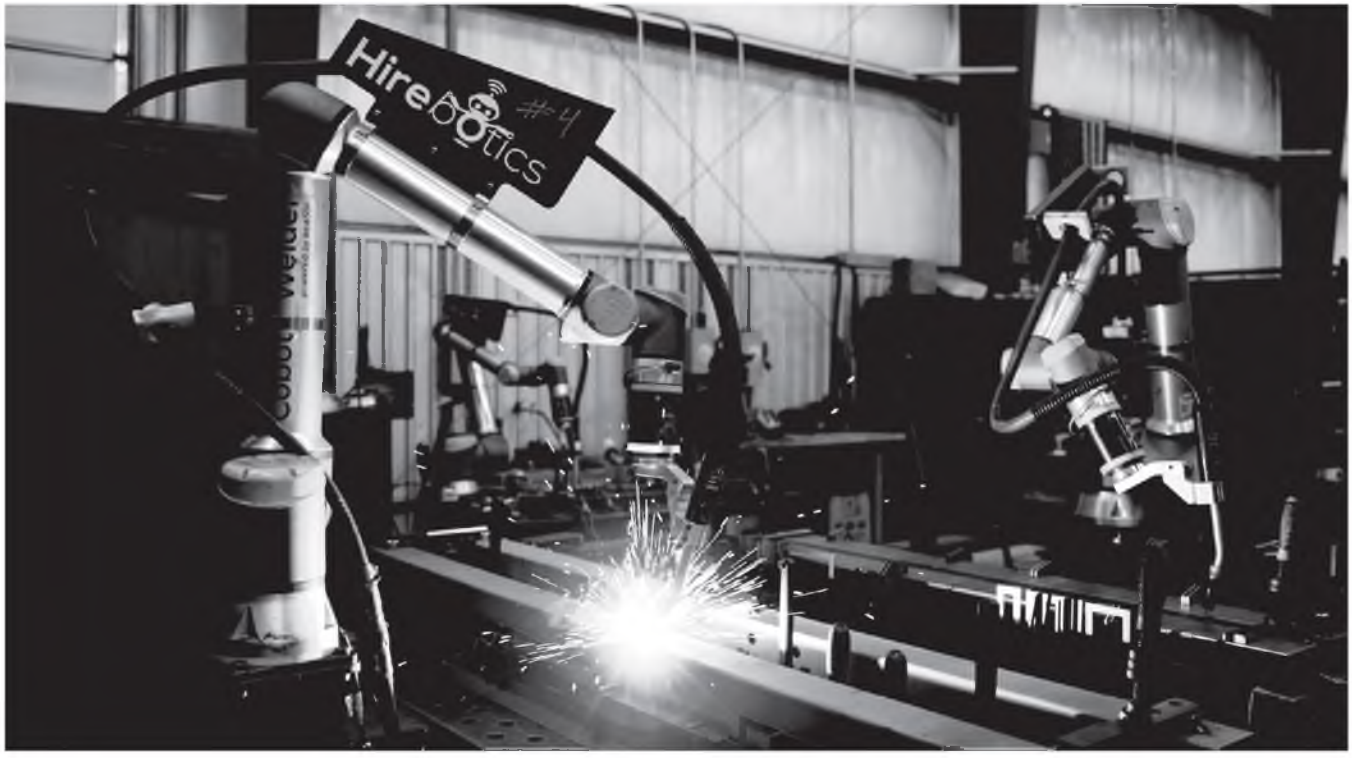

Weld Setting Optimization for COLLABORATIVE ROBOTS

BY KYANNE PEEK

There are many videos showcasing how collaborative robots, or cobots as they're commonly known, can weld. What is not always shown and less understood is how to maximize welding efficiency with cobots. Optimizing weld settings when using a cobot can increase productivity and quality and reduce costs.

Why Weld with a Collaborative Robot?

As industries face a shortage of skilled labor, cobots offer a solution. Cobots can significantly enhance the productivity of the existing workforce.

"The cobot allows you to establish a procedure that is followed precisely over and over again, akin to following a recipe," explained Andy Harris, welding technology supervisor at Wenger Mfg., Sabetha, Kans.

Harris also pointed out the overlooked cost of rework when welding manually vs. cobot welding, stating, "Millions are spent on postweld cleanup [with manual welding]. Cobots can significantly reduce this by ensuring welds are done correctly the first time."

It's no wonder cobots have quickly become a must-have for many manufacturing plants and welding shops.

Differences between Manual and Cobot Welding

Manual welding is a skill that has been honed over centuries and requires a high level of craftsmanship and experience.

A welder must have a steady hand and an experienced eye to produce consistent welds. However, manual welding can lead to fatigue and distraction, and even the subtlest hand tremors can introduce variability in weld quality; over the course of a day, the precision and consistency of a welder's work can ebb and flow due to these natural fluctuations. The consistency and repeatability of the cobot help control the essential variables for ideal welds every time.

How Cobots Affect Essential Weld Setting Variables

Experienced welders know that many variables influence the quality of a weld. The perfect recipe not only maintains the quality of the welds but also optimizes the use of materials like wire and shielding gas to reduce rework and costs.

"When you improve quality, you have to improve the process, and the robot provides absolute control over the essential variables required in a welding process," said Harris.

The main variables the use of a cobot will affect are as follows:

TRAVERSE ANGLES — Traverse angle precision is crucial to ensure the weld bead is deposited correctly to achieve optimal joint penetration and minimize defects such as undercut or excessive reinforcement.

In a production scenario, welders may inadvertently vary the angle due to hand movements or repositioning. On the other hand, cobots are programmed to hold the torch at a set angle, ensuring a uniform weld every time — Fig. 1.

CONTACT-TIP-TO-WORK DISTANCE — The distance between the contact tip and the workpiece is crucial. A ¼-in. variance can drop the amperage and significantly affect the joint's integrity.

Because cobots are programmed and can do highly repeatable work, they ensure that the contact-tip-to-work distance remains consistent throughout the welding process and along the weld for tightly toleranced welded components.

AMPERAGE AND VOLTAGE — The amperage and voltage ratio is crucial for the quality and uniformity of a weld. A variation in this ratio can result in excessive spatter and weak welds. The contact-tip-to-work distance is a key factor influencing this ratio. So, here again, the control delivered by the cobot will ensure a consistent ratio, preventing excessive spatter and mitigating other quality issues such as porosity, incomplete fusion, and weak welds.

Maintaining all the above-mentioned parameters consistently enhances the overall reliability and efficiency of the welding process and ensures that each weld meets the same high standards.

TRAVEL SPEED — Travel speed directly influences production throughput, weld quality, and heat management. When the previously mentioned variables are constant, cobots have significant advantages for maintaining high travel speeds.

"While a human might achieve 12–20 in. per minute at best, a cobot can consistently operate at three to four times that speed," Harris stated.

Faster travel speeds can prevent common welding defects such as melt-through and excessive joint penetration — Fig. 2.

DEPOSITION RATE — The metal deposition rate dictates the welding speed and creates the limiting step for arc-on conditions. Cobots make it easier to achieve a consistent deposition rate through providing constant robot travel speed and wire feed speed. A more consistent deposition rate enables faster metal deposition, increasing welding speeds while protecting joint quality.

SHIELDING GAS — Proper use of shielding gas is essential in welding for both quality and cost. Overwelding, which is common in the industry, leads to excessive gas usage, wasting nearly 500% more gas than needed in a given year. Incorporating a cobot into the welding process can significantly mitigate this issue. Its consistent control optimizes shielding gas usage and ensures that only the necessary amount is used for each weld.

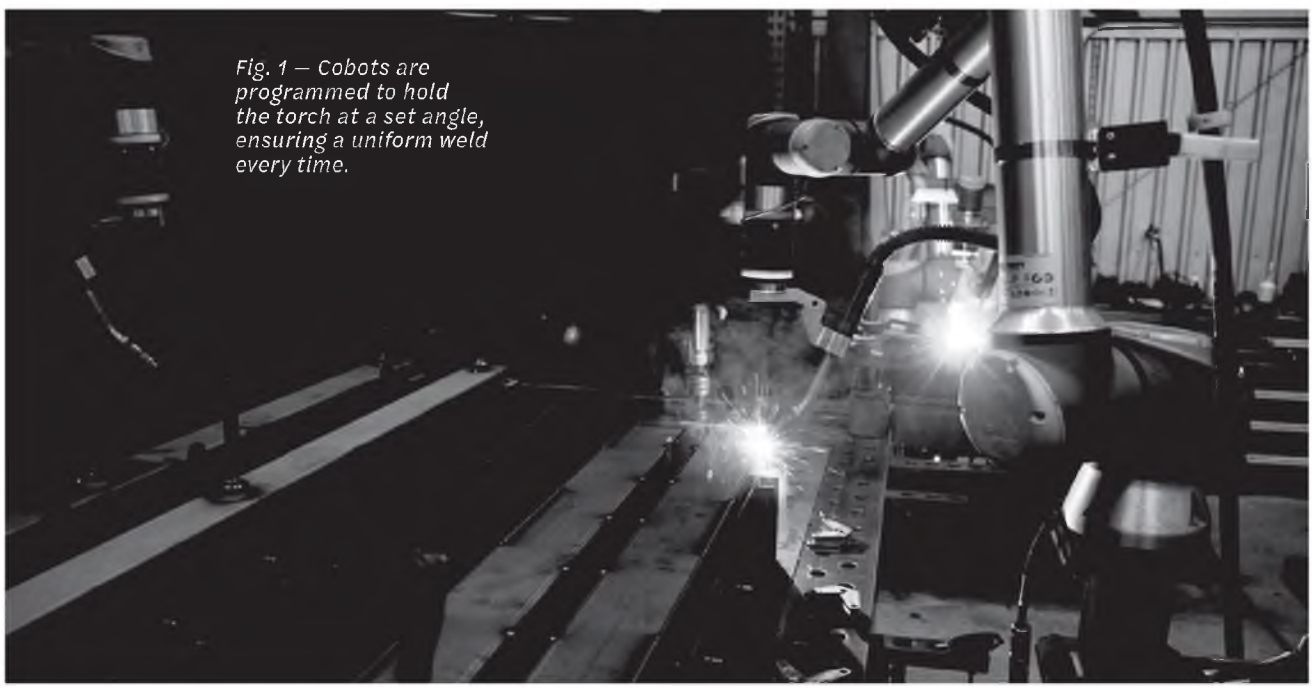

Fig. 1 — Cobots are programmed to hold the torch at a set angle, ensuring a uniform weld every time.

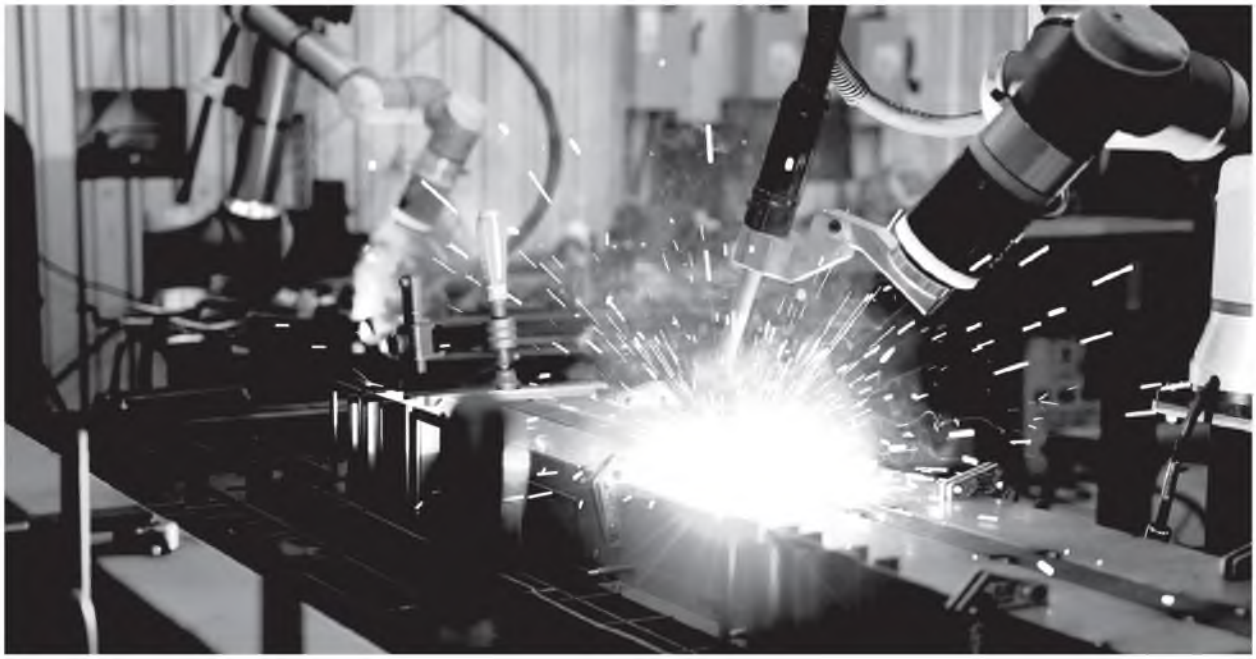

Fig. 2 — The precise control cobots provide makes the process more stable and predictable and leads to consistent, high-quality welds.

Performance at Optimized Settings — Manual vs. Cobot

Cobots allow companies to set and optimize their welding process by working with more constant parameters. The welding speed can be increased while achieving the required weld specs and quality. Moreover, the whole welding process is more cost-effective and productive with fewer mistakes, reduced waste, and lower rework.

Productivity

In manual welding, the operator factor, or the actual arc-on time, which directly impacts cost efficiency, can be surprisingly low. The industry standard average operator factor is approximately 10 to 12%, with the highest being 20%. For a 10-hour day, this translates to 60 minutes of arc-on time.

Cobots drastically change this operator factor dynamic. "With a robot, you train it and it never stops. It doesn't have to raise its hood to move from one joint to another. It just automatically goes because that's the way it was taught," Harris said.

Cobots can significantly increase the operator factor by maintaining continuous operation, potentially tripling the arc-on time compared to manual welding.

Cost Savings

Being able to set and optimize your welding process will result in big financial gains on multiple fronts.

"If my amps are too high or my volts are too high for my amperage, I'll get a lot of spatter. A lot of spatter costs millions of dollars every day in our industries," Harris explained.

Spatter cleanup and weld repair add substantial labor time, driving up the costs. The control the cobot delivers prevents excessive spatter and mitigates other quality issues such as porosity, incomplete fusion, and weak welds.

Cobots optimize the recipe of filler metal, speed, angles, and shielding gas to maximize welding efficiency. This benefit also avoids unnecessary expenses that occur through overwelding.

Conclusion

The use of cobots in welding marks an exciting era where technology meets skill. These robots, programmed by skilled operators, are changing the industry. They bring a level of consistency and efficiency that's hard to achieve by manual welding.

Cobots relieve skilled welders from repetitive and physically demanding tasks and allow them to focus on more complex aspects of welding that require insight and decision-making skills.

More importantly, the cost-effectiveness brought about by cobots through reduced material waste and lower rework rates adds a significant financial aspect to their value. These benefits make them an indispensable asset in modern welding operations.

As we embrace cobots, we're not just keeping up with technological trends; we're actively shaping a future where efficiency and expertise go hand in hand. WJ

KYANNE PEEK (*kpeek@hirebotics.com*) is applications manager, Hirebotics, Nashville, Tenn.

2024 AWS POSTER COMPETITION AT FABTECH

October 15-17 | Orange County Convention Center | Orlando, FL

The AWS Poster Competition is a key component of the AWS Professional Program. Visual displays of technical or business projects are welcome for inclusion in the competition. Authors are invited to submit a video (3 to 4 minutes) along with their poster. Posters and videos will present results from welding and additive manufacturing (AM) related studies, which are best conveyed visually, as well as research results involving study and analysis of graphs, micrographs, tables, or CAD drawings.

Submissions are welcomed in five categories:

- **Students in High School Welding Programs**
- **High School Students in University Research Programs**
- **Students in Two-Year College or Certificate Programs**
- **Undergraduate Students in Four-Year Programs**
- **Graduate Students**
- **Professionals**

Prizes for each category:

1st Place: $750
2nd Place: $500
3rd Place: $300

Plaques for top 3 places

Requirements and judging criteria:

- **Posters must be submitted online.** Follow the guidelines through the link below.
- Find more information about submission, design guidelines, judging criteria, lists of topics, and general tips at ***https://www.aws.org/Community-and-Events/Conferences-and-Events/Posters-Competition/***
- Instructions for the submission of videos will be available on the website.
- Technical topics relevant to the welding industry are acceptable (business studies, welding processes and controls, welding procedures, welding design, structural integrity related to welding, weld inspection, welding metallurgy, and AM).
- Posters and videos accepted for the competition will be judged based on technical content, clarity of communication, novelty/relevance of the subject, and overall aesthetic impression.

Goals of the competition include:

- Advancing the science, technology, and application of welding and allied joining and cutting processes, including additive manufacturing (AM), through visual communication of work undertaken to address technical and commercial challenges.
- Highlight investigative work in the above mentioned fields by recognizing the investigators and institutions that support these endeavors.
- Promoting the development of students' communication skills and knowledge of welding, AM, and related technologies.

Submission Deadline: July 31, 2024

Not a member? Join AWS today for even more savings on AWS products, including conferences and events. Visit **aws.org/membership** for more information.

Stay Connected

aws.org