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Better shielding gas flow, efficient welding

Automotive supplier reduces gas consumption, optimizes welding

By Tim Heston, Senior Editor

Earlier this year a weld department manager attended a conference and set up a booth showing several weld joints that looked as if they were completed by a true artisan, one who knew how to manipulate the gas tungsten arc welding torch.

Thing is, those joints weren't TIG welded. A robot gas metal arc welded (GMAW) them with a regulator that controlled gas flow in a unique way. Without an initial burst, the gas flow instead rose immediately to a consistent cubic foot per hour (CFH), creating a smooth column that continuously enveloped the weld pool. This, combined with different contact tips and a welding wire with higher silicon content, produced welds that wetted smoothly and efficiently to the base metal.

The booth showcasing these welds was at ICON (Improvement Conference for North America), an event organized by Reynoldsburg, Ohio-based TS Tech USA Corp., the North American operation of TS Tech, a global auto supplier with headquarters in Japan. This year at ICON, that beauty of a weld won first prize.

Figure 1 A new weld regulator technology—shown here in green, connected to a welding power source on a boom—changes the nature of gas flow around a weld, according to sources. This, they said, can improve weld quality and save gas. (Note: This shows the regulator in use at a contract fabricator. The robotic and manual welding operations at TS Tech are not pictured.) *Photo courtesy of Syner-G Welding Regulators.*

Jamie Tuma, weld department manager, spoke of the accomplishment in that matter-of-fact, just-doing-my-job manner so common in manufacturing. He approached the project with almost a militaristic methodology, and for good reason. "These welds make up the infrastructure of a car seat, and people's lives are at stake."

Tuma oversees 52 robotic weld cells that join metal 0.003 to 0.094 inch thick in various joint configurations. Manual welders and robots use pulsed GMAW that helps control the heat that goes into the weld joint, allowing them to wire-weld such thin material. The Ohio plant, which started mass production in 1995, was TS Tech's first in the U.S. Today the facility employs more than a thousand people.

Culture of Continuous Improvement

Like many in the automotive business, T.S. Tech has instituted continuous improvement programs that strive to increase efficiency. Tuma's continuous improvement team analyzed wire and gun consumables. They saw significant improvements after switching to a wire with higher silicon content, which allows the arc to stabilize quicker and start solidifying, making the welding process more efficient. Improvement also came from different contact tips and diffusers that could absorb more heat.

But Tuma's team also examined another, perhaps slightly less recognized area for improvement: shielding gas flow.

In a roundabout way, Tuma can thank high welding gas prices in Australia for an innovation that helped win that first prize at ICON. High welding gas prices in Australia created demand in that country for any product that could help welders optimize gas utilization. Engineers Down Under recognized the opportunity and developed a new

kind of welding gas regulator that, according to sources, saves gas and improves weld quality. Its proprietary technology makes gas flow consistent from arc-on to arc-off, which allows welders to set a lower CFH. The product also is touted to reduce the time between gas and arc ignition at the beginning of a weld, and between arc-out and gas-off, resulting in less wasted gas.

"If you have too much gas or too little gas, you can weaken your weld quality and strength," said Fred Hughes, sales manager for Columbus, Ohio-based Syner-G Welding Regulators, which has introduced the Australian technology to North America.

How Welding Gas Flows

For a rough analogy, consider a kitchen faucet. Turn it on slightly, just past a drip, and the water drops down inconsistently in globules. Turn the faucet on all the way, and you get a steady column of water, but perhaps with some misting outside. Adjust that faucet to a halfway point, and you get a smooth, straight column. That smooth, direct column is very suitable for welding, Hughes said, and it's what the new gas regulator technology aims to do: turn on immediately to a consistent CFH flowing in a smooth column over the weld pool, then shut off immediately at the end of the weld.

Hughes explained how shielding gas delivery affects weld quality with a garden hose analogy. Pull the trigger, and you get that initial, dramatic burst of water before it settles down into a consistent stream. When, say, someone turns on the bathwater inside, you notice the pressure drop slightly. Then you put your hand close to the stream and feel a fine mist; breeze and other atmospheric conditions force some tiny droplets to mist out. Finally, you let go of the trigger, and the water column droops down rapidly, but not instantaneously, to nothing.

The same attributes can be applied to a column of gas enveloping an arc and molten weld pool. Consider a shop with 10 welding booths. Welder No. 1's booth is directly by the bulk tank, while welder No. 10 is farthest away. Welder No. 10 pulls the trigger, and a large volume of gas shoots out briefly before settling down to a stream per the preset CFH. Then he experiences a drop in pressure as other welders pull their triggers and draw gas from the system, so welder No. 10 turns up the gas flow to compensate. This results in slight inconsistencies in gas flow among stations.

In fact, experienced welders tweak the CFH level to perfect welding setups. They read the weld pool to look for signs of contamination from lack of shielding gas coverage, or pool turbulence from excessive CFH, which leads to poor bead development and opens the door for defects like porosity and undercut. Welders learn to adapt to inconsistent gas over time. And the more inconsistent a shop's gas flow, the longer it may take for new welders to perfect their craft.

Hughes explained that the actual path that gas takes affects weld quality. Gas can flow in a venturi, descending in a swirl toward the weld pool. If the CFH is set too low, the gas can dissipate and won't completely envelop the arc and weld pool. On the other hand, having the CFH too high can cause turbulence in the venturi. Some gas may escape (think about that fine mist from the hose's water stream), and inconsistencies in the gas body can trap impurities from the atmosphere.

To improve this, Tuma and his team invested in that Australian technology, which changes the nature of the gas flow. Gas is released in a fashion that prevents that initial burst. The flow rises to the preset CFH and remains there until the end of the weld, when the CFH quickly drops to zero. In a bulk-tank arrangement, if others initiate welding, the technology balances flow to maintain consistent CFH at all welding stations, Hughes said.

Called the Synergizer, the welding gas regulator can be attached to individual cylinder setups or integrated into bulk distribution systems (see Figures 1 and 2). Because the technology controls gas flow in a new way, "you can actually run your welds at a lower CFH," Hughes said.

Welding Gas Savings

Tuma's department has saved 34 percent on gas usage during the past year, and he pointed out that the plant *did not* decrease CFH. The gas savings came from reducing the lag between gas-flow-start and arc-on at the beginning of the weld, and between arc-stop and gas-flow-stop after the weld's end.

At TS Tech, the transition to a new welding protocol, particularly one so critical, happens methodically. Currently each robot cell receives 25 CFH, and plant managers continue to collect data. "We are running test cells now," Tuma said, "and we'll probably lower the gas flow to 15 CFH next year."

Figure 2 These gas regulators, integrated into a bulk distribution system, cause gas to flow in a consistent way around the arc, sources said. *Photo courtesy of Syner-G Welding Regulators.*

Piece of the Improvement Puzzle

Tuma added that perfecting gas flow was just a piece of the improvement puzzle. Different contact tips, wire, and new gun angles during certain welds also helped TS Tech optimize its welding operation—hence the team's recognition at the ICON event.

"Overall weld savings was 34 percent over the year," Tuma continued, "and that was with us not operating at full capacity. If we had been running the same volume we were during previous years, I believe the savings would have been closer to 45 percent." FAB

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