



Previously welded with a laser, this automobile transmission part is being resistance welded with the Capacitor Discharge (CD) process.

Join the CLUB

Fabricators now use green, efficient technologies that make joining aluminum and high-strength steels easy

As a young salesman, T. J. Snow Co. Inc. CEO Tom Snow says he was routinely asked about what was new in resistance spot and projection welding? “I would have to say, ‘Not much,’” he recalls. “But now, when customers ask me that question, I often answer, ‘How much time do you have?’”

Snow is referring to advances in a process that, until recently, sat on the welding world’s back burner. His company’s role in these developments isn’t surprising. A pioneering spirit runs in the family.

Tom Snow’s father, Jim Snow, founded the Chattanooga, Tennessee, business on

April Fool’s day in 1963 with nothing more than a desk in the family dining room and a \$500 car. Today a 67,000-sq.-ft. facility on 12 acres employs 95 people. The company celebrated its 55th anniversary last month.

“Dad believed that metal fabricators deserved expertise, service and fair prices on resistance welding machinery and supplies,” says Snow. “And those values have continued to drive our growth and success.”

The supplier’s reputation is reflected in its broad product line, which includes pedestal spot and projection welders, heavy-duty projection and spot welders, special multi-gun production welding machines and turnkey robotic systems. In

addition, the company distributes all related supplies and accessories.

“Resistance welding has always been considered a small niche market,” acknowledges T. J. Snow Senior Applications Engineer Jeff Morgan, “but the need to produce lighter weight automobiles has opened the door to some unique opportunities.”

Tackling tough alloys

“In order to meet Corporate Average Fuel Economy (CAFE) standards for improved gas mileage, carmakers have adopted new alloys, including high-strength steels and aluminum,” he continues. “At the same



CEO Tom Snow, left, and Senior Applications Engineer Jeff Morgan. These CD-welded ring projection nuts (below) were tested—the numbers indicate pounds of force required to break the weld, demonstrating that T. J. Snow exceeded customer requirements.

Conventional AC resistance welders create a 60-cycle sine wave that rises to a pre-determined voltage and then drops back down to zero. The passage of time between those two peaks equates to lost energy, whereas MFDC generates an efficient square wave that is continuous.

“With AC, you have a chunk of time where energy is not being passed to the weld,” Morgan explains. “An average weld takes approximately 10 cycles and that means the AC welder produces a sine wave 10 times. That represents a lot of wasted time. MFDC reclaims that lost time and gives a welder more control, which is ideal for welding aluminum.”

MFDC is eco-friendly, he adds, while lightweighting the entire weld process. Further, it “provides a pure, consistent energy source for welding with much less primary energy use.”

The need to resistance weld high-strength steels (HSS) has ushered in its own set of challenges. “Today, everyone who builds cars or makes car parts is faced with welding high-strength steels in order to save weight,” says Morgan. “Newer alloys have tensile strengths ranging from 1400 to 1500 megapascals (MPa), and these materials have surfaces like very strong glass, which makes it difficult to produce a weld equal to the strength of the base material.”

For example, when fasteners like nuts and studs are resistance projection welded to ultra-high-strength steels, fabricators often face difficulty in getting the strength they need at the point of connection due to the heat-affected zone (HAZ). Under these conditions, the heat generated by a weld softens and weakens the material by altering its microstructure.

Capacitor discharge

To help automakers and their suppliers weld the new materials successfully, T. J. Snow now promotes the Capacitor Discharge (CD) resistance welding process,

“With CD resistance welding, we’ve come as close as is humanly possible to eliminating the HAZ.”

Jeff Morgan, T. J. Snow Co. Inc.



time, insurance companies want cars that are strong enough to survive a crash and these trends have introduced some big challenges for resistance welding.”

T. J. Snow’s medium frequency direct current (MFDC) and capacitor discharge (CD) resistance welding systems help customers to meet those challenges.

Aluminum can be spot welded sufficiently with the proper equipment, Morgan says, “but the plant infrastructure required to sustain weld quality is problematic. Compared to welding carbon steel and other materials, aluminum takes three to four times the energy. Our suppliers had to develop transformers that could supply the necessary energy but still be compact enough to be carried by a robot.”

After obtaining a welding engineering degree from Ohio State University, Morgan has traced the path of resistance

welding for more than 40 years. He worked at Ford Motor Co., where he helped to specify and purchase tooling for assembly plants. Later, he became the first engineer hired by Nissan at its original North American production facility in Smyrna, Tennessee. “When I first got involved with manufacturing cars, the spot welding guns were all manually operated,” he recalls, “and then we moved into the robotic age.”

The weight of conventional alternating current (AC) transformers required large robots, he notes, “but today’s MFDC power supplies are much smaller, yet have the capability to produce two to three times more energy.

“Cost and the welding application typically determine a manufacturer’s choice between an MFDC transformer and the older AC option.”

Welding

which is gaining popularity. Unlike conventional resistance welding methods that use energy directly from the plant's incoming power supply, CD resistance welders use stored energy discharged from large capacitor banks.

Welding times are very short and concentrated, which guarantees that the energy required to resistance weld is concentrated at the weld zone. Therefore, changes to the workpiece in the heat-affected zone are minimized.

"With CD resistance welding, we've come as close as is humanly possible to eliminating the HAZ and retaining nearly all of the base material's original strength," explains Morgan. "We've had incredible results with this process, which also works well on ring projections that need to be hermitically sealed."

In the past, he says, the company placed more focus on resistance spot or projection welding of automotive and appliance parts. But with CD resistance welding, it is moving into the realm of

An operator uses a medium frequency direct current (MFDC) press-type resistance welder to projection-weld a nut to an auto part made from high-strength steel.



more precise components like automatic transmission parts that were traditionally laser welded.

"Although laser welding has been the method of choice for these types of applications, that process can be finicky and hard to maintain," says Morgan.

The introduction of CD resistance welding represents a major metamorphosis. Heat is generated where it's needed instead

of spreading out to the rest of the part. Plus, energy draw is low because the welder is connected to three-phase power, which spreads the primary load over all three legs.

"Although CD welders often produce 80,000 secondary amps or more," says Morgan, "you can immediately pick up the part with your bare hands after the weld cycle is completed because the heat generated outside of the joint is so small,

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whereas you would typically need gloves with the AC or MFDC processes.”

Most applications can benefit from MFDC resistance welding, but manufacturers must be able to justify the costs upfront and T. J. Snow teaches engineers and companies how to do that.

Education

“We see factories running out of electrical capacity to support conventional AC machines because they have added too many welders,” according to Morgan. “Some plants even need to interlock their resistance welders so only one can fire at a given time.”

The case T. J. Snow makes is that with the installation of MFDC and CD welders, manufacturers are embracing a very green process. Wires feeding the welding machine are smaller and so are circuit breakers. An upfront investment will be offset with lower operating costs over the long run.

Proper maintenance is key, and as materials become more exotic, the geometry of the electrode becomes more important, along with the method for dressing the tip.

To help industry understand how to use these advances in resistance welding, T. J. Snow holds seminars all over the country. “We believe education is critical,” says Morgan. “Tribal knowledge is diminishing as baby boomers retire and companies hire crops of unskilled employees.”

T. J. Snow is active with the Resistance Welding Manufacturing Alliance, a standing committee of the American Welding Society. Tom Snow just completed his term as RWMA chairman and continues to serve on a committee that is preparing the exam for a new Resistance Welding Professional certification program.

“AWS has long offered a certification in arc welding,” he says. “But resistance welding has been considered a black art and the process didn’t command the respect it should because people didn’t understand it. This certification has been a long time coming.”

Resistance welding controls are where T. J. Snow sees the need for creative engineering talents next. Advances are being made in adaptive control systems that will ensure weld strength by monitoring the weld during the process and making adjustments on the fly, before the weld is complete.

Customers recognize the value of technologies like CD and MFDC by investing in it. “It’s not unusual to get a call from a supplier to an automotive assembly plant that the parts they resistance welded are falling apart,” Morgan says. “They are motivated to find solutions that will eliminate that problem because, unchecked, it could result in a factory shutdown and even a recall. When that happens, they could face substantial back charges.”

Of the progress Snow has seen over his 45-year career, he remarks, “Properly applied, resistance welding is still the strongest, fastest and least expensive way to join metal and I’m glad I’ve lived long enough to see these developments come to fruition.”

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T. J. Snow Co. Inc., Chattanooga, 423/894-6234,
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