WELDING JOURNAL

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The Importance of Welding Competitions

Charles House
Program chair of welding technology at Ivy Tech Community College

Welding competitions are vital to high school students and their instructors. They give students an opportunity to experience the pressures of print reading, safety, rules, and regulations in a competitive environment.

A welding competition illustrates what a day in the welding field can look like: working within a set timeframe, producing quality work, managing time effectively, and following the correct sequence of steps. Students must lay out and measure their welds, understand prints and weld symbols, follow specifications, and demonstrate the skills they have developed in the classroom.

These competitions also provide instructors with an opportunity to assess their students, noting where they are excelling and where additional instruction may be needed. The results can help instructors identify areas for improvement in their classes and better prepare students for the welding industry.

The future of welding depends on the students who choose to pursue this craft. It is up to all of us to help them hone their skills, build confidence, and carry the welding profession into the future.

One of the challenges of organizing a welding competition is ensuring that it is fair, consistent, and properly conducted. Prints and requirements may change for each welding process and from one competition to another, and proctors do their best to apply them consistently. That alone is a tremendous responsibility.

The Indiana Section has hosted the Midwest Welding Competition for 48 years, and we intend to continue that tradition. Learning how to organize and conduct these competitions from people such as Bob Richwine, welding institute director at Ivy Tech Community College; the late Gary Tucker, a committed Section member and instructor at Ivy Tech; and Gary Dugger, an accomplished CWI and Section member, has been a blessing to many of us in the Indiana Section 027. Their knowledge and dedication have helped preserve something that is much bigger than any one competition.

Industry sponsorship is one area that needs more support. The industry leaders who are committed to advancing and promoting the welding profession are not as numerous as we might hope. We are fortunate to have companies and individuals who continue to support the Midwest Welding Competition and recognize the value these events provide to students.

Over the years, many of the students who competed have returned as representatives of companies and corporations, bringing with them the opportunity to give back and support the next generation of welders.

We never truly know the impact we have on a student or where their journey will take them. The student standing at a welding booth today could be tomorrow's welding instructor, Certified Welding Inspector, supervisor, business owner, or industry leader.

The future of welding is standing in front of us. Our job is to help the next generation build it. WJ

"A welding competition illustrates what a day in the welding field can look like: working within a set timeframe, producing quality work, managing time effectively, and following the correct sequence of steps."

BY JARED MASSIC

10 GTAW HABITS THAT LEAD TO BETTER WELDS

Learn practical techniques for improving control and consistency

Gas tungsten arc welding (GTAW) has a reputation for being one of the most unforgiving processes in the shop. It demands hand-eye-foot coordination, control of travel speed and filler metal addition, and exceptional cleanliness. Unlike processes that may be more forgiving of minor surface contamination, GTAW can quickly reveal impurities and inconsistency. Machine settings matter, but consistent results also come from setup, positioning, and disciplined habits developed through repetition. These ten habits give students and developing welders effective ways to build control, consistency, and sound welding practices.

1 Thorough Metal Preparation

Clean metal is the foundation of a sound GTA weld. Remove oil, rust, paint, heavy mill scale, dross, and other contamination before initiating the arc. Pay particular attention to plasma-cut edges, where hard oxides can remain after cutting. Clean joint surfaces and cut edges to bright metal using appropriate mechanical or chemical methods. Aluminum requires special attention because its oxide layer has a much higher melting point than the base metal and can interfere with weld pool control and fusion. A dedicated stainless steel brush can be used immediately before welding. Good preparation improves weld quality while reducing exposure to fumes from oils, coatings, and other contaminants.

2 Always Be Comfortable

When learning GTAW, body position should be simple, fluid, and repeatable. Establish a solid brace before the arc is initiated and perform a dry run along the joint. This lets you check torch angle, wrist movement, lead slack, and clearance before adding heat and glare. For beginning torch-control exercises, start with short-fused beads and focus on steady movement. Anchoring the torch wrist and using a controlled pivot can help develop repeatable motion before progressing to longer passes. A comfortable position removes unnecessary variables while foundational skills develop.

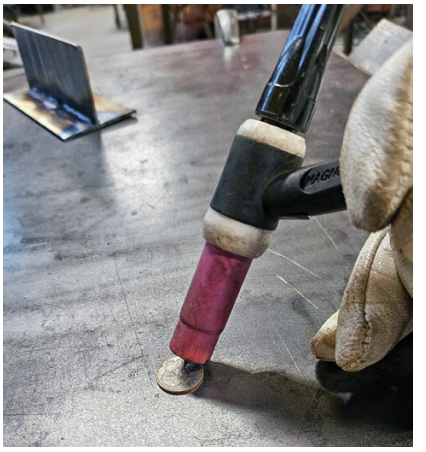
3 Watch the Leading Edge of the Pool

The weld pool is where the weld is made. Beginners often stare at the finished bead behind the tungsten, causing them to lose control of travel speed or drift from the joint. Instead, focus on the leading edge of the weld pool and the joint ahead of the tungsten. This provides feedback about fusion, tie-in, travel speed, and joint alignment. A useful exercise is tracing winding or irregular lines on a plate, forcing the welder to actively steer the pool. As control improves, the finished bead becomes the result of what the welder sees and controls at the front of the pool.

The proper torch angle and placement of filler rod into the leading edge of the weld pool.

4 Consistent Arc Length and Torch Angle

A consistent arc length is critical to controlling heat input and bead width. A practical starting point is an arc length approximately equal to the tungsten diameter. Maintain a controlled torch angle, generally around 15 to 20 deg in the direction of travel. Excessive arc length or torch angle can spread the arc and reduce heat concentration. Tungsten stickout should be selected based on the cup and shielding requirements rather than allowed to become excessive. The goal is simple: Keep tungsten height and torch position consistent from beginning to end.



A dime exercise. Gently push the dime across the table and get comfortable with arc length and torch angle.

5 Feed Filler Rod into the Shielding Envelope

Filler technique is more than touching the rod to the pool. Keep the heated end of the filler rod within the shielding gas envelope as much as practical. Pulling the rod several inches away exposes its hot end to the atmosphere and can introduce oxidation and contamination when it returns to the pool. Brace the filler hand when possible and practice feeding the rod through the fingers while maintaining a comfortable relationship between the torch and filler rod. Controlled movement keeps filler delivery consistent and helps prevent premature heating or balling.

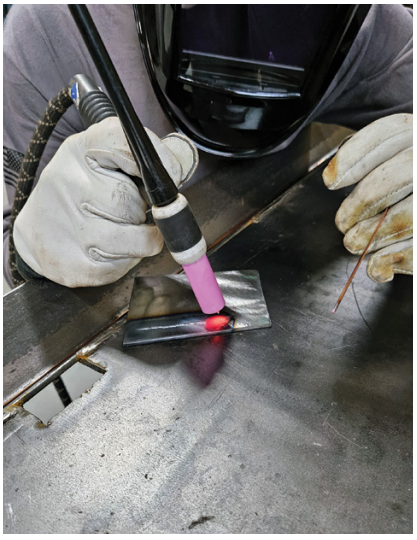
6 Proper Tungsten Preparation

The tungsten electrode is central to arc stability. Grind it lengthwise with a wheel or sharpener dedicated to tungsten rather than grinding across its diameter. Longitudinal grinding produces a consistent electrode surface and helps promote a stable, predictable arc. Tungsten contamination is common when learning GTAW, but welding with a contaminated tungsten electrode teaches the wrong lesson. If the tungsten touches the pool or filler metal, stop, remove the contaminated portion, and regrind it. The extra time is worthwhile because students need to be repeatedly exposed to what a clean, stable arc and weld pool should look like.

7 Amperage Control and Heat Management

A useful starting guideline is approximately one amp per 0.001 in. of material thickness. For example, 1/8-in.-thick material suggests a starting point near 125 A. This is not a universal setting; material, joint design, and technique affect the final amperage. When using a foot pedal, additional amperage capacity can provide headroom for quickly establishing the weld pool. The welder can then adjust the current to maintain the desired pool size and travel speed as heat builds in the workpiece. At termination, taper the current gradually rather than abruptly releasing the pedal when the equipment and procedure allow current control.

A contaminated (left) vs. clean (right) tungsten electrode.



Maintain torch position during postflow to protect the hot tungsten and weld area.

Excessive gas flow can create turbulence and reduce shielding quality, so use a flow rate appropriate for the cup, gas lens, and welding environment.

8 Shielding Gas and Weld Termination

GTAW depends on continuous shielding of the tungsten, weld pool, and cooling weld metal. Excessive gas flow can create turbulence and reduce shielding quality, so use a flow rate appropriate for the cup, gas lens, and welding environment. At the end of the weld, do not immediately pull the torch away from the hot crater. Hold the torch in position while postflow continues to protect the tungsten and weld area. Add a final small amount of filler metal while tapering the heat to help fill the crater and reduce termination defects. Postflow requirements vary with current, electrode size, cup, and machine setup.

9 Read the Weld

The finished weld is a record of what happened under the hood. Students can learn to connect bead appearance with their physical actions. Uniform bead width can indicate consistent travel and heat control, while widening toward the end can indicate heat buildup or insufficient travel speed. Ripple spacing can reveal changes in cadence or filler delivery. Undercut may point to excessive heat, a long arc, or torch-position problems. Dull, gray, or contaminated surfaces can indicate excessive oxidation, overheating, or inadequate shielding. Learning to read these visual indicators turns every coupon into a feedback loop for the next pass.

A student welds with the proper hand placement.

10 Develop a Rhythmic Cadence and Build Muscle Memory

GTAW requires both hands, the eyes, and sometimes the foot to work together. A repeatable cadence helps coordinate those movements. A simple pattern is travel, pause, dab, repeat. Move forward, establish the leading edge of the weld pool, add filler metal to the front of the pool, withdraw the rod while maintaining shielding, and continue. The goal is not to weld mechanically to a beat but to develop predictable timing and filler delivery. On machines equipped with pulse, low-frequency pulsing can provide a training reference, but it should supplement — not replace — the welder's ability to read and control the weld pool.

Patience Builds Precision

GTAW should be learned as a progression rather than as a single skill. Start with clean material and a comfortable position. Establish torch control, learn to monitor the weld pool, maintain a consistent arc length, feed filler metal deliberately, and correct tungsten contamination immediately. Then develop heat control, shielding, termination, and rhythm.

The goal is not a perfect weld on the first attempt. It is to make each attempt more intentional than the one before it. GTAW exposes inconsistency, but that is also what makes it valuable to learn. The patience and coordination developed while controlling a GTAW weld pool can carry over to every other welding process.

Slow down. Pay attention. Learn from the weld pool. Make the next weld better. WJ

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BY DAVID PIETROCOLA

Best Practices for AUTOMATING GRAINING AND BLENDING PROCESSES

A worker utilizing robotic finishing processes.

Discover key considerations for achieving consistent surface-finishing results with robotic systems

While robotic welding has been widely adopted and further accelerated by collaborative robots in recent years, the automation of downstream processes, such as material removal and surface finishing, has lagged. That is beginning to change with the emergence of AI-powered robots that use 3D vision and force-feedback sensors to process parts accurately and consistently. However, their integration into manufacturing processes requires a systems-level mindset to maximize the likelihood of success and sustained adoption in operations. This article highlights key areas to prioritize when considering the adoption of automation in graining and blending processes, which are difficult but critical for the final part. For example, grained finishes, such as No. 3 and No. 4, are ubiquitous in architectural and appliance applications, where the directional grain adds aesthetic sophistication while minimizing the effects of scratches from daily use.

Upstream Processing Consistency

Graining and blending typically occur after fabrication processes such as machining, bending, and welding. If those processes are performed manually, part-to-part variation must be considered in the downstream finishing process. This can lead to additional system complexity and costs associated with fixturing, sensors, or AI capabilities. For example, a manual weld bead will exhibit variability in its contours and shape, requiring characterization before a leveling material-removal task can be performed.

The material's nominal surface may also affect the graining operation. Pre-existing scratches will require a preprocessing step, either manually or by selecting the appropriate abrasive grits to prime the surface. Prepolished material may vary from mill to mill, and the blending operation in a postweld or postbend area will require additional vision or AI capabilities to blend the grain correctly.

Process, Tool, and Media Selection

Graining is affected by the type of abrasive, applied force, revolutions per minute, and surface speed. A wide spectrum of abrasive materials is available to achieve specific surface finishes, each with unique characteristics that make it suitable for different materials and applications. Among the most common are aluminum oxide, ceramic alumina, silicon carbide, zirconia alumina, and diamond (Ref. 1):

- Aluminum oxide is a versatile and economical choice that is widely used for grinding and finishing ferrous metals and softer alloys.
- Ceramic alumina is a premium option that offers exceptional hardness and longevity, making it ideal for working with alloys and hardened steels, including aluminum castings, stainless steel, and titanium alloys.
- Silicon carbide is known for its sharpness and is particularly effective on nonferrous metals like aluminum and stainless steel, often producing a finer surface finish than aluminum oxide.
- Zirconia alumina stands out for its durability and is well-suited for heavy grinding and high-pressure applications on hard metals and high-strength alloys.
- Diamond abrasives are the hardest material and are reserved for grinding extremely hard materials and applications requiring the highest level of precision.

These abrasive materials are manufactured into various forms to suit different stages of finishing. Your robot solution provider can advise on the best options to replace a manual process, but it may not be a direct translation. For example, a stroke-sander process might make more sense as a flap-wheel abrasive form factor when automated. In other cases, a belt sander designed for robotic arms may be justified. Abrasive manufacturers with automation-specific solutions are a resource for understanding options, including Walter, Norton, and 3M.

Graining applications must carefully consider the properties of the base material and the desired final surface condition to select the most appropriate abrasive grit and, if applicable, the sequence of grits. Different metals possess varying degrees of hardness, ductility, and thermal conductivity, necessitating abrasives with specific characteristics for effective processing. Using an unsuitable abrasive can lead to inefficient material removal, excessive heat generation, or a subpar surface finish.

To achieve specific grained finishes, such as a brushed or satin appearance, a progression of abrasives is often necessary. Start with a coarser grit to reduce the weld bead and then move to finer grits to smooth the surface further. For softened grain, nonwoven abrasives are typically used. It is also possible to combine steps by selecting an interwoven combo wheel that weaves coated abrasive sheets with alternating layers of a nonwoven abrasive.

Additional Tips for Automating Graining

- The repeatability of robot motion paths can exacerbate a tiger-striping look, where the passes are not blended seamlessly. Minimize the overlap of each pass to approximately 10% or less. Switch to a wider nonwoven wheel for the final process step to then blend the prior passes.
- Repeatability on similar parts can also lead to premature, uneven wear of the abrasive. Adjust motion paths to utilize the full surface of the abrasive. The use of AI-based solutions can help readily randomize motion paths to account for this.
- If cycle time allows, prioritize higher grits with multiple passes instead of starting progressions at lower grits. Lower grits create a deeper grain pattern, which can make blending more difficult.
- Leverage force control and/or compliance hardware to accurately apply consistent abrasive force to the part during the graining/blending process. A 5–10-lb force is a good starting point, with a robot tool center point speed of 2 in./s.

Conclusion

Ultimately, the desired grain finish and blending requirements dictate the selection of the abrasive material, its form, and the processing steps. Successful automation requires a systematic approach that considers the upstream processes. New technologies such as AI-powered robot programming and 3D scanning can enhance the capabilities and versatility of graining solutions. WJ

Reference

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