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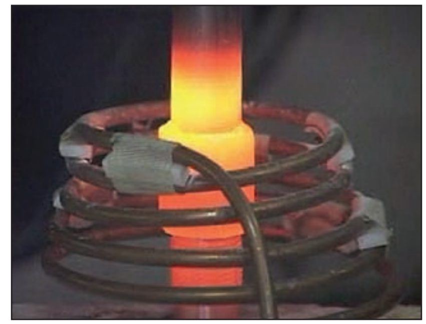
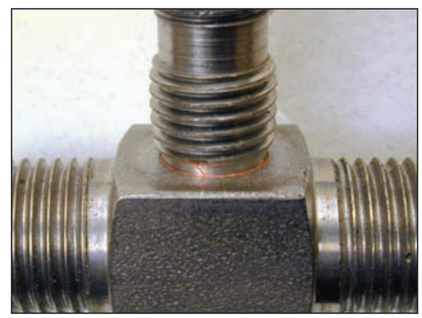
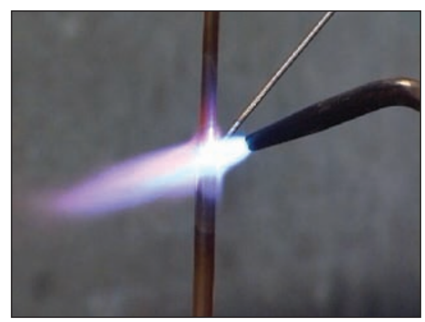
The Brazing Guide







Brazing is a method of joining two pieces of metal together with a third, molten filler metal. Of all the methods available for metal joining, brazing may be the most versatile. The process is relatively fast and economical, requires relatively low temperatures and is highly adaptable to automation and lean manufacturing initiatives.

Brazed joints have great tensile strength – they are often stronger than the two metals being bonded together. Brazed joints repel gas and liquid, withstand vibration and shock and are unaffected by normal changes in temperature. Because the metals to be joined are not themselves melted, they are not warped or otherwise distorted and retain their original metallurgical characteristics.

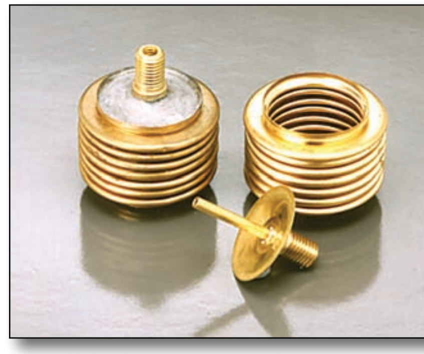
Use this guide to learn about the different aspects of brazing and the many advantages offered by this unique process.

Brazing Overview

WHAT IS BRAZING?

Brazing is a method of joining two pieces of metal together with a third, molten filler metal. The joint area is heated above the melting point of the filler metal but below the melting point of the metals being joined; the molten filler metal flows into the gap between the other two metal pieces by capillary action and forms a strong metallurgical bond as it cools.

Of all the methods available for metal joining, brazing may be the most versatile. Brazed joints have great tensile strength – they are often stronger than the two metals being bonded together. Brazed joints repel gas and liquid, withstand vibration and shock and are unaffected by normal changes in temperature. Because the metals being joined are not themselves melted, they are not warped or otherwise distorted and retain their original metallurgical characteristics.



Brazed joints have great strength.

Because brazed joints have a very clean, well-finished appearance, brazing often is the preferred bonding process for manufacturing plumbing fixtures, tools, heavy construction equipment and high-quality consumer products. The process is well-suited for joining dissimilar metals, which gives the assembly designer more material options. Complex assemblies can be manufactured in stages by using filler metals with progressively lower melting points. Brazing is relatively fast and economical, requires relatively low temperatures and is highly adaptable to automation and lean manufacturing initiatives.

WHEN BRAZING WORKS BEST

Among the many industrial options for joining metal, when does brazing work best? When considering which metal joining process to choose for a particular assembly, several factors should be considered: strength and permanence, the physical characteristics of the parts, the shape of the joint, and the production level desired.

As shown in Table 1, there are many techniques used to join metal: mechanical methods such as threading or bolting, adhesive bonding, soldering, welding and brazing. Each has its own advantages and limitations.

	Mechanical Bonding	Adhesive Bonding	Soldering	Welding	Brazing
Economy	BEST	BETTER	BETTER	GOOD	BETTER
Strength	GOOD	GOOD	BETTER	BEST	BEST
Energy Used	BEST	BETTER	BETTER	GOOD	BETTER
Control	GOOD	GOOD	BETTER	BEST	BEST
Flexibility	GOOD	GOOD	BETTER	BETTER	BEST

Table 1

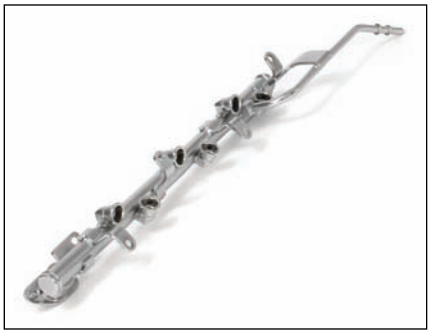
Brazing or welding are preferred when strength and permanence are primary considerations. Due to the fact that in brazing a filler metal is always used and generally the entire joint area is heated at the same time, brazing is a more robust process. This means that the joint clearances, fixturing, etc are much more forgiving in brazing than in welding. If strength is not a determining factor – or if the joint may be disassembled in the future – soldering, adhesive bonding or a simple mechanical fastening method are likely better choices.

Although brazing, soldering and welding are similar in many respects, there are important differences. Soldering generally can be done at lower temperatures (below 450°C), but does not produce as strong a joint. Welding, a higher-temperature process in which the two metals to be joined are actually melted and fused together, requires the most heat energy. Welded and brazed joints are usually at least as strong as the metals being joined. The welding process is ideal for applications which benefit from highly localized, pinpoint heating. But it is more difficult to apply to linear joining, not as easy to automate, and not easily adaptable for joining metals with different melting points.

It is also important to consider the physical characteristics of the parts and joint area. Because of its high temperature requirements, welding works best with relatively strong, thick parts

Brazed provides a clean, well-finished appearance.

that can withstand the heat. Brazing, which works at lower temperatures, may be the best choice for thinner parts because metal warpage and distortion can be minimized. Spot joints can be easily welded or brazed, but linear joints are easier to braze because the filler metal naturally flows into the joint area.



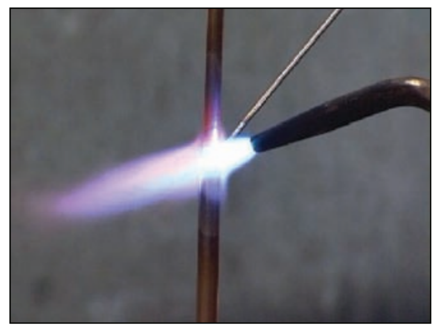
Multi-joint brazing

Both brazing and welding work well for joining metals with similar melting points, but it is generally easier to join dissimilar metals with brazing. Simply choose a filler metal with a lower melting point than either of the metals to be joined. While welding is difficult to automate partially or in stages, brazing is a more flexible process; pre-fluxing and pre-positioning stations can be set up to increase speed for high throughput requirements, or a conveyor can be used to transport groups of parts past the brazing station.

So for many metal joining procedures, brazing becomes the most logical solution. The advantages and flexibility that brazing offers are most fully realized when the heating process is carefully considered at the assembly design stage. Parts once visualized and manufactured as monolithic, one-piece units machined out of solid bar stock can be often be produced more quickly and economically by brazing together one or more metal components. Because a variety of metals can be utilized, brazing enables designers to optimize component functionality, weight and economy. Expensive machining, casting and forging processes can be eliminated without compromising the integrity of the part, and lower cost raw materials such as sheet metal, extrusions and stampings can be utilized. The manufacturing process becomes leaner, faster and ultimately more profitable.

HEAT SOURCES FOR BRAZING

The heat for brazing is typically provided by a hand-held torch, a furnace or an induction heating system. Other techniques include dip brazing and resistance brazing.



Torch brazing is often used for small assemblies.

Torch brazing is often used for small assemblies and low-volume applications. A “neutral” flame with a bluish to orange tip, a well-defined bluish white inner cone and no acetylene feather works the best; a flame with a colorless tip can cause oxidation. Although the quality of the joint is largely dependent on operator skill and consistency is sometimes an issue, torch brazing requires only a small investment and is very popular.

Furnace brazing does not required a skilled operator, and is often used to braze many assemblies at once. This method is only practical if the filler metal can be pre-positioned. Furnaces normally must be left on 24/7 to eliminate long start up and cool down delays, and are not particularly energy-efficient.

Dip brazing is used for small wires, sheets and other components that are small enough to be immersed. The parts are dipped in a molten flux bath which doubles as the heating agent. Resistance brazing is effective for joining relatively small, highly conductive metal parts. Heat is produced by the resistance of the parts to the current.

Induction heat has the advantages of speed, accuracy and consistency. In a well-designed induction system, each part is identically positioned in the induction coil and the filler material is carefully regulated. This type of system consistently and quickly delivers a precise amount of heat to a small area. The induction heating power supply’s internal timer can be used to control cycle time; temperature control feedback for each individual part can be provided with thermocouples, IR thermometers or visual temperature sensors. Induction furnaces are also available for high-volume brazing.

TYPES OF BRAZE JOINTS

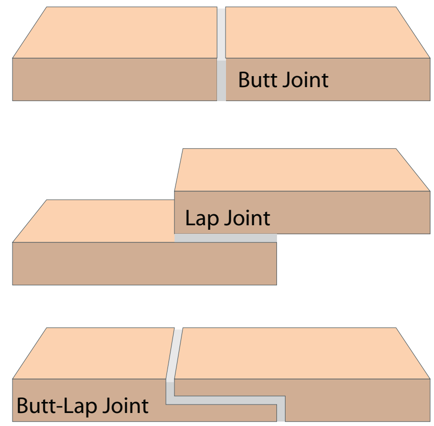
Although there are a wide variety of braze joints to suit varying part and assembly geometries and functions, most braze joints are variations of one of two basic types – the butt joint and the lap joint.

To form a butt joint, the two pieces of metal are positioned in an edge to edge, in an end-to-end arrangement as shown on Page 4. The strength of the bond depends to a large extent on the amount of bonding surface, but a properly formed butt joint will be strong enough to meet many application needs. The setup is relatively simple, and for some applications, it may be an advantage to have a consistent part thickness at the joint.

For applications which require a stronger bond, an alternative type of joint may be preferable. Lap joints have a larger bonding surface because the two metals overlap each other. Therefore a stronger bond is produced.

Lap joints do have a double thickness in the joint area, which may be a potential problem for applications where space is restricted. But for plumbing fixtures and similar applications, this is not a problem. The overlapping nature of the lap joint actually assists in positioning the parts for brazing; particularly with tubular parts, the joint becomes self-supporting because one part fits into the other.

The advantages of both basic joint types are combined in a butt-lap joint. Although this type of joint requires more work to assemble, it has both a single thickness and maximum strength, and is usually self-supporting.



Three types of braze joints

Basic Brazing Procedures

DETERMINE THE JOINT SPACING

In the brazing process, the filler metal is drawn into the joint by a pulling force known as capillary action during the heat cycle. So it is particularly important to maintain the right amount of space between the parts to allow this to happen. Usually, the strongest joints are made by allowing just enough space for the filler metal to flow into the joint area, typically in the range of .001" to .005" (0.25 mm to .127 mm). Wider spacing will generally result in a weaker joint.

It is also important to remember that metals expand and contract at different rates when heated and cooled. Particularly when joining dissimilar metals, expansion/contraction rates must be allowed for when the parts are positioned.

CHOOSE THE RIGHT BRAZING ALLOY

Silver, copper and aluminum alloys are commonly-used filler metals; silver is frequently chosen because it has a relatively low melting point. Copper braze has a higher melting point but is generally more economical. Depending on the application, the alloy may be in the form of a stick, paste or preform. A pre-formed brazing alloy is normally the best choice when even distribution and repeatability are paramount considerations.

ELIMINATE GREASE AND CONTAMINANTS

The braze material will not flow properly if grease, dirt or rust blocks its path. First remove any oil or grease with a degreasing solvent or other method. Then remove rust and scaling with a chemical bath, stainless steel wire brush or emory cloth. The joint area MUST be clean.

ADD FLUX OR USE PROTECTIVE ATMOSPHERE

When brazing is done in the open air, the joints are normally pre-coated with flux, a chemical compound which protects the part surfaces from air. A flux coating helps prevent oxidation when the metal heats up, protects the braze alloy and improves its flow. As heat is applied to the joint, the flux will dissolve and absorb the oxides that form. A variety of fluxes are available for use at different temperatures, with different metals and for a variety of environmental conditions. The point to remember is that the flux should melt and become completely liquid before the alloy melts. Most often flux is sold in paste form so it can be brushed on to the parts just before the actual heating cycle.


Brazing in a protective atmosphere

To eliminate flux, eliminate the presence of oxygen and braze your parts in a protective atmosphere such as nitrogen, hydrogen or dissociated ammonia. This type of brazing is usually completed in a controlled atmosphere glove box or a vacuum furnace. Without oxygen in the surrounding atmosphere, there is no potential for oxidation and the finished joint retains a clean, high quality appearance. The utilization of a protective atmosphere also eliminates any need for the post-braze acid cleaning bath.

Because of these advantages, protective atmosphere brazing has great appeal for manufacturers concerned with high throughput in a lean, continuous flow manufacturing environment.

POSITION PARTS CAREFULLY

Before applying heat to the parts, make sure they are properly-positioned and braced to remain in proper alignment. Particularly with lap joints, the laws of gravity help in this regard. Clamps, vises, additional weights and supports are sometimes needed. When choosing support materials, select those that are poor conductors of heat, such as stainless steel, inconel or ceramics. These will draw minimal heat away from the joint and preserve the efficiency of the heating process. Also look for support materials with compatible expansion rates so that the alignment is not disturbed.

TURN ON THE HEAT!

Most brazing processes run at temperatures between 800°F and 2,000°F. For a strongest braze joint, the metals that are being joined together need to be at close to the same temperature. Slow heat cycles generally produce better results than fast heat cycles. In many brazing operations, the filler metal is applied to the joint after the proper temperature is reached. Alternatively, brazing preforms can be positioned around the joint before the heat cycle begins. The melting filler metal will tend to flow toward areas of higher temperature, so it is good practice to apply heat to the side of the assembly opposite to where the filler metal is positioned. The heat then helps draw the molten metal down into the joint area.

CLEAN JOINTS (Not Required For Protected Atmosphere Brazing)

Parts which are brazed in an open-air atmosphere require a two-step cleaning operation. Flux residues are chemically corrosive and may weaken the joint if not completely removed. After the filler has solidified, a hot water quench immediately after the heat cycle is recommended. To remove residual oxidation, the parts can be dipped in hot sulfuric or hydrochloric acid. Care should be taken to avoid etching the joint with too strong an acid solution. Parts brazed in a protective atmosphere require no cleaning.

Induction Brazing

In addition to the general benefits induction heating brings to virtually any heating process, there are very specific reasons to use induction heating for industrial brazing. These include selective heating, better joint quality, reduced oxidation and acid cleaning, faster heating cycles and more consistent results.

• SELECTIVE HEATING

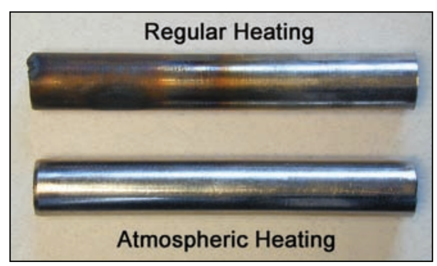
Induction heating can be targeted to provide heat to very small areas within tight production tolerances. Only those areas of the part within close proximity to the joint are heated; the rest of the part is not affected. Since there is no direct contact with the part, there is no opportunity for breakage. The life of the fixturing is substantially increased because problems due to repeated exposure to heat (such as distortion and metal fatigue) are eliminated. This advantage becomes particularly important with high-temperature brazing processes. With efficient coil design, careful fixturing and consistent part placement, it is possible to simultaneously provide heat in different areas of the same part.

• BETTER QUALITY JOINTS

Induction heating produces clean, leakproof joints by preventing the filler from flowing into areas that it shouldn't. This ability to create clean and controllable joints is one of the reasons that induction brazing is being used extensively for high-precision, high-reliability applications.

• REDUCED OXIDATION AND CLEANING

Flame heating in a normal atmosphere causes oxidation, scaling and carbon build up on the parts. To clean the parts, applications of joint-weakening flux and expensive acid cleaning baths have traditionally been required. Batch vacuum furnaces solve these problems, but have significant limitations of their own because of their large size, poor efficiency and lack of quality control. Brazing with induction reduces both oxidation and costly cleaning requirements, especially when a rapid cool-down cycle is used.



Regular heating vs. atmospheric heating

• FAST HEATING CYCLES

Because the induction heating cycle is very short in comparison to flame brazing, more parts can be processed in the same amount of time, and less heat is released to the surrounding environment.

• CONSISTENT RESULTS

Induction brazing is a very repeatable process because variables such as time, temperature, alloy, fixturing, and part positioning are very controllable. The internal power supply of the RF power supply can be used to control cycle time, and temperature control can be accomplished with pyrometers, visual temperature sensors or thermocouples.

For processes which involve medium to high production runs of the same parts, an automated part handling system is often utilized to further improve consistency and maximize productivity. The GH IA brazing system at right incorporates a four-position turntable with stations for automatic fluxing, induction heating and water cooling.

For the most part, induction brazing and soldering is done in an open-air environment. A controlled atmosphere can be utilized when it is necessary to keep the parts completely clean and free of oxidation.

Induction brazing generally works best with two pieces of similar metal. Dissimilar metals can also be joined by induction heating but they require special attention and techniques. This is due to differences in the materials' resistivity, relative magnetic permeability and coefficients of thermal expansion.

GH IA automated brazing system

Choosing A Brazing Atmosphere

The induction brazing process can be carried out in three different environments, each with its own advantages and disadvantages: open air; a controlled atmosphere of argon or other inert gas; or a high vacuum/high pressure environment.

OPEN AIR

An open air, oxygen atmosphere is frequently used for induction brazing. Open air has the advantages simplicity and economy. However, heating metals to high temperatures in a normal atmosphere causes chemical changes such as oxidation, scaling and carbon buildup on the parts. Applications of various types of flux are often used to reduce oxidation and improve the flow of the braze material, but at the same time they can reduce the strength of the joint. Acid cleaning baths are used to clean the parts as needed, but the extra cleaning step can be both expensive and time-consuming

But for some brazing processes, an open oxygen atmosphere may be the best choice; the oxidation, scaling and carbon buildup may not affect the part's performance or in some cases may even be beneficial. Or further machining and cleaning at a later stage of the manufacturing process make the whole issue irrelevant.

CONTROLLED ATMOSPHERE BRAZING

For lean manufacturing environments in which more control over joint quality is required and cycle times must be minimized, the next step beyond an open-air environment is to use a controlled atmosphere under normal or close-to-normal atmospheric pressure. In this environment, a high degree of control over the overall process can be achieved and open-air issues of oxidation, scaling and carbon buildup can be virtually eliminated.

A controlled atmosphere can be produced in a vacuum furnace, a sealed "glove box" or with an atmospheric bell jar. With a bell jar system, the parts are positioned before the bell jar is lowered into place and the controlled atmosphere is created. The glove box system is ideal for processes which require hands-on heating control. Learn more about brazing equipment.

A controlled atmosphere eliminates oxidation.

Inert atmospheres of nitrogen, argon, hydrogen and dissociated ammonia are common choices for controlled atmosphere brazing. Argon is more inert than nitrogen and therefore provides more control, but it is generally more expensive. The process temperature can also affect the performance of the gas chosen; nitrogen is often an economical choice but it is known to react with some steels above certain temperatures. Hydrogen - a strong deoxidizer with high thermal conductivity - is often used for copper brazing and annealing steel. Dissociated ammonia (75% hydrogen + 25% mononuclear nitrogen) is a relatively inexpensive atmosphere which can be successfully used for many types of brazing and annealing processes.

The selection of a gas for atmospheric brazing depends on a variety of process requirements including purity and heating temperature as well as cost considerations. The engineers at GH Induction Atmospheres have extensive experience in selecting the best atmosphere for a specific combination of material being brazed and filler metal, and have prepared a helpful Atmosphere Comparison Matrix. An additional Filler Metals Comparison Chart provides information about various filler metal characteristics.

Each atmospheric gas is generally available in different purity grades; the lower grades retain small amounts of water vapor or oxygen remain mixed with the pure gas. Using the highest grade is more expensive but a small amount of impurity may be just enough to contaminate a tightly-controlled process. The gases are available in cylinders, dewars bottles or in liquid bulk.

VACUUM BRAZING

Brazing in a high vacuum environment provides the most process control and produces the cleanest parts, free of any oxidation or scaling. It is the preferred brazing environment for brazing aerospace components, hardening medical devices and other applications that require the absolute highest part quality.

In a vacuum system, parts are heated in a fully enclosed, stainless steel chamber, which can be pumped down to 10^{-6} Torr. Special fixturing can be designed for automatic part loading and unloading, and quartz viewports can provide access for infrared temperature sensing of each individual part. This type of system is often used for brazing steel or nickel alloys with steel. An alternative method is to use a vacuum furnace, which is often the best choice for brazing parts of unusual shapes or "orphans" from other heating processes. The difference is that the induction furnace will heat the entire part rather than just a narrowly focused joint area.

Atmosphere Comparison Chart

What's the best filler metal for brazing stainless steel? What's the best atmosphere for brazing copper with silver? Our Selection Guide gives you the answers! Find your braze material and filler metal at left, read across to the suggested atmospheric environment at right,

Common Brazing Combinations		Suggested Brazing Atmospheres				
Material Being Brazed	Filler Metal	Vacuum	Hydrogen	Nitrogen	Argon	Air*
Steel	Copper	YES	No	YES	YES	No
Steel	Silver	No	YES	No	No	YES
Stainless Steel	Copper	YES	No	YES	YES	No
Stainless Steel	Silver	No	YES	No	No	YES
Stainless Steel	Gold	YES	YES	No	No	No
Stainless Steel	Nickel	YES	YES	No	No	No
Aluminum	Aluminum	YES	No	No	No	YES
Copper	Silver	No	No	No	No	YES
Copper	Silver w/Lithium	No	No	YES	YES	No
Nickel/Inconel/Cobalt	Silver	YES	No	No	No	No
Titanium	Silver w/Lithium	YES	No	No	No	No

Choosing An Alloy

Copper, nickel and silver are the most frequently-used base metals for brazing alloys; aluminum and gold are also used for specific purposes. The table below compares important characteristics and advantages of the most commonly used base metals.

Alloy	Brazing Temp.	Joint Clearance	Advantage
Copper	2000° F	interference to 0.002"	Joint Strength, Low Cost
Silver	1300° F	0.002-0.005"	Low Temperature
Silver with Lithium	1300° F	0.002-0.005"	Low Temperature, Self-Fluxing
Nickel	1900° F	0.002-0.008"	Joint Strength, Resistance to Corrosion
Aluminum	1080° F	0.002-0.01"	Only braze for aluminum
Gold	1800° F	0.002-0.008"	Resistance to oxidation and corrosion

For each base metal, many different alloy compositions are available. The additional metals combined with the base determine the alloy's compatibility for use in joining specific metals and individual process requirements. For example, vacuum brazing requires an alloy free of volatile elements such as cadmium. In addition to the composition of the alloy, other important characteristics to consider are melting range, required joint clearance and ease of flow.

The melting range for a brazing alloy is defined by the minimum temperature at which the alloy will start to melt ("solidus") and the temperature at which the alloy is 100% liquid ("liquidus"). For most purposes, the actual brazing temperature is 50°F to 200°F (30°C to 110°C) above the liquidus. The melting range is based on the alloy's chemical composition, but it is important to note that individual batch characteristics may very slightly. Some alloys (eutectics) have a very narrow melting range while other alloys have a comparatively wide range. Alloys with a narrow melting range are used for filling very narrow gaps while wider range alloys generally work better for filling larger gaps. Wide range alloys have a tendency to separate into their basic components if heated too slowly (liquidation). So it is almost always better heat rapidly through the melting range to reach brazing temperature.

High temperature brazing alloys such as gold, nickel and copper can be used for brazing many joints at once, but care must be taken with the joint design and joint clearance. Heating time should be minimized to the time needed to bring all components to the heating temperature and for the molten alloy to flow quickly. High temperature brazing is often used for joining cobalt or nickel-based superalloys.

Most brazing alloys are normally available in forms such as wire, foil, tape, powder and paste. For links to more information about individual brazing alloys and their characteristics, use GH IA's helpful Brazing Alloy Suppliers Guide.

Alloy Suppliers

DISCLAIMER: We are pleased to present this reference guide for your convenience. This list should not be interpreted as an endorsement of any specific company, nor will IA be responsible for the accuracy of any information presented on these sites. But it might save you some time!

Aluminum Brazing Alloys

Alco Tech Wire Company	www.alcotec.com/brazing.htm	Tel: 231-941-4111
Bellman-Melcor, Inc	www.bellmanmelcor.com	Tel: 708-532-5000
Lucas-Milhaupt, Inc.	www.lucasmilhaupt.com	Tel: 800-558-3856
Omni Technologies Corporation	www.omnibraze.com	Tel: 603-679-2211

Copper Brazing Alloys

Aufhauser Corporation	www.brazing.com	Tel: 800-645-9486
Bellman-Melcor, Inc	www.bellmanmelcor.com	Tel: 708-532-5000
J.W. Harris Co, Inc	www.jwharris.com	Tel: 513-754-2000
Lucas-Milhaupt, Inc.	www.lucasmilhaupt.com	Tel: 800-558-3856
SCM Metal Products	www.scmmetals.com	Tel: 919-544-8090
Stan Rubinstein Assoc., Inc	www.sra-solder.com	Tel: 800-545-4570
Tricon Industries, Inc	www.triconinc.com/brazing	Tel: 800-654-6850

Precious Metal Brazing Alloys (Gold, Platinum, Silver, Palladium)

Aufhauser Corporation	www.brazing.com	Tel: 800-645-9486
Bellman-Melcor, Inc	www.bellmanmelcor.com	Tel: 708-532-5000
J.W. Harris Co, Inc.	www.jwharris.com	Tel: 513-754-2000
Lucas-Milhaupt, Inc.	www.lucasmilhaupt.com	Tel: 800-558-3856
Stan Rubinstein Assoc., Inc	www.sra-solder.com	Tel: 800-545-4570
Turbo Braze Corporation	www.turbobraze.com	Tel: 800-526-4932
Wesgo Metals	www.wesgometals.com	Tel: 510-491-1100
Wolverine Joining Technologies, Inc	www.wlv.com	Tel: 401-739-9550

Nickel Brazing Alloys

North American Höganäs, Inc.	www.nah.com	Tel: 814-479-3500
Strong Welding Products	www.strongweldingproducts.com	Tel: 909-483-3222
Carpenter Powder Products	www.cartech.com	Tel: 412-257-5102
Lucas-Milhaupt, Inc.	www.lucasmilhaupt.com	Tel: 800-558-3856
Praxair Technology, Inc.	www.praxair.com	Tel: 800-825-3093
Sulzer Metco	www.sulzermetco.com	Tel: 248-288-1200
Vitta Corporation	www.vitta.com	Tel: 203-790-8155
Wall Colmonoy Corporation	www.wallcolmonoy.com	Tel: 248-585-6400

Brazing Preform Rings

Bellman-Melcor, Inc	www.bellmanmelcor.com	Tel: 708-532-5000
J.W. Harris Co, Inc.	www.jwharris.com	Tel: 513-754-2000
Lucas-Milhaupt, Inc.	www.lucasmilhaupt.com	Tel: 800-558-3856
Stan Rubinstein Assoc., Inc	www.sra-solder.com	Tel: 800-545-4570
Tricon Industries, Inc	www.triconinc.com/brazing	Tel: 800-654-6850

Brazing Equipment

OPEN AIR BRAZING

Semi-Automatic Indexing Turntable
- Eight part positions
- For small part induction brazing
- Full manual control for automatic override and process development
- Perfect for high speed automated processes

AB-1 Automated Brazing System
- Small 4'+x4' footprint fits your mfg. cell
- Indexing turntable for easy loading/unloading
- Multiple heat program capability
- Energy-efficient induction heating system
- Facilitates continuous flow manufacturing

AB-1

CONTROLLED ATMOSPHERE BRAZING

VF-30 Vacuum Furnace
- Small 6'x5' footprint fits your mfg. cell
- Heats to 1900°F in less than 15 minutes
- Cool down to 1200°F in 4.5 minutes
- 12" high, 12" ID heating zone (customizable)
- Ideal for unusually shaped parts and "orphans" from other processes
- Quickly heats entire part in stainless steel chamber

VF-30

Atmospheric Glove Boxes
- Integrated systems for auto and manual operation
- For use with nickel, titanium, superalloys, stainless steel and refractories
- Replacement for hydrogen belt furnaces
- Reduces a typical 25-minute, quartz lamp heating cycle to just three minutes
- Ergonomics increase operator comfort & safety

Bell Jar Heating Systems
- Vacuum chamber moves up & away to provide easy access to parts & fixturing
- Designed to handle 10^{-5} Torr pressure at moderate temperature
- Single chamber units ideal for lab use; automatic systems for high volume production
- Amazing flexibility in a cost-effective package
- Optional temperature control

Triple Quartz Chamber Brazing System
- Designed for moderate vacuum processes
- For brazing silver, copper and brass components with silver and copper alloys
- For use with standard atmospheric gases such as Nitrogen, Argon and Hydrogen
- Ideal for brazing HVAC, plumbing fixtures

HIGH VACUUM BRAZING

High Vacuum Brazing System
- Ideal for nickel brazing, aerospace applications
- For superalloys, titanium, refractories
- Individual part temperature measurement
- Auto/Manual Control with easy-to-use touchscreen
- Made for continuous operation

High Vacuum Brazing System

About GH Induction Atmospheres

GH Induction Atmospheres (GH IA) is a leading American provider of innovative industrial heating solutions for automotive, aerospace, medical and energy production applications. We are an experienced industrial heating system integrator working solely with induction-based technology. We design and manufacture customized, turnkey induction heating systems for industrial brazing, welding, heat treating, hardening and general purpose heating.

THE WORLDWIDE GH GROUP

GH Induction Atmospheres is part of the worldwide GH Group. GH Group is one of the largest most experienced induction heating companies in the world with headquarters based in Valencia, Spain, and affiliated Companies in Germany, France, Mexico, Brazil, Argentina, India and China. GH has over 4000 installations in more than 50 countries serving some of the most discriminating customers for induction heating and heat treating.

INNOVATIVE HEATING SOLUTIONS

The first step of our product development process is to determine how induction heating can be integrated into your manufacturing process. In our Application Lab, we'll evaluate your part samples and determine the best heating approach. Our in-house Metallurgical Laboratory reduces our process development and machine testing time for hardening and brazing applications. Capabilities include sectioning, metallurgical mounting, polishing, etching and metallographic examination.

The process of designing the mechanics to support the induction heating machine along with the fixturing to move the customer's parts in and out of the heating zone requires an experienced, innovative engineering team. Quite simply, our mechanical engineering staff knows how to move parts, and consistently designs innovative, cost-effective machines which meet and frequently exceed our customer's process requirements.

As machine development proceeds to the manufacturing stage, periodic customer design reviews ensure that there are no surprises. Internal reviews – our entire group of mechanical/electrical engineers regularly meet to review each other's work – ensure that the evolving system design will have the benefit of the entire team's experience and input.

So if you're searching for an experienced integrator to design and build a turnkey manufacturing machine from top quality components...if your lean manufacturing initiatives dictate the replacement of outdated, energy-inefficient production equipment...if your production requirements demand higher yields with reduced downtime...then call us today at 585.368.2120 to arrange a complimentary evaluation of your parts and process requirements!

GH INDUCTION ATMOSPHERES

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