIPMENT	<ul style="list-style-type: none">• Ambrell 30 kW induction heating system, equipped with a remote workhead containing eight 0.33μF capacitors for a total of 2.64 μF• An induction heating coil designed and developed specifically for this application.
FREQUENCY	73 kHz
MATERIAL	Aluminum bottle cap 2.36" (60 mm) tall, 1.18" (30 mm) diameter and 0.01" (0.3 mm) thick.
TEMPERATURE	428 °F (220 °C)
PROCESS	A double channel coil is used for the ink drying application. Fifteen bottle caps are placed inside the coil and power is applied for 3 seconds to dry the ink.
BENEFITS	<ul style="list-style-type: none">• Increased production over hot air drying• Drastically reduced drying floor space and exhaust requirements• Hands free operation



Bottle Cap



Custom designed channel coil with 15 bottle caps placed inside.



>> Complimentary Applications Testing



Our Applications Laboratory – known in the industry as THE LAB – is where we solve our customers' most demanding and challenging heating applications. Led by Dr. Girish Dahake's worldwide team of elite engineers, Ambrell is uniquely qualified to assist you with your heating process needs.

With more than thirty years of laboratory expertise, our engineers have evaluated thousands of applications. Our team consistently provides innovative and effective induction heating solutions that deliver extraordinary results in one application after another. It's why THE LAB is the gold standard in the industry.

We invite you to visit THE LAB in either of our two locations: one in the U.S. and one in Europe. You will experience our state-of-the-art testing facility, which is fully equipped with Ambrell induction heating systems and hundreds of proven coil designs. In addition, you can interface with our engineers and see first-hand how we design prototype coils and develop effective solutions to maximize the efficiency of your heating process.

Applications Laboratory Overview

- Customer access to a wide array of induction heating equipment in THE LAB
- Hundreds of proven coil designs available
- Rapid coil prototyping for unique applications
- Video recording for slow motion studies includes availability of remote access
- Computer software for thermal analysis
- Quenching and closed loop heat-sensing capabilities
- Convenient, easy-to-use online form to get your free PRECISION MATCH Lab service

Free PRECISION MATCH Lab Service

Our engineers will design and test the optimal solution for your application. Follow these three easy steps:

- 1) Send us your parts and process requirements.
- 2) Our engineers will analyze your process and heat your parts to develop the precise and optimal solution to match your needs.
- 3) You will receive your parts back for inspection including a video recording of the induction heating process of your parts as well as a laboratory report with a system recommendation.

Contact us today for a free feasibility testing at:
www.ambrell.com/services/lab-service-request



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