

WELDING *Journal*

AUGUST 2019



American Welding Society®

100

Industry Spotlight: Agriculture

- High-Speed Tandem Pulsed GTAW
- Laser Heat Treatment

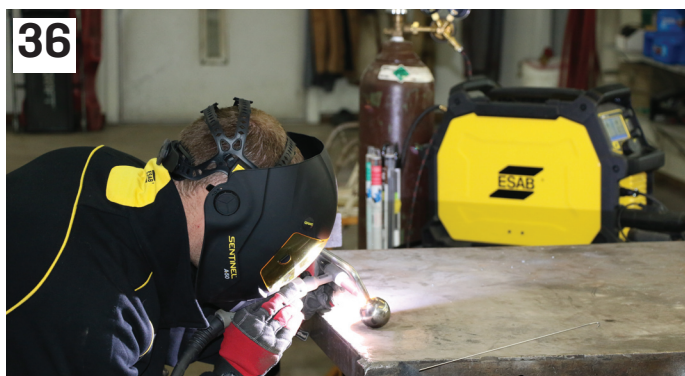
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On the cover: The Fred family uses portable, multiprocess welding machines not only for farm repairs but for their hobby of restoring antique tractors. (Photo courtesy of ESAB.)

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Welding Journal (ISSN 0043-2296) is published monthly by the American Welding Society for \$120.00 per year in the United States and possessions, \$160 per year in foreign countries; \$750 per single issue for domestic AWS members and \$10.00 per single issue for nonmembers and \$14.00 single issue for international. Not available for resale in either print or electronic form. American Welding Society is located at 8669 NW 36 St., # 130, Miami, FL 33166-6672; telephone (305) 443-9353. Periodicals postage paid in Miami, Fla., and additional mailing offices. **POSTMASTER:** Send address changes to *Welding Journal*, 8669 NW 36 St., # 130, Miami, FL 33166-6672. **Canada Post:** Publications Mail Agreement #40612608 Canada Returns to be sent to Bleuchip International, P.O. Box 25542, London, ON N6C 6B2, Canada.

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The Gold Standard Welding Reference: AWS Welding Handbook



Doug Kautz
Welding Handbook Chair

“As with all AWS publications and products, the *Welding Handbook* would not be possible without the dedicated efforts of hundreds of knowledgeable volunteers throughout the industry and the similarly dedicated staff at AWS.”

With the recent publication of the *Welding Handbook's* first volume in the Tenth Edition, it seems like a good time to reflect on how this resource has helped shape the world of welding.

For many welding professionals, the first American Welding Society (AWS) publication that they come across is the *Welding Handbook*; it was for me. During my junior high school shop class, where we were learning the rudiments of welding, there it was on the reference shelf. This was a small, rural school that didn't have many welding references, so the size of the set and the information contained therein was impressive. In those days, we didn't go much further than shielded metal arc and gas metal arc welding of carbon steels, but the nicely formatted knowledge contained in these books helped in so many areas.

As my career, and I'm sure many other people's careers, progressed, it became a go-to reference for many welding issues and questions. This compilation of welding knowledge is unsurpassed for its completeness and usefulness to welding professionals, from men and women just starting out to those nearing retirement, as well as on-the-floor production welders to teachers at research universities. It really is quite a remarkable set of volumes. And as the knowledge of welding and welded materials has grown, so has the *Welding Handbook*. Our committee believes this edition, when completed, will approach 5000 pages full of valuable welding data.

For those unfamiliar with the formatting of the *Welding Handbook*, volume one starts with a general compilation of data across the welding spectrum, from processes to materials, along with business information to standards, available for specific applications. The next two volumes cover welding and joining processes in detail, with arc welding and a few other processes covered in the second volume, and resistance and solid-state processes generally covered in the third volume. Subsequently, we turn our attention to the materials that are to be joined. Typically, the ferrous alloys are treated in the fourth volume, and then we round out the edition with nonferrous alloys, plastics, and composites in the fifth edition.

Another area that has become much more visible in recent years is the impact the *Weld-*

ing Handbook has internationally. No other reference set, in any language, provides anywhere near the breadth of information in such an easily used format. As I have grown to work with professionals from other countries, I have found that many of them also have copies of the *Welding Handbook* at their office, or they tell me they reference it.

As with all AWS publications and products, the *Welding Handbook* would not be possible without the dedicated efforts of hundreds of knowledgeable volunteers throughout the industry and the similarly dedicated staff at AWS. For those who have never worked on producing a large reference set, it is amazing the number of people who are involved from subject matter experts to technical writers and editors, as well as publishing and marketing experts. Without all of these important functions, a reference set of this size and quality would be impossible to produce.

At this time, I would like to personally thank all of the people who have made the *Welding Handbook* series possible. This includes all previous editions, as without that foundational work, this latest edition would be nowhere near as complete nor valuable to the welding community. Committee members typically start by working on a chapter where they can provide expertise to part or all of that chapter. After this type of participation, members may choose to lead the development of a chapter, followed by a volume. Volunteers who have broad experience and knowledge of the welding industry are also encouraged to become members of the main Welding Handbook Committee, where we work to ensure all of the volumes are consistent and easily used by the welding community.

The Welding Handbook Committee is presently working on the writing and compilation of the second and third volumes in this set as we try to speed the release of information in an industry that is also quickening its pace and need for concise and high-quality information. If you are interested in becoming part of the team (see page 59), or want to learn about how you can help to continue the tradition of excellence that is the *Welding Handbook*, I encourage you to visit aws.org/publications/weldinghandbook and either contact me at dougkautz@msn.com or Editor Kathy Sinnes at ksinnes@aws.org. 



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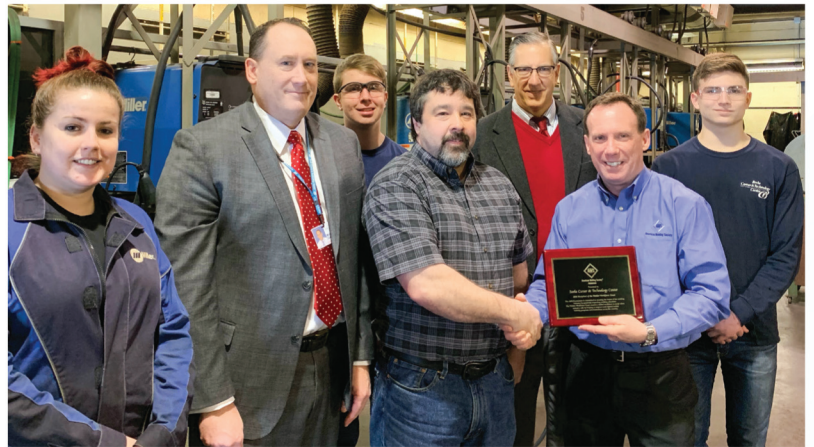
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AWS FOUNDATION AWARDS WELDER WORKFORCE GRANTS

The American Welding Society Foundation recently awarded Welder Workforce Grants to educational institutions committed to improving the welding industry through education.

AWS District Directors presented plaques to the schools to recognize the grants, which will provide funding of up to **\$25,000** to purchase equipment, expand facilities, and improve welder training.

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Presented to Samantha Farr by AWS Vice President Robert Roth, AWS Foundation Executive Director Monica Pfarr, and District 11 Director Phil Temple

2019 SPRING GRANT RECIPIENTS

Congratulations to our most recent Welder Workforce Grant Recipients

- **Alma High School**
Alma, Michigan
- **Diman Regional Vocational
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- **Northampton Community
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Bethlehem, Pennsylvania
- **Rowan-Cabarrus
Community College**
Salisbury, North Carolina
- **San Jacinto College
Central**
Pasadena, Texas

Virtual Reality Training Immerses Ag Students in Welding Skills

Interactive welding teaching techniques are utilized against the backdrop of agriculture programs

BY JAMEY McINTOSH

Welding is all around us. It is in the appliances we use to prepare our daily meals, the transportation we use to get around each day, the bridges that enable us to get from place to place, and the buildings we live and work in. Seventy percent of all manufactured products feature welded parts, with a variety of jobs in manufacturing, production,

construction, and more depending on employees with welding skills (Ref. 1).

Like welding, we see the impact of agriculture on a daily basis. Agriculture is responsible for the food we eat, the clothes we wear, the medicine we take, and the homes we live in. According to the U.S. Department of Agriculture Economic Research Service, in 2015, agriculture and related indus-

tries contributed \$992 billion to U.S. gross domestic product; jobs in farming, horticulture, food science, and more depend on employees with agriculture knowledge (Ref. 2). It is as vital to our lives as welding — and in education, the two courses of study often go hand in hand.

At Realityworks, we strive to create learning aids and develop programs



Fig. 1 — High school students practice basic welding skills on virtual reality welding simulators, which offer immediate, personalized feedback on fundamental techniques.



Fig. 2 — Marana High School Welding Instructor Kenton Webb explains to his students how to use a live welding training tool to fine-tune their welding techniques in the booth. The tool provides video game-like guides inside the welding helmet to guide students as they practice.

that engage today's students in high-demand career pathways and help them develop industry-needed skills. To do that successfully, we communicate regularly with education and industry representatives, paying close attention to their program needs and the hurdles they face as they train our future workforce.

The Need for Welders, Ag Skills

When we entered the welding education space five years ago, the American Welding Society (AWS) was estimating a growing skills gap in the welding industry. The organization concluded that by 2020, there will be a shortage of 290,000 professionals, including inspectors, engineers, welders, and teachers (Ref. 3). More recently, AWS Foundation Executive Director Monica Pfarr noted that within the next decade, there will be a need to fill nearly 3.5 million manufacturing jobs,

yet a gap in key manufacturing skills would "likely result in some two million of those jobs going unfilled." Pfarr also noted that the welding industry alone is expected to produce at least 5000 new jobs each year in the United States (Ref. 4). In short, the need for welders remains strong.

Similarly, agriculture careers are in high demand. When we started creating agriculture learning aids two years ago, employers were struggling to find qualified candidates for a number of growing careers. In 2016, there were 21.4 million full- and part-time jobs related to the agricultural and food industries; the USDA reported that between 2015 and 2020, there would be almost 58,000 annual openings for graduates with bachelor's or higher degrees in food, agriculture, renewable resources, or the environment (Ref. 5). However, the U.S. Department of Agriculture cites there are only about 35,000 new U.S. graduates with expertise in these areas each year (Ref. 6).

Importance of Training Tools, Learning Aids

When we talk to welding and agriculture educators today, we hear the need for training tools and programs that engage students in these in-demand fields and help them develop basic skills efficiently and effectively. Today's career and technical education (CTE) instructors often need to be experts in a variety of fields, and if training time isn't abundant or even available, the training tools themselves must be relatively easy to learn, and they must produce quantitative data.

Another need we often hear about is for learning aids that offer career exploration opportunities for those who are unfamiliar with potential job options. Welding may no longer be thought of as a "dirty job," but welding instructors tell us there are still plenty of students who could benefit from exposure to this in-demand career. Agriculture instructors battle similar as-

sumptions regularly as well, reporting that students often don't understand exactly what agriculture encompasses and don't know of the variety of agriculture careers that are available. Are these misconceptions because fewer students are coming to CTE courses from the farm? Perhaps. One hundred years ago, a third of Americans were farmers; today, fewer than 2% are (Ref. 7).

For those working to equip today's students with the skills to succeed in these high-demand careers, finding teaching strategies and training tools that engage students in these pathways and expose them to needed skills will help develop the skilled workers our workforce needs.

Virtual Reality in Agriculture Education

Fewer students may be coming from the farm, but interest in agriculture careers is growing. Membership in the National FFA Organization (Future Farmers of America), for example, is at an all-time high; there are more than 669,989 FFA members aged 12–21 in more than 8630 chapters in all 50 states. As I visit secondary and post-secondary classrooms across the country, I see more and more agriculture teachers exemplifying the FFA motto of “doing to learn,” utilizing interactive, 21st century training tools like virtual reality welding simulators to introduce their students to welding and help them learn basic skills — Fig. 1.

This teaching method appeals to today's students, who are used to having technology in their hands 24/7 and want to be hands-on and directly involved in the learning process. And with more nonfarm students studying agriculture than students with farm backgrounds, and ostensibly welding experience, virtual reality can also be a safe way to introduce students to a new skill.

Positive Examples

“Unlike real welding equipment, no one is afraid of a video game — they're just going to go for it,” said Dan Leinen, who used virtual reality welding simulators in his classroom when he taught agriculture education at Harlan Community High School in 2017. “The anxiety of going out and welding for the first time is totally



Fig. 3 — With the help of her instructor, a Wisconsin high school student practices welding for the first time on a virtual reality welding simulator.

gone. That's something I can't teach.”

Virtual reality also brings an engaging, game-like appeal to welding training, as today's students are not only used to gaming technology but expect digital learning tools to be deeply integrated into their education.

“I've found that with kids being more tech-savvy and gamer-savvy, I get more buy-in and interest,” said Kenton Webb, welding instructor at Marana High School in Arizona who uses both virtual reality welding simulators and live welding guidance systems in his classroom — Fig. 2. “These tools teach them all of the core functions of welding and give them that immediate

feedback they're looking for.”

Jennifer Pambrun was the regional CTE coordinator for Oregon's Inter-Mountain Education Service District (IMESD) when we spoke to her in 2017 about utilizing virtual reality welding simulators throughout the 18 school districts that IMESD serves. Pambrun said a shortage of teacher prep programs in the state meant new CTE instructors were not receiving the in-depth welding training they once did. That fact made tools like virtual reality welding simulators valuable, not only for giving students feedback on their welds but for giving novice teachers assessment data — Fig. 3.

"New teachers are struggling with their welding skills. They aren't coming in with confidence. This technology helps give [them] a break," said Pambrun. "I like how the simulators have the corrective action and the data and, of course, our class sizes keep getting bigger and bigger and bigger. There's a safety issue, too."

Research backs up the efficacy of virtual reality welding simulators. A 2011 study by Iowa State University on the training potential and cost implications of using virtual reality technology in welding training found that students who used virtual reality at least half the time performed significantly better than students who trained using traditional methods. In fact, the test group that included virtual reality in their program saw a 25–65% increase in qualified welds and in an average of 25% less time than the traditional welding group (Ref. 8). Against the backdrop of an agriculture program, numbers like these are even more important, since welding training is part of the larger whole of agriculture, rather than the focus.

Conclusion

Ultimately, agriculture students who learn how to weld will increase their own marketability. Within the sphere of agriculture, welders are employed by farm equipment dealers and manufacturers, seed production companies, feed and grain companies, and food production companies to name a few. Responsibilities include assembling, installing, and repairing equipment, as well as completing steel construction. Even if a welding-specific program doesn't spark enough interest to turn the program into a career, it could open a student's eyes to an opportunity in one of the science, technology, engineering, and math fields that make up almost 30% of the agricultural jobs predicted to be in high demand over the next five years, according to the U.S. Department of Agriculture (Ref. 9). [W](#)

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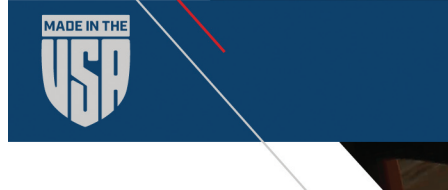
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