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CASE STUDY

Little things can mean a lot in robotic welding

How a truck body manufacturer got ***big results*** *from small improvements*

By George A. Weimer IV, Contributing Editor

Sometimes, the smallest things in a welding shop make the most difference in terms of productivity and, therefore, profitability. That's certainly the case with robotic welding.

Robotic welding is usually done in a cellular fashion or in conjunction with a fully automatic assembly line. As such, it offers more consistent quality than manual welding, but this quality depends on removal of almost all the usual welding variables from the process. No robot made to date can step off line to repair a tip, rewire, or otherwise troubleshoot, so the process must be nearly flawless for hours at a time.

One of these welding variables is the contact tip, a small cylindrical tube that transfers current to the weld wire as the wire passes through the center bore and contacts the bore surface. The contact tip is also used to guide the weld wire into the joint. It's important for the contact tips to be made in such a way and with very specific copper metallurgy so that the life and performance parameters are known and in close tolerance and consistency.

One option for robotic welding is the long-life contact tip. According to Brian Hackbarth, senior robotic welding technician at Tower Automotive in Milwaukee, Wisconsin, long-life tips have made a big difference on Tower's robotic welders in its truck and automotive frame production systems.

The Real Impact of a "Few" Delays

At the automotive company, 800 robots are used for arc welding of truck frames. In 1997, Hackbarth led a study to find out what could be done to reduce robotic delays on the truck frame line. He found that the main reasons for the delays were robotic arc starts and welding interruptions, and the company was averaging five occurrences per eight-hour shift.

Hackbarth felt comfortable with those numbers until he tallied up the actual costs of those "few" delays. Based on the downtime costs for one 26-robot line, the company was losing about $3,000 per day, or $690,000 per year.

As a result, the company rebuilt all of its wire feeders. It rechecked weld-wire positioning, inspected all of its welding fixtures, and generally examined all aspects of its robotic welding systems. Unfortunately, these measures made only a slight improvement in the delays.

Bore Size

A Best Practices committee then suggested trying a new, smaller inside diameter (ID) contact tip that another plant had been using.

The new contact tip had a 0.050-inch-ID bore versus the 0.054-inch-ID bore of that standard contact tip. The new bore also had a smoother finish. Evaluation tests in robotic workcells showed a 75 percent reduction in occurrences.

Further research found that many of the continuing occurrences were results of wear on the wire and bore. At this time, the company decided to consider the class 2 alloys that were used to produce long-life tips.

Material

The class 2 copper alloy that the company considered was copper chrome zirconium (99.1 percent copper, 0.65 percent chrome, and 0.08 percent zirconium). **Figure 1** presents some of the characteristics of copper chrome zirconium.

One of the suppliers of these tips for Tower is the Howard Hinz Company, Milwaukee. President David Hinz explained, "The material has been used for tips before. We made tips from copper chrome zirconium in 1990, but it has seen extensive use only recently." The main reason for

Copper Chrome Zirconium Characteristics

Material Type	Hardness	Electrical Conductivity	Thermal Conductivity	Softening Temp Centigrade	Tensile Strength	Yield Strength
Copper Chrome Zirconium Tip CU99.1 CR.65 ZR.08	80-92 RHB 155-185 HB	76-86 IN IACS	310-335	500°	34-86 ksi	14-77 ksi
122 Standard Copper Tip Phosphorus Deoxidized CU99.9 P .02	35 RHB 71 HB	85 IN IACS	360	205°	32-55 ksi	10-50 ksi

Figure 1

SOURCE: COPPER DEVELOPMENT ASSOCIATION

the increased interest today is the rapid spread of robotic welding.

Hinz says his customers have reported using three to four standard copper tips to one copper, chrome, and zirconium tip.

He also states that some of his customers have reported that this alloy provides up to 400 percent longer welding tip life if it is used in a robotic application. He noted, however, that engineers may program robots for 200 percent or 50 percent in terms of their own tool life management policies.

He adds that even though copper chrome zirconium tips can be used on manual torches as well as robots, there is less chance to see a benefit using the tips on a hand-held gun. Also, the copper chrome zirconium tips are best suited for higher-volume welding jobs to get the best return on investment (ROI) for the cost of the copper chrome zirconium tips.

Precise deburring is a critical process for copper chrome zirconium tips. Here, Dave Hinz inspects a tip after it has been deburred.

The Results

After numerous experiments with various welding techniques and tips, Tower decided to use copper chrome zirconium in a 0.050-inch bore size with round bore geometry and a final deburring treatment. Of the 800 robots doing arc welding for truck frames, about 30 percent are now using these contact tips.

"There is so much 'black art' involved in the running of high-volume robotic arc welding systems," noted Jeffrey Noruk, the company's manager of welding and robotics, "that it's hard to really pin down the reasons for this material's performance." He says other factors, such as hole size, smoothness, and the configuration of the torches, all contribute or detract from robotic welding downtime.

To many manufacturers, little things can mean a lot in robotic welding, whether it is one-hundredth of an inch in bore size, or one-hundredth of a percent zirconium. ●

George Weimer is a Contributing Editor for ***Practical Welding Today****. Howard Hinz Co. supplies copper chrome zirconium tips and customized tips and nozzles for the welding industry. Tower Automotive is a supplier for the automotive industry.*

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