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Resistance brazing processes create a new twist on an old idea

The brazing of small to medium components has traditionally been done by one of several methods. These include furnace brazing, torch brazing, induction brazing, and resistance brazing. Of these, resistance brazing is often the fastest, cleanest and most cost effective. Until recently, however, resistance brazing has found only limited use.

Resistance Grazing

The process is simple enough. Filler material in either paste or ribbon form is placed between two parts to be brazed. A standard resistance (spot) welder, along with a slightly modified welding control, is used as the power source to pass current either directly or indirectly through the parts. This current heats the components to allow melting of the filler material.

The problem, however, has been that parts heat at different rates, electrodes used to pass current behave in unpredictable ways, and minor component variations create vastly different joints. In using the resistance brazing process, the operator had a choice of using a fixed time and percent heat setting on the control, or manually holding a switch closed until the "right color" was observed at the joint.

Unitrol Electronics Inc., a manufacturer of conventional resistance welding controls, was presented with this problem over four years ago. The customer had been doing resistance brazing of silver sintered contact tips on electric switch assemblies for many years and was looking for a non-distruct method to detect the rejects. After several schemes were attempted without success, it was suggested that prevention of bad joints posed a better solution.

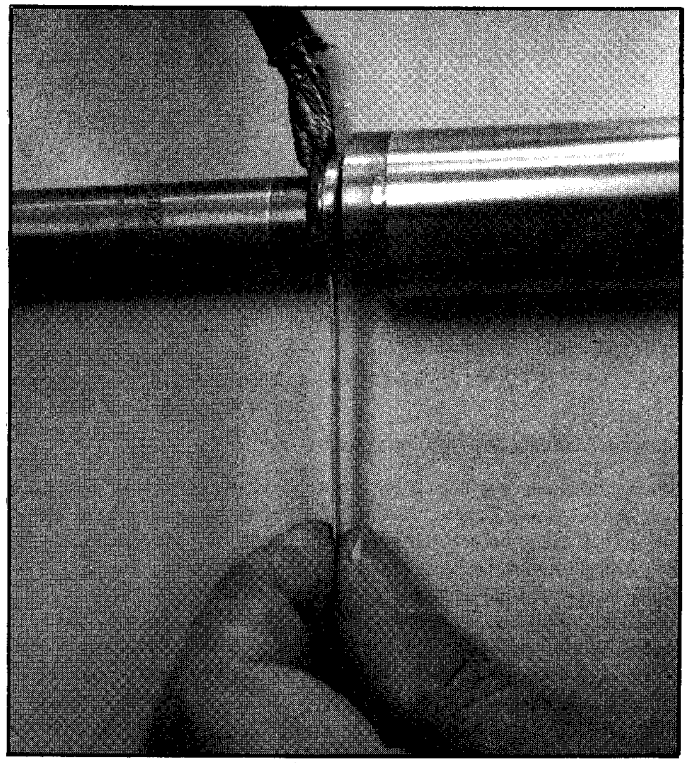

Figure 1
A copper stud, a braided cable and a filler ribbon are joined by the Instabraze Ribbon Process.

The result of this project is a pair of processes that Unitrol calls Instabraze. The two methods use traditional equipment, but substitute a new type of control system.

The Ribbon Break Process

While the initial applications were for small electrical components, later projects covered larger and more unusual joints. One fairly simple but effective use of this process was accomplished for Champion Parts Rebuilders Inc. of Oak Brook, Illinois.

Louis Mustari, manager of the R&D department, was given the task to find an alternate method for joining a braided copper power cable to a copper stud used as the high current input to automotive starters. The system in use at that time involved torch heating an entire 3/8-inch special stud. This heating both annealed the alloy copper stud and decreased the strength of the copper cable.

Figure 1 shows the Champion part being brazed. The copper stud, braided cable, and filler ribbon are sandwiched

between two special welding electrodes. Lenox Company's No. 15 High Conduct filler ribbon was chosen for the job. Because copper is being joined to copper, no flux is necessary with this braze material.

A small gauge electrical wire is connected to a point along the filler ribbon. This wire goes back to the control and connects to a detection circuit. A small outward pressure is applied on the filler ribbon as heat is applied through the electrodes.

When the outer edge of the filler ribbon melts, a signal is sent to the control to start a post heat sequence. **Figure 2** shows the electrical and temperature curves of this process. Note that, for very small parts, the post heat may be eliminated. However, on most assemblies, additional heat at a lower level is required to guarantee uniform temperature across the entire area being joined.

It is important to note that this Ribbon Break process uses the natural response of each individual part as a control. After three years of use, Mustari found this method had produced assemblies that retained their original hardness throughout the stud's threaded area, and produced tensile test values virtually identical to that of the unbrazed components. Because of these results, he now uses the Instabraze process on several new applications required for the rebuilding of automotive components.

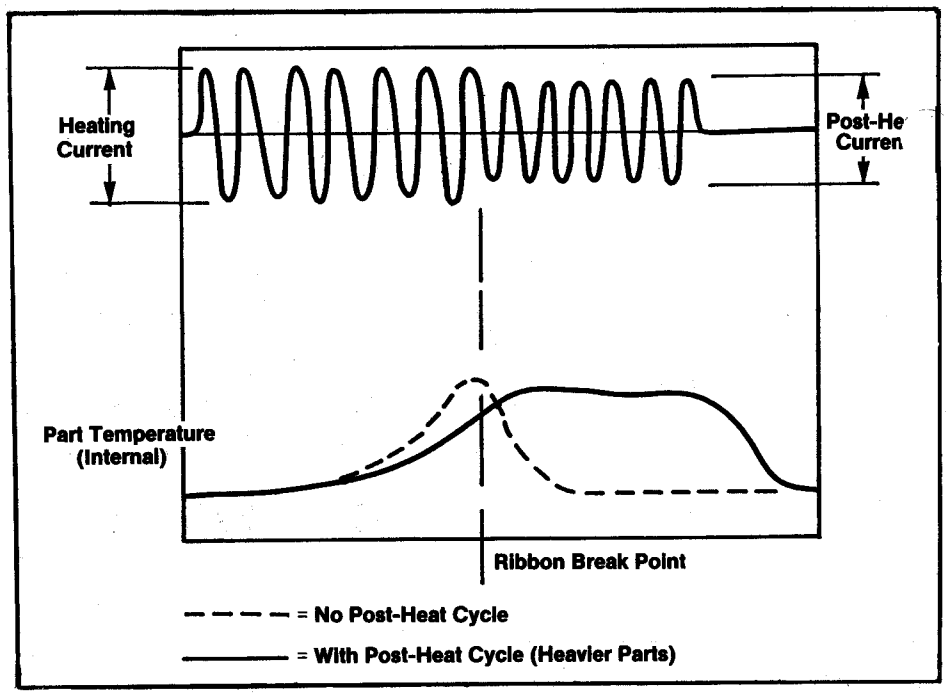

Figure 2
The Ribbon Break Process' electrical and temperature curves are traced.

Instabraze Temperature Feedback

A more complex application was employed by Whitley Products Inc., a producer of tubing components in Franklin, North Carolina. The company has a contract to produce over 1,400,000 air injection tube assemblies for General Motors' 350 engine.

This No. 304 stainless tube weldment, shown in **Figure 3**, required two types of joining. Three heavy stainless brackets were to be joined along the preformed tube, and a second 5/8-inch diameter stainless tube was to be silver soldered at one end to a "T" drilled hole.

Paul Scheuer, process engineer at Whitley, emphasized that the dimensional accuracy on all three planes was so critical that each part had to be inspected against a tight tolerance fixture. Because of the random distortion inherent in the traditional method of furnace brazing, elaborate correction fixtures were originally planned. Unitrol was given the challenge to engineer a line that would not distort the air injection assembly, produce joints similar to torch or furnace brazing, and deliver a minimum of 3,000 finished units per working day.

The process used for this job was Instabraze Temperature Feedback. As in the Ribbon Break process, parts are clamped between two special electrodes mounted in a normal resistance welder. The lense of a non-contact temperature monitor system is then installed and focused on a point just outside of the braze zone.

Ray Barnett of Whitley explained that a temperature is first set on the Unitrol control. In the case of the bracket to tube joint, a dab of Fusion Company No. STN-1240-650 brazing paste is then put on the bracket just prior to installation in the fixture.

As shown in **Figure 4**, heat is applied by the control and continues until the pre-selected temperature is reached. The control then goes into a sequence that accurately holds this temperature for a fixed time period. Lastly, the part is allowed to cool prior to the opening of the fixture.

A rather unique application of this system joined two tubes used in the assembly. Ray Ousley, tooling supervisor at Whitley, noted that parts had to be degreased prior to brazing if quality and consistent joints were to be realized. For this joint, a .031-inch diameter silver solder preform ring was used with an application of Harris Stay-Silver flux.

Because the Instabraze process worked on a very localized zone, clean up consisted only of water washing and minor hand wire brushing. The resultant "T" joint has to hold 65 psi. air pressure and pass a 95-100 foot pound strength test.

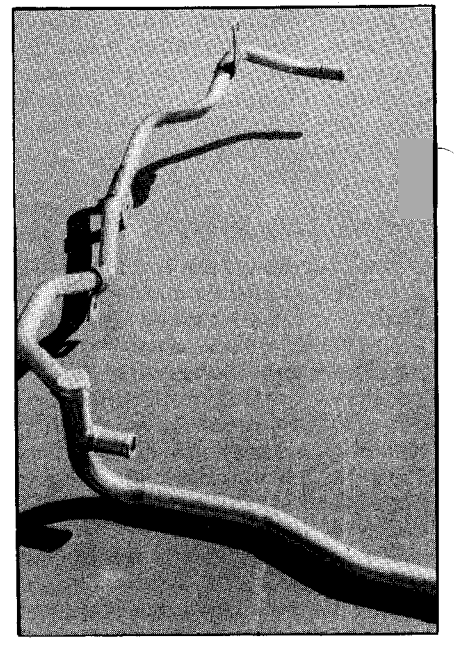

Figure 3
The stainless tube weldment required the Instabraze Temperature Feedback Process.

Ousley stated that they were averaging only five or six nonconforming assemblies per day of 3,000 part production. If electrodes require cleaning, the control will display the word "bad" and stop operation. A quick pass of a cleaning pad usually puts the machine back into operation.

Asked about the maintenance this high volume line, Ousley sta that the only task was to change the electrodes once every three or four weeks. The old electrodes can be refaced and used again.

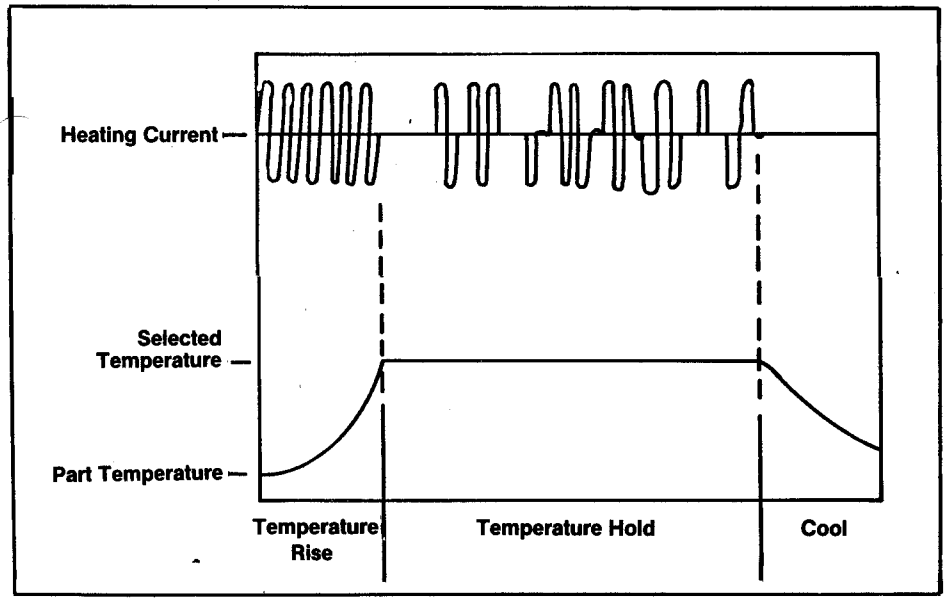

Figure 4
The control applies heat to maintain a pre-selected temperature.

A refrigerated water system, also provided by Unitrol Electronics, is used to do extensive cooling of all electrodes and machine parts. This critical step keeps the copper electrodes below a temperature that would alter their temper and cause a change in geometry.

He also noted that the temperature detection system, using a remote lense mounted on a fiber optic cable, required cleaning with a damp cloth once a day. Other than that, no special adjustments were normally required.

Roger Hirsch, president of Unitrol, commented that the challenge of this process lies in the almost endless variety of projects presented for evaluation. While many components, because of extreme mass or geometry, are not candidates for Instabraze, the company's finding more possibilities each day. It has looked at everything from refrigeration tanks to miniature hermetically sealed switches. Unitrol recently succeeded in doing soft soldering inside an industrial cartridge fuse for Little Fuse, Inc. of Des Plaines, Illinois. "In fact," Hirsch continued, "I am starting to think that the process, taken to its extreme, is only limited by the imagination of the welding engineer."

The information presented in this article was prepared by Roger Hirsch, President, Unitrol Electronics Inc., Northbrook, Illinois.