What it takes to get a consistent and quality weld from a robot

by Terry Tupper, senior engineer, materials joining group, Fanuc America Inc.
For several decades now, robots have been used to help manufacturers improve the quality and consistency of their welded goods. Every successful manufacturer has their unique story of what hurdles they had to overcome to reach the acceptable level of quality they depend on today. This article touches on some considerations for the average shop that will contribute to the goal of producing a quality end product.

**FIRST STEPS**

For a facility that’s considering an investment in robotic welding equipment, the first item to address is establishing a culture of change in the workplace. By doing so, employees will be more apt to embrace the new technology instead of resisting it. You can bring in the most advanced piece of robotic equipment, but if your organization is unwilling to support it, understand it and own it, you will be greatly disappointed with its performance at no fault of the machine or the supplier.

Furthermore, the employees responsible for the robotic system installation, implementation, support and maintenance should be involved from the early stages. This will allow them to address concerns and misconceptions and help identify and implement opportunities for improvement.

It’s also important to decide who will provide your equipment, whether that includes portions of the welding cell or a complete turnkey product. 

Fixtureless welding between a multi-arm robot cell. This cell simulates hard facing on an auger bit with TIG welding.
You have multiple choices among the robot suppliers, tooling suppliers, automation integration suppliers and so on.

One consideration is to use a supplier with previous experience setting up the production process you are looking to automate and can show designs for similar applications they have successfully sold. They should be able to quickly provide support for a down robot situation and have access to the critical parts needed to quickly recover.

Many projects have ended in frustration and disappointment, and, in some circumstances litigation, because of a misunderstanding of the deliverables and expectations. Make sure the goals and objectives for your project are clearly defined and agreed upon by all parties.

**JOINING UP**

Now it’s time to consider the actual weld. Robots by design are very repeatable: They are made to return to the exact position time after time. If the part you are considering has joints that don’t always fall in the same locations or suffer from poor fitup due to the tooling arrangement or cutting methods, these issues should be addressed prior to robotic welding. You must have a good understanding of the part variations so you can accommodate all the variability.

For example, when working with thick plate steel, a manual welder can strategically place his tacks in a manner that helps close gaps in the weld joints. If you are unable to make improvements upstream at the cutting or bending operations to achieve a better fitup, it may be necessary to use hydraulic clamps to squeeze out the gaps in preparation for robotic welding.

Similarly, if the parts have a heavy mill scale or layer of surface rust, a manual operator can adapt his travel speed to ensure penetration. For a robotic cell, it may be beneficial to have the parts bead blasted or lightly sanded prior to welding to ensure good root penetration.

One exercise that helps with understanding part variations is called Design for Manufacturing. This can take many forms, but the premise is to select a part and follow it through every process until it’s considered a finished product.

This includes evaluating if any steps can be improved, eliminated or added to benefit the downstream process and end result. If these issues cannot be addressed upstream, several tools are available for the robot to accommodate welding on variable parts. These include touch sensing to locate the part in 3-D space, a camera system or, in some cases, a laser tracking system to help the robot “adapt” to part variations.

After your part is selected, evaluate your tooling. Does the part honor the same datum structure through every stage of manufacturing? If it doesn’t, how are you accommodating or complying with your variability.
at each stage of processing? You could be creating a tolerance stack-up in the end product that could have easily been removed in an upstream process.

Remember, you have an opportunity to correct a lot of wrongs in this evaluation. Some simple considerations for variability could provide you with a higher quality part with minimal effort.

**HOW TO WELD**

At this stage, it’s time to evaluate your welding process for the part. The process can have an effect on the robustness of tooling, the access requirements to the weld joints as well as compensation for any hot metal expansion. If the welding process involves a laser, your joint geometry (fitup) and tooling need to be an order of magnitude higher quality than the requirements of, for instance, sub-arc welding or cladding.

A firm understanding of your part, its composition and variation is critical to the success of the chosen welding process. For example, laser welding shouldn’t be considered for a part that regularly has gaps in the weld joint. And when joining two...
pieces of 1-in. steel using a slip joint configuration, you can probably eliminate friction stir and TIG welding as options.

Choosing the correct joining process is as critical as any other step in the production process and it carries as much weight as any other decision in the quality of the end product.

After the welding process has been chosen, select the welding equipment supplier that can provide your hardware needs and be available for assistance and support during setup and after the sale. If welding isn’t a core competency at your facility, the right supplier with readily available support will be a critical component to your success.

SIMULATION VIEWS
Once you have the part and welding process identified, you can make an informed decision as to the size requirements of the robot. When it comes to selecting a robot, it’s typical to start with weight and reach requirements.

Most automation suppliers use simulation software to help determine the required robots and validate that the weld joints can be reached. Undergoing a full-scale simulation model before purchasing can be a great asset to use when making cost justifications.

By sharing the simulation with team members, you can address a lot of the “what ifs” and other concerns before the welding cell even touches your shop floor. The simulation can help identify access and reach issues and allow you to easily reposition the parts within the robot envelope to help reduce or eliminate issues before making the final decision.

Proper simulation provides a good cycle-time value to start planning around for other stations in your product process flow. The simulation also helps with adding more parts to existing tooling, if possible, or adding more welding stations to manage multiple parts or parts with large size variances. You will also benefit later from the simulated cell if you have to repurpose it for Make sure the goals and objectives for your project are clearly defined and agreed upon by all parties.
another application or for another division within your company.

**PAY A VISIT**

After selecting your part and process, it’s recommended to visit the suppliers under consideration and possibly some of their customers. Send sample parts to these suppliers and have them produce them while you are visiting. If your parts are too large or cumbersome or maybe just too expensive, try sending sample coupons that mimic the weld joints you expect to be the most numerous or difficult. This goes for welding equipment and welding cell manufacturers.

Next, have the companies you chose to build your system perform a small production run after completing assembly of your welding cell. This will allow you to see how your operators will interact with the cell on a first-hand basis. You will be able to see actual production times and address production issues that may arise before it’s delivered. You will also have an opportunity to perform a final inspection of the parts and make sure they are meeting quality standards and expectations.

Lastly, after the system is installed on your shop floor, identify the team that will take care of setting up the system, programming, maintenance and production. Most systems are built on large common platforms that make installation as easy as unloading from a truck and plugging in. Larger systems require more effort.

Once the welding cell is up and running, your team will need to stay on top of the preventive maintenance schedule. You will also need to set a separate routine interval for your welding consumables that will be based off the amount of welding performed. This may also be determined during the small production run at the supplier’s facility.

Paying attention to the details at every decision point will aid in receiving a robotic welding system that will deliver quality welds consistently from the time it hits your shop floor.

---

**U.S. Metalworking Sourcebook**

Whether you’re replacing capital equipment or purchasing consumables, finding and qualifying new suppliers adds to the workload of an already busy shop owner or production manager. Sorting through the thousands of companies that provide products to the metalworking industry can be both time consuming and frustrating. But that’s about to change!

U.S. Metalworking Sourcebook is a powerful, easy-to-use online resource that brings buyers and sellers together.

The Sourcebook is a research search tool already seen by over 280,000 job shop and OEM buyers of all levels throughout the U.S., Canada and Mexico. It was developed by Techgen Media Group, publishers of Fab Shop Magazine Direct, Shop Floor Lasers and Welding Productivity. We know metalworking, and we know how to help you find the supplier that best matches your needs, and with only a few keystrokes.

Log on to USMetalworkingSourcebook.com today to activate your listing. More than 3,000 companies are already included.

---

**FANUC AMERICA INC.**

Whether you’re replacing capital equipment or purchasing consumables, finding and qualifying new suppliers adds to the workload of an already busy shop owner or production manager. Sorting through the thousands of companies that provide products to the metalworking industry can be both time consuming and frustrating. But that’s about to change!

U.S. Metalworking Sourcebook is a powerful, easy-to-use online resource that brings buyers and sellers together.

The Sourcebook is a research search tool already seen by over 280,000 job shop and OEM buyers of all levels throughout the U.S., Canada and Mexico. It was developed by Techgen Media Group, publishers of Fab Shop Magazine Direct, Shop Floor Lasers and Welding Productivity. We know metalworking, and we know how to help you find the supplier that best matches your needs, and with only a few keystrokes.

Log on to USMetalworkingSourcebook.com today to activate your listing. More than 3,000 companies are already included.

---

WHERE BUYERS AND SELLERS MEET • USMetalworkingSourcebook.com