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FABTECH 2019 — An Investment in Know-How

Matthew Rubin
AWS Director, Expositions

We know you’ve got a lot on your plate. Whether you are in welding management, sales, or engineering, you’re got tons of things to accomplish and not enough hours in the day to do it. So, why add more to your schedule by traveling to the giant FABTECH exhibition (fabtechexpo.com), to be held November 11–14 in Chicago, Ill.?

Well, one reason is that this year’s FABTECH is expected to be the biggest ever held, and it is already established as the largest metal fabricating show in the United States. The latest technology in welding, metalworking, metal forming, and coating equipment will occupy 820,000 net sq ft at Chicago’s McCormick Place. As testament to its power to transform your business, this immense array of equipment and innovation is expected to attract some 48,000 visitors, including people who know what all this technology in one place can do to boost productivity and lay the groundwork for future success. Welding products alone will occupy nearly a quarter million sq ft, which will be more than ever before.

While the show offers up-front, hands-on demonstrations of equipment, that’s not all. There are more opportunities for gaining valuable know-how than anywhere else.

FABTECH will offer more than 175 education sessions, including 110 new sessions. The American Welding Society (AWS) will present a comprehensive lineup of welding education, led by top professionals, with programs focusing on best practices and new commercial developments in welding and thermal spray. These educational offerings will include in-depth conferences, seminars, the RWMA Resistance Welding School course, a Professional Program of technical presentations, Society events, and much more. Also, keep in mind, those who attend AWS education programs are awarded one professional development hour for each hour of attendance. The broad offering of education sessions off the show floor can transform your business or career. Targeted technical, operational, economic, and management sessions will give you the answers you need to increase both productivity and profits. You can also network with your peers, learn from industry experts, and explore the newest technologies in the industry.

Speaking of education, you can’t do better than to turn to AWS Codes and Standards, reference books, and other publications that will be featured in the AWS Bookstore at booth B27008. We offer hundreds of standards and other documents in the AWS library; come explore the entire catalog. And be sure to check out our new resource and news online hub, Welding Digest (weldingdigest.com), and inquire more about it during your visit to the AWS booth at B25008.

Numerous special events will also be offered at this year’s FABTECH. In honor of Veterans’ Day, the keynote speaker on Monday, November 11, will be Chad Hennings, who experienced 45 successful Air Force combat missions, and was also one of the most decorated college football players in NCAA history. He will explain his philosophy that excellence is not a destination, but an identity.

In addition, on that Monday and Tuesday, November 12, don’t miss the AWS Welding Competition at booth B17116. Also set to take place on Tuesday will be the keynote by Frank Abagnale, renowned international cybersecurity and fraud-prevention expert. The best-selling author will instruct attendees on how to protect themselves and their businesses from fraud.

Wednesday, November 13, will feature a “Women of FABTECH” networking breakfast celebrating the importance of women in the manufacturing sector. The keynote that day will be a presentation by Grant Imahara, former host on Discovery Channel’s MythBusters and an animatronics engineering expert. A leadership exchange on the same day will examine the impact of disruptive technology and the future of manufacturing.

Thursday, November 14, will include talks with an expert panel on building a workforce for the 21st century.

In short, we have lots to show you at FABTECH 2019, and we don’t want you to miss out on any of it. You can build your knowledge base and apply it directly to the business you serve.

Now is the time to register for free admission, obtain hotel information, and get all the other details of the event. Just go to fabtechexpo.com, where everything is organized and easily accessible.

As director of expositions for AWS, I look forward to meeting you at FABTECH this year. It’s the best exhibition for welding and metalworking. In other words, it’s know-how central, and it’s being held in the great city of Chicago. See you there!
In the late 1990s, the volunteer and staff leadership of the American Welding Society (AWS) decided that, as part of its mission, AWS should start a magazine dedicated to “materials inspection and testing personnel” and deliver it as a service to AWS certified individuals. Therefore, from its first issue, *Inspection Trends* has been delivered free of charge to everyone holding Certified Welding Inspector (CWI), Senior Certified Welding Inspector (SCWI), and Certified Welding Educator credentials. AWS delivered the inaugural issue in Summer 1998 — Fig. 1. Then-President Shirley Bollinger introduced the magazine in a column titled “Perspective,” but it also included a note from Terri Over, the first editor to oversee production of the publication.

The tradition of an “editor’s note” continued until the May 2018 issue, when volunteers began writing editorials on topics of interest to CWIs. That brought things back full circle to those early “perspectives,” which were also volunteer written.

That first issue covered fluorescent penetrant inspection, verification inspection during construction, the then-new SCWI program, mobile training units, and centralized certification. It offered a format today’s readers would easily recognize and which the publication still follows — a mix of articles covering visual inspection as well as other nondestructive examination (NDE) processes. However, some elements of that first magazine, such as a crossword puzzle, have long since gone by the wayside.

That first issue included a department that still remains as one of the magazine’s most-read segments, The Answer Is. Charles Patrick and Kenneth Erickson were the first set of experts. Erickson continued doing so for 20 years, ending his contributions with the January 2018 issue. For many years, Clifford “Kip” Mankenberg paired with Erickson for the column. When Mankenberg decided his regular work duties precluded him from participating, Albert J. Moore began offering his expertise. Moore now handles the column alone.

Moore has become *Inspection Trends*’s most prolific contributor, authoring numerous feature articles. His four-part series on Welding Procedure Specifications from 2010 and 2011 remain the most requested articles from the magazine.

Over the years, *Inspection Trends* has covered a wide variety of topics, from other NDE processes such as ultrasonic, radiographic, magnetic particle, and dye penetrant inspection to visual inspection tools and tricks to NDE education. It’s also dealt with issues such as inspectors’ responsibilities and ethics.

In 2016, *Inspection Trends* celebrated the 40th anniversary of the AWS Certified Welding Inspector program and included interviews with many of the original CWIs who were still maintaining their certification at that time — Fig. 2. As noted by John Gayler in his article in that issue, “Establishing a central certification program for welding personnel had been discussed at the highest levels of AWS as far back as 1951. One driving force for development of the CWI program was industry’s concern for the quantity and quality of welders available to support the growth in steel construction in the 1970s.”

Since February 2017 (Fig. 3), Richard D. Campbell and J. P. Christein have informed readers about the great communication tools of welding symbols and how to better understand and use those tools. They began with groove weld symbols, and in the eleventh article in the series (August 2019), they discussed common errors and misuses of welding symbols.

If you’re unfamiliar with *Inspection Trends*, you can read the current and past issues on the AWS website at aws.org/publications/page/inspection-trends.
Invest In Your Future; Become A Certified Welding Inspector

For over 40 years, Certified Welding Inspectors (CWIs) have been the gold standard for assuring weld quality in the oil & gas, transportation, aerospace and construction industries, in government contracting, and more. Start building a rewarding and lucrative career today by investing your time and effort into CWI exam preparation, using one of three convenient study options offered by the American Welding Society.

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Our **CWI Pre-Seminar** lets you study anytime, anywhere. The option includes 10 interactive courses covering fundamental welding principles & concepts frequently used by CWIs. Recommended for those who want to set their own pace or who want to do prep ahead of an instructor-led seminar.

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Our traditional **Instructor-Led CWI Seminar** is a week-long, intensive, in-person classroom covering the complete body of knowledge required of a CWI. If you need to brush up on your practical application and visual inspection skills, sign-up for the 3-Day intensive instructor-led CWI Part B training.

**CWI—CERTAINLY WORTH THE INVESTMENT**

For more information on how to apply for the exam or register for one of these study options, see us at FABTECH Booth B25008, or visit [aws.org/cwiwj](http://aws.org/cwiwj)
Weld failures can result from weld defects, such as cracking or inclusions, but there are a number of other issues in the welding operation that can also contribute to the problem. Whatever the cause, there is the potential for these failures to be catastrophic should they occur in a load-bearing application. The goal, of course, is to identify and prevent the potential for failure prior to a weld entering service to avoid property damage or personal injury.

While safety is the top reason for preventing weld failures, it is important to consider the lost productivity and increased costs associated with reworking poor-quality welds — Fig. 1. It can take a considerable amount of time to complete this task, particularly for longer welds or multipass welds on thicker sections.

Understanding common reasons for weld failures and how to prevent them can help welding operators maintain high levels of quality and efficiency.

Establishing a quality system for welding operations is key to preventing weld failures

BY TY LATTIMORE
Reason 1: Poor part or weld design

Insufficient weld size — because of design errors or incorrect interpretation of the part design — can lead to weld failures. This is due to the inability of an undersized weld to support the intended load in a static structure. A weld that is too small or too short for the application can fail from tension, compression, bending, or torsional loads. If a weld is made to be in an application where a cyclical load is going to be applied, it will be beneficial to consider a filler metal option with increased impact toughness and ductility.

In a highly restrained joint, meeting required weld sizes is critical — otherwise cracking can potentially occur. Where a highly restrained joint is unavoidable, welds that have a proper depth-to-width ratio can help to reduce the chances of weld cracking. Proper welding parameters can help to ensure that an adequate weld profile is being produced and reduce the risk of weld cracking in a restrained joint.

Factor of safety (FoS) is an important variable to consider during the design phase, as it establishes the maximum intended and allowable stress for the joint and ensures the component being produced can withstand loads greater than intended. If welds are failing, it is possible the intended maximum load is not properly communicated or the design's factor of safety is too low; the engineer must consider foreseeable misuse of products.

It is commonly desired to make a weld with a matching filler metal strength, but that can change depending on the application and base material being welded. For certain critical applications, it may be valuable to design the weldment with an overmatch in filler metal strength. Other applications are best served with a strength undermatch to improve fatigue life or weldability. Along with strength, chemistry is a valuable aspect to consider during weld design to gain proper fusion and the desired weld properties.

Reason 2: Inadequate welding procedure

Neglecting to follow the proper welding procedure or writing an inadequate procedure is another contributing factor to weld failure. Remember to properly utilize preheat and control interpass temperature. Properly written procedures with adequate preheat and interpass temperature slow the rate of cooling in the base material and the weld deposit. This ultimately helps reduce the risk of hydrogen cracking when welding carbon and low-alloy steels or similar materials.

When creating a welding procedure, start by referring to the filler metal product data sheet for welding parameter recommendations. Each filler metal has slightly different characteristics, and parameters are not one size fits all — Fig. 2. Proper parameter ranges on the welding procedure help provide consistently sound welds. It also may be valuable to conduct some additional testing such as cut and etch, bends, pulls, or breaks to ensure sound weld quality. The welding code that is being used will provide a standard to validate proper weld quality.

Always make sure the correct welding polarity is being used in accordance with the welding procedure and filler metal specifications. Shielding gas is another major influence that di-
Reason 3: Stress risers

Stress risers are caused by poor weld design and inadequate welding procedures or technique. They also appear in the form of weld defects or discontinuities that cause stress on the weld and can lead to failures by way of breaking, tearing, or cracking.

There are several types of stress risers and options for preventing them:

1. Porosity occurs when gas becomes trapped in the weld during solidification. Porosity typically results from the environment/atmosphere or improper shielding when welding steel. Shielding gas can also become trapped and cause porosity. Prevent this issue with proper part prep and removal of moisture from the weld area. Also ensure optimal shielding gas coverage (e.g., flow rate, angles, gas cup, and a leak-free system), and adequate preheat.

2. Hot cracking typically appears in the longitudinal direction of the weld at high temperatures (usually more than 1000°F) and almost immediately after cooling. It can take the form of segregation cracking, which is caused by elements with low melting points being rejected to the center of the weld when it solidifies. To prevent hot cracking, carefully match the filler metal and base material properties, ensure the proper joint design for the application, and follow all welding procedures. Preheat and interpass temperature control are also important.

3. Cold cracking commonly occurs at temperatures below 600°F and may not be noticeable until hours or days after the weld solidifies. It is often referred to as hydrogen-induced or heat-affected zone (HAZ) cracking. Using low-hydrogen filler metals and preheating the base material are good defenses against this defect.

4. Undercut typically results from excessive voltage and incorrect travel angle. Underfill is typically caused by travel speeds that are too fast for a given deposition rate. Reducing travel speed to allow for adequate fill, reducing voltage, and using proper travel angles can remedy the issue. Increasing wire diameter can also help to achieve desired travel speeds while allowing for proper deposition and fill rates.

5. Inclusions are caused by foreign materials in the weld. Burrs on the base material or slag from a shielded metal arc welding (SMAW) electrode or a flux-cored arc welding (FCAW) wire can contribute to inclusion. Prevent them by properly cleaning the base material and using a drag technique to keep slag out of the weld pool.

Reason 4: Poor welding technique

Poor welding technique can be attributed to a lack of training, newer welding operators with lower skill sets, or more experienced welders who may have acquired bad habits — Fig. 3. Whichever the case, incorrect techniques can affect weld quality and may lead to failures.

Using the proper work and travel angles are important means to prevent issues like undercut or an improperly sized weld. These angles will differ according to the filler metal being used. Work angle refers to how the welding gun or electrode is positioned in relation to the vertical member of the weld joint. Travel angle describes how the filler metal is positioned in relation to the weld pool and direction of travel. As mentioned previously, use a drag technique when welding with a SMAW electrode or FCAW wire due to the slag system. For solid wires or metal-cored wires that do not produce slag, a forehand or push technique is typically recommended.

The contact-tip-to-work-distance (CTWD) is another factor welding operators need to be mindful of to prevent poor weld quality and potential failures. CTWD increases or decreases amperage in a constant voltage (CV) process and changes voltage in a constant current (CC) process. A CTWD that is too long can cause an amperage drop, incomplete penetration, and/or loss of shielding gas. When the CTWD is too tight, porosity or worm tracks can present themselves when using FCAW wires. CTWD varies according to the filler metal being used. For example, E70T-1/E71T-1 gas-shielded FCAW wires usually have a CTWD between 1/2 and 1 in., depending on the wire diameter (the bigger the diameter, the greater the CTWD). An E71T-8 self-shielded FCAW wire may require up to 1-3/8-in. CTWD.

The correct travel speed is also important, as it can dramatically change weld size and bead appearance. Traveling too fast creates a thin, undersized, and ropey weld that may lack strength; traveling too slow can lead to incom-
complete penetration and a larger, flatter weld.

Reason 5: Incorrect inspection or testing

Not all welding applications require weld testing or welding to code; however, when these are necessary, welding codes provide a reliable and proven system to qualify welding procedures and guide welders to produce acceptable weld quality.

Always use code-approved testing standards for new procedure development, focusing on the correct number and type of testing for mechanical and chemical properties and/or nondestructive examination. The material being welded and how strict or critical the application is factors into how stringent testing should be. The code will specify acceptance criteria for production-made welds using either penetrant testing (PT), magnetic particle testing (MP), radiographic testing (RT), and/or ultrasonic testing (UT).

Follow code-approved inspection criteria to ensure welds meet the appropriate size and shape, and do not exceed the allowable discontinuity limit requirements. Codes dictate an allowable range of discontinuities in a weld — such as porosity — before they are considered a defect that must be reworked.

Welding inspection — visually, at a minimum — should be performed regularly in all applications, even if they do not have to adhere to welding codes. Be consistent and critical of weld quality and make the inspection process a priority to avoid weld failures.

Putting It All Together

Establishing and enforcing a quality system for welding operations, as well as implementing training, is key to preventing weld failures for both new and more experienced welding operators. It never hurts to pursue refresher courses in welding basics or to practice techniques to help establish good habits and gain positive results. Doing so can benefit the entire welding operation, in terms of improved quality, productivity, and cost savings.
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